Mark scheme

Extraction and corrosion of metals

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

Total marks

90

MARKS FOR EACH QUESTION

1	2	3	4	5	6	7	8	9	10	Total
6	10	11	6	6	8	8	11	12	12	**90**

Question 1 [6]

1(a)(i)	hematite	1
1(a)(ii)	carbon (1) carbon dioxide (1)	2
1(b)	coating with plastic / painting / greasing / galvanising	1
1(c)	silver<chromium<beryllium <magnesium (1) if 2 marks not scored: 1 mark for 1 pair reversed (consecutive) OR magnesium<beryllium<chromium<silver	2

Question 2 [10]

2(a)	lead < nickel < zinc < titanium; (1 mark if one pair reversed)	2
2(b)	positive electrode: oxygen / O_2; negative electrode: aluminium / A*l*;	2 1 1
2(c)	test: (aqueous) sodium hydroxide / (aqueous) ammonia; result: (grey-) green precipitate / solid;	2 1 1
2(d)(i)	oxygen / air; water;	2 1 1
2(d)(ii)	idea of covering surface with tin / zinc / other suitable metal / plastic / grease / oil / paint / galvanising; prevents oxygen / air or water / moisture / steam from getting to the surface;	2 1 1

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Question 3 [11]

3 **(a)** air / oxygen [1]
water [1]
allow: damp / humid

(b) idea of reaction of the oxygen (in first two weeks) [1]
ignore: air reacting
(oxygen reacting) with the iron / rusting / iron reacts [1]
ignore: reaction with rust / reaction with iron oxide
(after 2 weeks) all the oxygen had reacted / there was no further reaction / reaction had stopped / no more oxygen [1]
ignore: no more air / experiment was finished

(c) (at start →) shiny / silvery [1]
allow: grey
(after 2 weeks →) brown / reddish brown / orange [1]
allow: red
ignore: dull

(d) add (aqueous) sodium hydroxide / (aqueous) ammonia [1]
reddish-brown / brown precipitate (both colour and ppt needed) [1]
reject: red precipitate
note: 2nd mark dependent on correct reagent

(e) iron + hydrochloric acid → iron chloride + hydrogen [2]
1 mark for iron chloride; 1 mark for hydrogen
ignore: wrong oxidation numbers / numbers in equation

[Total: 11]

Question 4 [6]

4	any 6 from: • crush lumps • pestle and mortar • weigh cassiterite • heat / reduce • with carbon / CO / more reactive metal, e.g. Zn • weigh tin • (mass of tin / initial mass) × 100 (%)	**6**

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Question 5 [6]

5(a)	D	1
5(b)	C	1
5(c)	H	1
5(d)	B	1
5(e)	C	1
5(f)	G	1

Question 6 [8]

6 **(a)** sodium is expensive / difficult to obtain sodium (from sodium chloride) / problems getting electricity / hard to extract sodium / high energy costs in extraction of sodium [1]

(b) **(i)** reduce temperature / reduce melting point (to 900/1000°C) temperature need not be stated, but if it is stated it must be within the range
better conductivity / solid aluminium oxide does not conduct
aluminium oxide is insoluble in water any **two** [2]

(ii) $2O^{2-} \rightarrow O_2 + 4e^-$ [2] or [0]

(iii) they burn (away) / react with oxygen / form carbon dioxide [1]

(c) hydrogen formed / aluminium above hydrogen in reactivity series / H^+ discharged in preference to Al^{3+} / aluminium is more reactive than hydrogen [1]
aluminium more reactive than carbon / carbon cannot reduce aluminium oxide / aluminium is higher than carbon in the reactivity series / carbon doesn't reduce aluminium oxide / carbon doesn't displace aluminium [1]
comparison is essential for mark

Question 7 [8]

7 **(a)** **(i)** cars, ships, bridges, construction, white goods, screws, nails, roofing, fencing, etc. [1]

(ii) e.g. stainless steel [1]
cooking utensils, surgical equipment, sinks or main use [1]

(b) blow in oxygen **NOT** air [1]
carbon dioxide and sulfur dioxide (escape as gases) [1]
COND on reaction with air / oxygen
add calcium oxide / quicklime [1]
ALLOW calcium carbonate, limestone
phosphorus oxide **or** silicon oxide (are acidic)
reacts (with calcium oxide / $CaCO_3$) [1]
to form slag / calcium silicate [1]

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Question 8 [11]

8(a)	bauxite/Alumina is dissolved in molten cryolite cryolite lowers the melting temperature molten aluminium forms *anode reaction*: $2O^{2-} \rightarrow O_2 + 4e^-$ *cathode reaction:* $Al^{3+} + 3e^- \rightarrow Al$	**5**

8(b)	carbon or graphite electrode reacts with oxygen / burns (in oxygen) / combusts	**2**
8(c)	*use 1*: manufacture of aircraft *reason 1*: low density *use 2*: food containers **OR** cooking foil *reason 2*: Al resistant to corrosion	**4**

Question 9 [12]

9(a)(i)	A;	**1**
9(a)(ii)	B;	**1**
9(a)(iii)	D;	**1**
9(a)(iv)	C;	**1**
9(a)(v)	C;	**1**
9(b)(i)	(hot) air;	**1**
9(b)(ii)	(molten) iron;	**1**
9(b)(iii)	any 2 from: carbon dioxide; carbon monoxide; nitrogen;	**2**
9(c)(i)	as the percentage of carbon increases, so the malleability decreases;	**1**
9(c)(ii)	**M1** oxygen (gas) blown in; **M2** carbon dioxide formed / $C + O_2 \rightarrow CO_2$;	**2** 1 1

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Question 10 **[12]**

10 **(a)** $C + O_2 \rightarrow CO_2$ [1]

(b) **(i)** CO_2 already formed (from C burning or from $CaCO_3$); [1]
then carbon reacts with carbon dioxide; [1]
or
$C + CO_2 \rightarrow 2CO$ = [2] If equation not balanced = [1]

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ [2]
not balanced = [1]
not: reduction by carbon

(c) to remove / neutralise silica / silicon dioxide / silicon(IV) oxide / sand; [1]
reacts with limestone to form slag / calcium silicate; [1]
$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ [1]
or $CaO + SiO_2 \rightarrow CaSiO_3$
or $CaCO_3 \rightarrow CaO + CO_2$

(d) **(i)** galvanising / galvanisation / sacrificial protection; [1]

(ii) sacrificial protection / zinc is sacrificed;
zinc corrodes rather than iron;
zinc is oxidised in preference to iron;
zinc reacts with oxygen and / water in preference to iron;
zinc more reactive / electropositive than iron;
zinc loses electrons more readily than iron;
electrons move on to iron
any **three** [3]

[Total: 12]

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