



HWA CHONG INSTITUTION
C2 Preliminary Examination
Higher 1

CANDIDATE NAME

CT GROUP

24S

CHEMISTRY

8873/01

Paper 1 Multiple Choice

22 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 or tape.

Write your name and CT group in the space provided at the top of this page.

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.

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 **11** printed pages and **1** blank page.

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

The table shows the fifth, sixth, seventh, eighth and ninth ionisation energies of an element in the third period.

	5th	6th	7th	8th	9th
ionisation energy / kJ mol ⁻¹	7200	8800	12 000	14 000	41 000

What element has these ionisation energy values?

- A** P **B** S **C** Cl **D** Ar
- 2 The mineral pyrite contains sulfur and a transition metal in the fourth period. A sample of pyrite was analysed and four different atoms were identified; **V**, **W**, **X** and **Y**. The table shows information about the four types of atoms found in the sample.

atom	relative mass	relative % abundance
V	31.97	63.8
W	33.97	2.8
X	53.94	31.4
Y	55.95	2.0

What is the relative atomic mass of sulfur in the sample?

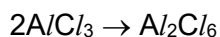
- A** 32.05 **B** 32.10 **C** 32.97 **D** 39.40
- 3 Which row about σ bonds and π bonds in hydrocarbons is correct?

	σ bonds	π bonds
A	can be formed by p orbitals but not s orbitals	can be formed by s orbitals but not p orbitals
B	can be formed by s orbitals but not p orbitals	can be formed by p orbitals but not s orbitals
C	can be formed by either s or p orbitals	can be formed by p orbitals but not s orbitals
D	can be formed by either s or p orbitals	can be formed by either s or p orbitals

- 4 What is the most likely bond angle at each nitrogen atom in the di-imine molecule, $\text{H}-\text{N}=\text{N}-\text{H}$?

A 107° **B** 118° **C** 120° **D** 180°

- 5 Aluminium chloride, AlCl_3 , dimerises to form Al_2Cl_6 .



Which statements are correct?

- 1 The geometrical arrangement of the atoms around aluminium changes from trigonal planar to tetrahedral.
- 2 Each aluminium atom contributes electrons to four covalent bonds.
- 3 There are 16 lone pairs of electrons in the Al_2Cl_6 molecule.

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

- 6 Metals have different electrical conductivities.

Which row shows the correct order of increasing electrical conductivity of each pair of these metals?

	Period 3	Period 4
A	$\text{Al} < \text{Mg}$	$\text{Ca} < \text{Cu}$
B	$\text{Al} < \text{Mg}$	$\text{Cu} < \text{Ca}$
C	$\text{Mg} < \text{Al}$	$\text{Ca} < \text{Cu}$
D	$\text{Mg} < \text{Al}$	$\text{Cu} < \text{Ca}$

- 7 What is the definition of an Arrhenius base?

- A** a substance that accepts hydrogen ions
B a substance that donates a lone 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 When a weak base is added to a strong acid an increase in pH from pH 2 to pH 6 occurs at the end-point.

What indicators would be suitable for use in a weak base and strong acid titration?

	indicator	pH range
1	bromocresol green	3.8–5.4
2	cresol purple	7.4–9.0
3	methyl orange	3.1–4.4
4	phenol red	6.8–8.4

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

- 9 At 50 °C, $K_w = 5.48 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.

What is the pH and pOH of pure water at 50 °C?

	pH	pOH
A	7	7
B	6.6	7.4
C	6.6	6.6
D	7.4	6.6

- 10 The variation in melting points of Period 3 elements, from sodium to chlorine, can be explained in terms of the structure and bonding in the elements.

Which statements are correct?

- From sodium to magnesium to aluminium, the melting points increase due to increasing charge density of the metal cations.
- Silicon has a high melting point because it has a giant covalent structure.
- From phosphorus to sulfur to chlorine, the melting points increase due to increasing number of electrons in the molecules.

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

- 11 Across a period, the elements show an increase in their maximum oxidation number in their oxides.

What explains this?

- an increase in ionisation energy
- an increase in the number of electrons used for bonding
- an increase in the number of electrons in the outer shell

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

12 Four separate experiments are performed.

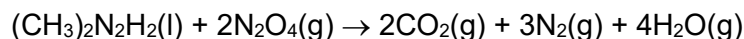
experiment 1	A spatula measure of Na_2O is added to a test-tube of water and the tube is shaken.
experiment 2	A spatula measure of MgO is added to a test-tube of water and the tube is shaken.
experiment 3	A spatula measure of Al_2O_3 is added to a test-tube of water and the tube is shaken.
experiment 4	A spatula measure of SiO_2 is added to a test-tube of water and the tube is shaken.

Which statements are correct?

- A** There is no temperature change in any of the four experiments.
B Two of the four experiments will result in a colourless solution with no undissolved solid.
C The pH is the same in experiments 1 and 2 after shaking.
D The pH is the same in experiments 3 and 4 after shaking.

13 Use of the Data Booklet is relevant to this question.

The reaction of $(\text{CH}_3)_2\text{N}_2\text{H}_2$ with N_2O_4 has been studied as a possible energy source for rockets.



0.25 moles of $(\text{CH}_3)_2\text{N}_2\text{H}_2$ is completely combusted in N_2O_4 . The product mixture is passed through saturated aqueous KOH and the final volume of gas, **Q**, is measured under room conditions.

What is the volume of gas **Q** collected in this reaction?

- A** 17 dm³ **B** 18 dm³ **C** 42 dm³ **D** 54 dm³

14 Use of the Data Booklet is relevant to this question.

When bromide ions undergo oxidation to form bromine, electrons are lost.

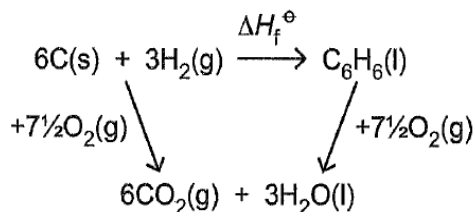


The charge on one electron is -1.60×10^{-19} C, where C is the unit in coulombs.

What is the charge lost, in coulombs, when 2.5 moles of bromine are formed from bromide ions?

- A** 4.00×10^{-19} **B** 8.00×10^{-19} **C** 2.41×10^5 **D** 4.82×10^5

- 15 An energy cycle and some data are given.

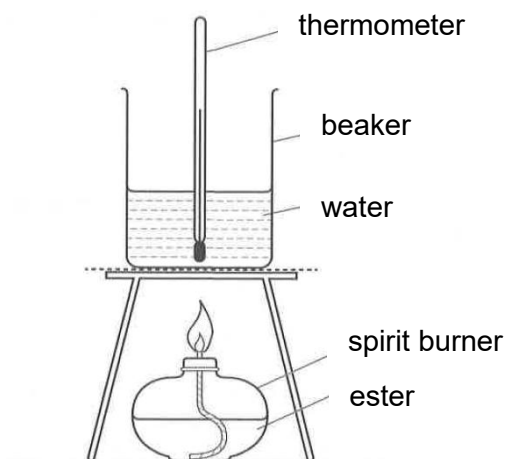


substance	standard enthalpy change of combustion / kJ mol^{-1}
$\text{C}_6\text{H}_6\text{(l)}$	-3267
C(s)	-394
$\text{H}_2\text{(g)}$	-286

What is the standard enthalpy change of formation, $\Delta H_f^\ominus$, of benzene, $\text{C}_6\text{H}_6\text{(l)}$?

- A** +45.0 kJ mol^{-1}
B -45.0 kJ mol^{-1}
C +2587 kJ mol^{-1}
D -2587 kJ mol^{-1}
- 16 Use of the Data Booklet is relevant to this question.

A student uses the apparatus shown to find the enthalpy change of combustion of an ester.



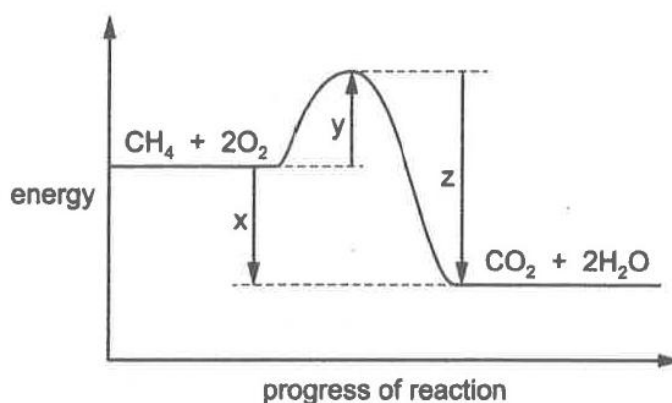
0.020 moles of ester was needed to raise the temperature of water in the beaker by 20°C .

The enthalpy change of combustion of the ester calculated from these results is $-1200 \text{ kJ mol}^{-1}$.

What is the mass of water in the beaker, to the nearest 10 g?

- A** 10 g **B** 290 g **C** 720 g **D** 1200 g

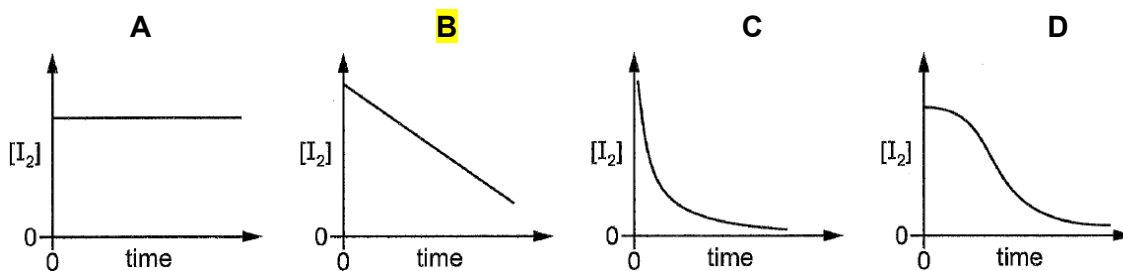
- 17 Methane burns in oxygen to form carbon dioxide and water. The energy profile diagram is shown.



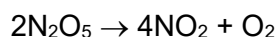
Which statement about bond breaking and forming is correct?

- A** The energy released in forming bonds is equal to x .
B The energy released in breaking bonds is equal to z .
C The energy released in forming bonds is more than the energy absorbed in breaking bonds.
D The energy released in breaking bonds is less than the energy absorbed in forming bonds.
- 18 The reaction of iodine with propanone in the presence of aqueous acid is zero order with respect to iodine.

Which diagram represents the variation of $[I_2]$ with time?



- 19 N_2O_5 is unstable and decomposes.



An experiment to study this reaction gave the following results.

time / s	$[\text{N}_2\text{O}_5] / \text{mol dm}^{-3}$
0	0.040
5	0.028
10	0.020
15	0.014
20	0.010
25	c

What is the rate equation and the value of c?

	rate equation	c
A	$\text{rate} = k[\text{N}_2\text{O}_5]$	0.005
B	$\text{rate} = k[\text{N}_2\text{O}_5]$	0.007
C	$\text{rate} = k[\text{N}_2\text{O}_5]^2$	0.005
D	$\text{rate} = k[\text{N}_2\text{O}_5]^2$	0.007

- 20 The rates of chemical reactions can often be increased by increasing the concentration of reactants or raising the temperature.

Which statements are correct?

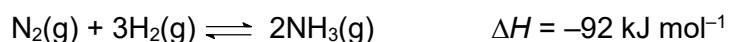
- 1 Increasing the concentration raises the peak of the Boltzmann distribution.
- 2 Increasing the concentration increases the proportion of particles having energy greater than the activation energy.
- 3 Increasing the temperature lowers the peak of the Boltzmann distribution.
- 4 Increasing the temperature increases the proportion of particles having energy greater than the activation energy.

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

21 Which statement best describes a dynamic equilibrium?

- A The forward and backward reactions have stopped, and the concentrations of reactants and products are constant.
- B The forward and backward reactions have stopped, and the concentrations of reactants and products are equal.
- C** The forward and backward reactions are occurring at equal rates, and the concentrations of reactants and products are constant.
- D The forward and backward reactions are occurring at equal rates, and the concentrations of reactants and products are equal.

22 Which changes in conditions would result in no change in the value of the equilibrium constant, K_c , for the following reaction?



- 1 increasing the concentration of N_2
- 2 increasing the total pressure
- 3 adding a catalyst

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

23 Use of the Data Booklet is relevant to this question.

A hydrocarbon that contains a benzene ring has an empirical formula C_4H_5 and relative molecular mass of 106.

How many constitutional isomers are possible?

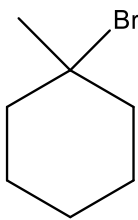
- A** 1 **B** 2 **C** 3 **D** 4

24 P and Q are two straight-chain unsaturated hydrocarbons with the molecular formula C_4H_8 . Each react separately with bromine gas. The products of the two reactions are different isomers.

Which pair of names could identify the two organic **products** made?

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

- 25 Compound R reacts with sodium hydroxide to form alkenes.

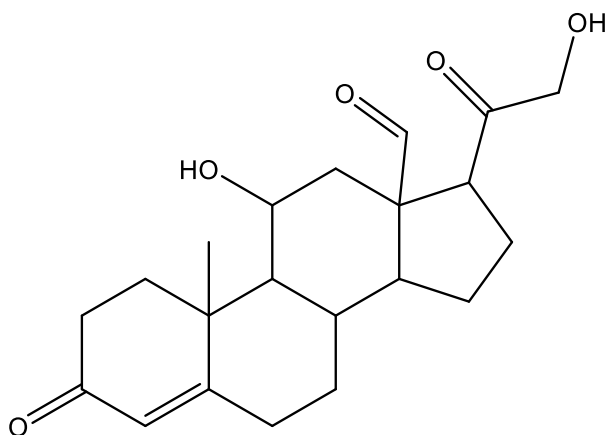


R

Which row gives the correct reagent and the number of different alkenes that can be formed?

	reagent	number of different alkenes
A	alcoholic NaOH	2
B	aqueous NaOH	2
C	alcoholic NaOH	3
D	aqueous NaOH	3

- 26 Aldosterone is a steroidal hormone in humans.



aldosterone

What is the molecular formula of aldosterone?

- A** $C_{20}H_{25}O_5$ **B** $C_{20}H_{28}O_5$ **C** $C_{21}H_{25}O_5$ **D** $C_{21}H_{28}O_5$
- 27 Use of the structure of aldosterone in question 26 is relevant to this question.

Aldosterone was reacted with hot acidified potassium dichromate(VI) solution.

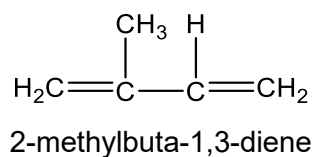
How many ketone groups are present in the **product**?

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

28 Which of the following shows the correct type of polymer for the given repeat unit?

	repeat unit	type of polymer
A	$-\text{CH}_2\text{CH}_2\text{O}-$	condensation
B	$-\text{CH}_2\text{CH}(\text{CO}_2\text{CH}_3)-$	condensation
C	$-\text{CH}_2\text{CH}(\text{CN})-$	addition
D	$-\text{COCH}_2\text{CH}_2\text{NH}-$	addition

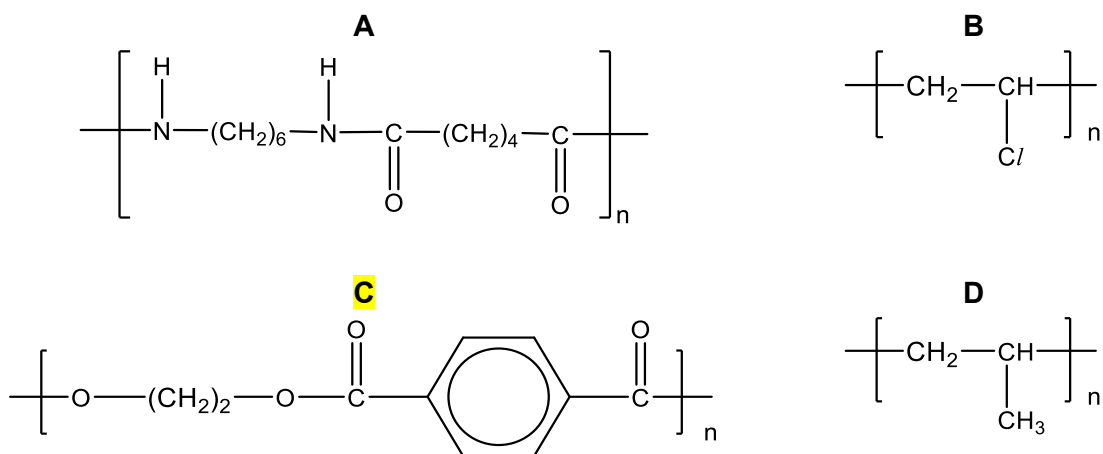
29 2-methylbuta-1,3-diene undergoes addition polymerisation to make synthetic rubber.



Which statement is correct?

- A** 2-methylbuta-1,3-diene exhibits cis-trans isomerism.
- B** All the C–C bonds in the polymer have the same length.
- C** 2-methylbuta-1,3-diene and the repeat unit of its polymer have different empirical formula.
- D** The repeat unit of its polymer contains 2 π electrons.

30 Which polymer is most suitable to make wrinkle-free shirts?



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