3 **(a)** Define specific latent heat.

....

....

.... [2]

(b) Explain why, for a substance, the specific latent heat of vaporisation is usually greater than the specific latent heat of fusion.

....

....

....

....

.... [3]

(c) An ice cube of mass 37.0 g at temperature 0.0 °C is placed in a beaker containing water of mass 208 g at temperature 26.4 °C.

When all the ice has melted, and all the water in the beaker has reached thermal equilibrium, the final temperature of all the water is 10.3 °C.

The specific heat capacity of water is $4.18\,\mathrm{J\,g^{-1}\,°C^{-1}}$.

The beaker has negligible specific heat capacity and is perfectly insulated from the surroundings.

Determine a value, to three significant figures, for the specific latent heat of fusion of water.

specific latent heat of fusion = ... $\mathrm{J\,g^{-1}}$ [4]

[Total: 9]

3 **(a)** Define specific heat capacity.

....

....

.... [2]

(b) A block of aluminium has a volume of $3.612 \times 10^{-3}\,m^3$ at a temperature of $0\,°C$.

Aluminium has a density of $2.700 \times 10^3\,kg\,m^{-3}$ at $0\,°C$.
It has a density of $2.620 \times 10^3\,kg\,m^{-3}$ at $500\,°C$.

The block is heated so that its temperature increases from $0\,°C$ to $500\,°C$ at an atmospheric pressure of $1.01 \times 10^5\,Pa$.
The increase in internal energy of the block is 4.38 MJ.

(i) Calculate the mass of the block.

mass = ... kg [2]

(ii) Show that the volume of the block at a temperature of $500\,°C$ is $3.722 \times 10^{-3}\,m^3$.

[1]

(iii) Use the information in **(b)(ii)** to determine the magnitude of the work done on the block when its temperature is raised from $0\,°C$ to $500\,°C$.

work done = ... J [2]

(iv) Explain whether the work done on the block is positive or negative.

....

....

.... [2]

(v) Use the first law of thermodynamics to determine, to three significant figures, a value for the specific heat capacity of aluminium. Explain your reasoning. Give a unit with your answer.

specific heat capacity = ... unit .... [3]

(c) Without further calculation, suggest with a reason how doubling the pressure in **(b)** is likely to affect the answer in **(b)(v)**.

....

....

.... [1]

[Total: 13]

3 **(a)** Define specific latent heat.

....

....

.... [2]

(b) Explain why, for a substance, the specific latent heat of vaporisation is usually greater than the specific latent heat of fusion.

....

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Determine a value, to three significant figures, for the specific latent heat of fusion of water.

specific latent heat of fusion = ... $\mathrm{J\,g^{-1}}$ [4]

[Total: 9]

2 **(a)** State what is meant by two objects being in thermal equilibrium.

....

....

.... [2]

(b) A mass X of ice at 0 °C is placed in a beaker containing a mass M of water at Celsius temperature t. The beaker is perfectly insulated and has negligible heat capacity. After some time, the ice that was added reaches thermal equilibrium with the original water in the beaker.

The specific latent heat of fusion of water is L. The specific heat capacity of water is c. The final Celsius temperature of the system is θ.

Give expressions, in terms of some or all of X, M, t, θ, L and c, for the thermal energy:

(i) E_1, gained by the ice as it melts to become water at 0 °C

E_1 = ... [1]

(ii) E_2, lost by the water as its Celsius temperature decreases from t to θ

E_2 = ... [1]

(iii) E_3, gained by the melted ice as its Celsius temperature increases from 0 °C to θ.

E_3 = ... [1]

(c) Use your answers in **(b)** to show that the final Celsius temperature θ of the system is given by

$$\theta = \frac{Mct - XL}{c(M + X)}.$$

[2]

[Total: 7]