VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY **8873/01**

Paper 1 Multiple Choice **19 September 2025**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and CT group on the Answer Sheet.

There are **thirty** 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.
A Data Booklet is provided.

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.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **10** printed pages.

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

1 ^{9}Be is used in the production of 'fast neutrons'.

How many neutrons are present in 0.09 g of ^{9}Be?
[*L* = Avogadro constant]

A 0.04 *L* **B** 0.05 *L* **C** 0.09 *L* **D** 0.45 *L*

2 The table below shows the fifth, sixth, seventh, eighth and ninth ionisation energies of elements **L** and **M** in kJ mol^{-1}. Elements **L** and **M** are found in period 3.

	5th	6th	7th	8th	9th
L	6270	21300	25400	29900	35900
M	6540	9360	11000	33600	38600

Given that all the atoms have at least an octet configuration, what could <u>not</u> be the formula of the compound formed by these two elements?

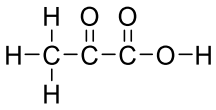
A LM_5

B LM_4^+

C LM_3

D LM_2

3 The diagram shows the structure of a pyruvic acid.



pyruvic acid

What set of bond angles are present in pyruvic acid?

A 120°, 109°, 105°

B 120°, 105°, 90°

C 180°, 120°, 109°

D 180°, 120°, 90°

4 Which statements about water are due to its ability to form hydrogen bonds?

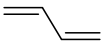
1 Liquid water is denser than ice.

2 Water has a significantly higher boiling point than methane, CH_4, even though both compounds have similar relative molecular masses.

3 The high surface tension of water enables some insects to walk on the surface of the ponds.

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

5 Synthetic rubber is commonly produced from the monomer buta-1,3-diene.



buta-1,3-diene

What are the numbers of σ and π bonds present in one molecule of buta-1,3-diene?

	σ	π
A	6	4
B	7	4
C	8	2
D	9	2

6 Which of the following molecules is <u>not</u> polar?

A CCl_3F **B** $NOCl$ **C** SF_4 **D** BF_3

7 What is the definition of an Arrhenius base?

A a substance that accepts hydrogen ions

B a substance that donates a pair of electrons

C a substance that produces hydroxide ions in aqueous solution

D a substance that readily reacts with an acid to form a salt and water only

8 A solid base is added to a small lake to reduce the effects of acid rain. The pH of the water in the lake changes from 4 to 6.

What is the change in $[H^+]$ of the water in the lake?

A It is 100 times smaller.

B It halves.

C It is 100 times greater.

D It doubles.

9 Which row gives the correct expression for K_w and for the K_b of ammonia, NH_3?

	K_w	$K_b(NH_3)$
A	$K_w = [H^+][OH^-]$	$K_b = [H^+][NH_2^-]/[NH_3]$
B	$K_w = [H^+][OH^-]$	$K_b = [OH^-][NH_4^+]/[NH_3]$
C	$K_w = [H^+][OH^-]/[H_2O]$	$K_b = [H^+][NH_2^-]/[NH_3]$
D	$K_w = [H^+][OH^-]/[H_2O]$	$K_b = [OH^-][NH_4^+]/[NH_3]$

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

Which chemical formula is <u>not</u> possible for phosphorous?

A P_4O_6

B P_4O_{10}

C PO_2

D PO_3

11 **M** is an element from the third period.

The aqueous chloride of **M** is acidic, and gives a white precipitate when reacted with NaOH(aq). This precipitate dissolves on reacting either with NaOH(aq) or with H_2SO_4(aq).

In which Group of the Periodic Table is **M** likely to be found?

A 1 **B** 2 **C** 13 **D** 14

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

The properties of chlorine, bromine (denoted as $\mathbf{X}_2$ in their elemental state) and their compounds are compared.

Which property is smaller for chlorine than for bromine?

A volatility of $\mathbf{X}_2$

B oxidising power of $\mathbf{X}_2$

C first ionisation energy of **X**(g)

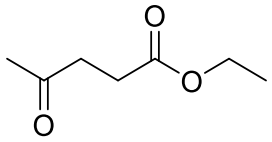
D the acid strength of H**X** in aqueous solutions

13 There is a change in the radius of an atom when it forms a cation or an anion.

Which changes in radius occur?

	atom to cation	atom to anion
A	decrease	increase
B	decrease	decrease
C	increase	increase
D	increase	decrease

14 Compound **G,** $C_7H_{12}O_3$, is a diesel fuel additive which reduces the amount of soot formed when the fuel burns.



compound **G**

How many moles of oxygen gas are needed to completely combust 1 mol of compound **G**?

A 8.5 **B** 9.0 **C** 9.5 **D** 10.0

15 Which pairs of enthalpy changes will always have the same sign, both negative or both positive?

1 lattice energy and enthalpy change of neutralisation

2 bond energy and enthalpy change of combustion

3 enthalpy change of formation and lattice energy

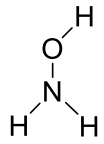
A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

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

When hydroxylamine reacts with hydrogen peroxide, H–O–O–H, in their gaseous states, the only products are nitrogen gas, $N_2(g)$ and steam, $H_2O(g)$.

$$2NH_2OH + H_2O_2 \rightarrow N_2 + 4H_2O$$

The average bond energy of N–O is 201 kJ mol^{-1}.



hydroxylamine

What is the enthalpy change of reaction when 1.0 mol of hydroxylamine reacts with hydrogen peroxide?

A −336 kJ mol^{-1}

B −672 kJ mol^{-1}

C +336 kJ mol^{-1}

D +672 kJ mol^{-1}

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

In which pair does the **second** named compound have a lattice energy that is more exothermic than the first?

A magnesium chloride, sodium chloride

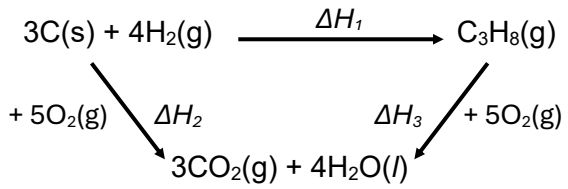
B magnesium oxide, calcium oxide

C potassium chloride, potassium fluoride

D sodium bromide, potassium bromide

18 The burning of fuels to release energy is an everyday occurrence in both the home and industry.

The diagram below shows an energy cycle involving the fuel propane.



Which one of the following statements is **incorrect**?

A ΔH_1 represents the enthalpy change of formation of $C_3H_8(g)$.

B ΔH_2 involves the enthalpy change of formation of $CO_2(g)$ and $H_2O(g)$.

C ΔH_2 involves the enthalpy change of combustion of C(s) and $H_2(g)$.

D ΔH_3 is the sum of ΔH_1 and ΔH_2.

19 Nitrogen(V) oxide undergoes decomposition according to the equation shown.

$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

The rate equation for this reaction is

$$\text{rate} = k[N_2O_5]$$

At a certain temperature when the initial $[N_2O_5]$ is 3.00 mol dm^{-3}, the half-life is 1100 minutes.

What is the half-life at the same temperature when the initial $[N_2O_5]$ is 1.50 mol dm^{-3}?

A 550 minutes **B** 1100 minutes **C** 2200 minutes **D** 4400 minutes

20 A reaction between R and S produces a gas.

This reaction is first order with respect to R and second order with respect to S. Two experiments were carried out.

In the first experiment, at given concentrations of R and S, 100 cm^3 of gas were produced during the first minute of the reaction.

In the second experiment, under the same external conditions, the initial concentration of R is doubled and that of S is halved.

What volume of gas will be produced in the second experiment, in the first minute of the reaction?

A 25 cm^3 **B** 50 cm^3 **C** 100 cm^3 **D** 200 cm^3

21 Which of the following statements describes the effects of a catalyst on a reaction?

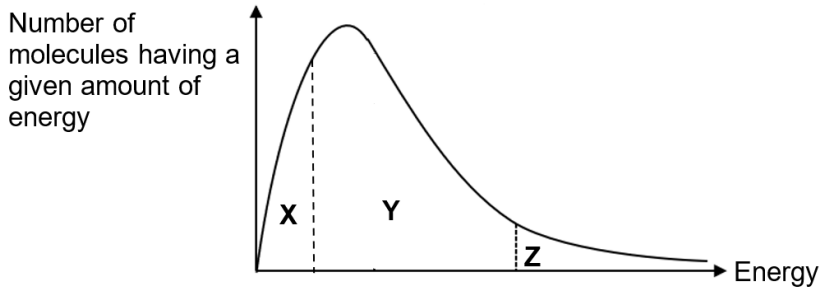
1 speeds up the reaction by providing an alternative pathway of lower activation energy.

2 increases the rate constant of the reaction.

3 increases the speed at which reacting particles collide with one another.

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

22 The Maxwell Boltzmann distribution curve shows the number of molecules having a given amount of kinetic energy at a particular temperature.



How would the areas of **Z** and (**X** + **Y** + **Z**) change if the temperature was lowered?

	Z	**X + Y + Z**
A	no change	increase
B	no change	decrease
C	decrease	no change
D	increase	no change

23 The equation below is the Contact process, which is a reversible exothermic reaction that is involved in the synthesis of sulfuric acid in the industry. The reaction is catalysed by vanadium(V) oxide (V_2O_5) and takes places in an enclosed vessel.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Which of the following modifications would increase the equilibrium constant, K_c, of the reaction?

1 decrease $[O_2]$

2 add more V_2O_5 catalyst

3 decrease temperature

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

24 A mixture of 1 mol of chlorine and 2 mol of nitrogen monoxide is allowed to come to equilibrium at a given temperature. The equilibrium mixture contains *x* mol of chlorine.

$$Cl_2(g) + 2NO(g) \rightleftharpoons 2NOCl(g)$$

What are the amounts of the other constituents of the equilibrium mixture?

	NO / mol	NOCl / mol
A	$2x$	$2x$
B	$2 - 2x$	$2x$
C	$2x$	$2 - 2x$
D	$2 - x$	$2 - x$

25 Which of the following statements is true about the use of nanoparticles as catalyst?

1 They can be used in smaller quantity compared to traditional heterogeneous catalysts.

2 They are more expensive than traditional heterogeneous catalyst to achieve the same extent of catalytic effect.

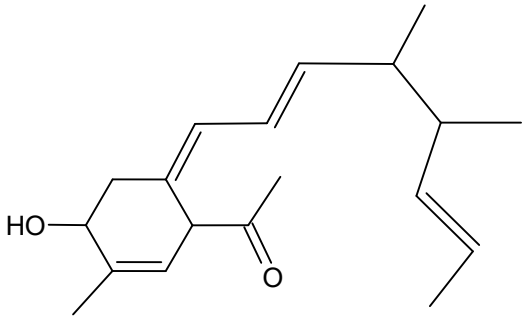
3 There is a larger surface area to volume ratio compared to that of traditional heterogeneous catalyst.

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

26 How many constitutional isomers does C_4H_9Cl have?

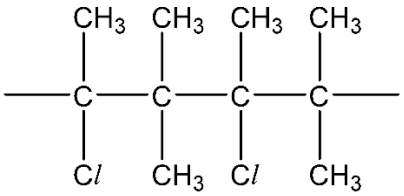
A 2 **B** 3 **C** 4 **D** 5

27 How many cis-trans isomers does the following molecule have?



A 4 **B** 8 **C** 16 **D** 32

28 A section of a polymer showing two repeat units is shown below:



Which statements are true about the polymer above?

1 It is an addition polymer.

2 The polymer cannot be broken down by hydrolysis.

3 The monomer is 2-chlorobut-2-ene.

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

29 The structural formula of X is $CH_3CH_2CH(CH_3)OCOCH_2CH_3$.

X can be made by reacting compounds Y and Z in the presence of concentrated sulfuric acid.

What are the identities of Y and Z?

	Y	Z
A	2–methylbutanoic acid	ethanol
B	3–methylbutanoic acid	ethanol
C	butan–2–ol	propanoic acid
D	butan–3–ol	propanoic acid

30 Which property of poly(vinyl chloride) (PVC) best explains for its use in raincoats?

A The polymer chains of PVC are closely packed together.

B PVC forms weak hydrogen bonds with water.

C PVC is an addition polymer.

D PVC is a non-polar polymer.