Class Adm No

Candidate Name: _____

H

millennia institute

2018 End-of-Year Exams
Pre-University 2

H1 CHEMISTRY **8873/01**

Paper 1 Multiple Choice **13 Sept 2018**

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not turn over this question paper until you are told to do so

Write in soft pencil.

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

Write your name, class and admission number in the spaces provided at the top of this page and on the Multiple Choice Answer Sheet provided.

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 Multiple Choice Answer Sheet provided.

Read the instructions on the Multiple Choice 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.

The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE	
TOTAL (30 marks)	

Section A

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

1 According to the equation below, how many moles of potassium chlorate, $KClO_3$, must be decomposed to generate 1000 cm^3 of O_2 gas at standard temperature and pressure?

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

A $\frac{2}{3}\left(\frac{1}{24}\right)$ mol

B $\frac{3}{2}\left(\frac{1}{24}\right)$ mol

C $\frac{2}{3}\left(\frac{1}{22.7}\right)$ mol

D $\frac{3}{2}\left(\frac{1}{22.7}\right)$ mol

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

It is suggested that SO_2 which contributes to acid rain, could be removed from a stream of waste gases by bubbling the gases through 0.25 mol dm^{-3} KOH, thereby producing K_2SO_3. What is the maximum mass of SO_2 that could be removed by 1000 dm^3 of the KOH solution?

A 4.0 kg

B 8.0 kg

C 16.0 kg

D 20.0 kg

3 To determine the molar mass of a weak monoprotic acid, a student titrated 25.0 cm^3 of the acid with aqueous NaOH. Which of the following are appropriate indicators that could be used for the titration?

1 Phenolphthalein
2 Methyl Orange
3 Bromothymol blue

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

4 A sample of 30.0 cm^3 of 0.050 mol dm^{-3} iron(II) sulfate is titrated against 0.025 mol dm^{-3} potassium manganate(VII) solution. It is found that 20.0 cm^3 of the manganate(VII) solution is required to reach end point.
What is the oxidation number of manganese at the end point?

A +2
B +3
C +4
D +5

5 The number of orbitals of a principal quantum number is dependent on the type of subshell. Which of the following statements about the s, p and d orbitals of principal quantum numbers 1, 2 and 3 are true?

1 Each s orbital can hold a minimum of two electrons.
2 There are 3 orbitals in a 2p subshell.
3 The s orbital has a lower energy than the p orbital with the same principal quantum number.

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

6 In the equilibrium represented below, which of the following species act as bases?

$$HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{2-}$$

1 HSO_4^-
2 H_2O
3 SO_4^{2-}

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

7 Which of the following can be classified as a Lewis acid?

A An ion which accepts a pair of electrons to form a bond.
B A molecule which donates a pair of electrons to form a bond.
C A ion which accepts a proton from water.
D A molecule which donates a proton to water.

8 Which of the following is a non-polar molecule that contains polar bonds?

A F_2
B CHF_3
C CO_2
D NH_3

9 Which of the following species has a see-saw structure?

A BrF_4^+
B BrF_4^-
C IF_5
D SO_4^{2-}

10 The energy profile diagram for the reaction X + Y → Z is shown below.

Which of the indicated energy differences is affected by the addition of a catalyst?

A I only
B II only
C III only
D I and II only

11 Calcination is a process which converts sodium hydrogen carbonate, $NaHCO_3$, to sodium carbonate, water and carbon dioxide. The balanced equation for the reaction is given below.

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$$

Standard enthalpy change of formation of $NaHCO_3(s)$ / kJ mol^{-1}	-951
Standard enthalpy change of formation of $Na_2CO_3(s)$ / kJ mol^{-1}	-1131
Standard enthalpy change of formation of $H_2O(l)$ / kJ mol^{-1}	-286
Standard enthalpy change of formation of $CO_2(g)$ / kJ mol^{-1}	-394

What is the standard enthalpy change for the calcination reaction?

A +860 kJ mol^{-1} **B** +91 kJ mol^{-1} **C** -91 kJ mol^{-1} **D** -860 kJ mol^{-1}

12 Which of the following is associated with a relatively slow rate of a chemical reaction?

A high temperature
B low activation energy
C strong bonds in reactant molecules
D high concentration of reactants

13 The radioactive decay of a sample of ^{131}I follows a first order kinetics. If a pure sample of ^{131}I undergoes radioactive decay and the half-life of the decay was found to be 10 days, what would be the half-life of the decay in a separate experiment where the initial concentration of the pure sample of ^{131}I was doubled?

A 2.5 days
B 5 days
C 10 days
D 20 days

14 The following table shows the results from a rate study of the reaction **X** + **Y** → **Z**.

Experiment	[X] / mol dm^{-3}	[Y] / mol dm^{-3}	Initial rate of formation of Z / mol dm^{-3} s^{-1}
1	0.40	0.10	R
2	0.20	0.20	?

Starting with known concentrations of **X** and **Y** in experiment **1**, the rate of formation of **Z** was measured. If the reaction was first order with respect to **X** and second order with respect to **Y**, what is the initial rate of formation of **Z** in experiment **2**?

A $\frac{R}{4}$

B $\frac{R}{2}$

C R

D 2R

15 Equal amounts of HC*l* and O_2 in a closed system are allowed to reach equilibrium as represented by the equation below. Which of the following must be true at equilibrium?

$$4HCl(g) + O_2(g) \rightleftharpoons 2Cl_2(g) + 2H_2O(g)$$

1 [HC*l*] must be less than [Cl_2]

2 [O_2] must be greater than [HC*l*]

3 [Cl_2] must equal [H_2O]

A 3 only

B 1 and 2 only

C 2 and 3 only

D 1,2 and 3

16 Carbon dioxide dissolves in water sparingly to produce carbonic acid, H_2CO_3.

$$CO_2(g) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$$

Carbonic acid further dissociates in water according to the two equations below.

$$H_2CO_3(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HCO_3^-(aq)$$

$$HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CO_3^{2-}(aq)$$

How would the addition of a small amount of NaOH(aq) affect $[CO_2]$, $[HCO_3^-]$ and $[CO_3^{2-}]$ when carbon dioxide dissolves in water?

	$[CO_2]$	$[HCO_3^-]$	$[CO_3^{2-}]$
A	decrease	decrease	increase
B	decrease	negligible change	increase
C	decrease	Increase	increase
D	increase	negligible change	decrease

17 Which of the following statements concerning the characteristics of halogens is **incorrect**?

A The fourth ionisation energies decrease as the atomic numbers of the halogens increase.

B Fluorine is the strongest oxidising agent.

C The ease of decomposition of hydrogen halides decreases down Group 17.

D The acid strength of an aqueous solution of the hydrogen halides increases from HC*l* to HI.

18 Which of the following elements from Period 3 (sodium to chlorine) in the Periodic Table forms an oxide which dissolves in water to form a solution of pH 13?

A Sodium

B Silicon

C Sulfur

D Chlorine

19 $[Al(H_2O)_6]^{3+}$ ion is hydrolysed in aqueous solution according to the equation below.

$$[Al(H_2O)_6]^{3+}(aq) + H_2O(l) \rightleftharpoons [Al(H_2O)_5(OH)]^{2+}(aq) + H_3O^+(aq)$$

Which statements about this reaction are true?

1 $[Al(H_2O)_5(OH)]^{2+}$ is relatively less likely to undergo hydrolysis compared to $[Al(H_2O)_6]^{3+}$.
2 The aluminium undergoes a change in oxidation state from +3 to +2.
3 The hydrolysis is favoured by low pH.

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

20 **G**, **H** and **J** are three elements found in Period 3 of the Periodic Table.

Among the elements in Period 3,

- The melting point of **G** is the highest.
- The electrical conductivity of **H** is the highest.
- The melting point of the oxides of **J** is the highest.

Which of the following elements is **not** represented by **G**, **H** or **J**?

A Na
B Mg
C Al
D Si

21 Based on the concepts of polarity and hydrogen bonding, which of the following sequences correctly lists the compounds below in the order of **increasing** solubility in water?

CH_3-CH_2-CH_2-CH_2-CH_3	CH_3-CH_2-CH_2-CH_2-OH	HO-CH_2-CH_2-CH_2-OH
X	**Y**	**Z**

A **Z < Y < X**

B **Y < Z < X**

C **Y < X < Z**

D **X < Y < Z**

22 Which of the following is true when one mole of ethane is mixed in the dark at room temperature with six moles of chlorine gas?

A CCl_3CCl_3 and HCl are formed.

B CH_3CH_2Cl and HCl are formed.

C CH_3CCl_3 and HCl are formed.

D There is no reaction.

23 An amine is prepared in the following reaction.

$$C_2H_5I + 2NH_3 \rightarrow C_2H_5NH_2 + NH_4I$$

What is the type of reaction taking place?

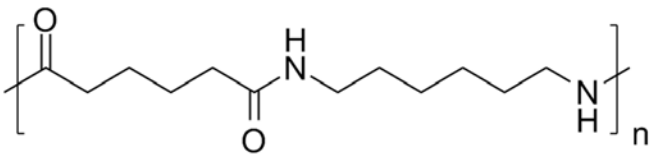
A addition

B substitution

C elimination

D redox

24 A repeat unit of nylon is shown below.



Nylon

Which of the following statements about nylon is correct?

A The monomers used are carboxylic acids and alcohols.

B It is formed via addition polymerisation.

C Water molecules are eliminated in the process of polymerisation.

D Hydrogen chloride molecules are eliminated in the process of polymerisation.

25 The mould *Phytophthora* damages many plants, destroying agricultural crops such as potatoes. A hormone-like compound called alpha 1 regulates the reproduction of all species of *Phytophthora*. The structure of alpha 1 is now known, giving scientists a key to the possible future eradication of the mould.

Which reagents will react with alpha 1?

1 $Br_2(aq)$

2 $SOCl_2$

3 $NaBH_4$

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1,2 and 3

26 Which one of the following compounds will react with its own oxidation product to give a fruity smelling liquid?

A ethene
B propane
C propan-1-ol
D propan-2-ol

27 Which of the following has hydrogen bonds between its polymer chains?

A poly(propene)
B polyamide
C poly(phenylethene)
D polyester

28 Which option best defines the size of nanoparticles?

A between 100 to 1000 nm
B between 0.1 to 10 nm
C between 1 to 100 nm
D between 0.01 to 1 nm

29 Carbon nanotubes usually form in bundles.

Which of the statements best describes the bundle seen in the figure above?

A The tubes are connected together by covalent C-C bonds.

B The tubes are randomly organised, with the axes of the tubes lying in random directions.

C The tubes are aligned, axes parallel, with dispersion forces operating between adjacent tubes.

D The bundles are of discrete sizes, and permanent dipoles hold the tubes together.

30 Which of the following pair of compounds show one compound which can be oxidised by acidified potassium dichromate(VI) and the other be reduced by sodium borohydride, $NaBH_4$?

$C_3H_7CH(OH)C_3H_7$	C_6H_5CHO	$C_3H_7COC_3H_7$	$(C_3H_7)_3COH$
I	**II**	**III**	**IV**

	Can be oxidised	Can be reduced
A	**I**	**II**
B	**II**	**IV**
C	**III**	**I**
D	**IV**	**III**

END OF PAPER 1

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