AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.4

Moments, levers and gears (physics only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**33**
Available paper years	**2003–2025**

Using this booklet

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

Name: _____ **Date:** _____

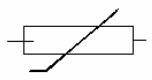
Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.5.4 Moments, levers and gears (physics only)

Answer 01 · Mark scheme June 2003 | 3451H | Original Q6 | Legacy

The full source mark scheme begins on page 67. Follow original question 6 in that document.

Answer 02 · Mark scheme June 2005 | 3451 | Original Q6 | Legacy

(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or 	accept correct circuit symbol allow phonetic spelling	1
	resistance goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.5.4 Moments, levers and gears (physics only)

Answer 02 · Mark scheme June 2005 | 3451 | Original Q6 | Legacy

3451/F Q12

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

4.5.4 Moments, levers and gears (physics only)

Answer 02 · Mark scheme June 2005 | 3451 | Original Q6 | Legacy

3451/F Q13

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

4.5.4 Moments, levers and gears (physics only)

Answer 02 · Mark scheme June 2005 | 3451 | Original Q6 | Legacy

3451/F Q14

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

cont…

3451/F Q14 cont…

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

4.5.4 Moments, levers and gears (physics only)

Answer 02 · Mark scheme

June 2005 | 3451 | Original Q6 | Legacy

3451/F Q15

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

4.5.4 Moments, levers and gears (physics only)

Answer 02 · Mark scheme

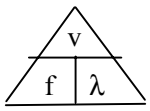
June 2005 | 3451 | Original Q6 | Legacy

3451/F Q16

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q17

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

4.5.4 Moments, levers and gears (physics only)

Answer 03 · Mark scheme June 2006 | 3451 | Original Q4 | Legacy

The full source mark scheme begins on page 89. Follow original question 4 in that document.

Answer 04 · Mark scheme June 2006 | 3451 | Original Q16 | Legacy

The full source mark scheme begins on page 89. Follow original question 16 in that document.

Answer 05 · Mark scheme June 2006 | 3451 | Original Q17 | Legacy

The full source mark scheme begins on page 89. Follow original question 17 in that document.

Answer 06 · Mark scheme June 2006 | 3462 | Original Q4 | Legacy

The full source mark scheme begins on page 109. Follow original question 4 in that document.

4.5.4 Moments, levers and gears (physics only)

Answer 07 · Mark scheme January 2008 | PHY3H | Original Q1 | Legacy

Question 1

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)' use a greater force / pull	or increases the perpendicular distance / length note 'lever' refers to 'spanner' note change the . . . (0) ignore references to wider / larger nut **either order**	1 1
total			5

4.5.4 Moments, levers and gears (physics only)

Answer 07 · Mark scheme

January 2008 | PHY3H | Original Q1 | Legacy

PHY3H

4.5.4 Moments, levers and gears (physics only)

Answer 08 · Mark scheme

Question 3

question	answers	extra information	mark
(a)	810 000 newton-metres / Nm	allow 45 000 × 18 for **1** mark	2 1
(b)	any **three** from: • their weight / mass can be altered / adjusted • so that the crane remains stable • so that the (total) clockwise moment equals the (total) anticlockwise moment • because not all containers are the same weight / mass • because not all containers will be / need to move the same distance (from the crane) • to keep the centre of mass (of the upper crane and container) in/above the base of the tower • so that the crane remains in equilibrium/balanced	ignore references to force throughout allow does not topple do **not** allow just 'moments are equal' do **not** allow 'not all containers are the same size / volume'	3
total			6

4.5.4 Moments, levers and gears (physics only)

Answer 08 · Mark scheme June 2008 | PHY3H | Original Q3 | Legacy

PHY3H

4.5.4 Moments, levers and gears (physics only)

Answer 09 · Mark scheme January 2010 | PHY3H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	will not fall over (1) **or** centre of mass will remain above the base (1) if the monitor is given a small push (1)	accept will not easily fall over (2) (line of action of the) weight will remain above within the base accept centre of gravity / c of g / c of m / c m depends on mark above	2
4(a)(ii)	(total) clockwise moment = (total) anticlockwise moment	**or** they are equal / balanced	1
4(b)	the position of the centre of mass has changed (1) the line of action of the weight is outside the base (1) producing a (resultant) moment (1)	points may be expressed in any order	3
Total			**6**

4.5.4 Moments, levers and gears (physics only)

Answer 09 · Mark scheme

January 2010 | PHY3H | Original Q4 | Legacy

PHY3H

4.5.4 Moments, levers and gears (physics only)

Answer 10 · Mark scheme

June 2010 | PHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	longer reaction time **or** greater thinking distance **or** greater stopping distance	accept slower reactions do **not** accept slower reaction time unless qualified accept greater thinking time accept greater stopping time greater braking distance negates answer	1
5(a)(ii)	lines / slopes have the same gradient **or** velocity decreases to zero in same time / in 2.6 seconds	accept slopes are the same accept any time between 2.3 and 2.8 accept braking distances are the same	1
5(a)(iii)	12	accept extracting both reaction times correctly for **1** mark (0.6 and 1.4) **or** time = 0.8(s) for **1** mark accept 0.8 × 15 for **2** marks accept calculating the distance travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for **2** marks	3

Question 5 continues on next page…

PHY2H

Question 5 continued…

question	answers	extra information	mark
5(b)	**Z**		1
	different force values give a unique / different resistance	only scores if **Z** chosen do **not** accept force and resistance are (directly) proportional accept answers in terms of why either **X or Y** would not be the best eg **X** – same resistance value is obtained for 2 different force values **Y** – all force values give the same resistance	1
Total			**7**

4.5.4 Moments, levers and gears (physics only)

Answer 10 · Mark scheme June 2010 | PHY2H | Original Q5 | Legacy

PHY2H

4.5.4 Moments, levers and gears (physics only)

Answer 11 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	the point at which the (total) mass seems to act / appears to be concentrated	accept 'weight' for 'mass' accept the point at which gravity seems to act do **not** accept a definitive statement eg where (all) the mass is	1
4(b)	wider / larger base	marks are for a correct comparison	1
	lower centre of mass	accept lower centre of gravity / c of g	1
4(c)	line of action (of the weight) lies / falls inside the base	in each case the underlined term must be used correctly to gain the mark	1
	the resultant moment returns mixer to its original position	accept there is no resultant moment / resultant moment is zero accept resulting moment for resultant moment do **not** accept converse argument	1
Total			**5**

4.5.4 Moments, levers and gears (physics only)

Answer 11 · Mark scheme June 2010 | PHY3H | Original Q4 | Legacy

PHY3H

4.5.4 Moments, levers and gears (physics only)

Answer 12 · Mark scheme

June 2010 | PHY3H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	38 400 Nm **or** newton metres	allow 6.4 × 6000 for **1** mark do **not** credit 'nm', 'mN' or 'metre newtons'	2 1
6(b)	16 000 (N) **or** 16 kN	allow **1** mark for 38 400 ÷ 2.4 accept their (a) ÷ 2.4 correctly calculated for **2** marks accept their (a) ÷ 2.4 for **1** mark	2
Total			**5**

4.5.4 Moments, levers and gears (physics only)

Answer 12 · Mark scheme June 2010 | PHY3H | Original Q6 | Legacy

PHY3H

Question 4

question	answers	extra information	mark
4(a)(i)	kinetic	accept KE do **not** accept movement	1
4(a)(ii)	0.75 **or** 75 %	allow **1** mark for correct substitution ie $\frac{60\,000}{80\,000}$ an answer 0.75 % **or** 0.75 with a unit gains **1** mark only an answer 75 with or without a unit gains **1** mark only	2
4(b)	any **one** from: • large areas of land are flooded • peoples homes may be destroyed • habitat (of animals and plants) lost / damaged	 uses large areas of land / takes up large areas of land is insufficient construct is neutral very noisy is neutral	1

Question 4 continues on the next page . . .

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(c)(i)	system of cables and transformers	both required for the mark accept power lines / wires for cables ignore reference to pylons inclusions of power stations / consumers negates answer	1
4(c)(ii)	less energy loss / wasted (in the cables) as the cables are shorter	accept heat for energy do **not** accept no energy loss do **not** accept electricity for energy	1 1
Total			**7**

4.5.4 Moments, levers and gears (physics only)

Answer 13 · Mark scheme January 2011 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 14 · Mark scheme

Question 5

question	answers	extra information	mark
5(a)	1.2 metre(s)/m	allow **1** mark for conversion of 2.4 kN to 2400 N or for correct transformation without conversion ie d = 2880 ÷ 2.4	2 1
5(b)	any **two** from: • as the load increases the (total) clockwise moment increases • danger is that the fork lift truck / the load will topple / tip forward • (this will happen) when the total clockwise moment is equal to (or greater than) the anticlockwise moment • (load above 10.0 kN) moves line of action (from C of M) outside base (area)	accept moments will not be balanced	2
Total			**5**

4.5.4 Moments, levers and gears (physics only)

Answer 14 · Mark scheme January 2011 | PHY3H | Original Q5 | Legacy

PHY3H

Question 7

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

Question 7 continues on the next page

PHY2H

Question 7 continued

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

4.5.4 Moments, levers and gears (physics only)

Answer 16 · Mark scheme

June 2011 | PHY3H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	turning effect	accept turning force accept force x distance (accept symbols only if correctly defined) do **not** accept newtons x metres	1
2(a)(ii)	stop apparatus falling over	accept holds the stand in place accept make it safer / stable references to balanced / equilibrium are insufficient	1
2(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
2(a)(iv)	the centre of mass of the ruler is at the axis of rotation		1
2(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**

4.5.4 Moments, levers and gears (physics only)

Answer 16 · Mark scheme June 2011 | PHY3H | Original Q2 | Legacy

PHY3H

Answer 17 · Mark scheme November 2011 | PHY1AP | Original Q8 | Legacy

Eight	**3**	**4**	**4**	**2**

Question 2

question	answers	extra information	mark
2(a)(i)	1.25 (mSv)		1
2(a)(ii)	any **two** from: • (frequent) flying • living at altitude • living in areas with high radon concentrations • living in a building made from granite (blocks) • having more than the average number of X-rays or having a CT scan • working in a nuclear power station	accept stated occupation that involves flying accept a specific area, eg Cornwall accept more medical treatments accept any suggestion that could reasonably increase the level from a specific source	2
2(b)(i)	to be able to see the effect of exposure (to radon gas) **or** as a control	accept to compare (the effect of) exposure (with no exposure)	1
2(b)(ii)	increased levels of exposure increases the risk (of developing cancer) smoking increases the (harmful) effect of radon	accept exposure (to radon gas) increases the risk answers that simply reproduce statistics are insufficient	1 1
2(c)	LNT model – risk increases with increasing radiation (dose) level Radiation hormesis – low radiation (dose) levels reduce the risk	accept in (direct) proportion accept low doses increase the risk	1 1

Question 2 continues on the next page . . .

PH2HP

Question 2 continued

question	answers	extra information	mark
2(d)	two valid points made – examples: • animals have no choice and so should not be used • should not make animals suffer • better to experiment on animals than humans • experiments lead to a better understanding / new knowledge • experiments may lead to health improvement / cures for humans	results for animals may not apply to humans is insufficient	2
Total			**10**

4.5.4 Moments, levers and gears (physics only)

Answer 18 · Mark scheme June 2012 | PH2HP | Original Q2 | Legacy

PH2HP

Question 3

question	answers	extra information	mark
3(a)	750 newton(s) / N	allow **1** mark for correct substitution, ie 75 x 10 provided no subsequent steps shown do **not** accept n	2 1

3(b)			6
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 2, and apply a 'best-fit' approach to the marking.			
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There is a brief attempt to explain why the velocity / speed of the parachutist changes. **or** the effect of opening the parachute on velocity/speed is given.	The change in velocity/ speed is clearly explained in terms of force(s) **or** a reasoned argument for the open parachute producing a lower speed.	There is a clear and detailed explanation as to why the parachutist reaches terminal velocity **and** a reasoned argument for the open parachute producing a lower speed

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(b) (cont)	**examples of the physics points made in the response to explain first terminal velocity** • on leaving the plane the only force acting is weight (downwards) • as parachutist falls air resistance acts (upwards) • weight greater than air resistance **or** resultant force downwards • (resultant force downwards) so parachutist accelerates • as velocity / speed increases so does air resistance • terminal velocity reached when air resistance = weight **to explain second lower terminal velocity** • opening parachute increases surface area • opening parachute increases air resistance • air resistance is greater than weight • resultant force acts upwards / opposite direction to motion • parachutist decelerates / slows down • the lower velocity means a reduced air resistance • air resistance and weight become equal but at a lower (terminal) velocity	accept gravity for weight throughout accept drag / friction for air resistance accept terminal velocity reached when forces are balanced	

Question 3 continues on the next page . . .

PH2HP

Question 3 continued

question	answers	extra information	mark
3(c)(i)	any **one** from: • mass/weight of the (modelling) clay • material parachute made from • number / length of strings	 accept size/amount/volume/ shape of clay accept plasticine for (modelling) clay accept same (plastic) bag	1
3(c)(ii)	**C** smallest (area) so falls fastest (so taking least time)	reason only scores if **C** is chosen accept quickest/quicker for fastest if **A** is chosen with the reason given as 'the largest area so falls slowest' this gains **1** mark	1 1
Total			**12**

4.5.4 Moments, levers and gears (physics only)

Answer 19 · Mark scheme June 2012 | PH2HP | Original Q3 | Legacy

PH2HP

4.5.4 Moments, levers and gears (physics only)

Answer 20 · Mark scheme

June 2013 | PH3HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	liquids are (virtually) incompressible		1
4(b)	84	allow **1** mark for correct substitution, ie $1.5 \times 10^{6} = \frac{F}{5.6 \times 10^{-5}}$ numbers may not be written in standard form, ie $1\,500\,000 = \frac{F}{0.000\,056}$ allow **1** mark for an answer 216	2
4(c)	it (the force on the slave pistons) is greater / larger	accept force (at slave piston) = 216 (N)	1
	the area (touching the liquid) of the slave piston is greater than the area of the master piston	accept it has a bigger area just quoting numbers, eg the master piston is 5×10^{-5} and the slave piston is 14.4×10^{-5} is insufficient	1
Total			**5**

4.5.4 Moments, levers and gears (physics only)

Answer 20 · Mark scheme

June 2013 | PH3HP | Original Q4 | Legacy

PH3HP

4.5.4 Moments, levers and gears (physics only)

Answer 21 · Mark scheme

June 2013 | PH3HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	60	allow **1** mark for correct substitution (with d in metres), ie 36 = F × 0.6 an answer of 0.6 **or** 6 gains **1** mark	2
6(b)	the line of action of the weight lies outside the base / bottom (of the bag)	accept line of action of the weight acts through the side accept the weight (of the bag) acts outside the base / bottom (of the bag)	1
	a resultant / overall / unbalanced moment acts (on the bag)	accept the bag is not in equilibrium do **not** accept the bag is unbalanced	1
6(c)	0.0625	allow **1** mark for correct substitution, ie $16 = \frac{1}{f}$ an answer of 0.00625 gains **1** mark	2
	hertz / Hz	do **not** accept HZ **or** hz	1
Total			**7**

4.5.4 Moments, levers and gears (physics only)

Answer 21 · Mark scheme

June 2013 | PH3HP | Original Q6 | Legacy

PH3HP

4.5.4 Moments, levers and gears (physics only)

Answer 22 · Mark scheme June 2014 | PH2HP | Original Q5 | Legacy

5(a)	momentum before (jumping) = momentum after (jumping) before (jumping) momentum of skateboard and skateboarder is zero after (jumping) skateboarder has momentum (forwards) so skateboard must have (equal) momentum (backwards)	accept momentum (of the skateboard and skateboarder) is conserved accept before (jumping) momentum of skateboard is zero accept before (jumping) total momentum is zero answers only in terms of equal and opposite forces are insufficient	1 1 1	AO1 2.2.2b
5(b)	7	accept –7 for **3** marks allow **2** marks for momentum of skateboarder equals 12.6 **or** 0 = 42 × 0.3 + (1.8 × –v) **or** allow **1** mark for stating use of conservation of momentum	3	AO2 2.2.2b
Total			**6**	

4.5.4 Moments, levers and gears (physics only)

Answer 22 · Mark scheme

June 2014 | PH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

4.5.4 Moments, levers and gears (physics only)

Answer 23 · Mark scheme June 2014 | PH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
4(a)	3800	allow **1** mark for 2000 allow **1** mark for 1800 if neither of above scored, allow correct substitution for **1** mark (800 × 2.5) + (600 × 3) if moments have been calculated incorrectly, allow **1** mark for adding their two moment values correctly	3	AO1 AO2 3.2.2b
	newton metres **or** Nm	do **not** allow nm **or** NM	1	
4(b)	as the girl increases her distance (from the pivot) the clockwise moment increases		1	AO3 3.2.2b, c
	(F must increase) as the anticlockwise moment must increase		1	
	so (the anticlockwise moment) is equalled / balanced by the clockwise moment **or** so resultant / overall moment (on the board) is zero	accept to balance / equal the moments to balance the board is insufficient	1	
Total			**7**	

4.5.4 Moments, levers and gears (physics only)

Answer 24 · Mark scheme June 2015 | PH3HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)(i)	the line of action of the weight (of the bus) lies / acts outside of the base (of the bus) there is a resultant <u>moment</u> (acting on the bus)	allow line of action through the centre of mass lies / acts outside the base	1 1	AO1 P3.2.2f
7(a)(ii)	in normal use the centre of mass may be in a different position **or** passengers on the bus may affect the position of the centre of mass for safety, buses should always be tested beyond the normal operating conditions / parameters	 for safety is insufficient accept in case something unexpected happens	1 1	AO3 P3.2.2
7(b)(i)	a liquid is (virtually) incompressible	accept a liquid cannot be squashed a liquid is difficult to compress is insufficient	1	AO1 P3.2.3a

Question 7 continues on the next page . . .

4.5.4 Moments, levers and gears (physics only)

Answer 24 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(b)(ii)	84000	award **2** marks for $\frac{F}{0.28} = \frac{360}{0.0012}$ **or** $\frac{F}{0.28} = 300\,000$ **or** award **1** mark for $P = \frac{360}{0.0012}$ **or** 300 000 (Pa) seen anywhere	3	AO2 P3.2.3b, c
Total			8	

4.5.4 Moments, levers and gears (physics only)

Answer 24 · Mark scheme

June 2015 | PH3HP | Original Q7 | Legacy



4.5.4 Moments, levers and gears (physics only)

Answer 25 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	turning effect	accept force multiplied by perpendicular distance from the line of action of the force to the pivot	1	AO1 3.2.2a
5(a)(ii)	moments are equal (in size) and opposite (in direction)	both parts are required allow clockwise moment = anticlockwise moment	1	AO1 3.2.2c
5(a)(iii)	0.9 (N)	allow **2** marks for $F=0.18 \div 0.2$ provided no subsequent steps allow **1** mark for (anticlockwise moment) = 0.18 (Nm) allow **1** mark for correct substitution i.e. $1.5 \times 0.12 = F \times 0.20$	3	AO2 3.2.2e
5(b)	a longer drumstick lever gives a quieter sound a longer drumstick lever allows a greater range of volumes	 a greater force gives a louder sound is insufficient	1 1	AO3 3.2.2e
Total			7	

4.5.4 Moments, levers and gears (physics only)

Answer 25 · Mark scheme

June 2016 | PH3HP | Original Q5 | Legacy



4.5.4 Moments, levers and gears (physics only)

Answer 26 · Mark scheme

June 2016 | PH3HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	the point where the mass is (thought to be) concentrated		1	AO1 3.2.1a
6(a)(ii)	the centre of mass is higher the base (area) is smaller / narrower		1 1	AO2 3.2
6(b)	(the blocks at A and B) create equal and opposite moments the resultant moment is zero **or** the block at A creates an anti-clockwise moment (1) so this must be balanced by an equal clockwise moment from the block at B (1)	 accept (moments are in) equilibrium / balanced	1 1	AO1 3.2.2c
Total			5	

4.5.4 Moments, levers and gears (physics only)

Answer 26 · Mark scheme

June 2016 | PH3HP | Original Q6 | Legacy



4.5.4 Moments, levers and gears (physics only)

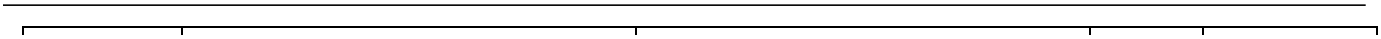
Answer 27 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	(hydraulic fluid is) incompressible	accept virtually incompressible	1	AO1 3.2.3a
5(b)	2.1×10^5	accept 210 000 for **3** marks allow **1** mark for correct substitution ie $5.2 \times 10^8 = F / 4.1 \times 10^{-4}$ allow **2** marks for an answer of 213200 **or** one that rounds to 2.1×10^5	3	AO2 3.2.3c
5(c)	The force (at the tips) is less because the tips are further away (from the pivot than the piston)	 reason only scores if correct answer given	1 1	AO3 3.2.2e
5(d)	The moments are equal (in size) The moments are opposite (in direction)	 accept clockwise moment = anti-clockwise moment for **2** marks if no other mark gained allow **1** mark for the moments are balanced **or** there is no resultant moment	1 1	AO1 3.2.2c
Total			**8**	

4.5.4 Moments, levers and gears (physics only)

Answer 27 · Mark scheme

June 2017 | PH3HP | Original Q5 | Legacy



4.5.4 Moments, levers and gears (physics only)

Answer 28 · Mark scheme

June 2019 | 8463/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	$41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ h = 0.50 (m)	an answer of 0.50 scores **3** marks allow a correct answer that rounds to 0.50 for **3** marks	1 1 1	4.1.1.2 AO2
3.2	kinetic energy = 0.5 × mass × (speed)^2 ***or*** $E_k = ½ mv^2$		1	4.1.1.2 AO1
3.3	$270 = ½ \times m \times 3^2$ $m = \frac{270}{(½ \times 3^2)}$ **or** $m = \frac{270}{4.5}$ m = 60 (kg)	an answer of 60 (kg) scores **3** marks	1 1 1	4.1.1.2 AO2

3.4	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear.		3–4	WS3.5 4.1.1.2 AO3
	Level 1: Relevant features are identified and differences noted.		1–2	
	No relevant content		0	
	Indicative content • males have a greater muscle power than females for most of their lives • males have a greater muscle power than females above 9/10 years old • males have a lower muscle power than females below 9/10 years old • there is a similar pattern for males and females as age increases • males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old • at 9/10 years old males have the same muscle power as females • peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg) • the rate of increase of muscle power is greater for males than females (between 5 and 25 years old) • the rate of decrease of muscle power is greater for males than females. Ignore comments relating to strength			
3.5	any **1** from: • maximum height reached is a better indicator of maximum muscle power • maximum / peak muscle power was being investigated, not mean / average muscle power • volunteer may not use maximum effort on the first try • performance may improve with practise • performance may get worse with tiredness	allow maximum time in the air for maximum height reached / jumped	1	WS3.7 4.1.1.4 AO3
Total			**12**	

4.5.4 Moments, levers and gears (physics only)

Answer 29 · Mark scheme

June 2019 | 8463/2H | Original Q10

Question 10

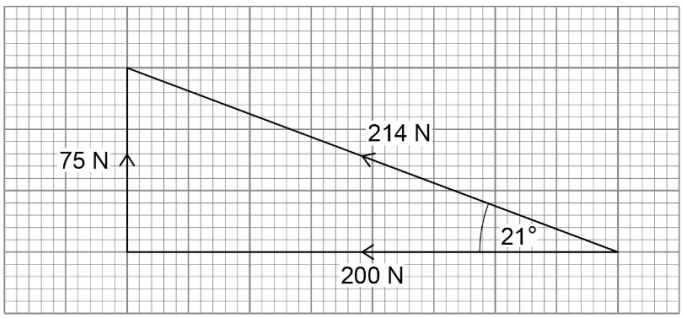
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	the (perpendicular) distance from the pivot / hinge to (the line of action of) the force is greater	allow distance from the rope to the pivot / hinge is greater (than distance between handle and pivot / hinge)	1	AO2/1 4.5.4
	so a smaller force is required	this mark is dependent on scoring the 1st mark an answer a smaller force is required at the rope to produce the same moment scores **2** marks	1	
10.2	924 = F × 0.15	an answer of 770 scores **6** marks	1	AO2/1 4.5.4 4.5.3
	F = 6160 (N)	allow use of E = ½ F e instead of k = F ÷ e and E = ½ × k × e^2	1	
	6160 = k × 0.25	allow their calculated F = k × 0.25	1	
	$k = \frac{6160}{0.25}$ **or** k = 24640 (N/m)	allow a value for k calculated using their calculated F	1	
	$E = \frac{½ \times 6160 \times 0.25 \times 0.25}{0.25}$	allow E = ½ × their calc. k × 0.25^2	1	
	E = 770 (J)	allow an answer consistent with their calculated k	1	
Total			**8**	

Answer 30 · Mark scheme

November 2021 | 8463/2H | Original Q7

Question 7

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

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

Total			**13**

4.5.4 Moments, levers and gears (physics only)

Answer 31 · Mark scheme

June 2023 | 8463/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	apply the force further away from the pivot	do not allow increase the length of the lever	1	AO2 4.5.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	v = 15 (m/s)		1	AO2 4.5.7.1
	24 000 = m × 15	allow a value of v = 14.5 (m/s)	1	
	$m = \frac{24\,000}{15}$		1	
	m = 1600 (kg)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	distance travelled during first 3 seconds = 22.5 (m)		1	AO2 4.5.6.1.5
	distance travelled during last 2 seconds = 30 (m)		1	
	total distance = 52.5 (m)	allow 53 (m) allow 1 mark for the correct addition of their calculated distances allow a maximum of 2 marks for total distance = 50.75 (m) if velocity used = 14.5 (m/s)	1	

4.5.4 Moments, levers and gears (physics only)

Answer 31 · Mark scheme

June 2023 | 8463/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	stopping distance includes thinking distance	allow stopping distance = braking distance + thinking distance	1	AO1
	there is an additional time before the driver applies the brakes.	allow the driver's reaction time will increase (due to the distraction)	1	AO2
	(so) the thinking distance will increase		1	AO2 4.5.6.1.1 4.5.6.3.1 4.5.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	work is done due to friction (in the brakes)	ignore friction alone	1	AO1 4.5.6.3.4
	(causing) an increase in the internal / thermal energy (of the brakes)		1	

Total Question 3	13

Answer 32 · Mark scheme

June 2024 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	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.
02.2	work done = force × distance **or** $W = F \times s$		1	AO1 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$35 = F \times 2.8$ $F = \frac{35}{2.8}$ $F = 12.5$ (N)	 allow 13 (N)	1 1 1	AO2 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	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.
02.5	moment = force × distance **or** $M = F \times d$		1	AO1 4.5.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	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.
02.7	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 2	**14**

Question 7

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

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

Answer 33 · Mark scheme

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

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

Total Question 7	12

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

Foundation

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Kathleen Tattersall: *Director General*

4.5.4 Moments, levers and gears (physics only)

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of Quality of Written Communication

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

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

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

4.5.4 Moments, levers and gears (physics only)

3.2 Marking of lists

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

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

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

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

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

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

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

3.3 Use of chemical symbols/formulae

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

3.4 The marking of quantitative relationships

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

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

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

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

3.5 Marking procedure for calculations

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

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

3.6 Interpretation of 'it'

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

3.7 Errors carried forward

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

Examples

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

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

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

3.8 Phonetic spelling

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

3.9 Brackets

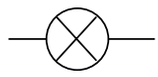
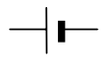
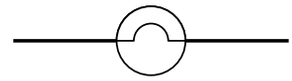
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q1

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q2

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q3

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q4

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

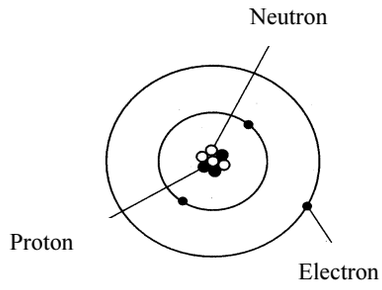
4.5.4 Moments, levers and gears (physics only)

3451/F Q5

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

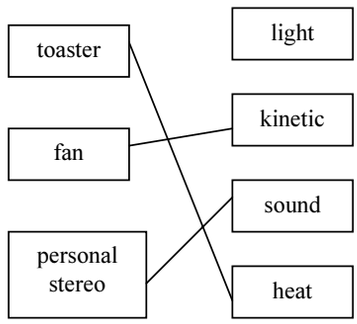
4.5.4 Moments, levers and gears (physics only)

3451/F Q6

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q7

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

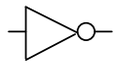
4.5.4 Moments, levers and gears (physics only)

3451/F Q8

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

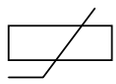
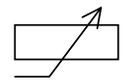
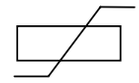
4.5.4 Moments, levers and gears (physics only)

3451/F Q9

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q9 continued

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q10

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q11

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q12

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q13

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

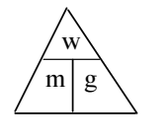
4.5.4 Moments, levers and gears (physics only)

3451/F Q14

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q15

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q16

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q17

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

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.

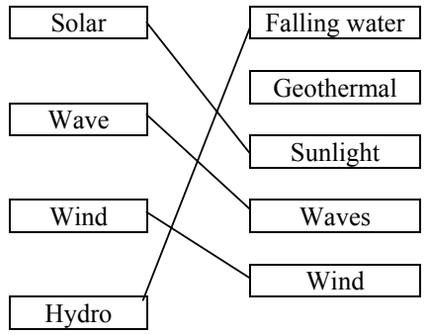
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

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4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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 swap the brown and blue wires round	accept wires must be connected to screws	1 1
total			4

3451/F Q6

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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>

4.5.4 Moments, levers and gears (physics only)

3451/F Q11

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

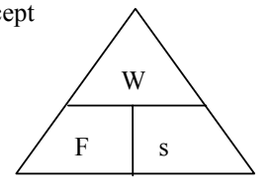
4.5.4 Moments, levers and gears (physics only)

3451/F Q14

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q15

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

3451/F Q18

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

OR (gate)

NOT (gate)

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

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

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

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

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

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

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

or

full current through electronic control system (1)

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

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

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

do not accept small current is turned into a large current

annotate Q✓ Q×

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

1

1

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

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B

Mark Scheme

2006 examination - June series

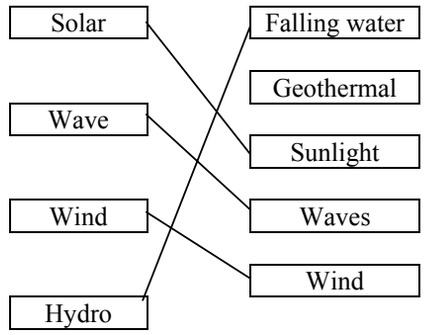
Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination.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

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

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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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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

3462/3F Q10

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

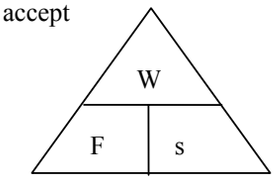
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

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

4.5.4 Moments, levers and gears (physics only)

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

4.5.4 Moments, levers and gears (physics only)

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 29 · Examiner comments

Question 10 (Standard/high and high demand)

10.1 There were a number of good answers here, though some students referred to momentum instead of moment, or work done = force × distance. A few students wrote about the distance between the rope and the spring (or the ramp) instead of the pivot.

10.2 Almost a third of the students scored all 6 marks and showed their working in a clear and logical sequence. Where students did not score all 6 marks, the equation for elastic potential energy was often correctly selected, but they did not appear to know how to use the other quantities given to find the spring constant correctly. Most students were able to use the moment and distance to calculate the force.

4.5.4 Moments, levers and gears (physics only)

Answer 29 · Examiner comments

June 2019 | 8463/2H | 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.

4.5.4 Moments, levers and gears (physics only)

Answer 30 · Examiner comments November 2021 | 8463/2H | Original Q7

Question 7

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

Answer 31 · Examiner comments June 2023 | 8463/2H | Original Q3

03.1

32% of students gained this mark. Common mistakes included physically changing the length of the lever, increasing the distance from the pivot without any reference to force, and increasing the distance of the lever to the pivot.

03.2

87% of students gained all 4 marks on this question. There were not many incorrect readings of velocity from the graph, and the most common error was usually 14.5 m/s. Those who did not score all the marks had made mathematical errors, such as incorrect rearranging.

03.3

55% of students gained all 3 marks. Those not scoring full marks, were often awarded the second marking point for calculating the distance travelled when the velocity was constant, and the third mark for adding up their two values.

34% scored zero because they had not appreciated that the area under the graph represented the distance travelled. A large number of students used distance = speed × time, not recognising that speed was not constant.

03.4

This question demonstrated that incorrect use, or lack of use, of scientific terminology has a negative effect. Students frequently confuse distance and time when answering this type of question. In addition, many talk about reaction times being slower, which implies time can slow down. Credit was given for slower reaction times, as was the use of 'thinking time' or descriptions of a greater response time. Only 17% gained full marks, as the link between stopping distance and thinking distance was often not made.

03.5

The majority of students did not answer this question in terms of work done. Most mentioned friction which on its own was not creditworthy. The second mark point was expressed correctly as kinetic energy being transferred to thermal energy. Unspecific answers about the release of energy were not credited, but the use heat energy instead of thermal was accepted.. Only 4% of students scored both marks, with 35% scoring one mark.

4.5.4 Moments, levers and gears (physics only)

Answer 32 · Examiner comments June 2024 | 8463/2H | Original Q2

02.1
79% of students scored the first mark, with a minority citing 9.8 N / gravity for the resultant vertical force. Many quoted Newton's laws as an explanation; very few students said, 'the child isn't accelerating' and a number stated that the forces were equal but failed to explain that the forces were in opposite directions.

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Answer 32 · Examiner comments June 2024 | 8463/2H | Original Q2

02.2
99.6% of students wrote down the correct equation for work done.

02.3
95% of students scored all 3 marks for this calculation of force. There were some errors rearranging.

02.4
84% of students gained the first mark point for explaining why the speed of the baby walker increased as the baby moved onto the hard floor, but few referred to the resultant force. A significant number of students thought there was no friction on the hard floor. Some responses were in terms of energy rather than forces.

02.5
99.7% of students wrote down the correct equation for the moment of a force.

02.6
75% of students scored all 3 marks for the calculation of the moment; 24% did not convert 7.5cm to 0.075m or converted incorrectly.

02.7
This question related to interaction of two gears. When marks were gained, this was primarily for the first mark point. Some expressed ideas for the second mark point and but rarely in the correct terms, sometimes referring to momentum, rather than moments. There were a number of responses in terms of energy transfers. 10% of students scored both marks, 73% scored 1 mark.

4.5.4 Moments, levers and gears (physics only)

Answer 33 · Examiner comments June 2025 | 8463/2H | Original Q7

7.1

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

7.2

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

7.3

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

7.4

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