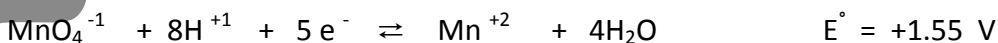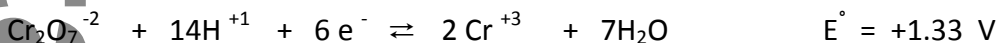# Quest: Redox and Electrochemistry

SCH4U_2015-2016

1. a) Write a balanced spontaneous net reaction in medium, (H^+), based on the unbalanced and incomplete half-reactions below,. $E^°$

$$MnO_4^- + 5e^- \rightarrow Mn^{2+} \qquad\qquad E^° = +1.49 \ V$$

$$O_2 + 4e^- \rightarrow 2H_2O \qquad\qquad E^° = +1.23 \ V$$

b) What is the $\Delta E^°$ for this reaction?

2. Consider the following half-cell reactions in aqueous solution:

$$Cr_2O_7^{-2} + 14H^{+1} + 6 e^- \rightleftarrows 2 Cr^{+3} + 7H_2O \qquad\qquad E^° = +1.33 \ V$$

$$MnO_4^{-1} + 8H^{+1} + 5 e^- \rightleftarrows Mn^{+2} + 4H_2O \qquad\qquad E^° = +1.55 \ V$$

a) Write and balance the reaction between $Cr_2O_7^{2-}$ and MnO_4^- in an aqueous acidic solution.

b) Calculate the overall electrode potential for the above reaction.

c) Identify the element that was oxidized and reduced in the reaction, and indicate whether the in oxidation number increases or decreases and by what amount

d) Is this reaction spontaneous? Explain in 20 words or less.

3. What will be produced when an iron rod is placed in a solution of silver nitrate? Justify your answer. Use the following standard electrode potentials to answer your question.

$$Fe^{2+}_{(aq)} + 2e^- \rightleftarrows Fe_{(s)} \qquad\qquad E^° = \ -0.4 \ 5 \ V$$

$$Ag^{1+}_{(aq)} + e^- \rightleftarrows Ag_{(s)} \qquad\qquad E^° = \ + 0.80 \ V$$

4. What is the cell potential (in volts) for the following cell?

$Cu_{(s)}$ | $CuSO_{4(aq)}$ (1.0 M) || $AgNO_{3(aq)}$ (1.0 M) | $Ag_{(s)}$

Use the following standard electrode potentials to answer your question.

$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$ E° =   + 0.34 V

$Ag^{1+}_{(aq)} + e^- \rightleftharpoons Ag_{(s)}$ E° =   + 0.80 V
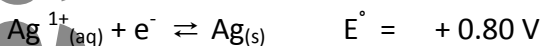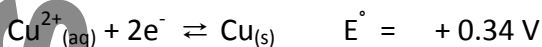
5. Buried copper pipes are often fitted with Zinc (Zn) strips. Why do you think this is done, justify your answer. Use the following standard electrode potentials to answer your question.
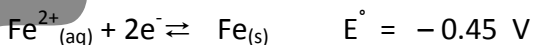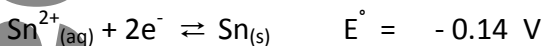
$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$ E° = -0.76 V

$Cu^{2+}_{(aq)} + 2e^- \rightleftharpoons Cu_{(s)}$ E° = + 0.34 V
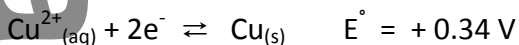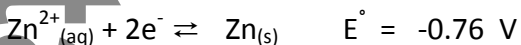
6. Consider the following standard electric potentials:

$Sn^{2+}_{(aq)} + 2e^- \rightleftharpoons Sn_{(s)}$ E° =   - 0.14 V

$Fe^{2+}_{(aq)} + 2e^- \rightleftharpoons Fe_{(s)}$ E° = − 0.45 V

$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)}$ E° = - 0.76 V
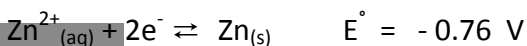
Some cars are made from coated steel. Use the above data to explain why zinc rather than tin is used for this coating.

7. An electrolytic cell was set up in order to investigate the electrolysis of lead bromide.

a. No current flows when lead bromide is solid, but there is a current flowing when the lead bromide is molten. Explain why this is so.

b. As a result of electrolysis, state what is formed at the:

i. anode (+ electrode)   ii. Cathode (- electrode)

c. Data collected showed that 2 Faradays of electricity produced 207 g of lead and 160 g of bromine.

i. how many moles of lead are produced by 2 Faradays?

ii. How many moles of bromine are produced by 2 Faradays?

iii. What is the formula of lead bromide?

d. Which of the following would increase the amount of lead produced?

i. more lead bromide   ii. a higher current   iii. longer time

8. An electrolysis experiment was carried out using molten sodium iodide and then it was repeated using an aqueous solution of sodium iodide.

a. the current only started to flow when the sodium iodide was molten and not before, (when it was solid). Explain this observation.

b. A colour appears around the anode, during both experiments. What is being formed?

c. A metal which rapidly tarnishes is formed at the cathode in the electrolysis of molten sodium iodide. What is it? Write the half –cell reaction for this observation.

d. A gas is formed at the cathode during the electrolysis of the aqueous solution of sodium iodide. What is it? Write the half –cell reaction for this observation. Explain where this gas has come from.

e. A current of 0.10 A was passed for 16 min. how many Faradays is this,

(1 Faraday = 96 500 C /mol)

f. 12.0 mL of gas was produced at the cathode during the electrolysis of the aqueous solution of sodium iodide at 25 ^{0}C and 100 kPa. How many moles of gas is this?