

Workbook



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Intermolecular Forces Liquids and Solids

Properties of Liquids

Questions

- 1) How much heat is required to vaporize 2.45 mol of methanol at 298 K?

$$\Delta H_{\text{vap}} \text{ methanol at } 298 \text{ K} = 38 \frac{\text{kJ}}{\text{mol}}$$

- 2) The enthalpy of vaporization of acetonitrile CH_3CN (l)

$$\text{equals } 29.75 \frac{\text{kJ}}{\text{mol}} \text{ at } 81.6 \text{ }^\circ\text{C}.$$

What is the volume of acetonitrile gas formed at $81.6 \text{ }^\circ\text{C}$ and 1 atm when 2.5 kJ of heat are absorbed at a constant temperature of $81.6 \text{ }^\circ\text{C}$?

- 3) 3.5 L of benzene gas form when a liquid sample of benzene absorbs 0.61 kJ of heat at 298 K and 95.1 mmHg.

Calculate ΔH_{vap} of benzene at 298 K.

- 4) Calculate the volume of methane gas, measured at $35.7 \text{ }^\circ\text{C}$ and 740 mmHg, that must be burned in order to vaporize 5.24 L of water at $100 \text{ }^\circ\text{C}$.

$$\Delta H_{\text{combustion}} \text{ CH}_4 = -890 \frac{\text{kJ}}{\text{mol}}, \Delta H_{\text{vap}} \text{ H}_2\text{O} = 40.7 \frac{\text{kJ}}{\text{mol}}$$

$$d(\text{H}_2\text{O}, 100 \text{ }^\circ\text{C}) = 0.96 \frac{\text{g}}{\text{mL}}$$

- 5) How much heat is required to raise the temperature of 157 g of ethanol from $15 \text{ }^\circ\text{C}$ to $25 \text{ }^\circ\text{C}$ and then vaporize the ethanol at $25 \text{ }^\circ\text{C}$?

$$\Delta H_{\text{vap}} \text{ Ethanol at } 298 \text{ K} = 42.6 \frac{\text{kJ}}{\text{mol}}$$

$$\text{Specific heat capacity of Ethanol} = 2.46 \frac{\text{J}}{\text{g}^\circ\text{C}}$$

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- 6) The enthalpy of vaporization of ethanol equals $38.6 \frac{\text{kJ}}{\text{mol}}$.
Calculate the vapor pressure of ethanol at 60 °C. The normal boiling point of ethanol equals 78.4 °C.
- 7) The vapor pressure of benzene equals 88.72 kPa at 349 K and 137.46 kPa at 363.5 K. Calculate the enthalpy of vaporization of benzene.
- 8) CHCl_3 has a vapor pressure of 197 mmHg at 23.0 °C and 448 mmHg at 45.0 °C. Calculate the vapor pressure of CHCl_3 at 30 °C.
- 9) Liquid ethanol and ethanol vapor are in dynamic equilibrium at 63.5 °C. A 670 mL sample of the ethanol vapor weighs 0.598 g. Calculate the vapor pressure of ethanol at 63.5 °C.
- 10) Calculate the density of methanol vapor in equilibrium with liquid methanol at 25 °C if the vapor pressure of methanol at 25 °C equals 16.85 kPa.

Answer Key

1) 93.1 kJ

2) 2.44 L

3) $33.89 \frac{\text{kJ}}{\text{mol}}$

4) 333.51 L

5) 149.13 kJ

6) 0.482 atm

7) $28.1 \frac{\text{kJ}}{\text{mol}}$

8) 258.06 mmHg

9) 406.6 mmHg

10) $0.218 \frac{\text{g}}{\text{L}}$

Properties of Solids

Questions

1) How much heat must be absorbed in order to melt 700 g of ice?

$$\Delta H_{\text{fusion ice}} = 6 \frac{\text{kJ}}{\text{mol}}$$

2) a) How much heat is released when a 0.67 kg sample of molten aluminum freezes?

b) How much heat is required to heat a 270 g sample of aluminum from 30 °C to 660 °C (the normal melting point of aluminum) and convert it all to liquid?

$$\Delta H_{\text{fusion aluminum}} = 10.7 \frac{\text{kJ}}{\text{mol}}, \text{ specific heat of aluminum} = 0.9 \frac{\text{J}}{\text{g}^\circ\text{C}}$$

Answer Key

1) $0.218 \frac{\text{g}}{\text{L}}$

2) a) 239.13 kJ

b) 96.36 kJ