Collins

AQA

GCSE

PHYSICS

H

SET B – Higher Tier

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Answers

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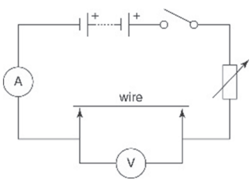
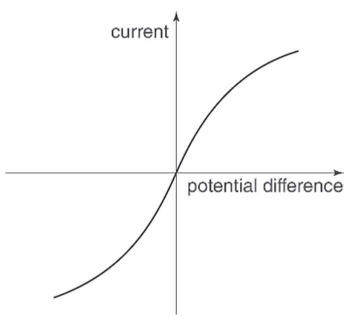
Paper 1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	**Level 2:** Coherent account detailing the difference and similarities of solids, liquids and gases. Both molecule motion and arrangement included.	3–4	4	**AO1** 4.3.1.1
	Level 1: Relevant comments comparing solids and liquids or liquids and gases but comparisons may not be made. Both molecule motion and arrangement for maximum mark.	1–2		
	No relevant content	0		
	Indicative content: Molecules in solid and liquid much closer than in gases Molecules in liquid (slightly) further apart than in solid Molecules in solid in a lattice / ordered arrangement In liquid, arrangement of molecules is less ordered Molecules in solid vibrate about a fixed position Molecules in solid are joined together Molecules in a liquid and gas move around, passing each other Molecules in a liquid and gas move randomly / in all directions			
01.2	Total kinetic energy and potential energy of all the atoms / molecules / particles in the material	1 mark for kinetic energy 1 mark for potential energy 1 mark for 'total' and/or 'all the atoms/ molecules'	3	**AO1** 4.3.2.1
01.3	The water temperature is increased The water is changed to steam at 100°C	Only two boxes ticked	1 1	**AO1** 4.3.2.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
02.1	**Level 2:** A coherent description of the steps required to demonstrate: – repulsion between like charges – attraction between unlike charges. For the maximum mark, the plan should include the initial step involving charging by friction	3–4	4	**AO2** 4.2.5.1
	Level 1: A clear description of steps that demonstrate: EITHER: repulsion between like charges OR attraction between unlike charges. For the maximum mark, the plan should include the initial step involving charging by friction	1–2		
	No relevant content	0		
	Indicative content: The rods can be charged by rubbing with a cloth Hold the charged rod close to the suspended rods A charged acetate rod repels a charged suspended acetate rod A charged polythene rod repels a charged suspended polythene rod A charged polythene rod attracts a charged suspended acetate rod A charged acetate rod attracts a charged suspended polyethene rod			
02.2	At least 4 radial field lines from the sphere's outer surface, evenly spaced Arrows on the radial lines point towards the sphere.		1 1	**AO1** 4.2.5.2
02.3	A repulsive force getting bigger	Only one box ticked	1	**AO1** 4.2.5.2
03.1	Light dependent resistor (accept LDR)		1	**AO1** 4.2.1.1
03.2	Total resistance = 500 (Ω)		1	**AO2** 4.2.2
03.3	Potential difference = current × resistance	Accept $V = I R$	1	**AO1** 4.2.1.3

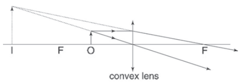
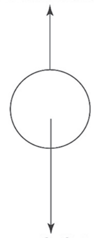
Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
03.4	$12 = I \times 500$ $I = \frac{12}{500}$ Ammeter reading = 0.024 (A)	1 mark for substitution 1 mark for rearranging 1 mark for answer Correct answer with no working shown = 3 marks Allow ecf from 03.2	3	**AO2** 4.2.1.3
03.5	Ammeter reading would decrease Because graph shows that circuit resistance increases in the dark		1 1	**AO1** 4.2.1.3 **AO3** 4.2.1.4
04.1	Ammeter in series with wire Variable resistor in correct position to enable the current through the wire to be changed. Voltmeter in correct position  	Allow ammeter and variable resistor to be in swapped places, or next to each other, as long as they are in series	1 1 1	**AO1** 4.2.1.4
04.2	Current is directly proportional to potential difference Yes (wire is an ohmic conductor)		1 1	**AO3** 4.2.1.4 **AO1** 4.2.1.4
04.3	Curve through origin as shown Negative section of line shown  		1 1	**AO1** 4.2.1.4
04.4	As the current increases, the filament gets hotter. Filament resistance increases as its temperature increases		1 1	**AO1** 4.2.1.4
05.1	Either: Alpha particles are not very penetrating Or: Alpha particles have low penetrating power And: Either: So alpha particles would not be able to pass out through the patient's body Or: So alpha particles could not be detected outside the patient's body	1 mark for either statement 1 mark for either statement	2	**AO1** 4.4.2.1 4.4.3.3
05.2	It allows sufficient time to conduct the investigation (before it has all decayed) Patient is not exposed to radiation for too long a time		1 1	**AO1** 4.4.3.3
05.3	Patient's body remains radioactive/ contaminated (for a significant period of time) Gamma (and beta) radiation will be emitted from the patient and could reach other people. This radiation could harm/would be a hazard to other people		1 1 1	**AO1** 4.4.3.3 4.4.2.4
06.1	($E_p = m\,g\,h$) $= 0.05 \times 10 \times 0.42$ Gain in gravitational potential energy = 0.21(J)	1 mark for substitution into correct equation 1 mark for answer Correct answer with no working shown = 2 marks	2	**AO2** 4.1.1.2
06.2	($E_k = \frac{1}{2} m v^2$) $E_k = \frac{1}{2} \times 0.05 \times 2.0^2$ $= 0.1$ J Kinetic energy (accept 0.1)	1 mark for substitution into correct equation 1 mark for answer Correct answer with no working shown = 2 marks	2	**AO2** 4.1.1.2
06.3	Energy is dissipated / transferred to the surroundings / as thermal energy / sound energy		1	**AO1** 4.1.2.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
07.1	Tangent drawn on curve at time 80s, working shows gradient data taken from the graph using a large triangle Gradient calculated Allow gradient in range 0.35 to 0.6 °C/s	1 mark for data extraction 1 mark for gradient in the range given	2	**AO2** 4.1.2.1
07.2	As the water gets hotter its temperature rise per second decreases. The gradient of the graph line decreases as the water temperature rises.		1 1	**AO3** 4.1.2.1
07.3	(The rate of dissipation of thermal energy to the surroundings) increases as the water temperature rises.		1	**AO3** 4.1.2.1
07.4	Polypropylene The lower the thermal conductivity, the lower the rate of energy transfer.		1 1	**AO3** 4.1.2.1 **AO1** 4.1.2.1
08.1	**Level 3:** A coherent plan covering all steps presented in a logical order detailing any additional apparatus used. The plan could be followed by another person to obtain a valid result for density. Reference made to minimising errors.	5–6	6	**AO2** 4.3.1.1
	Level 2: A clear plan covering all major experiment steps presented in a logical order detailing any additional apparatus used. The plan could be followed by another person to obtain valid results for the mass and volume of the pebble. At least one valid suggestion about reducing errors is made, with reasons.	3–4		
	Level 1: Some relevant statements but the plan could not be followed by another person to obtain valid results. There may be no indication of how to use equipment, use measurements or reduce errors.	1–2		
	No relevant content	0		
	Indicative content: Beaker and additional measuring cylinder required Fill the displacement can with water and allow the excess to drain into a beaker. Place the measuring cylinder under the spout of the displacement can. Lower the pebble into the can using the thread attached. Measure the volume of water in the measuring cylinder. The volume of displaced water is equal to the volume of the pebble. Repeat the process using a dry measuring cylinder of the same size. Calculate an average value for the volume of the pebble. Measure the mass of the (dry) pebble using a balance. Reference to avoiding systematic errors (e.g. reading the measuring cylinder at eye level or taking account of the meniscus, reason pebble is weighed while dry or ensuring the balance is zeroed) Calculate the density of the pebble using $\rho = \frac{m}{v}$			
08.2	Record the volume reading of the water in the measuring cylinder Lower the pebble into the measuring cylinder and record new volume Subtract the volume values to get the volume of the pebble		1 1 1	**AO2** 4.3.1.1
08.3	The size of each graduation in the larger measuring cylinder is bigger than for the smaller measuring cylinder So the volume measurement using the larger measuring cylinder would be less accurate than the method using the diplacement can.		1 1	**AO3** 4.3.1.1
09.1	At least one of the free neutrons is absorbed by another uranium nucleus causing the uranium nucleus to undergo fission releasing more neutrons which go on to cause more fission		1 1 1	**AO1** 4.4.4.1
09.2	Any number in the range 93–97 Any number in the range 135–139		1 1	**AO3** 4.4.4.1
09.3	38 protons 52 neutrons		1 1	**AO1** 4.4.1.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
09.4	$^{90}_{38}Sr \rightarrow ^{90}_{39}Y + ^{0}_{-1}e$	1 mark for both correct numbers for yttrium 1 mark for both correct numbers for the beta particle	2	**AO2** 4.4.2.2
09.5	$\frac{1}{16}$		1	**AO2** 4.4.2.3
09.6	Alpha particles (from the uranium) only travel a few cm in air/are not very penetrating Beta particles (from the fission fragments) can travel several metres in air/are more penetrating than alpha particles		1 1	**AO1** 4.4.2.1
09.7	Caesium-137 Krypton-85		1 1	**AO3** 4.4.3.2
10.1	Material regains its original properties if change is reversed		1	**AO1** 4.3.1.2
10.2	40 (°C)		1	**AO3** 4.3.2.3
10.3	10 (minutes)		1	**AO3** 4.3.2.3
10.4	Energy supplied by heater = 50 × 10 × 60 = 30 000 (J) 30 000 = 0.10 × L $L = \frac{30\,000}{0.10}$ Specific latent heat of fusion = 300 000 (J/kg)	1 mark for substitution into correct equation 1 mark for calculation of energy supplied Allow ecf from 10.3 1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer Allow ecf from calculation of energy supplied Correct answer with no working shown = 5 marks	5	**AO2** 4.1.1.4
10.5	Specific heat capacity in solid state is **larger** than in the liquid state Temperature rise in the solid state slower/lower rate than in the liquid state		1 1	**AO3** 4.3.2.2
11.1	($V = IR$) 9 = I × 15 $I = \frac{9}{15}$ Current ≈ 0.6 (A)	1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer Correct answer with no working shown = 3 marks Do not accept 0.60 A	3	**AO2** 4.2.1.3
11.2	Ammeter Y Its maximum current exceeds current in circuit Best (smallest) resolution in that current range / can measure smaller difference in current	If explanation is fully correct but ammeter chosen is wrong because of incorrect current calculated in 11.1, award 3 marks	1 1 1	**AO3** 4.2.1.3
11.3	(power = potential difference × current) P = 8.0 × 0.55 Power = 4.4 W (energy transferred = power × time) Energy supplied = 4.4 × 500 = 2200 J	1 mark for substitution into correct equation to calculate the power of the heater 1 mark for calculation of power 1 mark for substitution into correct equation to calculate energy supplied Correct answer with no working shown = 3 marks	3	**AO2** 4.2.4.1 and 4.2.4.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
11.4	$2200 = 0.50 \times c \times (30.1 - 20.1)$ $c = \dfrac{2200}{0.50 \times (30.1 - 20.1)}$ Specific heat capacity = 440	1 mark for substitution into correct equation 1 mark for rearranging 1 mark for answer Correct answer with no working shown = 3 marks Allow ecf from 11.3	3	**AO2** 4.1.1.3
	Unit: J/kg°C	1 mark for unit	1	**AO1** 4.1.1.3

Paper 2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
01.1	Refraction		1	**AO1** 4.6.2.2
01.2	Two rays with arrows passing through the lens as shown below.  Extrapolation of rays as dashed or dotted lines to show formation of an image (I) Image labelled (accept 'I' as the label)	1 mark for each ray 1 mark 1 mark	4	**AO1** 4.6.2.5
01.3	Can be either real or virtual Can be either upright or upside down	1 mark each No more than two boxes ticked	2	**AO1** 4.6.2.5
01.4	Always virtual Always upright	1 mark each No more than two boxes ticked	2	**AO1** 4.6.2.5
02.1	Weight (accept gravity) Normal contact force		1 1	**AO1** 4.5.1.3 4.5.1.2
02.2	C		1	**AO3** 4.5.6.1.5
02.3	B		1	**AO3** 4.5.6.1.5
02.4	Up and down arrows drawn, with down arrow larger than the up arrow Up arrow labelled air resistance Down arrow labelled weight (accept gravity) 	1 mark 1 mark 1 mark	3	**AO2** 4.5.1.4
02.5	Weight (accept gravity) Upthrust		1 1	**AO1** 4.5.1.3 4.5.5.1.2
03.1	Speed = $\dfrac{9.42 \times 10^{11}}{3.15 \times 10^{7}}$ Speed = 2.99×10^{4} m/s	1 mark for substitution and rearrangement of speed equation 1 mark for evaluation Correct answer with no working shown = 2 marks Additional 1 mark for correct answer given in standard form and to 3 sig figs	2 1	**AO2** 4.5.6.1.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
03.2	Number of times more massive = $\frac{10^{42}}{10^{30}} = 10^{12}$	1 mark for substitution 1 mark for answer Correct answer with no working shown = 2 marks	2	**AO2** 4.8.1.1
03.3	Red giant Massive expansion means the surface / outer layers of the Sun could reach / engulf the Earth		1 1	**AO1** 4.8.1.2
04.1	An increase in wavelength of the light (as a result) of the distant galaxy receding (moving away from us)		1 1	**AO1** 4.8.2
04.2	(in the previous model) the universe was thought to be static Observations suggested universe was expanding / everything in the universe was flying apart Observations led to the idea that the universe began from a small (hot and dense) region New model was needed: Big Bang (replaces old model)	1 mark each for any three correct statements	3	**AO1** 4.8.2
05.1	Radio waves		1	**AO1** 4.6.2.1
05.2	Visible light		1	**AO1** 4.6.2.1
05.3	ultraviolet		1	**AO1** 4.6.2.3
05.4	Infrared Microwaves (Either order)		1 1	**AO1** 4.6.2.4
05.5	X-rays are (mainly) absorbed by bony tissue X-rays (mainly) pass through soft tissue		1 1	**AO1** 4.6.2.4

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
05.6	($v = f\lambda$ $f = \frac{v}{\lambda}$) frequency = $\frac{3.0 \times 10^{8}}{2.0 \times 10^{-10}}$ Frequency = 1.5×10^{18} Unit: Hz	1 mark for rearrangement of and substitution into correct equation 1 mark for evaluation Correct answer with no working shown = 2 marks 1 mark for unit	2 1	**AO2** 4.6.1.2 **AO1** 4.6.1.2
05.7	(Figure 6.2 shows that) (electromagnetic) radiation of wavelength 0.1 m (10^{-1}m) is not absorbed by the Earth's atmosphere all of or 100% of (electromagnetic) radiation of wavelength 100 m (10^{2}m) is absorbed by the Earth's atmosphere	1 mark 1 mark	2	**AO3** 4.6.2.2
06.1	Intensity / power / energy radiated (per square cm) increases as the surface temperature increases Intensity / power radiated (per square cm) increases more quickly / at greater rate at higher temperatures	1 mark 1 mark Accept other conclusion consistent with the graph	2	**AO3** 4.6.3.1
06.2	**Level 2:** A coherent set of instructions that would result in a set of data that would enable the infrared emission rates from the different surfaces to be compared fairly. The need for the metal surface temperature as a control variable must have been considered	3–4	4	**AO2** 4.6.3.1 4.6.2.2
	Level 1: Some relevant content but may not be clear how to make a fair comparison of emission rates from the data generated	1–2		
	No relevant content	0		

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
	Indicative content: Position the infrared sensor at a specific distance from one of the container's surfaces Record an infrared sensor reading at a specific temperature (of the water in the container) Repeat the above steps with the infrared sensor pointing at each of the other three surfaces in turn checking the water temperature remains constant. Distance from sensor to container, and the temperature at which the meter reading is taken must be the same for all four vsurfaces			
06.3	Two of: Different surfaces emit different amounts of energy / infrared radiation in a given time (per square cm) A dull surface emits more energy / infrared radiation than a shiny surface of the same colour in a given time (per square cm) A dull metal / aluminium surface emits more infrared radiation than a polished metal / aluminium surface in a given time (per square cm) The dull black surface emits far more infrared radiation (per second, per square cm) / higher intensity of radiation than any other surface tested	Any two for 1 mark each	2	**AO3** 4.6.2.2
06.4	Two of: The infrared radiation (from the hot object) is made up of different wavelengths The amount of energy radiated varies with wavelength There is a continuous range of wavelengths emitted Most energy radiated at a small range of wavelengths	Any two for 1 mark each Accept other conclusion consistent with the graph	2	**AO3** 4.6.2.2
07.1	Two of: Distance, speed, mass, work, energy, time (Allow other answers)	1 mark each, maximum 2 marks	2	**AO1** 4.5.1.1 4.5.6.1.1
07.2	Increasing speed or accelerating Gradient is increasing		1 1	**AO3** 4.5.6.1.4
07.3	Attempt to determine gradient at time 3.0 s by drawing a tangent to the curve and forming large triangle Gradient calculated correctly giving speed in the range 6.9 to 7.6 (m/s)	1 mark 1 mark	2	**AO2** 4.5.6.1.4
07.4	average speed = $\frac{\text{total distance}}{\text{time}} = \frac{32}{5.0}$ average speed = 6.4 (m/s)	1 mark for substitution of data from graph into correct equation 1 mark for evaluation Correct answer with no working shown = 2 marks	2	**AO2** 4.5.6.1.2
08.1	Total momentum before (collision) = total momentum after Momentum of the van before the collision is equal to the momentum of the van and the car after the collision	1 mark for basic principle of momentum conservation But 2 marks for conservation of momentum described in the context of the event	2	**AO2** 4.5.7.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
08.2	(Momentum = *m v*) Momentum = 1000 × 5.0 = 5000	1 mark for substitution and evaluation of van's momentum before the collision	3	**AO2** 4.5.7.2
	5000 = (800 × 4.0) + (1000 × *v*)	1 mark for substitution into momentum conservation equation and rearranging		
	$v = \frac{5000 - 3200}{1000}$			
	Van's velocity immediately after collision = 1.8 m/s forwards	1 mark for evaluation and direction		
09.1	**Level 2:** Coherent, detailed description presented in a logical sequence leading to a current (or pd) being induced in the secondary coil. For the maximum mark the 'step-down' aspect must be described	3–4	4	**AO1** 4.7.3.4
	Level 1: Some relevant content but may not be presented in a logical sequence	1–2		
	No relevant content	0		
	Indicative content: A step-down transformer is used to reduce the potential difference In a step-down transformer, the secondary pd is smaller than the primary pd The current in the primary is a.c. The primary current induces/creates a magnetic field in the iron core. The magnetic field is changing The changing magnetic field induces a current (or pd) in the secondary coil			
09.2	$\frac{230}{12} = \frac{400}{\text{number of turns in sccondary coil}}$	1 mark for substitution into correct equation and rearranging	2	**AO2** 4.7.3.4
	Number of turns in secondary coil = 20.9 = 21 to nearest whole number	1 mark for evaluation Correct answer with no working shown = 2 marks Additional 1 mark for whole number	1	
09.3	($V_s \times I_s = V_p \times I_p$) $12 \times I_s = 230 \times 0.20$ $I_s = \frac{230 \times 0.20}{12}$	1 mark for substitution into correct equation and rearrangement	2	**AO2** 4.7.3.4
	Secondary current = 3.8 (A)	1 mark for evaluation Correct answer with no working shown = 2 marks Additional 1 mark for 2 significant figures	1	
10.1	Independent variable: Weight (attached to string)		1	**AO3** 4.5.6.2.2
	Dependent variable: acceleration		1	
	Control variable: mass (of glider) (accept same glider or same air track set up or any other appropriate control variable)		1	

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
10.2	speed = $\frac{\text{length of glider}}{\text{time to pass through first light gate}}$ speed = $\frac{0.12}{0.80}$ = 0.15 (m/s)	1 mark for correct equation 1 mark for substitution 1 mark for evaluation Correct answer with no working shown = 3 marks	3	**AO2** 4.5.6.1.2
10.3	speed = $\frac{\text{length of glider}}{\text{time to pass through second light gate}}$ speed = $\frac{0.12}{0.24}$ = 0.50 (m/s) (accept 0.5)	1 mark for substitution 1 mark for evaluation Correct answer with no working shown = 2 marks	2	**AO2** 4.5.6.1.2
10.4	acceleration = $\frac{(\text{final velocity})^2 - (\text{initial velocity})^2}{(2 \times \text{gate separation})}$ acceleration = $\frac{(0.50^2 - 0.15^2}{(2 \times 0.5)}$ = 0.2(3) m/s^2	1 mark for rearrangement of correctly chosen equation from Equation Sheet 1 mark for substitution 1 mark for evaluation Allow ecf from 10.2 and 10.3	3	**AO2** 4.5.6.1.5
10.5	(For the results to be as expected by the student) the graph should be a straight line passing through the origin Line misses the origin / has a non-zero y-intercept	1 mark 1 mark	2	**AO3** 4.5.6.2.2

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
11.1	**Level 3:** A coherent account explaining both thinking and braking distance with the effect of at least three factors considered for each	5–6	6	**AO1** 4.5.6.3.1 4.5.6.3.2 4.5.6.3.3
	Level 2: A clear account explaining both thinking and braking distance with the effect of two factors considered for each	3–4		
	Level 1: Some relevant comments but lacks detail	1–2		
	No relevant content	0		
	Indicative content: Thinking distance is the distance travelled by the car during the time that the driver is reacting to an emergency Braking distance is the distance travelled whilst the brakes are being applied Thinking distance + braking distance = stopping distance			
	Thinking distance can increase if the driver: • is tired or • has consumed drugs or alcohol or • is distracted by other people in the car or by other events going on outside the car Braking distance can be increased by: • the road surface, for example a wet or icy road, or • poor condition of the tyres or • poor condition of the brakes • the gradient of the road			
11.2	Both thinking distance and braking distance increase with speed Thinking distance increases steadily with speed But braking distance increases at an increasing rate with speed		1 1 1	**AO3** 4.5.6.3.1

Question	Answer(s)	Extra info	Mark(s)	AO/Spec ref.
11.3	Braking distance = 30 (m) (accept 29 to 31) ($W = F s$) 200 000 = $F \times 30$ Average braking force = 6667 (N) (accept 6500 to 6900)	1 mark for correct braking distance extracted from graph 1 mark for substitution into equation for work done 1 mark for evaluation	3	**AO2** 4.5.6.3.4 4.5.2