

Particle Model 2

Name: _____

Class: _____

Date: _____

Time: **30 minutes**

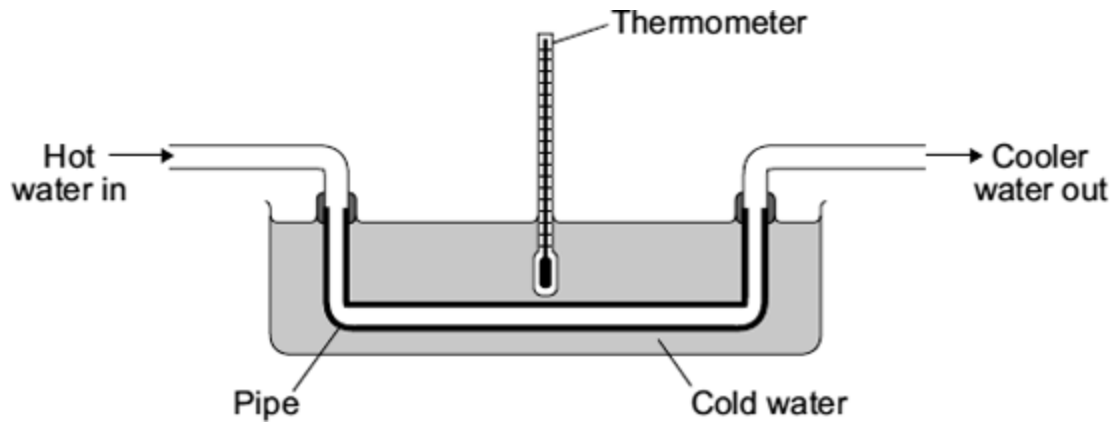
Marks: **30 marks**

Comments:

1.

Heat exchangers are devices that are used to transfer heat from one place to another.

The diagram shows a simple heat exchanger used by a student in an investigation.
Heat is transferred from the hot water inside the pipe to the cold water outside the pipe.



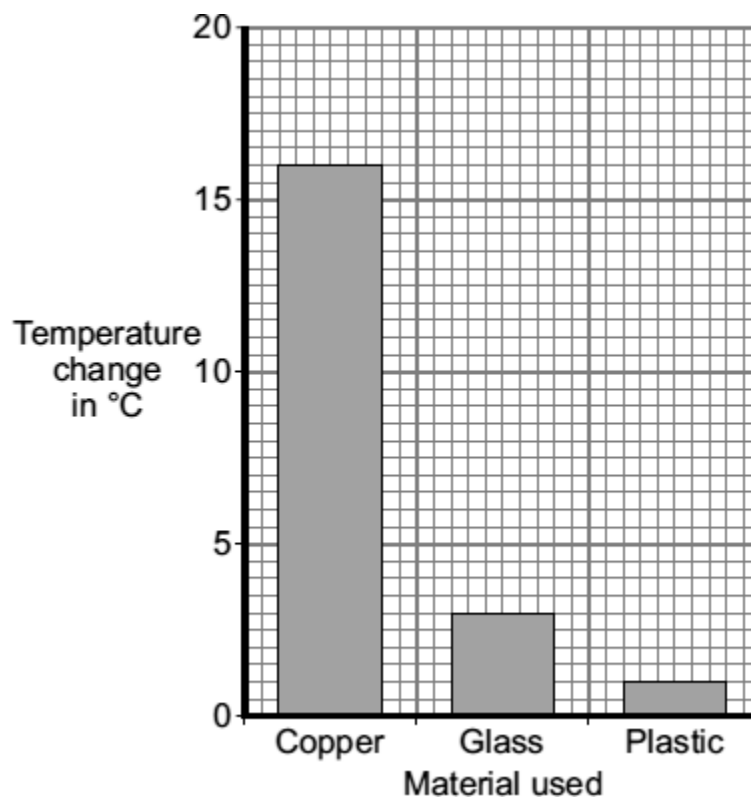
- (a) By which process is heat transferred from the hot water inside the pipe to the cold water outside the pipe?

(1)

- (b) The student wanted to find out if the efficiency of a heat exchanger depends on the material used to make the pipe. The student tested three different materials. For each material, the rate of flow of hot water through the pipe was kept the same.

The results obtained by the student are recorded in the table and displayed in the bar chart.

Material	Temperature of the cold water at the start in °C	Temperature of the cold water after 10 minutes in °C
Copper	20	36
Glass	20	23
Plastic	20	21



- (i) The rate of flow of hot water through the pipe was one of the control variables in the investigation.

Give **one** other control variable in the investigation.

(1)

- (ii) Why did the student draw a bar chart rather than a line graph?

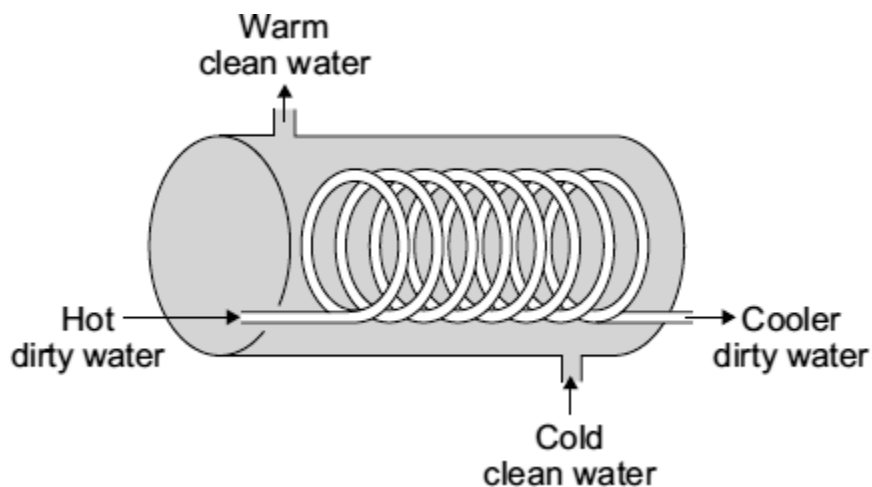
(1)

(iii) Which **one** of the three materials made the best heat exchanger?

Give a reason for your answer.

(2)

(c) The student finds a picture of a heat exchanger used in an industrial laundry. The heat exchanger uses hot, dirty water to warm cold, clean water.



Why does this heat exchanger transfer heat faster than the heat exchanger used by the student in the investigation?

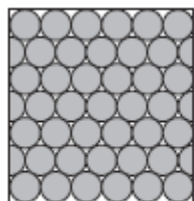
(1)

(Total 6 marks)

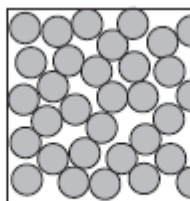
2.

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

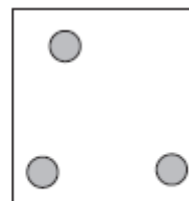
The diagram shows the arrangement of particles in a solid, a liquid and a gas.



Solid



Liquid



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)

- (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.



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

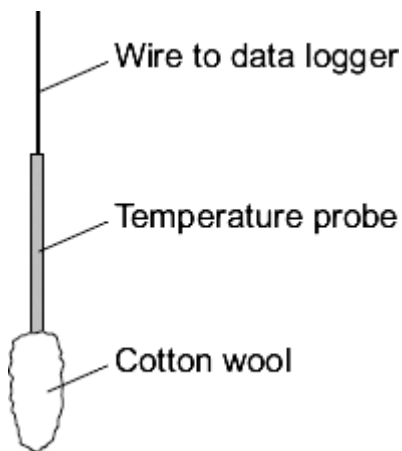
How does the space blanket reduce energy transfer to the surroundings?

(3)

(Total 7 marks)

5.

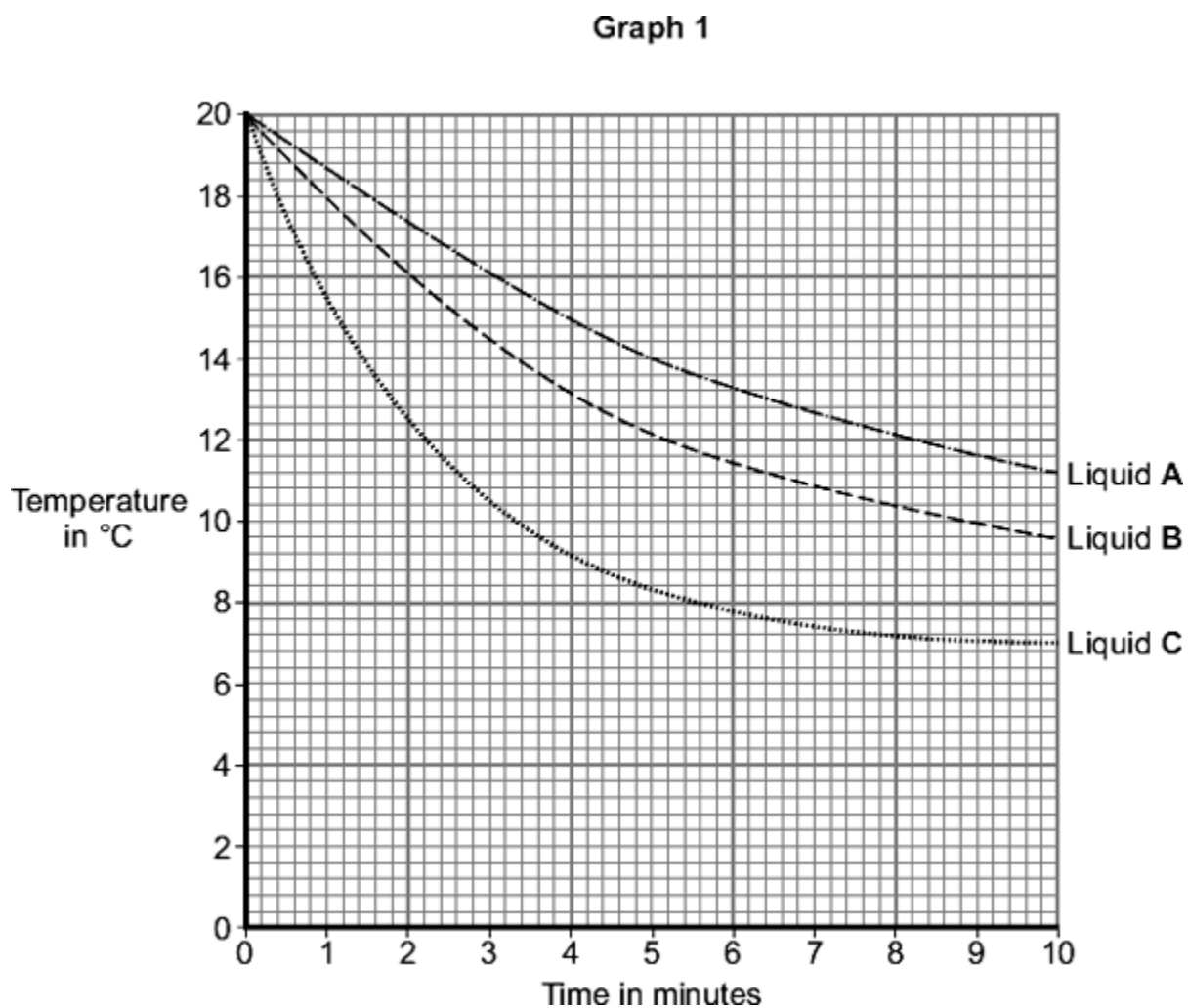
A student investigated the evaporation of three different liquids using the apparatus shown.



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**.



(a) Which liquid has the lowest boiling point?

Explain your choice.

Liquid _____

Explanation _____

(2)

(b) Room temperature is 20 °C.

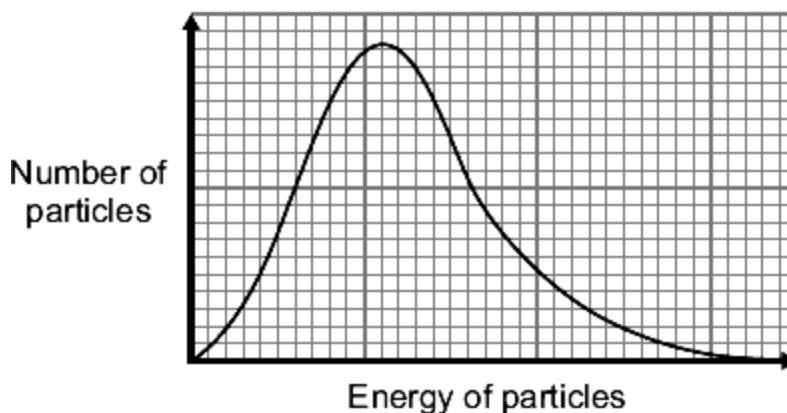
The line for liquid **C** reached a lower limit of 7 °C.

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

1.

(a) conduction

1

(b) (i) any **one** from:

- starting temperature (of cold water)
temperature is insufficient
- pipe length
accept size of pipe
- pipe diameter
- pipe (wall) thickness
- volume of cold water
accept amount for volume
- temperature of hot water (in)
- time

1

(ii) (type of) material is categoric

- accept one variable is categoric*
- accept variable(s) are categoric*
- accept it is categoric*
- accept variable(s) are not continuous*
- descriptions of variables ie names and numbers is insufficient*

1

(iii) copper

1

greatest temperature change

- only scores if copper chosen*
- accept heat for temperature*
- accept heated water the fastest*
- accept it was hottest (after 10 minutes)*
- accept it is the best / a good conductor*

1

(c) larger (surface) area

- accept the pipe is longer*
- accept hot (dirty) water (inside pipe) is in contact with the cold water (outside pipe) for a longer time*
- he pipe is a spiral is insufficient*

1

[6]

2.

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]

3.

(a) balls are far apart from each other

1

balls move randomly

1

(b) solid

1

gas

1

[4]

4.

- (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 evaporates
accept particles escape from the (surface of the) liquid

1

(which) lowers the average energy of (remaining) water / sweat particles
allow reference to the total energy of the liquid reducing
allow lowers the athlete's temperature
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]

5.

(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]