Question number	Answer	Notes	Marks
1	any six from: **discussion of conduction** MP1. metal spike conducts the thermal energy; MP2. thermal energy is conducted into middle of/inside the potato; **discussion of convection** MP3. convection (current) occurs; MP4. due to density of air decreasing / air expanding; MP5. potato receives hotter air near the top; **discussion of radiation** MP6. thermal energy is radiated/emitted from the black surface; MP7. potato absorbs thermal energy from all sides; **general** MP8. electrical energy is transferred into thermal energy in the heating element; total marks = 6	allow 'heat' for thermal energy throughout metal is a good conductor (of thermal energy) allow potato is heated / cooked from the inside ignore references to absorption at walls allow potato is heated / cooked from the outside	6

Question number	Answer	Notes	Marks
2 (a) (i)	C – a fuse		1
(ii)	Idea of independent switching for lamps / rooms;	Allow idea of one bulb blowing but not affecting others idea that bulbs in parallel are bright(er than in series)	1
(b)	MP1. Idea of current changing **direction**; MP2. Continuously;	vary is not enough Allow + and – current Can be shown as a diagram /graph (assume axes labels) Minimum requirement: MP1 shows both + and - (e.g. approximate sine curve) MP2 more than one cycle	2
(c) (i)	Conversion to seconds; Substitution in correct formula; Evaluation; e.g. t = 7 × 3600 (= 25200 s) E = 0.12 × 230 × 7 × 3600 700 000(J)	Allow 3600 or 25200 seen anywhere in working (695520) Correct answer without working scores full marks Accept alternative matching unit e.g. 696 kJ 11592 = 2 marks (time in mins) 193.2 = 2 marks (time in hours) Answer in Wh or Wmin with <u>matching</u> unit scores full marks.	3
(ii)	**B** - same as - less than		1

Total 8 marks

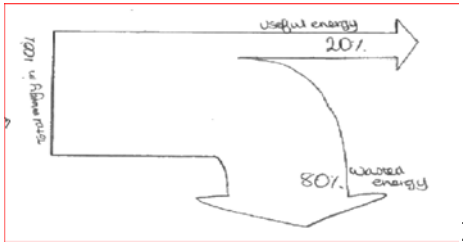
Question number	Answer	Notes	Marks
3 (a)	any 2 of: MP1. so that lamps work independently; MP2. so that they all get mains/same voltage/230V; MP3. so that different areas/rooms can have different brightness/power/light intensities of lamps;	 so that can light some rooms without all being on or off/each lamp has its own switch/if 1 lamp blows the others will still work allow no reduction in light output for main voltage allow different currents	2
(b)	D 1.38 A;		1
(c)	any 3 of: MP1. **current** increases over max value of fuse; MP2. fuse wire melts; MP3. cuts off current; MP4. prevents wire(s) in circuit from overheating;	 allow **current** gets too high blows/breaks breaks circuit ignore 'stops electricity' ignore electric shocks	3
(d) (i)	power = voltage x current	allow in standard symbols or in words	1
(ii)	substitution into correct equation; evaluation; e. 0.26 X 230 60 (W)	allow 240 V for mains but not incorrect current (62.4 W) allow 59.8 (W) condone 317(.4) (W) for 1 mark	2
(iii)	answer from (d)(ii) x **180** ; evaluation; unit; e. 60 X 180 11000 joules/J	accept correct use of E = V x I x t allow ecf from (d)(ii) mark independently allow 10800, 10764	3

<table>
<tr><td>3 (e) (i)</td><td><table><tr><th>S_1 position</th><th>S_2 position</th><th>lamp is lit</th></tr><tr><td>W</td><td>X</td><td>(yes)✓</td></tr><tr><td>W</td><td>Y</td><td>(no) ×</td></tr><tr><td>Z</td><td>X</td><td>(no) ×</td></tr><tr><td>Z</td><td>Y</td><td>(yes)✓</td></tr></table>any three correct;
all 4 correct;;</td><td>allow 1 mark when middle two rows blank, but otherwise correct

allow 1 mark when top and bottom rows blank but otherwise correct</td><td>2</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>(ii)</td><td>any sensible suggestion of 2 way switching;
e.
on a corridor
on stairs
basement/cellar
bedroom/kitchen light
room with 2 doorways</td><td>allow clear description of 2 switches controlling the same light</td><td>1</td></tr>
</table>

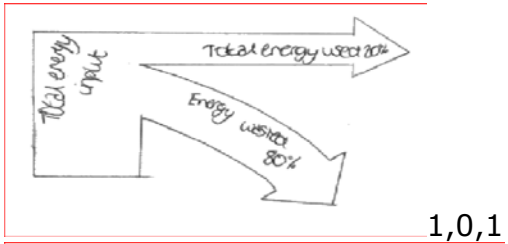
Total 15 marks

Question number	Answer	Notes	Marks
4 a i	B kettle		1
ii	A food mixer		1
b	any one from MP1 total energy always has the same value; MP2 energy cannot be created or destroyed; MP3 energy input = energy output ;	Allow student speak with two distinct ideas on energy e.g. none is lost or gained none is lost just transferred	1
c i	Both of: MP1 . is 20% of the energy input ; MP2 . (20%) is transferred usefully / as light; **OR both of:** MP3 . 80% of the energy input ; MP4 . (80%) is wasted / transferred as heat;	allow energy used for energy input 20% (or 80%) is not enough for the mark, 'energy input' or 'energy used' must be mentioned allow for 1 mark, a definition of efficiency condone power for energy independent marks	1 1
ii	Sankey diagram giving – MP1. One input and ONLY two outputs; MP2. Roughly correct proportions; MP3. Two correct labels; e.g.	allow • output arrows in either direction • both output arrows in same direction • 2 from o input/electrical/total, o useful/light, o wasted/heat/thermal ignore % on labels sound	1 1 1

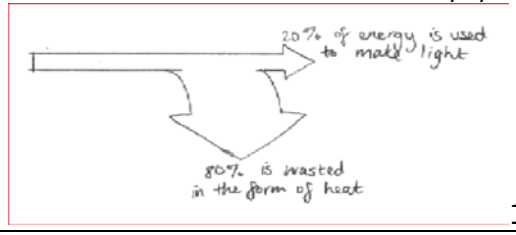


1,1,1

there must not be a size difference between input and outputs, even if the light is ~ 1/4 of heat
i.e. 100 units in and 100 units out



1,0,1



1,0,1

(Total for Question 4 = 8 marks)

Question number	Answer	Notes	Marks
5 a	(surface) area;		1
b i	Any one from: volume of water; timing period;	Ignore conditions of the room	1 1
ii	any TWO from: MP1. (this variable) would affect heat loss; MP2. so wouldn't know which factor/variable mattered ; MP3. otherwise not fair test /results would not be valid / results would not be reliable;	allow description of how the variable would affect heat loss	1
c	ANY SUITABLE e.g. • care with hot water • container not near edge of table/bench • do experiment while standing	allow • gloves • goggles	1
d i	31 40 28 25 ALL FOUR CORRECT = 2 -1 each mistake Minimum score = 0		2 1

ii	MP1. temperature (difference); MP2. (surface) area or time; MP3. relevant units on both;	X and Y unimportant	1 1
iii	Any TWO from: MP1. use water that is at the same starting temp; MP2. Pour in and wait until that temperature is reached before timing; MP3. method to ensure small time gap between pouring water and starting; MP4. put (same volumes into) containers in a water bath;	Accept sensible alternative workable method(s), allow two different methods e.g. do one at a time use other people to help	2

(Total for Question 5 = 12 marks)

Question number	Answer	Notes	Marks
6 a	a moon orbits a <u>planet</u>; a planet orbits a star (/the Sun) ;	Ignore • comments about eccentricity, oval, plane of orbit, time of orbit etc	1 1
b	Substitution; Evaluation; Unit (to **match** the value of v); e.g. $V = \frac{(2 \times \pi \times 385000)}{27} = \frac{2\ 417\ 800}{27}$ 90 000 km/day	Note value of π used may vary time values and corresponding approximate speeds are 27 days…….. 89 600 km/days 648 hours…….. 3 731 km/ hours 38 880 mins……. 62 km/min 2 332 800 s…… 1.04 km/s allow answers which round to 89 600 Accept suitable **matching** units	1 1 1
c i	$E=1/2\ mv^2$;	Accept • rearranged equation • equation in words	1
ii	substitution ; Mass converted to kg ; 47.(33…..) seen;	allow sub of mass as 50 g 1.496 or 1.5 seen gets 2 marks	3
d i	44(J) ;		1
ii	GPE = mgh;	Accept • rearranged equation • equation using (all the) words Allow for 'g' • gravitational field strength but NOT gravity	1

iii	Substitution and rearrangement; Calculation ; $\frac{12}{0.05 \times 1.6}$ 150 (m)	POT error loses 1 mark e.g. 0.15 (m) gets 1 mark	2
e	any Two from: • Value of g lower(on the Moon)/RA; • lack of air resistance (on the Moon)/RA; • Time of flight greater;	ignore • 'no gravity' allow • less gravity • drag for air resistance	2

(Total for Question 6 = 15 marks)