

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	substitution (1) work done = 84×0.25 evaluation (1) 21(J)	Full marks for correct answer even if no working is evident	(2)

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	21 J	Ecf from (a)(i)	(1)

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	substitution (1) $KE = \frac{1}{2} \times 27 \times (2.3)^2$ evaluation (1) = 71.4 (which is approx 71)	$V=2.29$ gains two marks Reverse argument which shows that $V = \sqrt{5.3}$ gains two marks	(2)

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	B		(1)

Question Number	Indicative Content	Mark
QWC *)	<p>An explanation linking some of the following points</p> <ul style="list-style-type: none"> • kinetic energy varies during swing • kinetic energy maximum at bottom of swing • kinetic energy minimum at top of swing • gravitational potential energy(gpe) varies during swing • gpe maximum at top of swing • gpe minimum at bottom of swing • (continuous) interchange of KE and gpe • total amount of energy is constant during one swing • over a number of swings max KE and max PE decreases • energy is dissipated/'lost' to surroundings • because of air resistance / friction • amplitude/size of swings decrease (as energy 'lost' to surroundings) <p>ignore references to momentum</p>	(6)
Level	Mark	Descriptor
	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited explanation which states some facts e.g. (max) Kinetic energy decreases over time. KE will transfer to GPE. or • KE increases and decreases over one swing. The height which the swing reaches gets less over time. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple explanation with links between facts; either over one period of oscillation or over several periods of oscillations. Kinetic energy decreases as he gets higher and the GPE increases. There is a continuous interchange of KE and gpe as he swings. or • KE is gradually transferred to heat so swing rises to a slightly lower height each time. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> • a detailed explanation with links between facts over one period of oscillation and over several periods of oscillations e.g. kinetic energy is at a maximum at bottom of swing There is a continuous interchange of KE and gpe. KE (and gpe) reduce over a number of swings as energy is dissipated to the surroundings due to friction. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

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

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

Question number	Answer	Mark
2(b)(i)	substitution into correct equation (1) $= 1.9 \times 10.0 \times 9.0$ answer (1) 171 (J) (which is about 170 J) Answer must be shown to 3 significant figures	(2)

Question number	Answer	Additional guidance	Mark
2(b)(ii)	rearrangement (1) (useful energy transferred) = efficiency \times total energy supplied substitution (1) $= (70 \times 170) \div 100$ answer (1) 119 (J)	award full marks for correct numerical answer without working accept (useful energy transferred) $= 170 \times 0.7$ OR $= 171 \times 0.7$ accept alternative answer from 171 (J) i.e. 120 (J)	(3)

Question number	Answer	Mark
2(c)	B	(1)

Question number	Answer	Mark
2(d)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks):</p> <ul style="list-style-type: none"> • the coil contains wires which have a resistance (1) • and current in the wire is due to movement of electrons through (close-packed) lattice of positive ions (1) • hence collisions between electrons and ions in the lattice transfer energy from electrons to the lattice (causing the temperature of the wires/coil to rise) (1) 	(3)

Question number	Answer	Mark
3(a)	C	(1)

Question number	Answer	Mark
3(b)(i)	change in GPE = mass × gravitational field strength × change in vertical height	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	transformation (1) $h = \Delta E \div mg$ substitution (1) $h = 39\,000 \div (580 \times 10)$ evaluation (1) 6.7 (m)	accept use of $g = 9.81$ accept 6.72 accept 6.85 (from $g = 9.81$)	(3)

Question number	Answer	Additional guidance	Mark
3(c)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: <ul style="list-style-type: none"> work is done against friction (1) energy is stored in another specified way (1) 	ignore references to friction as energy store acceptable stores are: <ul style="list-style-type: none"> KE of water thermal energy of water thermal energy of air (G)PE of water 	(2)

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	D the spring has more elastic potential energy than the weight has kinetic energy		(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	<p>A description including three from</p> <p>MP1 Elastic potential energy /EPE (in stretched spring) (1)</p> <p>MP2 (EPE is) transferred to KE (initially) (1)</p> <p>MP3 change from KE to GPE or vice versa(1)</p> <p>MP4 (correct idea of) energy changes continuing</p> <p>MP5 {total mechanical energy /kinetic +potential energy} decreases (continuously) (1)</p> <p>MP6 (Eventually all is transferred to) {thermal/heat} (energy) (1)</p>	<p>care should be taken not to award marks for contradictory examples</p> <p>Starting point for description does not matter</p> <p>Ignore sound energy</p> <p>EPE becomes/goes to KE (initially)</p> <p>condone amplitude decreases to zero KE or PE 'lost' to surroundings</p>	(3)

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	B increase the efficiency of the motorcycle		(1)

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	<p>MP1 (bump produces) relative motion (1)</p> <p>MP2 (motion between magnet and coil) {induces / generates} voltage (1)</p>	<p>coil moves round magnet/magnet moves {into/out of} coil / coil {cuts / moves across} magnetic field</p> <p>ignore magnets slide inside a coil (see stem)</p> <p>electromagnetic induction</p> <p>condone {induces / generates }</p> <p>{current/electricity}</p> <p>ignore (see stem)</p> <p>electrical energy provides / produces</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(b)(iii)	<p>An explanation linking</p> <p>MP1 {more/frequent} bumps (1) (idea of shorter time / increased frequency)</p> <p>MP2 (bigger bumps produce) bigger amplitude / move more up and down (idea of bigger size) (1)</p> <p>MP3 (so) {induced voltage /voltage generated} is larger (1)</p>	<p>idea of up and down for bump (coil / magnets) move up and down {faster / more often}</p> <p>(coil/magnets) move {further/higher/bigger distance} (up and down)</p> <p>{induced current/current generated} is larger</p> <p>electromagnetic induction gives more voltage/current</p> <p>condone more electricity/electrical energy is {induced / generated}</p> <p>allow once for MP1 (if MP1 or MP2 is not scored): 'bumpier' 'go in and out more'</p>	(3)

(Total for Question 3 = 10 marks)