Questions

Q1.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Solid, liquid and gas are states of matter.

Which process describes the change from a solid to a liquid?

(1)

☒ **A** melting

☒ **B** freezing

☒ **C** evaporation

☒ **D** condensation

(Total for question = 1 mark)

Q2.

The student decides to measure the temperature of the water every minute while it is being heated.

Figure 18 shows a graph of the student's results.

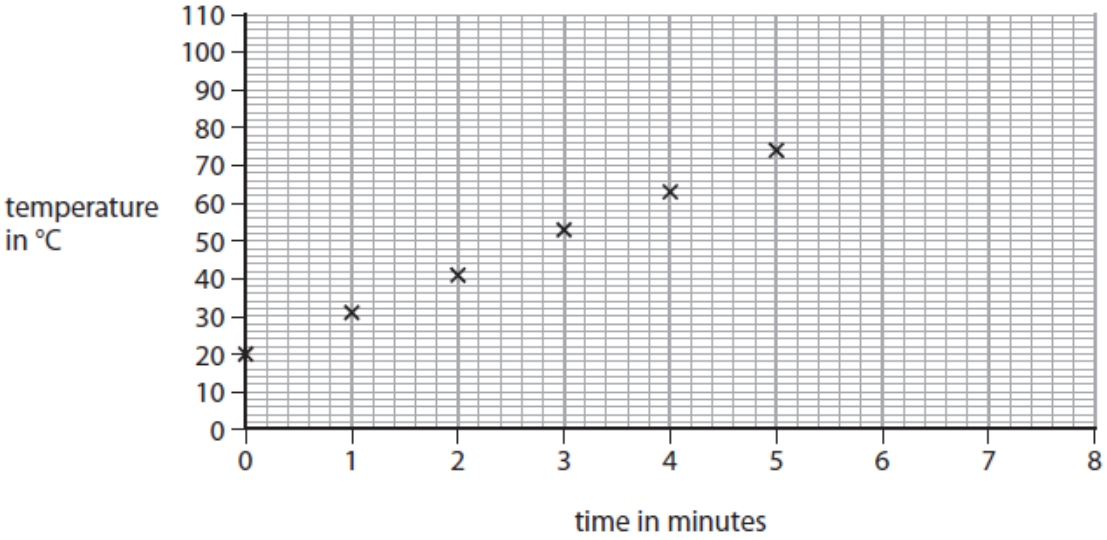

Figure 18

Predict the temperature of the water if the heating continues up to 8 minutes.

(1)

temperature of the water = ... °C

(Total for question = 1 mark)

Q3.

Another student decides to melt some ice.

The student melts 380 g of ice at 0 °C.

The specific latent heat of fusion of ice is 3.34×10^5 J/kg.

Calculate the thermal energy needed to melt the ice.

Select an equation from the list of equations at the end of this paper.

(2)

thermal energy needed = ... J

(Total for question = 2 marks)

Q4.

An electric heater is used to heat some water.

Figure 8 shows the experimental setup used.

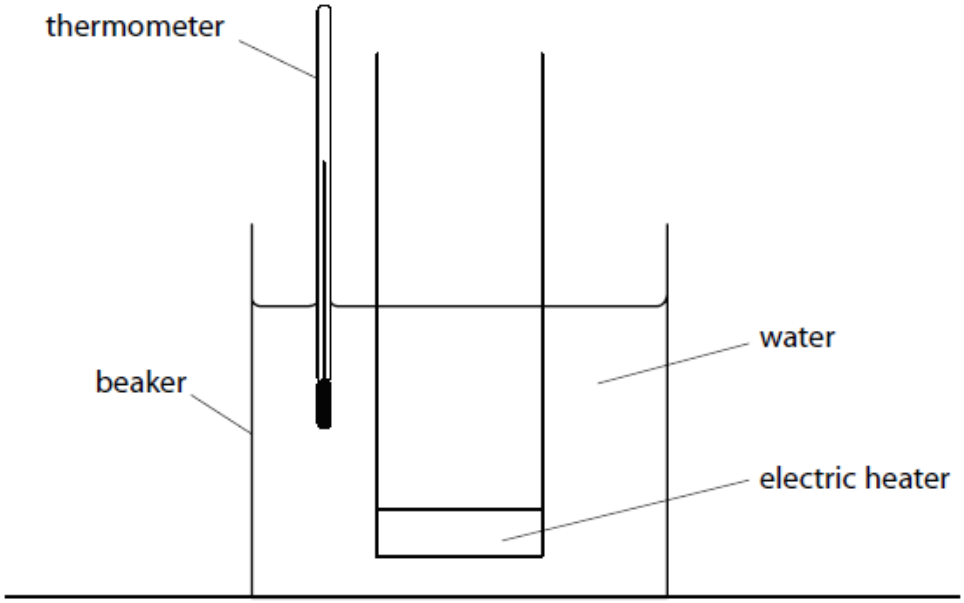

Figure 9 shows the energy transferred by the electric heater in 1 second.

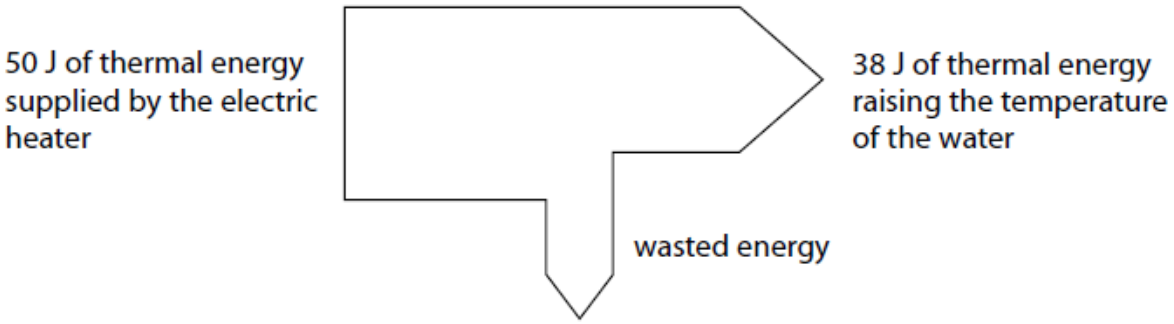

Figure 9

Explain **one** way the experiment can be improved to reduce the amount of wasted energy.

(2)

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(Total for question = 2 marks)

Q5.

An electric kettle is used to boil some water.

While the water is boiling, 566 000 J of thermal energy turns 0.250 kg of water into steam.

Calculate the specific latent heat of vaporisation of water.

Use an equation selected from the list of equations at the end of this paper.

(3)

specific latent heat = ... J/kg

(Total for question = 3 marks)

Q6.

An electric heater is used to heat some water.

Figure 8 shows the experimental setup used.

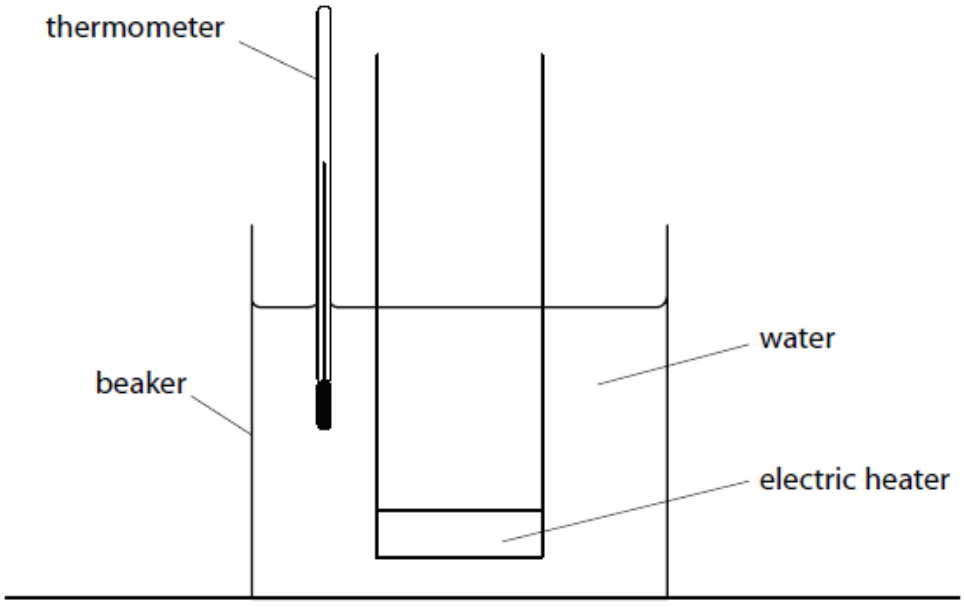

Figure 8

The initial mass of the water in the beaker is 0.72 kg.

The electric heater is switched on for some time and the water boils.

The mass of the water after the heater is switched off is 0.60 kg.

The thermal energy transferred to the water while it boils is 270 000 J.

Use an equation from the formula sheet to calculate the specific latent heat of the water.

(3)

specific latent heat = ... J/kg°C

(Total for question = 3 marks)

Q7.

As part of the testing of different types of steel, a steelworker needs to obtain a temperature-time graph for **solidifying** molten steel.

Figure 9 shows an arrangement the steelworker could use.

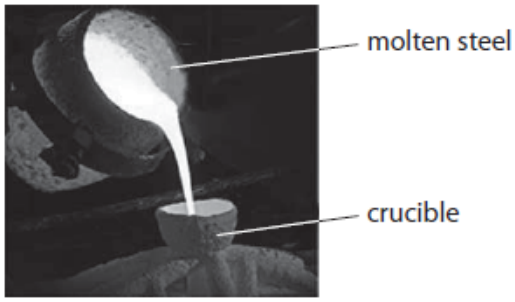

Figure 9

The following devices are available to the steel worker.
The melting point of these steels is between 1425 and 1540 °C

device	range of temperatures	other notes
Thermocouple thermometer	−50 to 1800 °C	Fast response time Probe inserted into melt
Infrared thermometer (pyrometer)	1200 to 2000 °C	Remotely read, using infrared radiation, measures the temperature of the surface it is aimed at
Platinum resistance thermometer	−200 to 850 °C	The most accurate of thermometers based on how resistance changes with temperature

Describe how the steelworker could obtain a temperature-time graph for steel as it goes from the liquid to the solid state.

(4)

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(Total for question = 4 marks)

Q8.

The espresso machine shown in Figure 27 is an electrical appliance.

(Source: © tanawaty/123RF)

Figure 27

The espresso machine has an electrical heater connected to a 440 V mains supply.

The power of the electrical heater is 3.5 kW.

(i) The rating of a fuse is the current above which it melts.

Which of these is the most suitable fuse for the espresso machine circuit?

(1)

☒ **A** 1 A

☒ **B** 5 A

☒ **C** 10 A

☒ **D** 13 A

(ii) Before the espresso machine can be used, its heater must raise the temperature of some cold water.

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

Show that it takes the heater about 90 s to raise the temperature of 1 kg of water from 18°C to 95°C.

Use an equation from the formula sheet.

(3)

(Total for question = 4 marks)

Q9.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A student determines the density of a liquid.

The student puts an empty measuring cylinder on a balance (Figure 10a).
The student then adds liquid to the measuring cylinder (Figure 10b).

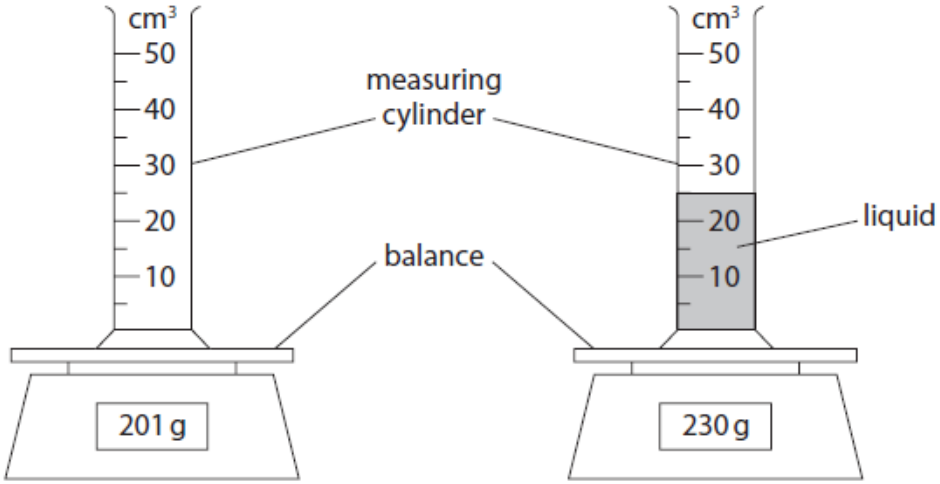

Figure 10a **Figure 10b**

Calculate the mass of liquid added and the volume of liquid added.

Use the information in Figures 10a and 10b.

(i) mass of liquid added = ... g

(1)

(ii) volume of liquid added = ... cm^3

(1)

(iii) Which equation should the student use to calculate the density of the liquid?

(1)

☒ **A** density = mass + volume

☒ **B** density = mass − volume

☒ **C** density = mass × volume

☒ **D** $\text{density} = \frac{\text{mass}}{\text{volume}}$

(iv) State **two** improvements the student could make to this investigation.

(2)

1 .....

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2 .....

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(Total for question = 5 marks)

Q10.

(i) Figure 11 shows an electric kettle.

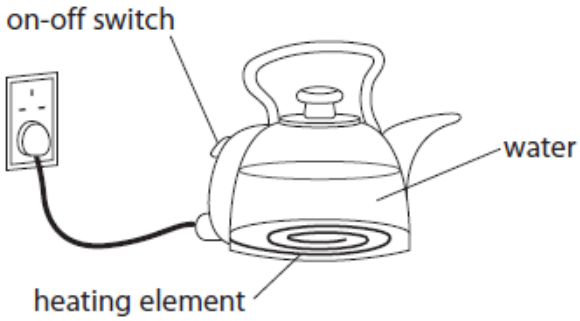

Figure 11

The kettle contains 1.5 kg of water.

The kettle is switched on.

Calculate the energy needed to raise the temperature of the water by 50 °C.

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

Use the equation

$$\Delta Q = m \times c \times \Delta\theta$$

(2)

energy needed = ... J

(ii) The amount of energy, *E*, needed to bring the water to boiling point is 670 000 J.

The kettle has a power of 3500 W.

Calculate the time, *t*, it takes to bring the water to boiling point.

Use the equation

$$P = \frac{E}{t}$$

(3)

time to bring the water to boiling point = ... s

(Total for question = 5 marks)

Q11.

A student sets up an experiment to measure the specific heat capacity of a metal.

Figure 8 shows the apparatus.

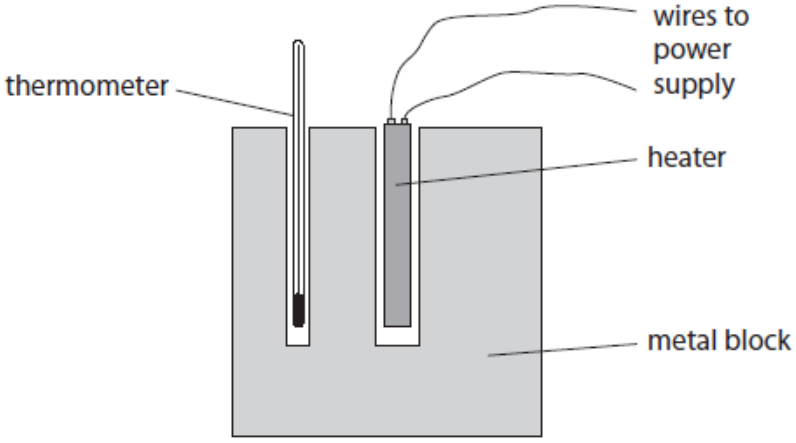

Figure 8

The heater is connected to a power supply and has a power of 50 W.

The student switches on the heater and measures the temperature rise after 5 minutes.

(i) State **two** improvements the student could make to the experiment.

(2)

1 .....

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2 .....

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(ii) Figure 9 shows the student's results.

mass of metal block	0.92 kg
power of heater	50 W
starting temperature	20 °C
finishing temperature	54 °C
time	300 s

Figure 9

Use the data in Figure 9 to calculate a value for the specific heat capacity of the metal.

Use the equation

$$\text{specific heat capacity} = \frac{\text{power} \times \text{time}}{\text{mass} \times \text{temperature rise}}$$

(3)

specific heat capacity = ... J/kg °C

(Total for question = 5 marks)

Q12.

* Describe how a student should carry out an experiment to determine the specific heat capacity of water.

(6)

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(Total for question = 6 marks)

Q13.

A student uses the apparatus in Figure 17 to determine the specific heat capacity of water.

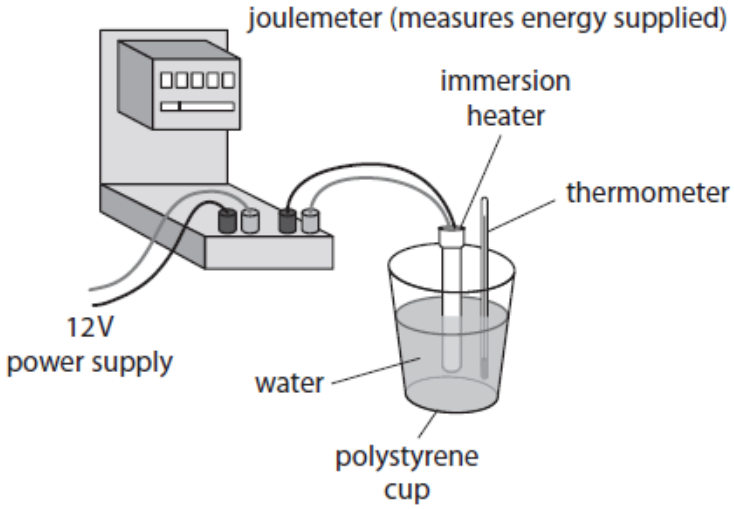

Figure 17

(i) State the measurements needed to calculate the specific heat capacity of water.

(4)

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(ii) State **two** ways that the apparatus could be adapted to improve the procedure.

(2)

1 .....

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2 .....

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(Total for question = 6 marks)

Q14.

A beaker contains 0.25 kg of water at room temperature.
The beaker of water is heated until the water reaches boiling point (100 °C).
The specific heat capacity of water is 4200 J/kg °C.
The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

temperature before heating = ... °C

(ii) The heating continues until 0.15 kg of the water has turned into steam.

The thermal energy needed to turn the boiling water into steam is 0.34 MJ.

Calculate the specific latent heat of vapourisation of water.
Use an equation selected from the list of equations at the end of this paper.

(2)

specific latent heat = ... MJ/kg

(iii) The graph in Figure 13 shows how the **volume** of 1 kg of water changes with temperature.

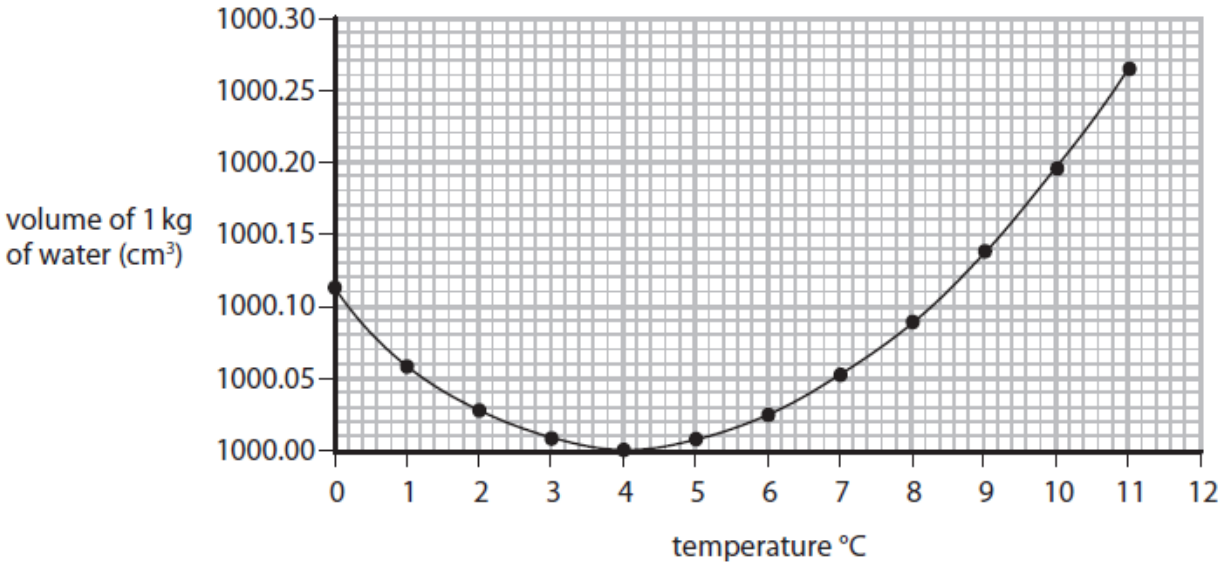

Figure 13

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 13.

Calculations are not required.

(2)

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(Total for question = 7 marks)

Q15.

A steel ball has a volume of 3.6 cm^3 and a mass of 28 g.

(i) Calculate the density of steel in kg/m3.

(3)

density = ... kg/m^3

(ii) The steel ball is at a room temperature of 20 °C.

It is then put in a pan of boiling water maintained at 100 °C.

Calculate how much thermal energy the ball gains as its temperature increases from 20 °C to 100 °C.

Specific heat capacity of steel = 510 J/kg °C

Use an equation selected from the list of equations at the end of this paper.

(2)

thermal energy gained = ... J

(iii) The steel ball is put into a furnace where it melts.

Compare the motion of particles in the steel when they are in the solid state with their motion when in the molten (liquid) state.

(3)

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(Total for question = 8 marks)

Q16.

The espresso machine shown in Figure 27 is an electrical appliance.

(Source: © tanawaty/123RF)

Figure 27

The espresso machine has a steam pipe that can be used to heat milk in a jug, as shown in Figure 28.

(Source: © Wavebreak Media Ltd/123RF)

Figure 28

Steam from the pipe enters the milk, where steam condenses to water.

The steam and hot water heat the milk.

(i) Describe, in terms of energy, how the arrangement and movement of particles in the steam changes as the steam enters the milk, condenses and cools.

(2)

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(ii) The specific heat capacity of milk is 3840 J/kg K.

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

The specific latent heat of condensation of steam is 2260 kJ/kg.

The temperature of the steam is 100°C

The mass of steam that condenses is 25 g.

The temperature of the milk rises from 5°C to 65°C.

By considering the transfer of energy from the steam to the milk, calculate the mass of milk that is heated by the steam and hot water.

Use equations from the formula sheet.

(4)

mass of milk = ... kg

(iii) Give **two** reasons why the actual mass of steam needed to heat the milk from 5°C to 65°C is greater than 25 g.

(2)

1 .....

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2 .....

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(Total for question = 8 marks)