RIVER VALLEY HIGH SCHOOL
JC 2 PRELIMINARY EXAMINATION

CANDIDATE NAME									
CLASS	2	3	J						
CENTRE NUMBER	S					INDEX NUMBER			

H2 CHEMISTRY 9729/01

Paper 1 Multiple Choice **18 September 2024**

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

Some isotopes are unstable and decompose naturally. In one type of decomposition, a neutron in the nucleus decomposes to form a proton, which is retained in the nucleus, and an electron, which is expelled from the atom.

Which change describes such a process?

A $^{11}C \rightarrow {}^{12}C$

B $^{22}Na \rightarrow {}^{22}Ne$

C $^{32}P \rightarrow {}^{31}P$

D $^{40}K \rightarrow {}^{40}Ca$

2 Which statement is correct?

A One mole of a compound is the amount that contains the same number of atoms as there are in 12.000 g of carbon-12.

B The relative isotopic mass of lithium-7 is given by the following expression.

$$\frac{\text{average mass of all isotopes of lithium}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$$

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

$$\frac{\text{average mass of one atom of oxygen}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$$

D The relative molecular mass of a compound *E* is given by the following expression.

$$\frac{\text{average mass of one atom of E}}{\frac{1}{12}\text{ the mass of one molecule of carbon-12}}$$

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

Sodium percarbonate, $(Na_2CO_3)_x.y(H_2O_2)$, is an oxidising agent in some home and laundry cleaning products.

10.0 cm^3 of 0.100 mol dm^{-3} sodium percarbonate releases 48.0 cm^3 of carbon dioxide at room conditions on acidification.

An identical sample, on titration with 0.0500 mol dm^{-3} $KMnO_4$, requires 24.0 cm^3 before the first pink colour appears. $KMnO_4$ reacts with H_2O_2 in the mole ratio 2 : 5.

What is the ratio $\frac{y}{x}$?

A $\frac{1}{3}$ **B** $\frac{2}{3}$ **C** $\frac{3}{2}$ **D** $\frac{3}{1}$

4 Which statement does **not** correctly describe the graphite lattice?

A The lattice contains delocalised electrons.

B Each carbon atom in the lattice has three closest neighbours.

C Weak intermolecular forces of attraction hold each layer of carbon atoms together.

D Conduction of electricity takes place parallel to the axis of the unhybridised 2p orbitals.

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

Which particle contains a single unpaired electron?

A a molecule of NO_2

B the copper ion in Cu_2O

C the lithium ion in lithium aluminium hydride

D a particle formed from the heterolytic fission of a chlorine molecule

6 Flask **P** contains 1 dm^3 of helium at 2 kPa and flask **Q** contains 2 dm^3 of neon at 1 kPa.

If the flasks are connected at constant temperature, what is the final pressure?

A 3 kPa **B** $\frac{5}{3}$ kPa **C** $\frac{3}{2}$ kPa **D** $\frac{4}{3}$ kPa

7 Given the following data, what is the standard enthalpy change of vapourisation of $H_2O(l)$?

$\Delta H^{\ominus}_c$ of $C_2H_6(g)$ = –1561 kJ mol^{-1}

$\Delta H^{\ominus}_f$ of $C_2H_6(g)$ = –85 kJ mol^{-1}

$\Delta H^{\ominus}_f$ of $CO_2(g)$ = –394 kJ mol^{-1}

$\Delta H^{\ominus}_f$ of $H_2O(g)$ = –243 kJ mol^{-1}

A –43 kJ mol^{-1}

B +43 kJ mol^{-1}

C –529 kJ mol^{-1}

D +529 kJ mol^{-1}

8 Both mercury(I) sulfate, Hg_2SO_4, and cadmium(I) sulfate, Cd_2SO_4, are odourless white crystalline solids. Hg_2SO_4 is sparingly soluble while Cd_2SO_4 is very soluble in water.

lattice energy of Hg_2SO_4 = –2127 kJ mol^{-1}

$\Delta H^{\ominus}_{hyd}$ of Hg^+ = –625 kJ mol^{-1}

$\Delta H^{\ominus}_{hyd}$ of SO_4^{2-} = –1160 kJ mol^{-1}

Which one of the following statements is correct?

A $\Delta H^{\ominus}_{soln}$ of Hg_2SO_4 is endothermic and $\Delta H^{\ominus}_{soln}$ of Cd_2SO_4 is exothermic.

B $\Delta H^{\ominus}_{soln}$ of Hg_2SO_4 has a magnitude of 283 kJ mol^{-1}.

C The lattice energy of Hg_2SO_4 is more exothermic than that of Cd_2SO_4.

D The standard enthalpy change of hydration of Hg^+ is more exothermic than that of Cd^+.

9 Solutes dissolve in solvents to form solutions. If a semi-permeable membrane is placed between a pure solvent and a solution containing a solute in that solvent, only pure solvent molecules will pass through the membrane into the solution. This process is called osmosis.

In which processes will ΔS be positive?

1 dissolving the solute in a solvent to form a dilute solution

2 the evaporation of solvent from the solution

3 the passage of the solvent through a semi-permeable membrane during osmosis

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

10 Ideal gases **A** and **B** react to produce a liquid **C**:

$$\mathbf{A}(g) + \mathbf{B}(g) \rightarrow \mathbf{C}(l)$$

When equimolar amounts of **A** and **B** were introduced into a vessel of volume *V*, the initial rate of the reaction is measured to be y mol dm^{-3} s^{-1}.

Given that the reaction is 1st order with respect to [**A**] and 2nd order with respect to [**B**], what would be the initial rate of the reaction if the vessel is compressed to a volume of 0.25*V*?

A 64y **B** 32y **C** 16y **D** 8y

11 The hydrolysis of ethylamide in aqueous solution can be catalysed by hydrogen ions from sulfuric acid.

To determine the order of reaction with respect to hydrogen ions, which method should be used?

A Measure the change in pH during the reaction.

B Measure the rate of reaction several times, but with different concentration of ethylamide each time.

C Measure the rate of reaction several times, but with different concentration of sulfuric acid each time.

D Remove samples at various time interval and titrate against a standard solution of aqueous sodium hydroxide.

12 Which statement concerning only the elements in Period 3 is **incorrect**?

A The element with the smallest anion is chlorine.

B The element with the highest melting point is aluminium.

C The element with the highest electrical conductivity is aluminium.

D The element with eight atoms in its molecule is sulfur.

13 In this question, the symbol '<' means 'less positive than' or 'more negative than'.

Silver chloride dissolves in dilute and concentrated $NH_3(aq)$ whereas silver bromide is only soluble in concentrated $NH_3(aq)$.

The following equations represent the equilibria involved.

$AgCl(s) = AgCl(aq)$ ΔG_1

$AgCl(aq) + 2NH_3(aq) = Ag(NH_3)_2Cl(aq)$ ΔG_2

$AgBr(s) = AgBr(aq)$ ΔG_3

$AgBr(aq) + 2NH_3(aq) = Ag(NH_3)_2Br(aq)$ ΔG_4

Some relationships between the free energies of the four reactions are as follow.

1 $(\Delta G_1 + \Delta G_2) < (\Delta G_3 + \Delta G_4)$

2 $\Delta G_2 = \Delta G_4$

3 $\Delta G_2 < \Delta G_4$

4 $\Delta G_1 < \Delta G_3$

Which relationships are correct?

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

14 Methanol is produced by the following reaction.

$$CO(g) + 2H_2(g) = CH_3OH(g) \qquad \Delta H = \text{negative}$$

Which pair of changes will definitely increase the amount of methanol present at equilibrium?

	pressure	temperature
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	Increase

15 At a body temperature of 36.9 °C, the value of K_w is 2.42×10^{-14}.

What is the concentration of OH^- when the blood pH value is 7.40?

A 3.98×10^{-8} **B** 1.56×10^{-7} **C** 2.51×10^{-7} **D** 6.08×10^{-7}

16 Which statements about the HCO_3^- ion and CO_3^{2-} ion is correct?

A They are isoelectronic.

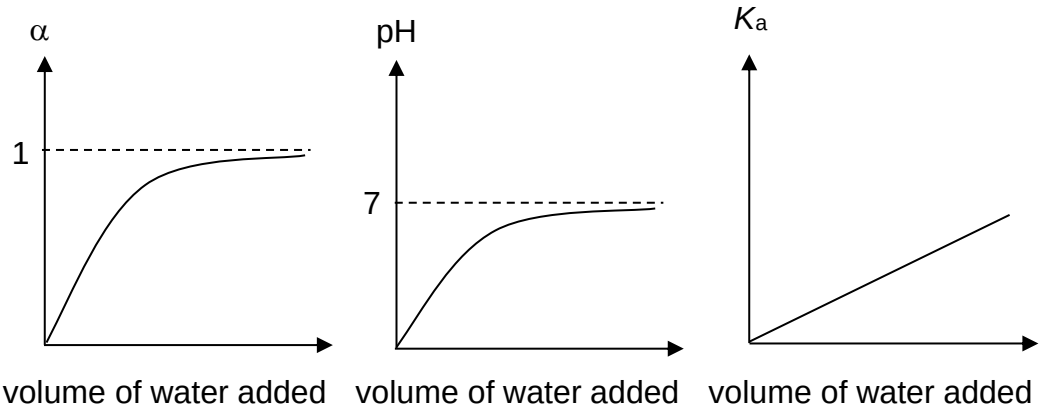
B They form the blood buffer system to control pH.

C CO_3^{2-} can only exhibit basic properties and HCO_3^- can only exhibit acidic properties.

D They are a conjugate acid-base pair because they are made up of a weak acid and a weak base.

17 Which graphs correctly show how the values of degree of dissociation, α, pH and K_a for a weak acid vary with the addition of water at 298 K?

1 **2** **3**



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

18 Given the solubility product, K_{sp}, of a sparingly soluble salt Ca_3X_2 is S, what is the value of $[Ca^{2+}(aq)]$ at equilibrium?

A $3(\frac{S}{108})^{\frac{1}{5}}$ **B** $3(\frac{S}{72})^{\frac{1}{5}}$ **C** $3(\frac{S}{6})^{\frac{1}{2}}$ **D** $S^{\frac{1}{5}}$

19 The solubility products of AgC*l* and Ag_2CrO_4 at 25 °C are as follows:

$$K_{sp}(AgCl) = 1.0 \times 10^{-20}\ mol^2\ dm^{-6}$$

$$K_{sp}(Ag_2CrO_4) = 2.5 \times 10^{-22}\ mol^3\ dm^{-9}$$

Which of the following statements are true?

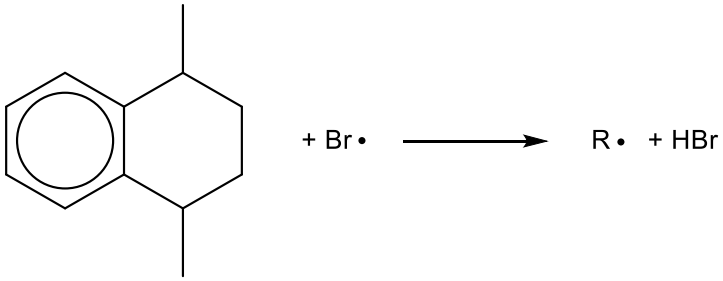
1 Addition of $AgNO_3$(aq) into a solution containing equal concentrations of Cl^- and CrO_4^{2-} ions results in the precipitation of Ag_2CrO_4 first.

2 Addition of $AgNO_3$(aq) into saturated solutions of AgC*l* and Ag_2CrO_4 results in a decrease in K_{sp} due to common ion effect.

3 Addition of NH_3(aq) to AgC*l* and Ag_2CrO_4 precipitates results in the dissolution of both precipitates.

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

20 When heated with bromine, the following hydrocarbon undergoes free radical substitution. In the propagation step, the free radical R• is formed by the loss of one hydrogen atom.



Which of the following statements is correct?

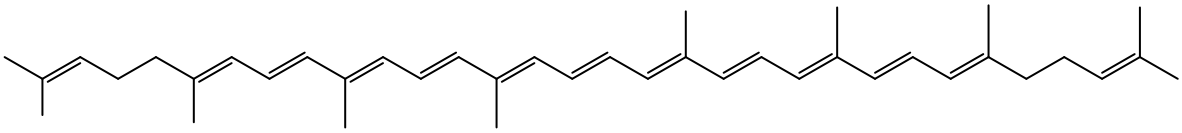
A Heterolytic fission of C#H bonds occurred.

B There are 3 possible constitutional isomeric form of R•.

C $C_{24}H_{32}$ is a trace product formed from R• in the termination step.

D There is only one pair of enantiomers among the monobrominated products.

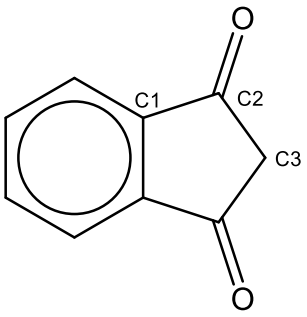
21 Lycopene is a red pigment in tomatoes.



How many different organic molecules are formed when lycopene is treated with hot acidified concentrated manganate(VII) ions?

A 3 **B** 4 **C** 8 **D** 14

22 Which statements about the following molecule are correct?



1 This molecule is planar.

2 There are 10 delocalised π electrons.

3 The bond energy of C1#C2 is greater than bond energy of C2#C3.

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

23 The reaction between propanal and HCN proceeds via two steps and the rate equation is as follows.

$$\text{rate} = k[CH_3CH_3CHO][CN^-]$$

Which of the following statements is correct?

1 All the products formed have the same stereochemistry.

2 The same product can be obtained by heating 1-chloropropan-1-ol with ethanolic NaCN.

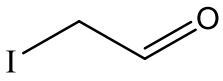
3 The reaction between propanone and HCN occurs at a faster rate than that between propanal and HCN.

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

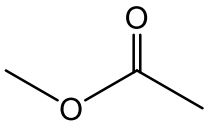
24 An aqueous iodine solution was added to compound **X** after it was heated in potassium hydroxide solution. No yellow precipitate was observed.

Which of the following is compound **X**?

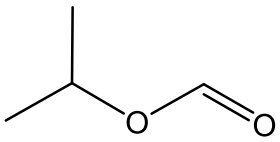
A



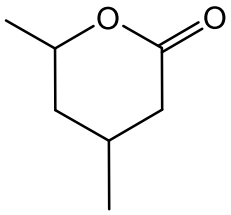
B



C



D



25 Each of the following reactions are carried out using the reagents and conditions stated.

Which reaction would give a good yield?

A $H_2C{=}CH_2 \xrightarrow{LiA/H_4 \text{ in dry ether}} CH_3CH_3$

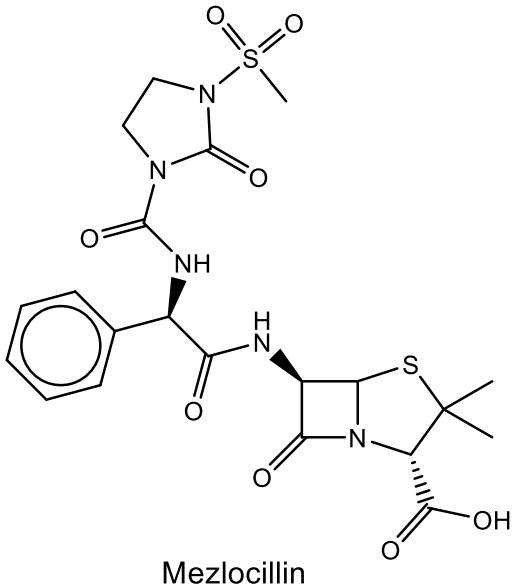
B $CH_3CH_2Br \xrightarrow[\text{heat under reflux}]{NaOH \text{ in } CH_3CH_2OH} H_2C{=}CH_2$

C $CH_3CH_2OH \xrightarrow[\text{heat with immediate distillation}]{\text{acidified } KMnO_4,} CH_3CHO$

D $CH_3CH_2Br \xrightarrow[\text{heat under reflux}]{\text{excess } NH_3 \text{ in } CH_3CH_2OH} CH_3CH_2NH_2$

26 *Use of Data Booklet is relevant to this question.*

Mezlocillin is a broad-spectrum penicillin antibiotic.



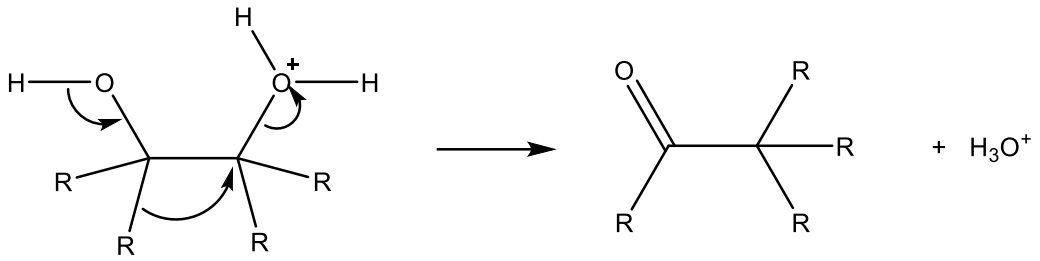
Mezlocillin

The reaction between mezlocillin and hot aqueous hydrochloric acid yields an organic compound with a single N atom.

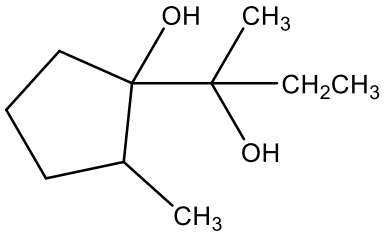
What is the relative molecular mass of the organic compound with a single N atom?

A 151.0 **B** 152.0 **C** 186.5 **D** 187.5

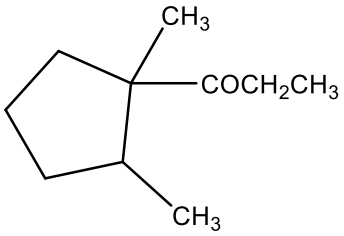
27 When a 1,2-diol is treated with a dilute acid, the protonated diol undergoes pinacol rearrangement as shown.



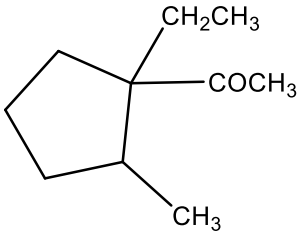
Which of the following products is **not** formed via pinacol rearrangement by adding dilute acid to diol **Z** shown below?



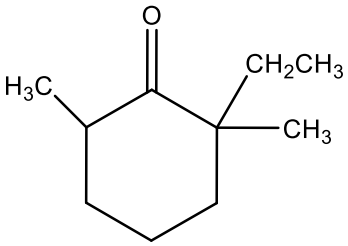
A



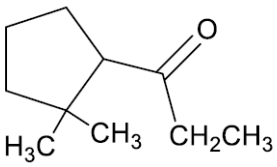
B



C



D



28 Which factors determine the number of atoms of copper deposited on the cathode of an electrolytic cell?

	$[Cu^{2+}(aq)]$	current	time
A	✓	✓	×
B	✓	×	×
C	×	✓	✓
D	×	×	✓

29 Visible light with longer wavelengths (such as red light) contains less energy than those with shorter wavelengths (such as purple light).

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.

Which of the following options is correct?

	energy gap between d-orbitals in yellow complex	repulsion between ligands and d-orbitals in yellow complex
A	larger	stronger
B	larger	weaker
C	smaller	stronger
D	smaller	weaker

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

Vanadium forms a number of coloured aqueous ions.

ion	colour
$V^{2+}(aq)$	violet
$V^{3+}(aq)$	green
$VO^{2+}(aq)$	blue
$VO_2^{+}(aq)$	yellow

What are the colours of the resulting solutions if an acidic solution of $VO_2^{+}(aq)$ is reacted separately with an excess of lead and with an excess of manganese?

	with lead metal	with manganese metal
A	green	blue
B	violet	blue
C	blue	violet
D	green	violet

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