Assessor's use only

QUESTION ONE

(a) Give the oxidation numbers of sulfur in the following compounds:

Compound	Oxidation number of sulfur
SO_2	
SO_4^{2-}	
H_2SO_4	
H_2S	

(b) When **concentrated sulfuric acid** is added to a solution containing **iodide ions** the reaction produces **H_2S** and **I_2** respectively. Write ion-electron half equations and then a fully balanced oxidation-reduction equation for this reaction.

(c) In a similar reaction to part (b) **concentrated sulfuric acid** is added to a solution containing **bromide ions** with the reaction this time producing **SO_2** and **Br_2** respectively. By considering the products in part (b) and comparing them to part (c), **explain** which of the ions, iodide or bromide, is the stronger reducing agent.

QUESTION TWO

Assessor's use only

(a) Write the ion-electron half equations for the following reactions and **describe** what would be observed.

(i) The oxidation of iron (II) ions in aqueous solution.

(ii) The oxidation of oxalic acid ($H_2C_2O_4$) solution forming CO_2.

(iii) The reduction of dichromate ions in acidic solution.

(b) Write ion-electron half equations and the overall oxidation-reduction equation for the reaction between the permanganate ions and iodide ions in a **basic** solution to form manganese dioxide and iodate ions.

QUESTION THREE

Assessor's use only

The Daniell electrochemical cell can be represented as:

$$\mathbf{Zn_{(s)}/Zn^{2+}_{(aq)}//Cu^{2+}_{(aq)}/Cu_{(s)}}$$

(a) Write ion-electron half equations for the above electrochemical cell indicating which species is the reducing agent (Reductant) and which species is the oxidising agent (Oxidant).

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(b) Draw and label below the set up required to measure the electrode potential (E° cell) of the Daniell electrochemical cell.

(c) Calculate the theoretical electrode potential (E° cell) for the Daniell cell given the following half-cell electrode potentials.

$E^{\circ}(Cu^{2+}/Cu) = +0.34$ V **$E^{\circ}(Zn^{2+}/Zn) = -0.76$ V**

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QUESTION FOUR

Assessor's use only

A lead-acid battery is shown in the picture below. Each cell in the battery contains **lead** and **lead dioxide (PbO_2)** electrodes immersed in an electrolyte of **sulfuric acid**. When a current is drawn from the battery the lead and lead dioxide electrodes produce **lead (II) ions**.

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(a) Write ion-electron half equations and a fully balanced oxidation-reduction equation for the lead-acid cell reaction. Identify the oxidation and reduction half-equations.

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(b) As the lead acid battery **discharges** an insoluble lead precipitate forms on the Pb and PbO_2 electrodes. Write the chemical formula for the precipitate that forms and **describe** what happens to the concentration of the sulfuric acid as the battery discharges.

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(c) The lead-acid battery is rechargeable. Write the fully balanced oxidation-reduction equation for the reaction that occurs when the battery is recharged.

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QUESTION FIVE

Assessor's use only

Use the standard electrode potentials shown below to determine whether the following reactions will take place or not. (Show your working).

	Standard Potential E° (volts)
F_2/F^-	**+2.87**
H_2O_2/H_2O	**+1.78**
$Cr_2O_7^{2-}/Cr^{3+}$	**+1.33**
Br_2/Br^-	**+1.07**
Fe^{3+}/Fe^{2+}	**+0.77**
Zn^{2+}/ Zn	**- 0.76**

(a) Will Br_2 oxidise Fe^{2+} to Fe^{3+}?

(b) Will H_2O_2 oxidise F^- to F_2?

(c) Will Zn reduce $Cr_2O_7^{2-}$ to Cr^{3+}?

QUESTION SIX

Assessor's use only

(a) Photochromic glass will darken when exposed to bright light. **Silver chloride** and **copper (I) chloride** crystals are added during the manufacture of the glass because one characteristic of silver chloride is its susceptibility to oxidation and reduction by light.

Write the ion-electron half equations for the oxidation and reduction of silver chloride to its respective **atoms**.

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(b) It is the **metal product** of one of the reactions above that causes the glass to darken and its production is dependent on the light intensity. When the glass is removed from the light it is the presence of copper (I) chloride in the glass that makes the darkening reversible through a two step process.

(i) Write a full ion-electron equation showing Cu^+ acting as a **reducing agent** to reverse one of the equations in part (a).

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(ii) One of the products of part (b)(i) now acts as an **oxidising agent** to completely reverse the darkening process. Write a full ion-electron equation showing this reaction.

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