

Paper 2 (4PH1/2P)

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

Total for Question 2 = 11 marks

Question number	Answer	Additional guidance	Mark
3(a)(i)	Advantage: any suitable (1) e.g. <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 Disadvantage: any suitable (1) e.g. <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)	A description that makes reference to the following three points: <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) 	data points must be referenced allow 1 mark for correct trend without any data references.	3

Question number	Answer	Additional guidance	Mark
3(b)	A description that includes reference to five of the following points: <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) $(\Delta\theta =) 57$ (°C) (1) final temperature = 77 (°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