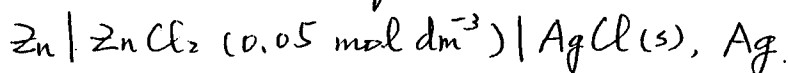


1) Calculate the velocity and the de Broglie wavelength of an electron accelerated by a potential of (a) 10V and (b) 1 kV. (16%)

Note: Planck constant, $h = 6.626 \times 10^{-34}$ Js

Electron rest mass $m_e = 9.11 \times 10^{-31}$ kg.

2) The electromotive force of the cell



is 1.015 V at 298K and the temperature coefficient of its electromotive force is $-4.92 \times 10^{-4} \text{ V K}^{-1}$. Write down the equation for the reaction occurring when the cell is allowed to discharge and calculate the changes in (a) Gibbs energy, (b) entropy, and (c) enthalpy attending this reaction at 298K. (17%)

3) At 25°C the molar volume of CO_2 is $23,920 \text{ cm}^3$ at 101.3 kPa and 7878 cm^3 at 303.9 kPa. Assume that the gas follows the van der Waals equation with $a = 0.364 \text{ m}^6 \text{ Pa mol}^{-1}$ and $b = 4.27 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$. Calculate ΔU , q , and w for the isothermal expansion of CO_2 from 303.9 to 101.3 kPa. (17%)

4) The saturated vapour pressures of benzene and toluene are both given by the equation,

$$\log_{10}(P^\circ/\text{Pa}) = \frac{-0.05223A}{T} + B$$

where T is absolute temperature and A and B have the following values:

	A	B
Benzene	32295 K	9.780
Toluene	39198 K	10.455

Assuming that mixtures of benzene and toluene form ideal solutions calculate the molar percentage of benzene in (a) a mixture which boils at 97°C under an external pressure of $1.013 \times 10^5 \text{ Pa}$, and (b) the initial condensate formed on distilling this mixture. (16%)

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5) A surface is half-covered by a gas when the pressure is 1 bar. The simple Langmuir isotherm applies:

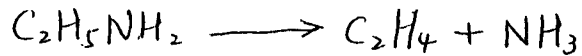
(a) What is the adsorption equilibrium constant K/bar^{-1} ?

(b) What pressures give 75%, 90%, 99%, 99.9% coverage?

(c) What coverage is given by pressures of 0.1 bar, 0.5 bar, 1000 bar?

(17%)

6) The rate constant for the thermal decomposition of ethylamine,



is $1.57 \times 10^{-3} \text{ s}^{-1}$ at 500°C . (a) Calculate the mean life and half-life for this reaction. (b) In an experiment at constant volume the initial pressure is 35 torr of ethylamine. Calculate the pressure in the vessel at 30 min.

(17%)