AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.5.2 CHEMICAL CELLS AND FUEL CELLS

SCORE	PERCENTAGE
/55	%

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Q1.

(a) copper, zinc, sodium chloride solution

1

(b) a reactant is used up

allow the reaction stops

allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant

1

(c) the reaction is not reversible

1

(d) $2H_2 + O_2 \longrightarrow 2H_2O$

allow fractions / multiples

*allow **1** mark for O_2*

2

(e) **Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

5–6

Level 2: Some logically linked reasons are given. There may also be a simple judgement.

3–4

Level 1: Relevant points are made. This is not logically linked.

1–2

No relevant content

0

Indicative content

reasons why fuel cells could be judged as better

from the table	**from other knowledge**
• time for refuelling a fuel cell is faster than recharging **or** a fuel cell does not need to be recharged • a fuel cell has a greater range	• hydrogen can be renewable if made by electrolysis using renewable energy • lithium-ion batteries can catch fire • produces only water **or** no pollutants produced • lithium-ion batteries may release toxic chemicals on disposal • lithium-ion batteries (eventually cannot be recharged so) have a finite life

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reasons why the lithium-ion battery could be judged as better

from the table	from other knowledge
• lithium-ion uses energy more efficiently • cost of lithium-ion car much less • cost of recharging much less than refuelling with hydrogen	• hydrogen is often made from fossil fuels so is not renewable • charging points are more widely available than hydrogen filling stations • hydrogen takes up a lot of space **or** is difficult to store • hydrogen can be highly flammable / explosive • no emissions produced • (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life

[11]

Q2.

(a) magnesium
zinc
iron
tin
(copper)

*three in the correct order scores **1** mark*
*all correct scores **2** marks*

2

(b) use 4 cells (each of voltage 1.5 V)

1

connect in series

1

(c) reaction stops

1

(because) one of the reactants is used up

1

(d) (hydrogen +) oxygen (⟶ water)

1

(e) any **two** from:
- produces water
- water is not harmful / polluting
- does not produce carbon dioxide
- does not produce other named pollutant

*allow an answer of **only** produces water for **2** marks*

2

[9]

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Q3.

(a) the chemical reaction is reversible

1

(b) any **two** from:
- type of electrode
- electrolyte
- concentration of electrolyte
- temperature

2

(c) $H_2 + \mathbf{2}OH^- \rightarrow \mathbf{2}H_2O + \mathbf{2}\ e^-$

allow multiples

1

(d) contains OH^- ions

1

(e) (bonds broken)

((6 × 412) + (2 × 360) + (2 × 464) + (3 × 498)) = 5614

1

(bonds made)
((4 × 805) + (8 × 464)) = 6932

1

(overall energy change)
(6932 − 5614) = −1318 (kJ / mol)

allow ecf from marking point 1 and / or marking point 2

1

*an answer of 1318 (kJ / mol) scores **3** marks*

[8]

Q4.

(a) (zinc has) lost electron(s)

accept loss of electrons

1

(b) copper is the least reactive

1

because it gave the most negative voltage when it was metal 2
or
it gave the biggest voltage with chromium
or
it gave the most positive voltage when it was metal 1

1

(c) −0.7 V

1

The voltage with chromium and copper is 1.2

accept use of other cell pairings such as tin with copper and tin with iron

1

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The voltage with chromium and iron is 0.5 and copper is less reactive (than iron)

1

(d) hydrogen + oxygen = water

1

(e) $H_2 \rightarrow 2H^+ + 2e^-$

1

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$

1

[9]

Q5.

(a) electrical

1

(b) using hydrogen saves petrol / diesel / *crude oil*

allow crude oil is non-renewable

ignore hydrogen is renewable

1

using hydrogen (in fuel cells) does not cause pollution

accept no carbon dioxide produced

allow less carbon dioxide produced

allow hydrogen produces <u>only</u> water

1

(c) (i) (–)486

*correct answer with or without working gains **3** marks*

if answer is incorrect:

*(2 × 436) + 498 **or** 1370 gains **1** mark*

*4 × 464 **or** 1856 gains **1** mark*

*correct subtraction of ecf gains **1** mark*

3

(ii) products lower than reactants

1

reaction curve correctly drawn

1

activation energy labelled

1

[9]

Q6.

(a) Aluminium has a low density

1

Aluminium is resistant to corrosion

1

(b) (i) (an alloy) is a <u>mixture</u> of metals

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accept (an alloy) can be a metal <u>mixed</u> with another metal ***or*** *iron <u>mixed</u> with carbon / a non-metal*

1

(ii) pure metals are soft

allow weak

or

alloys are hard

allow strong / keep their shape
ignore rust / corrosion

1

(c) (i) crude oil

1

(ii) hydrocarbons

1

(iii) oxygen

1

(d) (i) hydrogen

allow H_2 or H

1

(ii) <u>only</u> water is produced (from the fuel)

or

<u>no</u> carbon dioxide is produced (from the fuel)

allow <u>less</u> carbon dioxide produced ***or*** *<u>less</u> global warming*
allow carbon dioxide causes global warming

1

[9]

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