



YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE
NAME

CG

INDEX NO

CHEMISTRY

9729/01

Paper 1 Multiple Choice

17 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, glue or correction fluid.

Write your name and class on the Answer Sheet in the spaces provided unless this has been done for you.

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.

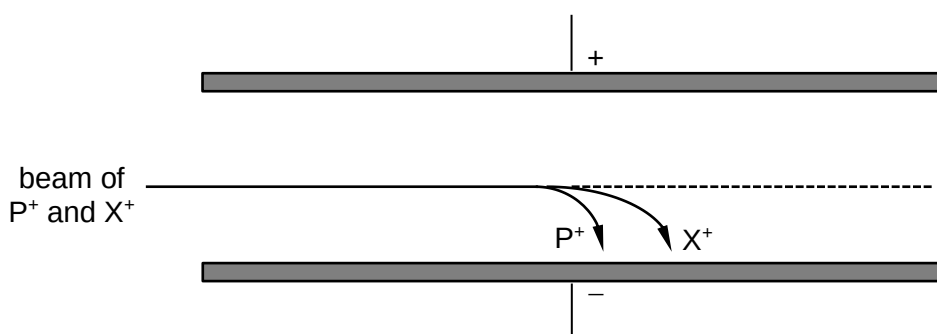
This document consists of **12** printed pages.

1 Which statement about the electrons in a ground state carbon atom is correct?

- A The occupied orbital of highest energy is spherical.
- B The occupied orbital of lowest energy is spherical.
- C There are more electrons in p orbitals than there are in s orbitals.
- D Electrons are present in four different energy levels.

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

In an experiment, an ore sample containing phosphorus and an unknown element X is vapourised, ionised and passed through an electric field at the same speed.



What could be the identity of element X?

- A sulfur
- B silicon
- C sodium
- D nitrogen

3 Which molecule or ion contains the smallest bond angle?

- A C_2H_4
- B HCHO
- C NH_4^+
- D NH_3

4 Which compounds contain an odd number of σ bonds?

- 1 C_2H_2
- 2 $\text{C}_2\text{H}_5\text{OH}$
- 3 CH_3CHO
- 4 $\text{CH}_3\text{CO}_2\text{H}$

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

- 5 Three identical flasks each contains the same mass of gases X, Y and Z respectively. The temperature, t , and pressure, p , of each flask are indicated below.

gas	temperature	pressure
X	t	p
Y	t	$2p$
Z	$2t$	p

Assuming ideal gas behaviour, what is the order of the relative molecular masses, M_r , of the three gases?

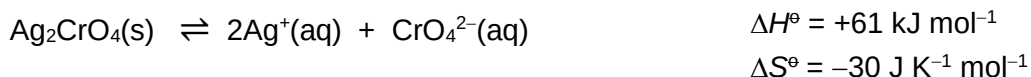
- A $M_r(Z) > M_r(X) > M_r(Y)$
- B $M_r(Z) > M_r(Y) > M_r(X)$
- C $M_r(X) > M_r(Y) > M_r(Z)$
- D $M_r(X) > M_r(Z) > M_r(Y)$
- 6 *Use of the Data Booklet is relevant to this question.*
How many atoms are there in 500 cm^3 of carbon dioxide at r.t.p.?
- A 1.25×10^{22} B 1.34×10^{22} C 3.76×10^{22} D 9.0×10^{26}
- 7 In oil refineries, an important process is the recovery of any sulfur from petroleum. Sulfur compounds are converted into the gas hydrogen sulfide, H_2S , by using a catalyst. The H_2S is then oxidised by using a controlled amount of air to give steam, $\text{H}_2\text{O}(\text{g})$, and sulfur, $\text{S}(\text{s})$.

The enthalpy change of formation of $\text{H}_2\text{S}(\text{g})$ is $-20.5 \text{ kJ mol}^{-1}$ and that of $\text{H}_2\text{O}(\text{g})$ is $-243.0 \text{ kJ mol}^{-1}$.

What is the enthalpy change of reaction per mole of H_2S ?

- A $-202.5 \text{ kJ mol}^{-1}$
- B $-222.5 \text{ kJ mol}^{-1}$
- C $-263.5 \text{ kJ mol}^{-1}$
- D $-445.0 \text{ kJ mol}^{-1}$

- 8 The equation describes the equilibrium between solid silver chromate and its aqueous ions.

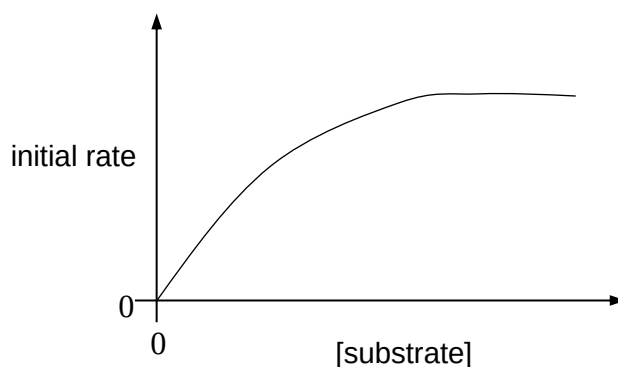


What can be deduced from the information about this equilibrium?

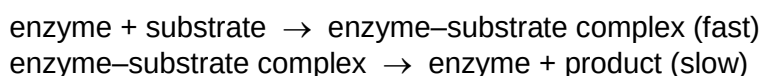
- 1 At 25 °C, $\Delta G^\ominus$ is negative.
- 2 At 25 °C, silver chromate is almost insoluble in water.
- 3 At 95 °C, silver chromate is more soluble in water than at 25 °C.

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

- 9 In an enzyme-catalysed reaction, the rate is affected by the concentration of substrate as shown in the graph below.



The steps that are common to most enzyme-catalysed reactions are



Which conclusion can be drawn about the kinetics of the enzyme-catalysed reaction?

- 1 When [substrate] is low, the reaction is first order with respect to the substrate.
- 2 When [substrate] is high, the reaction is zero order with respect to the substrate.
- 3 The rate equation is $\text{rate} = k[\text{enzyme-substrate}]$.

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

- 10** A radioactive element has two isotopes, X and Y, with half-lives of 5min and 15min respectively. An experiment starts with 4 times as many atoms of X as of Y.

Radioactive decay is a first order reaction.

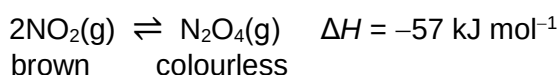
How long will it be before the number of atoms of X left equals the number of atoms of Y left?

- A** 5 min **B** 10 min **C** 15 min **D** 20 min

- 11.** Nitrogen dioxide, NO₂, is a brown gas.

Dinitrogen tetroxide, N₂O₄, is a colourless gas.

An equilibrium is established between NO₂ and N₂O₄ in a closed vessel.



Which row describes the effects of changing conditions on the colour of an equilibrium mixture of NO₂ and N₂O₄?

	increasing pressure	increasing temperature
A	colour becomes darker	colour becomes darker
B	colour becomes darker	colour becomes lighter
C	colour becomes lighter	colour becomes darker
D	colour becomes lighter	colour becomes lighter

- 12** What is a satisfactory indicator for the titration of 0.1 mol dm⁻³ ethanoic acid with 0.1 mol dm⁻³ aqueous ammonia?

- A** bromothymol blue (pH range 6.0 – 7.6)
B methyl red (pH range 4.2 – 6.3)
C phenolphthalein (pH range 8.2 – 10.0)
D there is no suitable indicator

- 13** What is the pH of an aqueous solution containing 0.1 mol dm⁻³ sodium benzoate and 0.01 mol dm⁻³ benzoic acid?

[K_a (benzoic acid) = 6 × 10⁻⁵ mol dm⁻³]

- A** 3.22 **B** 4.22 **C** 4.78 **D** 5.22

- 14** A solution contains a mixture of $1 \times 10^{-3} \text{ mol dm}^{-3}$ of bromide, fluoride, iodide and sulfate ions.

Values of the various lead(II) compound solubility product, K_{sp} , are given in the table.

	K_{sp}
lead(II) bromide	4.0×10^{-5}
lead(II) fluoride	2.7×10^{-8}
lead(II) iodide	7.1×10^{-9}
lead(II) sulfate	1.6×10^{-8}

Which lead(II) compounds will be precipitated first when 0.01 mol dm^{-3} of lead(II) nitrate is added dropwise into the solution?

- A** lead(II) bromide
- B** lead(II) fluoride
- C** lead(II) iodide
- D** lead(II) sulfate
- 15** Which statements about the Period 3 elements from sodium to chlorine are correct?
- 1 There is a change from metallic behaviour to non-metallic behaviour across the period.
 - 2 Their compounds show an increase in the maximum oxidation number across the period.
 - 3 The melting points of the elements decrease across the period.
- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only
- 16** The elements radon (Rn), francium (Fr) and radium (Ra) are consecutive in the Periodic Table.

What is the order of their first ionisation energies?

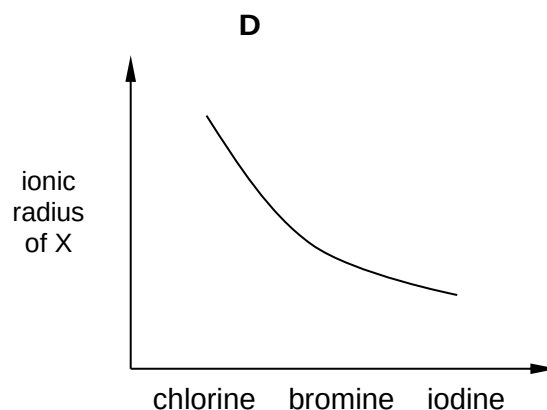
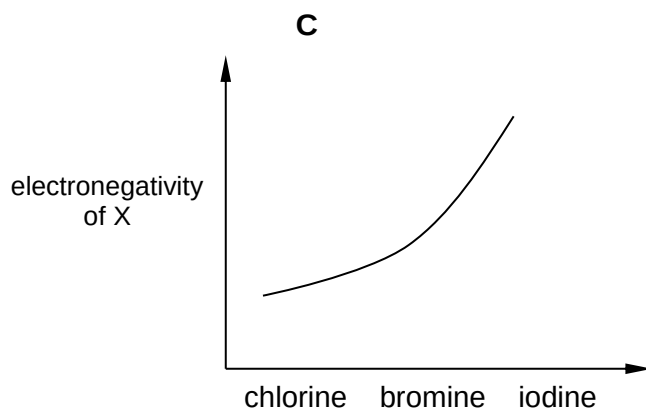
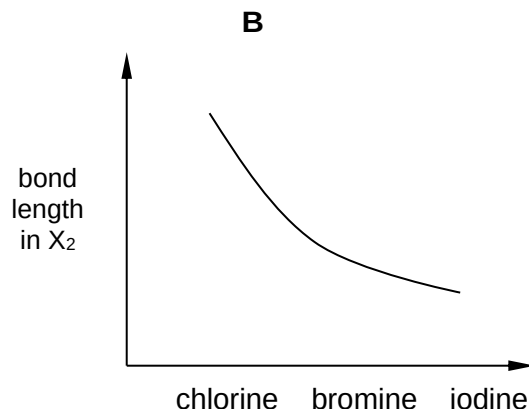
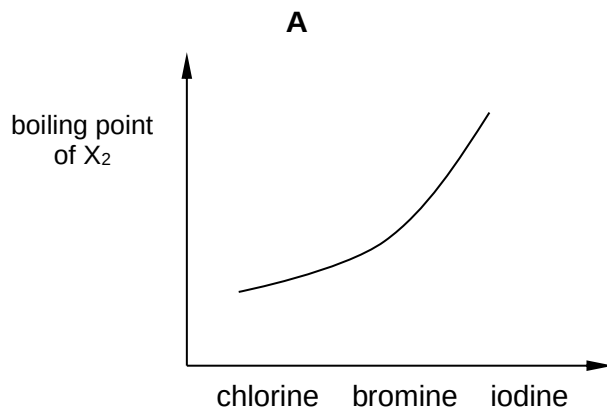
	least endothermic	→	most endothermic
A	Fr	Ra	Rn
B	Fr	Rn	Ra
C	Ra	Fr	Rn
D	Rn	Ra	Fr

- 17 The chloride of element J neither reacts with nor dissolves in water.

Which element could be J?

- A aluminium B carbon C magnesium D silicon

- 18 Which graph correctly describes a trend found in Group 17?



- 19 How many constitutional isomers are there in a molecule with

- molecular formula $C_7H_{12}O_2$ **and**
- a five-membered ring **and**
- a ketone group **and**
- a tertiary alcohol group?

- A 4 B 6 C 7 D 9

- 20 Complete combustion of a sample of a hydrocarbon, Y, gave 0.66 g of carbon dioxide and 0.36 g of water. What is the empirical formula of Y?

- A C_3H_4 B C_3H_5 C C_3H_8 D C_6H_8

- 21** The alkanes used to be known as the paraffin hydrocarbons - paraffin meaning 'lack of affinity' (i.e. unreactive).

Which statement is the best explanation of the 'lack of affinity' in alkanes?

- A** The atoms are arranged tetrahedrally around each carbon atom.
- B** There are no significant dipole moments in C–H and C–C bonds.
- C** The intermolecular forces are instantaneous dipole-induced dipole.
- D** There is free rotation about C–C single bonds.
- 22** In the free radical substitution of alkanes with bromine, the hydrogen atoms in the alkane do not react at the same rate with bromine radicals. The following table provides the relative rates of reaction of the different types of hydrogen atoms in an alkane with bromine radicals.

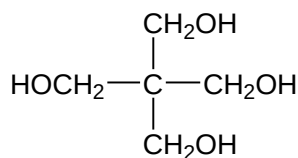
type of H atom	primary, $-\text{CH}_3$	secondary, $-\text{CH}_2$	tertiary $-\text{CH}$
relative rate of reaction with Br radical	1	4	6

When 2-methylbutane reacts with bromine in the presence of sunlight, monosubstituted products are formed.

Considering the type of H atom and their relative rate of reaction, what is the expected ratio of primary to secondary to tertiary bromoalkanes formed?

- A** 9 : 2 : 1
- B** 9 : 8 : 6
- C** 6 : 2 : 1
- D** 6 : 8 : 6

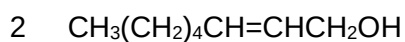
- 23 Pentaerythritol is used as an intermediate in the manufacture of paint.



pentaerythritol

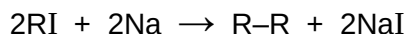
Which statement about pentaerythritol is correct?

- A It can react with HBr(aq) .
- B Its empirical and molecular formulae are different.
- C It can undergo elimination with hot concentrated sulfuric acid to form an alkene.
- D One mole of pentaerythritol gives two moles of hydrogen gas on reaction with excess sodium.
- 24 Which compounds, on complete oxidation with hot acidified potassium manganate(VII), would give two organic compounds?



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

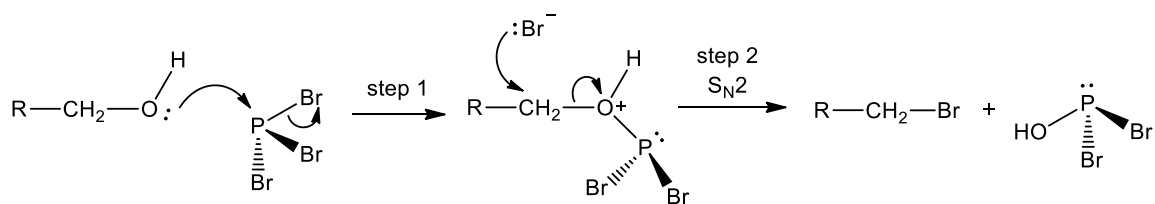
- 25 An iodoalkane and sodium react when heated under reflux in an inert organic solvent to form an alkane according to the equation.



When a mixture of equal number of moles of the two different iodoalkanes, $\text{CH}_3\text{CH}_2\text{I}$ and $\text{CH}_3\text{CHICH}_3$, is used, which of the following alkanes will **not** be formed?

- A $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$
- B $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)_2$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

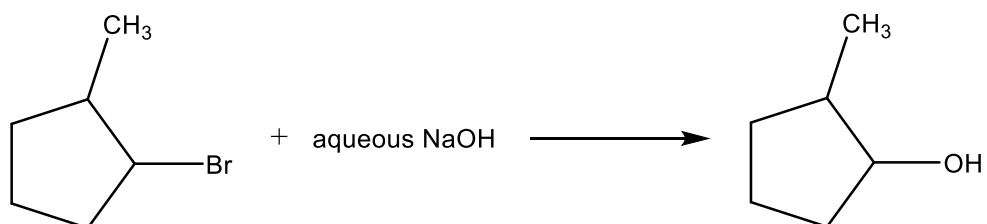
- 26 Bromoalkanes are commonly prepared by reacting either a primary or secondary alcohol with phosphorus tribromide, PBr_3 . The reaction usually involves two steps, and the mechanism is shown below.



Which statement about the reaction shown is correct?

- A The alcohol acts as a nucleophile in step 1.
- B The reaction can be carried out in aqueous medium.
- C The rate of reaction for step 1 is independent of the concentration of the alcohol.
- D Both step 1 and step 2 involve the formation of a 5-coordinated transition state.

- 27 By-products are formed during the preparation of many organic compounds. This usually occurs because the reagents can react in more than one way.



Which could be a by-product of this reaction?

- A**
- B**
- C**
- D**

- 28 Partial hydrolysis of a polypeptide containing 7 amino acid residues using an enzyme gives the following fragments.

lys-glu-phe
 ser-glu
 phe-cys
 glu-lys-glu
 val-ser

What is the structure of the polypeptide?

- A glu-lys-glu-phe-cys-val-ser
 B val-ser-glu-lys-glu-phe-cys
 C ser-glu-lys-glu-phe-phe-cys
 D glu-lys-glu-ser-glu-phe-cys
- 29 The followings are the standard electrode potentials of 4 elements, W, X, Y and Z.

$$E^\ominus(W^+/W) = +1.80 \text{ V}$$

$$E^\ominus(X^{2+}/X) = +0.30 \text{ V}$$

$$E^\ominus(Y^+/Y) = -0.90 \text{ V}$$

$$E^\ominus(Z^{2+}/Z) = -0.30 \text{ V}$$

Which statements are correct?

- 1 Z could be oxidised by Y^+ .
- 2 A cell consisting of W^+/W half cell and X^{2+}/X half cell has an e.m.f. of +1.5 V
- 3 W^+ is the strongest oxidising agent among all the species listed.

- A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 2 and 3 only
- 30 A current was passed through two cells connected in series. The first cell contained molten magnesium chloride, $MgCl_2$, while the other contained molten chromium (III) chloride, $CrCl_3$.

4.8 g of magnesium was liberated from the first cell. What is the mass of chromium liberated from the other cell?

- A 2.4 g B 3.2 g C 6.8 g D 15.6 g