AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.2

Work done and energy transfer

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**31**
Available paper years	**2004–2025**

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.

4.5.2 Work done and energy transfer

Answer 01 · Mark scheme June 2004 | 3451F | Original Q13 | Legacy

The full source mark scheme begins on page 47. Follow original question 13 in that document.

Answer 02 · Mark scheme June 2004 | 3462F3 | Original Q11 | Legacy

The full source mark scheme begins on page 68. Follow original question 11 in that document.

Answer 03 · Mark scheme June 2006 | 3451 | Original Q2 | Legacy

The full source mark scheme begins on page 85. Follow original question 2 in that document.

Answer 04 · Mark scheme June 2006 | 3451 | Original Q7 | Legacy

The full source mark scheme begins on page 85. Follow original question 7 in that document.

Answer 05 · Mark scheme June 2006 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 85. Follow original question 15 in that document.

4.5.2 Work done and energy transfer

Answer 06 · Mark scheme June 2006 | 3462 | Original Q2 | Legacy

The full source mark scheme begins on page 105. Follow original question 2 in that document.

Answer 07 · Mark scheme June 2006 | 3462 | Original Q7 | Legacy

The full source mark scheme begins on page 105. Follow original question 7 in that document.

Answer 08 · Mark scheme June 2006 | 3462 | Original Q13 | Legacy

The full source mark scheme begins on page 105. Follow original question 13 in that document.

4.5.2 Work done and energy transfer

Answer 09 · Mark scheme January 2008 | PHY3F | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
(a)	moment	**or** torque do **not** credit 'leverage'	1
(b)	4 (2)	**either** 0.20 × 20 (1) **or** allow '400' (1)	2
(c)	use a longer spanner **or** 'fit a pipe over the (end of the) spanner (to lengthen it)'	**or** increases the perpendicular distance / length note 'lever' refers to 'spanner' note change the . . . (0) ignore references to wider / larger nut	1
	use a greater force / pull	**either order**	1
total			5

4.5.2 Work done and energy transfer

Answer 10 · Mark scheme June 2008 | PHY3F | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
(a)(i)	**P**		1
(a)(ii)	the child's grip / hold / pull (on the roundabout / bar / rail)	**or** 'the tension in the child's arms' accept 'the child's muscles' accept 'friction between the child and the roundabout' do **not** accept just 'friction'	1
(a)(iii)	increases	accept any unambiguous indication that this ending has been selected	1
(b)(i)	360 (Nm)	credit either 240 × 1 ½ **or** 240 × 1.5 with **1** mark	2
(b)(ii)	move to(wards) the left / to(wards) the / his end	**or** move away from the centre / pivot / axis (of rotation) **or** move away from the girl / the child / his daughter	1
(c)(i)	**C**		1
(c)(ii)	friction / grip of the car / tyres / wheels (on the road)	do **not** accept just 'friction / grip'	1
total			8

4.5.2 Work done and energy transfer

Answer 10 · Mark scheme June 2008 | PHY3F | Original Q5 | Legacy

PHY3F

4.5.2 Work done and energy transfer

Answer 11 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)(i)	50 (N)	ignore any units	1
5(a)(ii)	resultant force		1
5(a)(iii)	4000	accept their (a)(i) × 80 correctly calculated for **2** marks allow **1** mark for correct substitution i.e. 50 × 80 or their (a)(i) × 80 ignore any units	2
5(b)(i)	joule		1
5(b)(ii)	heat		1
Total			**6**

4.5.2 Work done and energy transfer

Answer 11 · Mark scheme June 2009 | PHY2F | Original Q5 | Legacy

PHY2F

4.5.2 Work done and energy transfer

Answer 12 · Mark scheme June 2009 | PHY2F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	the thicker the tile, the greater the *(*fall) height	accept the higher(the fall) the thicker the tile accept there is a positive correlation do **not** accept they are proportional	1
6(a)(ii)	60(mm)	accept any number or range between 60 and 85 inclusive if units are given must match range	1
	(minimum thickness*)* needed to <u>reduce risk of injury</u>	reason must match thickness choice do **not** accept to keep child safe accept an answer in terms of – the thicker the tile, the less chance there is of a serious injury if the answer given is greater than 60 accept answers in terms of use of graph e.g. the graph shows that for a 2m fall a thickness of 60mm is needed minimum level answer' the graph shows that's what's needed' accept only if 60 is the answer	1
6(b)(i)	the time taken (to stop)		1
6(b)(ii)	(the) force (on)		1
Total			**5**

4.5.2 Work done and energy transfer

Answer 12 · Mark scheme June 2009 | PHY2F | Original Q6 | Legacy

PHY2F

Answer 13 · Mark scheme

June 2010 | PHY2F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(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
6(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
6(b)(i)	arrow drawn parallel (to) **and** down (the) slope	accept arrow drawn anywhere on the diagram	1
6(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
6(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**

4.5.2 Work done and energy transfer

Answer 13 · Mark scheme June 2010 | PHY2F | Original Q6 | Legacy

PHY2F

4.5.2 Work done and energy transfer

Answer 14 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	**C**		1
3(b)	moment	accept any unambiguous correct indication	1
3(c)	bigger than	accept any unambiguous correct indication	1
3(d)	120 (Ncm)	allow **1** mark for correct substitution ie 12 × 10	2
Total			**5**

4.5.2 Work done and energy transfer

Answer 14 · Mark scheme January 2011 | PHY3F | Original Q3 | Legacy

PHY3F

4.5.2 Work done and energy transfer

Answer 15 · Mark scheme

June 2011 | PHY2F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	572	allow **1** mark for correct substitution, ie 220 × 2.6 allow **1** mark for 220 x 260 = 57 200 **or** 220 x 2600 = 572 000 but to score this mark the entire calculation must be shown	2
7(b)(i)	smooth curve drawn	accept a line that is extrapolated back to 0 degrees, but not through the origin accept a straight line of best fit (point at 40 degrees can be treated as anomalous and line may stop at 30 degrees) do **not** accept straight lines drawn 'dot to dot' or directly from first to last point or a line going through the origin	1
7(b)(ii)	increases	accept a positive correlation do **not** accept proportional	1

Question 7 continues on the next page

PHY2F

Question 7 continued

question	answers	extra information	mark
7(b)(iii)	long plank	no mark for this, the marks are for the explanation	
	makes the angle small(er) (than a short plank)	accept increases the distance accept small(er) slope	1
	a small(er) force is needed		1
	or		
	short plank	no mark for this, the marks are for the explanation	
	a large(r) force is used over a short(er) distance (1)		
	less work done (1)	accept less energy transfer	
Total			**6**

4.5.2 Work done and energy transfer

Answer 16 · Mark scheme

June 2011 | PHY3F | Original Q8 | Legacy

Question 8

question	answers	extra information	mark
8(a)(i)	turning effect	accept turning force accept force x distance (accept symbols only if correctly defined) do **not** accept newtons x metres	1
8(a)(ii)	stop apparatus falling over	accept holds the stand in place accept make it safer / stable references to balanced / equilibrium are insufficient	1
8(a)(iii)	as x increases y increases in same proportion / ratios	 allow both marks for they are directly proportional **or** a specific example eg doubling y, doubles x allow both marks for a correct answer giving figures eg they increase in the ratio of 1 to 7 allow for **1** mark positive correlation	1 1
8(a)(iv)	the centre of mass of the ruler is at the axis of rotation		1
8(b)	108 newton metres / Nm	allow **1** mark for correct substitution ie 240 x 0.45 symbols must be correct for full credit the unit must be consistent with the numerical answer	2 1
Total			**8**

4.5.2 Work done and energy transfer

Answer 17 · Mark scheme

June 2012 | PH2FP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	horizontal arrow pointing to the left	judge by eye drawn anywhere on the diagram	1
3(a)(ii)	60 (N) (at steady speed) resultant force must be zero	 accept forces must balance/are equal accept no acceleration do **not** accept constant speed	1 1
3(b)	1680 joule	 allow **1** mark for correct substitution, ie 60 x 28 provided no subsequent step shown accept J do not accept j	2 1
Total			**6**

4.5.2 Work done and energy transfer

Answer 17 · Mark scheme

June 2012 | PH2FP | Original Q3 | Legacy

PH2FP

4.5.2 Work done and energy transfer

Answer 18 · Mark scheme

Question 8

question	answers	extra information	mark
8(a)	gravitational / gravity / weight	do **not** accept gravitational potential	1
8(b)	accelerating	accept speed / velocity increases	1
	the distance between the drops increases		1
	but the time between the drops is the same	accept the time between drops is (always) 5 seconds accept the drops fall at the same rate	1
8(c)(i)	any **one** from: • speed / velocity • (condition of) brakes / road surface / tyres • weather (conditions)	accept specific examples, eg wet / icy roads accept mass / weight of car friction is insufficient reference to any factor affecting thinking distance negates this answer	1

Question 8 continues on the next page . . .

PH2FP

Question 8 continued . . .

question	answers	extra information	mark
8(c)(ii)	75 000	allow **1** mark for correct substitution, ie 3000 × 25 provided no subsequent step shown **or** allow **1** mark for an answer 75 **or** allow **2** marks for 75 k(+ incorrect unit), eg 75 kN	2
	joules / J	do **not** accept j an answer 75 kJ gains **3** marks for full marks the unit and numerical answer must be consistent	1
Total			**8**

4.5.2 Work done and energy transfer

Answer 18 · Mark scheme

January 2013 | PH2FP | Original Q8 | Legacy

PH2FP

4.5.2 Work done and energy transfer

Answer 19 · Mark scheme June 2013 | PH2FP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	potential		1
4(b)(i)	13 200	allow **1** mark for correct substitution, ie 660 × 20 provided no subsequent step shown	2
4(b)(ii)	16.5 **or** $\frac{\text{their (b)(i)}}{800}$ correctly calculated	allow **1** mark for correct substitution, ie $\frac{13\,200}{800}$ **or** $\frac{\text{their (b)(i)}}{800}$ provided no subsequent step shown	2
Total			**5**

4.5.2 Work done and energy transfer

Answer 19 · Mark scheme June 2013 | PH2FP | Original Q4 | Legacy

PH2FP

Answer 20 · Mark scheme June 2014 | PH2FP | Original Q8 | Legacy

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

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

8(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.	

Answer 20 · 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

Question	Answers	Extra information	Mark	AO spec ref
8(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	
8(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**	

4.5.2 Work done and energy transfer

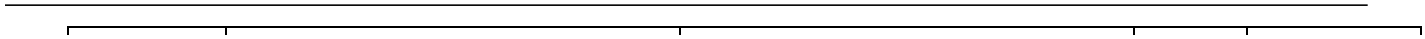
Answer 21 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	gravity	accept weight accept gravitational attraction / pull do not accept gravitational potential	1	AO1 2.2.1f
4(b)(i)	The height of the ramp.		1	AO2 HSW
4(b)(ii)	the mass of the wooden block		1	AO2 HSW
4(c)(i)	all points fit the pattern	accept all points are on the line	1	AO3 HSW
4(c)(ii)	1(.0) (N)	accept 0.9 to 1.0 inclusive	1	AO2 HSW
4(c)(iii)	the greater the height (of the ramp) the greater the force (required) but not in direct proportion	accept steeper ramp for height accept positive correlation accept line does not go through the origin allow it is a linear (pattern) accept a numerical example of increase in force and height	1 1	AO3 HSW
4(c)(iv)	B		1	AO3 HSW
4(d)	312	allow **1** mark for correct substitution ie W = 260 x 1.2 provided no subsequent step	2	AO2 2.2.1a/b
Total			**10**	

4.5.2 Work done and energy transfer

Answer 21 · Mark scheme

June 2017 | PH2FP | Original Q4 | Legacy



4.5.2 Work done and energy transfer

Answer 22 · Mark scheme June 2018 | 8463/1F | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	$P = \frac{120\ 000}{8.0}$ $P = 15\ 000$ (W)	an answer of 15 000 (W) scores **2** marks	1 1	AO2 4.1.1.4
09.2	energy is transferred in heating the surroundings friction causes energy to be transferred in non-useful ways		1 1	AO2 4.1.2.1
09.3	the switches are in parallel (so) closing either switch completes the circuit		1 1	AO2 4.2.1.1
09.4	gravitational potential energy = mass × gravitational field strength × height	allow E_p = m g h	1	AO1 4.1.1.2
09.5	$E_p = 280 \times 9.8 \times 14$ $E_p = 38\ 416$ (J) $E_p = 38\ 000$ (J)	an answer of 38 000 scores **3** marks an answer that rounds to 38 000 scores **2** marks	1 1 1	AO2 4.1.1.2
Total			**10**	

4.5.2 Work done and energy transfer

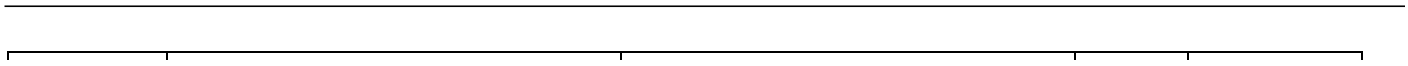
Answer 23 · Mark scheme June 2018 | 8463/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	work done = 11 500 × 2.60 work done = 29 900 (J)	an answer of 29 900 scores **2** marks	1 1	AO2 4.5.2
07.2	13 800		1	AO2 4.5.4
07.3	moment (of a force) = force x distance	allow M = F d	1	AO1 4.5.4
07.4	13 800 = 11 500 × distance distance = $\frac{13\,800}{11\,500}$ distance = 1.2(0 m)	of an answer 1.2(0) scores **3** marks	1 1 1	AO2 4.5.4
Total			**7**	

4.5.2 Work done and energy transfer

Answer 23 · Mark scheme

June 2018 | 8463/2F | Original Q7



Answer 24 · Mark scheme

June 2019 | 8463/2F | Original Q10

Question 10

Question	Answers	Mark	AO/ Spec. Ref
10.1	**Level 3**: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1/1 AO2/1 4.5.6.3.2 4.5.6.3.3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points 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 • reaction time explained in terms of longer reaction times increase thinking distance (from a given speed) • taking drugs • drinking alcohol • tiredness • age • distractions explained in terms of effect on driver's reaction time • speed explained in terms of the faster the vehicle the greater the distance travelled in the driver's reaction time (or converse) **OR** explained in terms of increased speed increases KE so increases work done to stop the vehicle • condition of the tyres • condition of road surface • wet/icy roads explained in terms of condition of tyres and road surface (including weather considerations) affecting <u>friction</u> (between tyres and road) • condition of brakes explained in terms of effect on braking force (applied to the wheels) or reduced <u>friction</u>		

Answer 24 · Mark scheme

June 2019 | 8463/2F | Original Q10

	• mass / weight of vehicle explained in terms of deceleration force or kinetic energy or change in momentum answers do not need to reference thinking / braking distance a Level 1 answer would list factors only **or** one factor with one linked explanation a Level 2 answer lists at least three factors with one linked explanation **or** two factors with two linked but different explanations a Level 3 answer lists at least three factors with at least two linked but different explanations			
10.2	work (done) = force × distance	allow W = F s	1	AO1/1 4.5.2
10.3	900 000 = 60 000 × distance distance = $\frac{900\ 000}{60\ 000}$ distance = 15 (m)	an answer 15 (m) scores **3** marks	1 1 1	AO2/1 4.5.2
10.4	brakes overheating **or** brakes locking (causing) loss of control **or** (causing) a skid	allow brake fade allow wheels locking allow increasing the stopping / braking distance **ONLY** if the first marking point scored ignore any effects on passengers or possible accidents	1 1	AO1/1 4.5.6.3.4
Total			**12**	

4.5.2 Work done and energy transfer

Answer 25 · Mark scheme

November 2020 | 8463/2F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	velocity includes direction	allow velocity is a vector (quantity) **and** speed is a scalar (quantity)	1	AO1 4.5.6.1.3
07.2	(an equal) force from the air pushes on the engine/aircraft in the opposite direction	 only scores if first marking point scored accept to the left **or** forwards if no other marks scored, allow **1** mark for pushes the engine forwards	1 1	AO2 4.5.6.2.3
07.3	correct value for distance and corresponding time (eg 12 000 m and 50 s) $v = \frac{\text{their change in distance}}{\text{their change in time}}$ speed = 240 (m/s)	 this mark may be awarded if distance and/or time are incorrectly read **from the graph** allow a correctly calculated answer using their values of distance and time **from the graph**	1 1 1	AO2 4.5.6.1.4
07.4	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$ **or** $a = \frac{\Delta v}{t}$		1	AO1 4.5.6.1.5

4.5.2 Work done and energy transfer

Answer 25 · Mark scheme November 2020 | 8463/2F | Original Q7

07.5	250 – 68 = 182 $0.14 = \frac{182}{t}$ $t = \frac{182}{0.14}$ t = 1300 (seconds)	 this mark may be awarded if the change in velocity is incorrectly/not calculated this mark may be awarded if the change in velocity is incorrectly/not calculated allow a correctly calculated answer using a change in velocity incorrectly/not calculated	1 1 1 1	AO2 4.5.6.1.5
07.6	work done = force × distance **or** W = F s		1	AO1 4.5.2
07.7	140 000 000 = force × 2000 $\text{force} = \frac{140\,000\,000}{2000}$ force = 70 000 (newtons)		1 1 1	AO2 4.5.2
Total			**15**	

Answer 26 · Mark scheme

November 2021 | 8463/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	30 (°)		1	AO2 4.5.2
04.2	zero error		1	AO3 4.5.2
04.3	subtract 0.5 N from each measurement		1	AO3 4.5.2
04.4	points plotted correctly	allow 5 correctly plotted for **2** marks, 2–4 correctly plotted for **1** mark allow ± half a square ignore any attempt at a line of best fit	2	AO2 4.5.2
04.5	the long ramp has a smaller angle (so) less force is needed (to hold the wheelchair stationary on the ramp)	allow description (eg shallower gradient / less steep) allow (so) less force is needed to move the wheelchair up the ramp	1 1	AO3 4.5.2
04.6	$W = 160 \times 2.5$ $W = 400$ (J)		1 1	AO2 4.5.2
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	tape measure **or** metre rule	allow ruler ignore metre stick	1	AO3 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$E_p = 50 \times 9.8 \times 1.7$ $E_p = 833$ (J)		1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$P = \frac{1800}{1.44}$ $P = 1250$ (W)		1 1	AO2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	stop-clock C		1	AO3 4.1.1.4

4.5.2 Work done and energy transfer

Answer 27 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	$E_k = 0.5 \times 70 \times 2.0^2$ $E_k = 140$ (J)		1 1	AO2 4.1.2.1

Total Question 2		**8**

Answer 28 · Mark scheme

June 2022 | 8463/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	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 the 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.
08.2	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

Answer 28 · Mark scheme

June 2022 | 8463/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	$20 = \frac{28}{t}$ $t = \frac{28}{20}$ 1.4 (s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$v^2 - 0^2 = 2 \times 10 \times 605$ $v^2 = 12\,100$ $v = 110$ (m/s)		1 1 1	AO2 4.5.6.1.5

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

4.5.2 Work done and energy transfer

Answer 28 · Mark scheme

June 2022 | 8463/2F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	*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 8		**13**

Answer 29 · Mark scheme

June 2023 | 8463/2F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	kinetic thermal	this order only	1 1	AO1 4.5.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(minimum braking) distance increases with increasing speed	allow positive correlation	1	AO2 4.5.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	increases		1	AO1 4.5.6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	12.5 – 5.0 = 7.5 (m/s) $t = \frac{7.5}{0.25}$ t = 30 (s)	 this mark may be awarded if the change in velocity is incorrectly calculated allow a correctly calculated answer using a change in velocity incorrectly calculated	1 1 1	AO2 4.5.6.1.5

Answer 29 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	*F* = 1600 × 0.25 *F* = 400 (N)		1 1	AO2 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	initial height of the ruler above the person's hand		1	AO3 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	there will be more variation in distances	allow reaction times for distances allow the three students tested are not typical	1	AO3 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	carry out the experiment listening to music then not listening to music (and compare the results)	 allow compare with original results	1 1	AO3 4.5.6.3.2

Total Question 2	**13**

Answer 30 · Mark scheme

June 2024 | 8463/2F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	0 (N) the child isn't accelerating (vertically) **or** upwards forces are equal to the downwards forces	 MP2 dependent on MP1 allow forces are balanced	1 1	AO2 4.5.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	work done = force × distance **or** $W = F \times s$		1	AO1 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	$35 = F \times 2.8$ $F = \frac{35}{2.8}$ $F = 12.5$ (N)	 allow 13 (N)	1 1 1	AO2 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	the resistive force has decreased so the resultant force increases	allow friction (between the wheels and the floor) has decreased	1 1	AO3 4.5.1.4 4.5.6.2.1 4.5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	moment = force × distance **or** $M = F \times d$		1	AO1 4.5.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	7.5 cm = 0.075 m $M = 2.0 \times 0.075$ $M = 0.15$ (Nm)	 allow a correct substitution of an incorrectly / not converted value of *d* allow an answer consistent with an incorrectly / not converted value of *d*	1 1 1	AO2 4.5.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	gear B rotates in the opposite direction (to gear A) **or** gear B rotates clockwise **or** gear B rotates faster than gear A (because) gear A exerts a force on gear B **or** (because) gear A causes a moment about the pivot of gear B		1 1	AO2 4.5.4

Total Question 9	**14**

Answer 31 · Mark scheme

June 2025 | 8463/2F | Original Q2

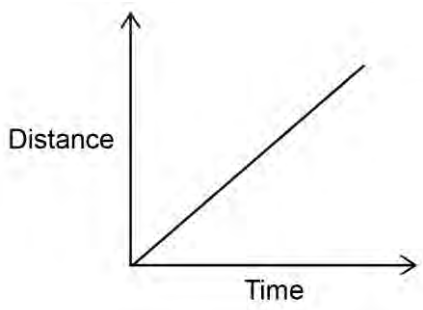
Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	W = 75 000 × 9.8 735 000 (N)		1 1	AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	W = 850 000 × 80 68 000 000 (J)		1 1	AO2 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	4 × 850 000 3 400 000 (N)		1 1	AO1 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	frictional force		1	AO1 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5			1	AO1 4.5.6.1.4

4.5.2 Work done and energy transfer

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	25 – 16 = 9 (m/s) $a = \frac{9}{150}$ 0.06 (m/s^2)	subsequent marks may be awarded if an incorrectly calculated change in velocity is used	1 1 1	AO2 4.5.6.1.5

Total Question 2	**11**

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.

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

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'.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

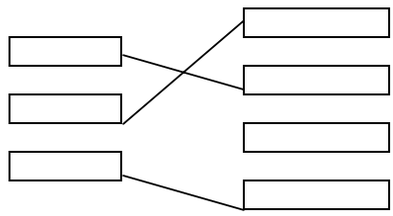
3451F Q2

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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 connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept petrol for (petrol vapour) accept catch fire for explode accept ground for earth	1 1
(c)	**Quality of written communication** any **two** from: • when current greater than fuse rating / value • fuse (becomes hot and) melts / burns out • circuit is broken	for a logical sequence accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity accept fuse blows / breaks accept circuit switched off this cannot score credit on its own	1 2
total			8

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

3451F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is solid 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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

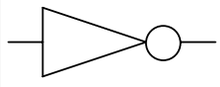
3451F Q6

	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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

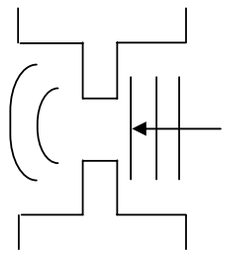
3451F Q8

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

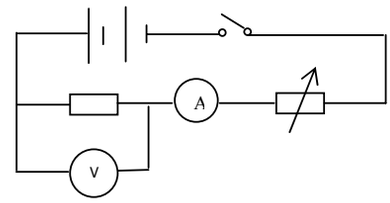
3451F Q9

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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 1.8×30) i.e. adding the correct 2 power values	2
total			9

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

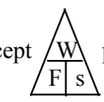
3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration <u>increases</u>	accept velocity / speed increases <u>more</u> 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 <u>correct</u> use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between <u>shuttle</u> and Earth) plus correct orbital speed (makes <u>shuttle</u> 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 <u>centripetal</u> 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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

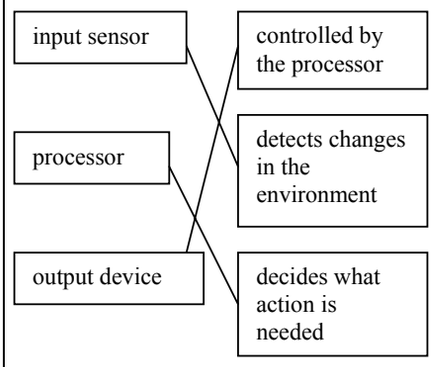
3451F Q13

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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)		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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

3451F Q16

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 deflected / repelled / repulsed by the (positive) nucleus C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards	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	max 2
total			5

Copyright © 2004 AQA and its licensors

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.

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.

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

4.5.2 Work done and energy transfer

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'.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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.

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

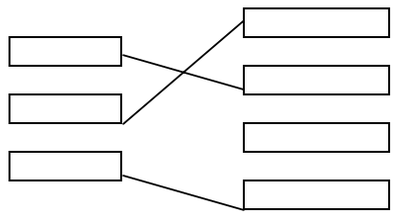
3462/3F Q2

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

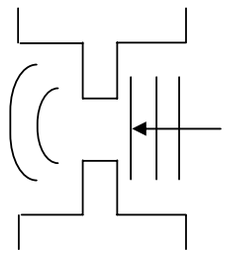
3462/3F Q6

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

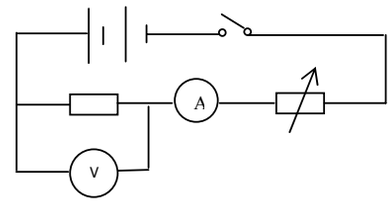
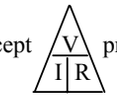
3462/3F Q7

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

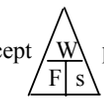
3462/3F Q10

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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

Copyright © 2004 AQA and its licensors

4.5.2 Work done and energy transfer

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 deflected / repelled / repulsed by the (positive) nucleus C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards	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	max 2
total			5

Copyright © 2004 AQA and its licensors

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

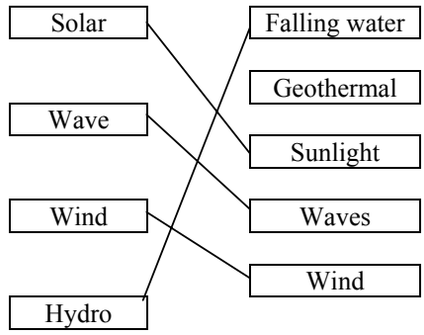
Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. 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.

Copyright © 2006 AQA and its licensors. All rights reserved.

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

Physics B – AQA GCSE Mark Scheme, 2006 June series

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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>

4.5.2 Work done and energy transfer

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

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

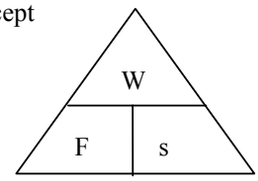
4.5.2 Work done and energy transfer

Physics B – AQA GCSE Mark Scheme, 2006 June series

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

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 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

Continued

4.5.2 Work done and energy transfer

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

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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.

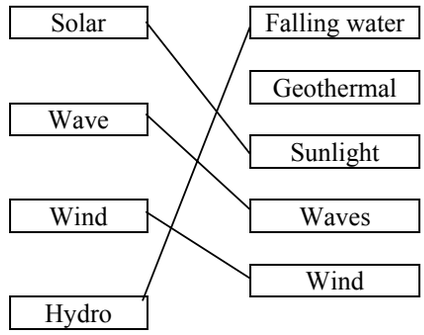
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

Copyright © 2006 AQA and its licensors. All rights reserved.

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

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

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		1
		accept for **1** mark only the filament lamp does not obey Ohm's law	
total			9

4.5.2 Work done and energy transfer

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

4.5.2 Work done and energy transfer

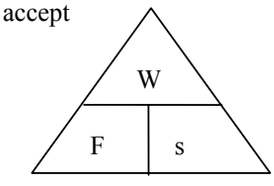
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

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

4.5.2 Work done and energy transfer

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 <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
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.5.2 Work done and energy transfer

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

Answer 23 · Examiner comments

June 2018 | 8463/2F | Original Q7

Question 7 (Low and Standard demand)

07.1 Nearly 93% of the students were able to correctly use the given equation.

07.2 Only a minority of the students (40%) understood that the anticlockwise moment would have the same size as the clockwise moment.

07.3 Nearly 50% of the students scored this mark.

07.4 Not all of the students who knew the equation scored three marks. Some of the students were distracted by the vertical distance of 2.60 metres given in question 07.1 and multiplied either the given moment or the given force by 2.60 before substituting into the equation.

4.5.2 Work done and energy transfer

Answer 24 · Examiner comments June 2019 | 8463/2F | Original Q10

Question 10 (Standard demand)

10.1 Although there was no need to do this, most students divided their answer into a consideration of thinking distance and a consideration of braking distance. Factors often given were to do with alcohol or drugs but rarely were they related to the effect on reaction time. A common error was to describe reaction time as being reduced and that leading to an increase in the thinking / stopping distance. Condition of the roads / tyres was common as was icy / wet roads. However these factors were rarely linked to a reduction in friction. A description in terms of less grip or traction was not acceptable. Weaker answers tended to describe what is meant by thinking distance and stopping distance without stating what changes either of these two distances.

10.2 This equation was well known, with 70% of students scoring the mark.

10.3 Just over 83% of the students scored all three marks.

10.4 There were few answers in terms of brakes overheating and the driver losing control of the car. Answers which did not score generally referred to the danger to passengers of whiplash, of hitting the windscreen or of cars behind crashing into the back of the car.

4.5.2 Work done and energy transfer

Answer 24 · Examiner comments

June 2019 | 8463/2F | Original Q10

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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

4.5.2 Work done and energy transfer

Answer 27 · Examiner comments

June 2022 | 8463/1F | Original Q2

Question 2 (Low demand)

02.1 About 80% of students answered this question correctly. ‘Metre stick’ was ignored, so if students gave a list eg ‘metre stick or tape measure’ they could still score the mark.

02.2 About 90% of students completed this calculation correctly, scoring 2 marks.

02.3 About 90% of students completed this calculation correctly, scoring 2 marks.

02.4 90% of students identified the correct stop-clock.

02.5 90% of students completed this calculation correctly, scoring 2 marks. The most common mistake was to not square the speed. This would then just score a mark for the substitution, if correct.

Answer 28 · Examiner comments

June 2022 | 8463/2F | Original Q8

Question 8 (Standard demand)

08.1 Many of the students were able to give one factor but only about one quarter went on to score both marks. A significant number of the students gave vague answers such as 'weather' and so scored zero.

08.2 Almost all the students were able to use the equations sheet to give the correct equation. 4% of the students did not attempt to give an equation

08.3 A significant number of the students multiplied the two values together and so scored zero. Approximately 10% of the students did not attempt the question.

08.4 Approximately 50% of the students scored 2 or 3 marks. A common error was to misunderstand what a calculated value of 12100 was. Some of the students thought this to be the final velocity whilst others went on to work out 12100 squared as the final velocity. Those scoring zero often failed to show any working out and so could not be given any of the 'method' marks.

08.5 Despite the equation sheet being given, 5% of the students did not give an equation.

08.6 The vast majority of the students did not convert the distance to metres and so scored only 2 marks.

Answer 29 · Examiner comments

June 2023 | 8463/2F | Original Q2

02.1

22 % of students scored 1 mark and 61 % of students scored both marks for identifying the energies

02.2

The majority of the students identified the correct relationship between the speed and the braking distance. Those that didn't described the graph rather than mentioning braking distance or speed, or used incorrect phrases eg 'directly proportional'.

02.3

84% of students knew that braking distance increases when a road becomes icy.

02.4

This 3-mark question required students to calculate the change in velocity then use this correctly to determine the time taken. Many students failed to show how they calculated the change in velocity and could not be awarded any marks.

4.5.2 Work done and energy transfer

Answer 29 · Examiner comments June 2023 | 8463/2F | Original Q2

02.5

86 % scored 2 marks for calculating the resultant force. Common mistakes involved dividing instead of multiplying, or calculating 1600 x 0.25^2, the squared apparently being inferred from the unit of deceleration (m/s^2).

02.6

77% of students were able to identify the control variable for the investigation.

02.7

Many students correctly stated that there would be a greater number of results, which could lead to a change in the mean. But some simply stated that different people have different reaction times. Credit was also given for those that stated the reaction times of 3 children tested may not be representative of the whole class. However, some only answered by saying ‘only 3 children were tested’ which was insufficient to get the mark.

02.8

30 % scored 1 mark and only 33 % scored 2 marks. Rather than describing a change to the experiment students would state how they thought music would affect the reaction time, or why music would affect the reaction time.
Many who got 1 mark suggested they did the experiment with music on but did not say to compare with previous results or do it with music off.

4.5.2 Work done and energy transfer

Answer 30 · Examiner comments June 2024 | 8463/2F | Original Q9

09.1
42% of students correctly gave the resultant vertical force on the child as 0N, but then failed to score the second mark point, as they stated that the child is not moving or there is no force acting. Only 3% understood the concept that a stationary object has forces acting on it, but those forces are balanced.

09.2
93% of students managed to write down the correct equation for the moment of a force.

09.3
A well answered calculation of force, with 74% of students gaining all 3 marks. Some students tried to convert the units.

09.4
Only 0.5% of students scored 2 marks for explaining why the speed of the baby walker increased as the baby moved onto the hard floor, and 52% scored 1 mark. Most students understood that the friction was less on the hard floor but did not go on to describe what happens to the resultant force.

09.5
93% of students chose the correct equation for the moment of a force.

09.6

© 2024 AQA and its licensors. All rights reserved.

Answer 30 · Examiner comments June 2024 | 8463/2F | Original Q9

This calculation of the moment of the force was well answered with 14% of students scoring all 3 marks. About 72% forgot to convert the cm to m, or made a mistake converting, and scored 2 marks.

09.7
This question related to interaction of two gears. Of those that scored marks, most got the first mark point for stating the gears moved in opposite directions, with the minority discussing the different speeds. Very few achieved the second mark point. For those who did, it was for stating gear A exerts a force on gear B. A few attempted to explain it as gear A causing a moment about the pivot of gear B but some mentioned momentum instead of moment, thereby causing confusion in the response.

© 2024 AQA and its licensors. All rights reserved.

Mark Ranges and Award of Grades

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

© 2024 AQA and its licensors. All rights reserved.

4.5.2 Work done and energy transfer

Questions matter

GCSE
Physics
8463/2F

Report on the examination

Version: 1.0
June 2025

© 2025 AQA

4.5.2 Work done and energy transfer

Further copies of this report are available from aqa.org.uk

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

© 2025 AQA

Report on the examination – GCSE - Physics – 8463/2H – June 2025

General comments

Students should pay attention to the number of options that need to be ticked when doing multiple choice questions. They should make sure they cross out wrong options when they change their minds, as marks cannot be awarded where there are multiple ticks instead of one.

Many students demonstrated good maths skills, although there are always issues with rearrangements. Formula triangles are not always helpful. Students who had correctly written down an equation in a previous question and then tried to use a formula triangle often scored no marks, because they don't understand how to use them. If they had substituted into the equation from the equations sheet they would have scored the 1st mark.

Students had access to the equations sheet for this examination series. A minority of the students however did not use them to find the appropriate equation.

Levels of demand

Questions are set at two levels of demand on this paper:

- Low demand questions are targeted at students working at grades 1–3.
- Standard demand questions are targeted at students working at grades 4–5.

A student's final grade, however, is based on their attainment across the qualification, not just on questions that may have been targeted at the level at which they are working.

01.1

Over 90 % of the students knew that a protractor is used to measure angles. The phonetic spelling of protractor was allowed.

01.2

Almost 70% of the students scored all four marks for completing the graph. Despite a clear instruction a significant number did not label the y-axis. A number of the students did not use a ruler to draw the line of best fit.

01.3

Most of the students correctly identified the relationship between the angle of incidence and the angle of reflection.

01.4

Half of the students knew which measurement was the amplitude of a wave. Most of the others thought the vertical distance between a peak and a trough was the amplitude.

01.5

About 80 % of the students knew which line showed the wavelength of the wave. The most common incorrect answer was the distance showing half the wavelength.

© 2025 AQA and its licensors. All rights reserved.

Report on the examination – GCSE - Physics – 8463/2H – June 2025

01.6

Over 90 % of the students correctly calculated the wavelength. Those who did not achieve full marks mainly did so by not choosing the correct unit for wavelength, with Pa being a popular incorrect choice.

01.7

This was well answered, with most of the students scoring both marks. A few inverted the equation and thus calculated the period incorrectly.

02.1

Most of the students correctly calculated the weight of coal.

02.2

Just over 90% of the students were able to use the work done equation correctly. Those that did not get full marks tended to put an additional step into the calculation by dividing the answer 68 000 000 by 4; the number of engines in total.
Occasionally a student would attempt to convert the number calculated into standard form. Whilst not being penalised, this was not required.

02.3

Well answered by most students. As with part 02.2, occasionally a student would attempt to convert the number calculated into standard form.

02.4

Nearly 90% of the students could identify that friction was a contact force.

02.5

Most of the students identified the correct distance-time graph for constant speed.

02.6

This was the 1st calculation that was more challenging for many students. A common error was to use only one of the quoted velocities to calculate the acceleration rather than using the difference between the velocities. However just over 80 % did score full marks, with 10 % scoring zero or not attempting the question.

03.1

Approximately 60% of the students scored both marks. Often students did not know the correct word for a natural satellite. However, many correctly identified ‘star’ for the second word.

03.2

Most of the students knew that we are part of the Milky Way galaxy.

03.3

© 2025 AQA

Only about 40 % of the students knew that the Sun will eventually become a black dwarf. The most popular wrong answer was that it would become a black hole.

03.4

Just fewer than 40 % of the students knew that a very distant galaxy moves faster than a nearer galaxy.

03.5

About 70 % of the students knew that an increase in the wavelength of light from a distant galaxy is called red-shift.

03.6

About 60 % of the students selected the correct word to describe the beginning of the universe.

03.7

Almost 80 % of the students knew that the universe is expanding.

04.1

Just over 70 % of the students were able to make the connection between the mass of a vehicle and how it would affect the maximum acceleration.

04.2

Over 90 % of the students scored full marks for calculating the resultant force using F = ma. However, some of the students thought that the value of acceleration needed to be squared and then multiplied by mass.

04.3

This level of response question proved too challenging for many. Only just over 1 % of the students scored full marks. Most identified that the driving force would increase, but fewer recognised that as this happened the air resistance would also increase, with many stating that the air resistance would decrease as the cars speed increased.

04.4

Most of the students knew that the thinking distance is affected by the driver's reaction time.

04.5

Just fewer than 70 % of the students were aware that the braking distance is the distance travelled under the braking force.

04.6

Only just over 20 % of the students scored full marks for using the graph of distance against speed to find the stopping distance. The correct distances were often identified from the graph. However, these were then either subtracted from each other, divided or multiplied rather than added.

© 2025 AQA

Report on the examination – GCSE - Physics – 8463/2H – June 2025

04.7
Nearly 80 % of the students identified factors that would increase the stopping distance of a car. Despite two being emboldened twice in the question, some students only ticked one box.

05.1
The principal focus was correctly identified by just over 60 % of the students.

05.2
About 80 % of the students knew that the change in direction of light as it enters a lens is called refraction.

05.3
Nearly 70 % the students recognised the shape of a convex lens.

05.4
Under a half of the students managed to correctly measure the object height and image height. This may have been due to a lack of skill or a lack of equipment.

05.5
This was much more successfully answered than part 05.4 with nearly 90 % of the students scoring both marks. These students used their values from part 05.4 to calculate magnification.

05.6
Just fewer than 50 % of the students knew that magnification is a ratio, but almost the same number thought it is a power.

05.7
This was a challenging question. Most of the students that did score a mark were awarded only the first mark point. This was for explaining that white light is transmitted through colourless glass. A lot of the students think of white light as an entity in itself rather than the result of the colours of the visible light combined. Few used the word transmitted but rather described it as passing through or goes through.
For the 2nd and 3rd mark points many of the students decided that white light was reflected or refracted, reinforcing the misconception that white light is a single entity rather than being made up of a combination of wavelengths. The idea that filters would absorb different wavelengths of light seemed to be difficult for the students to express, with very few achieving the third mark.

06.1
Only just over 30 % of the students could identify two magnetic materials from the list, with about 60 % being able to identify one. Again, a number of students ticked just one box or more than two boxes.

© 2025 AQA

Report on the examination – GCSE - Physics – 8463/2H – June 2025

06.2
Just over 70 % of the students correctly named the iron nails as induced magnets.

06.3
Just fewer than 40 % of the students knew the direction of the magnetic field.

06.4
Nearly 80 % of the students recognised the shape of the magnetic field around a current carrying wire.

06.5
Very few of the students could give two changes that would increase the magnetic field strength. 'Increasing the current' was a common correct response. Many of the students answered 'increasing the number of coils' as such they were implying the wire was already coiled and not answering the question asked, which was about the straight wire shown in Figure 10.

07.1
Nearly 60 % of the students understood what is meant by the moment of a force. The most common incorrect option was 'The direction of the force.'

07.2
The correct resultant moment was selected by just over 80 % of the students.

07.3
Students generally answered this well, identifying position 7 and on which side of the balance the tag should be placed. Some indicated this on the diagram which was an accepted alternative response, provided what was written did not contradict it.

07.4
Some students wrote the equation for the moment of a force in words and then in symbols. This risks not gaining the mark if either is incorrect. Also, correct use of symbols should be stressed, especially when they are given in the question. It was surprising that some of the students scored zero or did not attempt to write down an equation despite having the equations sheet.

07.5
Almost three quarters of the students were able to rearrange the equation and then calculate the distance between the pivot and the tag on the balance.

08.1
Most of the students found this level of response question difficult to answer. Only just over 1 % gave a level 2 answer. Many of the students scored 2, 1 or 0 marks. Of those that scored a mark the most common response was light travels faster than sound. Many also tried to describe light and sound as transverse and longitudinal waves, with the majority getting this

© 2025 AQA

confused. Very few identified acceptable similarities. Common answers that did not gain credit included light travels at the speed of light, sound travels at the speed of sound, light can be seen and sound cannot be seen.

08.2

Just fewer than 80 % of the students choose the correct equation for calculating speed.

08.3

This question required students to rearrange the equation. About three quarters of the students scored all three marks.

09.1

About 65 % of the students correctly stated the independent variable in this investigation.

09.2

Just over 40 % of the students scored both marks for identifying a risk of harm and a suitable safety precaution to reduce the risk. Too few students connected a hazard, such as a falling weight, becoming a risk of harm when it hit or hurt the student.

09.3

Students were expected to clearly describe two improvements to the arrangement shown that would improve the accuracy of the results. Many had difficulty describing their ideas clearly and answers were often too vague to gain credit.

09.4

Almost 40 % of the students scored this mark usually by explaining that the spring length was not 0 cm rather than describing the relationship between spring length and force.

09.5

This was not successfully answered, with only about 2 % of the students scoring both marks and a further 13 % scoring one mark. The 1st mark point was for stating or giving a clear description of inelastic deformation. Of those who were awarded marks most of them described how the spring had reached or passed its limit of proportionality.

09.6

Over 90 % of the students selected the correct equation.

09.7

Nearly 80 % of the students scored all three marks. Those that did not often rearranged the equation incorrectly.

10.1

Only about 5% of the students correctly calculated the uncertainty correctly from either the range or the mean.

© 2025 AQA

4.5.2 Work done and energy transfer

10.2

Just over 40 % of the students identified that a random error had caused the variation in this investigation. A greater proportion of the students thought there was a systematic error but this would not have accounted for the variation in the results.

10.3

This mark was awarded for a clear description of variation in the way the ball was dropped. For example, through different heights, at different speeds, or a different delay each time. Common answers giving reaction time or human error were too vague, to be awarded marks unless qualified.

10.4

Just fewer than 30 % of the students scored all three marks. Many of the students took only one value from the graph rather than a corresponding pair of values and so scored 0. Those that used a pair of correct values often then used them the wrong way round when calculating the gradient.

© 2025 AQA

Report on the examination – GCSE - Physics – 8463/2H – June 2025

Mark Ranges and Award of Grades

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

© 2025 AQA and its licensors. All rights reserved.