



VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CHEMISTRY

9729/01

Paper 1 Multiple Choice

24 September 2020

1 hour

Additional Materials: Multiple Choice Answer Sheet
 Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, CT group and VJC exam number on the Answer Sheet in the spaces provided unless this has been done for you. Do not shade your NRIC number.

DO NOT WRITE IN ANY BARCODES.

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 choices in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. No mark will 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 **12** printed pages.

1 Which particle contains the most number of unpaired electrons?

- A Cr B Cu^{2+} C Mn^{2+} D Te^{2-}

2 Which ion has less electrons than neutrons and less neutrons than protons?

Ion	Neutrons	Nucleons
W^-	18	37
X^{2+}	17	34
Y^{3+}	16	33
Z^{3-}	16	31

- A W^- B X^{2+} C Y^{3+} D Z^{3-}

3 What is the number of σ and π bonds in the molecule, $(\text{CN})_2\text{CC}(\text{CN})_2$?

- | | σ | π |
|---|----------|-------|
| A | 5 | 9 |
| B | 9 | 5 |
| C | 9 | 9 |
| D | 13 | 5 |

4 Which species have the same shape as XeF_2 ?

- A Cl_2O B NO_2
 C IBr_2^- D SO_3^{2-}

5 The Gas Laws can be summarised in the general gas equation $pV=nRT$, where each symbol has its usual meaning.

Which of the following statements are correct?

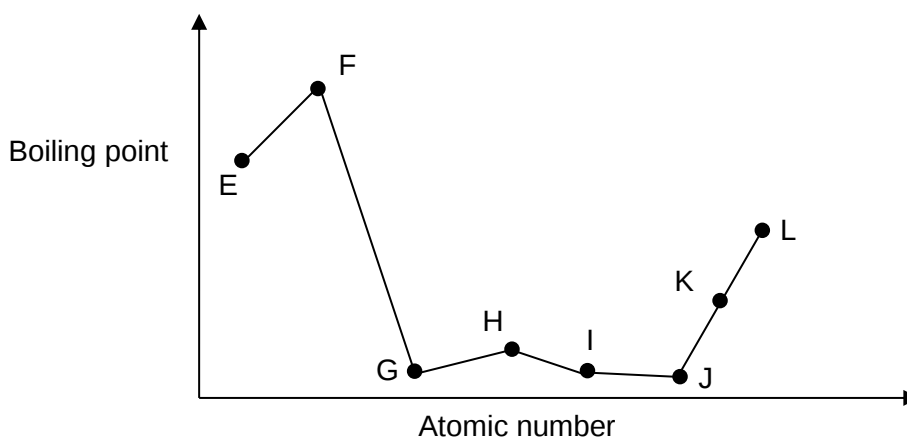
- One mole of any ideal gas occupies the same volume under the same conditions of temperature and pressure.
- The density of an ideal gas at constant pressure is inversely proportional to the temperature.
- The volume of a given mass of an ideal gas is doubled if its temperature is raised from 25 °C to 50 °C at constant pressure.

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

- 6 In an experiment, 0.10 g of a volatile liquid P formed 0.025 dm³ of vapour at 100°C and at 1 bar. What is the relative molecular mass of P?

- A $\frac{0.10 \times 373}{0.025 \times 22.7}$
- B $\frac{0.025 \times 273 \times 22.7}{0.10 \times 373}$
- C $\frac{0.025 \times 373 \times 22.7}{0.10 \times 273}$
- D $\frac{0.10 \times 373 \times 22.7}{0.025 \times 273}$

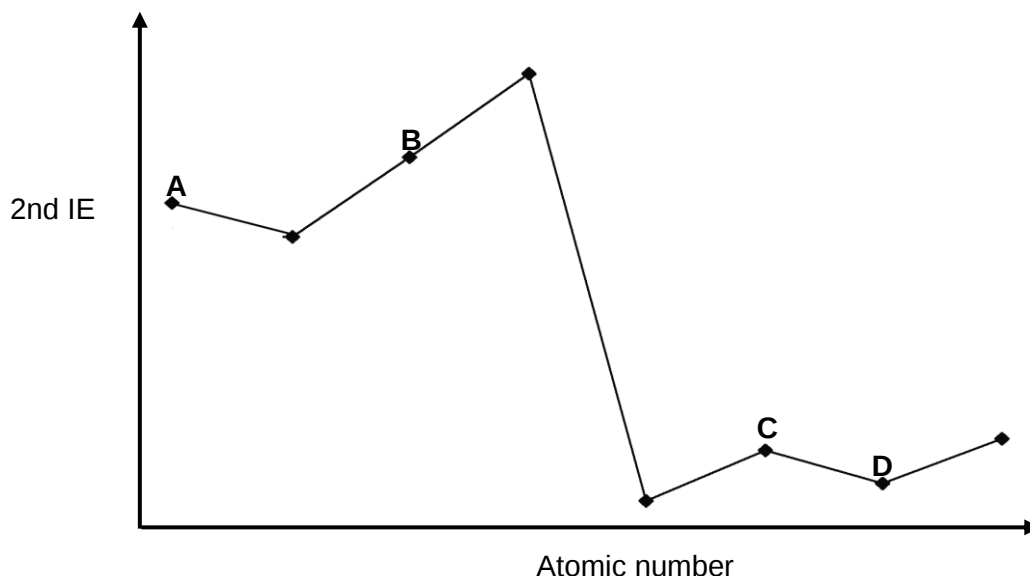
- 7 The graph below shows the variation in the boiling point for 8 consecutive elements in the Periodic Table, all with atomic number less than 21.



Which statements are correct?

- 1 The chloride of E reacts with aqueous sodium hydroxide to give a precipitate which is soluble in excess sodium hydroxide.
 - 2 The oxide of F is neutral in aqueous solution.
 - 3 The oxide of K dissolves readily in water to give a strongly alkaline solution.
- A 1, 2 and 3 B 1 and 2 only
- C 1 only D 2 and 3 only

- 8 The following graph shows the second ionisation energy of eight consecutive elements.



Element P belongs to Period 3 of the Periodic Table. It has poor electrical conductivity and its chloride has a simple molecular structure.

With reference to the graph above, which of the options **A**, **B**, **C** or **D**, corresponds to the second ionisation energy of element P?

- 9 Which of the following factors best explains why magnesium sulfate has a higher solubility than barium sulfate?
- A** Barium is more electropositive than magnesium.
B The charge density of magnesium ions is greater than that of the barium ions.
C Magnesium sulfate has numerically larger lattice energy than barium sulfate.
D The hydration of barium ions is more exothermic than that of magnesium ions.
- 10 Due to its radioactive nature, the properties of astatine, At, have to be estimated based on its position in the Periodic Table.

Which of the predictions concerning At or its compounds is correct?

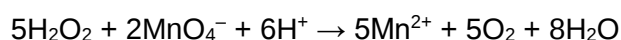
- A** Hydrogen astatide has a higher decomposition temperature than hydrogen bromide.
B Astatine is a light coloured solid at room temperature.
C Silver astatide is soluble in $\text{NH}_3(\text{aq})$.
D Iodine is a stronger oxidising agent than astatine.
- 11 Which of the following has the most number of atoms?
- A** 24 dm^3 of oxygen gas at r.t.p.
B 65 g nitrogen gas
C 18.75 cm^3 of ethanol where the density of ethanol is 0.8 g cm^{-3}
D 254 g of copper metal

- 12 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 $y \text{ dm}^3$ of methane is burned?

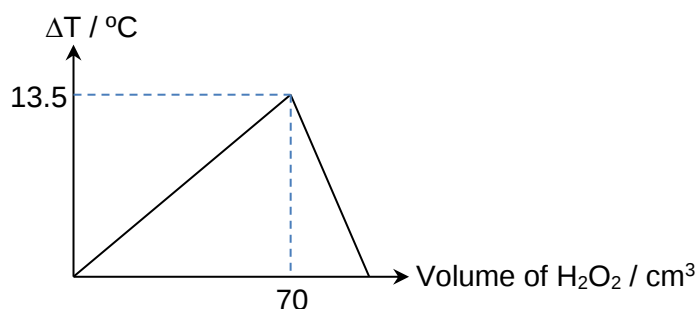
- A $(2y - \frac{0.01y}{2}) \text{ dm}^3$
 B $(2y - 0.01y) \text{ dm}^3$
 C $(y - \frac{0.01y}{2}) \text{ dm}^3$
 D $(y - 0.01y) \text{ dm}^3$

- 13 Hydrogen peroxide reacts with acidified potassium permanganate to produce oxygen gas.



Varying volumes of H_2O_2 of an unknown concentration was reacted with varying volumes of 0.50 mol dm^{-3} acidified KMnO_4 in a series of experiments.

The total volume of solutions used in each experiment was 100 cm^3 . In each experiment, the difference between the highest temperature reached and the initial temperature was calculated, and was plotted against the volume of H_2O_2 used to produce the graph below.



What is the concentration of H_2O_2 and the enthalpy change of the reaction per mole of H_2O_2 ? [You may assume that specific heat capacity of the solution is $4.2 \text{ J g}^{-1} \text{ K}^{-1}$ and density of the solution is 1 g cm^{-3} .]

	[H_2O_2]	Enthalpy change of reaction
A	$0.536 \text{ mol dm}^{-3}$	-151 kJ mol^{-1}
B	$0.214 \text{ mol dm}^{-3}$	-378 kJ mol^{-1}
C	$0.536 \text{ mol dm}^{-3}$	$-3210 \text{ kJ mol}^{-1}$
D	$0.214 \text{ mol dm}^{-3}$	$-8030 \text{ kJ mol}^{-1}$

16 Consider the given information about the following two solutions at 298 K:

- $1.00 \times 10^{-1} \text{ mol dm}^{-3}$ of HA gives a pH 2
- $1.00 \times 10^{-3} \text{ mol dm}^{-3}$ of HB gives a pH 3

Which of the following statement is correct?

- A HA is a stronger acid than HB.
 B The pK_b of A^- is higher than that of B^- .
 C When HA and HB are separately titrated with NaOH, the pH value of both their equivalence points are greater than 7.
 D Methyl orange cannot be used for the titration between HA and sodium hydroxide.

17 Which one of the following will form a buffer solution when added to 0.300 mol of $\text{NaHCO}_3(\text{aq})$?

- 1 0.400 mol CO_2
- 2 0.400 mol HCl
- 3 0.200 mol NaOH
- 4 0.200 mol Na_2CO_3

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

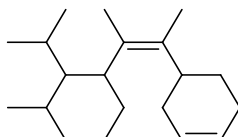
18 To prepare 'deionised' water, tap water containing ions, including chloride ions, is passed through a column of resin that helps to remove the ions present.

If the concentration of chloride ions that leaves the column is high enough to cause the precipitation of silver chloride when 1 cm^3 of this water is added to 1 cm^3 of 1 mol dm^{-3} silver nitrate solution, the water is no longer considered 'deionised'.

What is the maximum allowed concentration of chloride ions that can be present in the water that leaves the column? [K_{sp} of $\text{AgCl} = 1.8 \times 10^{-10} \text{ mol}^2 \text{ dm}^{-6}$]

- A $1.8 \times 10^{-10} \text{ mol dm}^{-3}$
 B $3.6 \times 10^{-10} \text{ mol dm}^{-3}$
 C $7.2 \times 10^{-10} \text{ mol dm}^{-3}$
 D $1.8 \times 10^{-11} \text{ mol dm}^{-3}$

19 How many stereoisomers does the molecule shown below have?



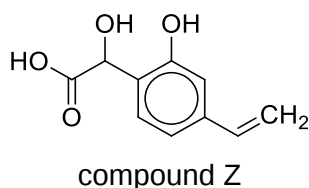
- A 4
 B 8
 C 16
 D 32

20 Which of the following reactions will give an optically inactive mixture?

- 1-bromohexane heated with alcoholic NaCN.
- 3-bromo-3-methylhexane heated with aqueous NaOH.
- But-1-ene reacted with HBr dissolved in organic solvent.
- Butanone reacted with HCN, trace amount of NaOH.

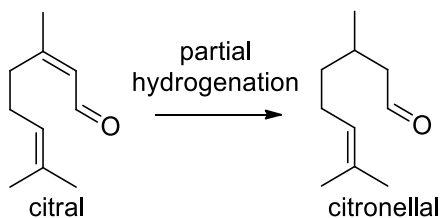
- A** 1, 2, 3 and 4
B 1, 2 and 3 only
C 1 and 3 only
D 2 and 4 only

21 Which of the following statements is correct about compound Z?



- A** A molecule of Z contains 8 sp² hybridised carbon atoms.
- B** Z undergoes a condensation reaction with aqueous ammonia to give an amide
- C** 1 mol of Z produced 3 mol of hydrogen gas when reacted with excess sodium.
- D** A molecule of Z can incorporate up to 4 bromine atoms when reacted with aqueous bromine.

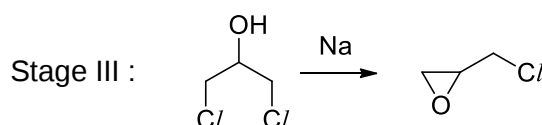
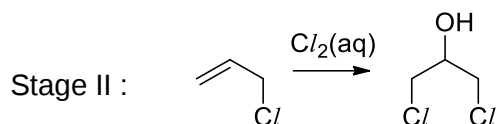
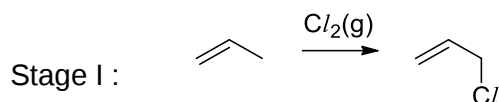
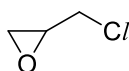
22 Citral can be partially hydrogenated to form citronellal as shown:



Which of the following can be used to distinguish between citral and citronellal?

- A** hot acidified potassium manganate(VII)
B cold alkaline potassium manganate(VII)
C Fehling's solution
D liquid bromine

- 23** Epoxy resins are polymers which are used in adhesives. One monomer used in their manufacture has the following structure.

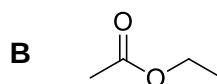
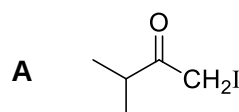


Which statements are correct for the above synthesis?

- 1 Stage I requires the use of ultraviolet light.
- 2 Stage II is an electrophilic addition.
- 3 Stage III is a nucleophilic substitution.

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

- 24 Which of the following compound does **not** gives a yellow precipitate with hot alkaline aqueous iodine?



- C** CH_3CONH_2 **D** $\text{CH}_3\text{CH}_2\text{OH}$

- 25** A student carried out an experiment to study the ease of hydrolysis of a series of organic compounds, and recorded the observations based on the addition of hot ethanolic silver nitrate.

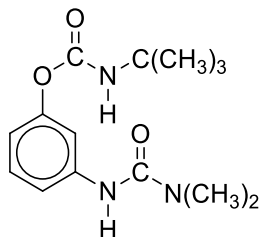
Which one of the following gives the expected results?

Time taken for precipitate to appear

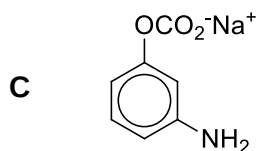
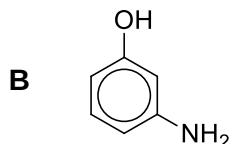
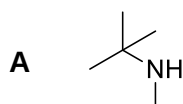
Shortest $\longrightarrow$ Longest

A	$\text{CH}_3\text{CH}=\text{CHBr}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$	$\text{C}_6\text{H}_5\text{COC}l$
B	$\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{COC}l$	$\text{C}_6\text{H}_5\text{Cl}$
C	$\text{C}_6\text{H}_5\text{COC}l$	$\text{CH}_3\text{CH}=\text{CHBr}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$
D	$\text{C}_6\text{H}_5\text{COC}l$	$\text{C}_6\text{H}_5\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$	$\text{C}_6\text{H}_5\text{Cl}$

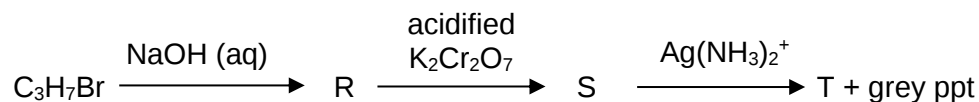
- 26 The structure of the herbicide *Karbutilate* may be represented as shown.



What would be formed by prolonged boiling of *Karbutilate* with aqueous sodium hydroxide?



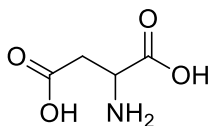
- 27 The compound $\text{C}_3\text{H}_7\text{Br}$ undergoes a sequence of reactions as follows:



What could be the formulae for R, S and T?

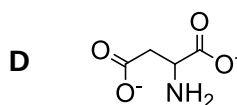
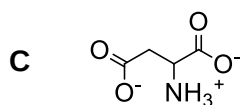
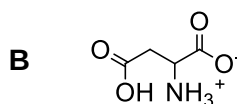
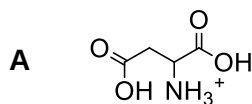
	R	S	T
A	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CHO}$	CH_3CO_2^-
B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CHO}$	$\text{CH}_3\text{CH}_2\text{CO}_2^-$
C	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$	$\text{CH}_3\text{CH}_2\text{CHO}$
D	$\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$	CH_3COCH_3	CH_3CO_2^-

- 28 Aspartic acid was first discovered in 1827 by Plisson. It is found in animal sources such as luncheon meats and sausages as well as vegetable sources such as sprouting seeds, oat flakes, avocado and asparagus.



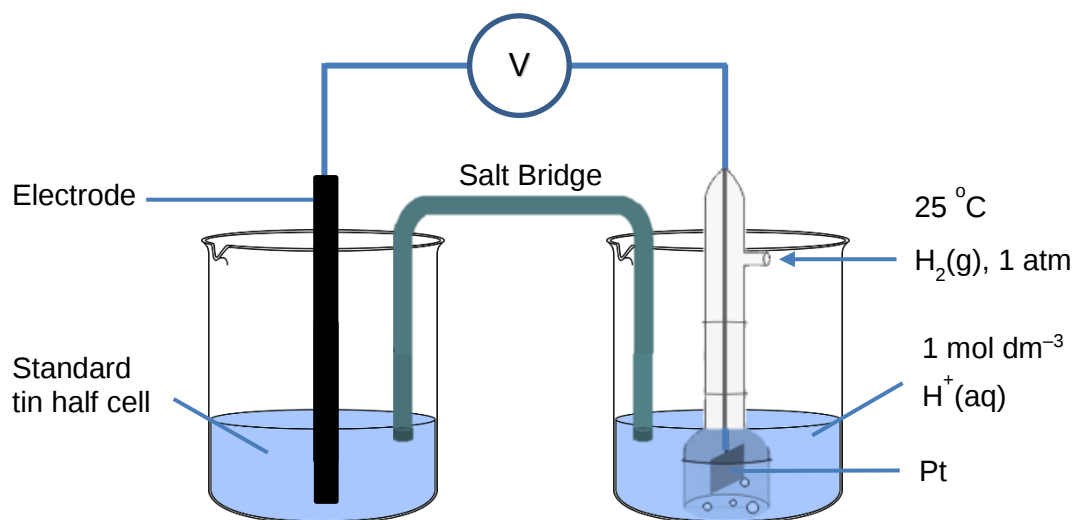
There are three pK_a values associated with aspartic acid: 2.0, 3.8, 9.8

What is the structure of the major species in a solution of aspartic acid at pH 7?



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

The diagram represents an experiment to determine the value of the $E^\ominus(\text{Sn}^{2+} | \text{Sn})$, the standard electrode potential of tin.



The e.m.f. of the cell was found to be 0.18 V rather than the expected 0.14 V. Two students, Y and Z, suggested the following possible explanation.

Y: $[\text{H}^+(\text{aq})]$ was lower than 1.00 mol dm^{-3}

Z: $[\text{Sn}^{2+}(\text{aq})]$ was greater than 1.00 mol dm^{-3}

Which of the explanations could be correct?

A Both Y and Z

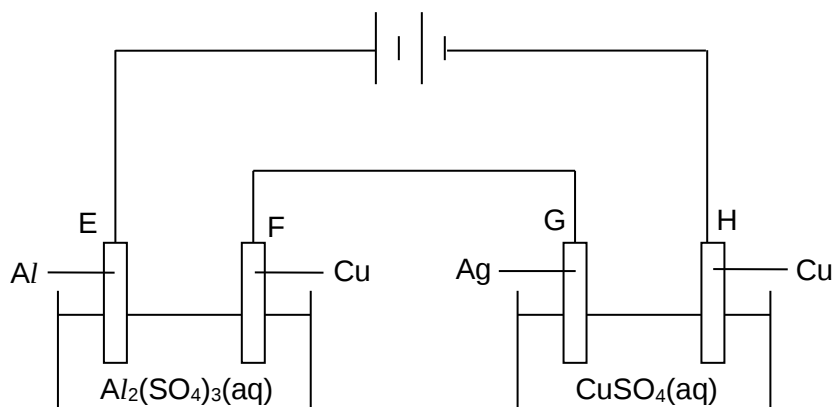
B Y only

C Z only

D Neither Y nor Z

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

Two cells are connected in series as shown in the diagram where E, F, G and H are electrodes.



After the current is passed for some time, at which electrode will there be the greatest change in mass?

A E

B F

C G

D H