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 <u>wavelength</u> the greater the (rise in) temperature

or

the lower the <u>frequency</u> 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) $v = f \times \lambda$

9.4×10^{-6}

accept 9.375×10^{-6} or 9.38×10^{-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 <u>radiates / emits</u> 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 <u>temperature</u> 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 <u>into</u> 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**

<u>both</u> required and none other

or **B** and **D**

<u>both</u> required and none other

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

accept only the shape changes

1

(ii) **B** <u>radiates</u> heat faster

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

1

or B is a better <u>emitter</u> (of heat)

but B has a smaller (surface) <u>area</u> **or** B has a smaller (surface) <u>area</u>: 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]