PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



EXAM QUESTION PACK

SECTION 5: SOLIDS, LIQUIDS AND GASES (PACK 2)

SCORE	PERCENTAGE
/152	%

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Q1.

(a) Describe the arrangement and motion of particles in a solid.

You may draw a diagram to help your answer.

(3)

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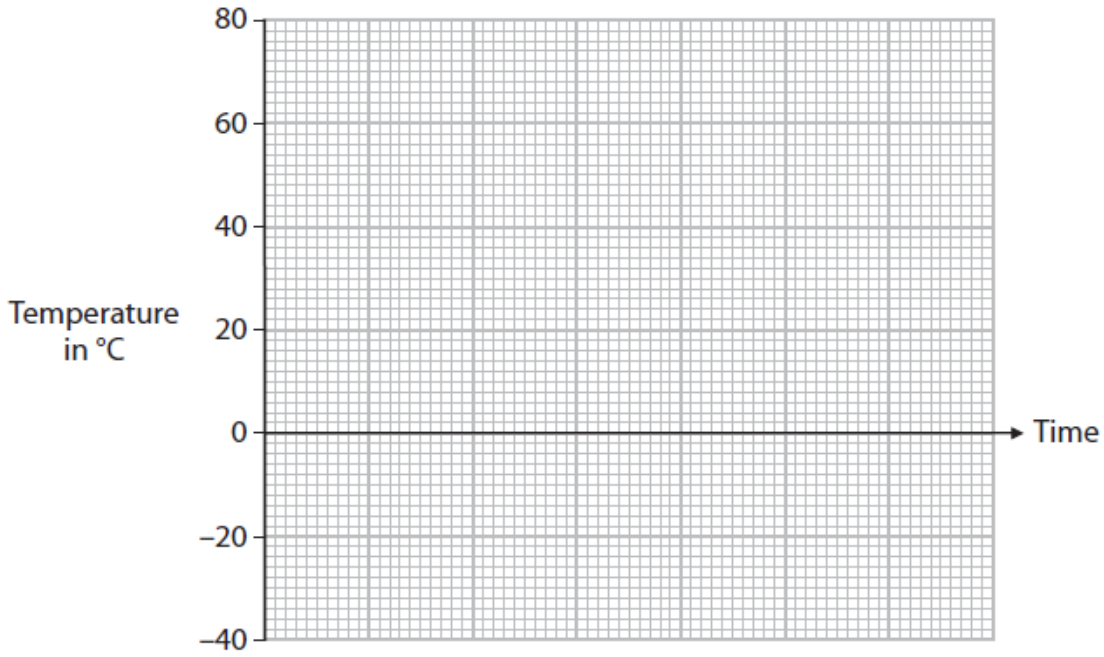
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(b) A solid changes state by melting at a certain temperature.

(3)

For phosphorus, this change of state occurs at 44 °C.

Sketch how the temperature of a sample of phosphorus changes when it is heated at a constant rate from –40 °C to 80 °C.



(Total for question = 6 marks)

Q2.

The photograph shows a brass mass.



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(a) State the formula linking density, mass and volume.

(1)

(b) The brass mass has a mass of 454 g.

The density of brass is 8.46 g/cm^3.

Calculate the volume of the brass mass.

Give the unit.

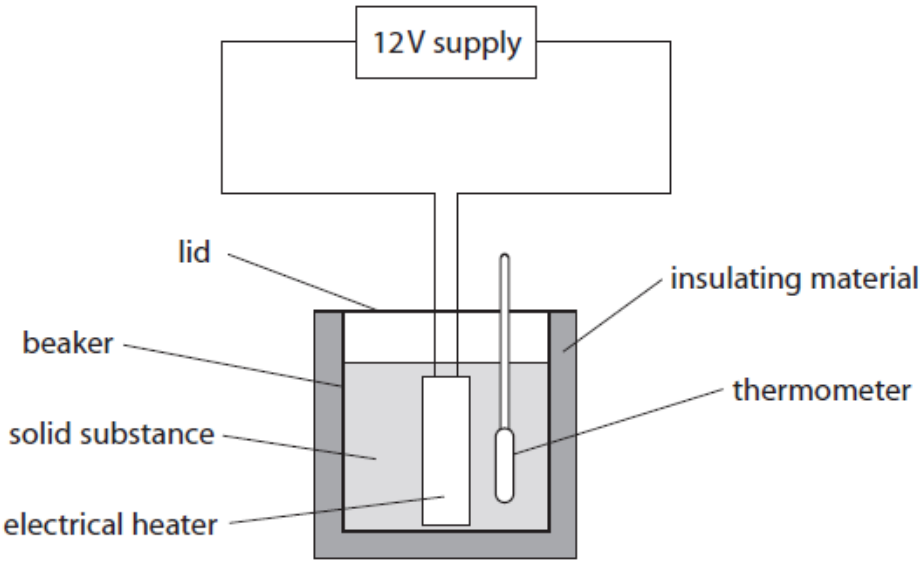
(3)

volume = ... unit .....

(Total for question = 4 marks)

Q3.

The diagram shows some of the apparatus a student uses to investigate the effect of heating a solid substance.



(a) Describe how the student could use their apparatus to help determine the specific heat capacity of the substance.

You should give details of any additional apparatus needed in your answer.

(5)

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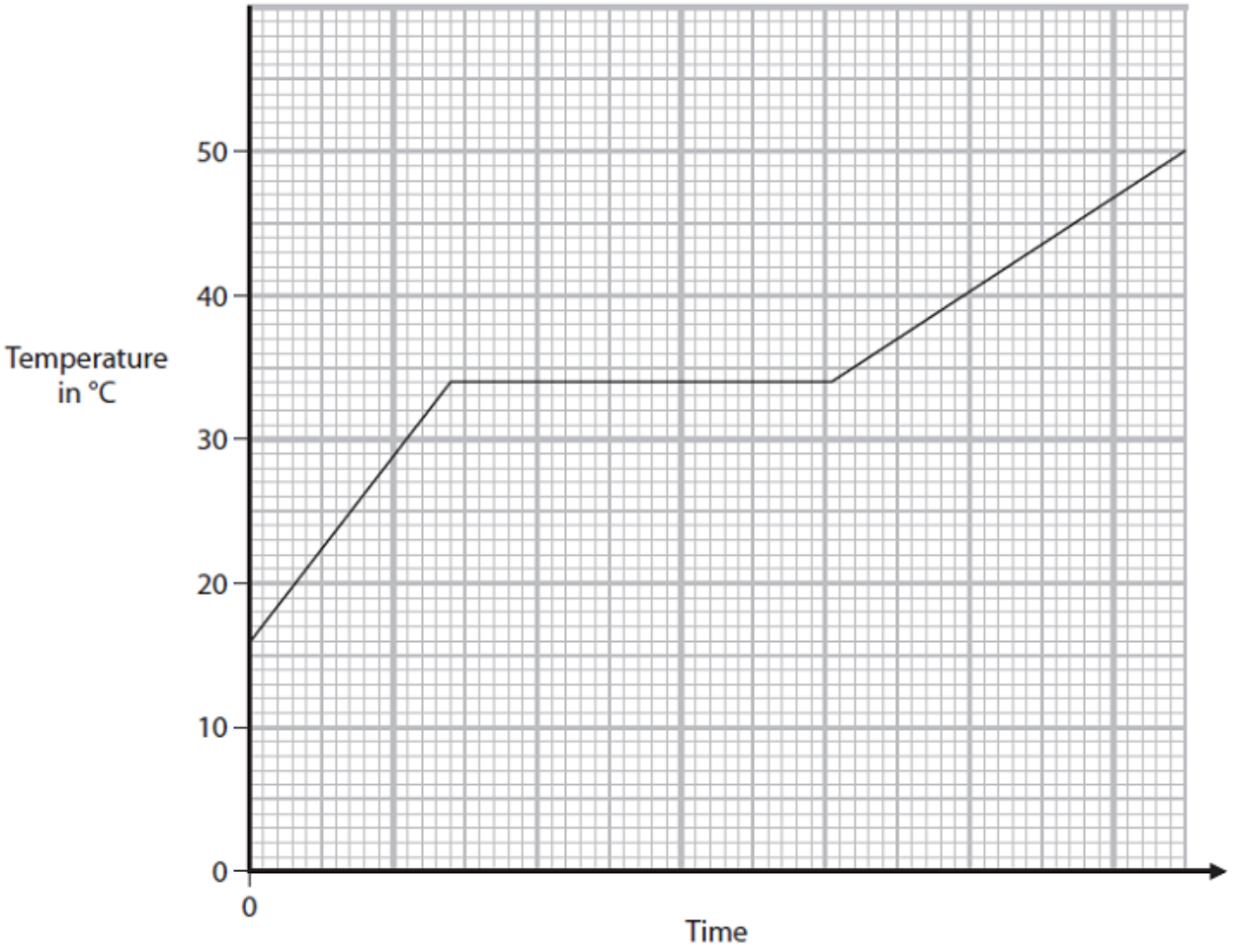
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(b) The student continues to heat the substance, keeping the power of the heater constant.

The graph shows how the temperature of the substance changes with time.



(i) Use the graph to determine the melting point of this substance.

(1)

melting point = ... °C

(ii) Describe, in terms of particles, what is happening in the substance when the graph line is horizontal.

(2)

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(iii) Suggest why the two non-horizontal lines on the graph have different gradients.

(2)

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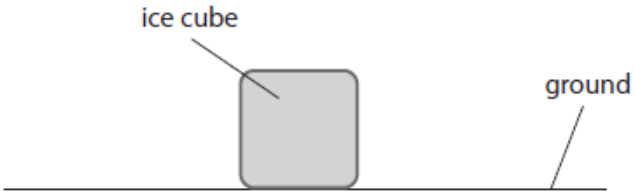
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(Total for question = 10 marks)

Q4.

This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is 2.6×10^{-4} m^2.

Calculate the pressure the ice cube exerts on the ground.

(4)

pressure = ... Pa

(ii) The ice cube melts and becomes a puddle with a larger cross-sectional area.

Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

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(b) Ice melts at a temperature of 0 °C.

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of –10 °C to a temperature of 20 °C.

(3)



(c) Explain the changes that occur when a solid melts.

Refer to particles in your answer.

(2)

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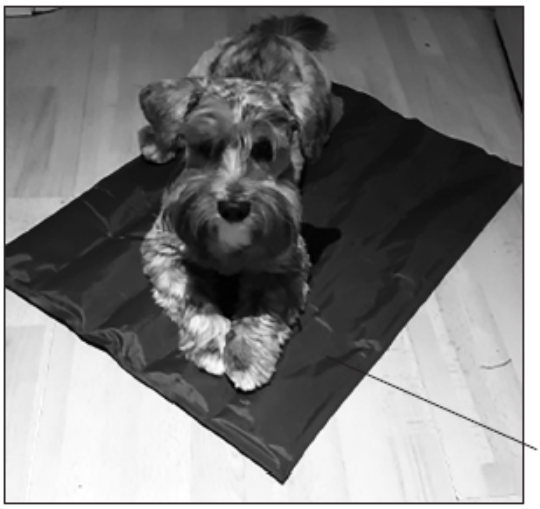
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(Total for question = 11 marks)

Q5.

A dog sits on a water-filled bag to keep cool.



(a) The table shows some data about the dog and the water in the bag.

mass of water in kg	8.7
power output of dog by heating in W	75
specific heat capacity of water in J/kg °C	4200
initial temperature of water in °C	16

The dog sits on the bag for 22 minutes.

(i) Calculate the energy transferred from the dog to the water by heating in 22 minutes.

(3)

energy = ... J

(ii) State an assumption you have made when calculating the energy transferred.

(1)

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(iii) Calculate the temperature of the water after 22 minutes.

(4)

temperature = ... °C

(b) Discuss why conduction is the main way that thermal energy is transferred from the dog to the water.

(3)

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(Total for question = 11 marks)

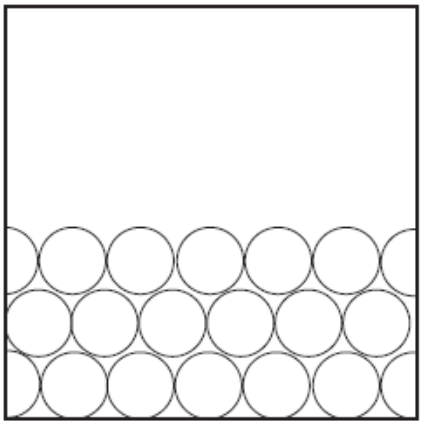
Q6.

This question is about liquid nitrogen.

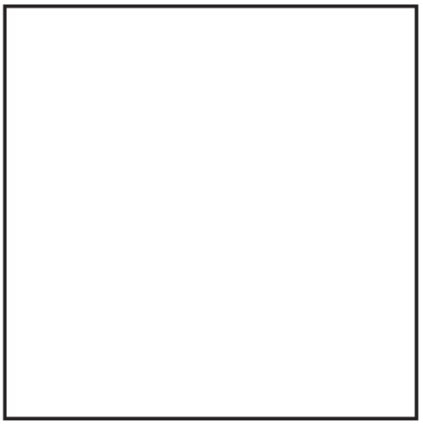
(a) (i) The diagram shows the arrangement of particles in solid nitrogen.

Draw the arrangement of particles in liquid nitrogen.

(2)



solid



liquid

(ii) Describe the motion of the particles in liquid nitrogen.

(1)

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(b) A teacher uses this method to find the density of liquid nitrogen.

- measure the mass of a container
- pour liquid nitrogen into the container
- measure the total mass of the container and the liquid nitrogen
- read the volume of the liquid nitrogen from the scale on the side of the container

(i) Give a safety precaution the teacher should take when pouring the liquid nitrogen.

(1)

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(ii) State the name of the apparatus that the teacher should use to measure the mass of the container.

(1)

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(iii) The table shows the teacher's results.

mass of container in g	75
mass of container + liquid nitrogen in g	149
volume of liquid nitrogen in cm^3	88

Calculate the mass of liquid nitrogen in the container.

(1)

mass = ... g

(iv) State the formula linking density, mass and volume.

(1)

(v) Calculate the density of the liquid nitrogen.

Give a suitable unit.

(3)

density = ...unit = ...

(c) Over time, the liquid nitrogen warms up and changes state from a liquid into a gas.

Describe the changes to the arrangement and motion of particles when the liquid nitrogen changes state.

(3)

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(Total for question = 13 marks)

Q7.

Energy is transferred from the Sun to the Earth.

(a) Nuclear fusion happens in the Sun.

(i) Which energy store of the Sun decreases during nuclear fusion?

(1)

☒ **A** chemical

☒ **B** kinetic

☒ **C** nuclear

☒ **D** thermal

(ii) How is energy transferred through space from the Sun to the Earth?

(1)

☒ **A** by heating

☒ **B** by radiation

☒ **C** electrically

☒ **D** mechanically

(b) Solar panels use energy from the Sun to heat water.



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(i) The total area of the solar panels is 15 m^2.

Each 1.0 m^2 of the solar panels receives 1000 J of energy per second from the Sun.

Show that the total energy transferred to the solar panels in 2 hours is about 100 MJ.

(3)

(ii) A mass of 1100 kg of cold water is in the solar panels at an initial temperature of 20 °C.

Calculate the final temperature of this water after it has been heated by the Sun for 2 hours.

[specific heat capacity of water = 4200 J/kg °C]

(4)

final temperature = ... °C

(iii) Give a reason why the actual final temperature of the water will be lower than the calculated value.

(1)

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(Total for question = 10 marks)

Q8.

This question is about heating water.

(a) Liquid water boils and becomes a gas at 100 °C.

Describe the differences between the arrangement and motion of particles in a liquid and in a gas.

You may include a diagram in your answer.

(3)

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(b) A teacher uses a 2200 W kettle to heat water.

The kettle is switched on for 2 minutes.

(i) Calculate the energy transferred by the kettle.

(3)

energy transferred = ... J

(ii) State the equation relating change in thermal energy, mass, specific heat capacity and change in temperature.

(1)

.....

(iii) The mass of water in the kettle is 1.1 kg and its initial temperature is 20 °C.

Calculate the final temperature of the water after it has been heated for 2.0 minutes.

[the specific heat capacity of water is 4200 J/kg °C]

(4)

final temperature = ... °C

(c) The teacher measures the final temperature of the water after heating it for 2 minutes.

(i) Name a piece of equipment the teacher could use to measure the temperature of the water.

(1)

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(ii) Explain why the measured final temperature is different from your calculated value.

(2)

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(Total for question = 14 marks)

Q9.

This question is about solids, liquids and gases.

(a) Melting is the process that occurs when a solid changes into a liquid.

Using ideas about particles, describe the process of melting.

(2)

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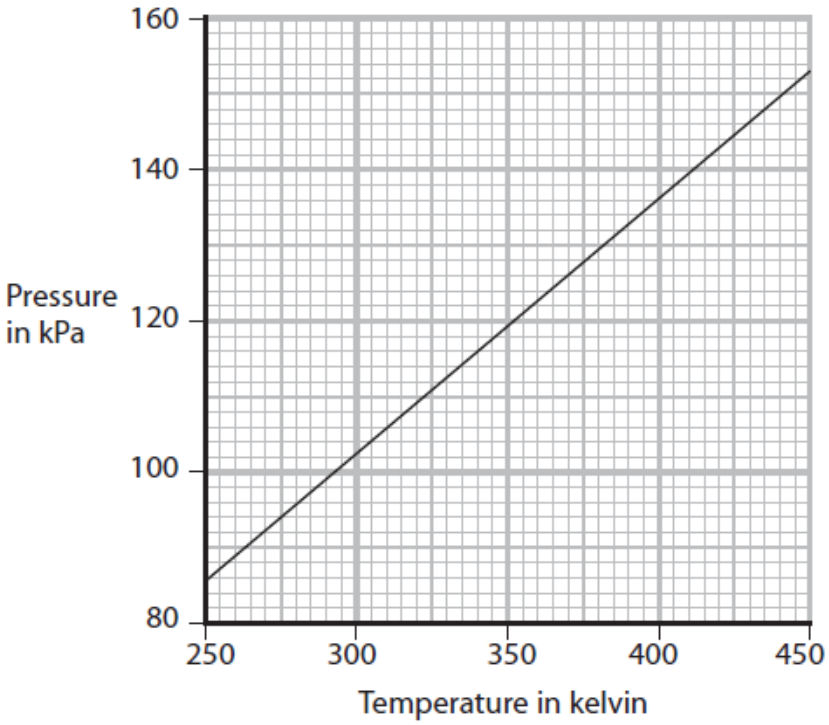
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(b) A sealed metal flask contains air at room temperature.

The flask is then heated.

The graph shows how the pressure of the air increases as its temperature increases.



(i) Explain how heating the flask increases the temperature of the air inside the flask.

(2)

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(ii) Explain why the pressure of the air increases as its temperature increases.

(2)

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(iii) Using the graph, determine the pressure of the air when its temperature is 400 K.

(1)

pressure = ... kPa

(iv) The air in the flask is now cooled to a temperature of 230 K.

Calculate the new pressure of the air.

(3)

pressure = ... kPa

(Total for question = 10 marks)

Q10.

This question is about specific heat capacity.

(a) State what is meant by the term **specific heat capacity**.

(2)

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(b) A student uses this method to measure the specific heat capacity of water.

- place an aluminium block of known mass in an oven at a temperature of 220 °C
- place water of known mass in a container at a temperature of 20 ° C
- leave the aluminium block in the oven for 10 minutes
- remove the aluminium block from the oven and place the block in the water
- measure the maximum temperature of the water after it has been heated by the aluminium block

The student uses their data to calculate the specific heat capacity of water.

Give two ways that they could improve their method to increase the accuracy of their value of specific heat capacity.

(2)

1 .....

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2 .....

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(c) The box shows the student's data.

Mass of aluminium block = 1.6 kg

Mass of water = 2.3 kg

Initial temperature of water = 20 °C

Maximum temperature of water = 38 °C

(i) When the water reaches its maximum temperature, the water and aluminium block are in thermal equilibrium.

State the temperature of the aluminium block as it reaches thermal equilibrium with the water.

(1)

temperature of aluminium = ... °C

(ii) Calculate the temperature change of the water when it has been heated to its maximum temperature.

(1)

temperature change of water = ... °C

(iii) The water gains 190 000 J of energy in its thermal store as it is heated to its maximum temperature.

Calculate the specific heat capacity of water.

(3)

specific heat capacity of water = ... J / kg °C

(d) After finishing the experiment, the student removes the aluminium block and places the container of water into a freezer.

The water loses energy at a constant rate and cools from 38 °C to –20 °C.

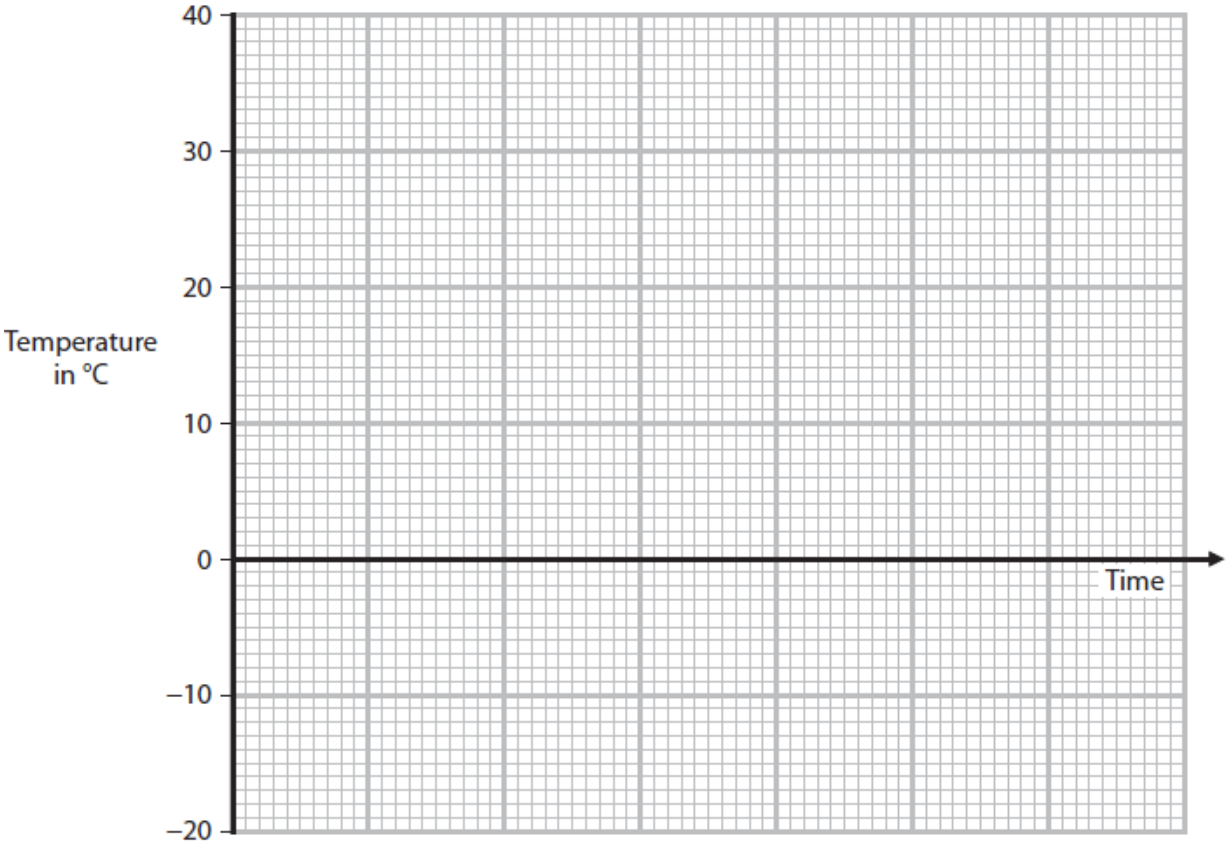
The water freezes and turns into ice at 0 °C.

Ice has a lower specific heat capacity than water.

Use the axes to sketch a temperature-time graph from when the water is placed in the freezer until it reaches its lowest temperature.

No calculations are required.

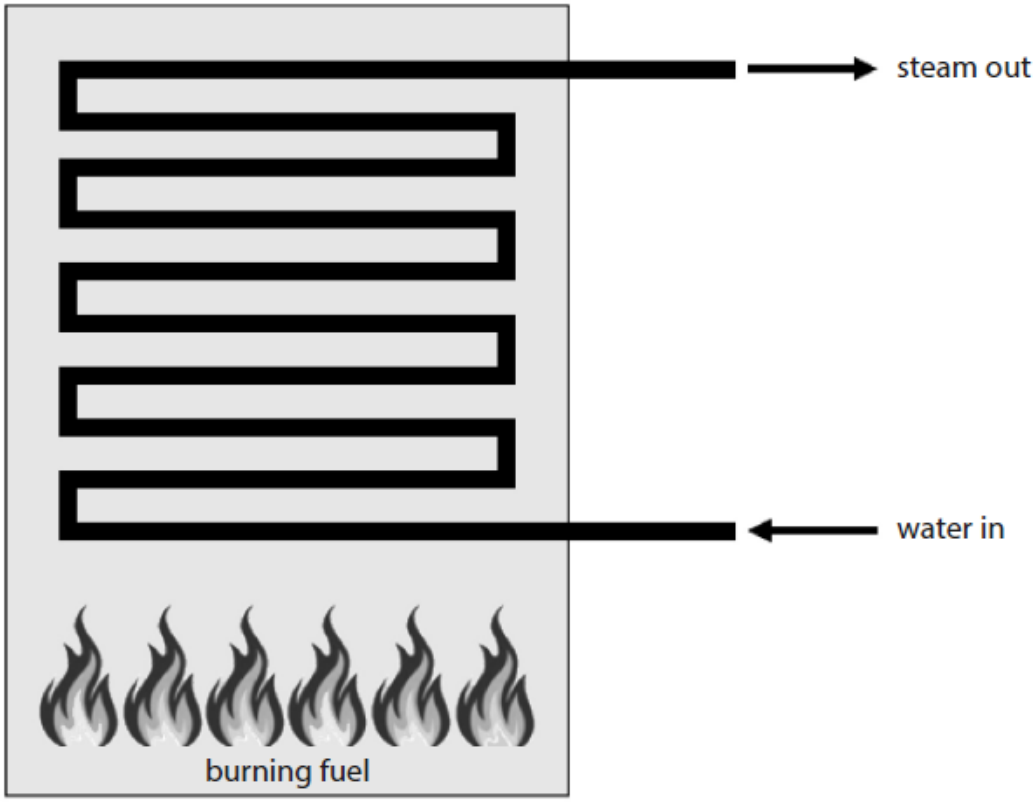
(4)



(Total for question = 13 marks)

Q11.

Conventional power stations burn fuel in a furnace.



(a) The fuel can be a solid, a liquid or a gas.

Describe the motion of particles in a solid, a liquid and a gas.

(3)

solid

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liquid

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gas

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(b) When the fuel is burned, energy is transferred from the fuel to the water.

The water boils and turns into steam.

(i) Describe how energy stored in the fuel is transferred to the water.

Refer to energy stores and transfers in your answer.

(3)

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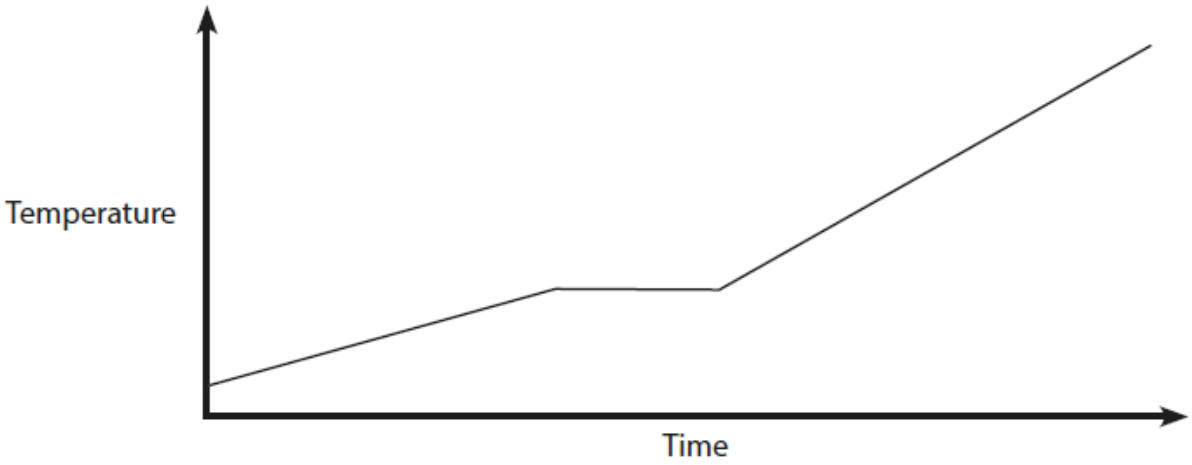
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(ii) The temperature-time graph shows how the temperature of the water changes as it is heated in the furnace at a constant rate.



Explain how the graph shows that the water changes state as it is heated.

(2)

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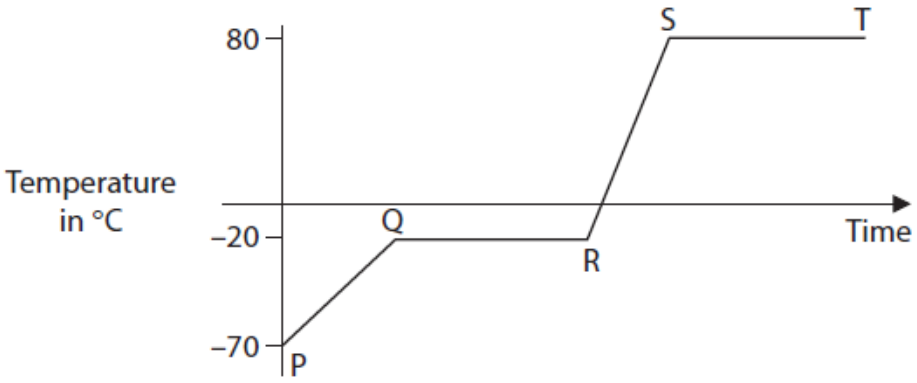
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(Total for question = 8 marks)

Q12.

The diagram shows the temperature-time graph for a substance which is heated at a constant rate.



(a) (i) Which section of the graph shows when the substance is melting?

(1)

☒ **A** PQ

☒ **B** QR

☒ **C** RS

☒ **D** ST

(ii) Which section of the graph shows when all the substance is a solid?

(1)

☒ **A** PQ

☒ **B** QR

☒ **C** RS

☒ **D** ST

(iii) Draw particles in the box to show the arrangement of particles when the substance is a gas.

(1)



(iv) Which of these statements best describes the motion of particles in a gas?

(1)

☒ **A** they vibrate about fixed points

☒ **B** they are stationary

☒ **C** they slide past each other

☒ **D** they move quickly and randomly

(b) (i) Name a piece of apparatus that could be used to measure the temperature of the substance.

(1)

.....

(ii) Determine the boiling point of this substance.

(1)

boiling point = ... °C

(c) The substance has a mass of 1.2 kg.

Calculate the energy required to raise the temperature of the substance from 10 °C to 37 °C.

[assume specific heat capacity of substance = 840 J/kg °C]

(3)

energy = ... J

(Total for question = 9 marks)

Q13.

A student uses a small iron nail and a beaker of water to estimate the temperature of a flame. The diagram shows some of the equipment used.



This is the student's method

- place a thermometer into the beaker of water
- record the temperature of the water
- heat the nail in the flame for a long period of time
- quickly move the nail into the beaker of water
- record the highest temperature of the water

(a) State a safety precaution the student should take.

(1)

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(b) While in the water, the thermal energy store of the nail decreases and the thermal energy store of the water increases until their temperatures are the same.

The energy lost from the nail is equal to the energy gained by the water.

The table shows the student's results.

Mass of water in g	138
Specific heat capacity of water in J/kg °C	4200
Temperature change of water in °C	5.0
Mass of nail in g	4.8
Specific heat capacity of iron in J/kg °C	450

(i) Show that the energy gained by the water is approximately 3000 J.

(2)

(ii) Calculate the temperature change of the nail.

(3)

Temperature change = ... °C

(iii) Give a reason why the calculated temperature change of the nail is lower than the actual temperature change.

(1)

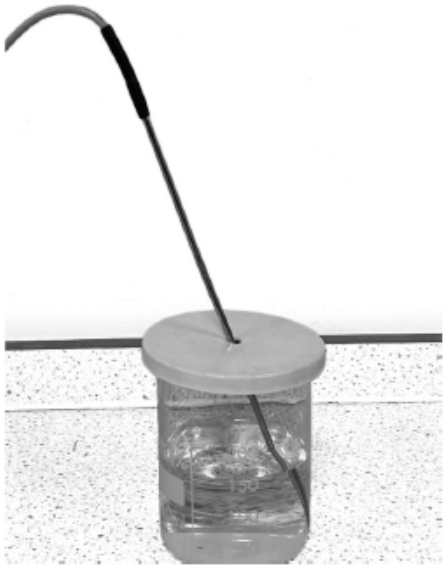
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(Total for question = 7 marks)

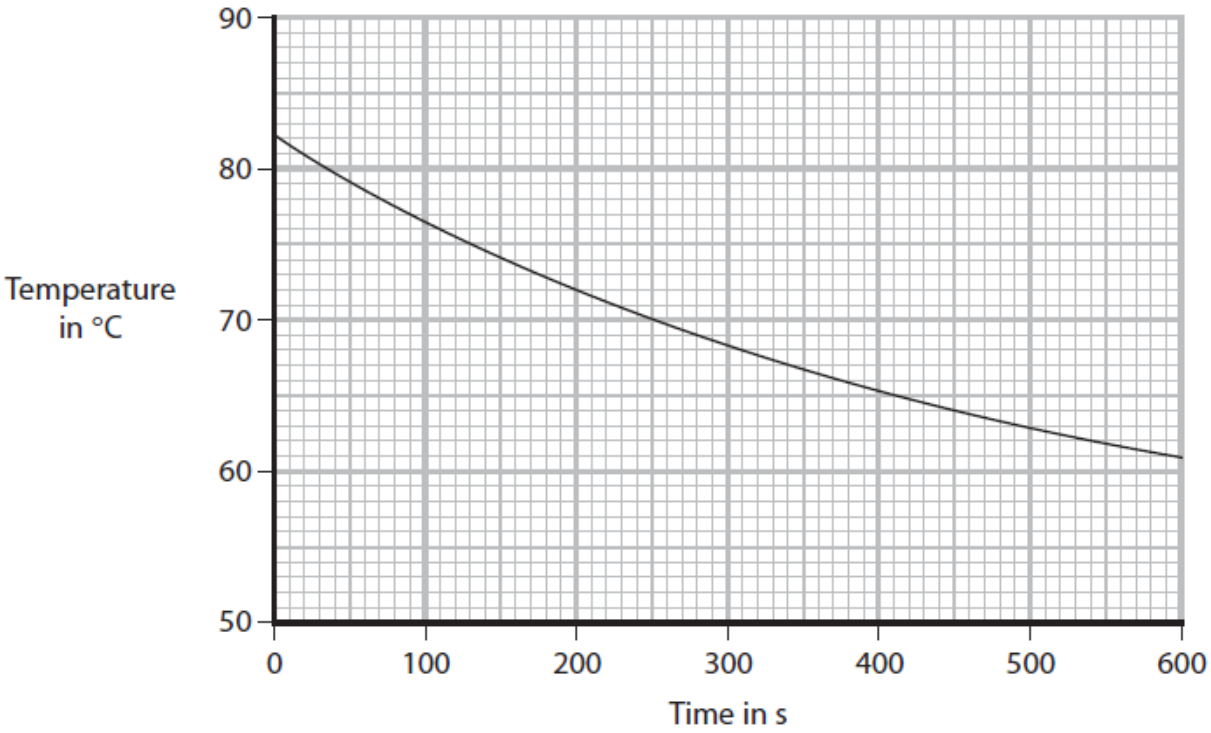
Q14.

A student investigates the rate of cooling of water in a beaker.



The student pours boiling water into a beaker and monitors the temperature of the water for a period of time.

The graph shows the student's results.



(a) The rate of cooling is represented by the gradient of the graph and is measured in °C/s.

By drawing a tangent to the curve, determine the rate of cooling of the water at 70 °C.

(4)

rate of cooling = ... °C/s

(b) The student repeats the investigation with the same beaker wrapped in woollen insulation.



Sketch another line on the graph to show the expected results when the beaker is wrapped in woollen insulation.

Assume that the starting temperature of the water is 82 °C.

(2)

(Total for question = 6 marks)

Q15.

A student heats a sample of water.

The student measures the temperature of the sample of water during heating.

(a) The sample of water has a mass of 0.45 kg.

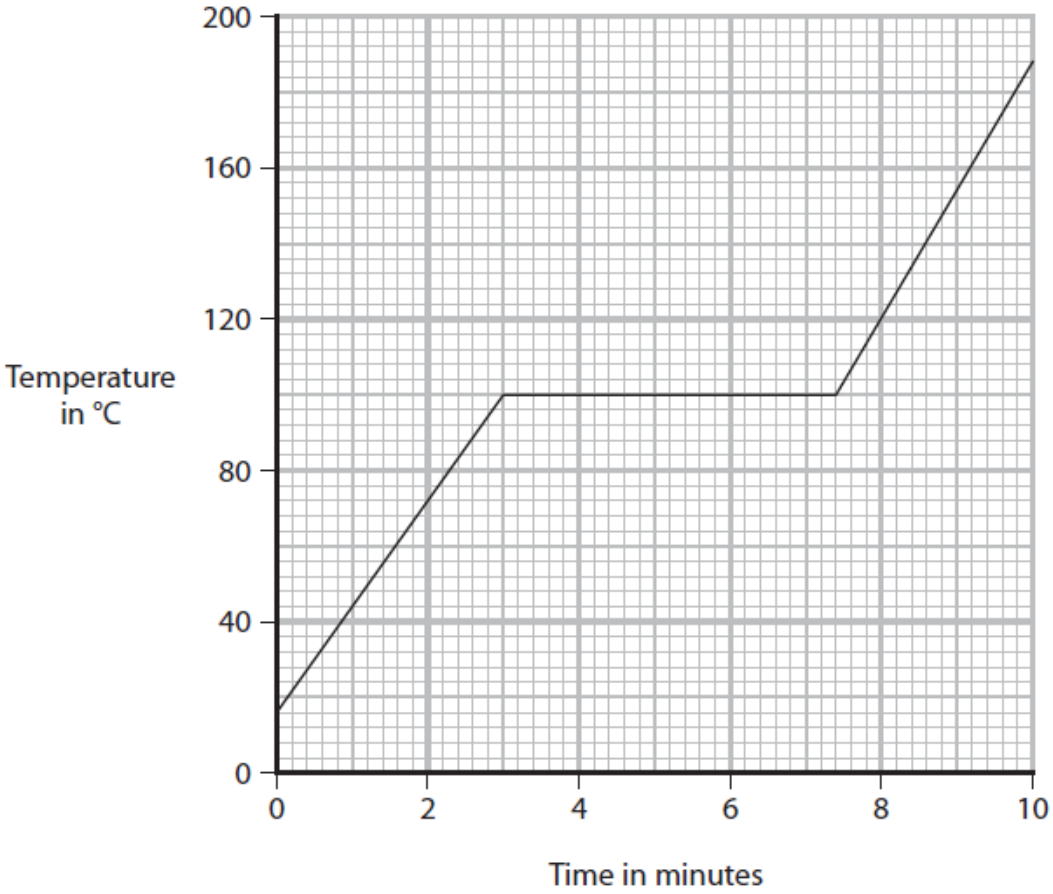
Calculate the energy required to increase the temperature of the water from 16 °C to 100 °C.

[specific heat capacity of water = 4200 J / kg °C]

(3)

energy = ... J

(b) The diagram shows the temperature-time graph for the sample of water.



(i) Use the graph to determine the time taken from when the water started to boil to when the water stopped boiling.

(1)

time taken = ... minutes

(ii) The heater used to heat the water has a power rating of 2200 W.

Calculate the energy required to boil all of the water.

(3)

energy = ... J

(c) Give a reason why the liquid water should be stirred during the heating.

(1)

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(d) When water boils, the liquid water becomes a gas called steam.

Describe the changes in arrangement and motion of the molecules in liquid water and the molecules in steam.

(4)

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(Total for question = 12 marks)

Q16.

The Parker Solar Probe is a spacecraft that was launched in 2018 on a mission to explore the Sun.

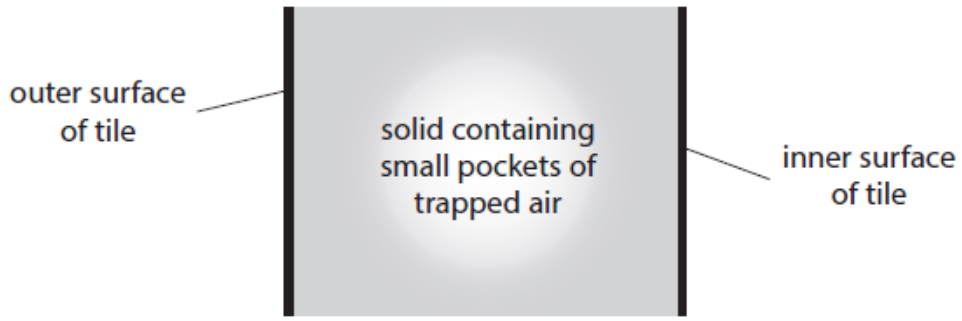
The spacecraft is partly covered in tiles.

These tiles are filled with a solid containing small pockets of trapped air.

The outer surface of the tiles is painted white.

These tiles protect the electric circuits in the spacecraft from extreme temperatures.

(a) The diagram shows one of these tiles in cross-section.



(i) Explain why the outer surface of the tile is painted white.

(2)

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(ii) Explain how the small pockets of trapped air help to reduce thermal energy transfer from the outer surface to the inner surface of the tile.

(2)

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(b) The electric circuits inside the spacecraft are cooled by 4.5 kg of water.

The initial temperature of the water is 35 °C.

The thermal store of the water increases by 210 kJ.

Calculate the final temperature of the water.

[specific heat capacity of water = 4200 J/kg °C]

(4)

final temperature = ... °C

(Total for question = 8 marks)