

**M1.** (a) (i) to check rise in temperature (of other thermometers) was due to the (different wavelengths of) light  
*accept as a control / comparison*  
*to measure room temperature is insufficient*

1

(ii) any **two** from three:

- different colours produce different heating effects / (rises in) temperatures
- red light produces the greatest heating effect / (rise in) temperature

**or**

- violet produces the least heating effect / (rise in) temperature
- all colours produce a greater heating effect than outside the spectrum

*an answer*

*the longer the wavelength the greater the (rise in) temperature*

**or**

*the lower the frequency the greater the (rise in) temperature*  
*gains both marks*

2

(b) move a thermometer into the infrared region / just beyond the red light  
*allow use an infrared camera / infrared sensor*

1

the temperature increases beyond 24(°C)

*accept temperature higher than for the red light*

1

(c)  $v = f \times \lambda$

$9.4 \times 10^{-6}$

*accept  $9.375 \times 10^{-6}$  or  $9.38 \times 10^{-6}$*

**or**

0.0000094

*accept 0.000009375*

**or** 0.00000938

*allow 1 mark for correct substitution*

*ie  $3 \times 10^8 = 3.2 \times 10^{13} \times \lambda$*

2

- (d) at night the surroundings are cooler  
*accept at night the air is colder*  
*there is no heat from the Sun is insufficient*

**or**

at night there is a greater temperature difference between people and surroundings  
1

(so surroundings) emit less infrared (than in daytime)  
*accept camera detects a greater contrast*

**or**

gives larger difference in infrared emitted (between people and surroundings)  
1

[9]

- M2.** (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 - *not* heat rises  
air from C moves into the heater / particles from C move into the heater to  
replace it / them

*any four for 1 mark each*

4

- (b) (i) radiation  
*for one mark*

1

- (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)

*any one for 1 mark*

1

**[6]**

- M3.** (a) ions / electrons gain (kinetic) energy  
*accept atom / particles / molecules for ion*  
*accept ions vibrate faster*  
*accept ions vibrate with a bigger amplitude*  
*accept ions vibrate more*  
*do not accept ions move faster* 1
- (free) electrons transfer energy by collision with ions  
**or** energy transferred by collisions between vibrating ions 1
- (b) move faster or take up more space  
*do not accept start to move / vibrate* 1
- (warmer) water expands **or** becomes less dense (than cooler water)  
*do not accept answers in terms of particles expanding* 1
- warm water rises (through colder water) **or** colder water falls to take its place 1
- (c) transfer of energy by waves / infrared (radiation)  
*accept rays for waves*  
*do not accept transfer of energy by electromagnetic waves*  
*ignore reference to heat* 1

[6]

**M4.** (a) conduction

*do **not** accept conductor*

1

(b) the freezer

*both parts needed*

greater temperature difference (between freezer and room)

*do **not** accept because it is the coldest*

1

(c) any **two** from:

- 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*

2

[4]

**M5.** (i) *this mark only scores if a correct pair is chosen **and** a correct reason given*

**A and C**

*both required and none other*

**or B and D**

*both required and none other*

*only one (independent) variable **or** different shapes but the same colour  
accept only the shape changes*

1

(ii) **B radiates** heat faster

*converse answer in terms of **A** gains full marks*

1

**or B** is a better emitter (of heat)

but B has a smaller (surface) area **or** B has a smaller (surface) area: volume ratio

*allow **2** marks for both lose the same quantity / amount of heat in the same time*

***or** both have same rate of heat loss*

*allow **1** mark for both lose the same quantity / amount of heat*

1

(iii) any **one** from:

- transfer a lot of heat (too rapidly)

- water temperature drops too rapidly

*accept (significantly) more heat will be lost from the first radiator*

- water too cold for the next radiator

*mention of absorption of heat negates mark*

1

[4]