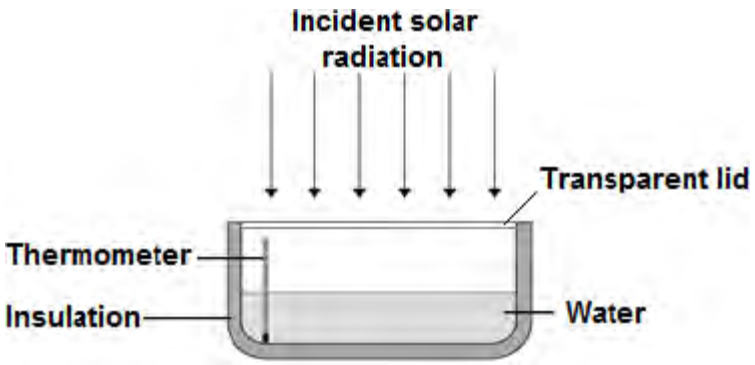
**Q1.** A student investigated how much energy from the Sun was incident on the Earth's surface at her location.

She put an insulated pan of water in direct sunlight and measured the time it took for the temperature of the water to increase by 0.6 °C.

The apparatus she used is shown in the figure below.




(a) Choose the most appropriate resolution for the thermometer used by the student.

Tick **one** box.

0.1 °C ☐

0.5 °C ☐

1.0 °C ☐

**(1)**

(b) The energy transferred to the water was 1050 J.

The time taken for the water temperature to increase by 0.6 °C was 5 minutes.

The specific heat capacity of water is 4200 J / kg °C.

Write down the equation which links energy transferred, power and time.

.....

**(1)**

(c) Calculate the mean power supplied by the Sun to the water in the pan.

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Average power = ..... W

**(2)**

(d) Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

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Mass = ..... kg

**(3)**

(e) The student's results can only be used as an estimate of the mean power at her location.

Give **one** reason why.

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.....

**(1)**

**(Total 8 marks)**

**Q2.**All objects emit and absorb infrared radiation.

(a) Use the correct answer from the box to complete each sentence.

| | | | |
|---|---|---|---|
| **dark matt** | **dark shiny** | **light matt** | **light shiny** |

The best emitters of infrared radiation have

..... surfaces.

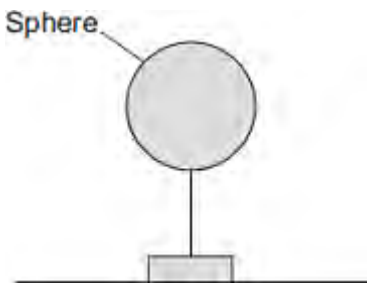
The worst emitters of infrared radiation have

..... surfaces.

**(2)**

(b) **Diagram 1** shows a sphere which is at a much higher temperature than its surroundings.

**Diagram 1**



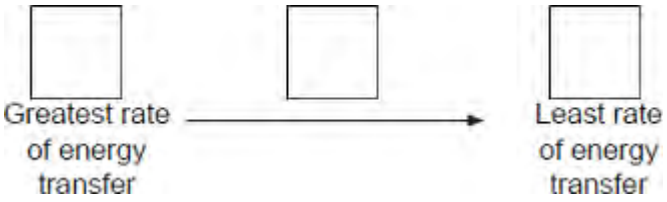

Energy is transferred from the sphere to the surroundings.

The table shows readings for the sphere in three different conditions, **A**, **B** and **C**.

| Condition | Temperature of sphere in °C | Temperature of surroundings in °C |
|---|---|---|
| **A** | 70 | 5 |
| **B** | 80 | 0 |
| **C** | 90 | 30 |

In each of the conditions, **A**, **B** and **C**, the sphere transfers energy to the surroundings at a different rate.

Put conditions **A**, **B** and **C** in the correct order.




Give a reason for your answer.

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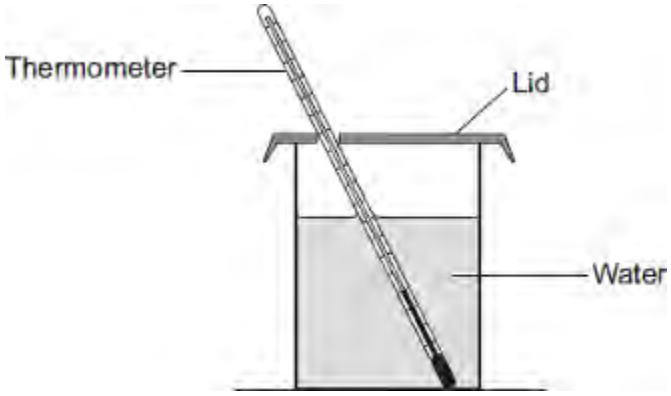
.....

**(2)**

(c) **Diagram 2** shows a can containing water.

A student investigates how quickly a can of water heats up when it is cooler than room temperature.

**Diagram 2**




The student has four cans, each made of the same material, with the following outer surfaces.

**dark matt** **dark shiny** **light matt** **light shiny**

The student times how long it takes the water in each can to reach room temperature.

Each can contains the same mass of water at the same starting temperature.

(i) Which can of water will reach room temperature the quickest?

Give a reason for your answer.

.....

.....

.....

.....

**(2)**

(ii) Apart from material of the can, mass of water and starting temperature, suggest **three** control variables for the student's investigation.

1 .....

.....

2 .....

.....

3 .....

.....

**(3)**

(d) The photographs show two different foxes.

**Fox A** **Fox B**

By Algkalv (Own work) [CC-BY-3.0], via Wikimedia Commons

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Which fox is better adapted to survive cold conditions?

Give reasons for your answer.

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**(3)**

**(Total 12 marks)**

**Q3.** When you transfer *energy* to a shopping trolley, the amount of *work done* depends on the *force* used and the *distance moved*.


Complete the table by using the correct units from the box.

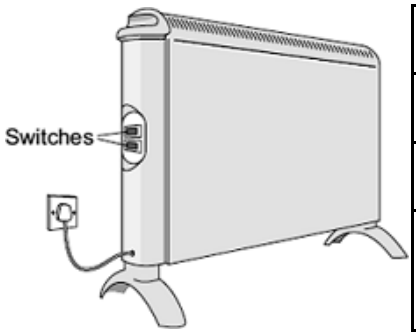
| joule (J) | metre (m) | newton (N) |
|---|---|---|

The first one has been done for you.

| Quantity | Unit |
|---|---|
| energy (transferred) | joule |
| force | |
| distance (moved) | |
| work done | |

**(Total 2 marks)**

**Q4.** (a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.




| Setting | Power in watts |
|---|---|
| Low | 700 |
| Medium | 1400 |
| High | |

(i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

.....

Power = ..... kilowatts

**(1)**

(ii) The heater is used on the **high** power setting. It is switched on for 1½ hours.

Calculate the energy transferred from the mains to the heater in 1½ hours.

Show clearly how you work out your answer and give the unit.

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.....

.....

Energy transferred = .....

**(3)**

(iii) This type of heater is a very efficient device.

What is meant by a device being very efficient?

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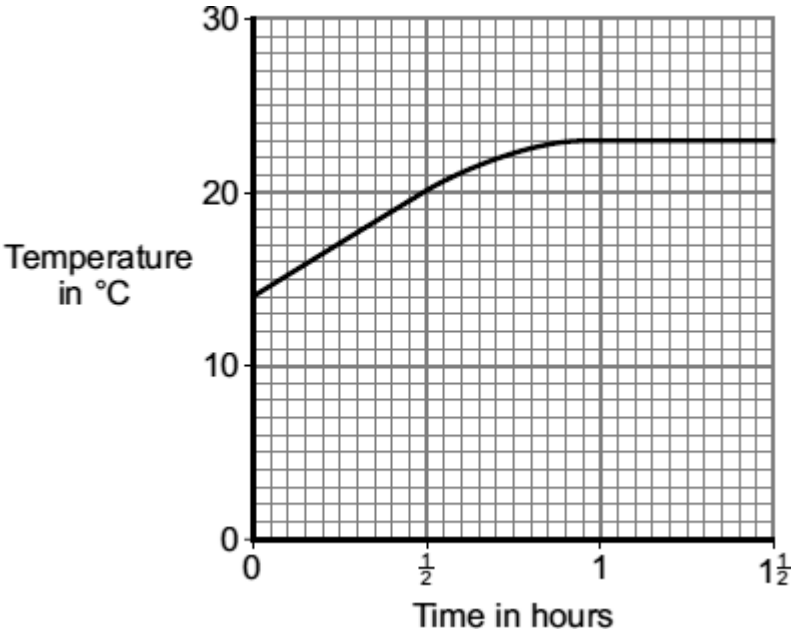
.....

**(1)**

(b) The graph shows how the temperature of a room changes during the 1½ hours that the heater is used.




After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

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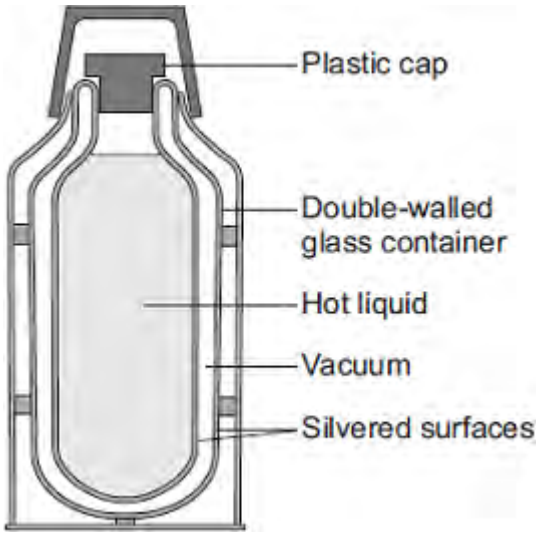
**(2)**

**(Total 7 marks)**

**Q5.**(a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The diagram shows the structure of a vacuum flask.




A vacuum flask is designed to reduce the rate of energy transfer by heating processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

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**(6)**

(b) Arctic foxes live in a very cold environment.

© Purestock/Thinkstock

Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

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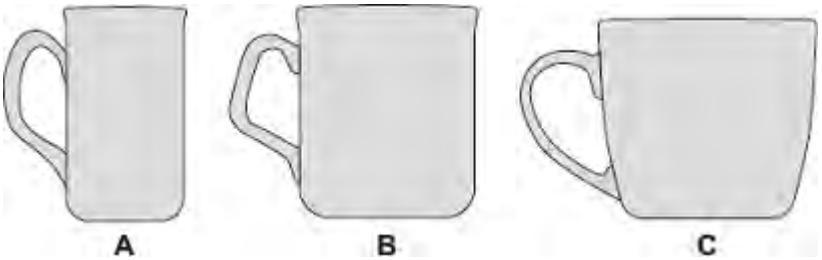
**(2)**
**(Total 8 marks)**

**Q6.** The diagram shows three cups **A**, **B** and **C**.




Energy is transferred from hot water in the cups to the surroundings.

(a) Use the correct answer from the box to complete each sentence.

| condensation | conduction | convection |
|---|---|---|

Energy is transferred through the walls of the cup by ..... .

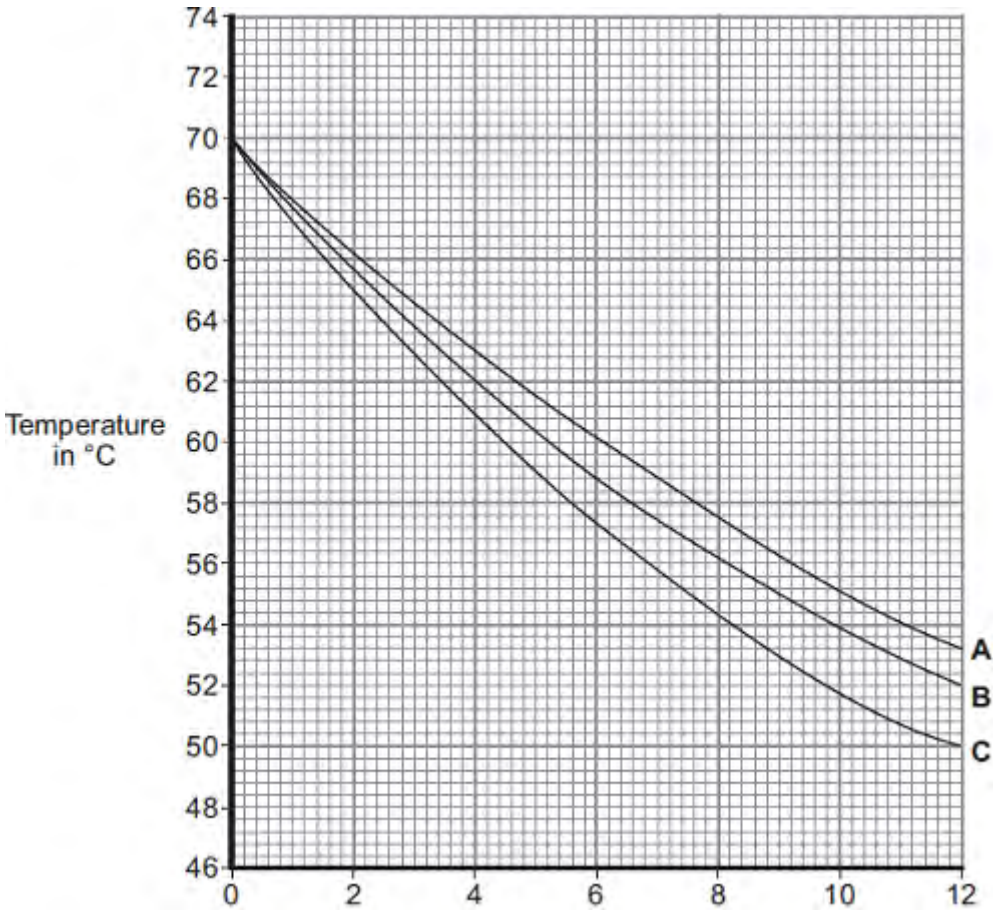
In the air around the cup, energy is transferred by ..... .

**(2)**

(b) Some students investigated how the rate of cooling of water in a cup depends on the surface area of the water in contact with the air.

They used cups **A**, **B** and **C**. They poured the same volume of hot water into each cup and recorded the temperature of the water at regular time intervals.

The results are shown on the graph.



Time in minutes

(i) What was the starting temperature of the water for each cup?

Starting temperature = ..... °C

**(1)**

(ii) Calculate the temperature fall of the water in cup **B** in the first 9 minutes.

.....

Temperature fall = ..... °C

**(2)**

(iii) Which cup, **A**, **B** or **C**, has the greatest rate of cooling? ☐

Using the graph, give a reason for your answer.

.....

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**(2)**

(iv) The investigation was repeated using the bowl shown in the diagram.

The same starting temperature and volume of water were used.

Draw on the graph in part **(b)** another line to show the expected result.

**(1)**

(v) After 4 hours, the temperature of the water in each of the cups and the bowl was 20°C.

Suggest why the temperature does **not** fall below 20°C.

.....

**(1)**

(c) (i) The mass of water in each cup is 200 g.

Calculate the energy, in joules, transferred from the water in a cup when the temperature of the water falls by 8°C.

Specific heat capacity of water = 4200 J / kg°C.

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Energy transferred = ..... J

**(3)**

(ii) Explain, in terms of particles, how evaporation causes the cooling of water.

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**(4)**

**(Total 16 marks)**