A2 Level Physics

Chapter 9 – Thermal Physics

9.2.2 Solid, Liquid and Gas

Worked Examples

Solid, Liquid and Gas

Exam Style Question 1

Fig. 6.1 shows how the volume V of a fixed mass of an ideal gas at constant pressure varies with temperature θ from $0\ °C$ to $120\ °C$.

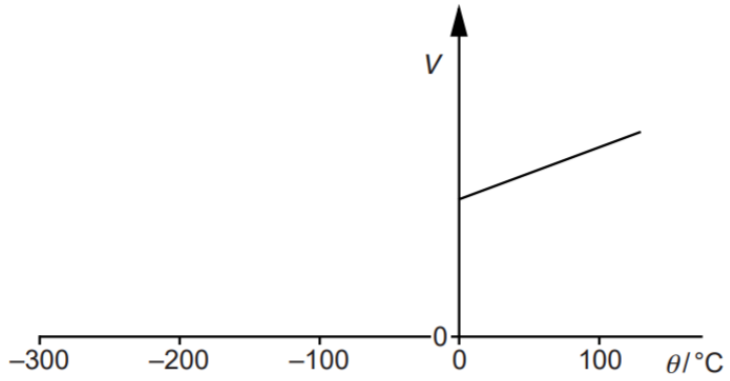

Fig. 6.1

(a) Describe how this graph leads to the concept of an absolute zero of temperature.

(b) A mass of gas is enclosed in a tank. The gas is cooled until it becomes a liquid. During this process its internal energy changes.

(i) State what is meant by the internal energy of the gas.

(ii) Explain why the internal energy of the gas differs from that of its liquid phase.

Solid, Liquid and Gas

Exam Style Question 1

(a) Describe how this graph leads to the concept of an absolute zero of temperature.

The answer can be shown on the graph by extending the graph backwards until it intercepts the x-axis to a negative temperature. The interception point is around $-273\ ℃$.

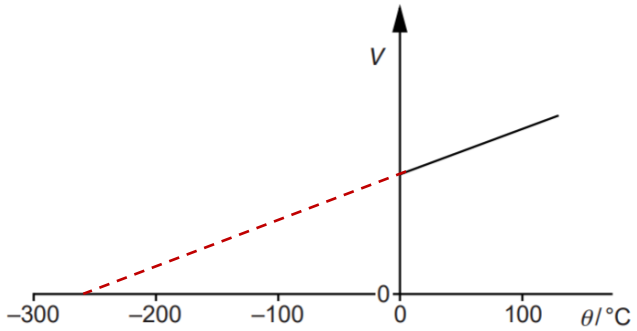

Fig. 6.1

The graph also shows that volume is zero (or is negligible) at absolute zero.

(b) A mass of gas is enclosed in a tank. The gas is cooled until it becomes a liquid. During this process its internal energy changes.
(i) State what is meant by the internal energy of the gas.

Internal energy of a system is the sum of the random distribution of kinetic and potential energies of all atoms (or molecules) in the system.

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Solid, Liquid and Gas

Exam Style Question 1

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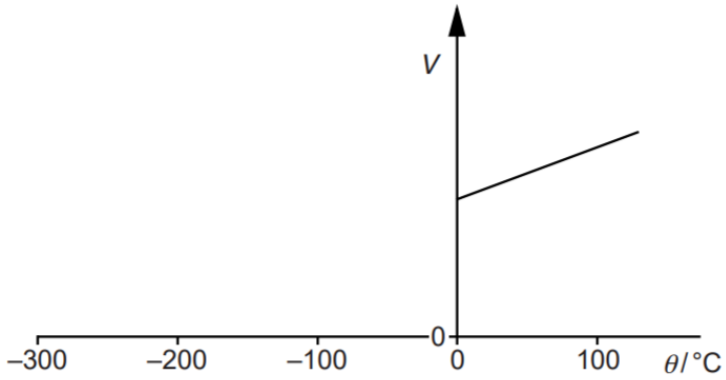

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(i) State what is meant by the internal energy of the gas.

(ii) Explain why the internal energy of the gas differs from that of its liquid phase.

Solid, Liquid and Gas

Exam Style Question 1

(ii) Explain why the internal energy of the gas differs from that of its liquid phase.

Increasing a substance's internal energy raises the KE and/or PE associated with its molecules' random motion and positions. Both the KE and PE components are present in about similar amounts. When a substance is heated, the kinetic energy of the molecules typically increases.
Gas has the highest internal energy because in the liquid and solid state, a lot of energy that is tied up in the bonds between atoms or molecules. These phases have a lower internal energy since this energy contributes negatively to their internal energy.
The KE increases as a gas or liquid is heated, causing the atoms or molecules to vibrate or move faster. The molecules or atoms in a gas have a higher KE because they are not bonded together, however the atoms in a liquid have a lower KE because they still have weak bonds.
Also because atoms in a gas are more widely spaced, the potential energy of the gas phase is higher than that of the liquid phase.

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Exam Style Question 2

Fig. 6.1 shows the apparatus used to observe Brownian motion using pollen grains suspended in a liquid.

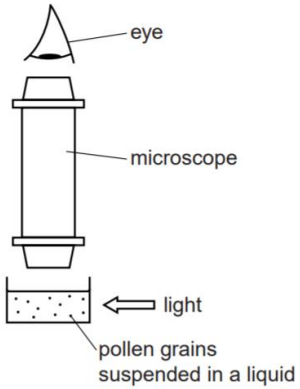

Fig. 6.1

(a) (i) State two conclusions that may be deduced about the molecules of the liquid from the motion of the pollen grains observed with the microscope.

(ii) Suggest how the motion of these pollen grains could be increased.

Solid, Liquid and Gas

Exam Style Question 2

(a) (i) State two conclusions that may be deduced about the molecules of the liquid from the motion of the pollen grains observed with the microscope.

- Molecules of the liquid are in random motion.
- Molecules of liquid are smaller than pollen grains.

(ii) Suggest how the motion of these pollen grains could be increased.

- Increase the temperature of the liquid.

Please see ‘9.2.1 Solid, Liquid and Gas notes’ pack for revision notes.

For more revision notes, tutorials and worked examples please visit www.tutorpacks.co.uk.

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