

9701 Chemistry Paper 1 - Electrochemistry

Topical questions | 85 questions

1. Question | 9701 Feb-March 2016 P1 V2 Q19

- 19** After black and white photographic film has been developed, unreacted silver bromide is removed by reaction with sodium thiosulfate.



What is the function of the thiosulfate ion?

- A** to make the silver ions soluble
- B** to oxidise the silver ions
- C** to reduce the bromine
- D** to reduce the silver ions

2. Question | 9701 May-June 2016 P1 V1 Q22

- 22** Which pair of reagents will take part in a redox reaction?

- A** $\text{CH}_3\text{CHCH}_2 + \text{Br}_2$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{concentrated H}_3\text{PO}_4$
- C** $\text{CH}_3\text{COCH}_3 + \text{HCN}$
- D** $\text{HCO}_2\text{C}_2\text{H}_5 + \text{dilute H}_2\text{SO}_4$

3. Question | 9701 May-June 2016 P1 V2 Q17

- 17** Nitrogen(II) oxide, NO, nitrogen(IV) oxide, NO₂, carbon monoxide, CO, and unburnt hydrocarbons are present in the exhaust gases of internal combustion engines. When catalytic converters are used to remove these compounds from the exhaust gases, redox reactions occur.

What happens to each compound in the catalytic converter?

	NO	NO ₂	CO	hydrocarbons
A	oxidised	oxidised	reduced	oxidised
B	oxidised	oxidised	oxidised	oxidised
C	reduced	reduced	oxidised	oxidised
D	reduced	reduced	reduced	reduced

4. Question | 9701 May-June 2016 P1 V3 Q34

34 When KClO_3 is heated, the following reaction occurs.



Which statements are correct?

- 1** The oxidation state of Cl in KClO_3 is +5.
- 2** The oxidation state of some Cl atoms decreases by 6.
- 3** The reaction involves disproportionation.

5. Question | 9701 Oct-Nov 2016 P1 V1 Q3

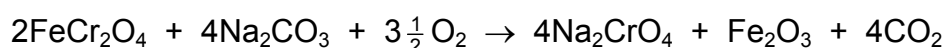
3 The reaction between acidified dichromate(VI) ions, $\text{Cr}_2\text{O}_7^{2-}$, and aqueous Fe^{2+} ions results in the dichromate(VI) ions being reduced to Cr^{3+} ions.

What is the correct equation for this reaction?

- A** $\text{Cr}_2\text{O}_7^{2-} + \text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + \text{Fe}^{3+} + 7\text{H}_2\text{O}$
- B** $\text{Cr}_2\text{O}_7^{2-} + 2\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 2\text{Fe}^{3+} + 7\text{H}_2\text{O}$
- C** $\text{Cr}_2\text{O}_7^{2-} + 3\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Fe}^{3+} + 7\text{H}_2\text{O}$
- D** $\text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$

6. Question | 9701 Oct-Nov 2016 P1 V1 Q9

9 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.

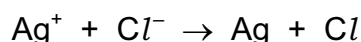


What happens in this reaction?

- 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.

7. Question | 9701 Oct-Nov 2016 P1 V2 Q31

- 31** Photochromic lenses in spectacles darken in sunlight because silver crystals are produced by the reaction shown.



Which statements are correct for this reaction?

- 1** Both silver and chlorine atoms have an oxidation number of zero.
- 2** The oxidation number of chlorine increases.
- 3** Electrons are transferred from Cl^- ions to Ag^+ ions.

8. Question | 9701 Oct-Nov 2016 P1 V3 Q3

- 3** The reaction between acidified dichromate(VI) ions, $\text{Cr}_2\text{O}_7^{2-}$, and aqueous Fe^{2+} ions results in the dichromate(VI) ions being reduced to Cr^{3+} ions.

What is the correct equation for this reaction?

- A** $\text{Cr}_2\text{O}_7^{2-} + \text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + \text{Fe}^{3+} + 7\text{H}_2\text{O}$
- B** $\text{Cr}_2\text{O}_7^{2-} + 2\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 2\text{Fe}^{3+} + 7\text{H}_2\text{O}$
- C** $\text{Cr}_2\text{O}_7^{2-} + 3\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Fe}^{3+} + 7\text{H}_2\text{O}$
- D** $\text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$

9. Question | 9701 Feb-March 2017 P1 V2 Q33

- 33** Which of these statements are always correct?

- 1** The sum of the oxidation numbers of all the atoms in a compound is zero.
- 2** The oxidation number of sodium in a salt is positive.
- 3** The oxidation number of chlorine in a compound is negative.

10. Question | 9701 May-June 2017 P1 V1 Q8

- 8 Solutions containing chlorate(I) ions are used as household bleaches and disinfectants. These solutions decompose on heating as shown.

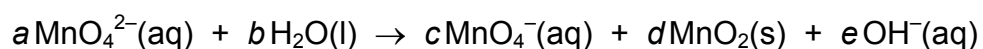


Which oxidation state is shown by chlorine in each of these three ions?

	ClO^-	ClO_3^-	Cl^-
A	+1	+3	−1
B	−1	+3	+1
C	+1	+5	−1
D	−1	+5	+1

11. Question | 9701 May-June 2017 P1 V1 Q9

- 9 When K_2MnO_4 is dissolved in water, the following reaction occurs.

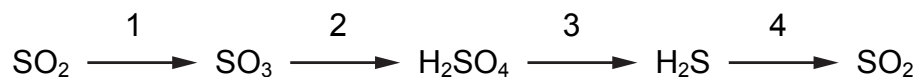


What are the values of a and c in the balanced chemical equation?

	a	c
A	2	1
B	3	2
C	4	3
D	5	4

12. Question | 9701 May-June 2017 P1 V2 Q8

8 A reaction sequence is shown.



In each stage of this sequence the sulfur is oxidised, reduced or neither oxidised nor reduced.

Which row is correct?

	1	2	3	4
A	neither	oxidised	reduced	reduced
B	oxidised	neither	reduced	reduced
C	oxidised	neither	reduced	oxidised
D	oxidised	oxidised	reduced	oxidised

13. Question | 9701 May-June 2017 P1 V3 Q7

7 Vanadium reacts with dilute sulfuric acid to form $\text{V}_2(\text{SO}_4)_3$ and hydrogen gas.

What happens to vanadium atoms in this reaction?

- A** They lose three electrons and are oxidised.
- B** They lose three electrons and are reduced.
- C** They lose two electrons and are oxidised.
- D** They lose two electrons and are reduced.

14. Question | 9701 Oct-Nov 2017 P1 V1 Q6

- 6** One of the reactions in a lead / acid cell 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.

15. Question | 9701 Oct-Nov 2017 P1 V1 Q33

- 33** One way of recovering tin from old printed circuit boards is to dissolve it in a mixture of concentrated hydrochloric acid and concentrated nitric acid. The tin dissolves because it reacts with the mixture of these concentrated acids.



Which statements about this reaction are correct?

- 1** Nitrogen is present in three different oxidation states in the reactants and products.
- 2** The oxidation state of tin increases from 0 to +4.
- 3** The oxidation state of chlorine remains the same.

16. Question | 9701 Oct-Nov 2017 P1 V2 Q8

- 8 Which statement is **always** correct for an oxidation reaction?
- A It involves the gain of oxygen by an element.
 - B For one reactant to be oxidised a different reactant must be reduced.
 - C The element or ion being oxidised will gain electrons.
 - D The oxidation number of the element being oxidised will increase.

17. Question | 9701 Oct-Nov 2017 P1 V3 Q6

- 6 One of the reactions in a lead / acid cell 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.

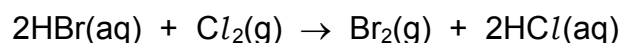
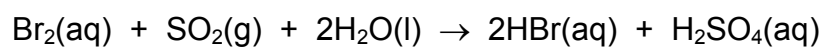
18. Question | 9701 Feb-March 2018 P1 V2 Q10

- 10 Which reaction is **not** a redox reaction?

- A $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
- B $2\text{Mg}(\text{NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$
- C $\text{SO}_2 + \text{NO}_2 \rightarrow \text{SO}_3 + \text{NO}$
- D $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$

17 Bromine is extracted from sea-water.

In the final stages of the process two redox reactions take place.



Which row is correct?

	strongest oxidising agent	→	weakest oxidising agent
A	Br_2	SO_2	Cl_2
B	Cl_2	Br_2	SO_2
C	Cl_2	SO_2	Br_2
D	SO_2	Br_2	Cl_2

- 8** Ethanedioate ions, $\text{C}_2\text{O}_4^{2-}$, react with a suitable reagent to form CO_2 . A half-equation for this reaction is shown.



Which row is correct?

	oxidation state of carbon in $\text{C}_2\text{O}_4^{2-}$	type of reaction
A	+3	oxidation
B	+3	reduction
C	+5	oxidation
D	+5	reduction

21. Question | 9701 May-June 2018 P1 V1 Q9

9 Oxidation numbers should be used to answer this question.

A redox reaction takes place between hydroxylammonium ions, $[\text{NH}_3\text{OH}]^+$, and acidified iron(III) ions, Fe^{3+} . The products are iron(II) ions, Fe^{2+} , H^+ ions, water and a compound of nitrogen.

The mole ratio of reacting hydroxylammonium ions to reacting iron(III) ions is 1 : 2.

Which nitrogen-containing compound could be formed in the reaction?

- A** NH_3 **B** N_2O **C** NO **D** NO_2

22. Question | 9701 May-June 2018 P1 V1 Q14

14 Chlorine reacts with **cold** aqueous sodium hydroxide to produce sodium chloride, water and compound X.

Chlorine reacts with **hot** aqueous sodium hydroxide to produce sodium chloride, water and compound Y.

What are the oxidation states of chlorine in compound X and compound Y?

	X	Y
A	−1	−5
B	−1	+5
C	+1	−5
D	+1	+5

23. Question | 9701 May-June 2018 P1 V1 Q35

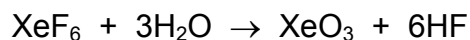
35 Each of the three mixtures shown can result in a chemical reaction.

Which mixtures result in a redox reaction?

- 1** bromine + hydrogen
- 2** sodium chloride + concentrated sulfuric acid
- 3** potassium iodide + silver nitrate

24. Question | 9701 May-June 2018 P1 V3 Q8

- 8** Xenon hexafluoride, XeF_6 , reacts with water.

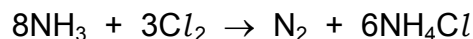


Which statement is correct?

- A** Hydrogen is reduced in this reaction.
- B** Hydrogen is the only element oxidised in this reaction.
- C** The only element oxidised in this reaction is xenon.
- D** This is not a redox reaction.

25. Question | 9701 May-June 2018 P1 V3 Q33

- 33** Ammonia and chlorine react as shown.

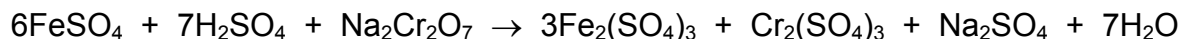


Which statements are correct?

- 1** Each nitrogen atom is oxidised.
- 2** Each chlorine atom is reduced.
- 3** Ammonia behaves as a base.

26. Question | 9701 Oct-Nov 2018 P1 V2 Q33

- 33** Aqueous iron(II) sulfate can take part in redox reactions.



Which redox changes occur during this reaction?

- 1** Fe(II) is oxidised to Fe(III).
- 2** Cr(VI) is reduced to Cr(III).
- 3** Oxygen is reduced to water.

27. Question | 9701 Oct-Nov 2018 P1 V3 Q8

- 8** A transition metal ion, M^{2+} , reacts with acidified dichromate(VI) ions to form M^{4+} ions, Cr^{3+} ions, and H_2O .

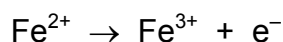
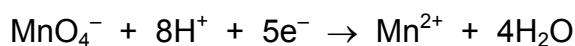
Which equation correctly represents this reaction?

- A** $Cr_2O_7^{2-} + 14H^+ + M^{2+} \rightarrow 2Cr^{3+} + 7H_2O + M^{4+}$
- B** $Cr_2O_7^{2-} + 14H^+ + 2M^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 2M^{4+}$
- C** $Cr_2O_7^{2-} + 14H^+ + 3M^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 3M^{4+}$
- D** $Cr_2O_7^{2-} + 14H^+ + 6M^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6M^{4+}$

28. Question | 9701 Feb-March 2019 P1 V2 Q10

- 10** Acidified potassium manganate(VII) reacts with iron(II) ethanedioate, FeC_2O_4 .

The reactions taking place are shown.

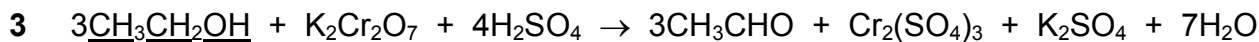
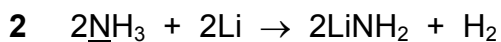
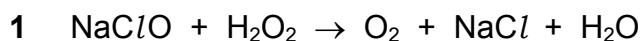


How many moles of iron(II) ethanedioate react with **one** mole of potassium manganate(VII)?

- A** 0.60 **B** 1.67 **C** 2.50 **D** 5.00

29. Question | 9701 Feb-March 2019 P1 V2 Q33

- 33** In which reactions is the underlined element or compound reduced?



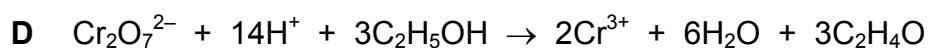
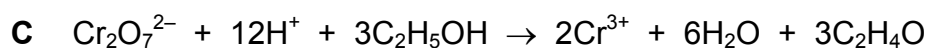
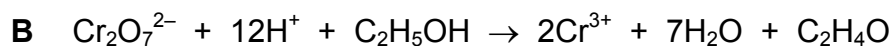
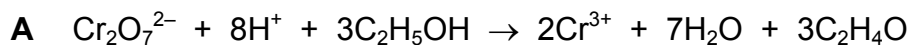
30. Question | 9701 May-June 2019 P1 V3 Q8

8 Ethanol can be oxidised to ethanal by dilute acidified dichromate(VI) ions.

The oxidation reaction equation is $\text{C}_2\text{H}_5\text{OH} \rightarrow \text{C}_2\text{H}_4\text{O} + 2\text{H}^+ + 2\text{e}^-$.

The reduction reaction equation is $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$.

Which equation is correct?



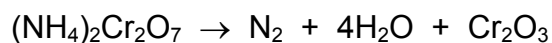
31. Question | 9701 Oct-Nov 2019 P1 V1 Q6

6 What is the oxidation number of sulfur in each species?

	H ₂ S	SO ₂	H ₂ SO ₃
A	−2	+4	+4
B	−2	+4	+6
C	+2	−4	+4
D	+2	−4	+6

32. Question | 9701 Oct-Nov 2019 P1 V2 Q8

8 (NH₄)₂Cr₂O₇ decomposes when heated.



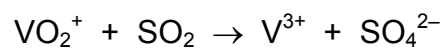
Which element is oxidised and which element is reduced?

	oxidised	reduced
A	chromium	nitrogen
B	hydrogen	chromium
C	nitrogen	chromium
D	nitrogen	hydrogen

6 What is the oxidation number of sulfur in each species?

	H ₂ S	SO ₂	H ₂ SO ₃
A	−2	+4	+4
B	−2	+4	+6
C	+2	−4	+4
D	+2	−4	+6

5 In the redox reaction shown, how do the oxidation states of vanadium and sulfur change?



	vanadium		sulfur	
	from	to	from	to
A	+1	+3	0	−2
B	+1	+3	+4	+6
C	+5	+3	0	−2
D	+5	+3	+4	+6

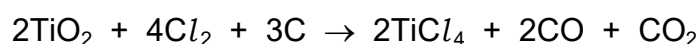
35. Question | 9701 Feb-March 2020 P1 V2 Q10

10 When the equation is correctly balanced, what is the value of c ?

**A** 3**B** 4**C** 5**D** 6

36. Question | 9701 Oct-Nov 2020 P1 V1 Q9

9 The first stage in the chloride process for the manufacture of titanium consists of the following reaction.



What is reduced in this reaction?

A carbon**B** chlorine**C** oxygen**D** titanium

37. Question | 9701 Oct-Nov 2020 P1 V2 Q9

9 Chlorine dioxide, ClO_2 , reacts with sodium hydroxide in the reaction shown.

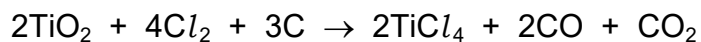


Which statement correctly describes this redox reaction?

A Chlorine atoms are oxidised and oxygen atoms are reduced.**B** Chlorine atoms are reduced and oxygen atoms are oxidised.**C** Some chlorine atoms are oxidised and some chlorine atoms are reduced.**D** Some oxygen atoms are oxidised and some oxygen atoms are reduced.

38. Question | 9701 Oct-Nov 2020 P1 V3 Q9

- 9** The first stage in the chloride process for the manufacture of titanium consists of the following reaction.



What is reduced in this reaction?

- A** carbon
- B** chlorine
- C** oxygen
- D** titanium

39. Question | 9701 Feb-March 2021 P1 V2 Q18

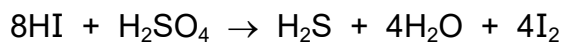
- 18** NO, NO₂, CO and unburnt hydrocarbons are present in the exhaust gases of internal combustion engines. When catalytic converters are used to remove these compounds from the exhaust gases, redox reactions occur.

What happens to each compound in the catalytic converter?

	NO	NO ₂	CO	unburnt hydrocarbons
A	oxidised	oxidised	reduced	oxidised
B	oxidised	oxidised	oxidised	oxidised
C	reduced	reduced	oxidised	oxidised
D	reduced	reduced	reduced	reduced

40. Question | 9701 May-June 2021 P1 V1 Q9

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

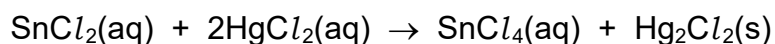


Which row gives the change in oxidation number of iodine and of sulfur in this reaction?

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

41. Question | 9701 May-June 2021 P1 V2 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+}

42. Question | 9701 May-June 2021 P1 V3 Q9

- 9** Copper dissolves in dilute nitric acid producing a blue solution of $\text{Cu}(\text{NO}_3)_2$, water and nitrogen(II) oxide as the only products.

How many moles of acid react with three moles of copper in the balanced equation?

- A** 2 **B** 4 **C** 6 **D** 8

43. Question | 9701 May-June 2021 P1 V3 Q32

- 32** The equation shows the decomposition of three moles of an ion containing chromium in an acid solution.



Which statements are correct?

- 1** One mole of CrO_4^{3-} is reduced.
- 2** Two moles of CrO_4^{3-} are oxidised.
- 3** Three moles of electrons are transferred.

44. Question | 9701 Oct-Nov 2021 P1 V1 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?

- A** $\text{Cr}_2\text{O}_7^{2-} + \text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + \text{Zn}^{2+} + 7\text{H}_2\text{O}$
- B** $\text{Cr}_2\text{O}_7^{2-} + \text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$
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- D** $2\text{Cr}_2\text{O}_7^{2-} + 3\text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$

45. Question | 9701 Oct-Nov 2021 P1 V2 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

46. Question | 9701 Oct-Nov 2021 P1 V2 Q33

- 33** Which reactions are redox reactions?

- $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
- $2\text{K}_2\text{CrO}_4 + 2\text{H}^+ \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{K}^+ + \text{H}_2\text{O}$
- $\text{CuCO}_3 + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

47. Question | 9701 Oct-Nov 2021 P1 V3 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?

- A** $\text{Cr}_2\text{O}_7^{2-} + \text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + \text{Zn}^{2+} + 7\text{H}_2\text{O}$
- B** $\text{Cr}_2\text{O}_7^{2-} + \text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$
- C** $\text{Cr}_2\text{O}_7^{2-} + 3\text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$
- D** $2\text{Cr}_2\text{O}_7^{2-} + 3\text{Zn} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 3\text{Zn}^{2+} + 7\text{H}_2\text{O}$

48. Question | 9701 Oct-Nov 2021 P1 V3 Q17

17 Z is a compound of sodium, chlorine and oxygen.

It contains 45.1% by mass of oxygen.

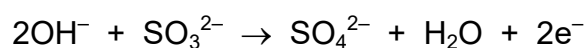
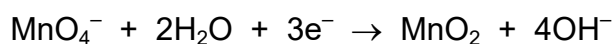
Z is prepared by reacting sodium hydroxide with chlorine.

Which row shows the conditions used for the reaction and the oxidation state of chlorine in Z?

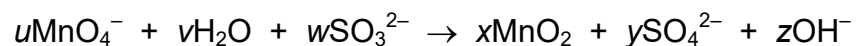
	reaction conditions	oxidation state of Cl in Z
A	cold dilute NaOH	+1
B	cold dilute NaOH	+5
C	hot concentrated NaOH	+1
D	hot concentrated NaOH	+5

49. Question | 9701 Feb-March 2022 P1 V2 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

50. Question | 9701 May-June 2022 P1 V1 Q12

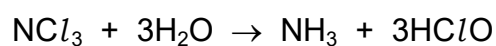
- 12** In the treatment of domestic water supplies, chlorine is added to water to kill bacteria. Some ClO^- ions are formed.

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

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

51. Question | 9701 May-June 2022 P1 V2 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.

52. Question | 9701 May-June 2022 P1 V2 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+}

53. Question | 9701 May-June 2022 P1 V3 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

54. Question | 9701 May-June 2022 P1 V3 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

55. Question | 9701 Oct-Nov 2022 P1 V1 Q12

- 12** Sodium dichromate(VI), $\text{Na}_2\text{Cr}_2\text{O}_7$, reacts with hydrogen peroxide, H_2O_2 , producing Cr^{3+} ions, water and oxygen.

What is the correctly balanced ionic equation for this reaction?

- A** $\text{Cr}_2\text{O}_7^{2-} + 2\text{H}^+ + \text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 2\text{H}_2\text{O} + 4\text{O}_2$
- B** $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$
- C** $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 6\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 10\text{H}_2\text{O} + 6\text{O}_2$
- D** $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$

56. Question | 9701 Oct-Nov 2022 P1 V2 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+}

57. Question | 9701 Oct-Nov 2022 P1 V3 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** $+9$

58. Question | 9701 Oct-Nov 2022 P1 V3 Q12

- 12** Sodium dichromate(VI), $\text{Na}_2\text{Cr}_2\text{O}_7$, reacts with hydrogen peroxide, H_2O_2 , producing Cr^{3+} ions, water and oxygen.

What is the correctly balanced ionic equation for this reaction?

- A** $\text{Cr}_2\text{O}_7^{2-} + 2\text{H}^+ + \text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 2\text{H}_2\text{O} + 4\text{O}_2$
- B** $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$
- C** $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 6\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 10\text{H}_2\text{O} + 6\text{O}_2$
- D** $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$

59. Question | 9701 Specimen 2022 P1 Q5

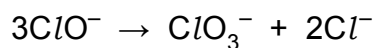
- 5** A medal has a total surface area of 150 cm^2 . It is evenly coated with silver by electrolysis. Its mass increases by 0.216 g .

How many atoms of silver are deposited per cm^2 on the surface of the medal?

- A** 8.0×10^{18} **B** 1.8×10^{19} **C** 8.7×10^{20} **D** 1.2×10^{21}

60. Question | 9701 Specimen 2022 P1 Q10

- 10** Solutions containing chlorate(I) ions are used as household bleaches and disinfectants. These solutions decompose on heating as shown.



Which oxidation states are shown by chlorine in these three ions?

	ClO^-	ClO_3^-	Cl^-
A	+1	+3	-1
B	-1	+3	+1
C	+1	+5	-1
D	-1	+5	+1

61. Question | 9701 Feb-March 2023 P1 V2 Q7

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

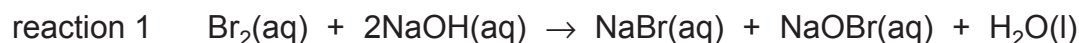


Which statement about this reaction is correct?

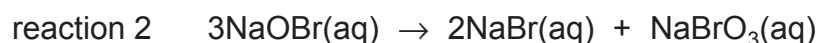
- A** Calcium is reduced and silicon is neither oxidised nor reduced.
- B** Magnesium is reduced and calcium is neither oxidised nor reduced.
- C** Magnesium is reduced and silicon is neither oxidised nor reduced.
- D** Silicon is reduced and calcium is neither oxidised nor reduced.

62. Question | 9701 May-June 2023 P1 V1 Q9

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



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



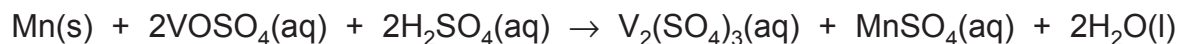
Which reactions are disproportionations?

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

63. Question | 9701 May-June 2023 P1 V2 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.



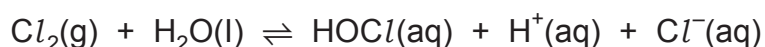
Which statement about this reaction is correct?

- 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.

64. Question | 9701 Oct-Nov 2023 P1 V1 Q11

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

The following reaction produces this molecule.

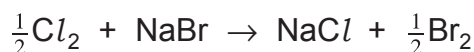


Which statement about this reaction is correct?

- 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.

65. Question | 9701 Oct-Nov 2023 P1 V2 Q12

12 Chlorine reacts with sodium bromide.



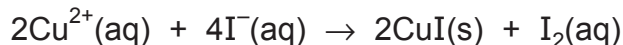
Which words correctly describe this reaction?

- 1 redox
- 2 displacement
- 3 disproportionation

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

66. Question | 9701 Oct-Nov 2023 P1 V2 Q13

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



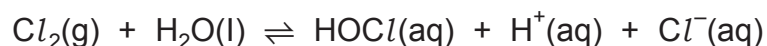
What is the change in oxidation state of copper?

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

67. Question | 9701 Oct-Nov 2023 P1 V3 Q11

11 $\text{HOCl}(\text{aq})$ 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.

68. Question | 9701 Feb-March 2024 P1 V2 Q11

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

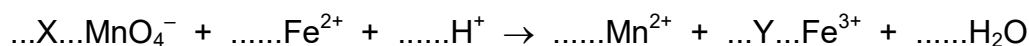


Which statement about this reaction is correct?

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

69. Question | 9701 Feb-March 2024 P1 V2 Q12

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

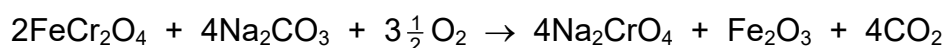


What are X and Y when the equation is balanced?

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

70. Question | 9701 May-June 2024 P1 V1 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.

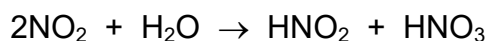


What happens in this reaction?

- 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.

71. Question | 9701 May-June 2024 P1 V2 Q11

- 11** Nitrogen dioxide reacts with water.

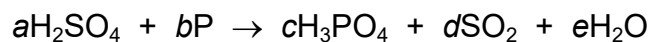


Which statement about this reaction is correct?

- 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.

72. Question | 9701 May-June 2024 P1 V2 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

73. Question | 9701 May-June 2024 P1 V3 Q11

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

- A** $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
B $2\text{ClO}^- \rightarrow \text{Cl}^- + \text{ClO}_2^-$
C $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HClO}$
D $2\text{NaClO}_2 + \text{Cl}_2 \rightarrow 2\text{NaCl} + 2\text{ClO}_2$

74. Question | 9701 May-June 2024 P1 V3 Q13

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

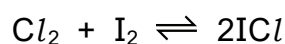
- No other nitrogen containing product is produced.
- Nitrogen is the only element oxidised or reduced.

What are the values of W , U and V ?

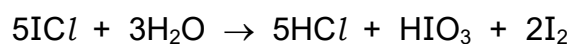
	W	U	V
A	2	1	1
B	3	1	2
C	5	3	2
D	5	1	4

75. Question | 9701 May-June 2024 P1 V3 Q22

22 ICl is made when Cl_2 and I_2 react together.



ICl reacts with water.



Which row is correct?

	oxidation number of I in ICl	reaction occurring when ICl reacts with H_2O
A	+1	the iodine atoms are oxidised to form I_2
B	+1	the iodine atoms are oxidised to form HIO_3
C	-1	the chlorine atoms are reduced to form HCl
D	-1	the iodine atoms are oxidised to form HIO_3

76. Question | 9701 Oct-Nov 2024 P1 V1 Q11

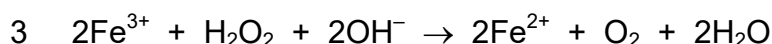
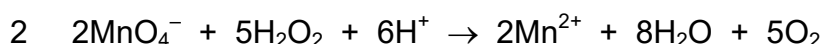
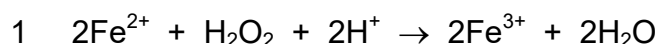
- 11** In alkaline solution, MnO_4^- ions oxidise SO_3^{2-} ions to SO_4^{2-} ions. The MnO_4^- ions are reduced to MnO_2 .

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

77. Question | 9701 Oct-Nov 2024 P1 V2 Q11

- 11** Equations for some reactions of hydrogen peroxide are given.

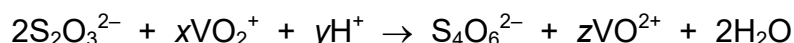


In which reactions is hydrogen peroxide acting as a reducing agent?

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

78. Question | 9701 Oct-Nov 2024 P1 V2 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

9701 Chemistry Paper 1 - Electrochemistry

Topical questions | 85 questions

79. Question | 9701 Oct-Nov 2024 P1 V3 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

80. Question | 9701 Feb-March 2025 P1 V2 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

81. Question | 9701 Feb-March 2025 P1 V2 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

82. Question | 9701 May-June 2025 P1 V4 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.

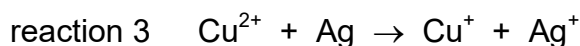
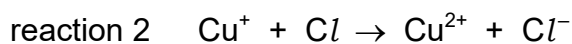
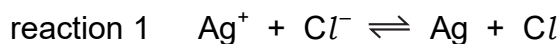
In which reaction does the underlined element have the largest increase in oxidation state?

- A** $3\underline{\text{Cr}}\text{O}_4^{3-}(\text{aq}) + 8\text{H}^+(\text{aq}) \rightarrow 2\text{CrO}_4^{2-}(\text{aq}) + \text{Cr}^{3+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$
- B** $2\underline{\text{N}}\text{O}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HNO}_3(\text{aq}) + \text{HNO}_2(\text{aq})$
- C** $\underline{\text{S}}_2\text{O}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{S}(\text{s}) + \text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- D** $2\underline{\text{S}}_2\text{O}_4^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{S}_2\text{O}_3^{2-}(\text{aq}) + 2\text{HSO}_3^-(\text{aq})$

83. Question | 9701 Oct-Nov 2025 P1 V1 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.

84. Question | 9701 Oct-Nov 2025 P1 V3 Q10

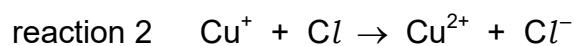
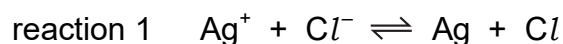
10 Which equation shows hydrogen acting as an oxidising agent?

- A** $\text{H}_2 + 2\text{K} \rightarrow 2\text{K}^+\text{H}^-$
- B** $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$
- C** $\text{H}_2 + \text{Cu}_2\text{S} + \text{ZnO} \rightarrow 2\text{Cu} + \text{ZnS} + \text{H}_2\text{O}$
- D** $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$

85. Question | 9701 Oct-Nov 2025 P1 V3 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.