



ST ANDREW'S JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATIONS
HIGHER 1

CANDIDATE
NAME

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CLASS

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CHEMISTRY

8873/01

Paper 1 Multiple Choice

18 September 2025

Candidate answer on the Optical Answer Sheet

1 hour

Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

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 Optical Answer Sheet.

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 **16** printed pages (including this cover page).

1 Which statement is correct?

A One mole of a compound is the amount that contains the same number of atoms as there are in 12.0 g of ^{12}C .

B The relative isotopic mass of beryllium-9 is given by the following expression.

$$\frac{\text{average mass of all isotopes of beryllium}}{\frac{1}{12} \text{ the mass of one atom of } ^{12}\text{C}}$$

C The relative atomic mass of oxygen is given by the following expression.

$$\frac{\text{average mass of one atom of oxygen}}{\frac{1}{12} \text{ the mass of one atom of } ^{12}\text{C}}$$

D The relative molecular mass of Q is given by the following expression.

$$\frac{\text{average mass of one atom of Q}}{\frac{1}{12} \text{ the mass of one atom of } ^{12}\text{C}}$$

2 10 cm³ of a gaseous hydrocarbon, C_xH_y, was exploded with an excess of oxygen. There was a contraction of 40 cm³. When the products were treated with aqueous sodium hydroxide, there was a further contraction of 50 cm³. All gas volumes are measured at room temperature and pressure.

What is the molecular formula of the hydrocarbon?

A C₄H₈

B C₄H₁₀

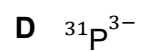
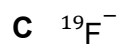
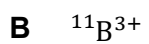
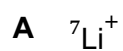
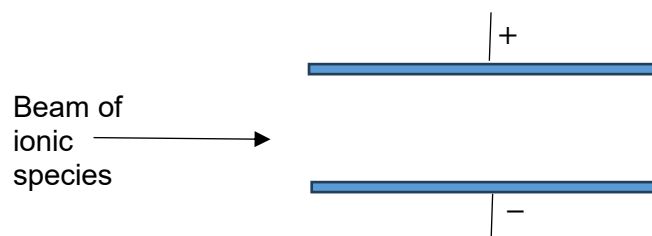
C C₅H₁₀

D C₅H₁₂

- 3 In which row are X and Y atoms or ions of different isotopes of the same element?

	X			Y		
	Number of electrons	charge	Nucleon number	Number of electrons	charge	Nucleon number
A	3	+3	12	9	-3	12
B	8	0	16	11	-1	19
C	10	+1	23	10	+1	24
D	18	-3	31	12	+3	31

- 4 Which particle will deflect the most when moving with the same speed through an electric field?



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

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

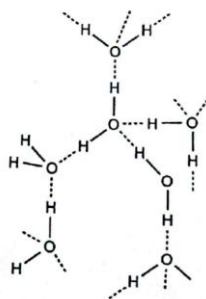
Element	5th	6th	7th	8th	9th
IE/ kJmol^{-1}	13352	16611	20115	25491	28934

What element has these ionisation energy values?

- A P B S C Cl D Ar
- 6 Which molecules are **not** polar?
- 1 H₂S 2 CS₂ 3 SO₂ 4 SF₆

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

- 7 The diagram shows the structure of part of a crystal of ice.



Which statement is correct?

- A** The hydrogen bonds, shown by the dotted lines, are stronger than the O–H covalent bonds.
- B** The weaker covalent bonds in ice causes it to be less dense than water.
- C** All the bond angles surrounding each oxygen atom are 120° .
- D** Each oxygen can form 2 hydrogen bonds.
- 8 Some information about some of the elements of Period 5 of the Periodic Table is shown:

element	Rb	Sr	In	Sn	Sb	Te	I	Xe
Electrical conductivity	high	high	high	high	high	semi-conductor	zero	zero
Boiling point / K	961	1650	2300	2540	1650	1260	457	165

Which statement about these elements is correct?

- A** Both I and Xe have simple molecular structures.
- B** Elements from Rb to Te have giant metallic structures.
- C** There are less elements with metallic structures in Period 5 than in Period 3.
- D** Sr has higher boiling point than Rb because of higher charge density.

- 9 A mixture consisting of gaseous compounds, S, T, U and V, is slowly cooled.

Gaseous Compound	M_r	Compound
S	72	$\text{CH}_3\text{CH}_2\text{COCH}_3$
T	74	$\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
U	72	$(\text{CH}_3)_4\text{C}$
V	72	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

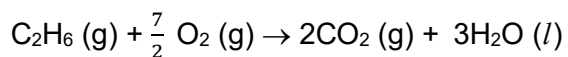
In which order, from first to last, will the compounds condense to form their liquids?

- A $\text{T} \rightarrow \text{S} \rightarrow \text{V} \rightarrow \text{U}$
- B $\text{U} \rightarrow \text{V} \rightarrow \text{S} \rightarrow \text{T}$
- C $\text{S} \rightarrow \text{T} \rightarrow \text{V} \rightarrow \text{U}$
- D $\text{V} \rightarrow \text{U} \rightarrow \text{S} \rightarrow \text{T}$
- 10 In a chlorine molecule, Cl_2 , the two chlorine atoms are held together by a single covalent bond. The bond energy is 244 kJ mol^{-1} . The bond length is 0.198 nm .

What do the terms *bond energy* and *bond length* mean?

	bond energy	bond length
A	the energy needed to make one mole of bonds	the distance between the outer shells of the two bonded atoms
B	the energy needed to make one mole of bonds	the distance between the nuclei of the two bonded atoms
C	the energy needed to break one mole of bonds	the distance between the outer shells of the two bonded atoms
D	the energy needed to break one mole of bonds	the distance between the nuclei of the two bonded atoms

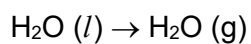
- 11** The standard enthalpy change of combustion of ethane is $-1560 \text{ kJ mol}^{-1}$.



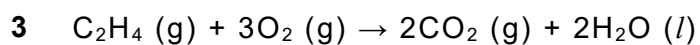
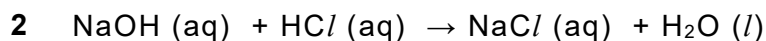
Values of the relevant average bond energies are given in the table.

Bond	C–H	C–C	C=O	O–H	O=O
Average bond energy/ kJ mol^{-1}	410	350	805	460	496

What is the value for the enthalpy change of vaporisation of water?



- A** -126
- B** -42
- C** $+42$
- D** $+126$
- 12** Which of the following reactions are exothermic?



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

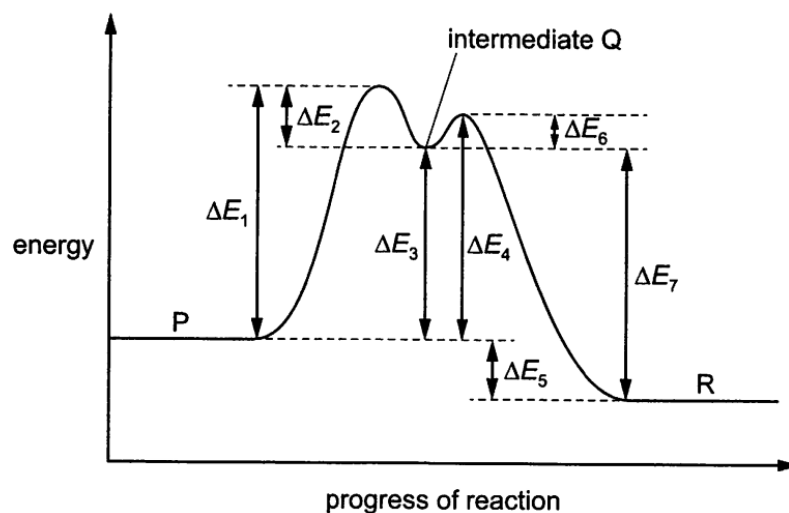
- 13** This question refers to 'reaction Z' in which compound P is converted into compound R.



This reaction can be broken down into two stages.



The energy profile of the reaction Z is shown.



Which rows about the magnitudes of activation energy and enthalpy change of reaction are correct?

		magnitude of activation energy	magnitude of enthalpy change of reaction
1	for reaction Z	ΔE_1	ΔE_5
2	for stage 1	ΔE_1	ΔE_3
3	for stage 2	ΔE_4	ΔE_7

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

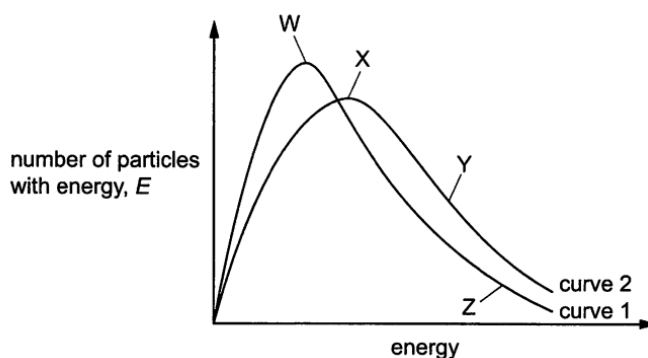
- 14** The half-life of the first-order gaseous reaction in which M_2 molecules become converted into M atoms is 30 minutes. 1 mol of M_2 is put into a sealed vessel at pressure p .

What will be true when 75% of M_2 has been converted into M atoms?

- 1 Three half-lives have passed.
- 2 60 minutes have elapsed.
- 3 1.5 mol of M have been formed.

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

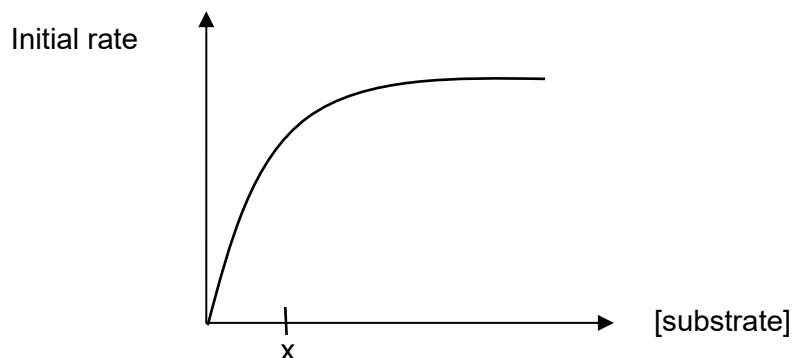
- 15** Curves 1 and 2 show the Boltzmann distributions for identical compositions of a reaction mixture which occur at different temperatures.



Which statement is correct?

- A** Curve 1 applies to the faster reaction and point W indicates particles with lower energy than point Z.
B Curve 1 applies to the faster reaction and point W indicates particles with higher energy than point Z.
C Curve 2 applies to the faster reaction and point X indicates particles with lower energy than point Y.
D Curve 2 applies to the faster reaction and point X indicates particles with higher energy than point Y.

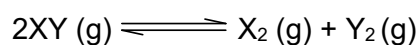
- 16 The graph shows how the initial rate of reaction varies for an enzyme catalysed reaction as the substrate concentration changes.



Which of the statements correctly describe the situation when $[\text{substrate}] = x$?

- 1 The initial rate of reaction is affected by increasing $[\text{substrate}]$.
- 2 The order of reaction with respect to $[\text{substrate}]$ is 1.
- 3 There are no more enzyme active sites available.

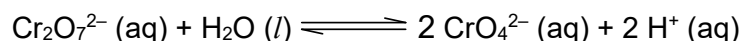
- A** 1, 2 and 3
- B** 1 and 2 only
- C** 2 and 3 only
- D** 3 only
- 17 A sample of 1 mole of XY was placed in an empty 1 dm^3 container and allowed to reach equilibrium according to the following equation.



At equilibrium, x mol of the XY had dissociated. What is the value of the equilibrium constant, K_p , at the temperature of the experiment?

- A** $\left[\frac{x}{(1-x)}\right]^2$
- B** $\left[\frac{(1-x)}{x}\right]^2$
- C** $\left[\frac{x}{4(1-x)}\right]^2$
- D** $\left[\frac{4(1-x)}{x}\right]^2$

- 18 Orange dichromate(VI), $\text{Cr}_2\text{O}_7^{2-}$, and yellow chromate(VI) ions, CrO_4^{2-} , exist in equilibrium in aqueous solution.



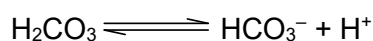
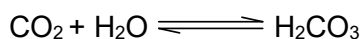
Which statement about this equilibrium is correct?

- A In strong alkali, the solution appears yellow.
- B Addition of a catalyst will shift the position of equilibrium to the left.
- C Addition of $\text{Cr}_2\text{O}_7^{2-}$ will shift the position of equilibrium to the left.
- D Lowering the pH will increase concentration of CrO_4^{2-} ions.

- 19 Which pair contains an Arrhenius acid and Arrhenius base?

	Acid	Base
A	KCl	NaOH
B	HCl	KOH
C	CH_3COOH	NH_3
D	H_2SO_4	NH_3

- 20 The concentration of carbon dioxide in the blood is regulated by the following equilibria.



What statements about these equilibria are correct when the pH of the blood decreases?

- 1 Both equilibria move to the left.
 - 2 HCO_3^- acts as an Bronsted Lowry acid.
 - 3 More CO_2 is produced.
- A 1, 2 and 3
 - B 1 and 2 only
 - C 1 and 3 only
 - D 1 only

- 21** Which row describes the properties of oxides of aluminium and phosphorus?

	oxide of aluminium	oxide of phosphorus
A	exists as a solid at room temperature	exists as a gas at room temperature
B	conducts electricity in the solid state	does not conduct electricity at room temperature
C	dissolves in water to give a solution which has a pH greater than 7	reacts with water to give a solution which has a pH less than 7
D	reacts with aqueous sodium hydroxide	reacts with aqueous sodium hydroxide

- 22** A 4 g cube of sodium is added to an excess of water. The volume of hydrogen gas evolved is measured over time until the reaction is complete.

The experiment is repeated with a 4 g cube of lithium and an excess of water at the same temperature.

Which row is correct?

	time taken for the reaction to complete with lithium	total volume of hydrogen gas evolved with lithium
A	longer than with sodium	the same as with sodium
B	longer than with sodium	more than with sodium
C	shorter than with sodium	the same as with sodium
D	shorter than with sodium	more than with sodium

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

Table 1 shows the results of experiments in which the halogens, W_2 , X_2 and Y_2 , were added to separate aqueous solutions containing W^- , X^- and Y^- ions. The possible identities of the halogens are chlorine, bromine and iodine.

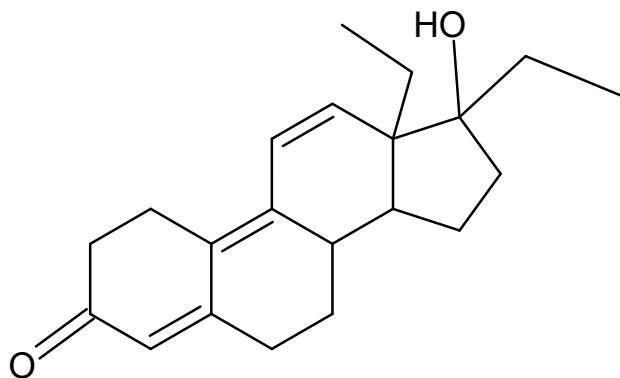
	W^- (aq)	X^- (aq)	Y^- (aq)
W_2	-	no reaction	no reaction
X_2	W_2 formed	-	no reaction
Y_2	W_2 formed	X_2 formed	-

Table 1

Which of the statements is correct?

- A** W_2 is a greenish yellow gas.
- B** The oxidising power of Y_2 is least.
- C** A brown solution is formed when X_2 is added to excess W^- .
- D** A purple layer is formed above the aqueous layer when Y_2 is added to X^- , followed by hexane.

24 THG is a steroid that mimics the effects of natural hormones and promotes muscle growth. It has the following structure.



THG

What is the molecular formula of THG?

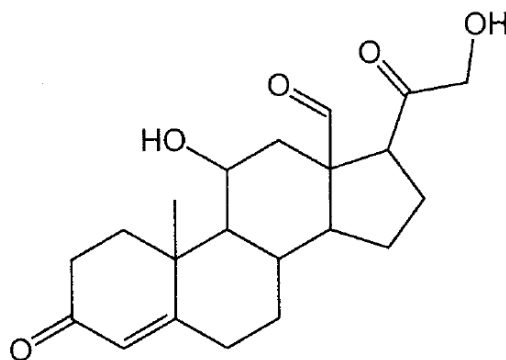
- | | |
|----------------------------|----------------------------|
| A $C_{21}H_{28}O_2$ | B $C_{21}H_{26}O_2$ |
| C $C_{19}H_{28}O_2$ | D $C_{19}H_{23}O_2$ |

25 Which statement about constitutional isomers is correct?

- A** 3-methylbut-1-ene and pent-1-ene are constitutional isomers.
- B** All constitutional isomers have the same chemical properties.
- C** Constitutional isomers can have different empirical formula.
- D** C_4H_{10} has three constitutional isomers.

26 Aldosterone is a steroidal hormone in humans.

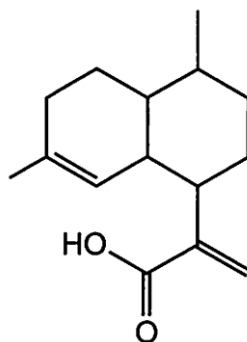
Which row correctly describes the number of ketone and primary alcohol groups in aldosterone?



aldosterone

	Number of ketone groups	Number of primary alcohol groups
A	2	1
B	2	2
C	3	1
D	3	2

- 27 Artemisinic acid is a useful intermediate for making the anti-malaria drug, artemisin.



artemisinic acid
 $C_{15}H_{22}O_2$

Which statement about this compound is correct?

- A It does not decolourise liquid bromine in the dark.
 - B It can exhibit cis-trans isomerism around the C=C.
 - C 1 mol of artemisinic acid reacts with 3 mol of hydrogen in the presence of nickel catalyst.
 - D It can react with aqueous sodium carbonate to form carbon dioxide.
- 28 Which compounds could be a product of a single reaction of propan-1-ol?
- 1 propanal
 - 2 propanone
 - 3 propene
- A 1, 2 and 3
 - B 1 and 3 only
 - C 2 and 3 only
 - D 1 only

- 29** Compound X and Y have the same functional group.

Compound X reacts with acidified potassium dichromate(VI) solution, giving compound Z after the mixture has been heated under reflux.

Compound Y reacts with compound Z, in the presence of a few drops of concentrated sulfuric acid, to give $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_3$.

What is compound X?

- A** ethanol
 - B** ethanal
 - C** propan-1-ol
 - D** propanal
- 30** Catalytic converters are used to convert the toxic gases produced from the internal combustion engines of vehicles into less harmful compounds.

Which equations represent reactions that will take place in the catalytic converter?

- 1 Oxides of nitrogen + carbon monoxide $\rightarrow$ nitrogen + carbon dioxide
 - 2 Unburnt hydrocarbons + carbon monoxide $\rightarrow$ carbon dioxide + water
 - 3 Carbon monoxide + oxygen $\rightarrow$ carbon dioxide
- A** 1 and 2 only
 - B** 1 and 3 only
 - C** 2 and 3 only
 - D** 3 only

END OF PAPER