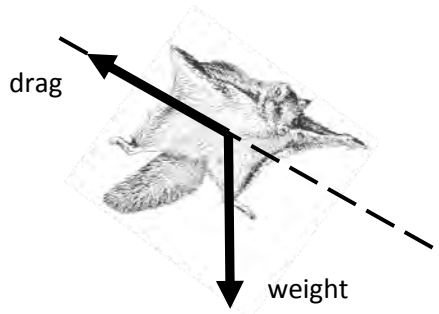
Question number	Answer	Notes	Marks
1 (a) (i)	Current that passes in one direction **only**;	ignore current varies	1
(ii)	Any three of - MP1 provides a connection / current to the coil/commutator; MP2 idea of reverses the current in the coil; MP3 Every half turn; MP4 Reverses (coil) field /polarity (every half turn); MP5 So that the force is always in the same direction; MP6 So that the motor keeps turning (the same way);	allow swops the contacts/ ensures that current always flows clockwise through the coil/eq so the moment is always in the same direction	3
(iii)	Any one of - Still spins clockwise; No (overall) effect/direction remains the same; The two changes cancel out/nothing changes;	Ignore “nothing happens” unless clear that rotation continues	1
(b) (i)	power = voltage × current;	Accept symbols P=I×V Condone a mix of correct symbols and words	1
(ii)	Substitution and calculation; Conversion to megawatts; e.g. P=I×V P= 4000 × 600 = 2 400 000 (W) = 2 400 000 ÷ 1 000 000 = 2.4 (MW)	division by 10^6 or 1 000 000 seen correct answer without working scores two marks	2

Continued

Question number	Answer	Notes	Marks
1 (c) (i)	work done = force × distance (moved)	Accept symbols W=F×d W =Fd	1
(ii)	Substitution; Calculation; e.g. Work = 400 000 × 190 76 000 000 (J)	Accept 76 MJ with correct unit 7.6×10^7 (J) 76×10^6 (J)	2
(d) (i)	Substitution into given equation; P = W/t Rearrangement; Calculation; e.g. 1.9 = 67 ÷ t……worth 1 t = 67 ÷ 1.9 ……worth 2 = 35 (s)…….worth 3	No mark for the equation as it is given in QP Substitution and rearrangement in either order Or (in joules and watts) 67 000 000 ÷ 1 900 000 (35.26) correct answer without working =3	3
(ii)	Any one of :- Takes longer /eq; More time needed to raise coal; Load moves more slowly;	Ignore: unqualified comments about the amount of work done	1

Total 15 marks

Question number	Answer	Notes	Marks
2 (a) (i)	gravitational potential energy = mass × g × height	Allow abbreviations e. g.p.e. = mgh for g/gravitational field strength reject 'gravity'	1
(ii)	Substitution into correct equation; Evaluation; e.g. g.p.e. = 0.19 × 10 × 17 = 32 (J)	32.3 (J) (or 31.6 J when g = 9.8 ms^{-2}) allow 32300 for 1 mark	2
(iii)	Value same as for (a)(ii)	Allow "the same"	1
(b) (i)	Judge by eye **Weight** shown acting downwards; Drag shown acting against motion;  	NB NO label = no mark Allow abbreviations for labels e.g W, mg ignore gravity	2
(ii)	k.e. = ½ × mass × $velocity^2$	Allow abbreviations e.g. k.e. = ½mv^2	1
(iii)	Substitution into correct equation; Evaluation; e.g. k.e. = ½ × 0.19 × 13^2 = 16 (J)	(16.055) 16055 gets 1 mark	2
(iv)	**A** an unbalanced force acts on the squirrel		1

Total 10 marks

Question number			Answer	Notes	Marks
3			any **six** points from the following 2 groups: **<u>Relating to energy and position</u>** MP1 statement re KE values e.g. KE is zero at top and bottom OR KE is greatest/4J in the middle; MP2 statement re GPE values e.g. GPE is greatest/25J at the top OR GPE is least/5J at the bottom; MP3 statement re EPE values e.g. EPE is greatest/21J at the bottom OR EPE is least/1J at the top; MP4 the change in GPE/EPE is 20J OR the change in KE is 4J; MP5 change in GPE/EPE > change in KE; MP6 total energy is constant (in all three charts)/eq; **<u>Relating to speed and position</u>** MP7 in the middle speed is greatest; MP8 in the middle v = 2.8 (m/s); MP9 ball is stationary at the top/bottom;	 allow GPE decreases as the ball moves down allow EPE increases as the ball moves down allow ball moves through height of 2 metres	6

Total 6 marks

Question number	Answer	Notes	Marks
4 (a) (i)	can all be switched separately ; others stay alight when 1 bulb blows/eq;		2
(ii)	One of - to prevent overheating in the circuit / appliance/ wiring/ lamps; to switch off the circuit; to prevent current exceeding a certain value;	IGNORE live wire/plug	1
(iii)	(if or when) current exceeds stated value/current too high; the fuse (over heats and) melts; this breaks the circuit/stops the current/ turns the circuit off;	 allow “fuse blows” ignore burns ignore ‘stops the electricity’	3

Question number	Answer	Notes	Marks
4 (b) (i)	P= I x V ;	Allow • rearrangements • standard abbreviations • equation in words	1
(ii)	rearrangement; sub into equation; evaluation; e.g. I= P/V =250 /230 =1.1 (A)	rearrange and sub in either order allow a power of ten (POT) error for -1 1.09 (A)	3
(iii)	value 3 (A); fuse (value should only be) a little bigger than the current;	Allow ecf from bii	2
(iv)	In ANY order Any two from:- MP1. circuit breakers are resettable/eq; MP2. circuit breakers work instantly/ fuses do not work instantly; MP3. doesn't require earth wire; MP4. Circuit breakers are more sensitive;		2
(c)	D		1

(Total for Question 4 = 15 marks)

Question number	Answer	Notes	Marks
5 (a) (i)	work done = force × distance moved;	accept standard abbreviations rearrangements	(1)
(ii)	Substitution into correct equation; evaluation; e.g. = 23 X 0.34 7.8 (J)	allow a POT error for -1 7.82	(2)
(b)	determination of time for 1 movement/eq; substitution; evaluation; e.g. 15 times in 60 s = 4 s = $\frac{7.8}{4}$ 2.0 (W)	ecf from (aii) allow: calculation of total work done /60 allow 1 mark for correct use of 15 1.955, 2 (W) allow 1 mark only for 7.82/60 or 782/60	(3)

Total for Question 5 = 6 marks

Question number			Answer	Notes	Marks
6	(a)	(i)	power = voltage x current;	Accept rearrangements and symbols e.g. current = power ÷ voltage, P=IV, I=P/V ignore a triangle mnemonic an eqn in units	1
		(ii)	2.9 (A);	Accept 2.92 (A), 2.916 (A)	1
	(b)	(i)	Any **three** of : MP1. if current gets too high/exceeds 13A or a set value; MP2. fuse (wire) melts / breaks; MP3. breaking circuit / switching off; MP4. prevents cable over heating;	allow: fuse blows stops current /flow of electrons	3
		(ii)	any **one** of: MP1. cable can't be fully extended; MP2. limits the use of the extension cable; MP3. can't exceed 1200 W; MP4. can't reach 10.0 (A) / max working value/eq; **AND** (because otherwise) 5 A fuse will blow/ will cut the power;	allow RA ignore vague comments re energy or power being too much or too high	2
		(iii)	(to prevent) the cable overheating/OWTTE;		1

Total 8 marks