

SERANGOON JUNIOR COLLEGE General Certificate of Education Advanced Level Higher 2

## CHEMISTRY

9746/01

# Preliminary Examination Paper 1 MCQ

28 Aug 2009 1 hour

Additional Materials:

OMS Data Booklet

### **READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid on the OMS. Write your name and index number on the OMS in the spaces provided.

There are **forty** 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 OMS

#### Follow the instructions given to you on how to fill in the OMS.

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.

#### Answer ALL Questions

- 1 3.920 g of an oxide of formula MO was completely dissolved in 30.0 cm<sup>3</sup> of 2.00 mol dm<sup>-3</sup> sulphuric acid. The resulting solution was made up to 100 cm<sup>3</sup>. 25.0 cm<sup>3</sup> of this solution was neutralised by 27.5 cm<sup>3</sup> of 0.100 mol dm<sup>-3</sup> sodium hydroxide. What is the relative atomic mass of M?
  - **A** 47.9
  - **B** 54.9
  - **C** 55.9
  - **D** 101.0
- **2** A commercial production of iodine involves the reduction of a solution of iodate(V) ions,  $IO_3^-$ , with the theoretical quantity of hydrogen sulphite ions,  $HSO_3^-$  in acidic condition. The hydrogen sulphite ions are oxidised to sulphate ions,  $SO_4^{2-}$  while the iodate(V) ions are reduced to iodine,  $I_2$ .

Given  $H_2O(l) + HSO_3(aq) \rightarrow SO_4^{2-}(aq) + 3H^+(aq) + 2e^-$ 

How many moles of hydrogen sulphite ions are needed to reduce one mole of iodate(V) ions?

- **A** 0.4
- **B** 1
- **C** 2.5
- **D** 5
- **3** One of the isotopes of carbon is carbon-14. Carbon-14 is radioactive and is used in carbon dating by archaeologists. Which one of the following species is isotonic and isoelectronic with respect to an atom of carbon-14?
  - **A**  ${}^{13}C^{-}$
  - **B** <sup>14</sup>N<sup>+</sup>
  - **C** <sup>16</sup>O<sup>2+</sup>
  - **D**  ${}^{17}\text{F}^+$



5 Polyurethane is used in coatings, insulators and adhesives.



Polyurethane

What are the values of the bond angles marked **a** and **b** in polyurethane?

	а	b
Α	90	90
В	120	120
С	107	120
D	109.5	90

6 Zinc oxide reacts with hydrogen according to the following equation.

 $ZnO(s) + H_2(g) \implies Zn(s) + H_2O(g)$ 

At temperature T and a total pressure of 10 atm, it is found that initial amounts of 1 mole of zinc oxide and hydrogen gas each produce 0.01 mole of zinc and steam at equilibrium. What is the approximate value of  $K_p$  at temperature T?

- **A** 10<sup>-4</sup>
- **B** 10<sup>-2</sup>
- **C** 10
- **D** 100
- 7 Hydrogen peroxide reacts with acidified iodide ions liberating iodine according to the equation below:

 $H_2O_2$  (aq) + 2H<sup>+</sup> (aq) + 2I<sup>-</sup> (aq)  $\rightarrow$  I<sub>2</sub> (aq) + 2H<sub>2</sub>O (l)

The kinetics of this reaction were investigated and it was found to have the following rate equation:

rate = k [H<sub>2</sub>O<sub>2</sub>] [I<sup>-</sup>]

Two series of experiments were conducted giving rise to Graph A and Graph B.



Which of the following shows the correct labeling of the x-axis for **Graph A** and y-axis for **Graph B**?

Α	<b>x-axis for Graph A</b> [H <sub>2</sub> O <sub>2</sub> ] [I <sup>-</sup> ] / mol <sup>2</sup> dm <sup>-6</sup>	<b>y-axis for Graph B</b> [H <sup>+</sup> ] / mol dm⁻³
в	[I <sup>-</sup> ] [H <sup>+</sup> ] / mol <sup>2</sup> dm <sup>-6</sup>	[I <sub>2</sub> ] / mol dm <sup>-3</sup>
С	$[H_2O_2] / mol dm^{-3}$	[I <sup>-</sup> ] / mol dm <sup>-3</sup>
D	[H⁺] / mol dm⁻³	$[H_2O_2]/mol dm^{-3}$

- A 1 mol of NaOH and 1 mol of CH<sub>3</sub>COOH
- **B** 1 mol of CH<sub>3</sub>COOH and 1 mol of CH<sub>3</sub>COO<sup>-</sup>Na<sup>+</sup>
- **C** 1 mol of HCl and 1 mol of  $CH_3COO^-Na^+$
- **D** 1 mol of  $CH_3COO^-NH_4^+$
- **9** When the concentration of Ca<sup>2+</sup> ions in water is greater than 10<sup>-5</sup> mol dm<sup>-3</sup>, an insoluble scum would be formed with soap.

To prevent scum forming with soap, what minimum mass of sodium carbonate should be added to 1 dm<sup>3</sup> of water? [Solubility product of  $CaCO_3 = 5.0 \times 10^{-9} \text{ mol}^2 \text{ dm}^{-6}$ ]

- **A** 0.037 g
- **B** 0.042 g
- **C** 0.050 g
- **D** 0.053 g
- **10** The enthalpy change of neutralisation of dilute sulphuric acid by dilute sodium hydroxide is the heat liberated when
  - A 1 mole of  $H_2SO_4$  reacts with  $\frac{1}{2}$  mole of NaOH
  - **B** 1 mole of  $H_2SO_4$  reacts with 1 mole of NaOH
  - **C** 1 mole of  $H_2SO_4$  reacts with 2 mole of NaOH
  - **D**  $\frac{1}{2}$  mole of H<sub>2</sub>SO<sub>4</sub> reacts with 1 mole of NaOH

**11** Tetrachloroethene is commonly used as a degreasing solvent. The enthalpy change for the reaction below is -878.5 kJ mol<sup>-1</sup>.

 $C_2H_4$  (g) + 4HCl (g) + 2O<sub>2</sub> (g)  $\rightarrow C_2Cl_4$  (l) + 4H<sub>2</sub>O (l)

Which of the following is the enthalpy change of formation of tetrachloroethene given the following information?

 $\Delta H_{f} (C_{2}H_{4} (g)) = +52.3 \text{ kJ mol}^{-1}$ 

 $\Delta H_{f}$  (HC*l* (g)) = -92.3 kJ mol<sup>-1</sup>

 $\Delta H_{f} (H_{2}O(l)) = -285.8 \text{ kJ mol}^{-1}$ 

- **A** -9.2 kJ mol<sup>-1</sup>
- **B** -52.2 kJ mol<sup>-1</sup>
- **C** -330 kJ mol<sup>-1</sup>
- **D** -633 kJ mol<sup>-1</sup>
- **12** Given the cell diagram,

Cu (s) / Cu<sup>2+</sup> (aq) // Ag<sup>+</sup> (aq) / Ag (s)

Which of the following statement is **correct**?

- **A** The mass of the silver electrode will decrease.
- **B** Electrons flow from the silver electrode to the copper electrode in the external circuit.
- **C** When NaOH(aq) is added to the  $Cu^{2+}(aq)/Cu(s)$  half cell, the  $E^{\theta}_{cell}$  will become less positive.
- D Replacing the Ag<sup>+</sup>(aq)/Ag(s) half cell with Co<sup>2+</sup>(aq)/Co(s) half cell will reverse the direction of electron flow in the external circuit.

**13** A current of 0.2 A passing for 5 hours through a solution of gold ions deposits a mass of 2.45 g of gold on the cathode. Which of these expressions gives the charge on a gold ion?

$$A \qquad \frac{2.45 \times 0.2 \times 5 \times 60 \times 60}{197 \times 96500}$$

- $B \qquad \frac{0.2 \times 5 \times 60 \times 60 \times 197}{96500 \times 2.45}$
- $c \qquad \frac{2.45 \times 96500}{197 \times 0.2 \times 5 \times 60 \times 60}$
- $D \qquad \frac{197 \times 0.2 \times 5 \times 60 \times 96500}{2.45}$

**14** The following shows the variation of a property of the first 20 elements in the Periodic Table with the proton number of the element.



What is the property?

- A Atomic radius
- B First ionisation energy
- **C** Ionic radius
- **D** Melting point
- **15** Which of the following elements has an oxide with a giant structure and a chloride which is readily hydrolysed?
  - A Silicon
  - B Sodium
  - **C** Phosphorus
  - **D** Carbon

- 16 Which of the statements about Group II elements is correct?
  - **A** The reducing power decreases down the group.
  - **B** The ionic radius increases down the group.
  - **C** The electronegativity increases down the group.
  - **D** The reactivity with water decreases down the group.
- **17** The solubility of the Group II sulphates decreases as the proton number increases. Which factor affects this trend?
  - **A** The atomic radius of the metal atom
  - **B** The enthalpy change of formation of the sulphate
  - **C** The enthalpy change of hydration of the metal ion
  - **D** The first ionisation energy of the metal
- **18** A solution **E** is given the following treatment:



Which one of the following could be compound **E**?

- A AgNO<sub>3</sub>
- B Ag<sub>2</sub>SO<sub>4</sub>
- **C**  $Pb(NO_3)_2$
- D PbSO<sub>4</sub>

**19** A student wrote the following description in his practical manual:

"When *concentrated sulphuric acid* is added to a solution of sodium iodide, rapid evolution of *white fumes* is being observed. Subsequently, production of *reddish brown vapour* and *rotten egg smell* are being observed."

Which part of the above description is **incorrect**?

- **A** The sulphuric acid used should be diluted, not concentrated.
- **B** The fumes should be violet, not white.
- **C** The vapour should be violet, not reddish brown.
- **D** The smell should be sweet smelling, not rotten egg.
- **20** Which of the following transition metals in its ground state has an unpaired electron in an *s* orbital?
  - A Chromium
  - B Cobalt
  - **C** Iron
  - **D** Manganese
- **21** The table below lists some of the characteristics of vanadium and calcium.

Property	Vanadium	Calcium	
1. Colour of Complexes/ions	Coloured	Colourless	
2. Density	Low	High	
3. Conductivity	Low	High	
4. Oxidation State	Variable	Fixed	
5. First Ionisation Energy	Lower	Higher	

Which of the following sets of properties are correct?

- **A** 1 and 2
- **B** 1 and 3
- **C** 1 and 4
- **D** 1 and 5

		Ċ=Ċ-Ċ-H	
	sp <sup>2</sup>	sp <sup>3</sup>	
Α	2	5	
В	3	4	
С	8	5	
D	9	4	

**22** Identify the number of  $sp^2$  and  $sp^3$  hybridised carbon atoms in the given structure:

- **23** Which of the following is the propagation step in the reaction between ethane and bromine in the presence of ultraviolet light?
  - A  $Br_2 \rightarrow 2Br_1$
  - **B**  $CH_3CH_2 \bullet + Br \bullet \rightarrow CH_3CH_2Br$
  - **C**  $CH_3CH_2 \bullet + HBr \rightarrow CH_3CH_2Br + H$
  - **D**  $CH_3CH_2 + Br_2 \rightarrow CH_3CH_2Br + Br$
- **24** Ethene reacts with bromine to form dibromoethane. Which of the following best describes the organic intermediate in this reaction?
  - **A** The shape about each carbon in the intermediate is trigonal planar.
  - **B** It has a negative charge.
  - **C** It is an electrophile.
  - **D** It is a free radical.
- 25 Which sequence shows the increasing ease of hydrolysis?
  - $\mathbf{A} \quad \mathbf{C}_{6}\mathbf{H}_{5}\mathbf{Br} > \mathbf{C}_{6}\mathbf{H}_{5}\mathbf{CH}_{2}\mathbf{Cl} > \mathbf{CH}_{3}\mathbf{CH}_{2}\mathbf{COC}l > \mathbf{CH}_{3}\mathbf{CH}_{2}\mathbf{I}$
  - $\mathbf{B} \quad \mathsf{CH}_3\mathsf{CH}_2\mathsf{COC}l > \mathsf{CH}_3\mathsf{CH}_2\mathsf{I} > \mathsf{C}_6\mathsf{H}_5\mathsf{CH}_2\mathsf{Br} > \mathsf{C}_6\mathsf{H}_5\mathsf{CH}_2\mathsf{C}l$
  - $C \quad C_6H_5Cl > CH_3COCH_2Cl > C_6H_5CH_2Br > CH_3CH_2I$
  - **D**  $C_6H_5Br > CH_3CH_2Cl > C_6H_5CH_2I > CH_3CH_2COCl$

 $\begin{array}{ccc} H & H & O \\ I & I & I \end{array}$ 

26 Which reagent could be used to distinguish between pentan-2-ol and pentan-2-one?

- A aqueous bromine
- **B** alkaline aqueous iodine
- **C** acidified potassium manganate(VII)
- **D** sodium carbonate
- 27 A 3-step reaction scheme is shown below.



Which one of the following correctly describes the types of organic reactions for steps I and III?

Step I	Step III	
Electrophilic substitution	Nucleophilic addition	
Electrophilic substitution	Electrophilic addition	
Nucleophilic substitution	Nucleophilic addition	
Nucleophilic substitution	Electrophilic substitution	

- 28 An ester G has the following chemical formula: C<sub>3</sub>H<sub>7</sub>COOC<sub>3</sub>H<sub>7</sub> Which pair of compounds can be produced when G is refluxed with dilute sulphuric acid?
  - A CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COOH and (CH<sub>3</sub>)<sub>2</sub>CO
  - **B** (CH<sub>3</sub>)<sub>2</sub>CHCOOH and CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH
  - **C**  $CH_3CH_2COOH$  and  $CH_3CH_2CH_2OH$
  - **D**  $(CH_3)_2CHCOCl$  and  $(CH_3)_2CHOH$

A B C D **29** Partial hydrolysis of insulin, the hormone essential for carbohydrate metabolism gives the following tripeptide.

$$(CH_{2}CH_{2}CO_{2}H)$$

$$(CH_{3})_{2}CHCH(NH_{2})CONHCHCONHCH(CH_{3})CO_{2}H$$

Insulin

Which compound could be obtained by further hydrolysis of this tripeptide?

- **A**  $CH_3CH(CO_2H)_2$
- **B**  $(CH_3)_2CHCH(NH_2)CONH_2$
- C H<sub>2</sub>NCONHCH(CH<sub>2</sub>CH<sub>2</sub>CO<sub>2</sub>H)CO<sub>2</sub>H
- **D**  $H_2NCH(CH_2CH_2CO_2H)CONHCH(CH_3)CO_2H$
- **30** The painkiller Phenacetin can be made as follows:



What could be the reagent **J**?

- $A \quad CH_3CH_2NH_2$
- B CH<sub>3</sub>COCH<sub>3</sub>
- C CH<sub>3</sub>COOH
- **D**  $CH_3COCl$

For **questions 31 – 40**, one or more of the numbered statements **1** to **3** may be correct. Decide whether each of the statements is or is not correct. The responses **A** to **D** should be selected on the basis of

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

No other combination of statements is to be used.

**31** Carbon disulphide, CS<sub>2</sub>, is a volatile flammable liquid used in the manufacture of cellophane. On combustion, CS<sub>2</sub> is oxidised as follows.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

Which of the following statement(s) may be reflected from the above equation?

- 1 If 20 cm<sup>3</sup> of CS<sub>2</sub> is reacted with 100 cm<sup>3</sup> of oxygen, 60% of the final volume of gas will dissolved in alkali
- **2** 38.1 g of CS<sub>2</sub> will react exactly with 33.6 dm<sup>3</sup> of O<sub>2</sub> under standard temperature and pressure.
- **3** When 30 cm<sup>3</sup> of CS<sub>2</sub> was reacted with 60 cm<sup>3</sup> of oxygen, 30 cm<sup>3</sup> of CO<sub>2</sub> will be produced.
- 32 Which of the following process(es) has/have a positive change in the entropy?
  - 1 N<sub>2</sub> gas at 10 atm  $\rightarrow$  N<sub>2</sub> gas at 1 atm
  - 2 Copper + Zinc  $\rightarrow$  Brass
  - **3** Graphite  $\rightarrow$  Diamond
- **33** Some standard redox potential ( $E^{\theta}$ ) values are given in the table below.

Electrode reaction	$E^{ heta}/V$
$Fe^{3^+}$ (aq) + e $\rightleftharpoons$ $Fe^{2^+}$ (aq)	+0.77
Sn <sup>4+</sup> (aq) + 2e $\rightleftharpoons$ Sn <sup>2+</sup> (aq)	+0.15
$Ce^{4+}(aq) + e \rightleftharpoons Ce^{3+}(aq)$	+1.45

Predict which of the following reactions would occur under standard conditions.

- 2 Sn<sup>2+</sup> (aq) + 2Fe<sup>3+</sup> (aq)  $\rightarrow$  Sn<sup>4+</sup> (aq) + 2Fe<sup>2+</sup> (aq)
- **3**  $2Ce^{4+}(aq) + Sn^{2+}(aq) \rightarrow 2Ce^{3+}(aq) + Sn^{4+}(aq)$

- 34 Anhydrous calcium nitrate and anhydrous magnesium nitrate both decompose on heating, producing nitrogen dioxide and oxygen gas. Which of the following statement(s) is/are true about the decomposition reactions mentioned above?
  - 1 Both nitrates leave a residue of metal oxide.
  - **2** A lower temperature was needed to produce nitrogen dioxide and oxygen from magnesium nitrate than calcium nitrate.
  - **3** The volume of oxygen produced is half the volume of nitrogen dioxide produced for both nitrates.
- **35** The results of experiments in which the halogens  $X_2$ ,  $Y_2$  and  $Z_2$  were added to separate aqueous solutions of  $X^-$ ,  $Y^-$  and  $Z^-$  ions are shown in the table below:

	X-	Y <sup>-</sup>	Z
<b>X</b> <sub>2</sub>	No reaction	No reaction	X <sup>−</sup> formed
<b>Y</b> <sub>2</sub>	Y <sup>−</sup> formed	No reaction	Y <sup>−</sup> formed
<b>Z</b> <sub>2</sub>	No reaction	No reaction	No reaction

Which of the following statements correctly account for the observations?

- 1 The order of oxidising power in increasing order is  $Z_2 < X_2 < Y_2$ .
- **2**  $\mathbf{Y}^-$  is a weaker reducing agent than  $\mathbf{Z}^-$ .
- **3**  $X^-$  is the weakest reducing agent.
- **36** Which of the following statement(s) is/are true?
  - 1 The electronic configuration of the iron cation in the metal complex  $Fe(CN)_6^{4-}$  is [Ar]3d<sup>6</sup>.
  - **2** The  $Zn^{2+}$  ions are coloured due to ability of the electrons to undergo d-d transition.
  - **3** Fe exhibits variable oxidation state due to the availability of vacant s, p and d orbitals.
- **37** Which of the following compound(s) forms a yellow precipitate when warmed with alkaline aqueous iodine?
  - 1 butan-2-ol
  - 2 1-phenylethanol
  - 3 2-phenylethanol

- **38** Which of the following reagents can be used to distinguish between  $C_6H_5CHO$  and  $C_6H_5COCH_3$ ?
  - **1** Aqueous  $[Ag(NH_3)_2]^+$
  - 2 Alkaline solution of iodine
  - **3** 2,4-dinitrophenylhydrazine
- 39 It has been noted that prolonged exposure of wine to the atmosphere will result in the wine becoming "vinegary". Therefore, wineries attempt to prevent such exposure by storing the wine in a mixture of carbon dioxide and nitrogen. How does this mixture prevent the "vinegary" taste from occurring?
  - 1 Oxidation of ethanol into ethanoic acid will be prevented.
  - 2 The acidity of the wine will be decreased.
  - 3 The amount of carbon dioxide dissolved in the wine will be increased.
- **40** *Psilocin* is a psychedelic mushroom alkaloid which is the active compound that produces hallucinations from ingesting "magic mushrooms" and amplifies sensory experience. Compound **K** is a derivative of *Psilocin*.



Which of the following statement(s) is/are true for compound K?

- 1 It gives white fumes with CH<sub>3</sub>COC*l*.
- It dissolves in both aqueous acids and alkalis.
   The nitrogen containing group in the ring has a lower pK<sub>b</sub> than the nitrogen
- **3** containing group in the side chain.

#### -END OF PAPER-