

Forces between particles and what they decide

AP Chemistry · Test answers (mark scheme)

Marking points are given after each answer. Award marks for correct physics even if the wording differs. In calculations, award a method mark for correct substitution and an answer mark for the correct value with unit.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 3

Question 1 Naming forces (2 marks)

CH₃OH: **hydrogen bonding**. CH₃Cl: **dipole-dipole** (with dispersion).

Marking: 1 mark each.

Question 2 Boiling point trend (3 marks)

a. **London dispersion forces**.

b. Molar mass and the number of electrons increase down the group, making the electron cloud larger and more polarisable. Temporary dipoles are stronger, so more energy is needed to separate molecules.

Marking: 1 for polarisable cloud, 1 for stronger attractions.

Question 3 Vapour pressure (3 marks)

a. The pressure of the vapour when the rate of evaporation equals the rate of condensation (dynamic equilibrium).

b. More molecules have enough kinetic energy to overcome the intermolecular forces, so the rate of evaporation is higher and a new equilibrium is reached at a **higher vapour pressure**.

Marking: 2 for definition; 1 for more energetic molecules and higher pressure.

Question 4 Ethanol and ethoxyethane (3 marks)

Ethanol has an O–H bond and forms **hydrogen bonds**. Ethoxyethane has no O–H and only dipole-dipole and dispersion forces. Hydrogen bonds are stronger than the extra dispersion forces in the larger ether, so ethanol needs more energy to boil.

Marking: 1 H-bonding in ethanol, 1 none in ether, 1 comparison.

Question 5 Clausius-Clapeyron (3 marks)

$$\ln(P_2/20.0) = (30\,000/8.314) \times (1/300 - 1/320) = 3608.4 \times 2.0833 \times 10^{-4} = 0.7518$$

$$P_2 = 20.0 \times e^{0.7518} = 20.0 \times 2.121 = \mathbf{42.4\text{ kPa}}$$

Marking: 1 correct substitution, 1 exponent, 1 answer with unit.

Question 6 Types of solid (2 marks)

Quartz is a **covalent network** solid: melting breaks strong covalent bonds. Iodine is a **molecular** solid: melting only overcomes weak dispersion forces between I₂ molecules.

Marking: 1 classification; 1 reason.

Question 7 Altitude cooking (2 marks)

Inside the cooker the pressure is above 101.3 kPa, so water must reach a vapour pressure higher than that to boil. **The boiling point rises above 100 °C**, and food cooks faster at the higher temperature.

Marking: 1 pressure link; 1 higher boiling temperature.

Question 8 Rank three liquids (2 marks)

Order: **A (butane, 0 °C) < B (propanone, 56 °C) < C (ethanol, 78 °C)**. Butane has dispersion forces only; propanone adds dipole-dipole; ethanol forms hydrogen bonds.

Marking: 1 order; 1 justification.