Particle Model Part 2

17 Questions

Name: _____

Class: _____

Date: _____

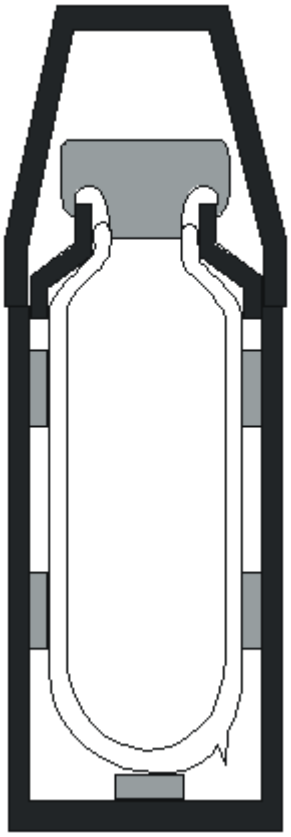
Time:

Marks:

Comments:

Q1.

The diagram below shows a vacuum flask.



(a) Give **two** features of the flask which reduce heat loss by conduction.

1. _____

2. _____

(2)

(b) Give **one** feature of the flask which reduces heat loss by radiation.

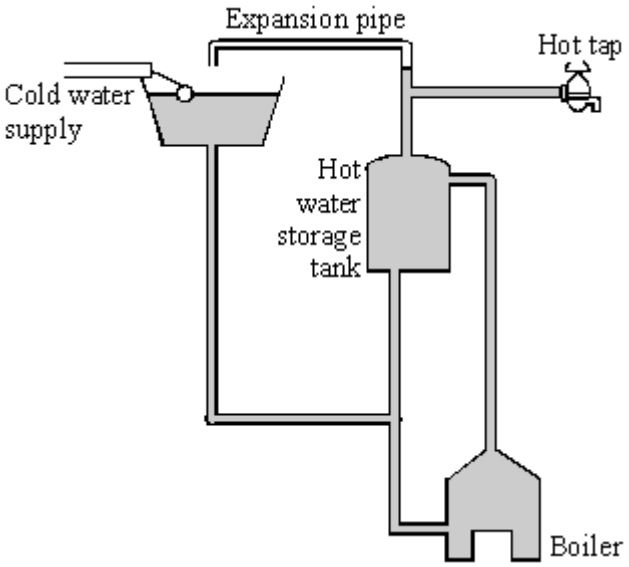
_____

(1)

(Total 3 marks)

Q2.

(a) The diagram shows a hot water system.



(i) Explain why the boiler is below the hot water tank.

_____

_____

_____

(ii) Why is heat energy transferred from hot water in the tank to the surrounding air?

_____

_____

(iii) Name the process by which energy is transferred through the sides of the tank.

_____

(iv) How may heat loss from the hot water tank be reduced?

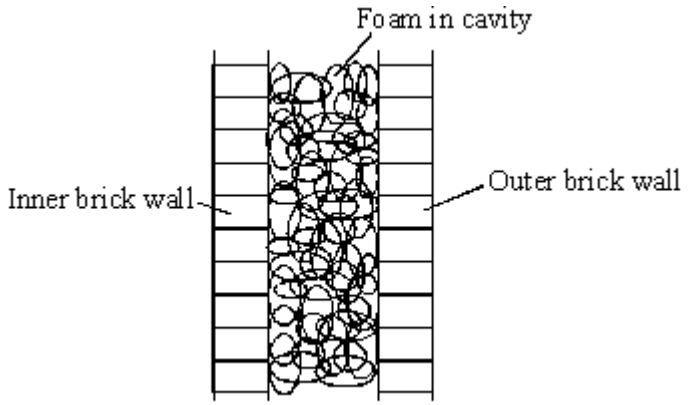
_____

_____

_____

(6)

(b) One way of reducing heat loss from a house is by cavity wall insulation. Foam is pumped between the inner and outer brick walls as shown in the diagram.



How is heat loss from a house reduced by:

(i) having a cavity wall?

_____

_____

_____

_____

(ii) filling the cavity with foam?

_____

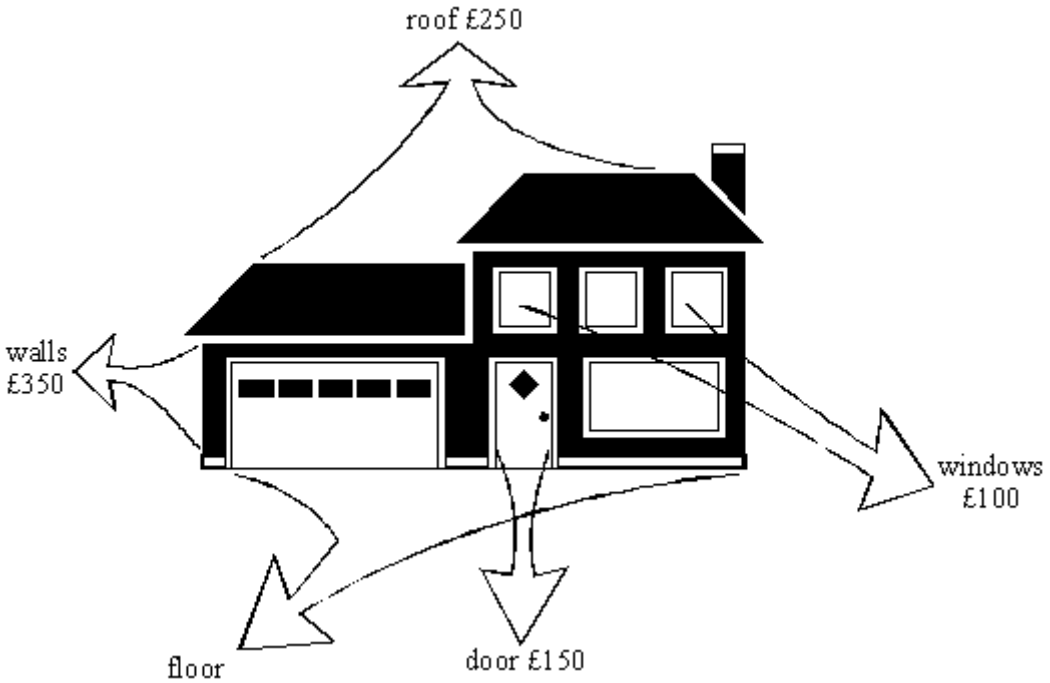
_____

(3)

(Total 9 marks)

Q3.

The diagram below shows a house which has **not** been insulated. The cost of the energy lost from different parts of the house during one year is shown on the diagram.



(a) The total cost of the energy lost during one year is £1000.

(i) What is the cost of the energy lost through the floor?

_____

(2)

(ii) Suggest one way of reducing this loss.

_____

(1)

(b) The table below shows how some parts of the house may be insulated to reduce energy losses. The cost of each method of insulation is also given.

WHERE LOST	COST OF ENERGY LOST PER YEAR (£)	METOD OF INSULATION	COST OF INSULATION (£)
roof	250	fibre-glass in loft	300
walls	350	foam filled cavity	800
windows	100	double glazing	4500
doors	150	draught proofing	5

(i) Which method of insulation would you install first? Explain why.

_____

_____

_____

_____

(3)

(ii) Which method of insulation would you install last? Explain why.

_____

_____

_____

_____

(3)

(Total 9 marks)

Q4.

The table gives information about some methods of conserving energy in a house.

Conservation method	**Installation cost in £**	**Annual saving on energy bills in £**

Cavity wall insulation	500	60
Hot water tank jacket	10	15
Loft insulation	110	60
Thermostatic radiator valves	75	20

(a) Explain which of the methods in the table is the most cost effective way of saving energy over a 10 year period. To obtain full marks you must support your answer with calculations.

_____

_____

_____

_____

(3)

(b) Describe what happens to the energy which is 'wasted' in a house.

_____

_____

_____

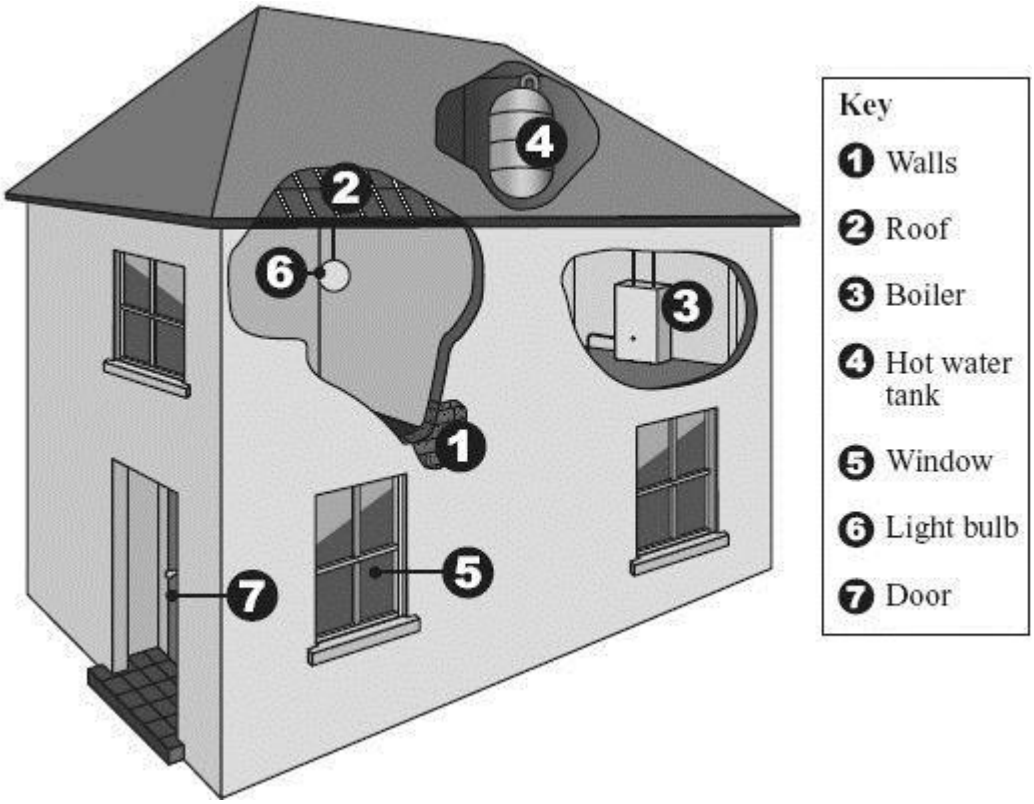
_____

(2)

(Total 5 marks)

Q5.

The drawing shows parts of a house where it is possible to reduce the amount of energy lost.



(a) Give **one** way in which the amount of energy lost can be reduced from each of the following parts of the house.

1, **2** and **4** _____

5 _____

7 _____

(3)

(b) Energy consumption can be reduced by using a more efficient boiler or more efficient light bulbs.

What is meant by a *more efficient* light bulb?

_____

_____

(1)

(Total 4 marks)

Q6.

People do a number of things to reduce the energy loss from their homes.

(a) Describe **one** thing they may do to cut down the energy loss through:

(i) the roof;

_____

(1)

(ii) the outside walls;

_____

(1)

(iii) the glass in the windows;

_____

(1)

(iv) gaps around the front and back doors.

_____

(1)

(b) A house is more difficult to keep warm in cold weather. What other type of weather makes it difficult to keep a house warm?

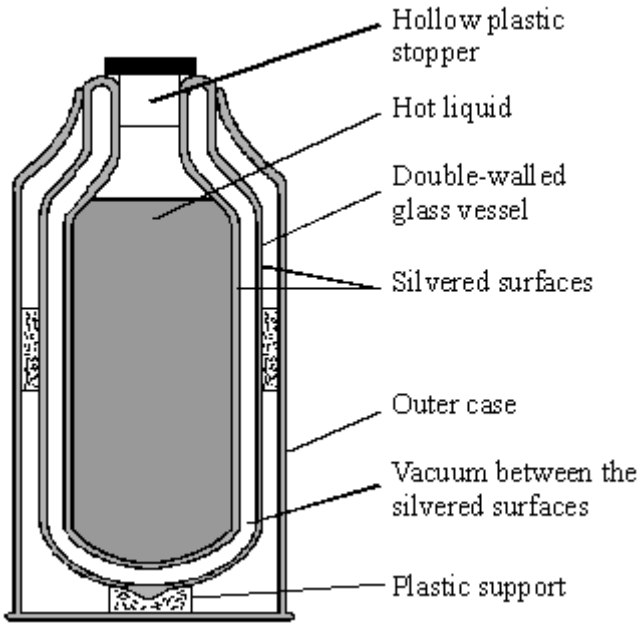
_____

(1)

(Total 5 marks)

Q7.

The drawing shows a section of a vacuum flask.



(a) Heat is slowly "lost" from the hot liquid in the closed flask. It may be transferred by:

conduction	convention	evaporation	radiation

Choose from the words above to complete the following sentences. You may use a word once, more than once or not at all.

(i) The vacuum between the glass walls reduces

_____ and _____

(2)

(ii) The silvered surfaces of the glass walls reduce

_____

(1)

(iii) The stopper in the opening of the flask reduces

_____ and _____

(2)

(iv) Heat is transferred by the air molecules, away from the vacuum flask, by

_____

(1)

(v) The plastic of the plastic stopper is preferred to metal because it cuts down

_____

(1)

(b) Mark **X** on the diagram of the vacuum flask where the liquid in the flask is hottest.

(1)

(c) Explain, in terms of particles, how heat is conducted through a glass wall of the vacuum flask.

_____

_____

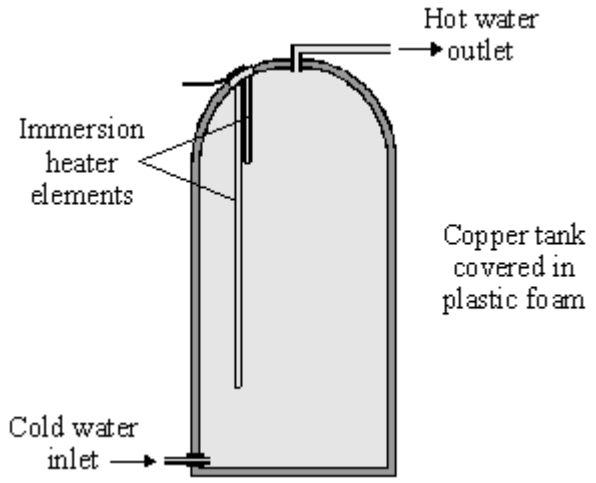
_____

(2)

(Total 10 marks)

Q8.

The diagram shows a type of electric immersion heater in a hot water tank. These hot water tanks are normally found in airing cupboards.



Information on the immersion heater states:

230 V
10 A

(a) Immersion heaters for hot water tanks often have a switch on them labelled *bath* or

sink. The *bath* position of the switch has **both** parts of the immersion heater elements in the circuit. The *sink* position has only the short heater element in the circuit.

(i) Explain why the hot water outlet is at the top of the tank, and the cold water inlet is at the bottom of the tank.

_____

_____

_____

(2)

(ii) Explain how the *sink* position for the immersion heater is able to save energy.

_____

_____

_____

(2)

(b) The copper tank is surrounded by plastic foam to minimise energy loss.

Explain why a pale, shiny surface to the foam also helps to minimise energy loss.

_____

_____

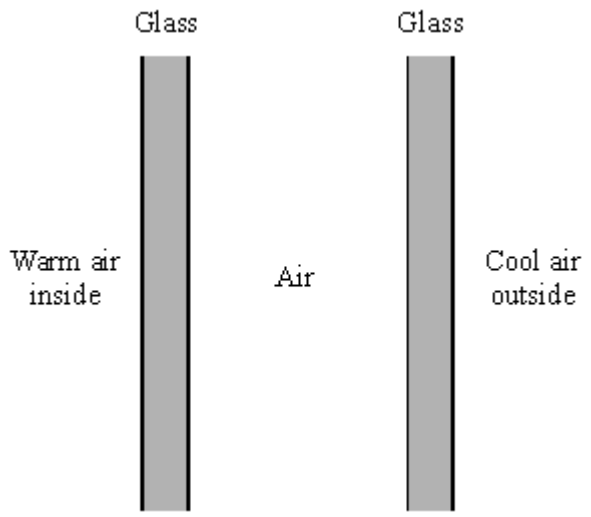
_____

(2)

(Total 6 marks)

Q9.

The diagram shows a side view of a double-glazed window.



(a) Use each of the terms in the box to explain how heat is lost from inside a house through the window.

conduction	**convection**	**radiation**

_____

_____

_____

_____

_____

_____

(3)

(b) Besides heat, state **one other** form of energy that passes through double-glazed windows.

_____

(1)

(c) Explain why plastic foam cavity wall insulation cuts down energy transfer between warm inner walls and cooler outer walls.

_____

_____

_____

_____

(2)

(d) When it rains the walls and windows of a house get wet.

Explain how the drying process can increase the cooling of the house.

_____

_____

_____

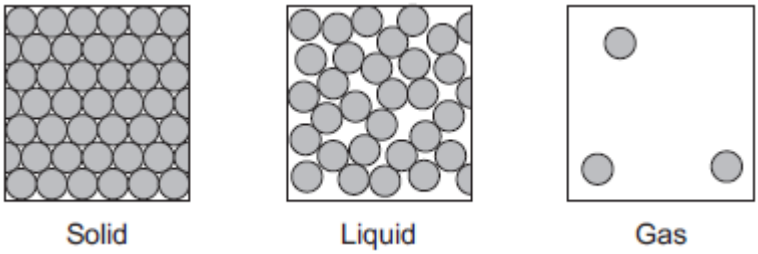
(2)

(Total 8 marks)

Q10.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The diagram shows the arrangement of particles in a solid, a liquid and a gas.



Use the diagram above and your own knowledge to compare solids, liquids and gases in terms of their particles.

You should include information about the arrangement, movement and energy of the particles.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q11.

Figure 1 shows a woman filling her bathroom sink with hot water.

Figure 1

(a) The mirror changes from being dry to being covered with small drops of water.

Name the process causing this change on the mirror.

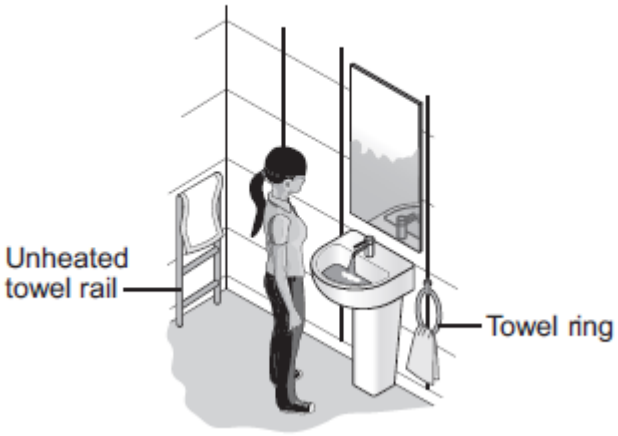
_____

(1)

(b) The woman dries herself with a towel. She hangs the wet towel in the bathroom to dry.

Figure 2 shows two places she could hang the towel.

Figure 2



The towel will dry faster if it is hung from the unheated towel rail instead of the towel ring.

Explain why.

_____

_____

_____

_____

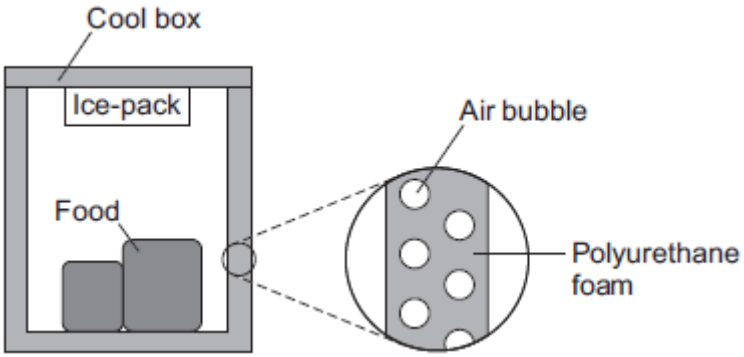
(2)

(Total 3 marks)

Q12.

The figure below shows a cool box.

A cool box is used to keep food colder than the surroundings. The cool box consists of plastic walls with a layer of polyurethane foam between them.



(a) The polyurethane foam has a low U-value.

Why does the polyurethane foam need to have a low U-value?

_____

_____

(1)

(b) The polyurethane foam contains air bubbles.

Explain how the air bubbles reduce energy transfer through the walls of the cool box.

You should refer to the processes of energy transfer in your answer.

_____

_____

_____

_____

_____

_____

(3)

(c) An ice-pack can be placed inside the cool box. An ice-pack contains a material with a very high specific heat capacity. The ice-pack is frozen in a freezer and cooled to –18 °C before being put in the cool box.

The ice-pack keeps the contents of the cool box cooler than the surroundings for a long time.

Describe how.

_____

_____

_____

_____

_____

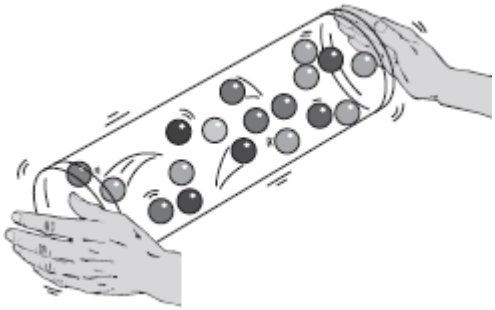
_____

(3)

(Total 7 marks)

Q13.

A student shakes a tube containing small balls to model the movement of particles in a gas.



(a) Why is this a good model for the movement of particles in a gas?

Tick (✓) **two** boxes.

The balls move slowly.	☐
The balls are far apart from each other.	☐
The balls are different colours.	☐
The balls move randomly.	☐

(2)

(b) For a given material, in which state of matter:

are the particles in a regular arrangement?

_____

do the particles have the most kinetic energy?

_____

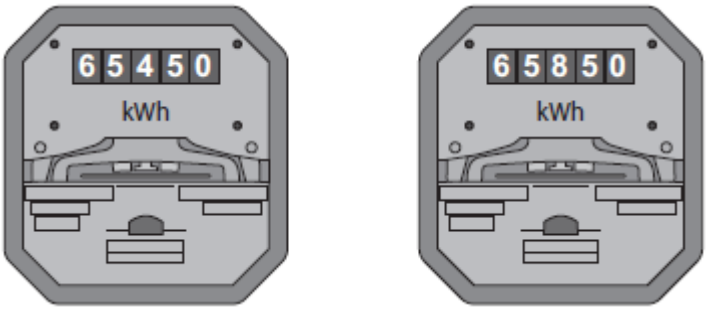
(2)
(Total 4 marks)

Q14.

A householder wants to reduce her electricity bills.
The householder takes readings from her electricity meter to see how much electricity she is using.

The pictures show the electricity meter readings at the start and end of April in 2013.

At the start of April **At the end of April**



(a) How many kilowatt-hours of electricity did she use in April?

_____

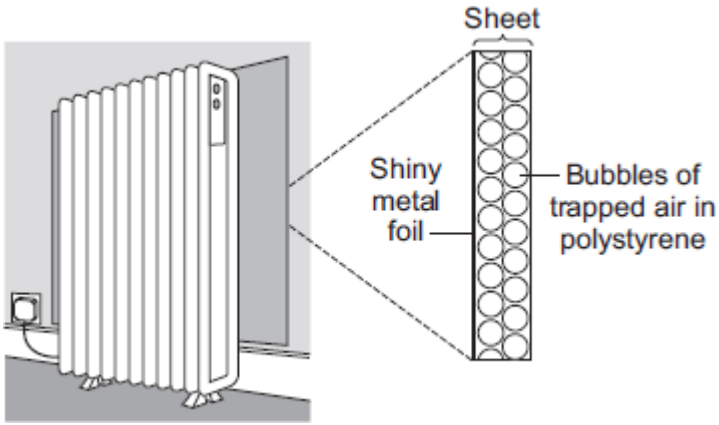
_____

Number of kilowatt-hours = _____

(2)

(b) The householder wants to reduce energy transfer from a room so she puts a special sheet between a heater and the wall.

The side of the sheet facing the heater is shiny metal foil.
The side of the sheet facing the wall is polystyrene.
The polystyrene contains bubbles of trapped air.



What properties of the sheet make it good for reducing energy transfer from the room?

Draw a ring around each correct answer to complete the sentences.

(i) Shiny surfaces are good

absorbers
emitters
reflectors

of infrared radiation.

(1)

(ii) The air in the polystyrene is a good

conductor.
insulator.
emitter.

(1)

(c) The householder turns her heater thermostat down by 2°C so the temperature of the room is lower.

The specific heat capacity of air is 1000 J/kg°C.

The mass of air in the room is 50 kg.

Calculate the energy needed to change the temperature of 50 kg of air by 2°C.

Use the correct equation from the Physics Equations Sheet.

_____

_____

_____

_____

Energy = _____ J

(2)

(Total 6 marks)

Q15.

An athlete runs in a marathon race. As he runs, his body gets hotter.

His body produces sweat to help him cool down.

(a) Explain in terms of particles, how sweating helps the athlete to cool down.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) At the end of the race, the athlete is covered with a ‘space blanket’ made from shiny foil to prevent him from cooling too quickly.

© Fuse/Thinkstock

He wraps the space blanket around his body to reduce energy transfer to the surroundings.

How does the space blanket reduce energy transfer to the surroundings?

_____

_____

_____

_____

_____

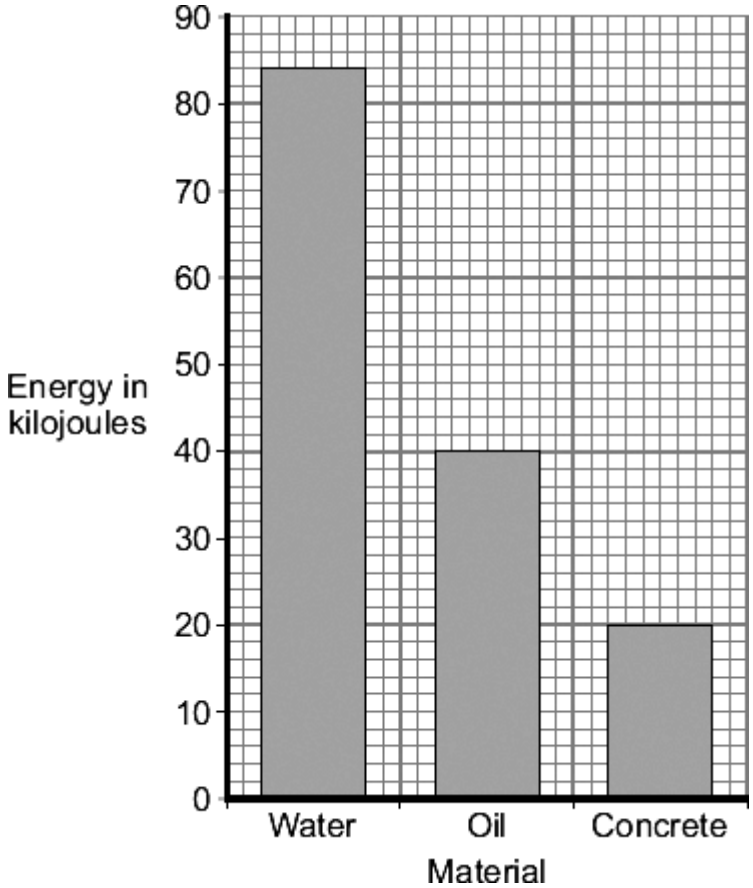
_____

(3)

(Total 7 marks)

Q16.

The bar chart shows the amount of energy needed to raise the temperature of 1 kg of three materials by 20 °C. The materials are used inside heaters.



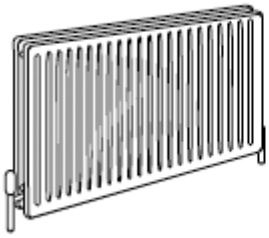
(a) Which material stores most energy?

_____

(1)

(b) The heaters that use the different materials are shown below. The power output when the heaters are being used is shown below each picture.

Water-filled heater

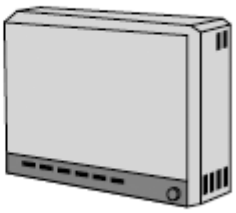


3 kW

Oil-filled heater

1.5 kW

Storage heater
(has concrete blocks inside)



1.7 kW

Each heater is put in one of three identical rooms. Each room's temperature is 10 °C and the heaters are switched on for 5 hours.

Which heater would cause the biggest temperature rise in the room?

Give a reason for your answer.

Heater _____

Reason _____

(2)

(c) Aluminium has a specific heat capacity of 900 J/kg °C.

Calculate how much energy is needed to raise the temperature of 2 kg of aluminium by 15 °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

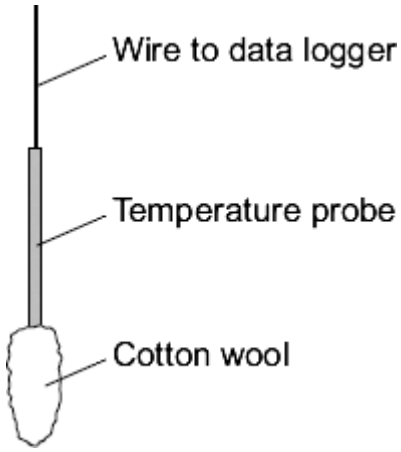
Energy = _____ J

(2)

(Total 5 marks)

Q17.

A student investigated the evaporation of three different liquids using the apparatus shown.

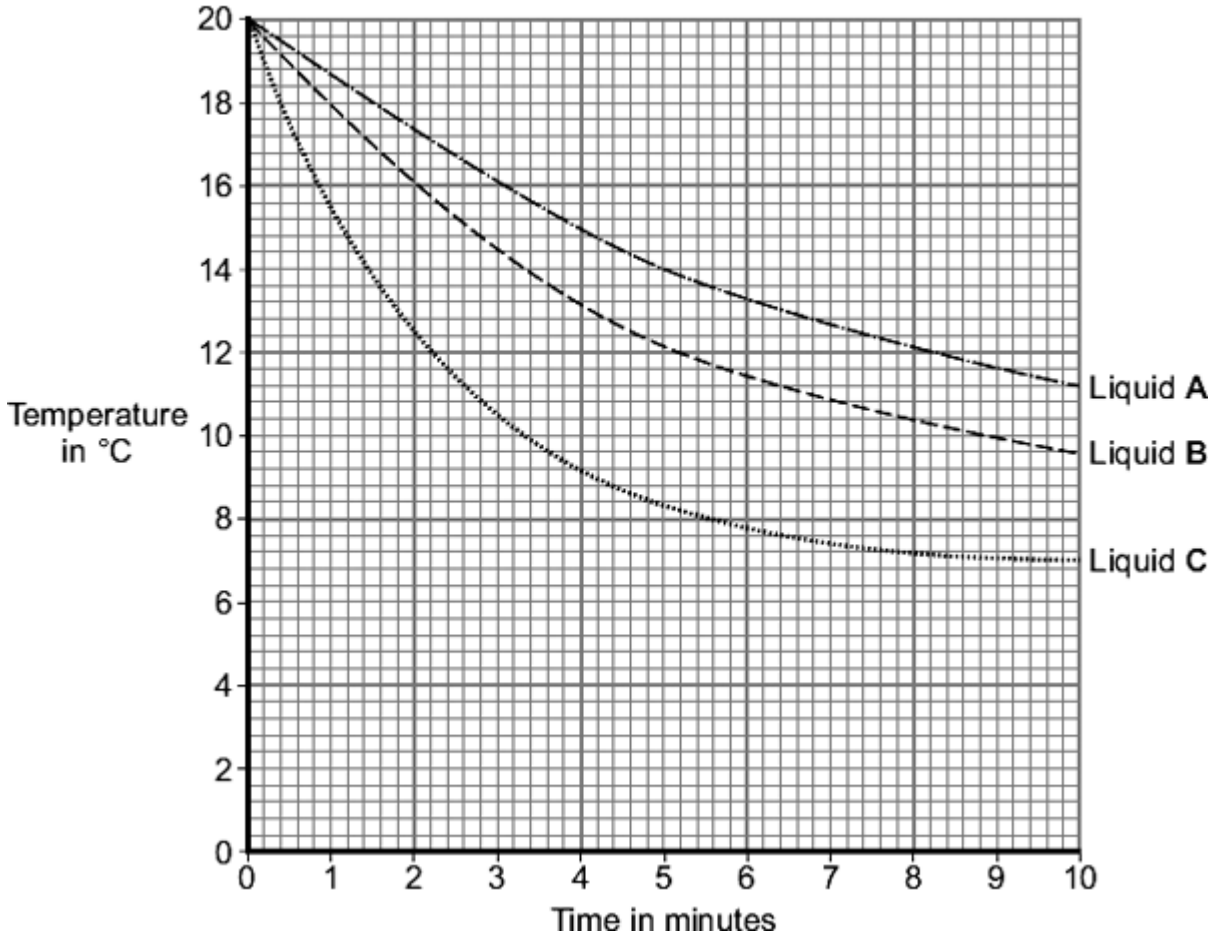


Identical pieces of cotton wool were soaked in one of three liquids, **A**, **B** or **C**, that have different boiling points. The same volume of liquid, at the same starting temperature, was used each time.

The temperature of the cotton wool was measured during a ten minute period.

The results are shown on **Graph 1**.

Graph 1



(a) Which liquid has the lowest boiling point?

Explain your choice.

Liquid _____

Explanation _____

_____

_____

_____

(2)

(b) Room temperature is 20 °C.

The line for liquid **C** reached a lower limit of 7 °C.

Explain why the temperature did **not** fall below 7 °C.

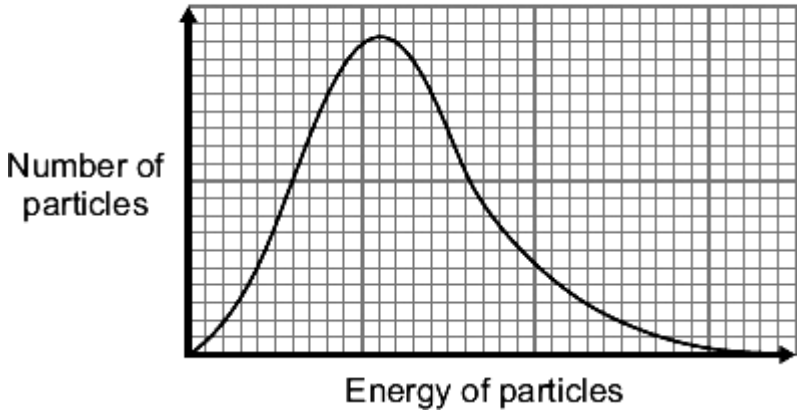
_____

_____

(1)

(c) **Graph 2** shows the distribution of energy among particles in a liquid.

Graph 2



Explain, in terms of the particles in a liquid, why evaporation causes cooling.

You may use information from **Graph 2** to help you with your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)

Mark schemes

Q1.

(a) plastic/glass walls; vacuum; insulating top

any two for 1 mark each

2

(b) silvering/shiny on either wall

for 1 mark

1

[3]

Q2.

(a) (i) hot water rises (not heat)

for 1 mark

due to convection currents
or water expands/becomes less dense on heating
or less dense water rises

any for 1 mark

2

(ii) inside hotter (than outside)

for 1 mark

1

(iii) (heat transfer by) conduction

for 1 mark

1

(iv) surround/cover/insulate tank with poor conductor **or** named insulator

for 1 mark each

2

(b) (i) air is an insulator/poor conductor

for 1 mark

1

(ii) convection stopped foam is an insulator/poor conductor

for 1 mark each

2

[9]

Q3.

(a) (i) £150

gets 2

Else 1000 – (250 + 350 + 100 + 150) or 1000 – 850

gets 1

2

(ii) (Named) floor covering
OR Insulation under floor

for 1 mark

1

(b) (i) Draught proof doors or fibre glass in loft or in cavity

For draught proofing

gains 1 mark

Very low cost/easy to install
Repays for itself quickly/cost recuperated quickly
Reasonable energy saving

any 2 for 1 mark each

For loft insulation

Second lowest installation cost/easy to install
Reasonable large energy savings for this cost
Reasonable payback time

gains 1 mark

For foam filled cavity

Biggest energy/cash saving
Cost effective

any 2 for 1 mark each

3

(ii) **Double glazing**

gains 1 mark

Costs most
Saves least energy
Least cost effective

any 2 for 1 mark each

3

[9]

Q4.

(a) loft insulation

1

energy saved in 10 years £600

1

net saving (600 – 110) £490

1

OR

hot water jacket

1

energy saved in 10 years £140

1

This is the highest percentage saving on cost

1

(b) transferred to environment / surroundings

1

as heat / thermal energy

1

[5]

Q5.

(a) insulation

allow example e.g fibreglass

1

double glazing

allow curtains

1

draught excluder

allow double glazing / close fitting door

allow turning down thermostat once only / turn down the heating

1

(b) transfers more useful energy

allow converts more energy into light / less into heat / less energy wasted

1

[4]

Q6.

(a) (i) (insulate it) with **fibre** glass **or** foam **or** felt **or** polystyrene beads **or** rockwool **or** (aluminium) foil

an example must be included

do not credit loft insulation

1

(ii) fill the cavity with fibre glass **or** foam **or** mineral wool **or** polystyrene **or** named liner inside wall **or** making walls thicker

an example must be included

do not credit cavity wall insulation

1

(iii) double glaze **or** draw the curtains **or** blinds **or** thicker glass **or** secondary glazing described

do not credit fit smaller windows

1

(iv) put in draught excluder (or described) **or** strip **or** description of filling gaps **or** seal gaps **or** double glazed doors **or** build porch **or** curtains inside door **or** mat under door

do not credit just carpet

accept buy new doors

accept premise that gap is between frame and wall as well as between frame and door

1

(b) windy **or** stormy **or** wet **or** snow **or**
rain **or** sleet **or** hail **or** fog **or** mist

do not credit frosty

1

[5]

Q7.

(a) (i) conduction

1

convection

they may be in either order

1

(ii) radiation

1

(iii) evaporation

1

convection

they may be in either order

1

(iv) convection

1

(v) conduction

1

(b) in the middle above halfway up (above line joining top of spacers)

below the surface of the liquid

1

(c) by particles vibrating more

*particles shake more **or** move more*

do not credit they start vibrating

1

they pass on the energy **or** vibrations

do not credit heat

1

[10]

Q8.

(a) (i) the outlet mark

hot water rises **or** floats up

do not accept heat rises

the inlet mark

1

cold water replacing any drawn off comes in at the bottom and does not mix with hot **or** cool the hot water

do not accept descriptions of a convection current

1

(ii) only heats top (of tank) **or** a small volume

credit heats less water

1

no mixing occurs with cold because hot water is less dense **or** water is a poor conductor

no mixing because cold water is more dense

1

(b) radiation (losses from tank)

do not accept reflection of heat

1

lower from light **or** white **or** shiny surfaces

credit they are poor radiators for both marks

1

[6]

Q9.

(a) (heat) is conducted through the glass

the answers must be within the context of the question

1

(heat) passes through glass and air by radiation

both glass and air required

1

(heat) crosses the air gap by convection

mention of conduction through air is neutral

1

(b) any **one** from

light

accept sunlight

gamma rays

X-rays

radio

*accept sound **or** ir **or** microwaves **or** electromagnet waves*

1

(c) any **two** from

cuts down convection currents

accept stops air moving

air pockets trap air (from moving)

accept has air pockets
*do not accept stops heat moving **or** traps heat*

foam is a poor conductor

air in the foam is a good insulator

accept air is a good insulator in air pockets for both marks

2

(d) evaporation (of the water)

do not accept rain is cold

1

takes energy from the house

*accept takes heat away **or** higher energy molecules leave first*

1

[8]

Q10.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

0 marks
No creditworthy response

Level 1 (1 – 2 marks)
At least **one** relevant statement is made

Level 2 (3 – 4 marks)
Relevant statements are made about two of the states
or
a relevant statement is made about each state

Level 3 (5 – 6 marks)
Relevant statements are made about each of the three states

Examples of the Physics points made in the response:

ignore statements about the states of matter

*a description without mention of particles, but clearly about particles, can gain **max** 4 marks*

solids:

- arranged in a regular pattern
  allow closely / tightly packed / compact
- particles vibrate about fixed points
  allow cannot move freely / around
- particles have low energy.

liquids:

- pattern is irregular
  allow close together
- particles are not fixed in place **or** can move freely / around
- particles have more energy than solids and / or less energy than gases.

gases:

- particles are in a random pattern
  allow far apart
- particles move (about) freely / randomly
  allow move fast(er)
- particles have high energy.

[6]

Q11.

(a) condensation

1

(b) larger (exposed) surface area

1

(so) water can evaporate faster
or
(so) more water (molecules) can escape

allow more water can evaporate

1

[3]

Q12.

(a) so it is a good insulator

ignore references to efficiency

allow low (rate of) energy / 'heat' transfer

*do **not** accept prevents energy transfer*

1

(b) air is a(n) (good) insulator

allow air is a poor conductor

1

(so) air reduces conduction

*do **not** allow stops conduction*

1

trapped air / air bubbles reduce(s) / stop(s) convection

1

(c) any **three** from:

- ice-pack is (much) colder than the cool box contents
- ice-pack reduces the (overall) temperature of the cool box / air (in the cool box)
- ice pack requires a lot of energy to heat up / increase temperature / change temperature

  allow 'heat' for energy
- ice-pack requires heating up before the cool box contents warm up

  allow 'heat' for energy
  allow ice-pack takes a long time to heat up / increase temperature / change temperature
- ice-pack cools the air which becomes more dense and sinks

  allow ice-pack cools the air and causes (a) convection (current)

  accept energy / 'heat' is needed to melt the (contents of the) ice-pack

3

[7]

Q13.

(a) balls are far apart from each other

1

balls move randomly

1

(b) solid

1

gas

1

[4]

Q14.

(a) 400(kWh)

*65850 – 65450 gains **1** mark provided no subsequent step shown*

2

(b) (i) reflectors

1

(ii) insulator

1

(c) 100 000(J)

*correct substitution i.e.50 × 1000 × 2 gains **1** mark provided no subsequent step shown*

2

[6]

Q15.

(a) energy transferred from athlete / skin / body to water / sweat

allow water / sweat heated by athlete

1

(so) more energetic (water / sweat) particles escape (from the liquid)

accept particles with higher speeds escape (from the liquid)

1

water / sweat <u>evaporates</u>

accept particles escape from the (surface of the) liquid

1

(which) lowers the <u>average</u> energy of (remaining) water / sweat particles

allow reference to the total energy of the liquid reducing

allow lowers the athlete's <u>temperature</u>

ignore cool down

1

(b) any **three** from:

accept IR / radiation / heat / infrared / energy throughout

- the blanket traps air
- air is an insulator

  accept for 2 marks trapped air reduces conduction / convection

- space blanket reflects infrared radiation (back to the body)

  ignore incident solar radiation

ignore reflects light
ignore bounces off

- space blanket is a poor emitter / radiator of infrared radiation
  *do **not** accept does not emit infrared radiation*

3

[7]

Q16.

(a) water
allow H_2O / OH_2

1

(b) water (filled heater)
allow 3kW

1

highest power (output) / most powerful / highest number of watts
only scores if first marking point correct
allow highest energy / heat <u>output</u>
allow has more power
ignore stores most energy /references to heat

1

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

27 000
*allow **1** mark for correct substitution into correct equation:*
$2 \times 900 \times 15$
or
$2000 \times 900 \times 15$
or
27 000 000

2

[5]

Q17.

(a) (liquid C)
no mark awarded for stating liquid C
no marks awarded if liquid A or B chosen

(causes) biggest temperature decrease
allow cools quicker / the quickest

1

(because it) evaporates quickest
allow evaporates quicker
allow most / more evaporated
ignore references to boiling

1

(b) all of the liquid has evaporated
accept no net energy transfer

allow it was dry

1

(c) particles with most energy / highest speed evaporate

allow hottest particles

1

these particles escape from the (surface of the) liquid

accept overcoming the attractive forces (between particles)

1

decreasing mean energy of particles (left in liquid)

allow some reference to the total energy of the liquid reducing

1

which lowers the temperature

ignore cool down

1

[7]