AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.6.1.5

Acceleration

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**50**
Available paper years	**2003–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.5.6.1.5 Acceleration

Answer 01 · Mark scheme June 2003 | 3451H | Original Q10 | Legacy

The full source mark scheme begins on page 92. Follow original question 10 in that document.

Answer 02 · Mark scheme June 2003 | 3462H3 | Original Q8 | Legacy

The full source mark scheme begins on page 114. Follow original question 8 in that document.

Answer 03 · Mark scheme June 2004 | 3451H | Original Q5 | Legacy

The full source mark scheme begins on page 131. Follow original question 5 in that document.

Answer 04 · Mark scheme June 2004 | 3462H3 | Original Q5 | Legacy

The full source mark scheme begins on page 152. Follow original question 5 in that document.

Answer 05 · Mark scheme June 2005 | 3451 | Original Q4 | Legacy

The full source mark scheme begins on page 169. Follow original question 4 in that document.

4.5.6.1.5 Acceleration

Answer 06 · Mark scheme June 2005 | 3462 | Original Q4 | Legacy

The full source mark scheme begins on page 187. Follow original question 4 in that document.

Answer 07 · Mark scheme June 2006 | 3451 | Original Q12 | Legacy

The full source mark scheme begins on page 201. Follow original question 12 in that document.

Answer 08 · Mark scheme June 2006 | 3462 | Original Q10 | Legacy

The full source mark scheme begins on page 221. Follow original question 10 in that document.

4.5.6.1.5 Acceleration

Answer 09 · Mark scheme

Question 5

question	answers	extra information	mark
(a)(i)	a single force that has the same effect as all the forces combined	accept all the forces added / the sum of the forces / overall force	1
(ii)	constant speed (in a straight line) **or** constant velocity	do **not** accept stationary	1
(b)	3	allow **1** mark for correct substitution into transformed equation accept answer 0.003 gains **1** mark answer = 0.75 gains **1** mark	2
	m/s^2		1
(c)	as speed increases air resistance increases	accept drag / friction for air resistance	1
	reducing the resultant force		1
total			7

4.5.6.1.5 Acceleration

Answer 09 · Mark scheme

January 2008 | PHY2H | Original Q5 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 10 · Mark scheme

Question 6

question	answers	extra information	mark
(a)(i)	velocity includes direction	accept velocity is a vector	1
(ii)	64	allow **1** mark for obtaining values of 16 and 4 from the graph **or** marking correct area or correct attempt to calculate an area	2
(iii)	any **two** from: • velocity zero from 0 to 4 seconds • increasing in 0.2 s (or very rapidly) to 8 m/s • decreasing to zero over the next 8 seconds		2
(iv)	momentum before does not equal momentum after **or** total momentum changes **or** an external force was applied	ignore reference to energy	1
(b)	to reduce the momentum of the driver a smaller (constant) force would be needed	 do **not** accept reduces the impact / impulse on the driver	1 1
total			8

4.5.6.1.5 Acceleration

Answer 11 · Mark scheme

June 2008 | PHY2H | Original Q5 | Legacy

Question 5

	answers	extra information	mark
(a)	4	allow **1** mark for extracting correct information 12	2
	m/s^2	ignore negative sign	1
(b)	9 (s)		1
total			4

4.5.6.1.5 Acceleration

Answer 11 · Mark scheme June 2008 | PHY2H | Original Q5 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 12 · Mark scheme

Question 7

	answers	extra information	mark
(a)	4 (m/s)	**1** mark for correct transformation of either equation **1** mark for correct substitution with or without transformation **1** mark for correct use of 0.6N max score of **2** if answer is incorrect	3
(b)	**greater** change in momentum **or** **greater** mass of air (each second) **or** increase in velocity of air	accept speed for velocity	1
	force upwards increased **or** force up greater than force down	lift force is increased do **not** accept upthrust accept weight for force down	1
(c)	• increase the time **to stop**		1
	• decrease rate of change in momentum or same momentum change	accept reduced deceleration/ acceleration	1
	• reducing the force on the toy	do **not** accept answers in terms of the impact/ force being absorbed do **not** accept answers in terms of energy transfer do **not** credit impact is reduced	1
total			8

4.5.6.1.5 Acceleration

Answer 13 · Mark scheme

June 2008 | PHY3H | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
(a)	any **two** ideas: • (acceleration occurs when) the direction (of each capsule) changes • velocity has direction • acceleration is (rate of) change of velocity		2
(b)	to(wards) the centre (of the wheel)		1
(c)	centripetal	allow minor misspellings but do **not** credit a response which could be 'centrifugal'	1
(d)	the greater the radius / diameter / circumference (of the wheel) the smaller the (resultant) force (required)	accept 'the size' both parts required for the mark accept converse	1
total			5

4.5.6.1.5 Acceleration

Answer 14 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	4.5	allow **1** mark for correct substitution i.e. 9 ÷ 2	2
2(a)(ii)	m/s^2	accept answer given in (a)(i) if not contradicted here	1
2(a)(iii)	speed		1
2(a)(iv)	straight line from the origin passing through (2s, 9 m/s)	allow **1** mark for straight line from the origin passing through to t = 2 seconds allow **1** mark for an attempt to draw a straight line from the origin passing through (2,9) allow **1** mark for a minimum of 3 points plotted with no line provided if joined up would give correct answer. Points must include(0,0) and (2,9)	2
2(b)(i)	**B** smallest (impact) force on all/ every/ any surfaces	if **A** or **C** given scores **0** marks in total these marks are awarded for comparative answers	1 1 1

Question 2 continues on the next page

PHY2H

Question 2 continued

2(b)(ii)	(conditions) can be repeated **or** difficult to measure forces with human athletes	accept answers in terms of variations in human athletes e.g. athletes may have different weights area / size of feet may be different difficult to measure forces athletes run at different speeds accept any answer that states or implies that with humans the conditions needed to repeat tests may not be constant e.g. athletes unable to maintain constant speed during tests (or during repeat tests) do **not** accept the robots are more accurate human error is insufficient fair test is insufficient	1
Total			**10**

4.5.6.1.5 Acceleration

Answer 14 · Mark scheme

January 2009 | PHY2H | Original Q2 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 15 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	gravity	accept weight do **not** accept mass accept gravitational pull	1
3(b)(i)	Initially force L greater than force M	accept there is a resultant force downwards	1
	(as speed increases) force M increases	accept the resultant force decreases	1
	when M = L, (speed is constant)	accept resultant force is 0 accept gravity/weighty for L accept drag/ upthrust/ resistance/friction for M do **not** accept air resistance for M but penalise only once	1
3(b)(ii)	terminal <u>velocity</u>		1
3(b)(iii)	0.15	accept an answer between 0.14 – 0.16 an answer of 0.1 gains no credit allow **1** mark for showing correct use of the graph	2
Total			**7**

4.5.6.1.5 Acceleration

Answer 15 · Mark scheme

June 2009 | PHY2H | Original Q3 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 16 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	210	allow **1** mark for correct substitution i.e. 35 × 6	2
	kg m/s **or** Ns	do **not** accept n for N accept 210 000g m/s for **3** marks	1
4(a)(ii)	840	if answer given is not 840 accept their (a)(i) in kg m/s ÷ 0.25 correctly calculated for both marks allow **1** mark for correct substitution i.e. 210 ÷ 0.25 or their (a)(i) ÷ 0.25	2
4(b)	increases the time to stop	accept increases impact time do **not** accept any references to slowing down time	1
	decreases rate of change in momentum	accept reduces acceleration/ deceleration reduces momentum is insufficient	1
	reduces the force (on the child)		1
4(c)	any **two** from: • insufficient range of tests/ thicknesses for required cfh	accept need data for thicknesses above 80 mm/ cfh 2.7m not enough tests is insufficient	2
	• (seems to be) some anomalous data		
	• *(*repeats) needed to improve reliability (of data)	accept data/ results are unreliable do **not** accept maybe systematic/ random error do **not** accept reference to precision	
	• need to test greater range/variety of dummies	accept children for dummies accept specific factor such as weight/height/size	

Question 4 continues on the next page . . .

4.5.6.1.5 Acceleration

PHY2H

Question 4 continued . . .

question	answers	extra information	mark
4(d)	Tyres do not need to be dumped/ burned/ less land-fill/ saves on raw materials	accept less waste do **not** accept recycling on its own	1
Total			**11**

4.5.6.1.5 Acceleration

Answer 16 · Mark scheme June 2009 | PHY2H | Original Q4 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 17 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	96	allow **1** mark for correct substitution ie 80 × 1.2	2
	newton or N	allow Newton do **not** allow n	1
1(b)(i)	direction		1
1(b)(ii)	velocity and time are continuous (variables)	answers must refer to both variables accept the variables are continuous / not categoric accept the data / 'it' is continuous accept the data / 'it' is not categoric	1
1(b)(iii)	**C**		1
	velocity is not changing	the **2** marks for reason may be scored even if **A** or **B** are chosen accept speed for velocity accept speed is constant (9 m/s) accept **not** decelerating accept **not** accelerating accept reached terminal velocity	1
	forces must be balanced **or** resultant force is zero	accept forces are equal accept arrows are the same length / size do **not** accept the arrows are equal	1
Total			**8**

4.5.6.1.5 Acceleration

Answer 17 · Mark scheme

January 2010 | PHY2H | Original Q1 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 18 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	distance (from the Sun in millions of km) and time taken for orbit	both required in either order **not** just 'time taken'	1
1(b)(i)	**either** distance (from the Sun in millions of km) **or** time taken for orbit (and) (average) temperature	 **not** just 'time taken' both required in either order	1
1(b)(ii)	(+) 430 / (+) 470 **or** Mercury / Venus		1
1(c)	25 (hours)	do **not** accept 24 (hours)	1
1(d)	...different positions at different times		1
1(e)	…direction…speed gravitational	both and in the correct order	1 1
Total			**7**

4.5.6.1.5 Acceleration

Answer 18 · Mark scheme

January 2010 | PHY3H | Original Q1 | Legacy

PHY3H

4.5.6.1.5 Acceleration

Answer 19 · Mark scheme

June 2019 | PHY2H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	75 000 newtons / N	accept correct substitution for **1** mark ie 7500 × 10 do **not** accept n full credit for using g = 9.8 **or** 9.81	2 1
1(a)(ii)	60 000 000	accept for both marks their (a)(i) × 800 correctly calculated accept correct substitution for **1** mark ie their (a)(i) × 800	2
1(b)(i)	arrow drawn parallel (to) **and** down (the) slope	accept arrow drawn anywhere on the diagram	1
1(b)(ii)	increases GPE transformed to KE **or** speed increasing	 accept is accelerating however 'speed increasing' only scores if correctly linked to increasing kinetic energy	1 1
1(c)	so more likely to wear one **or** they know wearing a helmet is likely to / will reduce (risk) head injury **or** so can make an (informed) choice (about wearing one)		1
Total			**9**

4.5.6.1.5 Acceleration

Answer 19 · Mark scheme

June 2010 | PHY2H | Original Q1 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 20 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)(i)	120		1
1(a)(ii)	20	accept 140-their (a)(i) provided answer is not negative	1
1(a)(iii)	as speed increases drag force / water resistance / friction / **D** increases (until) **D** = 140 N or (until) **D** = **T**	 forces balance is insufficient	1 1 1
1(b)(i)	(average) speed (of swimmer)		1
1(b)(ii)	any **two** from: • more data • force may vary (a lot) / change • give more <u>reliable average</u>	 accept results for data do **not** accept more accurate data ignore references to anomalies ignore accurate / precise	2

Question 1 continues on the next page . . .

4.5.6.1.5 Acceleration

PHY2H

Question 1 continued . . .

question	answers	extra information	mark
1(b)(iii)	examples of acceptable responses: • most / some females produce smaller forces • most / some males produce larger forces • some females swim as fast as males but use a smaller force • most of the faster swimmers are male • most of the slower swimmers are female • range of the (average) speed of males is smaller than the range of the (average) speed of females • range of the (average) force of the males is greater than the range of the (average) force of the females	do **not** accept <u>all</u> females produce smaller forces do **not** accept <u>all</u> males produce larger forces do **not** accept <u>all</u> males swim faster do **not** accept <u>all</u> females swim slower	1
1(b)(iv)	exert maximum (hand) force (throughout the swim / stroke)	accept (any method to) increase (hand) force practise more is insufficient	1
Total			**10**

4.5.6.1.5 Acceleration

Answer 20 · Mark scheme January 2011 | PHY2H | Original Q1 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 21 · Mark scheme

June 2011 | PHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	48	allow for **1** mark correct method shown, ie 6 × 8 **or** correct area indicated on the graph	2
5(b)	diagonal line from (0,0) to (6,48) / (6, their (a))	if answer to (a) is greater than 50, scale must be changed to gain this mark	1
	horizontal line at 48m between 6 and 10 seconds	accept horizontal line drawn at their (a) between 6 and 10 seconds	1
Total			**4**

4.5.6.1.5 Acceleration

Answer 21 · Mark scheme June 2011 | PHY2H | Original Q5 | Legacy

PHY2H

4.5.6.1.5 Acceleration

Answer 22 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)	4.2	2 marks for correct substitution **and** transformation, ie 1155/275 allow **1** mark for correct resultant force with a subsequent incorrect method, ie 1155 allow **1** mark for an incorrect resultant force with a subsequent correct method, eg answers of 7.27 or 10.34 gain **1** mark	3
7(b)(i)	YES any **two** from: • data (from police files) can be trusted • data answers the question asked • large sample used NO any **two** from: • the sample is not representative • the sample size is too small • accident files do not indicate age / experience of riders	marks are for the explanation allow a conclusion can be made from the data an answer YES and NO can score **1** mark from each set of mark points	2

Question 7 continues on the next page

PHY2H

Question 7 continued

question	answers	extra information	mark
7(b)(ii)	more accidents with motorbikes up to 125 cc	accept for **2** marks an answer in terms of number of under 125 cc to accidents ratio compared correctly with number of over 500 cc to accidents ratio	1
	even though there are fewer of these bikes than bikes over 500 cc		1
7(c)(i)	increases the time taken to stop	accept increases collision time	1
	decreases rate of change in momentum	accept reduces acceleration / deceleration accept $F = \frac{\Delta mv}{\Delta t}$ reduces momentum is insufficient	1
	reduces the force (on the rider)		1
7(c)(ii)	YES any sensible reason, eg: • cannot put a price on life / injury • fewer (serious) injuries • reduces cost of health care / compensation NO any sensible suggestion, eg: • money better spent on … • total number of riders involved is small	the mark is for the reason accept may save lives accept reduces risk of injury needs to be specific	1
Total			**11**

4.5.6.1.5 Acceleration

Answer 23 · Mark scheme

January 2013 | PH2HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	more streamlined air resistance is smaller (for same speed) so reaches a higher speed (before resultant force is 0)	accept decrease surface area accept drag for air resistance friction is insufficient ignore reference to mass	1 1 1
5(b)(i)	1.7	allow **1** mark for correct method, ie $\frac{5}{3}$ **or** allow **1** mark for an answer with more than 2 sig figs that rounds to 1.7 **or** allow **1** mark for an answer of 17	2
5(b)(ii)	7.5	allow **1** mark for correct use of graph, eg $\frac{1}{2} \times 5 \times 3$	2
5(b)(iii)	air (resistance)	accept wind (resistance) drag is insufficient friction is insufficient	1
Total			**8**

4.5.6.1.5 Acceleration

Answer 23 · Mark scheme

January 2013 | PH2HP | Original Q5 | Legacy

PH2HP

4.5.6.1.5 Acceleration

Answer 24 · Mark scheme

June 2013 | PH2HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	(produces) a force from water on the boat in the forward direction	 accept in the opposite direction this must refer to the direction of the force not simply the boat moves forwards an answer produces an (equal and) opposite force gains **1** mark	1 1
1(b)(i)	1.5 m/s^2	 allow **1** mark for correct substitution, ie $\frac{16-4}{8}$ **or** $\frac{12}{8}$ provided no subsequent step shown ignore sign	2 1
1(b)(ii)	102 **or** their (b)(i) × 68 correctly calculated	 allow **1** mark for correct substitution, ie 1.5 × 68 **or** their (b)(i) × 68 provided no subsequent step shown	2
1(b)(iii)	greater than need to overcome resistance forces	reason only scores if greater than chosen accept named resistance force accept resistance forces act (on the water skier) do **not** accept gravity	1 1
Total			**9**

4.5.6.1.5 Acceleration

Answer 24 · Mark scheme

June 2013 | PH2HP | Original Q1 | Legacy

PH2HP

4.5.6.1.5 Acceleration

Answer 25 · Mark scheme

June 2013 | PH3HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	centripetal (force)	allow tension (between astronaut and seatbelt)	1
	towards the centre (of the G-machine / circle)	do **not** accept towards the centre of the Earth allow inwards	1
5(b)(i)		answers must be comparative accept velocity for speed	
	the greater the speed (of a centrifuge), the greater the force	accept positive correlation between speed and force speed and force are not proportional – treat as neutral	1
	the smaller the radius, the greater the force (at a given speed)	allow **(G machine) 1** has / produces a greater force (than **G machine 2**) at the same speed must be comparative, eg a small radius produces a large force = 0 marks on own	1
	as the speed increases the rate of change in force increases	accept force is proportional to the square of the speed **or** doubling speed, quadruples the force accept any clearly correct conclusion	1
5(b)(ii)	12000 (N) **or** 12 k(N)		1

Question 5 continues on the next page . . .

4.5.6.1.5 Acceleration

PH3HP

Question 5 continued . . .

question	answers	extra information	mark
5(c)(i)	the current (in the coil) creates a magnetic field (around the coil) so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)	accept the coil is an electromagnet accept the two magnetic fields interact (producing a force) if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max **1** mark	1 1
5(c)(ii)	vertically downwards arrow on side A **and** vertically upwards arrow on side C	one arrow insufficient	1
5(c)(iii)	the current is parallel to the magnetic field	allow the current and magnetic field are in the same direction allow it / the wire is parallel to the magnetic field	1
5(d)	increase the current / p.d. (of the coil)	accept decrease resistance accept voltage for p.d. accept increase strength of magnetic field / electromagnet	1

Question 5 continues on the next page . . .

4.5.6.1.5 Acceleration

PH3HP

Question 5 continued . . .

question	answers	extra information	mark
5(e)	yes with suitable reason **or** no with suitable reason	**eg** **yes** – it has increased our knowledge **yes** – It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples **no** – the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough) **no** mark for just **yes** / **no** reason must match **yes** / **no**	1
Total			**12**

4.5.6.1.5 Acceleration

Answer 25 · Mark scheme June 2013 | PH3HP | Original Q5 | Legacy

PH3HP

Answer 26 · Mark scheme June 2014 | PH2HP | Original Q3 | Legacy

3(a)(i)	friction		1	AO1 2.1.3a

3(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

3(a)(iii)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		**Mark** **6**	**AO spec ref**
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO2 AO3 2.1.4c
No relevant content.	There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points **or** a description of how the velocity changes between any two points.	There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z **or** a complete description of how the velocity changes from X to Z. **or** an explanation and description of velocity change for either X to Y or Y to Z	There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z **and** a description of the change in velocity between X and Z.	

4.5.6.1.5 Acceleration

Answer 26 · Mark scheme

examples of the points made in the response	extra information
X to Y • at X force A is greater than force B • cyclist accelerates • and velocity increases • as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity) • resultant force decreases • cyclist continues to accelerate but at a smaller value • so velocity continues to increase but at a lower rate **Y to Z** • from Y to Z force B (air resistance) increases • acceleration decreases • force B becomes equal to force A • resultant force is now zero • acceleration becomes zero • velocity increases until… • cyclist travels at constant / terminal velocity	accept speed for velocity throughout

4.5.6.1.5 Acceleration

Answer 26 · Mark scheme

Question	Answers	Extra information	Mark	AO spec ref
3(b)(i)	3360	allow **1** mark for correct substitution, ie 140 × 24 provided no subsequent step accept 3400 for **2** marks if correct substitution is shown	2	AO1 AO2 2.2.1b
	joule / J	do **not** accept j do **not** accept Nm	1	
3(b)(ii)	decreases	accept an alternative word / description for decrease do not accept slows down	1	AO1 2.1.3e
	temperature	accept thermal energy accept heat	1	
Total			**13**	

4.5.6.1.5 Acceleration

Answer 26 · Mark scheme

June 2014 | PH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

4.5.6.1.5 Acceleration

Answer 27 · Mark scheme

June 2015 | PH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)(i)	decreases (to zero) resultant force acts in opposite direction to motion	 accept air resistance and weight for resultant force accept resultant force acts downwards do **not** accept air resistance increases	1 1	AO1 2.1.1c/e	E
6(a)(ii)	velocity includes direction **or** velocity is a vector (quantity)		1	AO1 2.1.2d	E
6(b)(i) mark with 6bii 6biii	3.6	allow **1** mark for correct substitution i.e. ½ x 0.05 x 12^2 provided no subsequent step	2	AO2 2.2.1g	E
6(b)(ii) mark with 6bi, 6biii	3.6 **or** their (b)(i)		1	AO1 2.2	E
6(b)(iii) mark with 6bi, 6bii	7.2 **or** their (b)(ii) ÷ 0.5 correctly calculated	allow **1** mark for correct substitution i.e. 3.6 or their (b)(ii) = 0.05 x 10 x h	2	AO2 2.2.1f	E
6(b)(iv)	**B**		1	AO3 2.1	A
6(c)	range increases up to 45° range decreases from 45°	 the range is a maximum at 45° gains both marks for any two angles that add up	1 1	AO3 2.1	E

4.5.6.1.5 Acceleration

		to 90° the range is the same gains both marks the range increases then decreases gains **1** mark			
Total			**11**		

4.5.6.1.5 Acceleration

Answer 28 · Mark scheme

June 2016 | PH2HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	starting / stopping the stopwatch **or** timing over the smaller distances	human error is insufficient reaction time is insufficient accept not timing accurately do not accept references to measuring distance incorrectly	1	AO3 2.1
1(b)(i)	before		1	AO3 2.1
1(b)(ii)	increasing	accept accelerating it is not constant is insufficient it is less than after four seconds is insufficient it reaches a constant speed negates	1	AO3 2.1.2b
1(b)(iii)	calculate the gradient of the straight/steepest/constant section	accept gradient of any section after 5.5 seconds/30 cm	1	AO1 2.1.2b
1(b)(iv)	drag (force) increases (as the ball bearing gets faster) (until) drag (force) = weight **or** (until) resultant force is zero	accept frictional/upward force for drag accept upward force = downward force accept till forces are balanced	1 1	AO1 2.1.4b

4.5.6.1.5 Acceleration

Answer 28 · Mark scheme

1(c)	less than ball bearing increases speed at a greater rate **or** ball bearing has a greater acceleration **or** terminal velocity has not been reached so resultant force must be greater **or** as weight is the same (the drag must be less)	 accept it travels the same distance in less time accept the ball bearing is going faster accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score	1 1 1	AO3 2.1.4a/b
Total			**9**	

4.5.6.1.5 Acceleration

Answer 28 · Mark scheme

June 2016 | PH2HP | Original Q1 | Legacy



4.5.6.1.5 Acceleration

Answer 29 · Mark scheme

June 2016 | PH2HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	resultant force = zero **or** upward force = downward force	 accept forces are balanced accept weight for downward force	1	AO1 2.1.1d
7(b)(i)	84	allow **1** mark for correct substitution ie 840 = m × 10	2	AO2 2.1.4d
7(b)(ii)	12 **or** 1010 ÷ their (b)(i) correctly calculated m/s^2	accept 12.02 for both marks a resultant force of 1010 (N) gains **1** mark an answer 22(.02) gains 1 mark accept m/s/s	2 1	AO2 2.1.2a AO1 2.1.2a
Total			**6**	

4.5.6.1.5 Acceleration

Answer 30 · Mark scheme

June 2017 | PH2HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	momentum before (firing) = momentum after (firing) before firing momentum (of cannon and ball) is zero after (firing) the ball has momentum (forwards) so the cannon must have (equal) momentum (backwards)	accept momentum (of the cannon and ball) is conserved if no other marks are awarded answers only in terms of equal **and** opposite forces gain a maximum of **1** mark	1 1 1	AO1 2.2.2b
7(b)	1000 (kg m/s)	allow **2** marks for correctly calculating (final) velocity as 125 (m/s) allow **1** mark for correct substitution ie $2500 = \frac{v\ (-u)}{0.05}$ award **1** mark for an incorrectly calculated value of v correctly substituted and calculated in the equation momentum = m x v	3	AO2 2.1.2e 2.2.2a
Total			**6**	

4.5.6.1.5 Acceleration

Answer 31 · Mark scheme

June 2017 | PH3HP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)(i)	The direction is changing Because direction is changing the velocity is changing Because velocity is changing the train is accelerating	 accept velocity is speed in a certain direction accept acceleration is rate of change of velocity	1 1 1	AO1 3.2.4a 3.2.4b
8(a)(ii)	Track B has a larger radius allowing a greater speed for the same centripetal force	 accept requiring a lower centripetal force for the same speed	1 1	AO3 AO1 3.2.4c
8(b)(i)	The train can go faster round bends	accept it is less likely to topple ignore references to it will not topple over	1	AO3 3.2.4c
8(b)(ii)	There is no (resultant) moment		1	AO1 3.2.2f
8(c)(i)	**either** When the angle doubles the radius halves. An explanation using numbers quoted from the graph to support this eg at 2 degrees the minimum radius is 3000 m but at 4 degrees it is 1500 m. **or** The product of angle and radius is constant (the product is) 6000		 1 1	 AO2 3.2

4.5.6.1.5 Acceleration

Answer 31 · Mark scheme

8(c)(ii)	A computer simulation allows for more variables to be tested	accept computer models can control variables more easily accept can generate lots of results in a short time accept does not get damaged in test runs ignore references to accuracy ignore references to cost reduces the likelihood of human error is insufficient	1	AO3 3.2
Total			**10**	

4.5.6.1.5 Acceleration

Answer 32 · Mark scheme

June 2018 | 8463/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	uniform acceleration	allow constant / steady acceleration allow velocity / speed increasing at a constant rate ignore reference to direction acceleration scores **1** mark **or** velocity / speed is increasing scores **1** mark do **not** accept acceleration increases	2	AO1 4.5.6.1.5
01.2	up(wards)		1	AO1 4.5.6.1.5
01.3	a group of objects that interact		1	AO1 4.1.1.1
01.4	velocity just after bounce is less than just before bounce **or** the height at the top of the bounce is less than the height from which it was dropped	allow velocity is less / decreases allow speed for velocity velocity decreases to zero – on its own scores zero	1	AO3 4.5.6.1.5
	so the ball has lost energy		1	AO1 4.1.1.2
	correct reference to (loss of) ke or (reduced) gpe		1	AO1 4.1.2.1
	total energy of ball and Earth / ground is constant	allow 'a system' for ball and Earth allow energy is conserved	1	AO1 4.1.2.1
Total			**8**	

4.5.6.1.5 Acceleration

Answer 33 · Mark scheme

November 2020 | 8463/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Move the wooden block to the left.		1	AO3 4.5.6.2.2 RPA7
01.2	use a pulley (on the edge of the bench)	allow any feasible method to stop the string from rubbing	1	AO3 4.5.6.2.2 RPA7
01.3	suitable scale points plotted correctly line of best fit	 allow 5 correctly plotted for **2** marks **OR** 3–4 correctly plotted for **1** mark	1 2 1	AO2 4.5.6.2.2 RPA7
01.4	(directly) proportional	allow a correct description of direct proportionality ignore positive correlation allow weight (added to mass holder) for force allow f = ma for **1** mark	1	AO3 4.5.6.2.2 RPA7
01.5	repeat the measurements/investigation ignore anomalies **and** calculate the mean / average		1 1	AO3 4.5.6.2.2 RPA7
01.6	resultant force = mass × acceleration **or** F = m a		1	AO1 4.5.6.2.2 RPA7

4.5.6.1.5 Acceleration

Answer 33 · Mark scheme

November 2020 | 8463/2H | Original Q1

01.7	$0.375 = 0.60 \times a$ $a = \frac{0.375}{0.60}$ $a = 0.625\ (m/s^2)$ $a = 0.63\ (m/s^2)$		1 1 1 1	AO2 4.5.6.2.2 RPA7
Total			**14**	

4.5.6.1.5 Acceleration

Answer 34 · Mark scheme

November 2020 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	320 MHz = 3.2×10^8 Hz	allow 320 000 000	1	AO2
	$3.0 \times 10^8 = 3.2 \times 10^8 \times \lambda$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	$\lambda = \frac{3.0 \times 10^8}{3.2 \times 10^8}$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	wavelength = 0.9375	allow correct calculation using an incorrectly/not converted frequency allow an answer that rounds to 0.94	1	AO2
	metres **or** m		1	AO1 4.6.1.2
06.2	(alternating) current <u>induced</u> (in the electrical circuit)	allow <u>electrons</u> vibrate / oscillate (in the electrical circuit)	1	AO1 4.6.2.3
	with the same frequency as the radio wave		1	
06.3	Any **two** from: • (radio waves are) transverse	allow sound waves are longitudinal allow a description of transverse/longitudinal waves	2	AO1 4.6.1.1 4.6.1.2
	• (radio waves) travel at a higher speed • (radio waves) don't need a medium	allow (only) radio waves travel through a vacuum		
	• (radio waves are) electromagnetic	allow sound waves are mechanical		
06.4	accelerating	allow speeding up	1	AO3 4.5.6.1.4

4.5.6.1.5 Acceleration

Answer 34 · Mark scheme

06.5	appropriate tangent drawn correct reading from graph for change in distance and change in time (eg 5.6 (m) and 20 (s)) gradient of tangent shown (eg 5.6/20) 0.28 (m/s)	 allow correct reading from their tangent for change in distance and change in time allow correct gradient from their tangent this answer only allow 0.25 to 0.30 (m/s) if the tangent is appropriate allow 2.8 / 20 = 0.14 (m/s) for **1** mark	1 1 1 1	AO2 4.5.6.1.4
06.6	$0.52^2 - 0.12^2 = 2 \times 0.04 \times s$ $s = \frac{0.52^2 - 0.12^2}{2 \times 0.04}$ s = 3.2 (m) 0.48 = F x 3.2 $F = \frac{0.48}{3.2}$ F = 0.15 (N) **OR**	 this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F using an incorrectly calculated displacement	1 1 1 1 1 1	AO2 4.5.2 4.5.6.1.5

4.5.6.1.5 Acceleration

Answer 34 · Mark scheme

November 2020 | 8463/2H | Original Q6

	Alternative method 1 $t = \frac{0.52 - 0.12}{0.04}$ (1) t = 10 (s) (1) s = 0.32 × 10 = 3.2 (m) (1) 0.48 = F x 3.2 (1) $F = \frac{0.48}{3.2}$ (1) F = 0.15 (N) (1) **OR** Alternative method 2 $0.48 = (0.5 \times m \times 0.52^2) - (0.5 \times m \times 0.12^2)$ (1) 0.48 = 0.1352m – 0.0072m (1) 0.48 = 0.128m (1) m = 3.75 (1) F = 3.75 x 0.040 (1) F = 0.15 (N) (1)	allow a correctly calculated displacement from an incorrectly calculated t this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F from incorrectly calculated values for displacement and / or t allow their calculated m allow correctly calculated F using an incorrectly calculated m		

4.5.6.1.5 Acceleration

Answer 34 · Mark scheme

November 2020 | 8463/2H | Original Q6

06.7	there is a maximum forward force (provided by the motor) as the speed of the car increases air resistance increases until air resistance is equal in size to forward force so the car can no longer accelerate	allow driving force for forward force - throughout the car has a maximum acceleration is insufficient allow friction / drag for air resistance - throughout allow (until) the resultant force is zero allow forces are in equilibrium / balanced allow the car travels at terminal velocity	1 1 1 1	AO1 4.5.6.1.5
Total			**24**	

4.5.6.1.5 Acceleration

Answer 35 · Mark scheme

November 2021 | 8463/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	the total energy of the racing track and the car is constant.		1	AO1 4.1.2.1
08.2	$E_p = 0.040 \times 9.8 \times 0.90$	allow a correct substitution of an incorrectly/not converted value of h	1	AO2 4.1.1.1 4.1.1.2
	$E_p = 0.3528$ (J)	this answer only	1	
	$0.3528 = 0.5 \times 0.040 \times v^2$	allow a correct substitution of a calculated E_p	1	
	$v^2 = \frac{0.3528}{0.5 \times 0.040}$	allow a correct rearrangement using a calculated E_p	1	
	$v = 4.2$ (m/s)	allow an answer consistent with their calculated E_p	1	
08.3	more than 0.20 J		1	AO3 4.1.1.1
	(because) the car needs to be moving at the top of the loop **or** (because) the car needs to be moving to complete the loop **or** not all E_k at **B** will be transferred to E_p at **C**	this mark is dependent on scoring the first mark allow energy dissipated to the surroundings	1	
Total			**8**	

4.5.6.1.5 Acceleration

Answer 36 · Mark scheme

November 2021 | 8463/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO/ Spec. Ref
01.1	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.		3–4	AO1 4.5.6.3.3 4.5.6.3.4 4.1.1.2
	Level 1: Point are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.		1–2	
	No relevant content		0	
	Indicative content Factors • poor condition of tyres • poor road surface • wet or icy road • poor/worn brakes Explanation • because of decreased friction Factors • increased mass of car/passengers Explanation • increases kinetic energy of car • more work needs to be done to stop car • increases momentum of the car Factor • road slopes downhill Explanation • (a component of) gravity opposes the braking force • resultant (braking) force is reduced allow answers in terms of reducing braking distance throughout A single factor with no related explanation is insufficient to score a mark			

4.5.6.1.5 Acceleration

Answer 36 · Mark scheme

November 2021 | 8463/2H | Original Q1

01.2	resultant force = mass × acceleration		1	AO1 4.5.6.2.2
01.3	7200 = 1600 × *a* $a = \frac{7200}{1600}$ *a* = 4.5 (m/s^2)	ignore negatives throughout	1 1 1	AO2 4.5.6.2.2
01.4	15 (m) 38 (m) = 53 (m)	two correct values identified allow the correct addition of a misread braking distance and /or a misread thinking distance taken from the graph	1 1	AO3 4.5.6.3.1
01.5	$p = \frac{F}{A}$		1	AO1 4.5.5.1.1
01.6	120 000 = $\frac{60}{A}$ $A = \frac{60}{120\,000}$ *A* = 0.0005 *A* = 5 (.0) × 10^{-4} m^2	allow an answer given to 2 sig figs from an incorrect calculation using the given data	1 1 1 1 1	AO2 AO2 AO2 AO2 AO1 4.5.5.1.1
Total			**16**	

4.5.6.1.5 Acceleration

Answer 37 · Mark scheme

November 2021 | 8463/2H | Original Q7

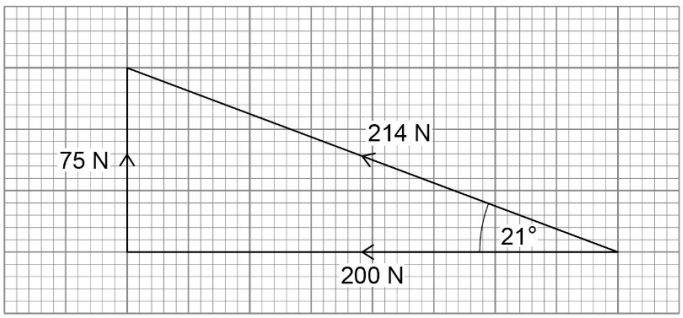
Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	friction		1	AO1 4.5.1.2
07.2	(area of rectangle =) 108 (m) (area of triangle =) 54 (m) (total area / distance =) 162 (m)	 allow a correctly calculated total area / distance from an incorrectly calculated area of rectangle and / or triangle	1 1 1	AO2 4.5.6.1.5
07.3	(the force on the pedal) causes a moment about the pedal axle which causes a force on the chain (which causes a moment about the rear axle)	 allow gear B for chain	1 1	AO1 4.5.4
07.4	$2.4^2 (- 0^2) = 2 \times a \times 18$ $a = \frac{2.4 \times 2.4}{36}$ $a = 0.16$ (m/s^2) <u>alternative method</u> t = 18 / 1.2 t = 15 (s) (1) a = 2.4 / 15 (1) $a = 0.16$ (m/s^2) (1)	 this mark may be awarded if the time is incorrectly calculated allow a correctly calculated acceleration from an incorrectly calculated time	1 1 1	AO2 4.5.6.1.5

4.5.6.1.5 Acceleration

Answer 37 · Mark scheme

November 2021 | 8463/2H | Original Q7

07.5	horizontal (200N) **and** vertical (75N) forces drawn to the same scale		1	AO2 4.5.1.4
	resultant force drawn in the correct direction	shown by an arrow head from bottom right to top left	1	
	resultant force with a value in the range 212 to 218 (N)	allow a calculated value of 213.6 **or** 214 (N)	1	
	direction in the range 20–22 (degrees from the horizontal)	allow 68–70 (degrees from the vertical) allow a bearing in the range 290–292 to gain full marks a vector diagram must have been drawn	1	
				

Total			**13**

4.5.6.1.5 Acceleration

Answer 38 · Mark scheme

November 2021 | 8463/2H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	hold thumb first finger and second finger (of left hand) at right angles to each other	allow first two fingers/index and middle for first and second finger throughout	1	AO1
	second finger represents the current pointing out of the paper		1	AO1
	first finger represents the field pointing downwards		1	AO3
	thumb points in the direction of the force / thrust / acceleration		1	AO3
	(therefore) the rod moves left to right	allow correct description (eg away from the magnet) dependent on scoring marking point 3 or 4	1	AO3 4.7.2.2
09.2	decrease the resistance of the variable resistor	allow increase the current/pd	1	AO3 4.7.2.2
	use a stronger magnet	allow use a magnet with a greater flux density	1	

4.5.6.1.5 Acceleration

Answer 38 · Mark scheme

November 2021 | 8463/2H | Original Q9

09.3	F = 0.30 × 1.7 × 0.050 F = 0.0255 (N) m = 0.004(0 kg) 0.0255 = 0.0040 × a a = 0.0255 / 0.0040 **or** a = 6.375 Δv = 6.375 × 0.15 = 0.95625 (m/s) <u>alternative method</u> F = 0.30 × 1.7 × 0.050 (1) F = 0.0255 (N) (1) m = 0.004(0 kg) (1) $0.0255 = \frac{0.0040 \times \Delta v}{0.15}$ (1) $\Delta v = \frac{0.0255 \times 0.15}{0.0040}$ (1) Δv = 0.95625 (m/s) (1)	this mark may be awarded if *m* is incorrectly / not converted and / or *F* is incorrectly calculated this mark may be awarded if *m* is incorrectly / not converted and / or *F* is incorrectly calculated allow a correct calculation using an incorrectly / not converted *m* and / or an incorrectly calculated *F* allow 0.96 **or** 0.956 (m/s) this mark may be awarded if *m* is incorrectly / not converted and / or *F* is incorrectly calculated this mark may be awarded if *m* is incorrectly / not converted and / or *F* is incorrectly calculated allow a correct calculation using an incorrectly / not converted *m* and / or an incorrectly calculated *F* allow 0.96 **or** 0.956 (m/s)	1 1 1 1 1 1	AO2 4.5.6.2.2 4.5.6.1.5 4.7.2.2
Total			**13**	

4.5.6.1.5 Acceleration

Answer 39 · Mark scheme

June 2022 | 8463/2HR | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from: • capacity of the battery • speed • mass / weight • uphill / downhill • stopping at traffic lights • condition of the road • (air) temperature • (incorrect) tyre pressure • streamlining of the car	allow energy/charge stored in battery allow efficiency of battery ignore size of battery allow terrain ignore 'the road' only ignore 'weather' only allow efficiency of engine allow anything that would use charge from the battery **or** anything that will reduce the energy stored	2	AO3 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	acceleration = change in velocity/time (taken) **or** $a = \frac{\Delta v}{t}$	allow any correct rearrangement allow $a = \frac{v - u}{t}$ do **not** accept $a = \frac{v}{t}$	1	AO1 4.5.6.1.5

4.5.6.1.5 Acceleration

Answer 39 · Mark scheme

June 2022 | 8463/2HR | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$20 = \frac{28}{t}$ $t = \frac{28}{20}$ 1.4 (s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	v^2 (- 0^2) = 2 × 10 × 605 v^2 = 12 100 v = 110 (m/s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	work done = force × distance **or** $W = Fs$	allow any correct rearrangement	1	AO1 4.5.2

4.5.6.1.5 Acceleration

Answer 39 · Mark scheme

June 2022 | 8463/2HR | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	*s* = 7500 (m)		1	AO2 4.5.2
	W = 4000 × 7500	allow correct substitution using incorrectly / not converted value of s	1	
	W = 30 000 000 (J)	allow correct calculation using incorrectly / not converted value of s	1	

Total Question 1		13

4.5.6.1.5 Acceleration

Answer 40 · Mark scheme

June 2022 | 8463/2HR | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	there is a resultant force acting	allow weight/gravity is greater than air resistance allow (initially) weight/gravity is the only force acting	1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	as the velocity of the hailstone increases air resistance increases until air resistance becomes equal to the weight of the hailstone so the resultant force is (equal to) zero	allow speed for velocity	1 1 1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	as mass increases the weight of a hailstone increases		1	AO3 4.5.6.1.5

4.5.6.1.5 Acceleration

Answer 40 · Mark scheme

June 2022 | 8463/2HR | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	kinetic energy depends on both mass and velocity	allow $E_k = ½ mv^2$	1	AO1
	as mass increases so does terminal / maximum velocity	a statement is required	1	AO1
	kinetic energy ∝ m and kinetic energy ∝ v^2 so as mass doubles kinetic energy more than doubles	this mark can be scored by relevant calculations	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	1 N m		1	AO3 4.5.2

4.5.6.1.5 Acceleration

Answer 40 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	mass = 0.0185 (kg)	allow 0.018 to 0.019 inclusive	1	AO2 4.5.7.3
	$F = \frac{0.0185 \times 25}{0.060}$	allow a correct substitution using an incorrectly / not converted value of *m*	1	
	F = 7.708 (N)	allow 7.7 (N) allow correct calculation using an incorrectly / not converted value of *m* **if no other marks are awarded** a misreading of the scale giving a value between 15.6 and 15.7 inclusive that is then correctly converted giving an answer between 6.50 and 6.54 scores 2 marks a misreading of the scale giving a value between 15.6 and 15.7 inclusive that is then not converted giving an answer between 6500 and 6542 scores 1 mark	1	

Total Question 4		**12**

4.5.6.1.5 Acceleration

Answer 41 · Mark scheme

June 2023 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7.1 (cm) 497 (m)	allow 7.0 to 7.3 (cm) allow 70 × their incorrect measurement of displacement	1 1	AO2 4.5.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	0 (N)		1	AO2 4.5.1.4

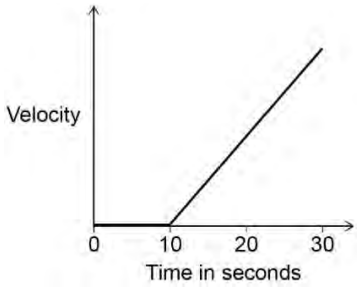
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	constant velocity	allow constant speed (in a straight line) do **not** accept stationary allow constant acceleration if a **mathematical error** in 02.2 gives a non-zero value for resultant force	1	AO1 4.5.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • tension • normal contact (force) • upthrust	allow lift, thrust and water resistance allow normal reaction (force) ignore drag	1	AO1 4.5.1.2

4.5.6.1.5 Acceleration

Answer 41 · Mark scheme

June 2023 | 8463/2H | Original Q2

Question	Answers		Mark	AO / Spec. Ref.
02.5	horizontal line drawn to 10s along the *x*-axis		1	AO3 4.5.6.1.4
	line with a positive gradient starting from 10 s	allow an upward curving line with increasing gradient starting from 10 s  	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	line of best fit drawn and extrapolated to 10 km	do **not** accept a straight line	1	AO2 4.5.5.2
	28 (kPa)	allow 26 to 32 (kPa) allow a value correctly extrapolated from their line allow 2 marks for a correct mathematically extrapolated value	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	the average density of the air above the aeroplane decreases		1	AO3 4.5.5.2

Total Question 2	10

4.5.6.1.5 Acceleration

Answer 42 · Mark scheme

June 2023 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the total amount of energy (of the bumper car and barrier) remains constant. **or** total momentum (of bumper car and barrier) before collision equals total momentum (of bumper car and barrier) after collision **or** the resultant external force acting (on the system) is zero	allow there are no external forces (acting on the system)	1	AO1 4.5.7.2 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the force of the car on the barrier is equal to the force of the barrier on the car and in the opposite direction		1	AO1 4.5.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$F = \frac{700}{0.28}$ F = 2 500 (N)		1 1	AO2 4.5.7.3

4.5.6.1.5 Acceleration

Answer 42 · Mark scheme

June 2023 | 8463/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	increases the time taken for the collision to occur	allow increases contact time do **not** accept slows down time	1	AO1 4.5.7.3
	(so) the rate of change of momentum decreases	allow reduces acceleration / deceleration	1	
	reducing the force (on the people)	reduces impact is insufficient	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$2.5^2 - u^2 = 2 \times 2.0 \times 1.5$		1	AO2 4.5.6.1.5
	$u^2 = 2.5^2 - (2 \times 2.0 \times 1.5)$		1	
	$u = 0.50$ (m/s)	allow 0.5 (m/s)	1	

Total Question 5	10

4.5.6.1.5 Acceleration

Answer 43 · Mark scheme

June 2024 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	elastic potential (energy)	*allow E_e / EPE*	1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$E_e = 0.5 \times 735 \times 8.0^2$	allow a correct substitution using k = 1470 (N/m) and e = 8 (m) **or** k = 1470 (N/m) and e = 16 (m) **or** k = 735 (N/m) and e = 16 (m)	1	AO2 4.1.1.2
	$E_e = 23\,520$ (J)	this answer only	1	
	total $E_e = 47\,040$ (J)	this answer only	1	
	$47\,040 = 240 \times 9.8 \times h$	allow a correct substitution of their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	$h = \dfrac{47\,040}{(240 \times 9.8)}$	allow a correct rearrangement using their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	$h = 20$ (m)	allow an answer consistent with their value of E_e (using $E_e = 0.5ke^2$)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	air resistance (opposes the motion of the pod upwards)		1	AO3
	(so) not all of the elastic potential energy will be transferred to gravitational potential energy	allow the energy transfer is not 100% efficient allow some energy is transferred to the surroundings allow some energy is dissipated ignore energy is wasted ignore reference to mass of person in pod	1	AO1 4.1.2.1 4.1.2.2

Total Question 6	9

4.5.6.1.5 Acceleration

Answer 44 · Mark scheme

June 2024 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	tension		1	AO2 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(combined) mass of trolley and mass hanger	allow mass / weight of trolley / hanger	1	AO1 4.5.6.2.2 RPA7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		allow speed for velocity throughout		AO3 4.5.6.1.5 4.5.6.1.2 4.5.6.2.2 RPA7
	divide distance travelled by time taken to give (average / mean) velocity		1	
	double mean velocity (to give maximum velocity)		1	
	divide change in velocity by time taken (to give acceleration)	allow divide maximum velocity by time (to give acceleration) allow use of $v^2 = u^2 + 2as$ allow correct use of $s = ut + \frac{1}{2}at^2$	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(range =) 0.06 (m/s^2) **or** (mean =) 1.36 (m/s^2)		1	AO3 4.5.6.2.2 RPA7
	uncertainty = ±0.03 (m/s^2)		1	

4.5.6.1.5 Acceleration

Answer 44 · Mark scheme

June 2024 | 8463/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	a component of the weight of the trolley acts parallel to runway (so) resultant force increases so acceleration increases	 allow work is done (by raising the trolley) so the trolley gains gravitational potential energy (1) gravitational potential energy is transferred to kinetic energy increasing the final velocity and the acceleration (1)	1 1	AO3 4.5.6.2.2

Total Question 5	9

4.5.6.1.5 Acceleration

Answer 45 · Mark scheme

June 2024 | 8463/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	$(\frac{1}{2} \times 56 \times 220) = 6160$ $(56 \times 380) = 21280$ $(6160 + 21280) = 27\,440$ (m)	 allow a correctly calculated total distance from an incorrectly calculated area of the rectangle and / or the triangle	1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	the gradient is less after 720 s so the deceleration is smaller so the braking force is smaller	allow the gradient is less after (velocity decreases to) 20 m/s	1 1 1	AO3 4.5.6.1.5 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	correct section of line identified attempt to calculate a gradient using values from the correct section of the graph eg gradient $= \frac{(-)36}{120}$ correct calculation using their correct values eg $a = (-)0.3$ (m/s^2)	judge by values used allow use of correct values obtained from the section of the graph after 720 s allow a correct calculation using correct values obtained from the section of the graph after 720 s if no other marks scored, an answer that rounds to 0.16 (m/s^2) scores 1 mark	1 1 1	AO2 4.5.6.1.5

4.5.6.1.5 Acceleration

Answer 45 · Mark scheme

June 2024 | 8463/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(–)270 000 = 240 000 × a		1	AO2 4.5.6.1.5
	$a = \frac{(-)270\,000}{240\,000}$		1	
	a = (–) 1.125 (m/s^2)	the equation $F = ma$ must have been used to score subsequent marks	1	
	0 = 60^2 + (2 × (–1.125) × s)	allow a correct substitution using their value of deceleration	1	
	$s = \frac{3600}{2.25}$	allow a correct re-arrangement using their value of deceleration	1	
	s = 1600 (m)	allow a correct calculation using their value of deceleration	1	
	OR			
	$E_k = \frac{1}{2} \times 240\,000 \times 60^2$ (1)			
	= 432 000 000 (1)			
	Δ E_k = work done (1)			
		the equation $E_k = \frac{1}{2}mv^2$ must have been used to score subsequent marks		
	432 000 000 = 270 000 × s (1)	allow a correct substitution using their value of E_k		
	$s = \frac{432\,000\,000}{270\,000}$ (1)	allow a correct re-arrangement using their value of E_k		
	s = 1600 (m) (1)	allow a correct calculation using their value of E_k		

07.4 cont.	**OR** $p = 240\,000 \times 60\ (= 14\,400\,000)$ (1) $270\,000 = \frac{14\,400\,000}{t}$ (1) $t = 53.333\ldots$(s) (1) mean speed $= \frac{60}{2} = 30$ (1) $s = 30 \times 53.333\ldots$ (1) $s = 1600$ (m) (1)	allow $t = 53$ (s) the equation $F = \frac{\text{change in momentum}}{\text{time taken}}$ must have been used to score subsequent marks allow a correct substitution using their value of t allow a correct calculation using their value of t		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	stopping distance includes both braking distance and thinking distance alcohol increases driver's reaction time which will increase the thinking distance so stopping distance increases		1 1 1	AO1 4.5.6.3.1 4.5.6.3.2

Total Question 7	**18**

4.5.6.1.5 Acceleration

Answer 46 · Mark scheme

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 64 \times 0.075^2$		1	AO2 4.1.1.1
	$E_e = 0.18$ (J)	the equation $E_e = 0.5ke^2$ must have been used to score subsequent calculation marks	1	4.1.1.2
	$0.18 = 0.5 \times 0.052 \times v^2$	allow a correct substitution using their value of E_e	1	
	$v^2 = \frac{0.18}{0.5 \times 0.052}$	allow a correct rearrangement using their value of E_e	1	
	$v = 2.631\ldots$ (m/s)	allow a correct calculation using their value of E_e	1	
	$v = 2.6$ (m/s)	allow an answer given to 2 sf using **all** the data in the question alternative approach: ($F = ke$) ($F = 64 \times 0.075$) (maximum) $F = 4.8$ (N) (1) ($F = ma$) ($4.8 = 0.052 \times a$) (maximum) $a = 92.3$ (m/s^2) (1) (mean) $a = 46.2$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 46.2 \times 0.075$ (1) **or** $v^2 = 6.923$ $v = 2.631\ldots$ (1) $v = 2.6$ (m/s) (1)	1	

4.5.6.1.5 Acceleration

Answer 46 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2		ignore comments about energy dissipation allow E_k for kinetic energy allow E_p for gravitational potential energy		AO1 4.1.1.1
	kinetic energy decreases moving from **A** to **B**	allow kinetic energy is transferred to gravitational potential energy while moving from **A** to **B** for MP1 and MP2	1	
	(and) gravitational potential energy increases moving from **A** to **B**		1	
	(then) gravitational potential energy decreases from **B** to **C** and kinetic energy increases	allow gravitational potential energy is transferred to kinetic energy while moving from **B** to **C**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	length of the toy car		1	AO2 4.1.1.2
	time for toy car to pass the light gate		1	

Total Question 10	11

4.5.6.1.5 Acceleration

Answer 47 · Mark scheme

June 2025 | 8463/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	range = 0.61 – 0.49 **or** range = 0.12 uncertainty = ± 0.06 (s)	allow mean = 0.55	1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	random error		1	AO3 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the ball may have been dropped from different heights **or** the initial speed of the ball may have been different **or** there may have been a different delay between the student pressing the start button and releasing the ball	allow the stopwatch did not always stop (immediately) when the ball hit the floor	1	AO3 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	corresponding values of height and time squared read from graph gradient = 5.0 acceleration = 10.0 (m/s^2)	eg 3.5 (m) and 0.70 (s^2) MP3 can be awarded for a correct calculation of acceleration using their gradient provided it is change in height ÷ change in time^2	1 1 1	AO2 4.5.6.1.5

Total Question 3	7

4.5.6.1.5 Acceleration

Answer 48 · Mark scheme

June 2025 | 8463/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	single arrow starting from dot, pointing vertically upwards and shorter than weight arrow		1	AO2
	labelled air resistance	allow drag	1	AO1 4.5.1.4 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	2.5 minutes = 150 s	all subsequent marks may be awarded if time is incorrectly / not converted	1	AO2 4.5.6.1.5
	$0.64 = \frac{v-0}{150}$		1	
	$v = 0.64 \times 150$		1	
	$v = 96$ (m/s)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(as the skydiver's velocity / speed increased) the air resistance increased	allow drag for air resistance throughout	1	AO1 4.5.6.1.5
	until the air resistance was equal to the weight of the sky diver (and in the opposite direction)		1	
	(so) the resultant force was zero		1	
	(so) the acceleration was zero (so the velocity was constant)		1	

4.5.6.1.5 Acceleration

Answer 48 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	greater weight of air above the skydiver as distance fallen increases and pressure = *F/A* (so pressure increases) **OR** the density of the air surrounding the skydiver increases as the skydiver falls (1) more frequent collisions of air particles with skydiver (so pressure increases) (1)	allow the mass / number of air molecules above the skydiver increases	1 1	AO1 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	triangle / parallelogram drawn with vertical line longer than horizontal line resultant force arrow in correct direction magnitude of resultant force in range 300 N to 320 N angle to vertical of resultant force in range 38 °– 42 °		1 1 1 1	AO2 AO2 AO3 AO3 4.5.1.4

Total Question 5	16

4.5.6.1.5 Acceleration

Answer 49 · Mark scheme

June 2025 | 8463/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	car **X** has a smaller maximum acceleration (than car **Y)**		1	AO3 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	increases the time taken (for the driver to come to a stop) (so) the rate of change of momentum decreases **or** the deceleration / acceleration of the driver is less (so) the force (on the driver) is reduced	allow for MP1 **and** MP2 the change of momentum is the same but over a greater time	1 1 1	AO1 4.5.6.2.2 4.5.7.3

4.5.6.1.5 Acceleration

Answer 49 · Mark scheme

June 2025 | 8463/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$0 - 18^2 = 2 \times a \times 24$		1	AO2 4.5.2
	$a = -\frac{324}{48}$		1	4.1.1.2 4.5.6.2.2 4.5.6.1.5
	$a = -6.75$	the equation $v^2 - u^2 = 2as$ must have been used to score subsequent marks	1	4.5.7.3
	$F = 1400 \times (-) 6.75$		1	
	9450 (N)		1	
	OR			
	$E_k = \frac{1}{2} \times 1400 \times 18^2$ (1)			
	$=226\ 800$ (1)	the equation $E_k = \frac{1}{2} m v^2$ must have been used to score subsequent marks		
	$226\ 800 = F \times 24$ (1)			
	$F = \frac{226\ 800}{24}$ (1)			
	9450 (N) (1)			
	OR			
	average velocity = (18 + 0) / 2 (1)			
	$24 = 9 \times t$ (1)			
	$t = \frac{24}{9}$ (1)	subsequent marks may be awarded if t has been calculated using initial velocity rather than average velocity		
	$F = \frac{1400 \times 18}{\frac{24}{9}}$ (1)			
	9450 (N) (1)			

4.5.6.1.5 Acceleration

Answer 49 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	work is done by friction (in the brakes) (some of the kinetic) energy (of the vehicle) is transferred as thermal energy (in the brakes)	ignore friction alone	1 1	AO1 4.5.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the brakes will overheat the driver will lose control of the car		1 1	AO1 4.5.6.3.4

Total Question 6	**13**

4.5.6.1.5 Acceleration

Answer 50 · Mark scheme

June 2025 | 8463/2H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	B		1	AO3 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	$F = 0.30 \times 2.0 \times 0.070$		1	AO2 4.7.2.2
	$F = 0.042$ (N)	the equation $F = BIl$ must have been used to score subsequent marks	1	
	$0.042 = 0.005 \times a$	subsequent marks may be awarded if an incorrectly / not converted mass is used	1	
	$a = \frac{0.042}{0.005}$		1	
	$a = 8.4$ (m/s^2)		1	

4.5.6.1.5 Acceleration

Answer 50 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(the interaction of) the magnetic fields produce forces on the sides of the coil (AB and CD)	do **not** accept answers describing a generator	1	AO1 4.7.2.3
	AB and CD move in opposite directions		1	
	(each half-revolution) the ends of the coil swap from one contact to the other	*allow 'split ring commutator' for ends of the coil'*	1	
	(so) current in each side of the coil is reversed, so the forces on each side of the coil are reversed		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	there is no current in the wire		1	AO1
	(so) there is no (magnetic) force acting (therefore there is no moment)	MP2 is dependent on MP1	1	AO3 4.5.1.4 4.7.2.3

Total Question 7	12

4.5.6.1.5 Acceleration

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

Foundation

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4.5.6.1.5 Acceleration

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

4.5.6.1.5 Acceleration

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

4.5.6.1.5 Acceleration

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

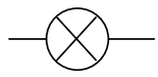
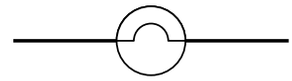
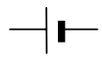
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.5.6.1.5 Acceleration

3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.5.6.1.5 Acceleration

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time wind generator can only produce when the wind is strong enough	accept fuel available all the time accept it's not always windy	1 1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.5.6.1.5 Acceleration

3451/F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.5.6.1.5 Acceleration

3451/F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

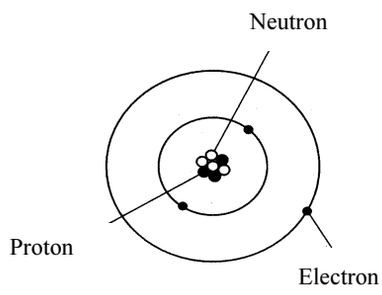
4.5.6.1.5 Acceleration

3451/F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

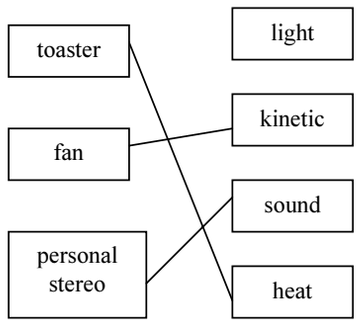
4.5.6.1.5 Acceleration

3451/F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.5.6.1.5 Acceleration

3451/F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

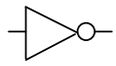
4.5.6.1.5 Acceleration

3451/F Q8

question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do **not** accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre line need not be accurately constructed using a ruler	1
(ii)	diverging (lens)	do **not** accept concave	1
(c)	converging film smaller than nearer to	accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake	1 1 1 1
(d)(i)	(image) bigger than object / enlarge	accept just 'made bigger'	1
(ii)	it / real image can be put on a screen **or** real image on the opposite side of the lens to the object	accept 'not an imaginary or virtual image' assume 'it' refers to a real image do **not** credit 'it can be seen'	1
(e)	**either** (the converging lens is) thick in the middle thin(ner) at the edge **or** (both) sides bend outwards (1) in the middle (1) **or** one side bends in the middle (1) more than the other side bends inwards (in the middle) (1)	thickest in the middle gains **2** marks convex gains **2** marks suitable diagrams gains **2** marks	1 1
total			12

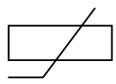
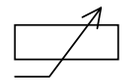
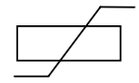
4.5.6.1.5 Acceleration

3451/F Q9

question	answers	extra information	mark
(a)(i)	off off on	all correct	1
(ii)	AND (gate)	accept and (gate)	1
(iii)	on on on	all correct	1
(iv)	OR (gate)	accept or (gate)	1
(b)(i)	1 0 **or** 0 1 0 1 1 0	do **not** credit on / off responses	1
(ii)		accept mirror image accept  accept with either or both parts shaded accept line through as shading	1
(c)		accept off for 0 and on for 1 throughout	
	0 0	both correct	1
	0 1	both correct	1
	1 1	both correct	1
	1 1	both correct	1

4.5.6.1.5 Acceleration

3451/F Q9 continued

(d)(i)		accept mirror image **or** inverted do **not** credit  **or**  or similar	1
(ii)	resistance decreases / increases / changes current (through it) increases / decreases / changes **or** temperature changes / increases / decreases (1) resistance changes / decreases / increases (1) (NTC thermistor) both marks independent but must be compatible to score **2** marks accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series		1 1
total			13

4.5.6.1.5 Acceleration

3451/F Q10

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.5.6.1.5 Acceleration

3451/F Q11

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.5.6.1.5 Acceleration

3451/F Q12

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.5.6.1.5 Acceleration

3451/F Q13

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

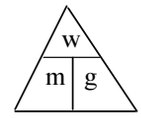
4.5.6.1.5 Acceleration

3451/F Q14

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

4.5.6.1.5 Acceleration

3451/F Q15

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

4.5.6.1.5 Acceleration

3451/F Q16

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do **not** award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do **not** credit cell accept (set of) cells accept power supply do **not** accept power pack	1
	(Y is a) LED	**or** light emitting diode	1
(ii)	longer (time)	do **not** accept 'slower time'	1
(iii)	any **two** from: current less (so) rate of flow of charge less **or** less coulombs per second (so) discharge is slower	 do **not** accept current slower accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit	2
(c)	4200	translation correct (= 4000) but percentage addition incorrect gains **1** mark translation incorrect but 5% addition is correct gains **1** mark accept 422.1 **or** 42.2 **or** 6.3 for **1** mark	2
	ohms **or** Ω	4.2 kilohms **or** 4.2 kΩ gains all **3** marks	1
total			10

4.5.6.1.5 Acceleration

3451/F Q17

question	answers	extra information	mark
(a)	point at which its mass (seems to) act **or** point at which gravity (seems to) act	accept …its weight acts accept correct statements if the intent is clear e.g. … if suspended, the centre of gravity will be directly under the point of suspension e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry) do **not** credit just 'it is a point'	1
(b)	**Quality of written communication** *The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **five** from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	*maximum of **4** marks if ideas not well expressed* **no** marks if method quite unworkable maximum of **3** marks if no 'repeat with other hole'	5
(c)(i)	(turning) effect **or** moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm **or** newton metre(s)	allow 44 × 0.4 **or** 0.4 × 44 for **1** mark do **not** accept N/m **or** N/cm 1760 Ncm gains all **3** marks	2 1
total			10

4.5.6.1.5 Acceleration

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Science: Double Award Co-ordinated

3462

Paper 3F

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Kathleen Tattersall: *Director General*

4.5.6.1.5 Acceleration

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

4.5.6.1.5 Acceleration

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

4.5.6.1.5 Acceleration

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

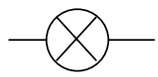
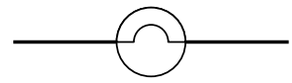
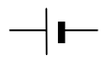
3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.5.6.1.5 Acceleration

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.5.6.1.5 Acceleration

3462/3F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.5.6.1.5 Acceleration

3462/3F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.5.6.1.5 Acceleration

3462/3F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

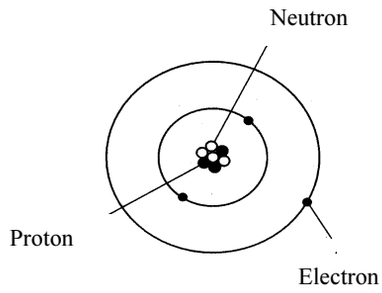
4.5.6.1.5 Acceleration

3462/3F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

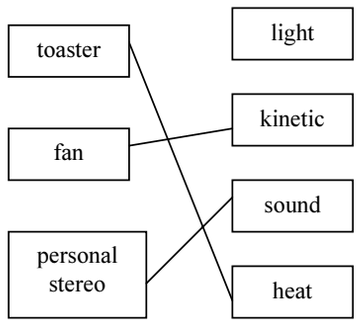
4.5.6.1.5 Acceleration

3462/3F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.5.6.1.5 Acceleration

3462/3F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

4.5.6.1.5 Acceleration

3462/3F Q8

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.5.6.1.5 Acceleration

3462/3F Q9

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.5.6.1.5 Acceleration

3462/3F Q10

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.5.6.1.5 Acceleration

3462/3F Q11

question	answers	extra information	mark
(a)	silver is a (good) reflector of heat (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

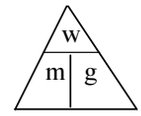
4.5.6.1.5 Acceleration

3462/3F Q12

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

4.5.6.1.5 Acceleration

3462/3F Q13

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.5.6.1.5 Acceleration

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.5.6.1.5 Acceleration

GCSE Physics
Foundation Tier 3451/F

3451F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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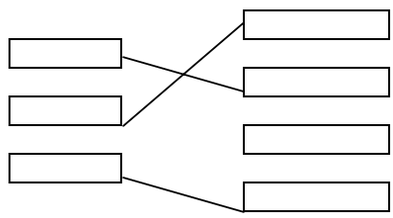
3451F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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4.5.6.1.5 Acceleration

3451F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.5.6.1.5 Acceleration

3451F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.5.6.1.5 Acceleration

3451F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.5.6.1.5 Acceleration

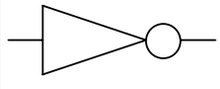
3451F Q6

	answers	extra information	mark
(a)	converging image object image object shorter		1 1 1 1 1 1
(b)(i)	(Earth's) gravity	accept centripetal accept minor misspellings, however, do **not** credit any response which could be 'centrifugal'	1
(ii)	to(wards) (the centre of the) Earth	allow inwards do **not** accept downwards	1
(c)(i)	**either** friction (force) **or** centripetal force between the tyres / wheels and (the surface of) the road	 allow grip allow on the tyres / wheels **or** towards the centre of the bend / arc / circle	 1 1
(ii)	mass **or** speed **or** momentum radius / diameter	allow weight allow velocity do **not** credit 'curvature' or 'circumference'	1 1
(d)	centripetal	accept minor misspellings (see above)	1
total			13

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4.5.6.1.5 Acceleration

3451F Q7

	answers	extra information	mark
(a)(i)	two switches in series **and** circuit complete	ignore small imperfections	1
(ii)	two switches in parallel **and** circuit complete	ignore small imperfections	1
(iii)	one switch in parallel with the cell / lamp (but **not** both)	ignore small imperfections	1
(iv)	(i) AND (ii) OR (iii) NOT	accept 'and' accept 'or' accept 'not'	1 1 1
(b)(i)	when it is light the sensor sends on / high / 1 signal to the gate off / low / 0 sent to the lamp **or** when it is dark the sensor sends off / low / 0 signal to the gate (1) on / high / 1 sent to the lamp (1)		1 1
(ii)	any suitable application	e.g. to switch a security light on (and off) e.g. to switch a light on when it is dark do **not** credit just '… to switch a light on / off'	1
(c)(i)		accept shading-in of either or both parts end connections are not required accept any orientation	1
(ii)	1 0 **or** 0 1 0 1 1 0	all correct	1
(iii)	truth (table)		1
total			12

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4.5.6.1.5 Acceleration

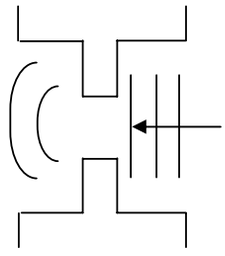
3451F Q8

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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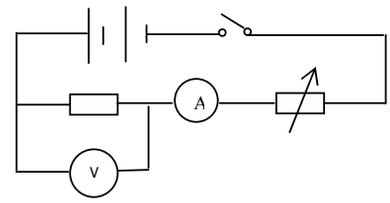
3451F Q9

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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4.5.6.1.5 Acceleration

3451F Q10

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.5.6.1.5 Acceleration

3451F Q11

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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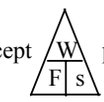
3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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4.5.6.1.5 Acceleration

3451F Q13

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.5.6.1.5 Acceleration

3451F Q14

	answers	extra information	mark
(a)(i)	current		1
(ii)	resistance decreases	 accept 'the flow of electrons / current (through it) increases' for **1** mark do **not** credit just '… it will get warmer'	1 1
(b)	input sensor → controlled by the processor processor → detects changes in the environment output device → decides what action is needed	all pairs correct one pair correct for **1** mark	2
(c)(i)	potential divider	accept voltage divider	1
(ii)	4 (volts)	$6 \times \frac{30}{45}$ for **1** mark	2
(iii)	across the new resistor…(will) increase across R_2 … (will) decrease	 N.B. independent marks	1 1
total			10

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4.5.6.1.5 Acceleration

3451F Q15

	answers	extra information	mark
(a)	relay (normally open) (switch)	each mark is independent	1
	… switch on a (larger) current (in another circuit) **or** switch on a higher voltage circuit	do **not** accept switch on another circuit **or** smaller / equal current	1
	light emitting diode / LED	do **not** credit LDR	1
	… in one / direct / certain direction **or** from left to right	**or** when the cathode is connected to the negative terminal / side **or** when the left-hand side is connected to the positive terminal / side do **not** credit just '… is big enough' do **not** accept 'positive direction'	1
	AND gate	accept 'and' gate	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs	do **not** accept numerical values unless expanded	1
(b)	**Quality of written communication**	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points Q ✓ Q X	1
	any **three** from: • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet	e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

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4.5.6.1.5 Acceleration

3451F Q16

question	answers	extra information	mark
(a)	**Y** and **Z** they have the same number of protons **or** same atomic number	 accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1 1
(b)	**Quality of written communication** A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	for correct use of terms underlined in B **or** C Q ✓ Q X describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	1 max 2
total			5

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Science: Double Award
Specification B (Co-ordinated)
3462/3F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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4.5.6.1.5 Acceleration

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4.5.6.1.5 Acceleration

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.5.6.1.5 Acceleration

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.5.6.1.5 Acceleration

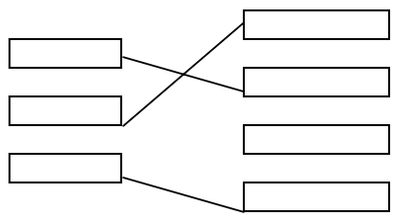
3462/3F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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4.5.6.1.5 Acceleration

3462/3F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.5.6.1.5 Acceleration

3462/3F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.5.6.1.5 Acceleration

3462/3F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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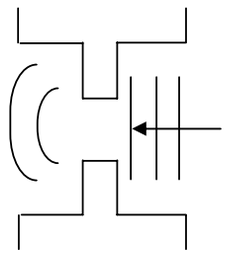
3462/3F Q6

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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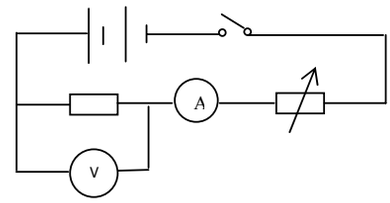
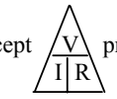
3462/3F Q7

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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4.5.6.1.5 Acceleration

3462/3F Q8

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.5.6.1.5 Acceleration

3462/3F Q9

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.5.6.1.5 Acceleration

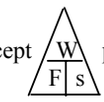
3462/3F Q10

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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4.5.6.1.5 Acceleration

3462/3F Q11

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.5.6.1.5 Acceleration

3462/3F Q12

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u>	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark	max 2
	C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	
total			5

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2005 examination – June series

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4.5.6.1.5 Acceleration

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3451/F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.5.6.1.5 Acceleration

3451/F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	X-rays do not go through lead	references to gamma rays are incorrect accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect	1
	Quality of written communication	award for a sensible sequence of **two** points	1
total			8

4.5.6.1.5 Acceleration

3451/F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

3451/F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.5.6.1.5 Acceleration

3451/F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.5.6.1.5 Acceleration

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest half-life	accept the others have longer half-lives	1
total			7

4.5.6.1.5 Acceleration

3451/F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.5.6.1.5 Acceleration

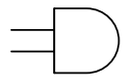
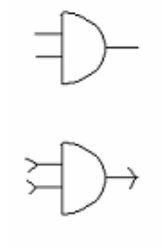
3451/F Q9

question	answers	extra information	mark
(a)	capacitor LDR relay (normally open)	accept condenser **or** light dependent resistor accept 'ldr', 'Ldr' etc. do **not** accept 'relay normally closed'	1 1 1
(b)(i)	battery	accept '(battery of) cells' do **not** accept 'battery / cell'	1
(ii)	LED	**or** light emitting diode accept 'led' or 'Led' do **not** accept just 'diode'	1
(iii)	B will light (but C will not)	accept '(only) B will work' accept 'one is on the other is off' do **not** accept 'C is on and B is off'	1
(iv)	any **one** from: B is connected the right way round (and C is not) a (light emitting) diode only allows (a significant) current to flow in one direction B's anode is connected to the positive side of the supply B's cathode is connected to the negative terminal	N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction if (iv) is completely consistent with (iii) which is wrong, allow **1** mark	1
(c)(i)	first input / second input / output 0 / 0 / **0** 1 / 0 / **0** 0 / 1 / **0** 1 / 1 / **1**	**all** correct allow: OFF NO OFF NO OFF NO ON YES	1
(ii)	truth (table)		1

cont…

4.5.6.1.5 Acceleration

3451/F Q9 cont…

(iii)		a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction allow 	1
(d)	light sensor	**or** light dependent resistor **or** LDR accept 'ldr', Ldr' etc allow solar cell, photo cell	1
	NOT gate	accept 'Not gate' **or** 'not gate' if both correct but in the wrong order credit with **1** mark	1
total			12

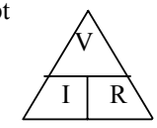
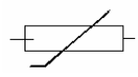
4.5.6.1.5 Acceleration

3451/F Q10

question	answers	extra information	mark
(a)(i)	rays continued to meet on the right hand side of the lens and beyond	must be straight lines from the right hand side of the lens ignore details through the lens allow if no arrows	1
	meet exactly on the axis	negate mark if contradictory arrow(s) added do not need to go beyond the focus for this mark	1
(ii)	(principal) focus	**or** focal (point)	1
(iii)	converging	**or** convex	1
(b)(i)	**A**		1
(ii)	rays seem to come from this point	**or** words to this effect **or** shows this on the diagram	1
(iii)	diverging	**or** concave	1
(c)	film	accept any unambiguous method of showing the correct response	1
	smaller than		1
	further away from		1
(d)	any **three** from: • real image can be put on a screen • virtual image cannot be put on a screen / film • virtual image is imaginary • real image is formed where (real) rays cross / converge • virtual image is where virtual / imaginary rays (seem to) come from • virtual image formed where virtual rays intersect / cross	allow film allow real image has light travelling through it **or** virtual image is where rays seem to come from	3
total			13

4.5.6.1.5 Acceleration

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or  resistance goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1 1
total			10

4.5.6.1.5 Acceleration

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q12

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.5.6.1.5 Acceleration

3451/F Q13

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.5.6.1.5 Acceleration

3451/F Q14

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

4.5.6.1.5 Acceleration

3451/F Q14 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.5.6.1.5 Acceleration

3451/F Q15

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do **not** accept just 'centripetal'	1
total			10

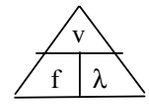
4.5.6.1.5 Acceleration

3451/F Q16

question	answers	extra information	mark
(a)(i)	**X** at the centre of the lifebelt	measuring from the centre of **X**, allow 2 mm tolerance in any direction	1
(ii)	any **two** from: below the point of suspension at the centre (of the lifebelt) (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only accept '(vertically) below **Y**' accept 'in the middle' **or** (because) the mass / weight is evenly distributed	2
(b)	Nm **or** newton metre(s) 750	accept Newton metre(s) do **not** accept any ambiguity in the symbol ie NM, nM or nm (moment) = force × (perpendicular) distance (between line of action and pivot) **or** (moment) = 500 × 1.5 gains **1** mark	1 2
(c)	**Quality of written communication**: any **three** connected points from: low(er) <u>centre of mass / gravity</u> (more) <u>stable</u> less likely to fall over the <u>turning effect / moment</u> (of the weight of case) is less so the pull on her arm is less	for **2** of the underlined terms used in the correct context **or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground **or** less <u>unstable</u> accept 'less likely to overturn' do **not** accept 'will not fall over' **or** so less effort is needed to hold the case ignore references to pulling the case	1 3
total			10

4.5.6.1.5 Acceleration

3451/F Q17

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

4.5.6.1.5 Acceleration

Version 1.0: *27092005*

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B (Co-ordinated)

Mark Scheme

2005 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.5.6.1.5 Acceleration

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3462/ 3F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.5.6.1.5 Acceleration

3462/3F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	**Quality of written communication**	award for a sensible sequence of **two** points	1
	X-rays do not go through lead	accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect references to gamma rays are incorrect	1
total			8

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

4.5.6.1.5 Acceleration

3462/3F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.5.6.1.5 Acceleration

3462/3F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest <u>half-life</u>	accept the others have longer <u>half-lives</u>	1
total			7

4.5.6.1.5 Acceleration

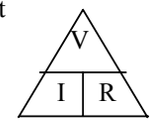
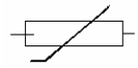
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.5.6.1.5 Acceleration

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or  resistance goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1 1
total			10

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q10

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.5.6.1.5 Acceleration

3462/3F Q11

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or lowest cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q12

question	answers	extra information	mark
(a)(i)	<u>constant</u> speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = <u>change in velocity</u> time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** a = $\frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept <u>no</u> friction	1

cont…

4.5.6.1.5 Acceleration

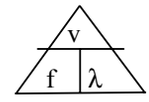
3462/3F Q12 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q13

question	answers	extra information	mark
(a)	**Quality of written communication**	all emboldened terms in candidate's answer used correctly	1
	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark	2
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

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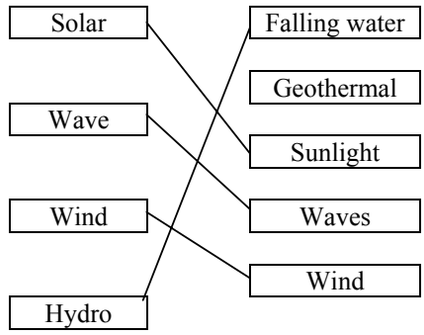
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4.5.6.1.5 Acceleration

Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.5.6.1.5 Acceleration

3451/F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.5.6.1.5 Acceleration

3451/F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.5.6.1.5 Acceleration

3451/F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.5.6.1.5 Acceleration

3451/F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3451/F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.5.6.1.5 Acceleration

3451/F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3451/F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.5.6.1.5 Acceleration

3451/F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.5.6.1.5 Acceleration

3451/F Q10

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)
LDR(s)
switch(es)
LED(s)
buzzer(s)
motor(s)</td><td>1 mark each
or light dependent resistor(s)
or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge

increases</td><td>accept ‘electrons’
accept ‘energy
or gets bigger/larger</td><td>1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

4.5.6.1.5 Acceleration

3451/F Q11

question	answers	extra information	mark
(a)(i)	A		1
(ii)	B		1
(iii)	mass is larger	credit if the response is clear by some other means e.g. it is ringed	1
	wire is shorter	credit if the response is clear by some other means e.g. it is ringed	1
(b)	moment		1
	distance		1
(c)(i)	1		1
(ii)	5		1
(iii)	any **two** from • remove slotted mass(es) • slide (slotted) masses / weights nearer pivot • slide forcemeter away from the pivot • slide rod to the left	 **or** ….. to the left **or** ….. to the right **or** …. so that the slotted masses side is shorter **or** …. so that the forcemeter side is longer	2
(d)	centre of the rectangle	accept *2*mm tolerance any direction	1
	centre of the circle	accept *2*mm tolerance any direction	1
	on centre line and 10mm above base	accept *2*mm tolerance any direction	1
total			13

4.5.6.1.5 Acceleration

3451/F Q12

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.5.6.1.5 Acceleration

3451/F Q12

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp		1
		accept for **1** mark only the filament lamp does not obey Ohm's law	
total			9

4.5.6.1.5 Acceleration

3451/F Q13

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

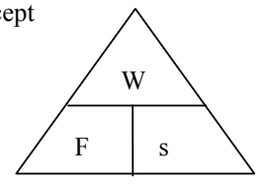
4.5.6.1.5 Acceleration

3451/F Q14

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.5.6.1.5 Acceleration

3451/F Q15

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u>	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it <u>increases</u>	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1

Continued

4.5.6.1.5 Acceleration

3451/F Q15

question	answers	extra information	mark
(ii) **E**	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.5.6.1.5 Acceleration

3451/F Q16

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

4.5.6.1.5 Acceleration

3451/F Q17

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do **not** have to be continued beyond F	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(b)	rays seem to come from a focus at G on the left and continued to the right of the lens	this mark is for the current idea of divergence	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(c)	…lens… …image… …object… …image… ...object… …lens…	lens as 1st and 6th words (1) image and object in the correct order 2nd and 3rd words (1) image and object in correct order 4th and 5th words (1)	max 3
(d)(i)	correct statement about real image real rays intersect / cross to form a real image **or** a real image can be formed on a screen **or** real image is (always) on the opposite side (of the lens) **or** real image is (always) upside down (to the object)	may be credited from a correct diagram	1
	correct statement about virtual / imaginary image virtual / imaginary rays intersect / cross to form a virtual image **or** a virtual / imaginary image cannot **or** virtual / imaginary image is (always) on the same side (of the lens) **or** virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

4.5.6.1.5 Acceleration

3451/F Q17

question	answers	extra information	mark
(ii)	**either** image needs to fall on / affect the film **or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone) **or** image needs to cause a chemical reaction (in / on the film)		1
total			10

4.5.6.1.5 Acceleration

3451/F Q18

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)

OR (gate)

NOT (gate)

LED or light emitting diode</td><td>accept ‘and’

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’

any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct

allow off or no
off no
on yes
off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch

either
small current from the electronic / control circuit / system (1)

large current through the output / (electric) fire (1)

or

full current through electronic control system (1)

may damage components / lead to overheating / electric shock (1)

QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’

or ‘small current through the coil (of the relay)’

do not accept small current is turned into a large current

annotate Q✓ Q×

if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1

1

1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B

Mark Scheme

2006 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

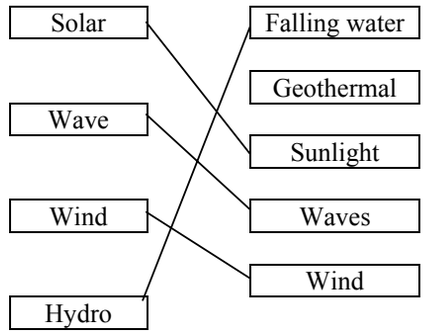
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.5.6.1.5 Acceleration

Double Award (Co-ordinated)
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.5.6.1.5 Acceleration

3462/3F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.5.6.1.5 Acceleration

3462/3F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3462/3F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.5.6.1.5 Acceleration

3462/3F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3462/3F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.5.6.1.5 Acceleration

3462/3F Q10

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q10

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp	accept for **1** mark only the filament lamp does not obey Ohm's law	1
total			9

4.5.6.1.5 Acceleration

3462/3F Q11

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.5.6.1.5 Acceleration

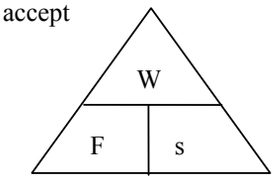
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q12

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.5.6.1.5 Acceleration

3462/3F Q13

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.5.6.1.5 Acceleration

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q14

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

4.5.6.1.5 Acceleration

Answer 32 · Examiner comments

June 2018 | 8463/2H | Original Q1

Question 1 (Standard demand)

01.1 Most of the students realised that the falling ball was accelerating or speeding up, but few wrote that the ball was accelerating at a constant rate. Some students did try to explain this, however they were often unable to express this uniform acceleration clearly. Phrases such as “accelerating at a constant speed” were common and did not score any marks.

01.2 Just over 70% of the students understood that the ball would be moving upwards.

01.3 Most of the students understood what is meant by ‘a system’ with nearly 90% choosing the correct answer.

01.4 Only about half of the students realised that the velocity of the ball was reduced after the bounce or that the ball would not reach the height it was dropped from. If this was written it was generally followed by a statement that repeated the stem of the question; the energy was transferred to the ground. Those students that did state that energy was lost from the ball did often refer to this as kinetic energy. Students often stated that as the velocity became more and more negative, the ball was continuing to slow down.

Answer 33 · Examiner comments

November 2020 | 8463/2H | Original Q1

Question 1 (Standard demand)

01.1 Approximately 85% of students identified the correct change to the apparatus.

01.2 To gain credit, the suggestions should be feasible. The most popular correct answers were ‘to add a pulley’ and ‘lubricate the string’.

01.3 Suitable scales should cover at least half of the graph paper and start at the origin. Lines of best fit are either straight as in this case or smooth curves, never ‘wiggly’ lines. Approximately 70% of students scored all four marks.

01.4 Students should understand that ‘direct proportion’ and ‘positive correlation’ do not have the same meaning.

4.5.6.1.5 Acceleration

Answer 33 · Examiner comments November 2020 | 8463/2H | Original Q1

01.5 The question was about improving this investigation and not changing to a different investigation. Those students scoring one mark generally did so for the idea of 'repeating the investigation'. A significant number of students added 'to take a mean' but did not score the mark as the idea of 'ignoring anomalies' was omitted.

01.6 Approximately 88% of students were able to recall this equation.

01.7 This calculation was generally well answered, although a significant number of the students failed to give the answer to 2 significant figures.

Answer 34 · Examiner comments November 2020 | 8463/2H | Original Q6

Question 6 (Standard and standard/high and high demand)

06.1 The majority of the students were able to convert MHz to Hz correctly. A large number of the students did not know the unit of wavelength with the symbol 'λ' being a common incorrect answer.

06.2 Only 3% of students were able to write a complete answer to this question. Many of the students described the final movement of the car rather than what happens in the electrical circuit. A significant number of the students thought that absorbing radio waves would result in sound being produced. Some of the students realised that there would be a current in the aerial but used terms such as 'produce a current' and 'produce an electrical signal' which were insufficient for credit to be awarded.

06.3 The most frequent correct answer was to state that radio waves are transverse and sound waves are longitudinal. Another popular correct answer was the idea of radio waves being able to travel through a vacuum / space. Comparisons of wavelength / frequency did not gain any marks due to the overlapping range of wavelength and frequency of radio waves and sound waves.

06.4 83% of students correctly described the motion of the car during the first 30 seconds.

06.5 The majority of the students knew how to calculate velocity from a straight line graph but failed to realise the significance of the curved line. Those few students that drew an appropriate tangent to the line at 20s generally went on to score all four marks.

06.6 Whilst 25% of the students gained all six marks for this calculation, a significant number of the remaining students gained partial credit for clearly showing the working out, part of which was correct.

06.7 There were very few complete and correct answers to this question. A significant number of the students correctly referred to air resistance increasing with speed but then went on to state that air resistance becomes equal to speed. It was common for answers to be in terms of real cars, the effect of speed on braking distances or the likely increase in accidents.

4.5.6.1.5 Acceleration

Answer 35 · Examiner comments November 2021 | 8463/1H | Original Q8

Question 8
This question was well attempted, with the multistep calculation in **08.2** discriminating well between students. Many students calculated the change in gravitational potential energy but couldn't take the next step in the calculation, so scored 2 marks only.

Answer 36 · Examiner comments November 2021 | 8463/2H | Original Q1

Question 1 (Common Question)
Part **01.1** asked students to explain factors and not simply list them. However, this is what many of the students did. Another common error was to explain factors affecting thinking distance rather than as asked, braking distance. The required equations were well known and the calculation required to answer **01.3** was often given correctly. Reading values from a graph proved difficult with only about half of the students answering **01.4** correctly.Less than 50% of the students scored full marks in part **01.6**. Generally only those students completing the calculation correctly scored the unit mark. However many of the students did score the mark for correctly giving a calculated incorrect numerical answer in standard form.

Answer 37 · Examiner comments November 2021 | 8463/2H | Original Q7

Question 7
In part **07.1**, few students could name a force. Most of the students gave answers such as 'energy', momentum' and 'speed'. Once again reading a correct value from a graph proved difficult and prevented many of the students from scoring full marks. Despite part **07.3** using both the word 'force' and the word 'moment' few of the answers used either word and so scored no marks. Clear working out in part **07.4** allowed some students to gain some credit even when the final answer was wrong. An approach that was often seen was to first calculate time and then acceleration. However, those doing this tended to use the final velocity, instead of the average velocity. The final part produced few totally correct answers. Common errors included: showing the wrong direction, or not indicating the direction, of the resultant force; inaccurate scale drawing; no indication of what angle was being given; and giving a calculated answer with no vector diagram attempted.

4.5.6.1.5 Acceleration

Answer 38 · Examiner comments

November 2021 | 8463/2H | Original Q9

Question 9

Whilst many of the students could quote Fleming's Left Hand rule, few were able to apply it in order to explain how to predict the direction of the copper rod given in Figure 16. In part **09.2** an answer 'bigger magnet' is not necessarily the same as a 'stronger magnet' and neither is 'changing the current' necessarily the same as 'increasing the current'. In part **09.3** whilst there were few answers scoring all six marks many of the students gained partial credit by showing their working out clearly. A very common error was not to convert 4 g to kg.

Concluding Remarks

The paper presented to the students was broadly similar to that seen in previous series. Many of the errors made by the students were similar to those seen in previous series.

The failure to be able to accurately present information requiring recall from the specification (AO1), for example understanding the term 'elastically deformed' or describing the difference between a transverse wave and a longitudinal wave was commonly seen. Incorrect recall of equations stopped many students from scoring marks in calculations. Students often seemed to be unsure what the command word in a question meant. For example being asked to 'Explain' an application of Fleming's Left Hand rule is not the same as 'Describe'.

Areas of the specification that were particularly poorly answered were sections 4.7 (Magnetism and Electromagnetism), 4.8 (Space physics) and 4.6.2.5 (Lenses). Vector diagrams did not appear to be well understood.

Many of the students now understand the importance of showing clear working out when completing a calculation. This is crucial in the more complex calculations.

Similar to previous series a significant number of the students were unable to read values from graphs accurately and failed to realise when numerical values were not given in standard SI units.

4.5.6.1.5 Acceleration

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.6.1.5 Acceleration

Answer 41 · Examiner comments

June 2023 | 8463/2H | Original Q2

02.1

58% of students calculated the displacement correctly. Those who did not gain the mark simply measured the route taken by the aircraft and scaled that distance up, showing that many students do not appreciate the difference between displacement and distance.

02.2

82% of students successfully calculated the resultant force to be zero.

02.3

Having successfully calculated the resultant force to be zero, few students stated that the plane was moving at a constant speed. Many said it was stationary or accelerating, not appreciating the lack of resultant force.

02.4

Students did not appear to understand the concept of a contact force, often quoting gravity as one. In addition, they gave forces already quoted in the question as answers.

02.5

This was successfully done by the majority of students, with 64% correctly linking distance and velocity and drawing correct graphs.

02.6

The minority attempted to draw a smooth curve and extrapolate this to the 10km line. Those who did generally used the graph correctly, with 44% of students gaining both marks. A number of students misread the scale on the graph and quoted incorrect values from their line. It was common to see a straight line, which often allowed the award of 1 mark for a correct reading of the value.

02.7

84% of students knew that as the height of the aeroplane above the ground increased, the average density of the air decreased.

4.5.6.1.5 Acceleration

Answer 42 · Examiner comments — June 2023 | 8463/2H | Original Q5

05.1

41% of students were awarded this mark. There were a lot of good answers in terms of both conservation of energy and momentum. Answers in terms of no external forces were also credited. Some answers were too vague to score or were answered outside of the context of the question, for example, in terms of a Chemistry approach.

05.2

30% of students answered the question correctly. Those who did not, tended to just state Newton's 3rd Law, rather than stating how it applied in this context.

05.3

96% of students scored both mars for calculating the force.

05.4

10% of students were given all three marks for this explanation. Most responses were creditworthy. Reducing force was the most common 1 mark awarded. Many students also gained the first marking point, about increasing the time for the collision to occur.

Answer 42 · Examiner comments — June 2023 | 8463/2H | Original Q5

05.5

Students find it difficult to use this equation of motion. This was where not showing the substitution of the data in the equation had the biggest impact. Many students were unable to rearrange the equation with some dividing the two expressions instead of subtracting them. 68% gained all 3 marks, recognising that they had to square root their value to obtain the velocity.

4.5.6.1.5 Acceleration

Answer 43 · Examiner comments June 2024 | 8463/1H | Original Q6

Question 6 (High Demand)

06.1 90% of students scored this mark, for identifying that the elastic potential energy store increases as the bungee cords are stretched.

06.2 A challenging grade 8-9 calculation question. A common incorrect answer was '10' which scored 5 marks because the only mistake the student made was not doubling the elastic potential energy calculated for one bungee cord. Due to the various ways students approached the question it discriminated well between different abilities. 14% of students scored 6 marks, while 34% scored 5 marks and 28% scored 4 marks. As long as a student had used the elastic potential energy equation calculating a value of E_e using a value of k and e^2 they could score the marks for using the E_p equation.

06.3 12% of students scored 2 marks, while 46% of students scored 1 mark, in this question for identifying the ways in which energy was dissipated.

Answer 44 · Examiner comments June 2024 | 8463/2H | Original Q5

05.1
Only 25% of students were able to name the force acting through the string. There are a significant number of students on higher tier who are unable to distinguish between forces and types of energy.

05.2
29% of students gained this mark by identifying a control variable. There is a misconception that 'keeping things the same' equates to a control variable. The idea that you would, for example, change the string or the bench in the middle of an investigation is not creditworthy.

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4.5.6.1.5 Acceleration

Answer 44 · Examiner comments June 2024 | 8463/2H | Original Q5

05.3
Very few students (0.94%) scored full marks for a description of how to calculate acceleration with the given data. Very few appreciated the necessity to use the maximum velocity in the calculation and did not gain the second mark point as a result. Many students merely quote two formulae, often simply using symbols and not quoting the correct subject of the formula. Describing a calculation, rather than performing one, appears to be a skill that few students have practised.

05.4
This uncertainty calculation was generally well done, and those students who knew the difference between range, mean and uncertainty found the question straightforward. 62% gained both marks. However, it was clear that many students were unsure of the meaning of these terms and were therefore unable to calculate an uncertainty successfully.

05.5
This was a demanding question, requiring an explanation of how the raising of the runway affected the acceleration of the trolley. Very few students (0.3%) scored the full 2 marks. Many were able to appreciate the idea of acceleration increasing because of an increased resultant force, but virtually none could link this to the correct component of the weight. Those who adopted the energy approach in their answer similarly found the question challenging and failed to give a complete response relating work done to the energy transfer causing the increase in final velocity and hence acceleration.

Answer 45 · Examiner comments June 2024 | 8463/2H | Original Q7

07.1
Most students appreciated the idea of using the area under the graph to calculate the distance travelled with 55% scoring full marks. Some, however, tried to calculate the area under the whole graph rather than limiting their calculation to the first 600 s. Common mistakes were seen in those who could not read the scale on the axes correctly, or who tried to calculate the areas of incorrect triangles or rectangles.

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4.5.6.1.5 Acceleration

Answer 45 · Examiner comments

June 2024 | 8463/2H | Original Q7

07.2
A minority of students gained the first mark point for interpreting the velocity-time graph. Weaker responses referred to acceleration, or a slower deceleration, or stated that the rate of deceleration was slower. Only 49% gained marks on this question.

07.3
Students needed to determine the maximum deceleration from the velocity – time graph. Many incorrectly used the whole of the final section of the graph, calculating 2 gradients and adding them together, or used the section from 720s to 960 s. A minority calculated the average deceleration and were awarded a compensation mark. Most gradients were calculated with the correct values, but a small number read the velocity as 58 m/s or the time as 700 s or 1000 s. 41% scored all 3 marks.

07.4
30% of students scored full marks on this multi-step calculation of distance. These students tended to use the preferred method, or the first alternative method, given on the mark scheme. 45% scored 3 marks, usually because they used the final velocity instead of the mean velocity in distance = speed × time, so could not access the final 3 marks.

07.5
77% of students scored at least one mark in this question about how alcohol affects stopping distance. There was references to time being slowed down, and confusion between distance and time. 15% scored all 3 marks.

4.5.6.1.5 Acceleration

Answer 46 · Examiner comments June 2025 | 8463/1H | Original Q10

10.1

Many students were successful with this multi-step calculation question. Nearly 60% of the students scored 6 marks, while almost 10 % scored 5 marks. A significant number of students tried to answer the question using equations from paper 2, which was creditworthy, but virtually no students arrived at the correct answer using this method. Some students scored the significant figures mark by completing an incorrect calculation using all the data provided in the question. The most common mistake was not squaring the extension in the elastic potential energy equation. Ensuring that students substitute first before rearranging is a good way of scoring method marks in calculations, even if the final answer is incorrect.

10.2

Students who stated the names of energy stores didn't score any marks unless they stated how the amount of energy changed or stated that kinetic energy was transferred to gravitational potential energy, for example. Mention of elastic potential energy from the spring in Q10.1 was ignored for this question. E_k and *KE* were acceptable abbreviations for kinetic energy; E_p and *GPE* were acceptable abbreviations for gravitational potential energy. Just over 60 % of the students scored 3 marks, while just over 10% scored 2 marks and just fewer than 10 % scored 1 mark.

10.3

Only about 25 % of the students scored 2 marks for identifying the correct measurements needed to determine the speed of the car at the end of the track. Nearly 75% of the students scored 1 mark. The most common incorrect choice was the length of the track.

4.5.6.1.5 Acceleration

Answer 46 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.6.1.5 Acceleration

Answer 47 · Examiner comments June 2025 | 8463/2H | Original Q3

3.1

Just over half of the students were able to correctly calculate the uncertainty. Those who did not were able to find the mean or the range and gain one mark.

3.2

Just over 60 % of the students identified that there was a random error in this investigation. About 30 % thought there was a systematic error, which would not have accounted for the variation in the results.

3.3

Students were usually able to identify factors that might affect the measurements made but did not always answer in terms of the variation in the measurements made. It was not always appreciated that the variation in the measurement of time was caused by a variation in a factor, such as the release height. An answer simply stating 'the height that the ball was dropped from' was insufficient, without mentioning the variation in the drop height in repeats of the procedure.

3.4

Just over 80% of the students were able to take values from the graph, determine the gradient successfully and correctly calculate the acceleration of the ball. In a small number of instances, the reciprocal of the gradient was determined.

Answer 48 · Examiner comments June 2025 | 8463/2H | Original Q5

5.1

Students answered this free-body diagram question well with just over 60 % gaining both marks. Some students failed to realise that the air resistance should be represented by a smaller arrow than the one given in the diagram. Some students had drawn the dot again with labels added to their dot. Other arrows were occasionally added stating 'gravity' alongside weight.

5.2

Just over 60% of the students completed this calculation correctly. Most students understood the need to convert minutes into seconds. However, some students took data from elsewhere in the question, instead of using that given in the stem of this question part.

5.3

Students answered this question well. They generally had a good understanding of how the skydiver reached terminal velocity and described that air resistance increased to become

4.5.6.1.5 Acceleration

Answer 48 · Examiner comments June 2025 | 8463/2H | Original Q5

equal to the weight of the skydiver. A lot of the students were also correctly stating that the resultant force was zero.

5.4

There were two ways to explain why the atmospheric pressure changed as the sky diver fell. In both methods many students were awarded only one mark, often by giving both versions of the 1st mark point.
Method 1: Some students described more air above not referring to more weight of air. The second mark point was often missed as many students just stated so pressure increases, without referring to P=F/A.
Method 2: Many students correctly described that the density of the air increases, but the second mark point was often missed as students did not describe more 'frequent' collisions with the skydiver.

5.5

Only a small proportion of the students were able to draw a completely correct vector diagram and find the magnitude and direction of the resultant force. Most students were able to draw a triangle/parallelogram with the correct shape and orientation. The resultant force arrow head was often missing and when drawn was sometimes difficult to see. The magnitude was often correctly measured from the diagram or calculated. However, a significant number of the students measured the wrong angle.

4.5.6.1.5 Acceleration

Answer 49 · Examiner comments June 2025 | 8463/2H | Original Q6

6.1

This question was well answered with a number of students explaining their answer by linking it to F=ma showing a clear understanding of the link between variables. Students sometimes expanded their answers unnecessarily adding a detailed explanation as to why car X would have a lower maximum acceleration. Converse argument of car Y would have a greater maximum acceleration were common for this question.

6.2

This question topic proved difficult, as it has in previous exam series with only 15 % of the students scoring all 3 marks. Many answers did not show a scientific understanding of the concept, merely referring to the cushioning effect of airbags. Very few students scored the 2nd mark point being unaware of how the rate of change of momentum changed or deceleration. There were also a significant number of incorrect references to 'slowing down time'.

6.3

Just over 40 % of the students gained full marks for this multi-step calculation. Those who did mostly chose to use the equations of motion method before substituting their value of acceleration into F=ma. Very few students approached the problem from the kinetic energy method. The method using the average velocity was commonly used. However, very few students realised the necessity to use average velocity in their solution and were as a result a factor of two out in their final answer. This method also highlights that many students do not know which equations relate to constant velocity, and which relate to changing velocity.

Answer 49 · Examiner comments June 2025 | 8463/2H | Original Q6

6.4

Only a tiny minority of the students gained the 1st mark point for explaining why braking causes an increase in the temperature of the brakes, the majority failing to grasp the link between work done and frictional force. Many incorrectly referred to friction between the wheels and the road.

6.5

Just over half of the students gained marks for stating the risks of a large deceleration. Many students referenced crashes in their responses, notably involving the vehicle behind. Students rarely mentioned overheating, failing to make the link between this question and 6.4.

4.5.6.1.5 Acceleration

Answer 50 · Examiner comments June 2025 | 8463/2H | Original Q7

7.1

Just over 60% of the students were able to use Flemings Left Hand rule to work out which direction the copper rod would accelerate.

7.2

Just over half of the students scored all the marks on this multi-step calculation of acceleration. Those students not scoring full marks often failed to convert the mass correctly or did not rearrange the equation F=ma correctly.

7.3

This motor question was targeted at the most able students and proved very challenging. Only about one third of the students scored any marks at all. Only a very few of the students scored four marks. Most of the students who scored any marks were most likely to gain the 2nd and/or 3rd mark points. A significant number of the students confused motors with generators.

7.4

Another poorly answered high demand question. Many answers were to do with the coil being parallel to the field and there being no force. The majority of the students had missed that there would be no current flowing at that point due to the position of the coil. If this marking point was scored, responses usually continued to the idea of there being no forces acting. The 2nd mark point was dependent on the students scoring the 1st mark point.