YISHUN JUNIOR COLLEGE PRELIMINARY EXAMINATION

CHEMISTRY

8872/01 Higher 1

50 minutes

Paper 1 Multiple Choice

Additional materials: ORS

Data Booklet

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READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid. Write your name and CTG on the ORS form and shade your register number.

There are **30** questions on this paper. Answer **all** questions. For each question there are 4 possible answers A, B, C and D.

Choose the one you consider correct and record your choice in soft pencil on the ORS.

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 question paper.



Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 Chromium is obtained from the following reaction, $2Al + Cr_2O_3 \longrightarrow 2Cr + Al_2O_3$. Calculate the percentage yield of chromium when 180 g of chromium is obtained from a reaction between 100 g of aluminium and 400 g of chromium(III) oxide.
 - **A** 45.0%
 - **B** 36.0%
 - **C** 93.6%
 - **D** 131%
- 2 When 10 cm³ of a gaseous hydrocarbon was exploded with 100 cm³ of oxygen, the residual gas occupied 70 cm³. After shaking these residual gases with aqueous sodium hydroxide, the final volume was 20 cm³. All volumes were measured at room temperature and pressure. Calculate the molecular formula of the hydrocarbon.
 - **A** C₅H₁₀
 - **B** C₅H₁₂
 - **C** C₇H₁₂
 - **D** C₇H₁₄
- 3 In which one of the following is a redox reaction?
 - $A \quad CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
 - **B** $C_2H_5CH_2OH + Na \rightarrow C_2H_5CH_2ONa + H_2$
 - **C** $NH_3 + HCl \rightarrow NH_4Cl$
 - **D** $Al_2Cl_6 \rightarrow 2AlCl_3$

4 A plasma is a gaseous mixture in which the atoms have been completely stripped of their electrons, leaving bare nuclei. Predict the identity of *x*, *y* and *z*.



- The successive ionisation energies, in kJ mol⁻¹, of an element X are given below.
 870 1800 3000 3600 5800 7000 13200
 What is the number of valence electron(s) in the outermost shell of element X?
 - **A** 4
 - **B** 5
 - **C** 6
 - **D** 7

- 6 Which of the following does not have a macromolecular structure?
 - A Diamond
 - **B** Graphite
 - **C** Silicon dioxide
 - D Sodium chloride
- 7 In which of the following pairs does the first species have a larger bond angle than the second?
 - **A** NH₃, BF₃
 - **B** SO₃²⁻, SO₄²⁻
 - $C = ClO_3^{-}, BrO_3^{-}$
 - $\boldsymbol{D} \qquad H_2O, \, H_3O^+$
- 8 Which one of the following equations is used to define the first ionisation of bromine?
 - **A** $Br(g) + e^{-} \rightarrow Br^{-}(g)$
 - **B** $\frac{1}{2}Br_2(g) + e^- \rightarrow Br^-(g)$
 - **C** $Br(g) \rightarrow Br^+(g) + e^-$
 - $\mathbf{D} \quad \frac{1}{2}\mathrm{Br}_2(g) \rightarrow \mathrm{Br}^+(g) + \mathrm{e}^{\mathrm{-}}$

9 Consider the energy cycle below involving calcium fluoride



Using the following data, calculate $\Delta H_{\rm r}$.

enthalpy change of formation of $Ca^{2+} = -543 \text{ kJ mol}^{-1}$ enthalpy change of formation of $F^- = -333 \text{ kJ mol}^{-1}$ enthalpy change of formation of $CaF_2 = -1220 \text{ kJ mol}^{-1}$

- **A** -11 kJ mol⁻¹
- **B** +11 kJ mol⁻¹
- **C** -344 kJ mol⁻¹
- **D** +344 kJ mol⁻¹
- **10** The table shows some data on two acid-base indicators.

Indicator	Approximate pH	Colour change	
	range	acid	alkali
Bromocresol green	3.8 – 5.5	yellow	blue
Phenol red	6.8 - 8.5	yellow	red

Identify the colour change of a weakly acidic solution in the presence of each indicator.

	Bromocresol green	Phenol red
Α	Yellow	Yellow
В	Yellow	Red
С	Blue	Yellow
D	Blue	Red
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11 Given the following reaction in a vessel:

 $A_{(g)} + B_{(g)} \longrightarrow 2C_{(g)} + D_{(g)} \qquad \Delta H^{\theta} < 0$

Which of the following statement is correct?

- A Add a suitable catalyst and solvent to dissolve C will lead to an increase in rate of reaction and yield.
- **B** Increase temperature and increase pressure will lead to an increase in rate of reaction and yield.
- **C** Decrease the temperature and increase the pressure will lead to a decrease in rate of reaction and increase in yield.
- **D** Add a suitable catalyst and increase the pressure will lead to a decrease in rate of reaction but no change in yield.
- **12** Which of the following does not describe K_w, ionic product of water.
 - **A** It has units $mol^2 dm^{-6}$
 - **B** It increases when temperature increases
 - **C** It has a numerical value of 1.0×10^{-14} at 25°C
 - **D** It is the equilibrium constant for the reaction where water breaks down to its elements.

13 The radioactive decay of uranium-238 is the rate determining step in a series of changes in which lead is the final product formed. The radioactive decay is a first order reaction with a half-life of 4.5×10^9 years.

What is the age of a rock sample (originally lead free) with uranium to lead ratio of 1:7 now?

- **A** 1.5 x 10⁹ years
- **B** 2.25 x 10⁹ years
- **C** 9.0 x 10⁹ years
- **D** 13.5 x 10⁹ years
- **14** Which one of the following graphs shows how the rate of reaction changes with time for an autocatalytic reaction (i.e. a reaction catalysed by one of the products in the reaction)?



15 A mixture of the oxides of two elements of the third period is dissolved in water. The solution is approximately neutral.

What could be the constituents of the mixture?

Α	Al ₂ O ₃ and MgO	С	Na ₂ O and MgO
в	Na_2O and P_4O_{10}	D	SO_3 and P_4O_{10}

16 The element antimony occurs in Group V of the Periodic Table. Which one of the following sets of oxidation numbers is antimony likely to show in its compounds?

Α	+ 3 only	С	+ 3 and + 5
В	+ 5 only	D	+ 4 and + 5

17 The following graph shows the boiling points of eight consecutive elements, (i) to (vii), in Periods 2 and 3 of the Periodic Table.



Atomic Number

Which one of the following statements about the oxides of the elements is **INCORRECT**?

- **A** (i) forms an oxide with a melting point of 1286°C.
- **B** (v) forms an oxide which can react with bases.
- C (vi) forms a solid oxide.
- **D** (viii) can form an oxide with variable oxidation states.

18 The anti-asthma drug *Intal* contains disodium cromoglycate, which has the following structure.



What is the total number of sp^3 and sp^2 hydridized carbons in an *Intal* molecule?

Α	sp ³ 3	sp ² 20
В	20	3
С	18	5
D	5	18

19 The diagram below shows the structure of a catalytic converter as fitted into the exhaust system of a car.

Gases in	Gases out Surfaces coated with platinum and rhodium

Which of the following reactions could take place of the surface of the catalyst?

- I hydrocarbons + oxides of nitrogen \rightarrow carbon dioxide + water + nitrogen
- II carbon monoxide + oxides of nitrogen \rightarrow carbon dioxide + nitrogen
- III carbon monoxide + hydrocarbons \rightarrow carbon dioxide + water
- **A** I, II and III
- **B** I and II only
- **C** II and III only
- **D** I and III only

- **20** Why does the reaction $C_2H_5X + OH^- \rightarrow C_2H_5OH + X^-$ occur faster if X is iodine instead of bromine?
 - **A** The I⁻ ion is less hydrated in water than the Br⁻ ion.
 - **B** The C Br bond is more polar than the C I bond.
 - **C** The C Br bond is stronger than the C I bond.
 - **D** The overlapping of C Br orbitals is less effective than the C I overlap.
- 21 Which set of alcohols correctly shows a primary, a secondary and a tertiary alchol?



22 Which one of the following alcohols will give the greatest number of different alkenes when treated with concentrated sulphuric acid?

В

- C CH₃CH₂CH₂CH₂OH
- D CH₃CH₂CHCH₂CH₃ | OH
- **23** The oxo reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below.

$$CH_2 = CH_2 + CO + H_2 \xrightarrow[High T, p]{Catalyst} H_3CH_2CHO$$

Which of the following structural formulae correctly represents the product of the oxo reaction starting with but-2-ene?

- A CH₃CH₂CH(CH₃)CHO
- B CH₃CH₂CH₂CH₂CHO
- C CH₃CH₂COCH₂CH₃
- D (CH₃)₂CHCH₂CHO

- **24** The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction I). Aldol forms another compound on heating (reaction II).
 - I $2CH_3CHO \rightarrow CH_3CH(OH)CH_2CHO$
 - II $CH_3CH(OH)CH_2CHO \rightarrow CH_3CH=CHCHO + H_2O$

Which of the following best describes reaction I and II?

Α	I addition	II reduction
В	addition	elimination
С	elimination	reduction
D	substitution	elimination

- **25** Which compound reacts with its own oxidation product (an oxidation which involves no loss of carbon) to give a sweet-smelling liquid?
 - A propanal
 - **B** propanoic acid
 - **C** propanone
 - D propan-1-ol

Section **B**

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to place a tick against the statements that you consider to be correct).

The responses A to D should be selected on the basis of

A	В	С	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

- 26 Magnesium has a lower first ionisation than beryllium.Which statements help to explain this?
 - 1 the nuclear charge of magnesium is higher than beryllium.
 - 2 the electron to be ionised from magnesium is further from the nucleus than that in beryllium
 - 3 Magnesium has more electron shells than beryllium.
- 27 Which of the following describes the strength of a metallic bond?
 - 1 The larger the size of the metal ion(cation), the stronger is the metallic bond.
 - 2 The greater the charge of the metal ion(cation), the stronger is the metallic bond.
 - **3** The greater the number of valence electrons the metal has, the stronger is the metallic bond.

The responses A to D should be selected on the basis of

Α	В	С	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

- 28 Which of the following reactions are always exothermic?
 - 1 $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$
 - **2** $K^{+}(g) + Cl^{-}(g) \rightarrow KCl(s)$
 - **3** 2NaOH (aq) + H₂SO₄ (aq) \rightarrow Na₂SO₄ (aq) + 2 H₂O (l)
- **29** Which of the following react at a reasonable rate with chlorine at room temperature with sunlight but in the absence of a catalyst?
 - 1 methane
 - 2 ethene
 - 3 methylbenzene

The responses **A** to **D** should be selected on the basis of

Α	В	С	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

30 Chlorofluorocarbons (CFCs) pose environmental problems in that they cause the depletion of the ozone layer. Hydrochlorofluorocarbons (HCFCs) are alternatives which help to reduce the problem. The ozone depletion potential values of a CFC and a HCFC are given below.

	Ozone Depletion Potential (ODP)
CFCl ₃ (CFC)	1.0
CF ₃ CHCl ₂ (HCFC)	0.10

Which of the following could account for the difference in ODP?

- **1** The C–F and C–H bonds are stronger than C–C/ bond.
- **2** The concentration of Cl from $CFCl_3$ is higher than that from CF_3CHCl_2 , therefore the rate of depletion of ozone is faster.
- **3** Flourine atom is very stable while chlorine atom is very reactive.