



AS Level Chemistry

ELECTROCHEMISTRY

9701 - PAPER 1 MCQ

2021-2025 | 48 questions



2026 EDITION

Q1 - Easy

9701/12/F/M/24/Q11

11 One of the reactions in the rechargeable lead/acid battery is shown.



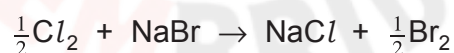
Which statement about this reaction is correct?

- A Lead is both oxidised and reduced.
- B Lead is neither oxidised nor reduced.
- C Lead is oxidised only.
- D Lead is reduced only.

Q2 - Easy

9701/12/O/N/23/Q12

12 Chlorine reacts with sodium bromide.



Which words correctly describe this reaction?

- 1 redox
- 2 displacement
- 3 disproportionation

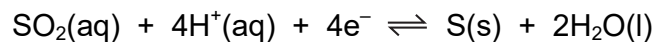
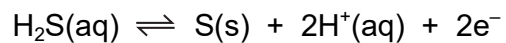
- A 1, 2 and 3
- B 1 and 2 only
- C 1 only
- D 2 only

Q3 - Hard

9701/12/O/N/25/Q3

- 3 The reaction of hydrogen sulfide with sulfur dioxide gives sulfur as one of the products.

The two relevant redox equations are shown.



How many moles of hydrogen sulfide are needed to react with sulfur dioxide to produce 1 mol of sulfur?

- A $\frac{1}{3}$ mol B $\frac{2}{3}$ mol C $\frac{3}{2}$ mol D 2 mol



Q4 - Easy

9701/12/F/M/23/Q6

- 6 The ore psilomelane may be considered to have the general formula $\text{Ba}(\text{Mn}^{x+})(\text{Mn}^{y+})_8\text{O}_{16}(\text{OH})_4$.

In this general formula, $x+$ and $y+$ are the two different oxidation states of manganese in psilomelane.

What could be the values of x and y ?

	x	y
A	2	4
B	6	4
C	6	3
D	7	3

Q5 - Easy

9701/12/F/M/25/Q14

- 14 Copper reacts with nitric acid under certain conditions. The products are copper(II) nitrate, water and an oxide of nitrogen.

3 mol of copper reacts with exactly 8 mol of nitric acid.

What is the oxidation state of nitrogen in the oxide produced?

- A** +1 **B** +2 **C** +3 **D** +4

Q6 - Easy

9701/11/M/J/21/Q9

- 9 When hydrogen iodide is reacted with concentrated sulfuric acid, several reactions occur, including:



Which row gives the change in oxidation number of iodine and of sulfur in this reaction?

	change in oxidation number of iodine	change in oxidation number of sulfur
A	-1	+6
B	-1	+8
C	+1	-6
D	+1	-8

Q7 - Easy

9701/11/M/J/22/Q11

- 11 A student reacts 4 mol of ammonia with oxygen to produce an oxide of nitrogen and water only. Each nitrogen atom increases its oxidation state by 5 in the reaction.

How many moles of oxygen gas react with 4 mol of ammonia in this reaction?

- A 4 mol B 5 mol C 7 mol D 10 mol

Q8 - Easy

9701/11/M/J/22/Q12

- 12 In the treatment of domestic water supplies, chlorine is added to water to kill bacteria. Some ClO^- ions are formed.

What is the change in oxidation number of chlorine when forming the ClO^- ion from aqueous chlorine?

- A -1 B 0 C +1 D +2

Q9 - Easy

9701/12/M/J/22/Q12

- 12 In which row do the oxidation numbers of vanadium increase?

	smallest	→	largest
A	VO_4^{3-}	VO_3^-	VO_2^+
B	VO^{2+}	V_2O_3	VO_4^{3-}
C	V_2O_3	VO^{2+}	VO_3^-
D	VO_4^{3-}	VO_2^+	VO^{2+}

Q10 - Easy

9701/13/M/J/23/Q14

- 14 Which particle contains nitrogen in the same oxidation state as in the ion $\text{N}_2\text{O}_2^{2-}$?

- A NH_2F B N_2O_4 C NO_3^- D HNF_2

Q11 - Easy

9701/12/M/J/25/Q5

- 5 'Red lead' is a red pigment with the formula Pb_3O_4 . Every formula unit of 'red lead' is the same.

Each formula unit contains three lead ions and four oxide ions. Lead has two different oxidation states in 'red lead'.

What are the oxidation states of lead in 'red lead'?

- A +1 and +2 B +1 and +3 C +2 and +4 D +2 and +6

Q12 - Easy

9701/11/O/N/22/Q11

- 11 Ammonium ions are converted into nitrate ions by bacteria.

What is the change in the oxidation number of nitrogen?

- A -6 B +6 C +8 D +9

Also appears as: 9701/13/O/N/22/Q11

Q13 - Easy

9701/12/O/N/22/Q5

- 5 Two moles of VO_2^+ ions react with one mole of zinc atoms in the presence of dilute acid. The products include Zn^{2+} ions and an ion, Y. Ion Y contains vanadium. Only zinc and vanadium change oxidation state in the reaction.

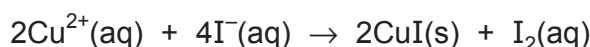
What is ion Y?

- A VO_3^- B VO^+ C VO^{2+} D VO_2^{2+}

Q14 - Easy

9701/12/O/N/23/Q13

- 13 The equation for the reaction between aqueous copper ions and aqueous iodide ions is as follows.



What is the change in oxidation state of copper?

- A +2 to -1 B +2 to 0 C +2 to +1 D +4 to +2

Q15 - Easy

9701/12/O/N/25/Q11

11 In which substance is the average oxidation number of sulfur the highest?

- A S_8 B $Na_2S_4O_6$ C $Na_2S_2O_3$ D SO_2Cl_2

Q16 - Easy

9701/12/O/N/22/Q6

6 The compound potassium bismuthate(V), $KBiO_3$, is a powerful oxidising agent.

What is the significance of the (V) in potassium bismuthate(V)?

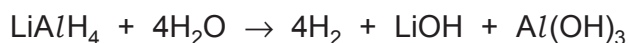
- A It is the oxidation number of the bismuth atom.
B It is the charge of the bismuthate ion.
C It is the oxidation number of the bismuthate ion.
D It is the sum of the charges of the two ions present.

Q17 - Hard

9701/12/M/J/23/Q11

11 $LiAlH_4$ contains AlH_4^- ions in which aluminium has an oxidation state of +3.

$LiAlH_4$ reacts with water, as shown.



In this reaction, each of the four water molecules produces one hydroxide ion. It does this by losing one H^+ ion, which reacts with the $LiAlH_4$.

Which changes in oxidation number occur in this reaction?

- A Al increases by 1 and H decreases by 1.
B H decreases by 2 and also increases by 1.
C H increases by 1 and also decreases by 1.
D O decreases by 1 and H increases by 1.

Q18 - Hard

9701/13/M/J/25/Q4

4 Chromium is present in compound X.

- Two moles of compound X react with exactly 3 moles of silicon.
- The only products of this reaction are 4 moles of chromium and 3 moles of a silicon compound in which the oxidation state of the silicon is +4.
- Chromium and silicon are the only elements that change their oxidation states in this reaction.

What could be the identity of compound X?

A Cr_2O_3

B Cr_2H_6

C Cr_2H_4

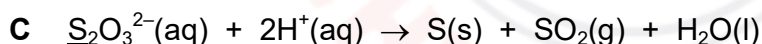
D Cr_2O_4

Q19 - Hard

9701/14/M/J/25/Q6

6 In this question, the average oxidation state of sulfur in $\underline{\text{S}}_2\text{O}_3^{2-}$ and sulfur in $\underline{\text{S}}_2\text{O}_4^{2-}$ should be used.

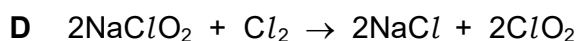
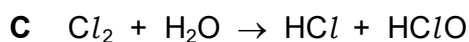
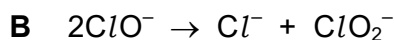
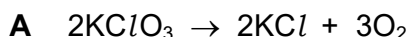
In which reaction does the underlined element have the largest increase in oxidation state?



Q20 - Hard

9701/13/M/J/24/Q11

11 In which reaction does the oxidation number of chlorine change by the largest amount?



Q21 - Hard

9701/12/O/N/21/Q10

- 10 In a catalytic converter in the exhaust system of a car, carbon monoxide is oxidised to carbon dioxide, and nitrogen monoxide is reduced to nitrogen.

What are the changes in oxidation number of carbon and nitrogen in these two processes?

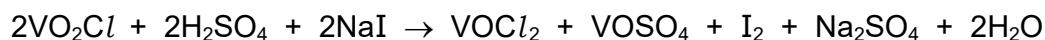
	carbon	nitrogen
A	-2	+2
B	-1	+1
C	+1	-1
D	+2	-2



Q22 - Easy

9701/12/F/M/21/Q8

- 8 VO_2Cl reacts with NaI under acidic conditions.



The oxidation state of Cl is -1 in VO_2Cl and in VOCl_2 .

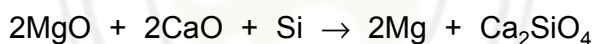
Which row about this reaction is correct?

	vanadium	iodine
A	is oxidised	is oxidised
B	is oxidised	is reduced
C	is reduced	is oxidised
D	is reduced	is reduced

Q23 - Easy

9701/12/F/M/23/Q7

- 7 Silicon reacts with a mixture of calcium oxide and magnesium oxide at 1200°C .



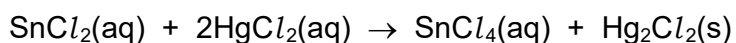
Which statement about this reaction is correct?

- A** Calcium is reduced and silicon is neither oxidised nor reduced.
B Magnesium is reduced and calcium is neither oxidised nor reduced.
C Magnesium is reduced and silicon is neither oxidised nor reduced.
D Silicon is reduced and calcium is neither oxidised nor reduced.

Q24 - Easy

9701/12/M/J/21/Q9

- 9 The equation for a redox reaction is shown.



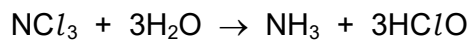
Which species is being oxidised in this reaction?

- A** Sn^{2+} **B** Cl^- **C** Hg^+ **D** Hg^{2+}

Q25 - Easy

9701/12/M/J/22/Q11

11 NCl_3 reacts with H_2O .



The oxidation state of nitrogen does not change in this reaction.

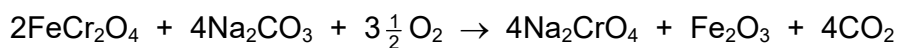
Which statement is correct?

- A Chlorine is reduced.
- B Chlorine is oxidised.
- C Hydrogen is both oxidised and reduced.
- D This is not a redox reaction.

Q26 - Hard

9701/11/M/J/24/Q11

11 Sodium chromate(VI), Na_2CrO_4 , is manufactured by heating chromite, FeCr_2O_4 , with sodium carbonate in an oxidising atmosphere. Chromite contains $\text{Cr}_2\text{O}_4^{2-}$ ions.



What happens in this reaction?

- A Chromium and iron are the only elements oxidised.
- B Chromium, iron and carbon are oxidised.
- C Only chromium is oxidised.
- D Only iron is oxidised.

Q27 - Easy

9701/13/M/J/22/Q11

11 NH_4NO_3 decomposes into N_2O and H_2O on heating.

Which statements are correct?

- 1 The ammonium ion is behaving as a reducing agent.
- 2 The nitrate(V) ion is behaving as an oxidising agent.
- 3 It is a redox reaction.
- 4 It is a disproportionation reaction.

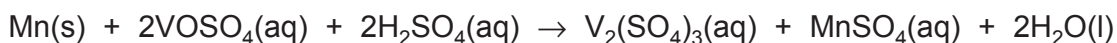
- A 1, 2, 3 and 4
B 1, 2 and 3 only
C 3 and 4 only
D 3 only

Q28 - Easy

9701/12/M/J/23/Q12

12 The vanadium salt, VOSO_4 , is soluble in water and reacts readily with powdered manganese in dilute sulfuric acid.

The equation for the reaction is shown.



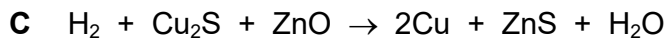
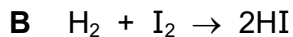
Which statement about this reaction is correct?

- A Hydrogen is oxidised in the reaction.
B Manganese is the reducing agent in this reaction.
C Sulfuric acid is the oxidising agent in this reaction.
D The oxidation state of the vanadium changes from +5 to +3.

Q29 - Easy

9701/11/O/N/25/Q10

10 Which equation shows hydrogen acting as an oxidising agent?



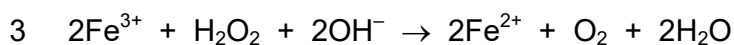
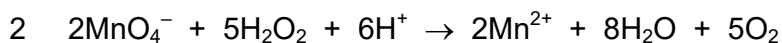
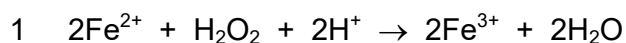
Also appears as: 9701/13/O/N/25/Q10



Q30 - Hard

9701/12/O/N/24/Q11

11 Equations for some reactions of hydrogen peroxide are given.



In which reactions is hydrogen peroxide acting as a reducing agent?

A 1 and 3

B 1 only

C 2 and 3

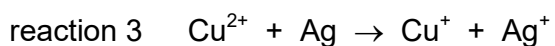
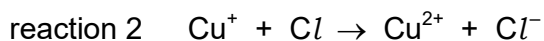
D 2 only

Q31 - Hard

9701/11/O/N/25/Q14

- 14 Photochromic glass, used for sunglasses, darkens when exposed to bright light and becomes more transparent again when the light is less bright. The darkness of the glass is due to the presence of silver atoms.

The following reactions are involved.



Which statement about these reactions is correct?

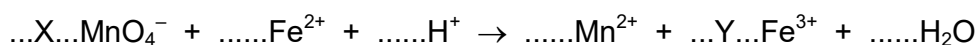
- A Cu^+ and Cu^{2+} ions act as catalysts.
- B Cu^+ ions act as an oxidising agent in reaction 2.
- C Reaction 3 increases the darkness of the glass.
- D Silver atoms are reduced in reaction 3.

Also appears as: 9701/13/O/N/25/Q14

Q32 - Easy

9701/12/F/M/24/Q12

12 KMnO_4 is an oxidising agent. Its reaction with Fe^{2+} is shown in the following ionic equation.



What are X and Y when the equation is balanced?

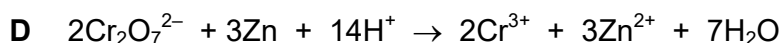
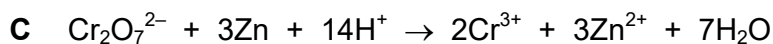
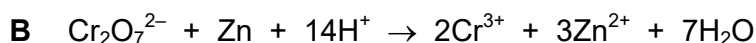
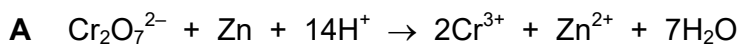
	X	Y
A	1	1
B	1	3
C	1	5
D	5	1

Q33 - Easy

9701/11/O/N/21/Q9

9 Zinc atoms can be oxidised to Zn^{2+} ions by dichromate(VI) ions in acid solution. Chromium is reduced to Cr^{3+} in this reaction.

Which equation is correct?



Also appears as: 9701/13/O/N/21/Q9

Q34 - Easy

9701/11/O/N/24/Q11

- 11 In alkaline solution, MnO_4^- ions oxidise SO_3^{2-} ions to SO_4^{2-} ions. The MnO_4^- ions are reduced to MnO_2 .

What is the ratio of the two ions in the balanced chemical equation for this reaction?

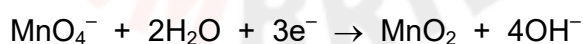
	MnO_4^-	SO_3^{2-}
A	2	3
B	3	2
C	4	7
D	7	4

Also appears as: 9701/13/O/N/24/Q11

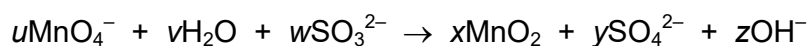
Q35 - Hard

9701/12/F/M/22/Q10

- 10 Two half-equations are shown.



The equation for the reaction between manganate(VII) ions and sulfite ions is shown.



Which statements are correct?

- 1 $u = x = z$
- 2 Manganese is reduced to oxidation state +4.
- 3 Sulfur is oxidised from oxidation state +4 to +6.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

Q36 - Hard

9701/13/M/J/22/Q12

12 A student adds 3 mol of acidified $\text{K}_2\text{Cr}_2\text{O}_7$ to an excess of I^- ions.

The chromium is all reduced to Cr^{3+} and I^- ions are oxidised to I_2 .

The I_2 released is reduced back to I^- ions by X mol of $\text{S}_2\text{O}_3^{2-}$ ions.

1 mol of I_2 is reduced by 2 mol of $\text{S}_2\text{O}_3^{2-}$ ions.

What is the value of X?

A 3

B 6

C 9

D 18

Q37 - Hard

9701/11/M/J/24/Q12

12 Oxygen can be prepared by the reaction of potassium manganate(VII), KMnO_4 , hydrogen peroxide, H_2O_2 , and sulfuric acid, H_2SO_4 . Each H_2O_2 molecule loses two electrons in this reaction. The other products of the reaction are potassium sulfate, manganese(II) sulfate and water.

How many moles of oxygen gas are produced when 1.0 mol of KMnO_4 reacts with an excess of H_2O_2 in acidic conditions?

A 2.0 mol

B 2.5 mol

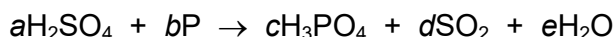
C 4.5 mol

D 5.0 mol

Q38 - Hard

9701/12/M/J/24/Q12

12 Phosphorus reacts with concentrated sulfuric acid to produce phosphoric acid, sulfur dioxide and water.



a , b , c , d and e are all whole numbers.

The equation can be balanced by using oxidation numbers.

What is the value of the sum $a + b + c + d + e$?

A 10

B 14

C 15

D 16

Q39 - Hard

9701/11/M/J/25/Q1

- 1 ICl_3 reacts with water in a redox reaction.



What are the numbers v , x and z in the correctly balanced equation?

	v	x	z
A	2	8	1
B	2	5	1
C	3	8	1
D	3	5	1

Q40 - Hard

9701/14/M/J/25/Q14

- 14 When K_2MnO_4 reacts with concentrated hydrochloric acid, the products include chlorine molecules and MnCl_2 . All of the manganese atoms are reduced to MnCl_2 .

Both Mn and Cl change their oxidation numbers during the reaction. No other element is oxidised or reduced.

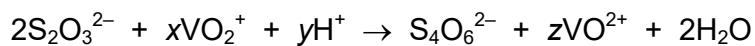
Using these changes in oxidation number, how many moles of chlorine will be produced when 1.0 mol of K_2MnO_4 reacts with an excess of hydrochloric acid?

- A** 2.0 mol **B** 2.5 mol **C** 3.0 mol **D** 4.0 mol

Q41 - Hard

9701/12/O/N/24/Q12

- 12 The equation for the reaction of aqueous thiosulfate ions, $\text{S}_2\text{O}_3^{2-}$, and aqueous dioxo-vanadium ions, VO_2^+ , is shown.



Which row shows two correct statements about the equation for this reaction?

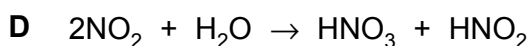
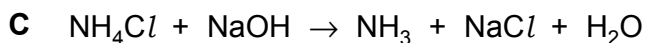
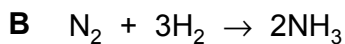
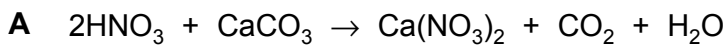
	comparison of x and y to z	change in oxidation number of vanadium
A	x and z are the same value and quarter the value of y	from +4 to +5
B	x and z are the same value and quarter the value of y	from +5 to +4
C	x and z are the same value and half the value of y	from +5 to +4
D	x and z are the same value and half the value of y	from +4 to +5

Q42 - Easy

9701/12/F/M/23/Q1

1 Four equations representing reactions of nitrogen or one of its compounds are given.

Which equation represents a disproportionation reaction?



Q43 - Easy

9701/12/F/M/25/Q11

11 The equation for a reaction of KClO_3 is shown.



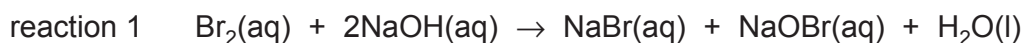
Which row is correct?

	disproportionation reaction	oxidation number of chlorine in KClO_4
A	yes	+4
B	yes	+7
C	no	+4
D	no	+7

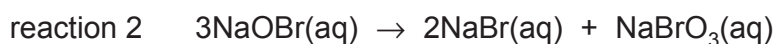
Q44 - Easy

9701/11/M/J/23/Q9

- 9 Bromine reacts with aqueous sodium hydroxide at 25 °C.



The NaOBr formed is unstable at 25 °C and reacts further.



Which reactions are disproportionations?

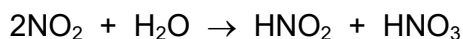
- A both reaction 1 and reaction 2
- B neither reaction 1 nor reaction 2
- C reaction 1 only
- D reaction 2 only



Q45 - Easy

9701/12/M/J/24/Q11

- 11 Nitrogen dioxide reacts with water.



Which statement about this reaction is correct?

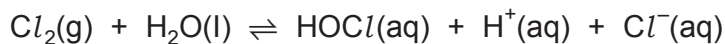
- A Both products are formed because oxygen atoms gain electrons.
- B Nitrogen atoms undergo disproportionation.
- C The oxidation number of hydrogen is increased.
- D Water acts as an oxidising agent.

Q46 - Easy

9701/11/O/N/23/Q11

11 HOCl(aq) is the molecule that kills bacteria when chlorine is added to water.

The following reaction produces this molecule.



Which statement about this reaction is correct?

- A Chlorine is both oxidised and reduced.
- B Chlorine is oxidised but **not** reduced.
- C Hydrogen is both oxidised and reduced.
- D Hydrogen is oxidised but **not** reduced.

Also appears as: 9701/13/O/N/23/Q11

Q47 - Hard

9701/13/M/J/23/Q6

6 Electronegativity differences can be used to help determine the oxidation number of an atom in different species. A number of rules are used which include:

- The more electronegative atom is given a negative oxidation number.
- Hydrogen is more electronegative than Group 1 metals.
- Oxygen is more electronegative than hydrogen.

Which row is correct?

	equation of reaction	redox reaction	disproportionation reaction
A	$2\text{CrO}_4^{2-} + 2\text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$	✓	✗
B	$\text{NaH} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$	✓	✓
C	$3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow \text{MnO}_2 + 2\text{MnO}_4^-$	✓	✓
D	$\text{VO}_3^- + 2\text{H}^+ \rightarrow \text{VO}_2^+ + \text{H}_2\text{O}$	✓	✗

Q48 - Hard

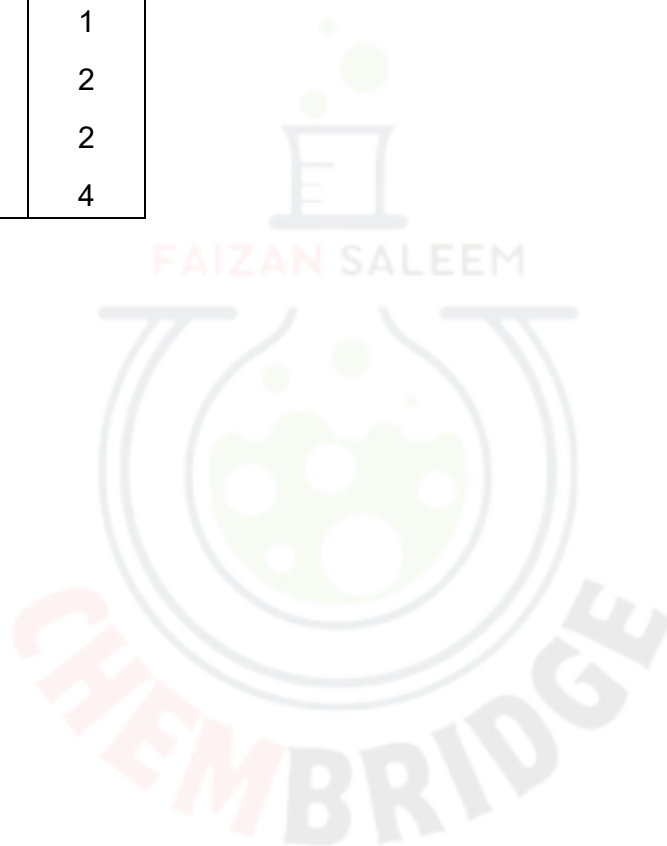
9701/13/M/J/24/Q13

13 W moles of HNO_2 undergoes a disproportionation reaction to produce U moles of HNO_3 and V moles of NO .

- No other nitrogen containing product is produced.
- Nitrogen is the only element oxidised or reduced.

What are the values of W, U and V?

	W	U	V
A	2	1	1
B	3	1	2
C	5	3	2
D	5	1	4



MARKING SCHEME

Official answer letters matched to the worksheet numbering.

Q1	9701/12/F/M/24/Q11	A	1 mark
Q2	9701/12/O/N/23/Q12	B	1 mark
Q3	9701/12/O/N/25/Q3	B	1 mark
Q4	9701/12/F/M/23/Q6	A	1 mark
Q5	9701/12/F/M/25/Q14	B	1 mark
Q6	9701/11/M/J/21/Q9	D	1 mark
Q7	9701/11/M/J/22/Q11	B	1 mark
Q8	9701/11/M/J/22/Q12	C	1 mark
Q9	9701/12/M/J/22/Q12	C	1 mark
Q10	9701/13/M/J/23/Q14	D	1 mark
Q11	9701/12/M/J/25/Q5	C	1 mark
Q12	9701/11/O/N/22/Q11	C	1 mark
Q13	9701/12/O/N/22/Q5	C	1 mark
Q14	9701/12/O/N/23/Q13	C	1 mark
Q15	9701/12/O/N/25/Q11	D	1 mark
Q16	9701/12/O/N/22/Q6	A	1 mark
Q17	9701/12/M/J/23/Q11	C	1 mark
Q18	9701/13/M/J/25/Q4	A	1 mark
Q19	9701/14/M/J/25/Q6	C	1 mark
Q20	9701/13/M/J/24/Q11	A	1 mark
Q21	9701/12/O/N/21/Q10	D	1 mark
Q22	9701/12/F/M/21/Q8	C	1 mark
Q23	9701/12/F/M/23/Q7	B	1 mark
Q24	9701/12/M/J/21/Q9	A	1 mark

MARKING SCHEME

Official answer letters matched to the worksheet numbering.

Q25	9701/12/M/J/22/Q11	D	1 mark
Q26	9701/11/M/J/24/Q11	A	1 mark
Q27	9701/13/M/J/22/Q11	B	1 mark
Q28	9701/12/M/J/23/Q12	B	1 mark
Q29	9701/11/O/N/25/Q10	A	1 mark
Q30	9701/12/O/N/24/Q11	C	1 mark
Q31	9701/11/O/N/25/Q14	A	1 mark
Q32	9701/12/F/M/24/Q12	C	1 mark
Q33	9701/11/O/N/21/Q9	C	1 mark
Q34	9701/11/O/N/24/Q11	A	1 mark
Q35	9701/12/F/M/22/Q10	A	1 mark
Q36	9701/13/M/J/22/Q12	D	1 mark
Q37	9701/11/M/J/24/Q12	B	1 mark
Q38	9701/12/M/J/24/Q12	D	1 mark
Q39	9701/11/M/J/25/Q1	C	1 mark
Q40	9701/14/M/J/25/Q14	A	1 mark
Q41	9701/12/O/N/24/Q12	C	1 mark
Q42	9701/12/F/M/23/Q1	D	1 mark
Q43	9701/12/F/M/25/Q11	B	1 mark
Q44	9701/11/M/J/23/Q9	A	1 mark
Q45	9701/12/M/J/24/Q11	B	1 mark
Q46	9701/11/O/N/23/Q11	A	1 mark
Q47	9701/13/M/J/23/Q6	C	1 mark
Q48	9701/13/M/J/24/Q13	B	1 mark