Question 5 Figure 2 shows plots of V (relative to the S.H.E.) versus $\log|i|$ for the competing processes of hydrogen liberation, at a particular value of pH, and metal M deposition, under standard concentration conditions, at a temperature of 298.15 K.

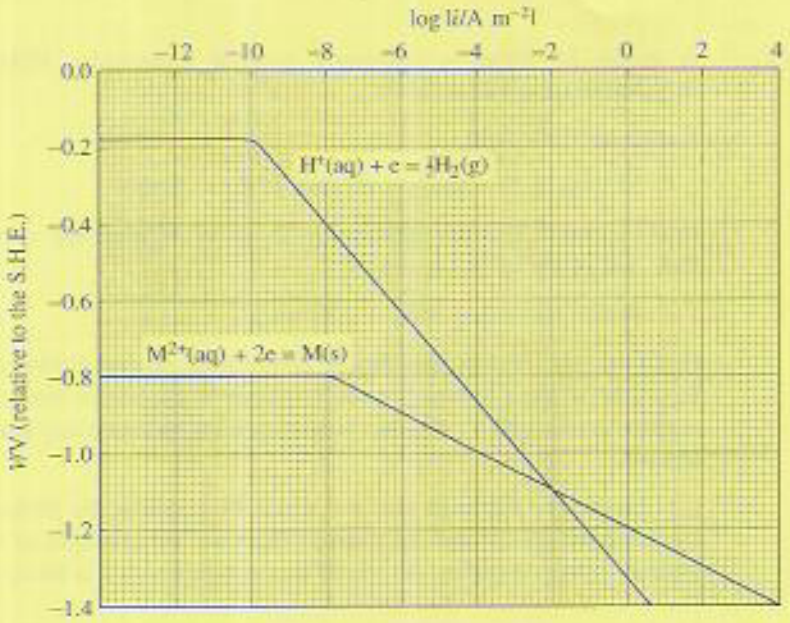

Figure 2 Plots of V (relative to the S.H.E.) versus $\log|i|$ for the competing processes of hydrogen liberation and metal M deposition, at an electrode composed of metal M.

(*a*) Determine the value of i_e for the following process:

$$M^{2+}(aq) + 2e = M(s) \qquad (11)$$

under the experimental conditions in Figure 2. Comment briefly on the significance of your value.

(*b*) Describe the processes taking place at the metal M electrode as the value of V (relative to the S.H.E.) is decreased from 0.0 V to −1.4 V, and comment briefly on the way that this change in V affects the current efficiency for the production of metal M.

Question 6 *You are required to answer* **ONLY TWO** *of the three parts (i)–(iii) of this question.*

(*i*) Consider the gas-phase reaction:

$$2CH_3OH(g) = C_2H_4(g) + 2H_2O(g) \qquad (12)$$

Write down an expression for the standard equilibrium constant, $K^{\ominus}$, of reaction 12, and show how this is related to the equilibrium constant expressed in terms of partial pressures, K_p. *State any assumptions you make.* Using appropriate information from the data sheet, determine whether you would expect the value of $K^{\ominus}$ for reaction 12 to increase or decrease with increasing temperature.

(*ii*) State the major classes of pollutants in vehicle exhausts that are thought to be implicated in the formation of photochemical smog, and describe *briefly* how the technology used to control these emissions has developed in response to tightening legislation. (Your answer should include examples of the relevant equations.)

(*iii*) Briefly account for the fact that mixed metallic oxides of transition and post-transition elements are good catalysts for the partial oxidation of hydrocarbons.