

The transfer of energy by heating processes

Mark scheme

1. (a) (i) silvered surfaces 1  
*more than the correct number of ticks in a row negates the mark*  
 radiation 1  
 plastic cap  
 conduction, convection (both required)

	conduction	convection	radiation
vacuum	✓	✓	
silvered surfaces			✓
plastic cap	✓	✓	

(1)

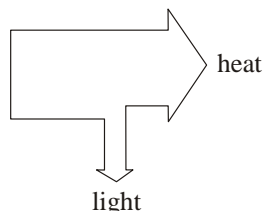
(1)

- (ii) any mention of air or any other substance in a vacuum scores zero  
 because there are no particles in a vacuum 1  
*accept atoms / molecules for particles*  
*accept vacuum is empty space*  
*accept there is nothing in a vacuum*  
*accept there is no air / gas in the vacuum*  
 conduction **and** convection need particles / medium  
*need reference to both conduction **and** convection*  
*accept correct descriptions*

- (b) (i) less heat lost (to air above the heater) 1  
*do **not** accept **no** heat lost*  
 light shiny surfaces are poor emitters (of radiation) 1  
*accept radiators for emitters*  
*references to reflection are neutral*

**or** dull, matt surfaces are good emitters (of radiation)  
*do **not** credit answers which infer reflection from the underside of the hood*  
*ignore correct reference to absorption*

- (ii) correct diagram drawn with one output arrow narrower than the other 1  
*ignore input*  
 arrows correctly labelled with energy form, eg 1



*flow charts score zero*

- (iii) energy cannot be destroyed 1  
*accept (principle of) conservation of energy*  
*do **not** accept because energy cannot be lost without clarification*

[9]

2. (a) (i) as a source of thermal radiation 1  
*accept heat for thermal radiation*  
*accept to act as the Sun*  
*do **not** accept sunlight alone*
- (ii) any **one** from: 1  
  - volume of water *accept amount for volume*
  - distance between lamp and boiling tube
  - initial / starting temperature of water
  - same room temperature*do **not** accept time or same insulation material*
- (iii) any **one** from: 1  
  - greater sensitivity / precision  
*do **not** accept more reliable (negates mark)*
  - could link to a computer for (automatic) data analysis
  - could take more frequent readings
  - reduces instrument reading error  
*accept more accurate*  
*do **not** accept easier to use on its own*
- (b) (i) acts as a control 1  
*accept to be able to make a comparison*  
*accept to see the difference*  
*do **not** accept 'to make it a fair test' OWTTE on its own*
- (ii) (plastic) foam and aluminium foil 1
- (iii) (aluminium) foil is a poor absorber of thermal radiation 1  
*accept heat / infra red for thermal radiation*  
**or** (aluminium) foil is a (good) reflector of thermal radiation  
*do **not** accept 'reflects sunlight' on its own*
- (plastic) foam traps air which is a (good) insulator 1  
*accept (plastic) foam is a poor conductor / (good) insulator*  
*do **not** accept 'the material' is a good insulator / poor conductor*
- (c) particles vibrate with a bigger /stronger amplitude / faster /  
with more (kinetic) energy 1  
*accept particles vibrate more*  
*do **not** accept start to vibrate only*
- energy transferred by collisions with other particles 1  
*do **not** accept answers in terms of free/mobile electrons*

[9]

3. (a) conduction *do not accept conductor* 1
- (b) the freezer *both parts needed*  
greater temperature difference (between freezer and room) 1  
*do not accept because it is the coldest*
- (c) any **two** from: 2
- poor absorber of heat / radiation  
*accept does not absorb heat poor emitter of heat / radiation is neutral*
  - reflects heat / radiation (from room away from fridge-freezer)
  - reduces heat transfer into the fridge-freezer
  - reduces power consumption of fridge-freezer  
*do not accept it is a bad conductor / good insulator*
- [4]
4. (a) (i) radiation **or** infra red 1  
*do not accept rays*  
*do not accept waves*  
*accept electromagnetic waves*
- (ii) good absorber (of heat) 1  
to absorb heat (**or** infrared)  
*do not accept 'attract' or 'capture' or soak*
- (iii) reduce heat loss (from the panel) 1  
*accept (good) (heat) insulator*  
*accept stop or reduce conduction*  
*accept stop or reduce convection*  
*accept traps heat*  
*accept keeps water hot*
- (iv) to reflect (back into the panel) heat **or** infrared **or** Sun's energy 1  
*do not accept 'bouncing'*  
*do not accept reflect Sun*  
*do not accept reflect sunlight or sun's rays*
- radiated **or** given out by the (black) pipe 1  
*accept back to pipe*  
*accept reduce heat loss for 1 mark*  
*accept reduce heat loss by radiation for 2 marks*  
*accept stop heat loss by radiation for 1 mark*
- (b) any **two** points from: 2
- use of a renewable energy resource
  - conservation of fuels (**or** named fuel)
  - produces no (atmospheric)
  - pollution (**or** named pollutant)  
*accept any reference to reduced or stopped use of fuel*  
*do not accept 'fewer power stations' unless qualified*
- [7]

5.	<p>(a) convection                  air is heated by the burner / particles gain energy                  air expands / particles move about more / particles move faster                  air becomes less dense / particles are more spread out                  air rises / particles rise - <i>not</i> heat rises                  air from C moves into the heater / particles from C move into the heater to replace it / them  <i>any four for 1 mark each</i></p> <p>(b) (i) radiation  <i>for one mark</i></p> <p>(ii) black surface radiates / emits well                  (allow absorbs and emits well) (allow comparison with shiny /white surfaces)                  large surface area needed high temperature (of the lumps)  <i>any one for 1 mark</i></p>	<p>4</p> <p>1</p> <p>1</p>	[6]
6.	<p>(a) length of pipe                  diameter of the pipe                  time  <i>each for 1 mark</i></p> <p>(b) convected } from boiler to radiator                  by water }                  conducted through steel                  radiated through air  <i>each for 1 mark</i></p>	<p>3</p> <p>4</p>	[7]