

## S<sub>5</sub> CHEMISTRY EXERCISES FOR S6 REVISION

### SECTION A:ORGANIC CHEMISTRY

1) Give main types of chemical reactions in organic chemistry. For each type add a chemical equation as an example

2) Draw the chemical mechanism of each type of reaction

3) a)How can you identify each functional group in organic chemistry?(equation ;conditions; observation)

b) How can you distinguish (equation; conditions; observations?)

i)aldehyde and ketones

ii)alkene and alkyne

iii)lairy;lairy and tertiairy alcohol

iv)methylated aldehyde anda non methylated aldehyde

v)phenol and carboxylic acid

vi)aniline and primairy amines

vii)

Explain the following observations

- When bromine in presence of dichloromethane is added to propene, only one product is formed i.e. 1,2-dibromopropane.
- When bromine water ( $\text{Br}_2/\text{H}_2\text{O}$ )is added to propene, a mixture of products namely 1,2-dibromopropane and bromopropane-2-ol are obtained.
- When bromine in presence of carbon tetrachloride and sodium chloride is added to propene, a mixture of products namely, 1,2-dibromopropane and bromo-2-chloropropane are formed.

4) Give chemical equations and conditions to pass from one functional group to another

i) Amine to alcohol

ii) Amide to amine

iii) Carboxylic acid to alkane

iv) Alkane to alkene and alkene to alkyne. Alkyne to alkene and alkene to alkane

v) Alcohol to aldehyde and aldehyde to carboxylic acid. Carboxylic acid to aldehyde and aldehyde to alcohol

vi) Alkyl halide to alcohol and alcohol to alkyl halide

vii) Alcohol to etheroxide and etheroxide to alcohol

viii) Reduce the length of the chain (butanoic acid to propanoic acid) and increase the length of the chain (propanoic acid to butanoic acid)

ix) Esterification and ester hydrolysis

x) Carboxylic acid to amide

5) a) Two isomers A and B have the same formula  $C_{17}H_{14}$ . The oxidation of A by hot solution of  $KMnO_4$  gives but-2-one and propanoic acid. The oxidation of B gives carboxylic acid  $(CH_3)_2CHCH_2CH_2COOH$  and a gas is evolved

i) Find and write the structural formula of A and B

ii) Name A and B

b) A: ethanamide

i) reacts with  $\text{Br}_2/\text{NaOH}_{(\text{aq})}$  → E under  $30^\circ\text{C}$

ii) reacts with  $\text{P}_2\text{O}_5$  → C

iii) reacts with B produces diethyletheroxide (give steps and conditions)

c)

7. Consider the alkane with the formula  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$

- Determine the percentage composition of carbon and hydrogen in the compound,
- Determine the empirical formula of the above compound,
- From the results in a) calculate the molecular formula of the compound,
- Write down the balanced chemical equation of combustion of the compound,
- Name the environmental problem that is caused by the performance of the reaction in d) and suggest different ways to solve that environmental problem.

8. Show how each of the following conversions can be accomplished with good yield

d)

7) An organic liquid **M** contains carbon, hydrogen and oxygen. When 0.25g of **M** is combusted, 0.592g of carbon dioxide and 0.30g of water was formed

- (i) calculate the empirical formula  
(ii) Molecular formula if the molecular mass is 74g/mol
- Write the structural formula and name of all isomers of **M**
- M** gives a yellow precipitate with solution of iodine in sodium hydroxide
  - Identify **M**
  - Describe briefly how the functional group in **M** may be determined
  - Give a reaction scheme of how **M** can be converted into but 2 yne

e)

**P** has the formula  $\text{C}_5\text{H}_8\text{O}_2$ . It forms a compound by reaction with hydrogen cyanide which has the formula  $\text{C}_7\text{H}_{10}\text{O}_2\text{N}_2$ . **P** gives a positive iodoform test, a silver mirror with Tollens' reagent and can be reduced to pentane. What is **P**?

f)

The formulae of two amino acids, glycine (Gly) and alanine (Ala), are given here: glycine is  $\text{H}_2\text{NCH}_2\text{COOH}$  alanine is  $\text{H}_2\text{NCH}(\text{CH}_3)\text{COOH}$ .

- a.
  - i. Give the systematic names of both amino acids.
  - ii. Draw their skeletal formulae.
- b. Alanine can exist as two stereoisomers.
  - i. Draw these two stereoisomers, showing how they differ in their spatial arrangements.
  - ii. Explain why glycine does not have stereoisomers.

7) Show how the following conversions can be done

i)  $\text{CH}_3\text{-CHOH-CH}_3$  to  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{OH}$  and  $\text{CH}_3\text{-CHBr-CH}_3$  to  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{Br}$

ii)  $\text{CH}_3\text{-CH}_2\text{-COOH}$  to  $\text{CH}_3\text{-CH}_2\text{-NH}_2$

iii) Propanoic acid to N-propylpropanamide

iv) Methyl ethanoate to ethene

v) Benzoic acid to 3-methylphenylamine

vi) Phenol to para-nitrobenzoic acid

vii) Nitrobenzene to 2-bromophenol

viii) Benzene to 1-phenylethanol

## SECTION B: MOLE CONCEPT

### Back titration:

1) A) 1.0g of the metal carbonate  $\text{MCO}_3$  was weighed and placed in 500ml beaker. Then 20ml of water was added to cover it. 40ml of 1M HCl was added. Effervescence occurs and after it had ceased, this solution was then transferred into a volumetric flask then made up to 250ml mark.

A aliquot of 25ml of the dilute mixture was then titrated with 0.1M NaOH using methylorange indicator .20ml of NaOH 0.1M was required to neutralize 25ml of the solution.

a) Calculate the number of moles of excess acid

b) Calculate the number of moles of the acid which reacted with the metal carbonate.

c) Calculate the atomic weight of the metal whose symbol is M

B)

0.9875 g of an impure potassium manganate (VII) was dissolved and the solution made up to 250 cm<sup>3</sup>. To 20.0 cm<sup>3</sup> of the resultant solution was added 5 cm<sup>3</sup> of 2 M sulphuric acid, warmed and titrated against sodium oxalate made by dissolving 1.675 g of anhydrous sodium oxalate to make 250 cm<sup>3</sup> of solution and 24.40 cm<sup>3</sup> of the oxalate solution was used. ( $\text{Na}_2\text{C}_2\text{O}_4 = 134$  and  $\text{KMnO}_4 = 158$ ). Calculate the percentage purity of potassium manganate(VII).

C)

DD

Determination of the purity of calcite: Calcium carbonate which is impure

Procedure:

- (i) A fixed mass 1.2g of calcite is weighed and dissolved in dilute hydrochloric acid
- (ii) To this solution is then added ammonia solution until the solution is alkaline and this is followed by addition of ammonium ethanedioate(oxalate) to precipitate all Calcium ions as calcium oxalate
- (iii) The precipitate is then filtered off, washed and then dissolved in a minimum dilute sulphuric acid solution and then solution made up to  $250\text{cm}^3$  in a volumetric flask with distilled water.
- (iv)  $25.0\text{cm}^3$  of the resultant solution in(iii) is pipetted and to it is added  $20\text{cm}^3$  of diluted sulphuric acid and the mixture is heated to about  $70^\circ\text{C}$ .
- (v) The hot solution is then titrated with  $0.02\text{M}$  potassium permanganate solution

Results:  $25.0\text{cm}^3$  of the oxalate solution required  $24.10\text{cm}^3$  of  $0.02\text{M}$   $\text{KMnO}_4$  solution for complete reaction which is detected by the intense purple colour.

- (a) Write down the overall equation for the above sequence of analysis
- (b) Calculate the percentage of purity of calcite

D)

1) Concentration of chlorine in treated water for domestic use can be monitored by testing water samples. In one such test, excess potassium iodide(KI) was added to  $1000\text{cm}^3$  sample of water.

The liberated iodine reacted with  $14.00\text{cm}^3$  of  $0.00100\text{M}$  sodium thiosulphate solution.

- a) Calculate the number of moles of sodium thiosulphate used in the reaction and hence the number of moles of iodine liberated.
- b) Write an equation for the reaction between  $\text{Cl}_2(\text{aq})$  and  $\text{I}^-(\text{aq})$  ions. Identify the reducing agent in this reaction.
- c) Calculate the number of moles of  $\text{Cl}_2$  and hence the mass of chlorine molecule in the original sample of water ( $\text{Cl}=35.5$ ).
- d) Write an equation for the reaction between  $\text{Cl}_2$  and water and show that this is a disproportionation reaction.
- e) Give the name of a suitable indicator to use in the titration of iodine solution with thiosulphate solution.

2) 5.00g of  $\text{NH}_4\text{Cl}$  containing some  $\text{NaCl}$  as impurities is boiled for about 10min with 100ml of 2M  $\text{NaOH}$  (present in excess). The residual solution is then made up to 250ml in a volumetric flask with distilled water. 25ml portions of the resultant solution are then titrated with 0.5M  $\text{HCl}$  to determine the amount of excess  $\text{NaOH}$  which was left unreacted with ammonium chloride salt using methylorange indicator.

25ml of the solution required 22.4ml of 0.5M  $\text{HCl}$  for neutralization using the methylorange indicator.

a) Calculate the % of ammonium chloride in the salt

b) Hence determine the % of ammonia in the salt (pure ammonium chloride)

### Iodo exercise

1) Solution  $\text{FA}_1$  is made by dissolving 1.2g of chromium salt Y to make 1000ml of solution. Salt Y is chromate  $\text{L}_2\text{CrO}_4$ . Solution  $\text{FA}_2$  is 0.05M sodium thiosulphate.

25ml  $\text{FA}_1$  is pipette into a clean conical flask and 10ml of 0.5  $\text{KI}$  is added. The iodine liberated is then titrated with  $\text{FA}_2$  using starch indicator.

a) Calculate the molarity of  $\text{FA}_1$

b) Calculate the molecular mass of the chromate Y of formula  $\text{L}_2\text{CrO}_4$

c) Calculate the % of Cr in chromate

d) Calculate the atomic weight of the element with symbol L.  $\text{FA}_2$  used is 9.27ml

2) Solution FA<sub>1</sub> was made by dissolving 3.2g of mixture of KIO<sub>3</sub> and KI to make 1l of solution.

Solution FA<sub>2</sub> was made by dissolving 1.24g of sodium thiosulphate pentahydrated to make 250ml of solution.

25ml of FA<sub>1</sub> solution is pipetted and then 20ml of 0.5M KI solution added. The solution on addition of 20ml of 2M sulphuric acid produces I<sub>2</sub>. This iodine produced is then titrated with FA<sub>2</sub> solution before using starch indicator. Average volume used of FA<sub>2</sub> 24.61ml.

a) Calculate the molarity of KIO<sub>3</sub> in FA<sub>1</sub>

3) FA<sub>1</sub> is a solution made by dissolving 20g of sodium thiosulphate pentahydrated in one liter solution.

FA<sub>2</sub> is an iodine solution.

FA<sub>3</sub> is a solution (containing 4.50g of substance P in one liter of solution M<sub>m</sub> of P:396.

25ml of FA<sub>1</sub> is pipetted in a clean conical flask and titrated with FA<sub>1</sub> using starch indicator.

25ml of FA<sub>2</sub> is pipette in conical fask and about 2g of sodium hydrogenocarbonate is added. The mixture is shaken to dissolve all the sodium hydrogenocarbonate and this solution titrated with FA<sub>3</sub> and starch solution. Average of FA<sub>3</sub> 22.02ml

a) Calculate the molarity of FA<sub>2</sub>

b) Determine the ratio in which P reacts with I<sub>2</sub>.

**Mangano and chromate exercises:**

1) A solution FA<sub>1</sub> contains 8.7g /l of HOOC-COOH and NaOOC-COONa. FA<sub>2</sub> is KMnO<sub>4</sub> 0.02M FA<sub>3</sub> is NaOH 0.1M

25ml portions of FA<sub>1</sub> is pipette in a clean conical flask and 2 or 3 drops of phenolphthalein added. This is then titrated with solution of FA<sub>3</sub> until the end point. The volume of FA<sub>3</sub> used is noted.

Then to this solution added 50ml of 1M sulphuric acid. This solution is then heated to just below boiling point (at temperature of 70°C) and titrated with FA<sub>2</sub> until a faint purple colour which persists for 30min or more is obtained. The volume of FA<sub>2</sub> used is also recorded separately.

Average volume FA<sub>3</sub>: 15.0cm<sup>3</sup>

Average volume FA<sub>2</sub>: 33.40cm<sup>3</sup>

Volume of pipette: 25cm<sup>3</sup>

a) Calculate the concentration in g/L of Ethanedioic acid

b) Calculate the concentration in g/L of sodium ethanedioate

c) Hence calculate the % of NaOOC-COONa in the mixture.

2) Solution **FA1** is 8.0g of the oxalate **K<sub>x</sub>H<sub>y</sub>(C<sub>2</sub>O<sub>4</sub>)<sub>z</sub>.nH<sub>2</sub>O** in 1dm<sup>3</sup> of solution. Solution **FA2** is 0.1M of sodium hydroxide. **FA3** is a solution of KMnO<sub>4</sub> 0.02M. 25cm<sup>3</sup> of **FA1** is pipetted in a clean conical flask, 2 or 3 drops of phenolphthalein indicator is added and then the solution titrated with 23.8cm<sup>3</sup> of **FA2**. The burette is then rinsed and filled with **FA3**. 25cm<sup>3</sup> of **FA1** is pipetted and is added to 25cm<sup>3</sup> of 2M H<sub>2</sub>SO<sub>4</sub>. This solution is then heated to about 70°C, the resultant is then titrated with 31.75cm<sup>3</sup> of **FA3** while hot.

(a) Calculate the value of x in the formula

(b) Calculate the value of y in the formula

(c) Calculate the value of z in the formula

(d) Calculate the molecular mass of the oxalate

(e) Calculate the number of water of crystallization  $n$ .

3)A) A solution  $FA_1$  is made by dissolving 2.7g of dichromate ion to make 250ml of solution.

Solution  $FA_2$  is prepared from equimolar mixture of iron(ii) and iron(iii). 25  $cm^3$  of  $FA_2$  is pipette in a clean conical flask and 5 $cm^3$  of 2M  $H_2SO_4$  is then added. Then 5 $cm^3$  of concentrated solution of phosphoric acid is added followed by 4 drops of a redox indicator(diphenyl). The content of the flask is then titrated with  $FA_1$ .

The end point is marked by the colour from green to violet. The green being due to  $Cr^{3+}$  ion formed.

Volume pipette 25.0 $cm^3$

Average volume of  $FA_1$  used 15.80 $cm^3$

B) Now 100ml of  $FA_2$  is then heated with 3g of zinc powder until either a pale green or colourless solution is obtained. The mixture is cooled. 25ml of the cooled solution is now pipette. 25ml of sulphuric acid is added followed by concentrated phosphoric acid and then four drops of redox indicator. Again the end point changed from green to purple solution.

Average volume of  $FA_1$  used 31.50ml.

a) Calculate the M of  $FA_1$  solution

b) Calculate the molarity of iron(ii)ion

c) Calculate the molarity of iron(iii)ion

d) Calculate the concentration in g/l of iron (ii)salt

e) Calculate the concentration in g/l of iron(iii)salt

f) Calculate the % of iron (iii)in  $FA_2$

4)a) Explain these terms: standard solution; primary standard solution

b)i) Why potassium dichromate is preferred to potassium permanganate in titration of reducing substances

ii) What is the double role of sulphuric acid in iron(ii) titration. What is the advantage and disadvantage of using  $KMnO_4$  in this experiment?

### SECTION C: THERMODYNAMIC

1)a)

In an experiment to find the enthalpy change in a reaction, 25 $cm^3$  of 0.5M copper sulphate solution was placed in a polystyrene cup and the

temperature recorded. Excess zinc powder was added and the mixture stirred. The increase in temperature was 21°C. The equation for the reaction is :  $\text{CuSO}_4(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$

- Why was excess zinc used in the reaction?
- Calculate the heat energy ( in joules) released in the reaction
- Calculate the number of moles of copper sulphate used in the reaction.
- Hence calculate the molar enthalpy change for the reaction.
- Give the main source of error in this experiment and suggest two methods of reducing this error

b) Define different types of enthalpy and state the Hess law

2)

200 cm<sup>3</sup> of water were heated by burning ethanol in a spirit burner. The following mass measurements were recorded:

Mass of spirit burner and ethanol (before burning) = 58.25 g

Mass of spirit burner and ethanol (after burning) = 57.62 g

The initial temperature of the water was 20.7 °C and the highest temperature recorded was 41.0°C. The specific heat capacity of water is 4.18 J g<sup>-1</sup> K<sup>-1</sup>.

Calculate the value of the standard enthalpy change of combustion of ethanol in kJ mol<sup>-1</sup>.

3)

Use the following data and calculate the enthalpy of formation of octane.

Enthalpy of combustion of carbon: - 393.5 kJ

Enthalpy of combustion of hydrogen: - 286 kJ

Enthalpy of octane: - 5471 kJ

4) a) Define the lattice energy. / 1 mk

b) Give two factors of lattice energy. / 2 mks

c) Given that  $\Delta H_f \text{ NaCl} = 411.3 \text{ kJ}$  Sublimation  $\text{Na} = 108 \text{ kJ/mole}$

$IE \text{ Na} = 500 \text{ kJ mole}^{-1}$ , Dissociation of  $\text{Cl}_2 = 242.2 \text{ kJ mole}^{-1}$

$E.A \text{ Cl}_2 = -364 \text{ kJ mole}^{-1}$

Draw the energy level diagram of  $\text{NaCl}$  formation

d) Calculate lattice energy of  $\text{NaCl}$ . / 3 mks

5) The table below shows the enthalpy changes needed to calculate the enthalpy change of formation of CaO:

Process	$\Delta H/\text{KJmol}^{-1}$
Lattice enthalpy for $\text{CaO}$	-3459
1 <sup>st</sup> ionization energy for Ca	+590
2 <sup>nd</sup> ionization energy for calcium	+1150
1 <sup>st</sup> electron affinity for oxygen	-141
2 <sup>nd</sup> electron affinity for oxygen	+798
$\Delta H_{\text{of}}$ atomization of oxygen	+249
$\Delta H_{\text{of}}$ atomization of calcium	+178

a) Explain why the 1<sup>st</sup> ionization energy of Ca is endothermic./2M

b) i) Draw the Born-Haber cycle for CaO including correct formulae, states, symbols and energy in KJ/mole/5M

ii) Use the Born-Haber cycle to calculate the  $\Delta H_{\text{of}}$  of CaO/2M

iii) The lattice enthalpy for iron(II) oxide is -3920KJ/mole. Suggest a reason for the difference in lattice enthalpy between CaO and FeO./3M

#### SECTION D: ELECTROCHEMISTRY

1) a) A current of 0.200A is passed through a solution of copper (II) sulphate within ten hours

i) Calculate the mass of copper deposited at the cathode  $m_{\text{Cu}}:63.5$   
;  $F:96500\text{C}$

ii) Calculate the volume of oxygen evolved at anode



Molar volume of ideal gas in standard conditions is  $24\text{dm}^3$

b)i) Name two applications of electrolysis

ii) What will you observe if you do electrolysis of copper(ii) sulphate solution with inert electrodes

2)

8. (a) What is meant by conductometric titration?

(b) Sketch the graph to show the variation in conductivity of the following conductometric titrations and explain the shape of each graph of the following reactions

1. titration of solution of HCl against NaOH
2. sodium hydroxide against ethanoic acid
3. Ammonia solution against hydrochloric acid
4. Silver nitrate against sodium chloride solution

c) The electrolytic conductivity of a saturated solution of silver chloride at  $23^{\circ}\text{C}$  is  $6.43 \times 10^{-5} \Omega\text{cm}^2\text{mol}^{-1}$

And that of water at the same temperature is  $3.82 \times 10^{-5} \Omega\text{cm}^2\text{mol}^{-1}$ , if the molar conductivity of silver chloride at  $23^{\circ}\text{C}$ , is  $533 \times 10^{-1} \Omega\text{cm}^2\text{mol}^{-1}$  calculate the solubility of silver chloride solution at  $23^{\circ}\text{C}$  in gram per liter

3)

### PHASE DIAGRAM

Compare the phase diagram of water and carbon dioxide

### EXERCISES FROM S6 UNITS

1)

3

[2] Large blocks of magnesium are bolted onto the hulls of iron ships in an attempt to prevent the iron being converted into iron (II), one of the steps in the rusting process.

Use the data below, where appropriate, to answer the questions which follow.

	$E^{\ominus} / \text{V}$
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^{-} \rightleftharpoons \text{Mg}(\text{s})$	-2.37
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-} \rightleftharpoons \text{Fe}(\text{s})$	-0.44
$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}(\text{aq})$	+0.40

- (a) Calculate the e.m.f. of the cell represented by  $\text{Mg}(\text{s})|\text{Mg}^{2+}(\text{aq})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$  under standard conditions.
- (b) Write a half-equation for the reaction occurring at the negative electrode of this cell when a current is drawn.
- (c) Deduce how the e.m.f. of the cell  $\text{Mg}(\text{s})|\text{Mg}^{2+}(\text{aq})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$  changes when the concentration of  $\text{Mg}^{2+}$  is decreased. Explain your answer.
- (d) Calculate a value for the e.m.f. of the cell represented by  $\text{Pt}(\text{s})|\text{OH}^{-}(\text{aq})|\text{O}_2(\text{g})||\text{Fe}^{2+}(\text{aq})|\text{Fe}(\text{s})$  and use it to explain why iron corrodes when in contact with water which contains dissolved oxygen.

[4] Calculate the voltage produced by the cell  $\text{Sn}_{(s)}|\text{Sn}^{2+}||\text{Ag}^+|\text{Ag}_{(s)}$  at  $25^\circ\text{C}$  given:

$$[\text{Sn}^{2+}] = 0.15 \text{ M}$$

$$[\text{Ag}^+] = 1.7 \text{ M}$$

[5] Hydrogen–oxygen fuel cells are used to provide electrical energy for electric motors in vehicles.

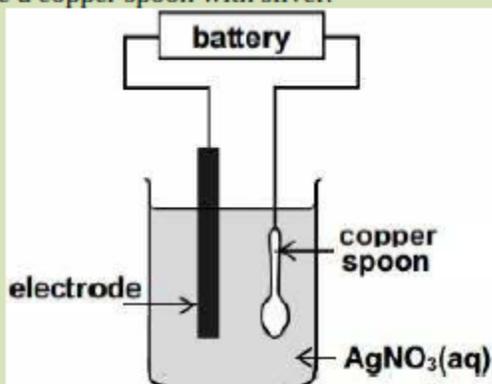
In a hydrogen–oxygen fuel cell, a current is generated that can be used to drive an electric motor.

- Deduce half-equations for the electrode reactions in a hydrogen–oxygen fuel cell.
- Use these half-equations to explain how an electric current can be generated.
- Explain why a fuel cell does **not** need to be recharged.
- To provide energy for a vehicle, hydrogen can be used either in a fuel cell or in an internal combustion engine.
  - Suggest the main advantage of using hydrogen in a fuel cell rather than in an internal combustion engine.
  - Identify **one** major hazard associated with the use of a hydrogen–oxygen fuel cell in a vehicle.

3

)4)

[7] Electroplating is one of the uses of electrolysis. The diagram below shows an electrolytic cell that can be used to plate a copper spoon with silver.



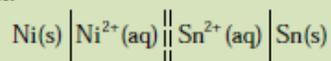
- Define the term oxidation in terms of electron transfer.
- What type of half-reaction takes place at the copper spoon? Write down only oxidation or reduction.
- Write down a half-reaction that explains the change that occurs on the surface of the copper spoon during electrolysis.
- Name the metal that is labelled 'electrode'.
- Give a reason why the concentration of the  $\text{AgNO}_3(\text{aq})$  remains constant during electrolysis.

2)

[3] The table below shows some values for standard electrode potentials.

Electrode	Electrode reaction	$E^\ominus / V$
A	$Mn^{2+}(aq) + 2e^- \rightleftharpoons Mn(s)$	-1.18
B	$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$	-0.44
C	$Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni(s)$	-0.25
D	$Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn(s)$	-0.14
E	$2H^+(g) + 2e^- \rightleftharpoons H_2(g)$	?

- (a) (i) Give the name of electrode E and indicate its role in the determination of standard electrode potentials.  
(ii) What is the value of the standard electrode potential for electrode E?
- (b) The electrochemical cell set up between electrodes C and D can be represented by the cell diagram:



- (i) Calculate the e.m.f. of this cell.  
(ii) State which would be the positive electrode.  
(iii) Write an equation to show the overall reaction in the cell.
- (c) Use the standard electrode potential data given in the table above:
- (i) To explain whether or not you would expect a reaction to occur if a piece of tin were to be added to a test tube containing aqueous iron(II) sulphate;  
(ii) To predict and explain two observations you would expect to make if a small piece of manganese were to be added to a test tube containing hydrochloric acid of concentration  $1 \text{ mol dm}^{-3}$ .