Past-paper walk-through

Redox ▪ 6.4

eXercise

Questions in this set

- 0620/21 N25 Q18 ▪ 1 mark
- 0620/22 N25 Q19 ▪ 1 mark
- 0620/23 N25 Q18 ▪ 1 mark
- 0620/23 N25 Q22 ▪ 1 mark
- 0620/42 N25 Q2 ▪ 19 marks
- 0620/22 J25 Q17 ▪ 1 mark
- 0620/23 J25 Q18 ▪ 1 mark
- 0620/22 M25 Q21 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 18

0620/21 N25 ▪ Q18 ▪ 1 mark

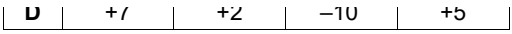
18 The ionic equation for the redox reaction between acidified manganate(VII) ions and iodide ions is shown.

$$2MnO_4^-(aq) + 16H^+(aq) + 10I^-(aq) \rightarrow 2Mn^{2+}(aq) + 5I_2(aq) + 8H_2O(l)$$

Which row shows the changes in oxidation number for manganese and for iodine during this reaction?

	manganese		iodine	
	from	to	from	to
A	–2	+4	–1	0
B	–2	+4	–10	+5
C	+7	+2	–1	0
D	+7	+2	–10	+5

Question 18



Solution 18

Answer: **C**

Why

- In MnO_4^- the four oxygens are -2 each, so manganese is $+7$; in Mn^{2+} it is $+2$.
- Iodide is -1 and iodine as I_2 is 0.
- So manganese falls from $+7$ to $+2$ and iodine rises from -1 to 0.

Question 19

0620/22 N25 ▪ Q19 ▪ 1 mark

19 What is the oxidation number of chromium in the $Cr_2O_7^{2-}$ ion?

A –2 **B** –1 **C** +6 **D** +12

Solution 19

Answer: **C**

Why

- Let the oxidation number of chromium be x.
- The seven oxygens are -2 each, so $2x + 7(-2) = -2$.
- $2x = 12$, so $x = +6$.

Question 18

0620/23 N25 ▪ Q18 ▪ 1 mark

18 Zinc reacts with dilute hydrochloric acid.

Which statement about the particles in the reaction is correct?

A Increasing the concentration of dilute hydrochloric acid increases the collision rate but has **no** effect on the activation energy.

B Increasing the concentration of dilute hydrochloric acid increases the collision rate and the activation energy.

C Increasing the temperature of the reaction increases the activation energy.

D Increasing the temperature of the reaction causes all collisions to lead to a reaction.

Solution 18

Answer: **A**

Why

- A more concentrated acid has more particles in the same volume.
- So collisions happen more often and the rate rises.
- But the particles' *energy* is unchanged, so the fraction able to react is exactly the same.

Question 22

0620/23 N25 ▪ Q22 ▪ 1 mark

22 The equation shows the reaction between copper and concentrated nitric acid.

$$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

Which element is reduced in this reaction?

A oxygen

B nitrogen

C copper

D hydrogen

Solution 22

Answer: **B**

Why

- In HNO_3 the nitrogen is $+5$; in NO_2 it is $+4$.
- A fall in oxidation number is reduction.
- Copper goes from 0 to $+2$, so the copper is oxidised, not reduced.

Question 2

0620/42 N25 ▪ Q2 ▪ 19 marks

2 Iron is extracted from iron ore in a blast furnace.

(a) The iron compound in the main iron ore used in the blast furnace is iron(III) oxide.

(i) State the name of the main iron ore used in the blast furnace.

Question 2

(ii) State how the main source of heat is provided in the blast furnace.

Question 2

(iii) Name the gaseous reducing agent in the blast furnace.

Question 2

(iv) Write a symbol equation for the reduction of iron(III) oxide by the gaseous reducing agent in **(a)(iii)**.

Question 2

(v) The main impurity in iron ore is silicon(IV) oxide.

Write **two** symbol equations to show the role of limestone in removing silicon(IV) oxide from iron ore.

Question 2

Question 2

[2]

(b) Table 2.1 shows four different isotopes of iron, **A**, **B**, **C** and **D**.

Table 2.1

A	B	C	D
^{54}Fe	^{56}Fe	^{57}Fe	^{58}Fe

Explain why **A**, **B**, **C** and **D** are isotopes of iron.

Question 2

(c) Iron can form two different ions, Fe^{2+} and Fe^{3+}.

(i) Complete Table 2.2 to show the number of protons, neutrons and electrons in the two iron ions shown.

Table 2.2

	$^{54}Fe^{2+}$	$^{58}Fe^{3+}$
protons		
neutrons		
electrons		

[2]

Question 2

[3]

Question 2

(ii) Describe a test for aqueous Fe^{2+} ions.

Question 2

[2]

(d) An oxidising agent converts Fe^{2+} ions to Fe^{3+} ions.

(i) Define the term oxidising agent.

Question 2

(ii) Explain why the conversion of Fe^{2+} ions to Fe^{3+} ions is described as oxidation.

Question 2

(iii) The oxidising agent for the conversion of Fe^{2+} ions to Fe^{3+} ions is aqueous potassium manganate(VII).

State **one** condition needed for the oxidation to take place.

Question 2

(e) Iodide ions, I^-, reduce Fe^{3+} ions to Fe^{2+} ions in aqueous solution.

Suggest the identity of the other product formed in this reaction.

Question 2

[Total: 19]

Solution 2

(a)(i)

Mark scheme

- hematite
- 1

Solution 2

(a)(ii)

Mark scheme

- burning of carbon (coke)
- 1
- 0620/42
- October/November 2025

Solution 2

(a)(iii)

Mark scheme

- carbon monoxide
- 1

Solution 2

(a)(iv)

Mark scheme

- $3CO + Fe2O3 \rightarrow 2Fe + 3CO2$ M1
- species M2
- correct equation
- 2

Solution 2

(a)(v)

Mark scheme

- M1 $CaCO3 \rightarrow CaO + CO2$ M2
- $CaO + SiO2 \rightarrow CaSiO3$
- 2

Solution 2

(b)

Mark scheme

- M1 atoms of the same element that have the same number of protons M2
- but different numbers of neutrons
- 2

Solution 2

(c)(i)

Mark scheme

- p = 26 and 26
- n = 28 and 32
- e = 24 and 23/3

Solution 2

(c)(ii)

Mark scheme

- M1 NaOH(aq) OR NH3(aq) M2
- green ppt.
- (insoluble in excess, ppt. turns brown near surface on standing)
- 2

Solution 2

(d)(i)

Mark scheme

- a substance that oxidises another substance and is itself reduced M1
- 'a substance' oxidises another substance M2
- is itself reduced
- 2

Solution 2

(d)(ii)

Mark scheme

- loss of (one) electron
- 1

(d)(iii)

Mark scheme

- acidified
- 1

Solution 2

(e)

Mark scheme

- iodine
- 1
- 0620/42
- October/November 2025

Question 17

0620/22 J25 ▪ Q17 ▪ 1 mark

17 Which equations show the underlined species acting as a reducing agent?

1 $\underline{Fe_2O_3} + 3CO \rightarrow 2Fe + 3CO_2$

2 $\underline{Fe} + CuSO_4 \rightarrow FeSO_4 + Cu$

3 $\underline{5Fe^{2+}} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

4 $\underline{Fe(OH)_2} + H_2SO_4 \rightarrow FeSO_4 + 2H_2O$

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

Solution 17

Answer: **C**

Why

- A reducing agent is itself oxidised, so its oxidation number must increase.
- In equation 2 iron goes from 0 to $+2$, and in equation 3 from $+2$ to $+3$ – both oxidised.
- In equation 1 the underlined species is reduced, and equation 4 is a neutralisation with no change at all.

Question 18

0620/23 J25 ▪ Q18 ▪ 1 mark

18 The equation represents a redox reaction.

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

What is the change in the oxidation number of iron in this reaction?

A from +2 to +3

B from +2 to 0

C from +3 to +2

Question 18

D from +3 to 0

Solution 18

Answer: **D**

Why

- In Fe_2O_3 the three oxygens are -2 each, so each iron must be $+3$.
- In the product the iron is an uncombined element, so its oxidation number is 0.
- So the change is from $+3$ to 0 – the iron has been reduced.

Question 21

0620/22 M25 ▪ Q21 ▪ 1 mark

21 Mercury(II) oxide, HgO, decomposes when heated.

The equation is shown.

$$2HgO \rightarrow 2Hg + O_2$$

Why is this a reduction reaction?

A The products weigh less than the reactants.

B There are fewer reactants than products.

C There is a gain of oxygen.

D There is a loss of oxygen.

Solution 21

Answer: **D**

Why

- Reduction is loss of oxygen, or gain of electrons.
- Mercury(II) oxide loses its oxygen to become mercury metal.
- The mercury also goes from $+2$ to 0, gaining electrons – both definitions agree.