Question Number	Answer	Acceptable answers	Mark
1(a)	**light** → electrical → **chemical** energy energy energy (1) (1)	These answers must be in the correct order	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	350 (J)	400 – 50 (J)	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	Substitution 50 ÷ 400 (1) or $\frac{50 \times 100}{400}$ (%) Evaluation 13(%) (1)	 12.5(%), 0.125, 0.13 or 1/8 Give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	An explanation linking the following points: black (1) (because) (good) absorber (of thermal radiation) (1)	 {absorbs / takes in} heat radiation **ignore** references to: attract good emitter light dark / darker	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	an explanation linking any **three** of the following points: • (bag / water) absorbs {thermal energy / heat / radiation} (1) • (bag / water) {radiates / emits} {thermal energy / heat / radiation} (1) • more heat radiated at higher temperature (1) • input and output are balanced (at steady temperature) (1)	idea of energy input e.g. "sun heats the bag up" idea of energy output idea of more heat lost (to surroundings)at higher temperature "absorbing heat at same rate as radiating heat" (3) **ignore** (sun) light / rays	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	An explanation linking • 60 % of {total/electrical/input/output} energy (is used/transferred) (1) • into/is kinetic/useful energy (1) If no other marks scored accept: 60% (of the energy produced by the motor) is useful/40% is wasted for 1 mark	**Accept reverse argument ie** 40 % of {total/electrical/input/output} energy (is/transferred) into/lost as/thermal (heat)/waste energy	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	☒ **B** energy		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	substitution 20 x 15 (1) evaluation 300 (J) (1) If no other mark scored award 1 mark for correct transposition ie E= P x t Ignore any unit given by candidate	Power of 10 error maximum of 1 mark eg 300 000 (J) gains 1 mark Give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iv)	substitution 18 ÷ 24 (x 100) (1) evaluation 0.75 or 75% (1) Ignore any unit given by candidate	Power of 10 error maximum of 1 mark give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b	tion of energy		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)	energy transferred per second		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	substitution (1) 0.25 x 230 evaluation (1) 58 (W)	 accept 57 to 58, and 60 (W) give full marks for correct answer, no working	 **(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	A description including the following points • (rate) of flow (1) • (of) charge (1)	 per second/flows/flowing electrons/ions/coulombs/C IGNORE electricity/amps/A	 **(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	(current) it is reduced	gets smaller/ decreases/ slows down/ drops/ lower	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	conversion of watts to kilowatts (1) substitution (1) 0.0005 x 48 x 26 evaluation (1) 0.62(4)(p) Note: 0.0005 x 48 x 26 scores 2 (conversion and substitution marks)	This is a 'show that' so marks are only awarded if working is shown. For no conversion of power but otherwise correct, 0.5 x 48 x 26 (1) 624 (p) (1) Any other power of ten error in power or cost seen in substitution 1 mark maximum Answers with no working get zero marks.	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)(iii)	Any **one** of the following points • ideas of energy conservation (1) • ideas of **atmospheric** polluting effects (1) • ideas of possible dangers (1) • reduces life of parts (TV) (1)	wastes energy (if left on) RA (NOT wastes electricity) CO_2 / SO_2 production/global warming/acid rain/greenhouse gases fire hazards/overheating /safer(when off) Ignore ozone layer references	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	An explanation linking the following points • 15 % of power /energy (1) • is transferred usefully (1) **Accept reverse argument** • 85% of power / energy (1) • is wasted (1)	 15 W / 15 J/s / 15 J transferred as light converted into useful energy/ is not wasted	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	• two qualitative output labels (1) light (energy) and thermal /heat (energy) • a quantitative output label (1) 15 J for light/used /useful or on narrower arrow (of otherwise unlabelled Sankey diagram)	useful/used (energy) and wasted (e 85 J for heat/wasted or on broader arrow (of otherwise unlabelled Sankey diagram)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)	Any **two** of the following reasons • Energy, e.g. (low-energy lamps) are more efficient / waste less energy / produce less heat (1) • Economy, e.g. (low-energy lamps) use less <u>electrical</u> energy /cost less to run / have a lower power (rating) (1) • Environment, e.g. using (low-energy lamps) reduces CO_2 emissions / saves fossil fuel (1) • Practical, e.g. (low-energy lamps) last longer / need replacing less often / (can be) easier to obtain (1)	Accept reverse arguments Accept 'they' for low-energy lamps idea of Payback, e.g. (low-energy lamps) are (more) cost effective (over time) Ignore unqualified environment statements filament lamps (have been) banned (in some countries)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	An explanation linking these three points • energy gain is from power supply(1) • energy loss is by radiation(1) • the loss and the gain are equal /at the same rate(1)	energy (comes) from the mains / supplied with electrical energy thermal/heat energy emitted infrared emitted the loss and gain are in equilibrium allow the filament gains <u>and</u> losses energy for (1) only	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	B it decreases		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	C it does not change		**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (b)(i)	horizontal arrow (judge by eye), pointing to the right **anywhere** on the diagram 		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)(ii)	substitution: (1) 130 000 × 75 evaluation: (1) 9 750 000 (kgm/s) (Ns)	give full marks for correct answer, no working Ignore minus sign 9.75×10^6 (kgm/s) (Ns)	**(2)**

Question Number	Answer	Acceptable answers	Mark
5 (b)(iii)	9 750 000 kgm/s	same value as answer to (b)(ii) Ignore minus sign	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(c)(i)	An explanation linking two of the following: • force is smaller/less (1) • momentum changes more slowly (1) • lower deceleration (1) • use of the formula (1)	 pressure is smaller/less slower deceleration force is proportional to rate of change of momentum/F= (mv – mu)/t	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(c)(ii)	Any two from: (for loaded aircraft) • has more mass (1) • has more momentum (1) • has more k.e. (1) • higher velocity • brakes need to do more work (1)	accept reverse argument for empty aircraft heavier/more passengers/more cargo higher speed/moving faster	**(2) expert**

Total marks for question 4 = 10 marks