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VCE Chemistry ¾
Fuel Cells [1.9]
Test

20 Marks. 1 Minute Reading. 16 Minutes Writing

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (3 marks)

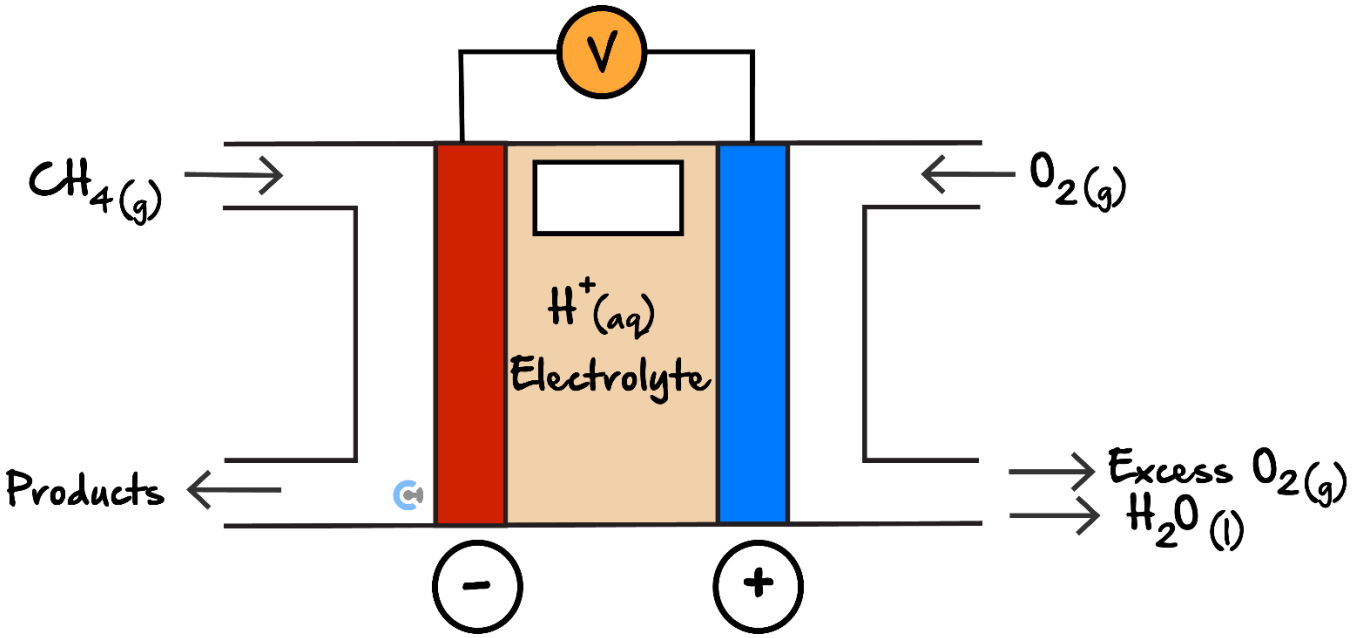
Tick whether the following statements are **true** or **false**.

	True	False
a. In a fuel cell, the reactants are already stored and are therefore finite.		
b. The fuel being consumed reacts at the anode in a fuel cell.		
c. The electrolyte is shared between both half-cells in a fuel cell.		
d. In fuel cells there are several energy conversions which take place, hindering their energy efficiency.		
e. In a fuel cell, the electrodes are porous, and because of these holes, the electrodes are not very electrically conductive.		
f. The type of electrolyte used influences the half-equations but has no impact on the overall equation occurring in a fuel cell.		

Space for Personal Notes

Question 2 (7 marks)

Below is a typical fuel cell used to generate electricity:



a. Draw an arrow in the box in the electrolyte to show the direction in which the $H^+(aq)$ ions will migrate. (1 mark)

b.

i. Write the overall equation occurring. (1 mark)

_____

ii. Write the oxidation half-equation. (1 mark)

_____

c. If the voltmeter in this cell reads a potential difference of 1.49 V at standard conditions and 1 M concentration for the electrolyte, calculate the E° of the oxidation reaction. (1 mark)

_____

_____

_____

d. This fuel cell is sometimes referred to as a proton exchange membrane fuel cell (PEMFC). Explain why it can be classified as such and outline the role protons play in this fuel cell. (2 marks)

_____

_____

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_____

e. Fuel cells such as this one have not yet entirely replaced coal-fired power stations to generate electricity. Suggest **one** reason as to why this is the case. Justify your answer. (1 mark)

_____

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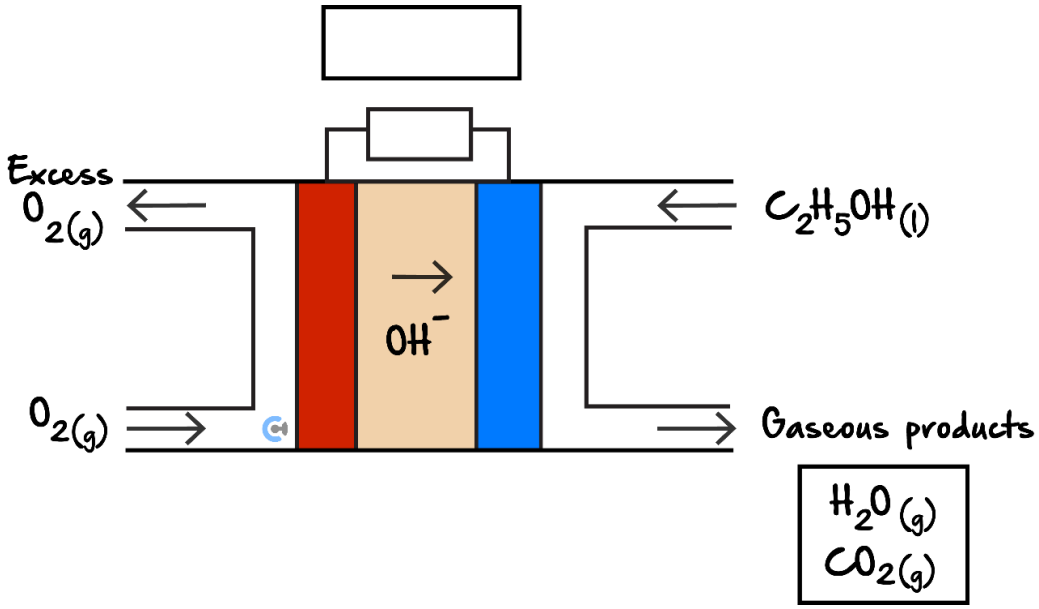
_____

Space for Personal Notes

Question 3 (5 marks)

An ethanol fuel cell with an alkaline electrolyte is depicted below:



a. In the box above the fuel cell, draw an arrow to represent the direction of electron flow through the circuit. (1 mark)

b. Write the balanced half-equation occurring at the electrode where the electrolyte is a reactant. (2 marks)

_____

_____

_____

c. Name and explain one property the electrodes in this fuel cell must possess. (1 mark)

_____

_____

_____

d. State **two** types of energy produced as this fuel cell operates. (1 mark)

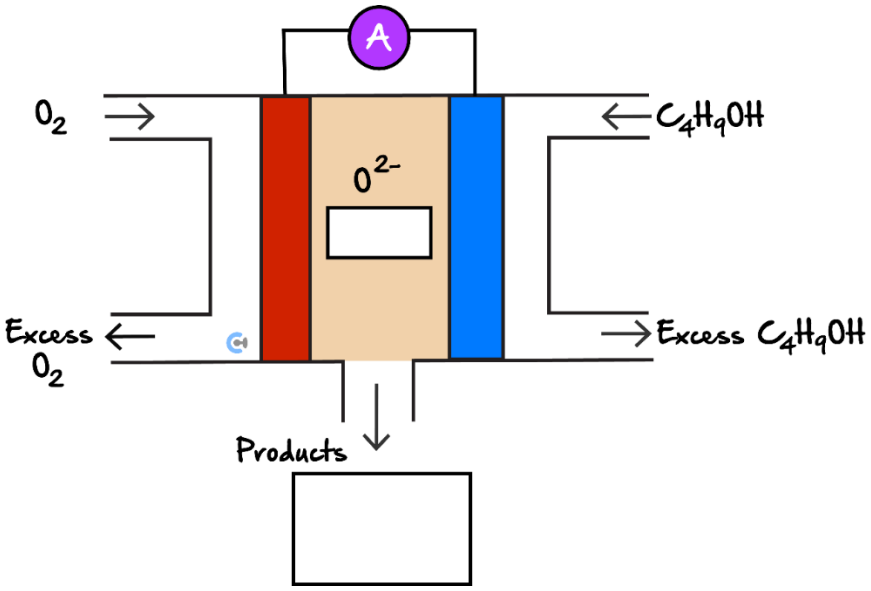
_____

_____

Section B: Extension (5 Marks)

Question 4 (5 marks)

Some fuel cells operate at very high temperatures and, as such, make use of molten electrolytes. One such cell used is shown below, which makes use of a solid oxide electrolyte:



a. In the box provided within the electrolyte, draw an arrow to depict the direction of oxide movement. (1 mark)

b. Write the half-equation occurring at the electrode to which electrons are being transferred. (1 mark)

_____

c. In the box provided below the diagram, write the products which will evolve as a result of the **overall** reaction occurring in the cell. Include states. (1 mark)

d. Write the half-equation occurring at the negative electrode. (1 mark)

_____

e. If the relevant half-equations were provided in the electrochemical series, would it be feasible to calculate the EMF generated by this cell? Justify your answer. (1 mark)

_____

_____

_____

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