

INNOVA JUNIOR COLLEGE

JC 2 PRELIMINARY EXAMINATION

in preparation for General Certificate of Education Advanced Level

Higher 2

CANDIDATE
NAME

CLASS

INDEX NUMBER

CHEMISTRY

9647/01

Paper 1 Multiple Choice

30 August 2016

1 hour

Additional Materials: Data Booklet
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and class on all the work you hand in.

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

This document consists of **17** printed pages and **1** blank page.

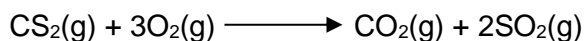


Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 Carbon disulfide, CS_2 , is a volatile liquid used in the production of cellophane which is used for food packaging.

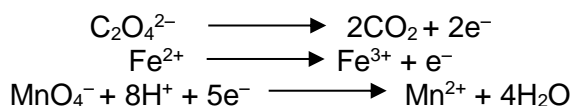
On combustion, CS_2 is oxidised as follows:



A 20 cm^3 sample of carbon disulfide vapour is ignited with 100 cm^3 of oxygen. The final volume of gas after burning is treated with an excess of aqueous alkali.

Which percentage of this final volume dissolves in alkali? (All volumes are measured at room temperature and pressure.)

- A 20%
 - B 40%
 - C 60%
 - D 80%
- 2 Consider the following half-equations



What volume of 0.01 mol dm^{-3} potassium manganate(VII) is needed to completely oxidise 25.0 cm^3 of an acidified solution of $0.01 \text{ mol dm}^{-3} \text{FeC}_2\text{O}_4$?

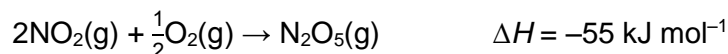
- A 5 cm^3
 - B 7.5 cm^3
 - C 10 cm^3
 - D 15 cm^3
- 3 Which electronic configuration represents an element that forms a simple ion with a charge of -3 ?
- A $1\text{s}^2 2\text{s}^2 2\text{p}^6 3\text{s}^2 3\text{p}^1$
 - B $1\text{s}^2 2\text{s}^2 2\text{p}^6 3\text{s}^2 3\text{p}^3$
 - C $1\text{s}^2 2\text{s}^2 2\text{p}^6 3\text{s}^2 3\text{p}^6 3\text{d}^1 4\text{s}^2$
 - D $1\text{s}^2 2\text{s}^2 2\text{p}^6 3\text{s}^2 3\text{p}^6 3\text{d}^3 4\text{s}^2$

- 4 Carbon dioxide is a gas at room temperature while silicon dioxide is a solid because
- A carbon dioxide contains double covalent bonds while silicon dioxide contains single covalent bonds.
 - B instantaneous dipole – induced dipole attractions are weaker than permanent dipole – permanent dipole attractions.
 - C carbon-oxygen bonds are less polar than silicon-oxygen bonds.
 - D van der Waals' forces are much weaker than covalent bonds.

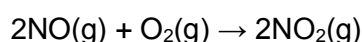
- 5 Under which conditions will the behaviour of a gas be **most** ideal?

	pressure	temperature
A	high	high
B	high	low
C	low	high
D	low	low

- 6 The enthalpy changes involving some oxides of nitrogen are given below:



What is the enthalpy change, in kJ mol^{-1} , of the following reaction?



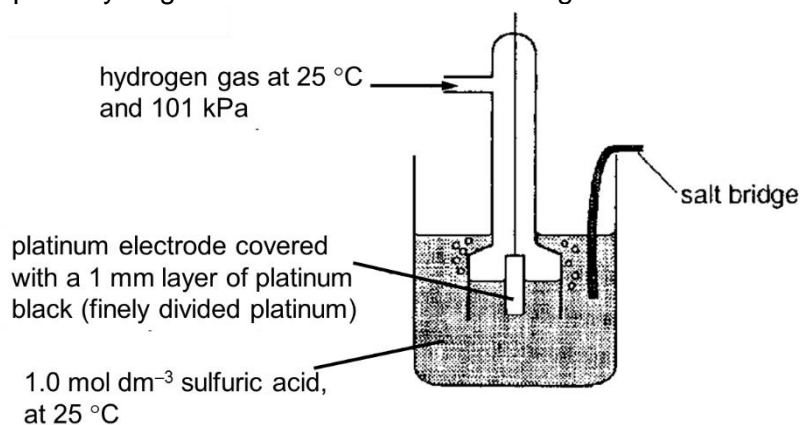
- A -114 B +114 C -136 D +136
- 7 A typical protein forms hundreds of hydrogen bonds and thousands of van der Waals' forces in folding from primary to tertiary structures.
- Which of the following thermodynamic state functions of the protein best represents the folding process?

	$\Delta G / \text{kJ mol}^{-1}$	$\Delta H / \text{kJ mol}^{-1}$	$\Delta S / \text{J K}^{-1} \text{mol}^{-1}$
A	–	–	–
B	+	–	+
C	–	+	–
D	+	+	–

- 8 When 1 mole of carbon dioxide gas solidifies as dry ice, 25.2 kJ of heat energy is evolved. The sublimation temperature of carbon dioxide is $-78.5\text{ }^{\circ}\text{C}$.

What is the entropy change when 132 g of carbon dioxide gas solidifies at this temperature?

- A $+130\text{ J K}^{-1}$
B -130 J K^{-1}
C $+389\text{ J K}^{-1}$
D -389 J K^{-1}
- 9 A student set up the hydrogen electrode shown in the diagram below.

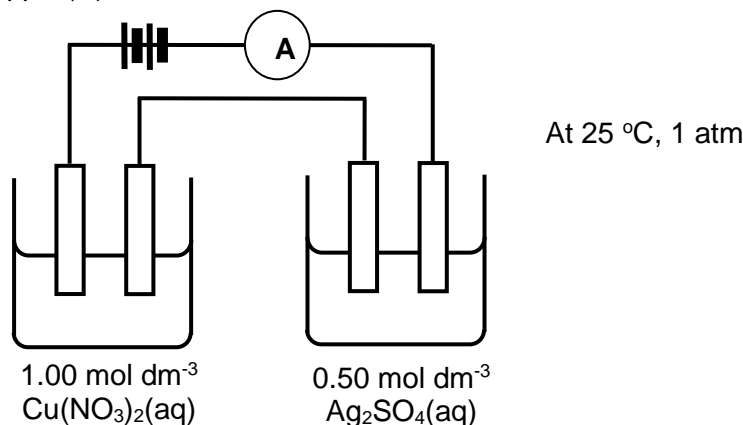


What would have to be changed to make this a standard hydrogen electrode?

- A the acid solution used
B the temperature of the gas and of the acid solution
C the pressure of the gas
D the metal comprising the electrode

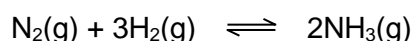
- 10 Use of the Data Booklet is relevant to this question.

Using inert electrodes, a current was passed through two beakers containing aqueous silver sulfate and aqueous copper(II) nitrate, connected in series under standard conditions.



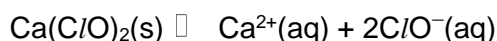
What is the ratio of the mass of silver to copper deposited after the current was passed for t minutes?

- A 0.59 B 0.85
C 1.70 D 3.40
- 11 A nitrogen-hydrogen mixture, initially in the mole ratio of 1:3, reached equilibrium with ammonia when 50% of the nitrogen had reacted. The total equilibrium pressure was p .



What was the partial pressure of ammonia in the equilibrium mixture?

- A $\frac{p}{3}$ B $\frac{p}{4}$ C $\frac{p}{6}$ D $\frac{2p}{7}$
- 12 Solid calcium hypochlorite pellets, Ca(ClO)₂(s), are added to swimming pools to form HClO(aq), which kills disease-causing bacteria and algae.



What is the effect on the solubility of calcium hypochlorite and bacterial growth when pH decreases?

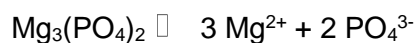
	solubility of calcium hypochlorite	effect on bacterial growth
A	decreases	more favourable
B	decreases	less favourable
C	increases	more favourable
D	increases	less favourable

- 13 The dissociation constant, K_w , for the ionisation of water, $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$, at different temperatures is given below.

temperature / °C	K_w
0	1.15×10^{-15}
25	1.00×10^{-14}
50	5.50×10^{-14}

What can be deduced from this information?

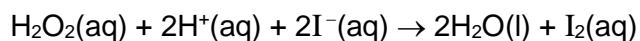
- A Only at 25 °C are $[\text{H}^+]$ and $[\text{OH}^-]$ equal.
 B The equilibrium lies furthest to the right at 0°C.
 C The forward reaction is exothermic.
 D The pH of water decreases as temperature increases.
- 14 A sparingly soluble salt, $\text{Mg}_3(\text{PO}_4)_2$ dissociates in aqueous solution as follows:



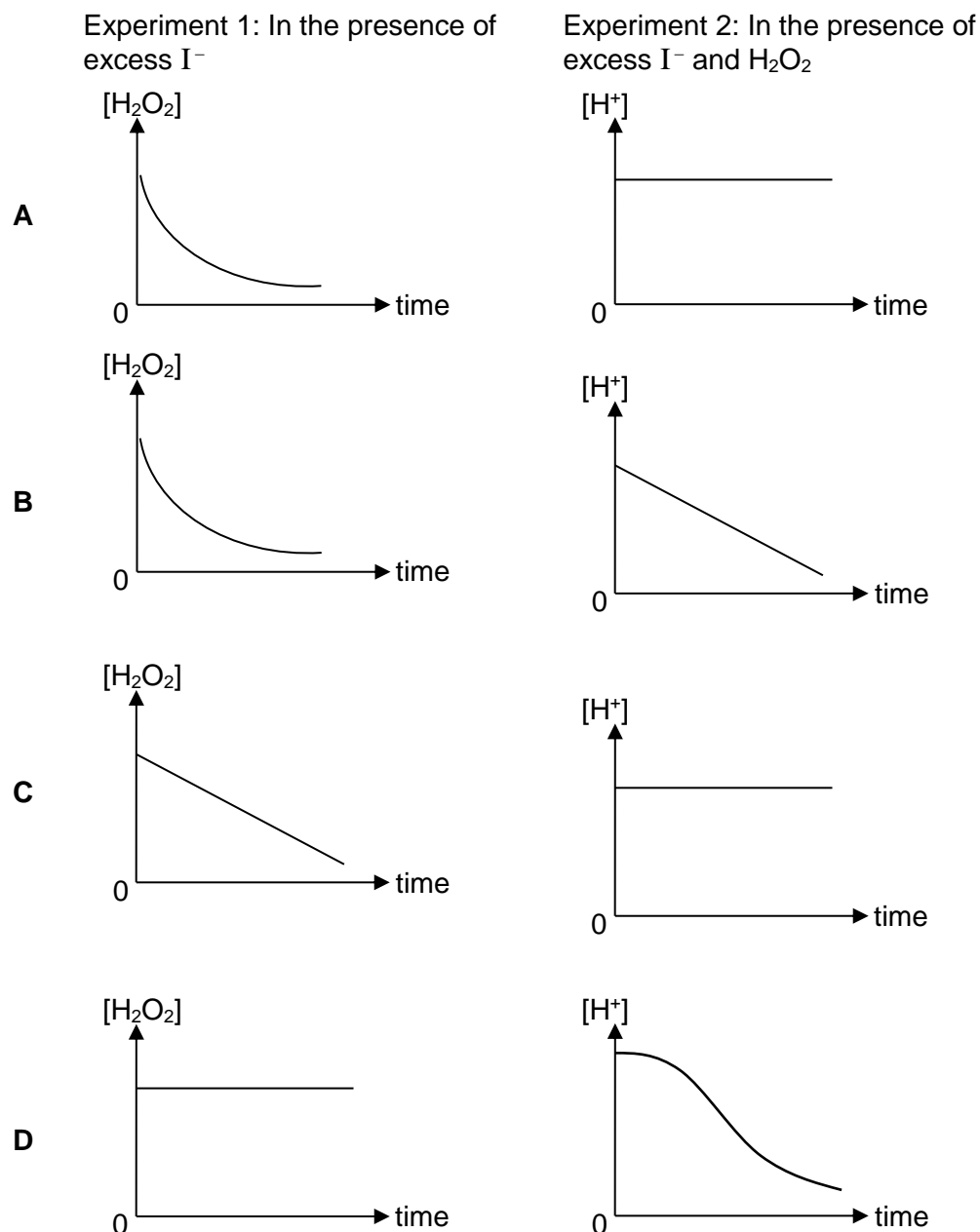
Given that the solubility product, K_{sp} of $\text{Mg}_3(\text{PO}_4)_2$ is Q , what is the value of $[\text{Mg}^{2+}]$ in a saturated solution?

- A $\left(\frac{9Q}{4}\right)^{\frac{1}{5}}$ B $\left(\frac{Q}{27}\right)^{\frac{1}{3}}$ C $\left(\frac{Q}{108}\right)^{\frac{1}{5}}$ D $\left(\frac{9Q}{64}\right)^{\frac{1}{3}}$

15. The reaction of hydrogen peroxide with iodide ions in an acidic solution is first order with respect to hydrogen peroxide as well as iodide ions, and zero order with respect to hydrogen ions.



Two experiments were carried out. Which pair of diagrams represents the variation of $[\text{H}_2\text{O}_2]$ and $[\text{H}^+]$ with time?



16 Aluminium is an element in the third period, Na to Ar, of the Periodic Table.

What is true for aluminium?

- A** Aluminium has the highest melting point of the elements in this period.
- B** Aluminium is the only element in this period whose chloride reacts with water to form an acidic solution.
- C** Aluminium is the only element in this period which can exist, at room temperature and pressure, as solid and conduct electricity.
- D** Aluminium is the only element in this period whose oxide reacts with both acids and bases.

17 Which of the following statements regarding Group II elements or their compounds is **correct**?

- A** Magnesium chloride has a higher melting point than barium chloride.
- B** Magnesium is a stronger reducing agent than strontium.
- C** Calcium hydroxide is more thermally stable than barium hydroxide.
- D** Strontium reacts more readily with oxygen than radium.

18 Which of the following statements about astatine, the element below iodine in Group VII of the periodic table, is **incorrect**?

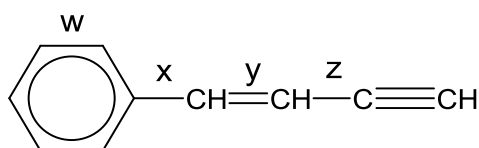
- A** Silver astatide is insoluble in aqueous ammonia.
- B** Hydrogen astatide is less stable to heat than hydrogen iodide.
- C** Sodium astatide and hot concentrated sulfuric acid react to form astatine.
- D** Astatine and aqueous potassium chloride react to form aqueous potassium astatide and chlorine.

- 19** When copper(II) chloride is dissolved in water it gives a blue solution. When this solution is treated with an excess of concentrated hydrochloric acid it turns yellow.

What are the formulae of the copper species in the blue and yellow solution?

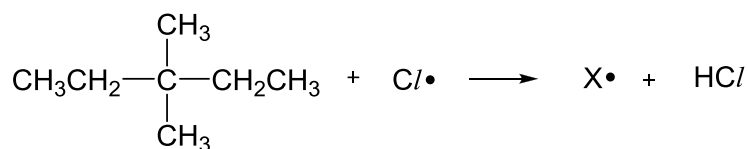
	blue	yellow
A	CuCl_2	$[\text{CuCl}_4]^{2-}$
B	$\text{CuCl}_2(\text{H}_2\text{O})_4$	$[\text{CuCl}_6]^{4-}$
C	$\text{Cu}(\text{OH})_2$	$\text{CuCl}_2(\text{H}_2\text{O})_4$
D	$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$	$[\text{CuCl}_4]^{2-}$

- 20** Four carbon-carbon bonds are labelled in the diagram.



Which bonds are made up of an $\text{sp}^2\text{-sp}^2$ overlap?

- A** w and y only
B w, x and y only
C w, x, y and z
D x and y only
- 21** When heated with chlorine, the hydrocarbon 3,3-dimethylpentane undergoes free radical substitution. In the propagation step, the free radical X^\bullet is formed by the loss of one hydrogen atom.



How many different forms of X^\bullet are theoretically possible?

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

- 22 Bromoethene, $\text{CH}_2=\text{CHBr}$, is unreactive to nucleophiles whereas 3-bromopropene, $\text{CH}_2=\text{CHCH}_2\text{Br}$ is very reactive by comparison.

What explains the lack of reactivity of $\text{CH}_2=\text{CHBr}$?

- A Substituted alkenes undergo only electrophilic addition.
 - B The $\text{C}=\text{C}$ double bond and the Br atom are both electron withdrawing which stabilises $\text{CH}_2=\text{CHBr}$.
 - C The electrons on the Br atom delocalise into the π bond.
 - D The presence of the π bond prevents free rotation of the C-Br bond this decreasing the reactivity.
- 23 Phosgene, COCl_2 , is a colourless gas that gained infamy as a chemical weapon during World War I. It is formed when trichloromethane, CHCl_3 , is left exposed to the atmosphere.

Below is a reaction scheme that involves trichloromethane and phosgene:



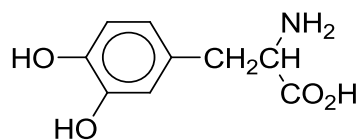
Which of the following type of reaction is **not** being observed in the reaction scheme?

- A oxidation
 - B elimination
 - C electrophilic addition
 - D nucleophilic substitution
- 24 A chlorine-containing organic compound, **X**, undergoes an elimination reaction when treated with hot ethanolic potassium hydroxide solution.

What is **X**?

- A CH_2Cl_2
- B C_2Cl_6
- C $(\text{CH}_3)_2\text{CHCH}_2\text{Cl}$
- D $(\text{CH}_3)_3\text{CCH}_2\text{Cl}$

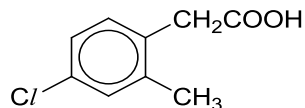
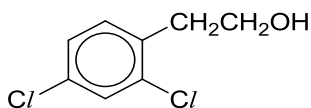
- 25 Dopamine is an important organic chemical that helps control the brain's reward and pleasure centres. It also helps regulate movement and emotional responses.



dopamine

Which of the following statements about dopamine is **incorrect**?

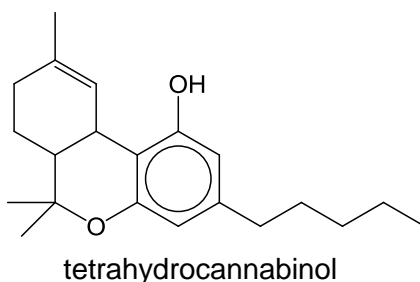
- A It is able to rotate plane-polarized light.
 - B It is soluble in water due to zwitterion formation.
 - C It migrates to the negative electrode of an electrolytic cell at pH 14.
 - D The acidity of dopamine will increase when aqueous bromine is added.
- 26 Two bottles containing the following reagents had their labels removed.



Which one of the following reagents can be used to distinguish between them?

- A sodium metal
- B sodium hydroxide
- C hot acidified potassium manganate(VII)
- D hot acidified potassium dichromate

- 27** Marijuana (cannabis) is the most widely used illegal drug in many developed countries. Medical studies have shown that the active ingredient in marijuana, tetrahydrocannabinol, might provide medical benefits to some patients.



In the following reactions, the tetrahydropyran remains unaltered.

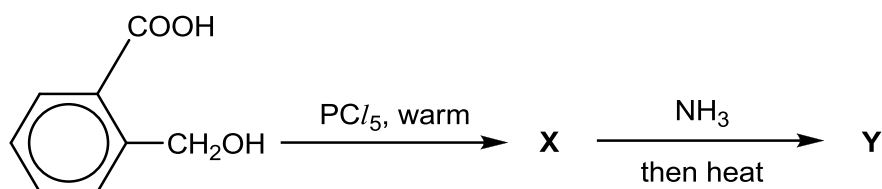
Which reaction will tetrahydrocannabinol undergo?

- A** It reacts with aqueous bromine to incorporate up to 2 atoms of bromine in each molecule.
- B** It reacts with hot acidified potassium dichromate(VI) to form a green solution.
- C** It reacts with dilute nitric acid to form a substitution product.
- D** It reacts with ethanoic acid to form a sweet-smelling product.
- 28** A student carried out an experiment to study the ease of hydrolysis of a series of chlorinated compounds, and recorded the observations based on the addition of acidified silver nitrate solution.

Which of the following gives the expected results?

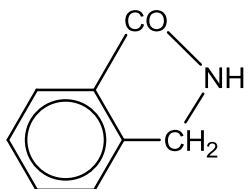
	time taken for precipitate to appear			
	shortest	—————→		longest
A	$\text{C}_6\text{H}_5\text{Cl}$	$\text{CH}_2\text{Cl}/\text{CONH}_2$	CH_3COCl	COCl_2
B	$\text{CH}_2\text{Cl}/\text{CONH}_2$	$\text{C}_6\text{H}_5\text{Cl}$	COCl_2	CH_3COCl
C	CH_3COCl	COCl_2	$\text{C}_6\text{H}_5\text{Cl}$	$\text{CH}_2\text{Cl}/\text{CONH}_2$
D	COCl_2	CH_3COCl	$\text{CH}_2\text{Cl}/\text{CONH}_2$	$\text{C}_6\text{H}_5\text{Cl}$

- 29 In the following two-step synthesis, **Y** a solid which is insoluble in water, is one of the components in the final reaction mixture.

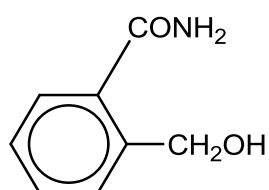


What is **Y**?

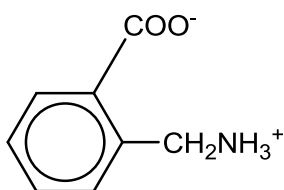
A



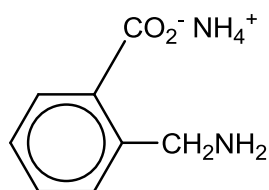
C



B



D



- 30 Benzylamine has the formula $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ and is a common precursor in organic synthesis.

Which of the following statements about benzylamine is correct?

- A** It decolourises aqueous Br_2 .
B It can be produced by reduction of $\text{C}_6\text{H}_5\text{CH}_2\text{CN}$.
C It reacts with CH_3COOH to form $\text{C}_6\text{H}_5\text{CH}_2\text{NHCOCH}_3$.
D It reacts with excess $\text{CH}_3\text{CH}_2\text{Cl}$ to form the compound, $\text{C}_{13}\text{H}_{22}\text{NCl}$.

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

- 31** Gaseous particle **Y** has a proton (atomic) number n and a charge of $+1$.

Gaseous particle **Z** has a proton (atomic) number of $n+1$ and is isoelectronic with **Y**.

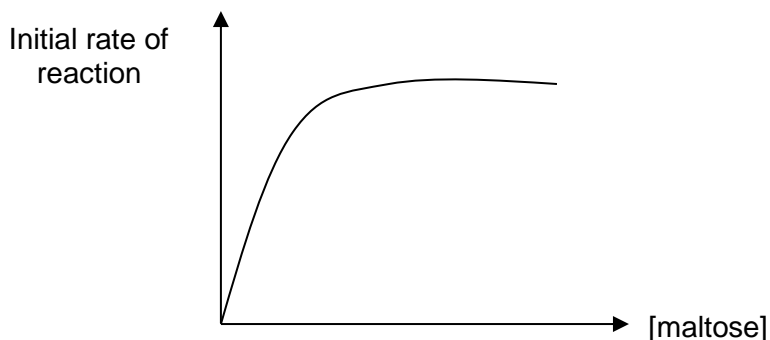
Which statement correctly describes **Y** and **Z**?

- 1** **Y** has a larger radius than **Z**.
- 2** **Y** requires more energy than **Z** when a further electron is removed from each particle.
- 3** **Y** releases more energy than **Z** when an electron is added to each particles.

- 32** Which of the following molecules will form a hydrogen bond with another of its own molecules?

- 1** CH_3NH_2
- 2** CH_3CHO
- 3** $\text{CH}_3\text{CH}_2\text{F}$

- 33 The graph below shows the results of an investigation of the initial rate of hydrolysis of maltose by the enzyme amylase. In the experiments, the initial concentration of maltose was varied but that of amylase was kept constant.



Which conclusions can be deduced from these results?

- 1 When [maltose] is low, the rate is first order with respect to [maltose].
 - 2 When [maltose] is high, the rate is independent of [maltose].
 - 3 When [maltose] is high, the rate is independent of [amylase].
- 34 With reference to the *Data Booklet* and the data below, deduce which of the following statements are correct.

Half-equation	E^θ/V
$\text{VO}_2^+(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{VO}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+1.00
$\text{VO}^{2+}(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^- \rightleftharpoons \text{V}^{3+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+0.34
$\text{V}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{V}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	-0.26

- 1 An excess of zinc is capable of reducing $\text{VO}_2^+(\text{aq})$ to $\text{V}^{2+}(\text{aq})$ in acidic conditions.
- 2 $\text{Fe}^{3+}(\text{aq})$ is capable of oxidising $\text{V}^{2+}(\text{aq})$ to $\text{VO}_2^+(\text{aq})$ in acidic conditions.
- 3 $\text{Zn}^{2+}(\text{aq})$ ions will oxidise $\text{V}^{2+}(\text{aq})$ ions to $\text{V}^{3+}(\text{aq})$ ions.

- 35** The working range and colour change of chlorophenol red is given below.

indicator	working pH range	colour change	
		Acid	Alkali
chlorophenol red	4.8 – 6.4	Yellow	Red

Two drops of this indicator are added to each of the three aqueous solutions listed below.

Which solution has its colour correctly stated?

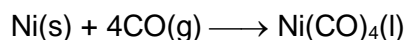
	solution	colour
1	aluminium oxide added to water	Red
2	0.1 mol dm ⁻³ of CH ₃ COOH ($K_a = 1.8 \times 10^{-5}$ mol dm ⁻³)	Yellow
3	solution of sodium ethanoate and ethanoic acid in 1:2 proportion [pK_a of ethanoic acid = 4.7]	Orange

- 36** Use of the Data Booklet is relevant to this question.

Which statements about the trends in properties of the hydrogen halides are correct?

- Volatility decreases in the order: HF > HCl > HBr > HI.
- Thermal stability increases in the order: HI < HBr < HCl < HF.
- Ease of oxidation increases in the order: HF < HCl < HBr < HI.

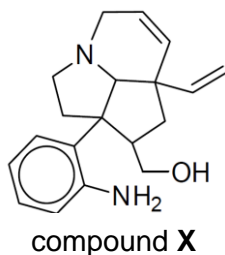
- 37** Nickel is purified by a method called the Mond process. The equation of the first step of the purification is shown below.



Which of the following statements are correct?

- CO is a monodentate ligand.
- Ni in Ni(CO)₄ has a co-ordination number of 4.
- The oxidation number of Ni in Ni(CO)₄ is zero.

- 38** Compound **X** is a synthetic precursor of *meloscine*, an alkaloid isolated from the New Caledonian plant *Melodinus Scandens* Forst.



Which of the following statements about its reactions are correct?

- 1 1 mol of **X** reacts with 2 mol of HBr(g) when heated.
 - 2 1 mol of **X** reacts with 4 mol of Br₂(aq) at room temperature.
 - 3 1 mol of **X** reacts with 2 mol of CH₃COCl at room temperature.
- 39** Which of the following reactions give products that does not rotate the plane of polarised light?
- 1 1-bromobutane refluxed with aqueous KOH
 - 2 butanone reacted with HCN, trace amount of NaOH
 - 3 but-1-ene reacted with bromine dissolved in organic solvent
- 40** Which of the following could result in the loss of the tertiary structure of a protein?
- 1 addition of weak acid
 - 2 addition of alcohol
 - 3 addition of AgNO₃ solution