Mark scheme

Electrochemistry

Chemistry 0620 · Questions from Paper 3, Paper 4 and Paper 6

Total marks

79

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
4	5	6	7	7	7	7	8	11	17	**79**

Question 1 [4]

1(a)(i)	negative electrode: lead (1) positive electrode: bromine (1)	**2**
1(a)(ii)	platinum (1)	**1**
1(b)	1 shared pair of electrons AND no other electrons on either H atom (1)	**1**

Question 2 [5]

2 **(a)** carbon / graphite (1) [1]

(b) bulb lights / fizzing / bubbles (1) [1]
ignore: names of electrodes
allow: solution gets paler / changes colour / green colour fades

(c) copper (1)
negative electrode / cathode (1) [2]

(d) electrolysis (1) [1]

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Question 3 [6]

3	**any 6 from** **MP1** find mass of spoon **MP2** silver nitrate dissolved in water **MP3** diagram showing complete circuit with electrodes in silver nitrate (solution) / electrolyte and a power supply **MP4** spoon / object to be plated as negative electrode / cathode in electrolysis **MP5** silver used as one of the electrodes in electrolysis After electrolysis **MP6** wash and dry spoon **MP7** find mass of spoon again (**after electrolysis)** and mass of silver = new mass – original mass	6

Question 4 [7]

4 **(a)** **(i)** electrolyte → D [1]
allow: (molten) sodium chloride
cathode → C [1]

(ii) graphite [1]

(b) floats on top of the sodium chloride [1]
allow: sodium is on top

(c) chlorine / Cl_2 [1]
allow: Cl
reject: chloride

(d) (anode →) chlorine / Cl_2 [1]
allow: oxygen / O_2
allow: Cl / O
reject: chloride / oxide
(cathode →) hydrogen / H_2 [1]
allow: H

[Total: 7]

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Question 5 [7]

5(a)	electroplating;	**1**	**R:** electrolysis
5(b)	prevent rusting / corrosion / attractive appearance / shiny;	**1**	
5(c)	the negative / cathode;	**1**	
5(d)	**M1** chromium (salt) / chromium + *any named* anion; **M2** nitrate / sulfate / chloride / ethanoate / *suitable* named anion;	**1** **1**	**M2** is dependent on **M1**
5(e)	coating will not stick / be even / dirt or grease will be trapped;	**1**	**I:** it will not conduct
5(f)	spoon not completely immersed in electrolyte / only half of spoon will be plated;	**1**	

Question 6 [7]

6(a)	electrodes	**1**
6(b)	bubbles / fizz / effervescence	**1**
6(c)(i)	more hydrogen twice as much hydrogen / half as much oxygen	**1** **1**
6(c)(ii)	water	**1**
6(d)	*lighted splint* no effect / brighter light for oxygen 'pops' for hydrogen **OR** *glowing splint* relights for oxygen no effect for hydrogen	 **1** **1** **1** **1**

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Question 7 [7]

7 **(a)** carbon dioxide/CO_2 [1]

(b) $2H_2 + O_2 \rightarrow 2H_2O$ [1]

(c) **(i)** anode/negative electrode **and** electrons lost(by hydrogen/H/H_2)/electrons move from this electrode [1]

(ii) $H_2 \rightarrow 2H^+ + 2e(^-)$ / $H_2 - 2e(^-) \rightarrow 2H^+$ / $H_2 + 2OH^- \rightarrow 2H_2O + 2e(^-)$ / $H_2 + 2OH^- - 2e(^-) \rightarrow 2H_2O$ [2]
Species (1) Balancing (1)

(d) Any **two** from:

CELL:	lightweight
	quieter
	fewer working parts/less maintenance
	more efficient **or** less energy wasted **or** more energy produced
SUSTAINABILITY:	conserves a limited resource/petroleum/fossil fuels
	unlimited supplies of renewable resource(of hydrogen from water)
POLLUTION:	No or less greenhouse effect
	No or less acid rain
	No or less toxic gases
	No or less smog
POLLUTANTS:	No or less C/soot
	No or less CO_2
	No or less CO
	No or less SO_2
	No or less oxides of nitrogen/NO/NO_2/N_2O_4/NO_x
	No or less (unburnt) hydrocarbons
	No or less low level ozone
	H_2O is the **only** product [2]

[Total: 7]

Question 8 [8]

8(a)	**breakdown** of an ionic **compound** when molten or in aqueous solution (1) (using) electricity / electric current / electrical energy (1)	**2**
8(b)	platinum / graphite	**1**
8(c)	$2H^+ + 2e \rightarrow H_2$	**1**

8(d)	Na^+ H^+ Cl^- OH^- all four (2) 3 or 2 (1)	**2**
8(e)	H^+ and Cl^- are discharged / removed (1) Na^+ and OH^- remain (1)	**2**

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Question 9 [11]

9(a)	**M1** breakdown by (the passage of) electricity **M2** of an ionic compound in molten or aqueous (state)	**2**
9(b)(i)	**M1** brown solution **OR** black solid **M2** iodine **M3** hydrogen **M4** copper	**4**

9(b)(ii)	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ **M1** OH^- **AND** e^- **M2** correct equation	**2**
9(c)(i)	copper **OR** anode forms Cu^{2+} which goes into the solution	**1**
9(c)(ii)	copper	**1**
9(c)(iii)	no change	**1**

Question 10 [17]

10(a)	the breakdown (into elements)	**1**
	of an (ionic) compound by (the passage of) electricity	**1**
10(b)(i)	oxygen	**1**
10(b)(ii)	**glowing** splint	**1**
	relights	**1**

10(b)(iii)	$2H^+ + 2e^- \rightarrow H_2$ **M1** gain of electrons by H^+ **M2** rest of equation	**2**
10(c)	*the wires:* electrons	**1**
	the electrolyte: ions	**1**
10(d)	any 2 from: • green gas at positive electrode • bulb is brighter • rate of bubbles increases	**2**
10(e)(i)	*anode made of:* impure copper	**1**
	cathode made of: (pure) copper	**1**
	electrolyte of: (aqueous) copper sulfate	**1**
10(e)(ii)	silver (impurities) fall to the bottom of the cell	**1**
	zinc (impurities) (dissolve) into solution (as ions)	**1**
	because zinc is more reactive than copper **AND** silver is less reactive than copper	**1**

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