Collins

AQA

GCSE

PHYSICS

H

SET A – Higher Tier

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Answers

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Paper 1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	beta		1	**AO1** 4.4.2.1
01.2	(Radiation with a high ionising power) produces a large number of ions (when the radiation collides with atoms) along each cm of its path (accept in a given distance). Alpha radiation has a short range in the human body (accept doesn't pass through skin/flesh)		1 1 1	**AO1** 4.4.2.1
01.3	Gamma radiation (easily) passes through the human body		1	**AO1** 4.4.3.3
01.4	6 hours The half-life has to be long enough so that the procedure can be completed. Half-life has to be short enough so that the patient is not radioactive for a long period of time.		1 1 1	**AO1** 4.4.3.3
02.1	**Level 2:** A detailed and coherent plan covering all the major steps is provided. The steps are presented in a logical order that could be followed by another person to obtain valid results.	3–4	4	**AO1** 4.2.1.3
	Level 1: Simple statements relating to relevant apparatus or steps are made but may not follow a logical sequence. The plan would not enable another person to obtain valid results.	1–2		
	No relevant content	0		
	Indicative content: • measure the length of wire between the crocodile clips • using a metre rule • close the switch • record the reading on the ammeter • record the reading on the voltmeter • open switch to stop the wire overheating • divide the voltmeter reading by the ammeter reading to determine the wire's resistance • repeat measurement to improve accuracy/minimise errors • repeat for different lengths of wire • plot a graph of resistance against length			
02.2	systematic error (accept zero error)		1	**AO3** 4.2.1.3 4.2.1.4

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
02.3	deduct 1 mm from each length measurement		1	**AO3** 4.2.1.3 4.2.1.4
02.4	straight line, positive gradient, through the origin		1	**AO1** 4.2.1.3 4.2.1.4
02.5	resistance decreases as the thickness increases Accept any other conclusion consistent with the pattern shown by the graph, such as doubling thickness reduces resistance to $\frac{1}{4}$		1	**AO3** 4.2.1.3
02.6	accept value in the range 1.6–2.5 (Ω)		1	**AO3** 4.2.1.3
03.1	($\Delta E = m\ c\ \Delta\theta$) $\Delta E = 1 \times 4200 \times 80$ thermal energy transferred = 336 000 (J)	1 mark for substitution into correct equation 1 mark for answer correct answer with no working shown = 2 marks	2	**AO2** 4.1.1.3
03.2	energy transferred = power × time	accept power = energy transferred / time	1	**AO1** 4.2.4.2
03.3	thermal energy transferred = 3000 × 120 = 360 000 (J)	1 mark for substitution 1 mark for answer correct answer with no working shown = 2 marks	2	**AO2** 4.2.4.2
03.4	either: efficiency = $\frac{\text{(useful output energy transfer)}}{\text{(total input energy transfer)}}$ or: efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	**AO1** 4.1.2.2
03.5	efficiency = $\frac{336000}{360000} \times 100$ efficiency = 93(%)	1 mark for substitution 1 mark for answer Correct answer with no working shown = 2 marks Allow error carried forward from 03.2 and 03.3 1 additional mark if answer given to 2 significant figures	2 1	**AO2** 4.1.2.2
03.6	(Thermal) energy is transferred to the body of the kettle.		1	**AO1** 4.1.2.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
04.1	An energy source that can be replenished / will not run out.	or wtte	1	**AO1** 4.1.3
04.2	**Level 3:** A coherent and detailed account comparing wind power and nuclear power in terms of both reliability and environmental effects.	5–6	6	**AO3** 4.1.3
	Level 2: A clear account with some valid comparisons of reliability and environmental effect.	3–4		
	Level 1: Some relevant comments regarding reliability and environmental effects but comparisons may not be made. The descriptions are vague and lack sufficient detail.	1–2		
	No relevant content	0		
	Indicative content **Wind power:** • renewable / doesn't run out • not reliable / predictable: only supplies energy when it is windy • usually windy somewhere in the UK • does not cause (atmospheric) pollution • no greenhouse gas emissions/does not contribute to climate change • noise disturbance may be an issue • possible hazard to birds • visual impact of turbines may be an issue **Nuclear power:** • not renewable / will run out • reliable: supplies energy continuously/ no disruption to the supply • not dependent on the weather • no greenhouse gas emissions/does not contribute to climate change • produces radioactive waste which may be hazardous for hundreds of years • accidents can lead to the emission of radioactive material into the environment			
05.1	Accept either 10^{-9} or 10^{-10} (m)		1	**AO1** 4.4.1.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
05.2	That a very small percentage are deflected by large angles could not be explained by plum pudding model / Needed to change model so that the positive charge / most of the mass is in a nucleus	1 mark	2	**AO3** 4.4.1.3
	Any 3 of: Both models have positive (and negative charge) present in the atom Positive charge is distributed throughout the atom in the plum pudding model but is contained within the central nucleus in the nuclear model Repulsion occurs between the alpha particles and the nucleus because they are both positively charged Most of the atom must be empty space. Deflected alpha particles must be hitting a small concentrated region of positive charge.	1 mark 1 mark each for any two of the three statements	2	**AO1** 4.4.1.3
05.3	79 protons in the nucleus		1	**AO1**
	118 neutrons in the nucleus		1	4.4.1.1
	79 electrons orbiting (surrounding) the nucleus		1	4.4.1.2
	at different distances or in different energy levels / shells		1	
06.1	cosmic rays / rocks / construction materials / food and drink	1 mark for any one source	1	**AO1** 4.4.3.1
06.2	the radon gas enters the human body when a person breathes in.		1	**AO1** 4.4.2.1
	the alpha particles emitted (by the radon) produce a lot of ionisation (accept the short range of alphas means all are absorbed by the body)		1	
	which is very damaging to the cells / the body / human tissue		1	

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
06.3	number of times greater = 5.3		1	**AO3** 4.4.3.1
06.4	time for activity to fall by half e.g. from 2000 to 1000: 3.8 days second set of values, e.g. 1000 to 500: 7.6 – 3.8 = 3.8 days average = 3.8 days half-life = 3.8 (days)	1 mark for working shown on graph 1 mark for obtaining 2 or more values and taking an average 1 mark for correct half-life allow maximum of 1 mark for correct answer with no working shown	3	**AO3** 4.4.2.3
06.5	at least 4 half-lives would have to pass accept 14, 15 or 16 days	1 mark 1 mark Allow error carried forward from 06.4 for half-life value	2	**AO2** 4.4.2.3
06.6	$^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + {}^{4}_{2}He$	1 mark each for each correctly substituted number	2	**AO2** 4.4.2.2
07.1	National Grid		1	**AO1** 4.2.4.3
07.2	(potential difference) continually changes direction / reverses direction		1	**AO1** 4.2.3.1
07.3	a person touching the casing could be electrocuted / current could pass through them (to earth)		1 1	**AO1** 4.2.3.2
07.4	earth (wire)	allow 'green and yellow striped one' or wtte	1	**AO1** 4.2.3.2
07.5	($P = V\ I$) $920 = 230 \times I$ $I = \frac{920}{230}$ current = 4.0 (A) (accept 4)	1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer correct answer with no working shown = 3 marks	3	**AO2** 4.2.4.1
08.1	($V = I\ R$) $3.0 = I \times 100$ $I = \frac{3.0}{100}$ current = 0.030 (A) (accept 0.03)	1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer correct answer with no working shown = 3 marks	3	**AO2** 4.2.1.3
08.2	5 mins = 300 s ($Q = I\ t$) $Q = 0.030 \times 300$ charge = 9.0 (C) (accept 9)	1 mark for correct unit conversion 1 mark for substitution into correct equation 1 mark for evaluation correct answer with no working shown = 3 marks	3	**AO2** 4.2.1.2
08.3	(energy transferred = $Q\ V$) energy transferred = 9.0×3.0 energy transferred = 27 (J)	1 mark for substitution into correct equation 1 mark for answer correct answer with no working shown = 2 marks	2	**AO2** 4.2.4.2
08.4	The potential difference across each bulb has the same value. The bulbs are connected in parallel.	1 mark for each correct statement ticked maximum 2 boxes ticked	2	**AO1** 4.2.2
08.5	The bulbs are connected in series. The current through each bulb has the same value.	1 mark for each correct statement ticked maximum 2 boxes ticked	2	**AO1** 4.2.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
09.1	**Level 3:** Coherent and detailed account that could be followed to generate data from which a valid comparison of the insulating materials can be made. Reference made to variables that must be the same for each material tested.	5–6	6	**AO2** 4.1.2.1
	Level 2: Following the account would enable data to be produced that could enable a comparison of the thermal properties of the materials to be made although the account may lack detail.	3–4		
	Level 1: Some relevant content but may not generate data which would enable a fair comparison of the materials. There may be no indication of how to use equipment, control variables or use measurements.	1–2		
	No relevant content	0		
	Indicative content: • pack the material to be tested in the space between the two beakers • the gap between the beaker is constant so the thickness of material is the same for all the materials tested • pour a specific volume of hot water into the inner beaker • put the lid on the beaker • use a stop clock to measure the time for the temperature to drop by a specific amount e.g. 80°C to 60°C • repeat for each material using the same volume of water and the same temperature drop • both the volume of water and the specific temperature drop must be the same for each material tested • compare the time measurements • the material which took the longest time for its temperature to drop by the specified amount is the best insulator			
09.2	cotton wool		1	**AO3** 4.1.2.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
09.3	either: the energy / rate of energy conducted is inversely proportional to thickness or: doubling the wall thickness halves the transfer of (thermal) energy / halves the rate of transfer data quoted from two points on the graph where one point corresponds to double the thickness of the other, to support the conclusion above	1 mark for either statement 1 mark each for the two suitable data sets	1 2	**AO3** 4.1.2.1
10.1	random / haphazard/in all directions		1	**AO1** 4.3.3.1
10.2	(air) molecules collide with the wall		1	**AO1** 4.3.3.1
10.3	air molecules move faster either: molecules exert a larger force (on the walls of the container) or: molecules hit walls more frequently	1 mark 1 mark for either statement	2	**AO1** 4.3.3.1
10.4	$p_1V_1 = p_2V_2$ $1.0 \times 10^5 \times 2.4 \times 10^{-3} = p \times 3.2 \times 10^{-3}$ $p = \frac{1.0 \times 10^5 \times 2.4 \times 10^{-3}}{3.2 \times 10^{-3}}$ new gas pressure = 7.5×10^4 (Pa)	1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer correct answer with no working shown = 3 marks	3	**AO2** 4.3.3.2
10.5				**AO2** 4.1.2.2

Quantity	Increases	Decreases	Doesn't change	
Internal energy of the molecules	✓			1
Average molecule speed	✓			1
Average separation of the molecules		✓		1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
11.1	gravitational potential energy = 100 × 10 × 10 = 10 000 (J) 50% of g.p.e. becomes kinetic energy $5000 = \frac{1}{2} \times 100 \times v^2$ speed = $\sqrt{\frac{2 \times 5000}{100}}$ speed = 10 m/s	1 mark for substitution into correct equation 1 mark for calculation of g.p.e. 1 mark for substitution into correct equation for k.e. 1 mark for rearranging for speed 1 mark for answer correct answer with no working shown = 5 marks	5	**AO2** 4.1.1.2

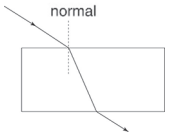
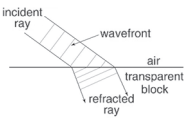
Paper 2

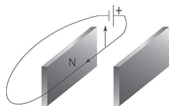
Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	either: oscillations are parallel to the direction the wave travels or: has areas of compression and rarefaction	1 mark for either statement	1	**AO1** 4.6.1.1
01.2	sound travels at different speeds through different materials sound travels faster through liquids than gases sound travels faster through solids than liquids	Accept any other conclusion consistent with the data. maximum 3 marks	1 1 1	**AO3** 4.6.1.4
01.3	speed = frequency × wavelength	accept $v = f \lambda$	1	**AO1** 4.6.1.2
01.4	4000 = 500 × wavelength wavelength = $\frac{4000}{500}$ wavelength = 8 (m)	1 mark for substitution 1 mark for rearranging 1 mark for answer correct answer with no working shown = 3 marks	3	**AO2** 4.6.1.2
01.5	20 Hz to 20 kHz	only one box ticked	1	**AO1** 4.6.1.4
01.6	one of: medical imaging industrial imaging echo sounding	1 mark allow any other suitable application	1	**AO1** 4.6.1.5
02.1	The resultant force on a stationary object is zero. The resultant force on an object moving at a steady speed is zero.	1 mark each only two boxes ticked	2	**AO1** 4.5.6.2.1
02.2	rolling resistance is not affected by the speed of the cyclist. air resistance increases with speed the rate at which the air resistance increases with speed gets greater at higher speeds		1 1 1	**AO3** 4.5.6.2
02.3	rolling resistance = 2 N air resistance = 7.5 N (accept 7 to 8 N) total resistive force = 9.5 (N) (accept 9 to 10)	1 mark 1 mark 1 mark correct answer with no working shown = 3 marks	3	**AO2** 4.5.6.2
02.4	work done = force × distance moved (in line of action of force)	accept $W = F s$ or $W = F d$	1	**AO1** 4.5.2
02.5	work done = 9.5 × 200 work done = 1900 (accept 1800 to 2000) unit: accept either J or N m	1 mark for substitution 1 mark for answer correct answer with no working shown = 2 marks allow error carried forward from 02.3 1 mark for correct unit	2 1	**AO2** 4.5.2, 4.5.6.2.1 **AO1** 4.5.2
02.6	force = mass × acceleration	accept $F = ma$	1	**AO1** 4.5.6.2.2
02.7	$F = 70 \times 2$ resultant force = 140 (N)	1 mark for substitution 1 mark for answer correct answer with no working shown = 2 marks	2	**AO2** 4.5.6.2.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
03.1	**Level 2:** A clear method referring specifically to the apparatus shown that would obtain valid results. At least one reference to minimising errors needed to gain the maximum mark.	3–4	4	**AO2** 4.5.3
	Level 1: A basic method that would obtain an extension measurement is given but may not refer specifically to the apparatus shown.	1–2		
	No relevant content	0		
	Indicative content: • with no weight attached, the metre rule reading in line with the pointer is recorded • a standard / known weight is attached to the spring • the metre rule reading in line with the pointer is again recorded. • the extension is the difference between the two readings • to minimise errors: ◦ view the pointer from the same horizontal level ◦ take repeat readings and average			
03.2	extension is directly proportional to the (stretching) force either: spring is not stretched beyond its limit of proportionality or: spring is behaving elastically / not inelastically deformed	1 mark 1 mark for either statement Accept alternative wording	2	**AO3** 4.5.3
03.3	force = spring constant × extension	accept $F = k\,e$	1	**AO1** 4.5.3
03.4	correct data taken from graph to determine spring constant use of $F = k\,e$ $k = F/e$ k = 50 N/m	1 mark 1 mark for substitution 1 mark for rearrangement 1 mark for correct answer	4	**AO2** 4.5.3

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
04.1	(moment = force × distance) 18 = force × 3.0 force = $\frac{18}{3.0}$ force = 6.0 (N) (accept 6)	1 mark for substitution into correct equation 1 mark for rearranging and answer correct answer with no working 2 marks	2	**AO2** 4.5.4
04.2	(anticlockwise moment = clockwise moment) 400 × 0.40 = F × 1.7 force = 94 N	1 mark for substitution into correct equation 1 mark for answer correct answer with no working 2 marks additional 1 mark if correct answer given to 2 s.f.	2 1	**AO2** 4.5.4
05.1	(momentum = 60 × 10) momentum = 600 (kg m/s)	1 mark for the correct answer	1	**AO2** 4.5.7.1
05.2	(force = $\frac{\text{change of momentum}}{\text{time}}$) force = $\frac{(600 - 0)}{0.1}$ force = 6000 N	1 mark for substitution into correct equation 1 mark for answer correct answer with no working 2 marks allow error carried forward from 05.1	2	**AO2** 4.5.7.3
05.3	**Level 2:** Coherent explanation considering changes in impact time and the rate at which the momentum changes.	3–4	4	**AO1** 4.5.7.3
	Level 1: Some relevant statements but may not refer specifically to the rate at which momentum changes.	1–2		
	No relevant content	0		
	Indicative content: • at the point of impact the air bag automatically inflates • when the dummy hits the inflated air bag, the air bag starts to deflate • the air bag deflates as air / gas exits through a hole in the air bag • the effect of the air bag deflating is to bring the dummy to a stop in a longer time than the collision impact time (of 0.1 s)			

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
	• the dummy's momentum change has the same value whether the air bag is present or not • when the air bag is present, the dummy's momentum changes at a slower rate • impact force is equal to the rate of change of momentum • so the impact force is reduced			
06.1	pressure in a liquid increases with depth either: the force pushing the water out of the hole is greater the deeper the water or: there is a greater weight of water / liquid above the water nearer the bottom of the can	1 mark 1 mark for either statement accept other correct statement	2	**AO1** 4.5.5.1.2
06.2	(liquid pressure = $h \rho g$) water pressure = 1000 × 1030 × 9.8 water pressure = 1.0×10^7 (Pa)	1 mark for substitution into correct equation 1 mark for answer correct answer with no working = 2 marks additional 1 mark for answer given to 2 s.f. and in standard form	2 1	**AO2** 4.5.5.1.2
06.3	as height (above sea level) increases, atmospheric pressure decreases		1	**AO3** 4.5.5.2
06.4	no, the student's suggestion is incorrect justification: pressure and height data correctly selected for two different heights.	1 mark 2 marks	3	**AO3** 4.5.5.2
07.1	independent variable: angle of incidence dependent variable: angle of refraction control variable: material (of the transparent block) (or any other appropriate control variable)		1 1 1	**AO3** 4.6.2.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
07.2		1 mark for refracted ray and for emerging ray 1 mark for angles towards and away from normal correct in each case	2	**AO1** 4.6.2.2
07.3	both missing data points correctly plotted best fitting curve passing within ½ small square of each point	1 mark for both points correctly plotted to within ½ small square 1 mark	2	**AO2** 4.6.2.2
07.4	angle of refraction increases as the angle of incidence increases but not in direct proportion angle of refraction tends towards a limiting value (or any other conclusion consistent with the graph)		1 1	**AO3** 4.6.2.2
07.5		four wavefronts drawn parallel to each other in direction shown for 1 mark wavefronts equally spaced for 1 mark wavefronts closer together than incident wavefronts for 1 mark	3	**AO1** 4.6.2.2
07.6	(wavelength) decreases		1	**AO1** 4.6.2.2
07.7	(wave) speed decreases because $v = f\lambda$ shows that $v \propto \lambda$		1 1	**AO1** 4.6.2.2
08.1	move magnet downwards (or upwards) into the coil / cardboard tube move coil / cardboard tube downwards (or upwards) around / over the magnet		1 1	**AO1** 4.7.3.1
08.2	rotating the handle makes the coil move / rotate so the coil is moving relative to the magnetic field		1 1	**AO1** 4.7.3.2
08.3	positive and negative peaks / values of potential difference		1	**AO3** 4.7.3.2
08.4	0.5 (s)		1	**AO3** 4.7.3.2
08.5	2.0 (V) (accept 2)		1	**AO3** 4.7.3.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
08.6	maximum potential difference would be greater either: one cycle would take a smaller time / time between peaks would be smaller or: frequency would be greater	1 mark 1 mark	2	**AO1** 4.7.3.1 4.7.3.2
09.1	arrows on (at least two) field lines showing direction from left to right		1	**AO1** 4.7.1.2
09.2		1 mark for arrow upwards as shown	1	**AO2** 4.7.2.2
09.3	($F = B\ I\ l$) $F = 0.20 \times 3.2 \times 0.050$ force = 0.032 (N)	1 mark for substitution into correct equation 1 mark for answer correct answer with no working 2 marks	2	**AO2** 4.7.2.2
09.4	(magnetic) force on one side of the coil is up (magnetic) force on the other side of the coil is down creating a moment / turning effect	1 mark 1 mark 1 mark	3	**AO1** 4.7.2.3

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
10.1	**Level 3:** Coherent description of all major stages in the correct sequence. Similarity in initial stages up to main sequence highlighted with clear distinction between later stages. The response makes logical links between clearly identified relevant points.	5–6	6	**AO1** 4.8.1.1 4.8.1.2
	Level 2: Coherent description of all major stages. Some details may be missing.	3–4		
	Level 1: Simple, relevant statements are made. The response may fail to make logical links between the points raised.	1–2		
	No relevant content	0		
	Indicative content: • birth to main sequence same stages for all stars • all stars are born in gas / dust cloud • gravity compresses the gas/dust to form a protostar • protostar gets hotter • (nuclear) fusion of hydrogen starts • lots of energy is released • while there is plenty of hydrogen to fuse the star is stable and is classed as a main sequence star • main sequence phase ends when run out of fuel / hydrogen to fuse • a star like the Sun is a main sequence star for much longer than a much more massive star • a star like the Sun expands to becomes a red giant • a much more massive star expands much more to become a red supergiant • the red giant blows away outer layers leaving its core as a small white dwarf • the red supergiant undergoes a massive explosion called a supernova leaving its core as either a neutron star or a black hole • high mass stars end with huge explosions of their outer layers / supernovae, whereas smaller mass stars do not have supernovae • high mass stars go on to form black holes or neutron stars whereas low mass stars form white / black dwarfs			

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
11.1	gradient = $\frac{8}{10}$ acceleration = 0.8 (m/s^2)	1 mark for correct data taken from graph to determine gradient 1 mark for answer	2	**AO2** 4.5.6.1.5
11.2	indication that the student has interpreted the enclosed area as the distance travelled area = (5 × 8) + (8 × 10) distance travelled = 120 m average speed = $\frac{120}{20}$ average speed = 6.0 m/s (accept 6)	1 mark 1 mark for calculation of distance travelled 1 mark for substitution into $s = vt$ and rearranging 1 mark for calculation of average speed correct answer with no working shown = 4 marks	4	**AO2** 4.5.6.1.5