

Test: Redox Reactions

1. Dichromate ions ($\text{Cr}_2\text{O}_7^{2-}$) were used in old police breathalyser tests to detect the presence of ethanol ($\text{C}_2\text{H}_6\text{O}$). Dichromate and ethanol react together to form Cr^{3+} and $\text{C}_2\text{H}_4\text{O}$.

(a) Write and balance the two half-equations for this reaction.

(4)

(b) Combine the half-equations to write the overall reaction equation.

(2)

(c) Determine the oxidation state of chromium in $\text{Cr}_2\text{O}_7^{2-}$.

(1)

(d) State the oxidation number change of carbon during this reaction.

(2)

(e) State whether the chromium half-equation represents oxidation or reduction.

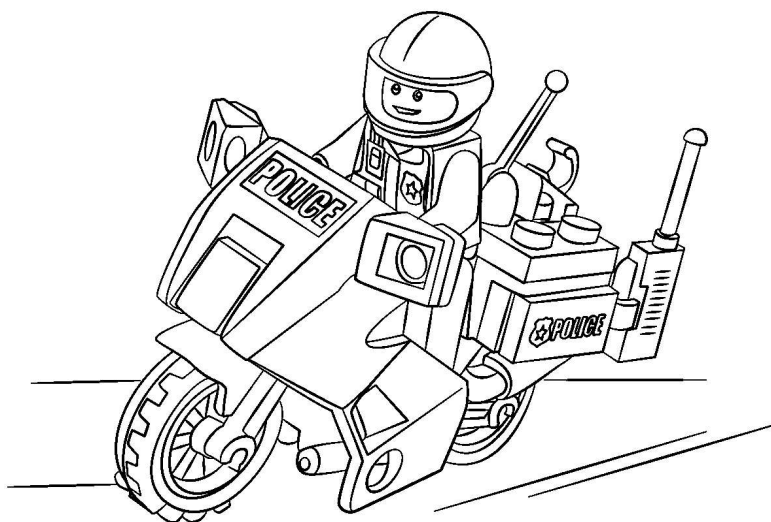
(1)

(f) State the formula for the species that is the reducing agent in this reaction.

(1)

(g) State whether this reaction requires acidic, neutral or alkaline conditions. Give a reason for your answer.

(2)



2. Iron (Fe) can be extracted from iron (III) oxide (Fe_2O_3) by reacting it with coke (C) at high temperatures in a blast furnace. This reaction also produces carbon monoxide gas (CO).

(a) State the oxidation number of carbon in coke.

_____ (1)

(b) Describe, in terms of electrons, how coke is acting as a reducing agent during this reaction.

_____ (2)

(c) Suggest why this process can be used to extract iron from iron oxide but can not be used to extract zinc from zinc oxide.

_____ (2)

3. Metal displacement reactions can be predicted by comparing positions on the metal activity series.

(a) State whether Mg or Cu is more active.

_____ (1)

(b) Hence state whether Mg^{2+} or Cu^{2+} is more readily reduced to metal form.

_____ (1)

(c) Explain why Mg can displace Cu^{2+} from solution but Mg^{2+} is not able to displace Cu^{2+} from solution.

_____ (2)

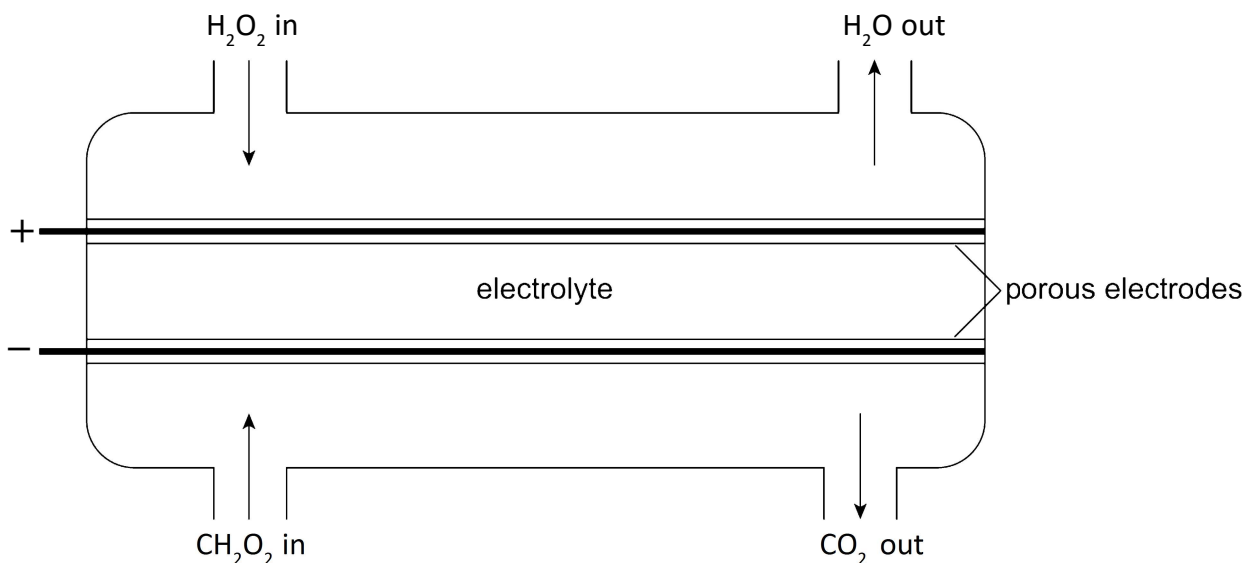
(d) Describe what would be observed if Mg powder is added into a beaker containing Cu^{3+} solution and the mixture is stirred.

_____ (2)

(e) Predict whether or not a reaction will occur if Au powder is used instead of Mg powder.

_____ (1)

4. A fuel cell is a galvanic cell where the reactants are being continuously supply. The diagram below shows a fuel cell which uses H_2O_2 and CH_2O_2 as reactants, and produces H_2O and CO_2 . The electrolyte acts as a salt bridge, allowing ions to flow between the electrodes.



- (a) State why a galvanic cell must be separated into two half-cells. (1)
- (b) State why it is necessary for ions to be able to flow between electrodes. (1)
- (c) Write and balance the two half-equations for this reaction. (4)

- (d) Combine the half-equations to write the overall reaction equation. (2)
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- (e) Explain why the oxidation number of oxygen in H_2O_2 is -1. You may use a diagram in your answer. (2)
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- (f) Identify either the - or + electrode as the anode. Give a reason for your answer. (2)
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- (g) Draw an arrow on the diagram to show the direction of flow of H^+ ions through the electrolyte. (1)

- (h) Draw a wire between the - and + electrodes. Indicate the direction of electron flow in the wire. (1)

- (i) Electric cars currently store power in rechargeable batteries, but fuel cells are being investigated as a possible future technology to use instead.

Suggest one advantage fuel cells could have over batteries in electric cars.

(1)