RIVER VALLEY HIGH SCHOOL
JC 2 PRELIMINARY EXAMINATION

CANDIDATE NAME								
CLASS	2	0	J					
CENTRE NUMBER	S					INDEX NUMBER		

H2 CHEMISTRY 9729/01

Paper 1 Multiple Choice **23 September 2021**

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, class, centre number and index number on the Answer Sheet in the spaces provided.

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 **14** printed pages and **2** blank pages.

1 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 number of moles of potassium chlorate(VII) which could be produced from 0.200 mol of potassium chlorate(V)?

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

2 Methane was burned in an incorrectly adjusted Bunsen burner. The methane was converted into a mixture of carbon dioxide and carbon monoxide in the ratio 99:1, together with water vapour.

What will be the volume of oxygen consumed when y dm^3 of methane is burned?

A $2y - \frac{0.01y}{2}$ dm^3

B $2y - 0.01y$ dm^3

C $y - \frac{0.01y}{2}$ dm^3

D $y - 0.01y$ dm^3

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

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

	Ionisation energy/ kJ mol^{-1}				
	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}
Element **A**	6274	21267	25431	29872	35905
Element **B**	7004	8496	27107	31719	36621
Element **D**	6542	9362	11018	33604	38600

Which statements are correct?

1 The first ionisation energy of **A** is lower than that of **B**.

2 The atom of element **A** will be isoelectronic with $\mathbf{D}^{2+}$.

3 **A** and **D** forms an ionic solid $\mathbf{AD}_3$.

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

4 In which order are the electrons lost in forming Ga^{4+} ion?

	1st	2nd	3rd	4th
A	3d	4p	4s	4s
B	3d	4s	4s	4p
C	4p	4s	3d	3d
D	4p	4s	4s	3d

5 Which pair of liquids, when mixed, will give out heat?

A CH_2Cl_2 and $CH_3COCH_2CH_3$

B CH_2Cl_2 and C_6H_{12}

C CF_4 and $COCl_2$

D CCl_4 and $C_{10}H_{21}OH$

6 A 10 m^3 of oxygen gas at a pressure of 50 kPa and 30 m^3 of nitrogen gas at a pressure of 100 kPa are introduced to a 15 m^3 vessel at 300 K. The pressure in the vessel after mixing is **E** kPa.

Subsequently, the 15 m^3 vessel is heated to a temperature of **F** K and total pressure at **F** K is 350 kPa.

Given that the gases do not react at all temperatures, what are the values of **E** and **F**?

	E kPa	**F** K
A	233	401
B	233	451
C	400	263
D	400	343

7 A molecule of BCl_3 is planar, whereas a molecule of PH_3 is pyramidal.

Which statements are responsible for the difference in shapes?

1 The repulsion between chlorine atoms is greater than that between hydrogen atoms.

2 The boron atom in BCl_3 has six electrons in its valence shell, whereas the phosphorus atom in PH_3 has eight.

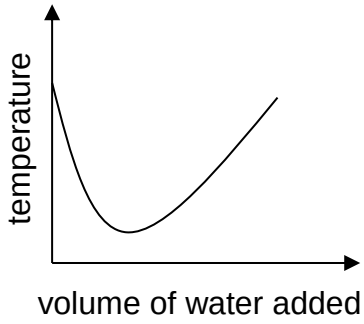
3 The atomic radius of phosphorus is greater than that of boron.

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

8 When water is stirred with glucose, strong hydrogen bonds are initially formed between glucose molecules and water molecules.

As more water is added, these hydrogen bonds are broken. Which of these graphs best represents the observed temperature changes?

A



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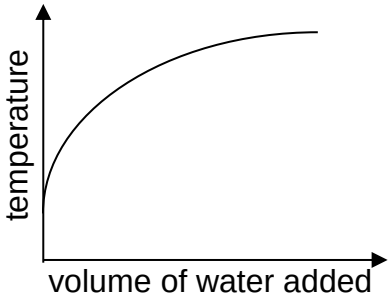

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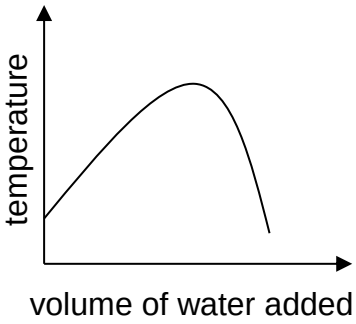

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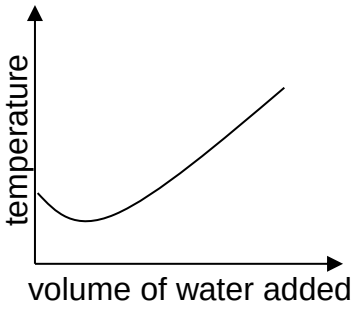


9 Highly toxic disulfur decafluoride decomposes by a free-radical process.

$$S_2F_{10}(g) \ll SF_4(g) + SF_6(g)$$

In a study of the decomposition, S_2F_{10} was placed in a 2.0 dm^3 flask and heated to 100 °C. The equilibrium $[S_2F_{10}]$ was found to be 0.5 mol dm^{-3}. More S_2F_{10} was then added and the new equilibrium $[S_2F_{10}]$ was 2.5 mol dm^{-3}.

What is the amount of S_2F_{10} reacted in terms of the equilibrium constant, K_c of the decomposition reaction when more S_2F_{10} was added?

A $(0.5K_c)^{0.5} - (2.5K_c)^{0.5}$

B $(2.5K_c)^{0.5} - (0.5K_c)^{0.5}$

C $(2K_c)^{0.5} - (10K_c)^{0.5}$

D $(10K_c)^{0.5} - (2K_c)^{0.5}$

10 Nitrogen oxide reacts with hydrogen gas as shown in the equation below.

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

The reaction was determined to be second order with respect to NO and first order with respect to H_2. In an experiment, 2.0 mol dm^{-3} of excess NO was used to react with H_2, the concentration of H_2 decreased to 6.25% of its original value in 24 minutes.

How many minutes will it take for the concentration of H_2 to decrease to 6.25% of its original value if the experiment was repeated using an excess of 4.0 mol dm^{-3} of NO?

A 1.5 **B** 4.5 **C** 6.0 **D** 9.0

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

Water dissociates as follows: $H_2O(l) \ll H^+(aq) + OH^-(aq)$

At 25 °C, the equilibrium value of $[H^+] = 10^{-7}$ mol dm^{-3} and $[H_2O] = \frac{1000}{18}$ mol dm^{-6}.

In which order would the numerical value of pH, pK_a and pK_w increase for this equilibrium at 25 °C?

	smallest ⟶		*largest*
A	pH	pK_a	pK_w
B	pH	pK_w	pK_a
C	pK_a	pK_w	pH
D	pK_w	pK_a	pH

12 The following reaction occurs when light is shone for a fixed period into a solution of CH_2ICH_2I and I_2 in tetrachloromethane at 100 °C.

$$CH_2ICH_2I \rightarrow CH_2{=}CH_2 + I_2$$

What conclusions about the rate of formation of iodine can be drawn from the data in the table?

experiment	relative initial concentrations		relative light intensity	relative initial rate of formation of iodine
	CH_2ICH_2I	I_2		
1	2	1	4	2
2	2	1	1	1
3	1	1	4	1
4	1	2	4	1

1 proportional to $\sqrt{\text{light intensity}}$

2 independent of initial concentration of I_2

3 proportional to initial concentration of CH_2ICH_2I

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

13 Which equations represent a Brønsted-Lowry acid-base reaction?

1 $C_6H_6 + Br^+ \rightarrow [C_6H_6Br]^+$

2 $CH_3CH_2NH_3^+ + NH_3 \rightarrow CH_3CH_2NH_2 + NH_4^+$

3 $CH_3CH_2^+ + Br^- \rightarrow CH_3CH_2Br$

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

14 The numerical values of the solubility product of $BaSO_4$, $BaCO_3$ and $Ba(IO_3)_2$ at 25 °C are given in the table below.

Compound	Solubility product
$BaSO_4$	1.1×10^{-10}
$BaCO_3$	2.6×10^{-9}
$Ba(IO_3)_2$	4.0×10^{-9}

An aqueous solution of $BaCl_2$ was added slowly, until in excess, to a solution containing 0.5 mol dm^{-3} Na_2SO_4, 1.0 mol dm^{-3} Na_2CO_3 and 1.5 mol dm^{-3} $NaIO_3$ at 25 °C.

What is the correct order of precipitation of the three barium salts?

	First to precipitate	⟶	Last to precipitate
A	$BaSO_4$	$BaCO_3$	$Ba(IO_3)_2$
B	$Ba(IO_3)_2$	$BaCO_3$	$BaSO_4$
C	$BaSO_4$	$Ba(IO_3)_2$	$BaCO_3$
D	$BaCO_3$	$Ba(IO_3)_2$	$BaSO_4$

15 Which factors determine the total amount of oxygen produced at the anode during the electrolysis of aqueous sodium fluoride?

	mass of electrode	current	time
A	✓	✓	✗
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✓

16 **W**, **X**, **Y** and **Z** are four consecutive elements in Period 3 but not necessarily in the order presented.

- Chloride of **W** dissolves in water and turns moist blue litmus red.
- **X** is a good conductor of electricity.
- **Y** has the highest melting point.
- **Z** has the largest ionic radius.

Which of the following is the correct sequence of the four elements in order of increasing atomic number?

A **X**, **Y**, **W**, **Z**

B **Y**, **W**, **X**, **Z**

C **X**, **W**, **Y**, **Z**

D **Z**, **Y**, **W**, **X**

17 In the construction of heart pacemakers, it is possible to use a small magnesium electrode which creates an electrical cell with the inhaled oxygen. The relevant half-equations are as follows:

$$Mg^{2+} + 2e^{-} \ll Mg \qquad E = -2.38\ V$$

$$\tfrac{1}{2}O_2 + 2H^{+} + 2e^{-} \ll H_2O \qquad E = +1.23\ V$$

Under standard conditions, the cell e.m.f. would be +3.61 V. However, when placed in the human body, a potential of +3.25 V is observed.

What is the best explanation for this lower e.m.f.?

A The low concentration of Mg^{2+} ions surrounding the magnesium electrode.

B The body fluid surrounding the electrodes has a pH of 7.5.

C The high concentration of O_2 surrounding the electrodes.

D The size of the magnesium electrode.

18 The high reactivity of fluorine is largely due to the low energy of the F–F bond.

Which statement does **not** account for the weak F–F bond?

A The F–F bond is weak because of the repulsion between the non-bonding electrons.

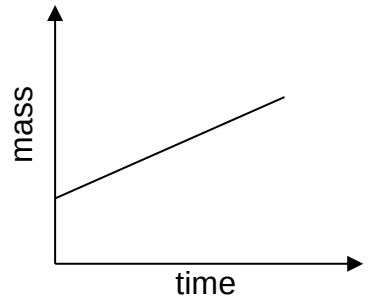
B The F–F bond is weak because of the short bond length.

C The F–F bond is weak because of the small number of electrons in fluorine atom.

D The F–F bond is weak because of the small size of fluorine atom.

19 Electrolysis of aqueous copper(II) sulfate was carried out using copper electrodes and a steady current. Which graph shows the change in mass of the cathode with time?

A



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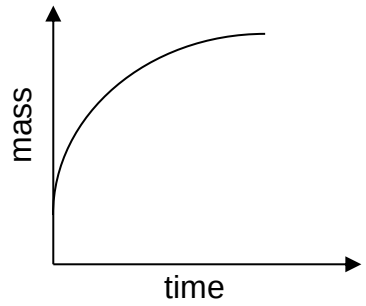

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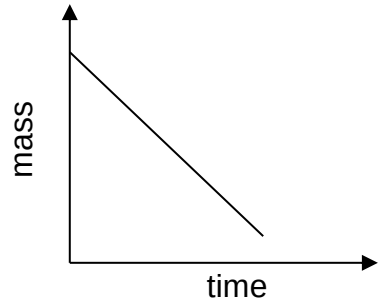

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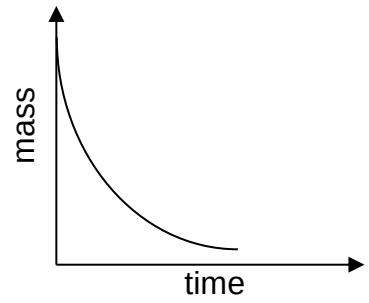
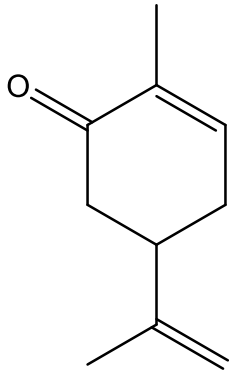


20 Carvone is the main ingredient of the flavouring agent oil of spearmint.



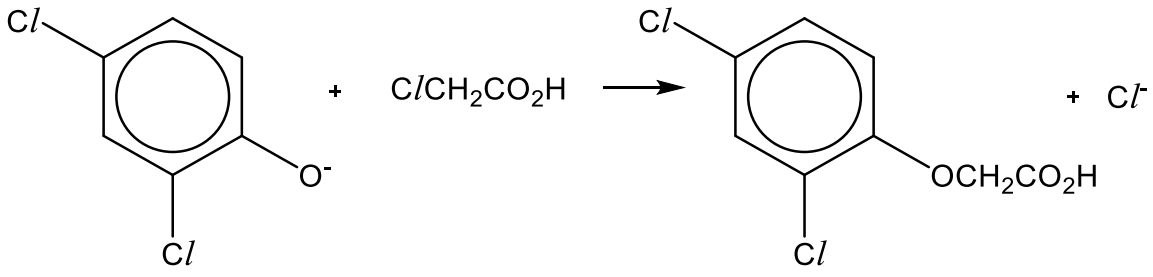
carvone

It can be reduced and hydrogenated to form **M**.

How many chiral centres do the molecules of carvone and **M** have?

	carvone	**M**
A	0	2
B	0	3
C	1	2
D	1	3

21 The weed killer (2,4-D) can be synthesised in the laboratory by the following reaction.



2,4-D

What is the mechanism of this reaction?

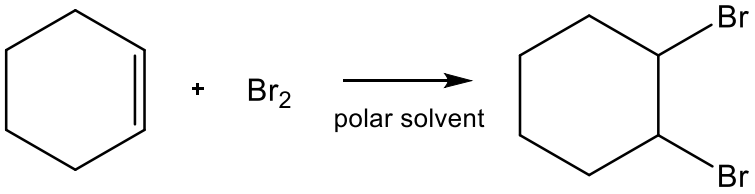
A condensation

B electrophilic substitution

C nucleophilic addition

D nucleophilic substitution

22 The equation represents an organic reaction.



Which statement about this reaction is **incorrect**?

A A nucleophile is involved in this reaction.

B A planar product is formed in the reaction.

C Bromine acts as an electrophile.

D The reaction can take place in the dark or in the presence of light.

23 Which method is the best in separating benzene from a mixture of benzene and an amine?

A extracting the benzene with hexane

B nitrating the benzene with a nitrating mixture

C shaking the mixture with dilute aqueous acid

D shaking the mixture with dilute aqueous alkali

24 A small peptide **N** is hydrolysed according to the following reaction.

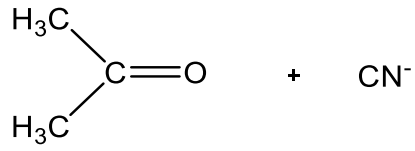
N $\rightarrow$ $2NH_2CH_2CO_2H + NH_2CH(CH_3)CO_2H + 2NH_2CH(CH_2OH)CO_2H$

(M_r = 75) (M_r = 89) (M_r = 105)

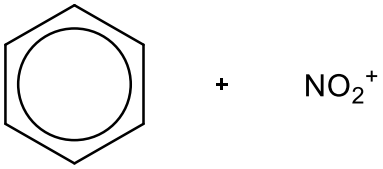
What is the M_r of **N**?

A 359 **B** 377 **C** 431 **D** 449

25 By considering the mechanism of the following reactions, which reaction does a carbon atom change from being sp^2 hybridised to being sp^3 hybridised?

1 

2 $CH_3CH_2Cl + OH^-$

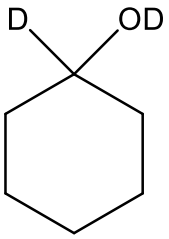
3 

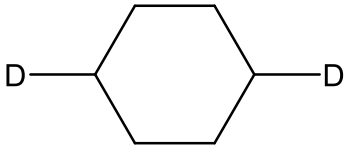
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 only

26 Deuterium, D, is an isotope of hydrogen, ^2_1H.

Which compound can be formed by the addition of D_2 to another molecule, in the presence of a platinum catalyst?

1 $CH_3CD_2ND_2$

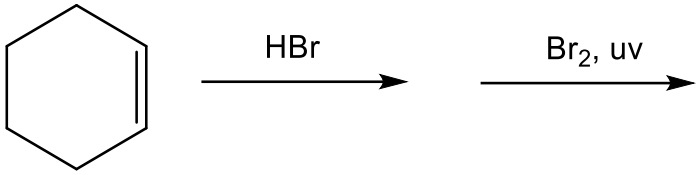
2 

3 

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

27 Which two-step process will **not** give a good yield of 1,2-dibromocyclohexane?

A



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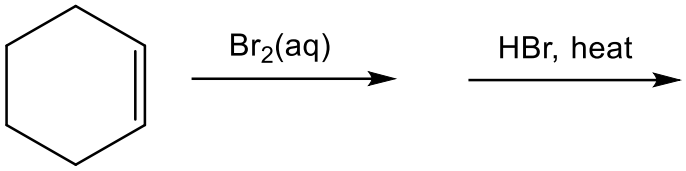

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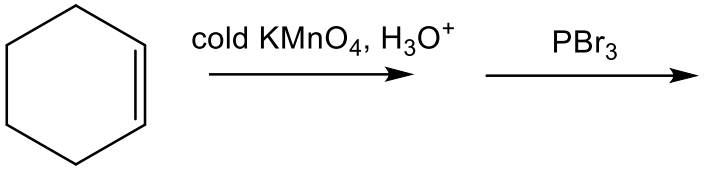

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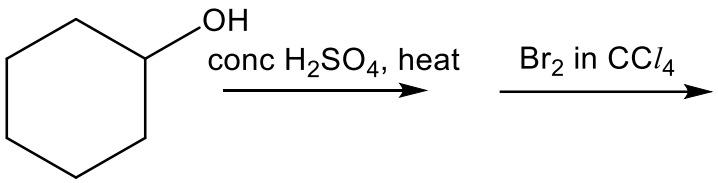


28 The acid dissociation constants of amino acids, K_1 and K_2, can be illustrated using the equations below.

$NH_3^+CHRCO_2H + H_2O \ll NH_3^+CHRCO_2^- + H_3O^+$ K_1

$NH_3^+CHRCO_2^- + H_2O \ll NH_2CHRCO_2^- + H_3O^+$ K_2

Which statement is correct for **any** amino acid?

A $NH_3^+CHRCO_2^-$ is the most common species present at pH 7

B pK_1 is larger than pK_2

C Multiplying K_1 and K_2 gives K_w

D Equal concentrations of $NH_3^+CHRCO_2^-$ and $NH_2CHRCO_2^-$ are present at pH = pK_2

29 When propene is bubbled through iodine monochloride, IC*l*, dissolved in a suitable solvent, a reaction occurs.

Which product will be present in the greatest yield?

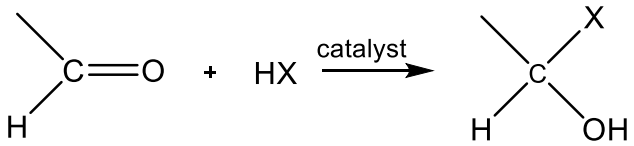
A CH_3CHCH_2I (Cl)

B CH_3CHCH_2I (I)

C CH_3CHCH_2Cl (I)

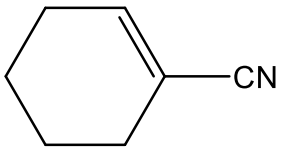
D CH_3CHCH_2Cl (Cl)

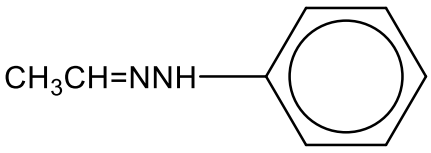
30 There are a range of reactions of the aldehyde group which have the pattern

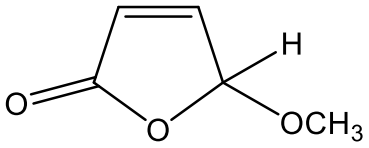


of which the formation of a cyanohydrin (where X = CN) is one.

Which compounds could be obtained by such an addition to an aldehyde group, followed by a dehydration?

1 

2 

3 

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

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