VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

# CHEMISTRY 8873/01

Paper 1 Multiple Choice

**19 September 2018**

**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 Exam Number, name and CT group on the Multiple Choice Answer Sheet.

There are **thirty** questions. 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 Multiple Choice 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 **8** printed pages.

1   The Avogadro constant is $L$. How many neutrons are present in 24 dm$^3$ of chlorine gas, measured at r.t.p?

    **A**    17$L$        **B**    18.5$L$        **C**    37$L$        **D**    71$L$

2   Which of the following elements does **not** have paired $p$ electrons in its ground state?

    **A**    carbon        **B**    oxygen        **C**    magnesium    **D**    neon

3   Gallium has the electronic configuration $[Ar]3d^{10}4s^24p^1$, where $[Ar]$ represents the electronic configuration of argon.

In which order are the electrons lost in forming the $Ga^{3+}$ ion?

|   | 1$^{st}$ | 2$^{nd}$ | 3$^{rd}$ |
|---|---|---|---|
| **A** | 3d | 4p | 4s |
| **B** | 3d | 4s | 4s |
| **C** | 4p | 4s | 3d |
| **D** | 4p | 4s | 4s |

4   Sodium thiosulfate is used in the textile industry to remove excess chlorine from bleaches by reducing it to chloride ions.

$$S_2O_3^{2-} + 4Cl_2 + 5H_2O \rightarrow 2HSO_4^- + 8H^+ + 8Cl^-$$
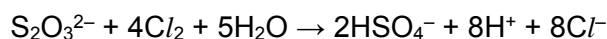
In this reaction, how many moles of electrons are transferred by 1 mol of thiosulfate ions?

    **A**    1        **B**    2        **C**    4        **D**    8

5   A carbon sample contains a mixture of $^{12}C$ and $^{14}C$ isotopes. When 1.000 g of this sample is burned completely in $^{16}O_2$. The mass of $CO_2$ formed is 3.629 g.

What is the percentage by mass of the $^{12}C$ isotope in this sample?

    **A**    85.0%        **B**    88.6%        **C**    90.0%        **D**    91.4%

6   When phosphoryl chloride, $POCl_3$, dissolves in water, it gives a mixture of phosphoric acid and hydrochloric acid. How many moles of sodium hydroxide would be needed to neutralise the solution formed by adding one mole of $POCl_3$ to excess water?

    **A**    3        **B**    4        **C**    5        **D**    6

7   Which of the elements exists as discrete molecules in the solid state?

    **A**    aluminium    **B**    silicon        **C**    iodine        **D**    argon

**8** Which of the following pairs have similar shapes and the first species has a smaller bond angle than the second species?

  1    $SiCl_4$, $PF_4^+$

  2    $PH_3$, $NH_3$

  3    $SO_3^{2-}$, $CO_3^{2-}$

**A** 1 only                            **B** 2 only

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

**9** But-2-enedioic acid, $HC(CO_2H)=C(CO_2H)H$, exists as a pair of *cis-trans* isomers. The *cis* isomer has a lower melting point than the *trans* isomer.

Which of the following statements is correct about but-2-enedioic acid?

  1    In the solid state, both the *cis* and *trans* isomers have the same density.

  2    Intramolecular hydrogen bonding is present in the *cis* isomer.

  3    The *cis* isomer is less polar than the *trans* isomer.

**A** 2 only                            **B** 1 and 2 only

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

**10** Which of the following statements about prop-1,2-diene, $H_2C=C=CH_2$, is **not** correct?

**A** Only two of the carbon atoms have the shape of trigonal planar.

**B** The two $\pi$-bonds in prop-1,2-diene are perpendicular to each other.

**C** There are only six $\sigma$-bonds in a prop-1,2-diene molecule.

**D** Prop-1,2-diene is a planar molecule.

**11** When aqueous ammonia is added to a solution containing hexaaquairon(III) ions, a red-brown precipitate is formed as shown below.

$$[Fe(H_2O)_6]^{3+}(aq) + 3NH_3(aq) \rightleftharpoons Fe(OH)_3(H_2O)_3(s) + 3NH_4^+(aq)$$

What is the role of ammonia in this reaction?

**A** Brønsted-Lowry base

**B** Brønsted-Lowry acid

**C** Lewis acid

**D** Reducing agent

**12** An enzyme, found in the stomach, operates at maximum efficiency when in an aqueous solution buffered at pH 5.

Which of the following combinations of substances would give the necessary buffer solution?

**A** 2 mol of HC$l$ and 1 mol of $CH_3CO_2H$

**B** 2 mol of NaOH and 1 mol of $CH_3CO_2H$

**C** 2 mol of HC$l$ and 1 mol of $CH_3CO_2Na$

**D** 2 mol of $CH_3CO_2H$ and 1 mol of NaOH

**13** Which of the following statements concerning the chlorine-containing compounds of period 3 elements is correct?

**A** PC$l_3$ and C$l_2O_7$ are both acidic in nature due to their reactions with water.

**B** NaC$l$ dissolves easily in water due to the favourable ion-dipole interactions and the compounds with the highest electrical conductivity in molten state is A$l$C$l_3$.

**C** The low boiling points of PC$l_3$ and C$l_2O_7$ are due to the weak P–C$l$ and C$l$–O bond energies.

**D** Both CC$l_4$ and SiC$l_4$ can dissolve in excess water completely to give an acidic solution.

**14** Which of the following statements about Group 1 and Group 17 elements is correct?

**A** Caesium is a stronger oxidising agent as compared to lithium.

**B** Caesium is a stronger reducing agent as compared to lithium.

**C** Chloride is a stronger oxidising agent as compared to iodide.

**D** Chlorine is a stronger reducing agent as compared to iodine.

**15** HI can decompose into $H_2$ and $I_2$ in the presence of heat. However, HF cannot decompose even under strong heating.

Which of the following statements correctly explains the above observation?

**A** The intermolecular forces of attraction between HI molecules are stronger as compared to that between HF molecules because HI molecules have more electrons.

**B** The intermolecular forces of attraction between HI molecules are weaker as compared to that between HF molecules because I atom is less electronegative.

**C** H–I bond is weaker than H–F bond due to less effective overlap of orbitals.

**D** I–I bond is weaker than F–F bond due to less effective overlap of orbitals.

**16** The lattice energies of the compounds, magnesium oxide, magnesium bromide, sodium oxide and sodium bromide are given below.

Which of the following values corresponds to the lattice energy of magnesium bromide?

**A** $-752$ kJ mol$^{-1}$        **B** $-2440$ kJ mol$^{-1}$

**C** $-2481$ kJ mol$^{-1}$        **D** $-3790$ kJ mol$^{-1}$

**17** The standard enthalpy change of combustion of but-1-ene, $C_4H_8(g)$ is $x$ kJ mol$^{-1}$.

The standard enthalpy change of the reaction $2C_2H_4(g) \rightarrow C_4H_8(g)$ is $y$ kJ mol$^{-1}$.

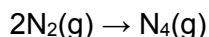What is the standard enthalpy change of combustion of ethene, $C_2H_4(g)$?

**A** $\dfrac{x}{2} + y$ kJ mol$^{-1}$ 

**B** $x + y$ kJ mol$^{-1}$

**C** $\dfrac{x+y}{2}$ kJ mol$^{-1}$ 

**D** $y - x$ kJ mol$^{-1}$

**18** *The use of the Data Booklet is relevant to this question.*

Nitrogen exists as the $N \equiv N$, whereas phosphorus has the structure as shown below.
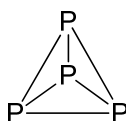


What is the enthalpy change for the following reaction, if nitrogen were to form a similar molecule $N_4$?

$$2N_2(g) \rightarrow N_4(g)$$

**A** $-928$ kJ mol$^{-1}$ 

**B** $-16$ kJ mol$^{-1}$

**C** $+16$ kJ mol$^{-1}$ 

**D** $+928$ kJ mol$^{-1}$

**19** Three experiments are conducted to determine the rate equation for a reaction between sulfuric acid and sodium thiosulfate. The volumes used and the time taken for the precipitate to form are shown below.

| Experiment | Volume of $H_2SO_4$ / cm$^3$ | Volume of $Na_2S_2O_3$ / cm$^3$ | Volume of water / cm$^3$ | Time / s |
|---|---|---|---|---|
| 1 | 20 | 20 | 20 | 30 |
| 2 | 40 | 20 | 0 | 15 |
| 3 | $x$ | 20 | 0 | 15 |

What could be a suitable value for $x$?

**A** 5 **B** 10 **C** 20 **D** 30

**20** Lead is the final product formed by a series of changes in which the rate-determining stage is the radioactive decay of uranium-238. This radioactive decay is a first-order reaction with a half-life of $4.5 \times 10^9$ years.

What would be the age of a rock sample, originally lead-free, in which the molar ratio of uranium to lead is now 1:7?

**A** $1.5 \times 10^9$ years 

**B** $2.25 \times 10^9$ years

**C** $9.0 \times 10^9$ years 

**D** $1.35 \times 10^{10}$ years

**21** A reversible reaction is catalysed.

Which of the following statements about this reaction are correct?

　　1　The catalyst alters the pathway of the reaction.

　　2　The catalyst reduces the activation energy for both the forward and the backward reaction.

　　3　The catalyst alters the composition of the equilibrium mixture.

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

**22** During the Haber process, the following three gases are in equilibrium as shown below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Which of the following will increase when the pressure is increased at constant temperature?

**A** activation energy

**B** enthalpy change of reaction

**C** rate constant for the forward reaction

**D** amount of $NH_3$ formed

**23** 1.6 mol of pure nitrosyl chloride gas, $NOCl$, was heated at 320 °C in a 2.0 dm$^3$ vessel. At equilibrium, 40% of the $NOCl$ gas has dissociated according to the equation below.

$$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$$

What is the numerical value of the equilibrium constant, $K_c$?

**A** 0.071　　　**B** 0.142　　　**C** 0.213　　　**D** 0.427

**24** The length, width and height of four clusters of metal atoms are shown below.

Which cluster of metal atoms is a nanomaterial but not a nanoparticle?

| | length / m | width / m | height / m |
|---|---|---|---|
| **A** | $2.0 \times 10^{-8}$ | $2.0 \times 10^{-8}$ | $2.0 \times 10^{-8}$ |
| **B** | $2.0 \times 10^{-10}$ | $2.0 \times 10^{-10}$ | $2.0 \times 10^{-10}$ |
| **C** | $2.0 \times 10^{-8}$ | $2.0 \times 10^{-6}$ | $2.0 \times 10^{-11}$ |
| **D** | $2.0 \times 10^{-6}$ | $2.0 \times 10^{-6}$ | $2.0 \times 10^{-6}$ |

**25** In 1933, Gibson and Fawcett maintained ethene at a temperature of 170 °C under a pressure of 200 atm in the presence of a trace of amount oxygen catalyst for several days. What was the major product discovered in the reaction vessel when it was cooled and opened?

| | | | |
|---|---|---|---|
| **A** | artificial diamond | **B** | poly(ethene) |
| **C** | graphene | **D** | carbon nanotube |

**26** Which of the following statements about nanomaterials is **not** correct?

   **A** Nanomaterials could be a good catalyst due to its high surface area to volume ratio.

   **B** Nanomaterials could be a good catalyst because some atoms at the edge are not fully bonded.

   **C** Nanomaterials can be used in cosmetic products because it has no potential harmful effects on human health.

   **D** Nanomaterials can lead to environment hazard if not disposed properly.

**27** Which of the following statements about the two alkenes, $CH_3CH_2CH=CH_2$ and $CH_3CH=CHCH_3$, is correct?

   **A** Only one of them exhibits *cis-trans* isomerism.

   **B** Only one of them may be polymerised.

   **C** Only one of them reacts with hydrogen to form butane.

   **D** Only one of them reacts with bromine to give 1,3-dibromobutane.

**28** Which of the following molecules can react with both acidified potassium dichromate($VI$) and sodium borohydride?

   **A** $C_6H_5CH_2OH$           **B** $C_6H_5CHO$

   **C** $C_6H_5COCH_3$          **D** $C_6H_5CH(OH)CH_3$

**29** Acrylic fibre is an addition polymer. Part of this polymer chain is shown below.



Which of the following monomers would form this polymer?

**30** An amide, **M**, has the empirical formula $C_7H_{15}ON$. When **M** is hydrolysed by heating under reflux with dilute hydrochloric acid, a carboxylic acid with empirical formula $C_2H_4O$ is obtained as one of the products.

What could be the skeletal formula of **M**?

1

2

3

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

**End of Paper**

| Qn | Answer |
|----|--------|
| 1  | C |
| 2  | A |
| 3  | D |
| 4  | D |
| 5  | C |
| 6  | D |
| 7  | C |
| 8  | B |
| 9  | A |
| 10 | D |
| 11 | A |
| 12 | D |
| 13 | A |
| 14 | B |
| 15 | C |
| 16 | B |
| 17 | C |
| 18 | D |
| 19 | B |
| 20 | D |
| 21 | B |
| 22 | D |
| 23 | A |
| 24 | C |
| 25 | B |
| 26 | C |
| 27 | A |
| 28 | B |
| 29 | A |
| 30 | D |