3.1 Thermal Concepts

Question Paper

Course	DP IB Physics
Section	3. Thermal Physics
Topic	3.1 Thermal Concepts
Difficulty	Easy

Time allowed: 60

Score: /49

Percentage: /100

Question 1a

(a)

Define the specific latent heat of fusion of a substance.

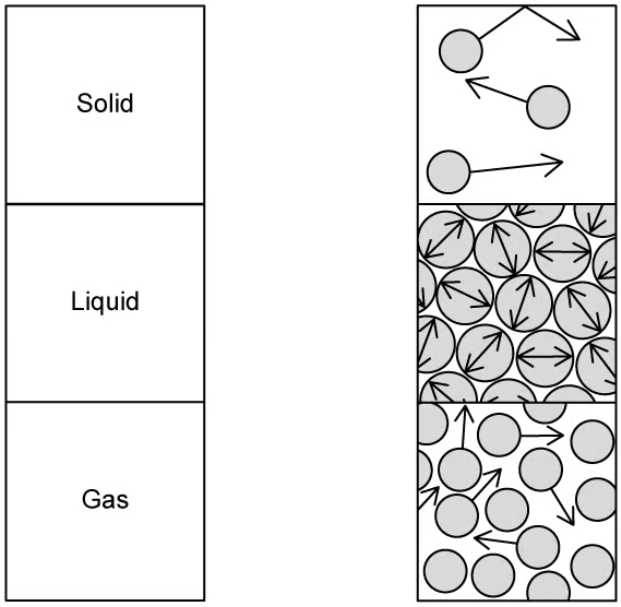
[2]

[2 marks]

Question 1b

(b)

Draw a line to indicate which molecular model of matter matches with which state.



[3]

[3 marks]

Question 1c

The following statements are about the molecular model of matter.

The potential energy changes during change of _____.

Potential energy is greater for _____ than for _____ more energy is required to _____ bonds than just _____ them.

Therefore, specific latent heat of _____ is _____ than specific latent heat of _____ for any substance.

(c)
Complete the missing gaps using keywords from the list provided.
You may use any keyword once, more than once, or not at all.

weaken
fusion
break
greater
vaporisation
less
state

[3]

[3 marks]

Question 1d

A 2.5 g block of ice is placed into a beaker of water where 825 J of energy is needed to melt the ice completely.

(d)

(i) Calculate the specific latent heat of fusion of ice.

[3]

(ii) State an assumption that you have made in your answer to part (i).

[1]

[4 marks]

Question 2a

a)
Define specific heat capacity.

[2]

[2 marks]

Question 2b

The change in thermal energy, Q is given by the equation:

$$Q = mc\Delta T$$

(b)
Define the following variables and state an appropriate unit for each:

(i)
m

[1]

(ii)
c

[1]

(iii)
ΔT

[1]

[3 marks]

Question 2c

A hot piece of copper is placed into a container of cold water. After a time, the copper and water reach thermal equilibrium.

(c)
Outline how it would be known when the copper and water reach thermal equilibrium.

[1]

[1 mark]

Question 2d

The following data are available:

Energy transferred to water = 5.6 kJ

Mass of copper = 0.72 kg

Specific heat capacity of copper = 389 $J\,kg^{-1}\,K^{-1}$

(d)
Calculate the change in temperature of the copper.

[4]

[4 marks]

Question 3a

(a)
Define internal energy

[2]

[2 marks]

Question 3b

The fraction of the internal energy that is due to molecular vibration varies in the different states of matter.

(b)
Arrange the following states of matter from highest to lowest fraction of internal energy due to molecular vibration.

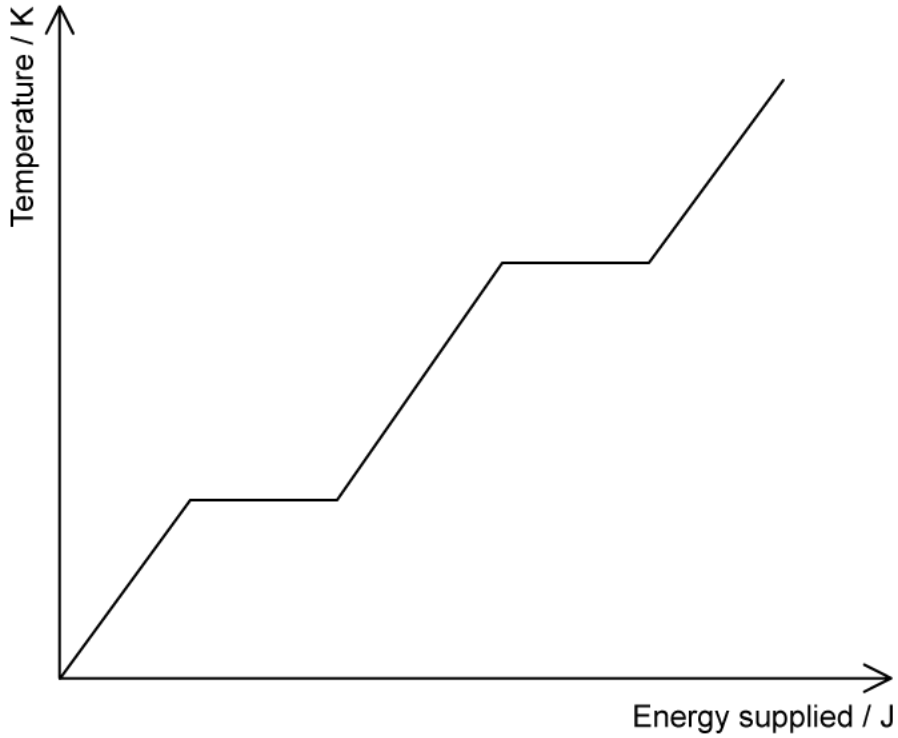
Gas	Solid	Liquid

[1]

[1 mark]

Question 3c

The heating graph shows the change in temperature against energy supplied for a specific substance.



(c)
Label the following on the graph:

(i)
Solid, liquid and gas

[1]

(ii)
Melting and boiling

[1]

[2 marks]

Question 3d

(d)
Label on the graph in part (c) the freezing point and the boiling point on the temperature axis.

[2]

[2 marks]

Question 4a

(a)
Define thermal energy.

[1]

[1 mark]

Question 4b

An immersion heater is placed in a beaker containing 350 g of water at a temperature of 15 °C. After some time, the temperature of the water is 42 °C. The thermal capacity of the beaker is negligible and the specific heat capacity of water is $4.2 \times 10^{3}\ \text{J kg}^{-1}\ \text{K}^{-1}$.

(b)
Estimate the change in internal energy of the water.

[4]

[4 marks]

Question 4c

The water is further heated until it starts to boil at constant temperature.

(c)
Choose the correct word in the explanation for this scenario:

All the (internal / thermal) energy is used to (separate / fuse) the molecules and not to increase their average (potential / kinetic) energy

[3]

[3 marks]

Question 4d

(d)
If water had a higher specific heat capacity, state two differences this would make to boiling water using an immersion heater.

[2]

[2 marks]

Question 5a

(a)
Define the latent heat of vaporisation of a substance.

[2]

[2 marks]

Question 5b

(b)
Place a tick (✓) next to the correct phase change for using specific latent heat of vaporisation and fusion in the following table.

	Evaporation	Melting	Freezing	Condensation
Latent heat of vaporisation				
Latent heat of fusion				

[2]

[2 marks]

Question 5c

The energy required to change the phase of a substance is given by

$$Q = mL$$

(c)
Define the following variables and state an appropriate unit for each:

(i)
m

[1]

(ii)
L

[1]

[2 marks]

Question 5d

3400 J of energy is needed to convert 16 g of oxygen from solid to a liquid.

(d)
Calculate the latent heat of vaporisation of oxygen.

[4]

[4 marks]