**M1.** (a) (i) conduction

**1**

convection

**1**

*correct order only*

(ii) to keep the ceramic bricks hot for a longer time

**1**

(b) (i) $E = P \times t$

18.2

*allow **1** mark for correct substitution ie 2.6 × 7 provided that no subsequent step is shown*

**2**

(ii) 91 (p)
**or** their (b)(i) × 5 correctly calculated

*accept £0.91*

*do **not** accept 0.91 without £ sign*

**1**

(c) $E = m \times c \times \theta$

2 250 000

*allow **1** mark for correct substitution ie 120 × 750 × 25 provided that no subsequent step is shown*

*answers 2250 kJ or 2.25 MJ gain both marks*

**2**

**[8]**

**M2.** (a) (i) conduction

**1**

(ii) atoms gain (kinetic) energy

*accept particles / molecules for atoms*

*do **not** accept electrons for atoms*

**or** atoms vibrate with a bigger amplitude

*accept vibrate faster / more*

*do **not** accept start to vibrate*

**or**

atoms collide with neighbouring atoms

**1**

transferring energy to (neighbouring / other) atoms

*do **not** accept heat for energy*

**or**

making these other atoms vibrate with a bigger amplitude

*accept faster / more for bigger amplitude*

*mention of (free) electrons moving and passing on energy negates this mark*

**1**

(b) (i) 5 (°C) to 25 (°C)

*either order*

**1**

(ii) a correct example of doubling temperature difference doubling heat transfer

eg going from 5 to 10 (°C) difference doubles heat transfer from 30 to 60 (J/s)

*accept for heat transfer number of joules / it*

*allow **1** mark for correctly reading 1 set of data eg at 5 °C the heat transfer is 30*

***or***

*for every 5°C increase in temperature difference heat transfer increases by 30 (J/s)*

*no credit for stating they are directly proportional*

**2**

(iii) 1800

*allow **1** mark for obtaining heat transfer value = 120*

**2**

(c) payback time calculated as 33 years

*calculations must be correct to score the first mark point*
*explanations must relate to it not being cost effective*

**1**

this is greater than lifetime of windows**or**total savings (over 30 years) = £4800 (1)

this is less than cost of windows (1)**or**

$\frac{5280}{30}$ = 176 (1)

this is more than the yearly savings (1)

**1**

**[10]**

**M3.** (a) (i) 20

**1**

(ii) convection

**1**

(iii) fit draughtproof strips

**1**

*accept lay carpet*
*accept fit curtains*
*accept close doors / windows / curtains*
*accept any reasonable suggestion for reducing a draught*
*'double glazing' alone is insufficient*

(b) air is (a good) insulator

**1**

**or** air is a poor conductor

*accept air cavity / 'it' for air*

reducing heat transfer by <u>conduction</u>

*accept stops for reduces*
*ignore convection*
*do **not** accept radiation*
*do **not** accept answers in terms of heat being trapped*

**1**

(c) (i) most cost effective

*accept it is cheaper or low<u>est</u> cost*
*accept shortest payback time*
*accept in terms of reducing heat loss by the largest amount*
*do **not** accept it is easier*
*ignore most heat is lost through the roof*

**1**

(ii) 4

**1**

**[7]**

**M4.** (a) conduction

*must be in correct order*

**1**

convection

**1**

(b) (i) 70

*accept ± half a square*
*(69.8 to 70.2)*

**1**

(ii) 15

*accept 14.6 to 15.4 for **2** marks*
*allow for **1** mark 70 − 55*
*ecf from (b)(i) ± half a square*

**2**

(iii) C

**1**

biggest drop in temperature during a given time

*accept it has the steepest gradient this is a dependent*

**1**

(iv) starting at 70 °C and below graph for C
must be a curve up to at least 8 minutes

**1**

(v) because 20 °C is room temperature

*accept same temperature as surroundings*

**1**

(c) (i) 6720

*correct answer with or without working gains **3** marks*
*6 720 000 gains **2** marks*
*correct substitution of E = 0.2 × 4200 × 8 gains **2** marks*
*correct substitution of E = 200 × 4200 × 8 gains **1** mark*

**3**

(ii) the fastest particles have enough energy
*accept molecules for particles*

**1**

to escape from the surface of the water

**1**

therefore the mean energy of the remaining particles decreases
*accept speed for energy*

**1**

the lower the mean energy of particles the lower the temperature (of the water)
*accept speed for energy*

**1**

**[16]**

**M5.** (a) (matt) black is a good emitter of infrared / radiation

*accept heat for infrared / radiationignore reference to good absorberattracts heat negates this marking point*

**1**

to give maximum (rate of) energy transfer (to surroundings)

*accept temperature (of coolant) falls fast(er)*

*accept black emits more radiation for **1** mark*

*black emits most radiation / black is the best emitter of radiation for **2** marks*

**1**

(b) the fins increase the surface area

*accept heat for energy*

**1**

so increasing the (rate of) energy transfer**or**so more fins greater (rate of) energy transfer

**1**

(c) 114 000

*allow **1** mark for correct temperature change, ie 15 (°C)*

***or***

*allow **2** marks for correct substitution, ie 2 × 3 800 × 15*

*answers of 851 200 **or** 737 200 gain **2** marks*

***or***

*substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark*

*an answer of 114 kJ gains **3** marks*

**3**

(d) increases the efficiency

**1**

less (input) energy is wasted

*accept some of the energy that would have been wasted is (usefully) used*

**or**

more (input) energy is usefully used

*accept heat for energy*

**1**

**[9]**

**M6.** (a) (i) 5(.0)

**1**

(ii) 35 **or** their (a)(i) × 7 correctly calculated

*allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

**2**

(iii) 525(p)**or**(£) 5.25**or**their (a)(ii) × 15 correctly calculated

*if unit p or £ given they must be consistent with the numerical answer*

**1**

(iv) decreases

**1**

temperature difference (between inside and outside) decreases

*accept gradient (of line) decreases*

*do **not** accept temperature (inside) decreases*

*do **not** accept graph goes down*

**1**

(b) air (bubbles are) trapped (in the foam)

*do **not** accept air traps heat*
*foam has air pockets is insufficient*

**1**

(and so the) air cannot circulate / move / form convection current

*air is a good insulator is insufficient*
*no convection current is insufficient*

*answers in terms of warm air from the room being trapped are incorrect and score no marks*

**1**

**[8]**