Question Number	Answer	Acceptable answers	Mark
1(a)(i)	substitution (1) work done = 84 x 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 = ½ x 27 x $(2.3)^2$ 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	*)	An explanation linking some of the following points • 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) ignore references to momentum	**(6)**
Level	**Mark**	**Descriptor**	
	0	No rewardable content	
1	**1 - 2**	• 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**	• 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**	• 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 × 10.0 × 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 × total energy supplied substitution (1) = (70 × 170)÷100 answer (1) 119 (J)	award full marks for correct numerical answer without working accept (useful energy transferred) = 170 × 0.7 OR = 171 × 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)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • 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: • work is done against friction (1) • energy is stored in another specified way (1)	ignore references to friction as energy store acceptable stores are: • 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)	A description including three from MP1 Elastic potential energy /EPE (in stretched spring) (1) MP2 (EPE is) transferred to KE (initially) (1) MP3 change from KE to GPE or vice versa(1) MP4 (correct idea of) energy changes continuing MP5 {total mechanical energy /kinetic +potential energy} decreases (continuously) (1) MP6 (Eventually all is transferred to) {thermal/heat} (energy) (1)	care should be taken not to award marks for contradictory examples Starting point for description does not matter Ignore sound energy EPE becomes/goes to KE (initially) condone amplitude decreases to zero KE or PE 'lost' to surroundings	**(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)	MP1 (bump produces) relative motion (1) MP2 (motion between magnet and coil) {induces / generates} voltage (1)	coil moves round magnet/magnet moves {into/out of} coil / coil {cuts / moves across} magnetic field ignore magnets slide inside a coil (see stem) electromagnetic induction condone {induces / generates } {current/electricity} ignore (see stem) electrical energy provides / produces	**(2)**

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

(Total for Question 3 = 10 marks)