

Paper 2 (4PH1/2P)

Question number	Answer	Additional guidance	Mark
1(a)(i)	Acceleration = change in velocity ÷ time taken	allow in words or acceptable symbols	1

Question number	Answer	Additional guidance	Mark
1(a)(ii)	Process includes: <ul style="list-style-type: none"> • substitution • evaluation • unit e.g. acceleration = $46/0.20$ (1) acceleration = 230 (1) unit = m/s^2 (1)	mark independently	3

Question number	Answer	Additional guidance	Mark
1(b)(i)	Momentum = mass × velocity	allow in words or acceptable symbols e.g. $p = m \times v$	1

Question number	Answer	Additional guidance	Mark
1(b)(ii)	Process includes: <ul style="list-style-type: none"> • conversion of mass to kg • substitution • evaluation e.g. 0.057 kg seen anywhere (1) ($p =$) 0.057×46 (1) ($p =$) 2.6 (kg m/s)(1)	2622 gains 2 marks allow 2.622	3

Question number	Answer	Mark
1(c)	An explanation that makes reference to three of the following points: <ul style="list-style-type: none"> • increase impact time (1) • (for) same change of momentum (1) • reference to force = change of momentum/time (1) • reduces force (1) 	3

Total for Question 1 = 11 marks

Question number	Answer	Additional guidance	Mark
2(a)	Idea of friction (between particles)	allow rubbing	1

Question number	Answer	Additional guidance	Mark
2(b)	An explanation linking: <ul style="list-style-type: none"> electrons in the ground (1) are repelled from the surface layers (1) 	reject for one mark movement of positive charges	2

Question number	Answer	Additional guidance	Mark
2(c)(i)	To remove (or add) electrons from the outer shells/levels of an atom	allow turning (atoms) into ions	1

Question number	Answer	Additional guidance	Mark
2(c)(ii)	Charge = current \times time	allow in words or any rearranged form e.g. $Q = I \times t$	1

Question number	Answer	Additional guidance	Mark
2(c)(iii)	<ul style="list-style-type: none"> Rearrangement Substitution and evaluation $t = Q/I \text{ (1)}$ $= 15/32\,000$ $= 0.00047 \text{ (s) (1)}$	POT error = -1 award full marks for correct numerical answer without working	2

Question number	Answer	Additional guidance	Mark
2(c)(iv)	<p>Process includes:</p> <ul style="list-style-type: none"> • substitution of $V (= IR)$ into energy equation • substitution • rearrangement • evaluation <p>$E = QIR$ (1)</p> <p>$510 \times 10^6 = 15 \times 32 \times 10^3 \times R$ (1)</p> <p>$(R =) \frac{510 \times 10^6}{15 \times 32 \times 10^3}$ (1)</p> <p>1060 (Ω) (1)</p>	<p>allow calculation of V from $E = QV$ or $E = VIt$</p> <p>allow substitution into $V = IR$</p> <p>allow rearrangement of $V = IR$</p> <p>1062.5</p> <p>must see answer to at least 2 significant figures in order to determine that evaluation is correct</p> <p>some supporting working must be seen with correct answer to receive full marks</p>	4

Total for Question 2 = 11 marks

Question number	Answer	Additional guidance	Mark
3(a)(i)	<p>Advantage: any suitable (1) e.g.</p> <ul style="list-style-type: none"> • does not contribute to global warming • wind available in all parts of Earth • can be used on a large or small scale <p>Disadvantage: any suitable (1) e.g.</p> <ul style="list-style-type: none"> • noisy • visual pollution • harm to (migratory flocks of) birds 	ignore renewable as given in the stem	2

Question number	Answer	Additional guidance	Mark
3(a)(ii)	<p>A description that makes reference to the following three points:</p> <ul style="list-style-type: none"> • no output until 5 m/s (1) • linear increase of output from 5 m/s to 15 m/s (1) • output constant at 0.6 MW for speeds over 15 m/s (1) 	<p>data points must be referenced</p> <p>allow 1 mark for correct trend without any data references.</p>	3

Question number	Answer	Additional guidance	Mark
3(b)	<p>A description that includes reference to five of the following points:</p> <p>construction:</p> <ul style="list-style-type: none"> • soft iron core (1) • primary coils (1) • secondary coils (1) <p>operation:</p> <ul style="list-style-type: none"> • lower voltage applied to the primary coils/RA (1) • must be a.c. (1) • number of primary coils < secondary coils (1) • turns ratio of 220 (1) 	may be shown on a labelled diagram	5

Total for Question 3 = 10 marks

Question number	Answer	Mark
4(a)	<p>A description that makes reference to three of the following points.</p> <p>For a liquid:</p> <ul style="list-style-type: none"> molecules closely spaced (1) molecules slide over one another (1) <p>For a gas:</p> <ul style="list-style-type: none"> molecules spread out (1) molecules move with random motion (1) 	3

Question number	Answer	Additional guidance	Mark
4(b)(i)	<p>Process includes:</p> <ul style="list-style-type: none"> Conversion of time into seconds substitution into or rearrangement of $P = W/t$ Evaluation <p>e.g. time = 120 seconds (1) 2200 = $W/120$ (1) $W = 260\,000$ (joules) (1)</p>	<p>seen anywhere in working</p> <p>allow 264 000 answer of 4400 (joules) gains 2 marks max</p>	3

Question number	Answer	Additional guidance	Mark
4(b)(ii)	<p>Energy transferred = mass × specific heat capacity × change in temperature</p>	<p>equation can be given in words or symbols</p> <p>e.g. $\Delta Q = m \times c \times \Delta\theta$</p> <p>allow E for Q, T for θ</p>	1

Question number	Answer	Additional guidance	Mark
4(b)(iii)	Process includes: <ul style="list-style-type: none"> • rearrangement of equation (1) • substitution into correct equation (1) • evaluation of temperature difference (1) • calculation of final temperature (1) e.g. $264\,000 = 1.1 \times 4200 \times \Delta\theta$ (1) $\Delta\theta = \frac{264\,000}{1.1 \times 4200}$ (1) $(\Delta\theta =) 57\, (^{\circ}\text{C})$ (1) final temperature = $77\, (^{\circ}\text{C})$ (1)	allow ecf from (b)(i)	4

Question number	Answer	Additional guidance	Mark
4(c)(i)	Thermometer	allow temperature sensor AND data logger	1

Question number	Answer	Mark
4(c)(ii)	An explanation that makes reference to the following points: <ul style="list-style-type: none"> • actual temperature lower than calculated (1) • energy is lost to the surroundings not all the energy is transferred to the water (1) 	2

Total for Question 4 = 14 marks

Question number	Answer	Additional guidance	Mark
5(a)(i)	Number of metal discs	allow load	1

Question number	Answer	Additional guidance	Mark
5(a)(ii)	(Soft) iron is a magnetic material	easy to magnetise/demagnetise	1

Question number	Answer	Mark
5(b)(i)	<ul style="list-style-type: none"> Scale on the y-axis (1) Both axes labelled with variable and unit (1) Plotted (1) Bars drawn (1) 	4

Question number	Answer	Mark
5(b)(ii)	To support the weight of the (soft iron) bar (1)	1

Question number	Answer	Additional guidance	Mark
5(b)(iii)	<p>An explanation that makes reference to three of the following points:</p> <ul style="list-style-type: none"> repeat and average (1) repeat anomalous result (1) use intermediate weights e.g. 1, 3, 5, 7, 9 (1) extend the range of the results beyond 10 weights (1) use standard masses (1) 	however expressed	3

Total for Question 5 = 10 marks

Question number	Answer	Mark
6(a)(i)	B	1

Question number	Answer	Mark
6(a)(ii)	A	1

Question number	Answer	Mark
6(a)(iii)	A	1

Question number	Answer	Mark
6(a)(iv)	A	1

Question number	Answer	Additional guidance	Mark
6(b)	Any two suitable reasons: e.g. <ul style="list-style-type: none"> stars are made mostly of hydrogen (1) helium is formed during fusion (1) carbon is formed during fusion (1) hydrogen formed after Big Bang (1) 	do not allow both helium from fusion and carbon from fusion allow helium formed after Big Bang	2

Question number	Answer	Additional guidance	Mark
6(c)(i)	<ul style="list-style-type: none"> Determination of λ_0 AND λ (1) Determination of $\Delta\lambda$ (1) e.g. 760 nm, 655 nm $\Delta\lambda = 105$ (nm)	allow ± 5 nm	2

Question number	Answer	Additional guidance	Mark
6(c)(ii)	Rearrangement of equation $v = \frac{\Delta \lambda}{\lambda_0} \times c \quad (1)$ substitution with correct power for c $v = \frac{3 \times 10^5 \times 10^5}{655} \quad (1)$ evaluation $4.8 \times 10^4 \text{ (km/s)} \quad (1)$	allow ecf from (c)(i) if the answer is given in m/s, check that the power is 10^7 award full marks for correct numerical answer without working	3

Question number	Answer	Additional guidance	Mark
6(d)	An explanation that makes reference to the following three points: <ul style="list-style-type: none"> • RHS shows red shift (1) • LHS shows blue shift (1) • the galaxy is spinning (1) 	RHS moving away from the astronomer LHS moving towards the astronomer	3

Total for Question 6 = 14 marks

TOTAL FOR PAPER = 70 MARKS