06 Redox Chemistry

Set B Competition Practice

Name	Time 45 minutes	Total 25 marks	Score ____ / 25

Marks by notes section For the marker: total each row. A score below the target means that section of the notes needs revising.

Notes section	Questions	Marks	Target	Score
2 Oxidation States	1, 2, 3	3	2	
3 Is It a Redox Reaction?	4, 5, 6	3	2	
4 Oxidising and Reducing Agents	7, 8, 9, 10	4	3	
5 Half-Equations	11, 12, 13, 14, 15, 16	6	4	
6 Disproportionation	17, 18	2	2	
7 Redox Titrations	19, 20, 21, 22, 23, 24, 25	7	5	

A Competition questions

25 MARKS

1 Ilmenite is a mineral made mainly of a mixture of iron(II) titanate, $FeTiO_3$, and iron(III) titanate, $Fe_2(TiO_3)_3$. Which row shows the oxidation state of titanium in the two compounds?

	$FeTiO_3$	$Fe_2(TiO_3)_3$
A	+2	+3
B	+4	+2
C	+4	+3
D	+4	+4

A row A **B** row B **C** row C **D** row D

/1

Answer ☐ [1]

2024 AES O Prelim P1 Q22

2 The table shows the formulae of compounds formed by carbon and other elements.

compound	chemical formula
potassium cyanide	KCN
iron(II) carbide	Fe_2C
carbon dioxide	CO_2
calcium carbonate	$CaCO_3$

In which two substances does carbon have the same oxidation state?

A carbon dioxide and calcium carbonate

B carbon dioxide and potassium cyanide

C iron(II) carbide and calcium carbonate

D iron(II) carbide and potassium cyanide

/1

Answer [1]

2024 BTYSS FYE O EOY P1 Q22

3 The compound $Bi_2Sr_2Ca_2Cu_3O_{10}$ is a superconductor. In it, bismuth is +3, strontium and calcium are +2 and oxygen is −2. What are the possible oxidation numbers of the three copper atoms?

A 0, +1, +2 **B** +1, +2, +2 **C** +1, +2, +3 **D** +2, +2, +3

/1

Answer [1]

2023 HCI J2 Prelim P1 Q29

4 During the Contact process, sulfuric acid is produced from sulfur in a series of stages: $S \rightarrow SO_2 \rightarrow SO_3 \rightarrow H_2S_2O_7 \rightarrow H_2SO_4$. Which statement correctly describes these stages?

A All stages involve oxidation and the highest oxidation state of sulfur is +12.

B Only three of the stages involve oxidation and the highest oxidation state of sulfur is +6.

C Only three of the stages involve oxidation and the highest oxidation state of sulfur is +12.

D Only two of the stages involve oxidation and the highest oxidation state of sulfur is +6.

/1

Answer [1]

2024 CHS O Prelim P1 Q18

5 Concentrated sulfuric acid reacts with solid potassium halides:

reaction 1: $H_2SO_4 + 2KCl \rightarrow 2HCl + K_2SO_4$
reaction 2: $2H_2SO_4 + 2KBr \rightarrow 2H_2O + Br_2 + K_2SO_4 + SO_2$
reaction 3: $5H_2SO_4 + 8KI \rightarrow 4H_2O + 4I_2 + 4K_2SO_4 + H_2S$

What is the change in the oxidation state of the sulfur that reacts in each reaction?

	reaction 1	reaction 2	reaction 3
A	0	0	4
B	0	2	4
C	0	2	8
D	2	4	8

A row A **B** row B **C** row C **D** row D

/1

Answer [1]

2024 PLMGSS O Prelim P1 Q25

6 Nitrogen monoxide is removed from car exhaust in a catalytic converter: $2CO + 2NO \rightarrow N_2 + 2CO_2$.
Which statement about the reaction is not correct?

A The oxidation state of carbon changes from +2 to +4.

B The oxidation state of nitrogen changes from +4 to 0.

C The oxidation state of oxygen is unchanged.

D The reaction is a redox reaction.

/1

Answer [1]

2025 JYSS O Prelim P1 Q22

7 Sulfur dioxide is converted to sulfur trioxide in two stages.

stage 1: $2NO + O_2 \rightarrow 2NO_2$
stage 2: $NO_2 + SO_2 \rightarrow SO_3 + NO$

Which statement is correct?

A Nitrogen dioxide is a reducing agent in stage 2.

B Nitrogen monoxide is reduced in stage 1.

C Oxygen is reduced in stage 1 due to a decrease in its oxidation state.

D Sulfur dioxide is an oxidising agent in stage 2.

/1

Answer [1]

2024 YSS O Prelim P1 Q22

8 The results of some experiments with sulfur dioxide are shown.

experiment	description	result
1	mix with dilute hydrochloric acid	does not react
2	mix with concentrated sodium hydroxide	a salt is formed
3	add Universal Indicator	Universal Indicator turns violet
4	add acidified aqueous potassium manganate(VII)	purple solution turns colourless

Which experiments show correct results?

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

Answer [1]

/1

2025 FHSS O Prelim P1 Q13

9 Aqueous iron(III) chloride reacts with aqueous potassium iodide: $vFeCl_3 + wKI \rightarrow xFeCl_2 + yKCl + I_2$. Which statements are correct?

1 In the balanced equation, v, w, x and y have the same value.
2 A purplish-black vapour is produced in the reaction.
3 Potassium iodide is used to test for the presence of an oxidising agent.

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

Answer [1]

/1

2023 Catholic High School O Prelim P1 Q17

10 NF_3 can be made from ammonia and fluorine: $4NH_3 + 3F_2 \rightarrow NF_3 + 3NH_4F$. Which statements about the reaction are correct?

1 NH_3 undergoes disproportionation.
2 The oxidation number of nitrogen in NF_3 is +3.
3 NH_3 is a stronger oxidising agent than F_2.
4 One mole of F_2 gains two moles of electrons.

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

Answer [1]

/1

2021 YIJC J1 MYE P1 Q8

11 50.0 cm^3 of 0.100 mol dm^{-3} $KClO_4(aq)$ reacted exactly with 50.0 cm^3 of 0.400 mol dm^{-3} $TiCl_3(aq)$. Ti(III) is oxidised to Ti(IV). What is the oxidation state of chlorine in the final product?

A −1 **B** +1 **C** +3 **D** +5

Answer [1]

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2018 RVHS J1 Common Test P1 Q2

12 The most common oxidation state of americium, Am, in aqueous solution is +3. Cu^{3+} oxidises $Am^{3+}(aq)$ in dilute HNO_3 and is itself reduced to Cu^{2+}. 20.0 cm^3 of 0.0120 mol dm^{-3} $Am^{3+}(aq)$ required 24.00 cm^3 of 0.0300 mol dm^{-3} Cu^{3+} for complete oxidation. What is the formula of the americium-containing species formed?

A AmO^+ **B** AmO^{2+} **C** AmO_2^{2+} **D** $Am_2O_2^{2+}$

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Answer [1]

2019 ACJC J2 Prelim P1 Q2

13 25.0 cm^3 of a 0.100 mol dm^{-3} solution of M_2O_5 is reduced by sulfur dioxide to a lower oxidation state. 50.0 cm^3 of 0.0200 mol dm^{-3} acidified potassium manganate(VII) is needed to re-oxidise M back to its original oxidation state. What is the oxidation state of M after reaction with sulfur dioxide?

A +2 **B** +3 **C** +4 **D** +5

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Answer [1]

2019 RVHS J1 Common Test P1 Q4

14 0.84 g of an oxide MO of a metal M was dissolved in excess sulfuric acid. 25.0 cm^3 of 0.12 mol dm^{-3} potassium manganate(VII) was required to oxidise M^{2+} to M^{3+}. What is the relative atomic mass of M?

A 36.0 **B** 40.0 **C** 52.0 **D** 56.0

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Answer [1]

2019 SAJC J2 Prelim P1 Q2

15 0.02 mol of an iodine oxide reacts with 0.2 mol of acidified potassium iodide to give 0.12 mol of iodine, I_2. What is the oxidation number of iodine in the oxide?

A +1 **B** +3 **C** +5 **D** +7

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Answer [1]

2024 DHS J2 Prelim P1 Q11

16 Consider the half-equations $Fe^{2+} \rightarrow Fe^{3+} + e^-$ and $C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$. 20 cm^3 of an acidified 0.020 mol dm^{-3} solution of FeC_2O_4 is oxidised by 15 cm^3 of 0.020 mol dm^{-3} $KMnO_4$. Both Fe^{2+} and $C_2O_4^{2-}$ are oxidised. What is the final oxidation state of manganese?

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

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Answer [1]

2024 HCI J2 Prelim P1 Q9

17 A comproportionation reaction is one where two reactants, each containing the same element in a different oxidation state, form a product in which that element has one oxidation state. 2 mol of hydrogen sulfide, H_2S, react with 1 mol of another sulfur-containing compound to form 3 mol of sulfur, S. What is a possible identity of the sulfur-containing compound?

A SO_2 **B** SO_3 **C** H_2SO_4 **D** SCl_2

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Answer [1]

2021 CJC J2 Prelim P1 Q11

18 When potassium chlorate(V), $KClO_3$, is heated at its melting point, it disproportionates to potassium chlorate(VII), $KClO_4$, and potassium chloride. What is the maximum amount of potassium chlorate(VII) that could be produced from 0.200 mol of potassium chlorate(V)?

A 0.200 mol **B** 0.150 mol **C** 0.100 mol **D** 0.0500 mol

Answer [1]

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2021 RVHS J2 Prelim P1 Q1

19 Excess iodide ions react with 15 cm^3 of a solution containing copper(II) ions: $4I^- + 2Cu^{2+} \rightarrow I_2 + 2CuI$. The iodine formed requires 20 cm^3 of 0.10 mol/dm^3 sodium thiosulfate: $I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$. What is the concentration of copper(II) ions in the solution?

A 0.100 mol/dm^3 **B** 0.133 mol/dm^3 **C** 0.267 mol/dm^3 **D** 0.304 mol/dm^3

Answer [1]

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2026 KSS O Prelim P1 Q15

20 The Winkler method finds the amount of dissolved oxygen in water.

step 1: $2Mn^{2+}(aq) + O_2(g) + 4OH^-(aq) \rightarrow 2MnO(OH)_2(s)$
step 2: $MnO(OH)_2(s) + 2I^-(aq) + 4H^+(aq) \rightarrow I_2(aq) + Mn^{2+}(aq) + 3H_2O(l)$
step 3: $I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$

A 5.00 dm^3 sample of water needed a total of 4.00×10^{-3} mol of thiosulfate in step 3. What concentration of oxygen was present in the sample?

A 3.20 mg/dm^3 **B** 6.40 mg/dm^3 **C** 12.8 mg/dm^3 **D** 32.0 mg/dm^3

Answer [1]

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2024 ANDSS O Prelim P1 Q24

21 Excess chlorine was bubbled through 250 cm^3 of aqueous sodium thiosulfate, $Na_2S_2O_3$, oxidising thiosulfate to sulfate ions. 25.0 cm^3 of the resulting solution gave 0.583 g of barium sulfate precipitate with excess aqueous barium nitrate. What is the concentration, in mol dm^{-3}, of sodium thiosulfate in the 250 cm^3 of solution?

A 0.005 **B** 0.050 **C** 0.100 **D** 0.243

Answer [1]

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2016 HCI J1 Promo P1 Q6

22 Iodate(V) ions react with iodide ions in acid: $IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$. 25.0 cm^3 of sulfuric acid is added to a solution containing excess iodate(V) and iodide ions, and the iodine produced is titrated with sodium thiosulfate. 22.00 cm^3 of 0.100 mol dm^{-3} sodium thiosulfate is needed. What is the concentration of the sulfuric acid, in mol dm^{-3}?

A 0.0440 **B** 0.0468 **C** 0.0587 **D** 0.0880

Answer [1]

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2020 VJC J1 Promo P1-P2 Q10

23 Carbon monoxide in air reacts with iodine pentoxide: $5CO + I_2O_5 \rightarrow I_2 + 5CO_2$. The iodine is titrated with sodium thiosulfate: $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$. A 100 cm^3 sample of polluted air gave iodine that needed 20.0 cm^3 of 0.20 mol dm^{-3} sodium thiosulfate. What is the concentration, in g dm^{-3}, of carbon monoxide in the sample?

A 0.100 **B** 1.12 **C** 2.80 **D** 11.2

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Answer [1]

2021 ASRJC J2 Prelim P1 Q7

24 Ethanedioate ions are oxidised by hot acidified potassium manganate(VII): $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$. What volume of 0.020 mol dm^{-3} potassium manganate(VII) is needed to oxidise 1.0×10^{-3} mol of the salt $KHC_2O_4 \cdot H_2C_2O_4$?

A 20 cm^3 **B** 40 cm^3 **C** 50 cm^3 **D** 125 cm^3

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Answer [1]

2022 EJC J1 MYE P1 Q9

25 25.0 cm^3 of 0.01 mol dm^{-3} potassium manganate(VII) was added to 25.0 cm^3 of 0.01 mol dm^{-3} ethanedioic acid. Z is the maximum volume of CO_2 produced at s.t.p. What is the value of Z?

A 10.8 cm^3 **B** 11.4 cm^3 **C** 21.2 cm^3 **D** 28.4 cm^3

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Answer [1]

SJChO Mock 3 P1 Q19

10 The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0		**Key** atomic number atomic symbol name relative atomic mass									5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –