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Federal Board SSC-II · Chemistry Chapter Quiz

Class 10 | Unit 2 : MATTER

ANSWER KEY (Total Marks: 65)

SECTION A (12 Marks)

Q1. Melting of ice at 0 °C, temperature stays constant because heat absorbed is used to:

Ans: (B) Overcome forces between particles, increasing their potential energy.

Q2. Gas changing directly into a solid is:

Ans: (C) Deposition.

Q3. Which statement about evaporation is correct?

Ans: (B) It occurs at the surface of a liquid at any temperature below the boiling point.

Q4. Flat region D to E (liquid to gas) on a heating curve:

Ans: (C) Boiling.

Q5. Gas compressed to half its volume at constant temperature, pressure becomes:

Ans: (B) Double. [$P_1V_1 = P_2V_2$, so $P_2 = 2P_1$]

Q6. 300 cm^3 at 300 K heated to 600 K at constant pressure, new volume:

Ans: (C) 600 cm^3. [$V_2 = 300 \times 600/300 = 600\ cm^3$]

Q7. Volume of 0.5 mole of a gas at RTP:

Ans: (B) 12 dm^3. [$0.5 \times 24 = 12\ dm^3$]

Q8. Which gas diffuses fastest at the same temperature?

Ans: (C) H_2 (lowest molar mass, so highest speed).

Q9. Water boils at a lower temperature on a high mountain because:

Ans: (A) Atmospheric pressure is lower.

Q10. Which is NOT an example of sublimation?

Ans: (D) Melting of ice cubes (solid to liquid, that is melting).

Q11. Liquid medicines generally act faster than tablets because:

Ans: (A) Their particles are already dispersed and diffuse quickly.

Q12. Rate of diffusion of a gas increases with temperature because:

Ans: (B) Molecules gain kinetic energy and move faster.

SECTION B (11 × 3 = 33 Marks)

Q2 (i) Explain, using kinetic particle theory, why the temperature remains constant while ice melts to water. [3]

(1) Temperature is a measure of the average kinetic energy (KE) of particles.

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(2) At 0 °C the heat absorbed by ice is not used to speed up the particles. It is used to overcome the forces of attraction holding the particles in the fixed lattice.

(3) So the potential energy (PE) of the particles increases while their average KE stays the same. Hence the temperature remains constant at 0 °C until all the ice has melted.

OR

Calculate the volume occupied by 3.5 moles of a gas at RTP (1 mole = 24 dm^3). [3]

Volume = number of moles × molar volume

= 3.5 × 24

= 84 dm^3

Ans: 3.5 moles of gas occupy 84 dm^3 at RTP.

(ii) Differentiate between evaporation and boiling (three points). [3]

(1) Evaporation takes place only at the surface of a liquid; boiling takes place throughout the liquid.

(2) Evaporation occurs at any temperature below the boiling point; boiling occurs only at a fixed temperature, the boiling point.

(3) Evaporation is a slow process with no bubbles; boiling is rapid with formation of bubbles of vapour inside the liquid.

OR

Explain why: (a) perfume applied on the palm makes it feel cold. (b) sweating cools the body. [1.5 + 1.5]

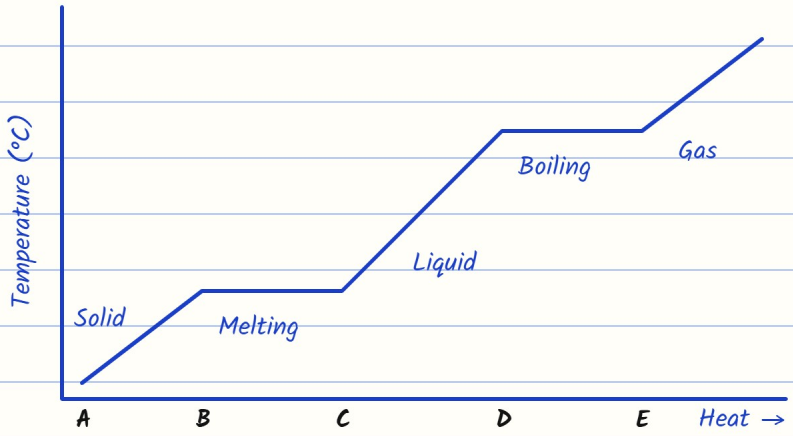
(a) Perfume is volatile and evaporates quickly. The most energetic particles escape from the surface, taking heat (latent heat) from the palm. The skin loses heat, so the palm feels cold.

(b) Sweat (water) on the skin evaporates by absorbing heat from the body. Loss of this heat lowers the body temperature, so sweating cools the body.

(iii) Sketch a heating curve for water and label the solid, melting, liquid, boiling and gas regions. State what happens to KE and PE in the flat regions. [3]

Heating curve of water (temperature against heat added):

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Flat regions (B–C melting at 0 °C and D–E boiling at 100 °C): temperature is constant, so the average KE of the particles stays constant. The heat absorbed is used to overcome the forces between particles, so their PE increases.

Sloping regions: KE increases (temperature rises) while PE stays nearly constant.

OR

Interpret a cooling curve and explain the significance of its flat regions. [3]

A cooling curve plots temperature against time as a substance loses heat, going gas, then liquid, then solid.

(1) Sloping parts: the gas, liquid or solid is cooling. KE of particles decreases, so temperature falls.

(2) First flat part: condensation (gas to liquid) at the condensing point. Second flat part: freezing (liquid to solid) at the freezing point.

(3) Significance: during a flat region the substance releases latent heat as attractive forces pull the particles together. PE decreases but KE stays constant, so temperature stays constant. The flat levels show the condensing and freezing points, which identify the substance and show its purity.

(iv) State Boyle's law, write its mathematical form, and explain it with kinetic particle theory. [1 + 1 + 1]

Statement: At constant temperature, the volume of a fixed mass of gas is inversely proportional to its pressure.

Mathematical form: $V \propto 1/P$, so PV = constant, or $P_1V_1 = P_2V_2$.

Explanation: When the volume is reduced at constant temperature, the particles are squeezed closer and speed (KE) is unchanged. They hit the container walls more often per second, so pressure increases. Hence smaller volume gives higher pressure.

OR

State Charles's law, write its mathematical form, and explain it with kinetic particle theory. [1 + 1 + 1]

Statement: At constant pressure, the volume of a fixed mass of gas is directly proportional to its

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absolute temperature (in kelvin).

Mathematical form: $V \propto T$, so V/T = constant, or $V_1/T_1 = V_2/T_2$.

Explanation: On heating, particles gain KE and move faster. They hit the walls harder and more often. To keep the pressure constant, the gas must expand. Hence volume increases with temperature.

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SECTION B (continued)

(v) A gas occupies 600 cm³ at 2 atm pressure. What will be its volume at 4 atm if the temperature is constant? [3]

Boyle's law applies (constant T): $P_1V_1 = P_2V_2$

Given: $P_1 = 2$ atm, $V_1 = 600$ cm³, $P_2 = 4$ atm, $V_2 = ?$

$2 \times 600 = 4 \times V_2$

$V_2 = 1200 / 4 = 300$ cm³

Ans: New volume = 300 cm³.

OR

A gas occupies 250 cm³ at 300 K. What will be its volume at 450 K if the pressure is constant? [3]

Charles's law applies (constant P): $V_1/T_1 = V_2/T_2$

Given: $V_1 = 250$ cm³, $T_1 = 300$ K, $T_2 = 450$ K, $V_2 = ?$

$V_2 = V_1 \times T_2 / T_1 = 250 \times 450 / 300$

$V_2 = 112500 / 300 = 375$ cm³

Ans: New volume = 375 cm³.

(vi) State Avogadro's law and explain it with kinetic particle theory. [1 + 2]

Statement: Equal volumes of all gases, at the same temperature and pressure, contain an equal number of molecules ($V \propto n$).

Explanation: Gas pressure is due to collisions of particles with the walls. At the same temperature all gases have the same average KE. If the number of particles increases, collisions increase. To keep the pressure constant the volume must increase in proportion. So equal volumes hold equal numbers of particles.

OR

Explain the effect of increasing temperature on the pressure of a gas in a sealed container. [3]

(1) On heating, the particles gain KE and move faster.

(2) They hit the walls more frequently and with greater force.

(3) The volume is fixed, so the pressure increases. Hence pressure is directly proportional to absolute temperature ($P \propto T$).

(vii) How does increasing the external pressure affect the boiling point of a liquid? Explain with the example of a pressure cooker. [1.5 + 1.5]

Effect: Increasing the external pressure raises the boiling point. A liquid boils when its vapour

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pressure becomes equal to the external pressure. Higher external pressure needs a higher temperature to reach this.

Pressure cooker: The sealed lid traps steam, so pressure inside rises above atmospheric pressure. Water now boils at a temperature higher than 100 °C (about 120 °C). Food cooks at this higher temperature, so it cooks faster.

OR

Why does water boil at a lower temperature at high altitudes? [3]

(1) At high altitude the atmospheric pressure is lower because there is less air above.

(2) Water boils when its vapour pressure equals the external pressure. With lower external pressure, less KE is needed for particles to escape.

(3) So water reaches its boiling point at a temperature below 100 °C.

(viii) Define diffusion. Explain diffusion of gases with the example of perfume spreading in a room. [1 + 2]

Definition: Diffusion is the spontaneous spreading (mixing) of particles of a substance from a region of higher concentration to a region of lower concentration, due to their random motion.

Perfume example: When perfume is sprayed, its particles are in constant random motion. They move into the spaces between air molecules, colliding with them on the way. They spread from the high-concentration spot to all parts of the room until evenly spread. This is why the smell reaches people far away after a short time.

OR

Describe, with the help of kinetic particle theory, how two gases mix when brought into contact. [3]

(1) Gas particles are always in rapid random motion and have large gaps between them.

(2) At the contact surface, particles of each gas move into the spaces of the other gas, and collide and change direction.

(3) The net movement is from higher to lower concentration of each gas, until a uniform mixture is formed. No stirring is required.

(ix) State Graham's law of diffusion. Which diffuses faster, H_2 (M = 2) or O_2 (M = 32)? Give a reason. [1 + 1 + 1]

Graham's law: At constant temperature and pressure, the rate of diffusion of a gas is inversely proportional to the square root of its molar mass.

$$\text{Rate} \propto 1 / \sqrt{M}$$

Faster gas: H_2 diffuses faster.

Reason: H_2 has the smaller molar mass (2 against 32). At the same temperature, lighter

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particles have the same average KE but move at higher speed. Rate(H_2)/Rate(O_2) = √(32/2) = √16 = 4, so H_2 is 4 times faster.

OR

Why is the diffusion of gases faster at higher temperatures? [3]

(1) Heating increases the KE of gas particles.

(2) They move faster and collide more often, covering the distance in less time.

(3) So mixing is quicker. Hence the rate of diffusion increases with temperature.

(x) Define sublimation. Give two examples and one practical application. [1 + 1 + 1]

Definition: Sublimation is the change of a solid directly into a gas on heating, without passing through the liquid state.

Examples: (1) dry ice (solid CO_2), (2) naphthalene balls (also iodine, camphor).

Application: Solid air fresheners slowly sublime and release fragrance into the room. (Other uses: freeze-drying of food, dye-sublimation printing.)

OR

Define deposition. Give two examples from daily life. [1 + 2]

Definition: Deposition is the change of a gas directly into a solid on cooling, without passing through the liquid state.

Examples: (1) Frost forming on grass, car windows and cold surfaces on winter nights, as water vapour turns directly to ice.

(2) Snow formation in clouds, where water vapour changes directly to ice crystals.

(xi) Why is the diffusion rate of a drug important in the body? [1.5 + 1.5]

(1) The diffusion rate decides how fast the drug moves from the site of intake into the bloodstream and reaches the target organ. This controls how quickly the drug starts to act.

(2) It decides the correct dose and effect. Too slow gives delayed relief; too fast can give a dangerously high concentration. So drugs are designed with a suitable diffusion rate.

OR

Explain why liquid medicines act faster than tablets, and state the purpose of controlled-release formulations. [1.5 + 1.5]

Liquid vs tablet: In a liquid medicine the drug particles are already dissolved and dispersed, so they diffuse quickly into the blood. A tablet must first break up and dissolve, which takes time. So liquids act faster.

Controlled release: Its purpose is to release the drug slowly and steadily over a long time. This keeps the drug at an effective level in the blood, reduces how often doses are needed, and lowers side effects.

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SECTION C (4 × 5 = 20 Marks)

Q3 Using kinetic particle theory, explain what happens to the particles, their energy and the temperature during: (a) melting (b) boiling (c) freezing (d) condensation. [4 × 1.25 = 5]

(a) Melting (solid to liquid): The vibrating particles in the fixed solid absorb heat. This energy overcomes the forces holding them in position, so they begin to slide past each other. PE increases, average KE stays the same, and the temperature stays constant at the melting point.

(b) Boiling (liquid to gas): Heat given to the liquid is used to break the attractions between particles completely. They escape as a gas, far apart and moving freely. PE increases greatly, KE stays the same, and the temperature stays constant at the boiling point.

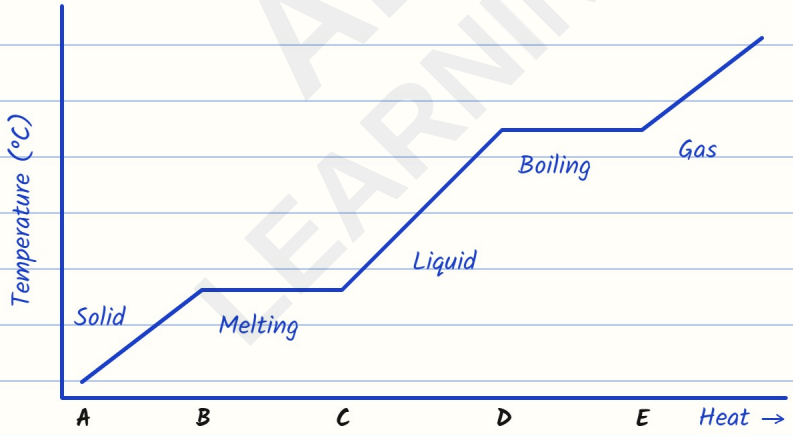
(c) Freezing (liquid to solid): The liquid loses heat. Attractive forces pull the particles into fixed positions and they only vibrate. Energy is released, so PE decreases while KE stays the same. The temperature stays constant at the freezing point.

(d) Condensation (gas to liquid): The gas loses heat and its particles come close together, as attractive forces take over. Energy is released, so PE decreases and KE stays the same. The temperature stays constant at the condensation point until the whole gas becomes liquid.

OR

Draw and label a heating curve of a pure substance. Explain each segment (A to B, B to C, C to D, D to E, E onward) in terms of kinetic energy and potential energy. [2 + 3]

Heating curve (temperature against heat added):



A to B (solid warming): Heat increases the vibration of the particles. KE increases, so temperature rises. PE stays nearly constant.

B to C (melting, flat): Heat is used to overcome the forces between particles. PE increases, KE stays constant, so temperature stays constant at the melting point. Solid and liquid exist together.

C to D (liquid warming): Particles move faster. KE increases and the temperature rises. PE stays nearly constant.

D to E (boiling, flat): Heat is used to separate the particles completely. PE increases greatly, KE

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stays constant, and the temperature stays constant at the boiling point.

E onward (gas warming): The widely spaced gas particles gain KE and move faster. Temperature rises again. PE is nearly constant.

Q4 (a) State Boyle's, Charles's and Avogadro's laws, each with its mathematical expression. (b) A gas at 1 atm has a volume of 4 dm^3. It is compressed at constant temperature to 2 dm^3. Find the new pressure. [3 + 2]

(a) Boyle's law: At constant temperature, the volume of a fixed mass of gas is inversely proportional to its pressure. $V \propto 1/P$, or $P_1V_1 = P_2V_2$.

Charles's law: At constant pressure, the volume of a fixed mass of gas is directly proportional to its absolute temperature (K). $V \propto T$, or $V_1/T_1 = V_2/T_2$.

Avogadro's law: At constant temperature and pressure, the volume of a gas is directly proportional to the number of moles (equal volumes of gases hold equal numbers of molecules). $V \propto n$, or $V_1/n_1 = V_2/n_2$.

(b) Boyle's law: $P_1V_1 = P_2V_2$

$1 \times 4 = P_2 \times 2$

$P_2 = 4 / 2 = 2$ atm

Ans: New pressure = 2 atm.

OR

(a) A balloon has a volume of 3.0 dm^3 at 27 °C. It is heated to 77 °C at constant pressure. Calculate the new volume (T = °C + 273). (b) Explain the result of part (a) in terms of kinetic particle theory. [2 + 3]

(a) $T_1 = 27 + 273 = 300$ K, $T_2 = 77 + 273 = 350$ K, $V_1 = 3.0$ dm^3

Charles's law: $V_1/T_1 = V_2/T_2$

$V_2 = V_1 \times T_2 / T_1 = 3.0 \times 350 / 300$

$V_2 = 3.5$ dm^3

Ans: New volume = 3.5 dm^3.

(b) On heating from 27 °C to 77 °C, the gas particles gain KE and move faster. They hit the walls of the balloon harder and more often, which would raise the pressure. To keep the pressure constant, the balloon expands. So the volume increases from 3.0 dm^3 to 3.5 dm^3, in direct proportion to the absolute temperature.

Q5 (a) Explain the process of diffusion using kinetic particle theory. (b) Discuss the effect of (i) molecular mass and (ii) temperature on the rate of diffusion. [2 + 3]

(a) Gas particles are in constant, rapid, random motion with large gaps between them. They collide with each other and spread into the empty spaces. There is a net movement from the

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region of higher concentration to lower concentration, until the particles are evenly distributed. No energy input or stirring is needed.

(b)(i) Molecular mass: At the same temperature all gases have the same average KE, but lighter particles move faster. So the lighter the gas, the faster it diffuses. Graham's law: rate $\propto 1/\sqrt{M}$. Example: H_2 diffuses faster than CO_2.

(ii) Temperature: Raising the temperature increases the KE and speed of the particles. They collide more often and spread faster, so the rate of diffusion increases. At low temperature, diffusion is slower.

OR

(a) Calculate how many times faster H_2 (M = 2) diffuses than CH_4 (M = 16) at the same temperature and pressure. (b) Explain your answer in terms of kinetic energy and particle velocity. [2 + 3]

(a) Graham's law: Rate(H_2) / Rate(CH_4) = $\sqrt{}$(M of CH_4 / M of H_2)

$= \sqrt{}(16 / 2) = \sqrt{8} \approx 2.83$

Ans: H_2 diffuses about 2.8 times faster than CH_4.

(b) At the same temperature, both gases have the same average KE, where $KE = \frac{1}{2}mv^2$. H_2 particles have a much smaller mass (2 against 16), so to have the same KE they must move with a higher velocity ($v \propto 1/\sqrt{m}$). The velocity ratio is $\sqrt{8} \approx 2.83$. Faster particles spread faster, so H_2 diffuses about 2.8 times faster.

Q6 (a) Define sublimation and name two substances that sublime. (b) Explain three applications of sublimation (solid air fresheners, dye-sublimation printing, freeze-drying). (c) State one environmental or practical drawback of sublimation-based products. [1 + 3 + 1]

(a) Sublimation is the change of a solid directly into a gas on heating, without passing through the liquid state. Substances: dry ice (solid CO_2) and naphthalene (also iodine, camphor).

(b)(1) Solid air fresheners: The solid slowly sublimes at room temperature and releases fragrance into the air. There is no liquid to spill, and the freshener lasts long.

(2) Dye-sublimation printing: Solid dye is heated and turns into gas. The gas enters the fabric or coated surface and turns solid again. The print is sharp, permanent and does not fade or crack easily.

(3) Freeze-drying: Food is frozen and kept under low pressure, and its ice sublimes directly to vapour. Water is removed without damaging the structure, taste and nutrients. The food becomes light and stays fresh for a long time.

(c) Drawback: Air fresheners keep releasing chemical vapours (volatile compounds) into the room air, which may cause allergies, headache and indoor air pollution. Their plastic containers also add

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to waste.

OR

Analyze the impact of altitude on the boiling point of water and on cooking times. Give a detailed explanation based on kinetic particle theory and external pressure. [5]

(1) Effect on boiling point: Atmospheric pressure falls as altitude rises because there is less air above. A liquid boils when its vapour pressure equals the external pressure. At high altitude the external pressure is lower, so this happens at a lower temperature. So water boils below 100 °C (about 70 °C at the top of Mount Everest).

(2) Kinetic particle theory: With less air pressing on the surface, the water particles need less KE to escape as vapour. Bubbles form at a lower temperature, so the particles of boiling water have lower average KE than at sea level.

(3) Effect on cooking time: The boiling water stays at a lower temperature, and food cannot get hotter than the water. Heat passes to the food more slowly, so food takes longer to cook.

(4) Solution: A pressure cooker raises the pressure inside, which raises the boiling point and reduces cooking time.

— End of Answer Key —

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