

Preliminary Examinations 2008 Pre-university 3

H2 CHEMISTRY

Tuesday

9 Sep 2008

9746 / 01

1h

Additional materials: OMR Data Booklet

READ THESE INSTRUCTIONS FIRST

- 1. Do not turn over this question paper until you are told to do so.
- 2. Write your name, class and index number in the spaces provided at the top of this page and on any separate answer paper used.
- 3. Attempt **ALL** the questions in Section A and B.
- 4. All answers are to be shaded on the OMR form provided using a 2B pencil.
- 6. Hand in your answers to the paper (OMR form) and question paper separately.

INFORMATION FOR CANDIDATES

No extra time will be given for shading of OMR form.

SECTION A (30 MARKS) Answer all questions on the OMR form provided

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

- Lithium forms compounds which are used in dry cells and storage batteries and in high temperature lubricants. It has two naturally occurring isotopes, ⁶Li (isotopic mass = 6.015121 amu) and ⁷Li (isotopic mass = 7.016003 amu). Lithium has an atomic mass of 6.9409 amu. What is the percentage abundance of the ⁶Li isotope?
 - **A** 7.503% **B** 46.16% **C** 86.66% **D** 92.50%
- In one experiment, 45.0cm³ of 0.2moldm⁻³ aqueous M²⁺ solution has reacted with 15.0cm³ of 0.1 moldm⁻³ aqueous acidified potassium dichromate (VI) solution. What is the oxidation state of M after the reaction?
 - **A** +3 **B** +4 **C** +5 **D** +7
- 3. Which one of the following is **not** a redox reaction?
 - **A** $Br_2 + SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2Br^-$
 - $\textbf{B} \qquad SnCl_2 + HgCl_2 \rightarrow Hg + SnCl_4$
 - $\label{eq:cu_2O} \textbf{C} \qquad Cu_2O + H_2SO_4 \rightarrow CuSO_4 + Cu + H_2O$
 - **D** $2CrO_4^{2-} + 2H + \rightarrow Cr_2O_7^{2-} + H_2O$
- 4. A mixture of 8.0g of a monoatomic gas X and an unknown quantity of diatomic gas Y has a volume of V m³ at s.t.p. When 20.0g of gas X is added to the mixture, under the same conditions, the volume of the mixture is 2V m³. Calculate the quantity of gas Y in the mixture.

[Relative molecular mass: X = 4, Y = 1]

A 2	ig <mark>E</mark>	<mark>3</mark> 3	g (C	5g	D	6g
------------	-------------------	------------------	-----	---	----	---	----

5. A new boron hydride, BxHy, has been isolated. To find its molar mass, you measure the pressure of the gas in a known volume at a known temperature. The following experimental data are collected:

Mass of the gas = 12.5mg	Pressure of the gas = 3306 Pa
Temperature = 25 °C	Volume of the flask = 125 mL

Which formula corresponds to the calculated mass?

- 6. Which one of the following is the electron arrangement of the **strongest** reducing agent?

Α	1s ² 2s ² 2p ⁵	В	1s ² 2s ² 2p ⁶ 3s ²
С	1s ² 2s ² 2p ⁶ 3s ² 3p ⁵	D	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ²

7. Which of the following molecules / ions has non-zero dipole moments?

Α	BF ₃	B	cis-HC/C=CHC/
С	CO ₂	D	ICI4 ⁻

8. Which one of the equations below represents a reaction that is feasible at all temperatures?

Α	$P(s) \rightarrow Q(s) + R(g)$	endothermic
В	$2L(g) + M(g) \rightarrow 2N(g)$	exothermic
C	$S(g) \rightarrow 2T(g)$	exothermic

 $\label{eq:alpha} \textbf{D} \qquad A(g) + B(g) \rightarrow \ C(g) \qquad \qquad \text{endothermic}$

9. Enthalpy changes for the following reactions can be determined experimentally:

 $\begin{aligned} & AH = -91.8 \text{ kJ} \\ & 4NH_3(g) + 5O_2(g) → 4NO(g) + 6H_2O(I) \\ & AH = -906.2 \text{ kJ} \\ & H_2(g) + \frac{1}{2}O_2(g) → H_2O(I) \\ \end{aligned}$

What is the enthalpy change of formation of NO(g)?

A	+90 kJ	В	+180 kJ	С	+361 kJ	D	+1270 kJ
---	--------	---	---------	---	---------	---	----------

Calcium hydride, CaH₂, is an ionic compound that contains H⁻ ions.
 The Born–Haber cycle for the formation of CaH₂ from Ca(s) and H₂(g) does <u>not</u> involve

- **A** the sublimation energy of calcium.
- **B** the first ionisation energy of calcium.
- **C** the atomisation energy of hydrogen.
- **D** the ionisation energy of hydrogen.
- 11. Which of the following statements regarding the half-life of a first-order reaction is true?
 - **A** The half-life is affected by pressure.
 - **B** The half-life depends on the concentration of the reactants.
 - **C** The half-life is shorter at lower temperature.
 - D At the end of the fourth half-life, the percentage of element left is 6.25% of original quantity.

12. Hydrogen sufide reacts with water according to the following equilibrium:

 $H_2S(aq) + 2H_2O(I) \implies 2H_3O^+(aq) + S^{2-}(aq)$

Which of the following changes would <u>**not**</u> influence the concentration of S^{2-} ions in the above equilibrium mixture?

- A Addition of ammonia
- B Addition of alumnium sulphate
- **C** Addition of sodium carbonate
- D Reduction of volume of container

13. For the reaction A (g) + B (g) = C (g) + D (g), suppose that the concentrations of these gases were the following in an equilibrium mixture:
[A] = 0.5, [B] = 4.0, [C] = 6.0, and [D] = 8.0 in a 1 dm³ container.

How many moles of D would have to be added to the mixture to raise the concentration of A to 1.0 mol dm⁻³?

Α	0.034 mol	В	0.5 mol	С	6.04 mol	D	12.1 mo

14. Which one of the following will produce a saturated solution with the highest pH?

A barium hydroxide B	beryllium hydroxide
----------------------	---------------------

Ccalcium hydroxideDstrontium hydroxide

15. The solubility of M_2Y_3 is 1 x 10⁻¹⁰ mol dm⁻³. What is the K_{sp} for the compound?

A 1×10^{-20} B 6×10^{-28} C 1×10^{-48} D 1	l x 10 ⁻⁵⁶
---	-----------------------

16. An acid-base titrations is carried out between HX and NaOH. Similar titration is also carried out between HY and NaOH. The change in pH is recorded and plotted as graphs shown below.



Which one of the following statements about a solution of HX is correct?

- A It is less concentrated and contains a weaker acid than the solution of HY.
- **B** It is more concentrated and contains a stronger acid than the solution of HY.
- **C** It is more concentrated and contains a weaker acid than the solution of HY.
- **D** It is less concentrated and contains a stronger acid than the solution of HY.
- A hydrogen-oxygen fuel cell currently in use generated a voltage of about 0.9V at a temperature between 70°C to 140°C.

Calculate the voltage for the hydrogen-oxygen fuel cell under standard conditions.

A -	0.43 V	В	- 0.83 V	С	+0.40V	D	+1.23 V
-----	--------	---	----------	---	--------	---	---------

18. The table below contains the reduction potential values for copper and mercury species.

Half-equations	E^{ϕ}/V
$Cu^{2+}(aq) + e \rightarrow Cu^{+}(aq)$	+0.15
$Cu^{+}(aq) + e \rightarrow Cu(s)$	+0.52
$Hg^{2+}(aq) + e \rightarrow Hg^{+}(aq)$	+0.91
$Hg^{+}(aq) + e \rightarrow Hg(I)$	+0.80

Using these data, which one of the following can be predicted?

- A Both Cu(I) and Hg(I) undergo disproportionation.
- **B** Only Cu(I) undergoes disproportionation.
- **C** Only Hg(I) undergoes disproportionation.
- **D** Neither Cu(I) nor Hg(I) undergoes disproportionation.
- 19. The following cell is set up to obtain a pure copper by electrolysis as shown in the diagram below.



When a current of 40A flows through the circuit for 26.80 minutes, the mass of the anode decreases by 26.47g. What is the percentage composition of copper in the copper alloy?

Α	50%	В	60%	С	70%	D	80%
				-			

20. A reaction scheme involving chromium is shown below:



Which of the following statement is incorrect?

- A The oxidation states of chromium shown in the above reaction scheme are +2,
 +3 and +6.
- **B** Only step **X** will produce a precipitate and a gas.
- **C** Steps **V**, **W** and **Z** will produce a colour change.
- **D** Steps **X** and **Y** will involve a change in the oxidation state of chromium.
- 21. The compound *cis*-retinal is shown below.



Which one of the labelled bonds leads to the prefix in the name? B

22. One mole of Compound X reacts with 1 mole of hydrogen gas in a catalytic hydrogenation reaction to give a planar molecule.



23. An amount of 2.25g of a monocarboxylic acid with empirical formula CH₂O requires 25.00cm³ of 1.00 moldm⁻³ aqueous sodium hydroxide solution for neutralization.

The number of structural isomers of this acid which undergo dehydration to become alkene and also react with aqueous sodium carbonate is _____.

A 1	B	2	С	3	D	4
------------	---	---	---	---	---	---

24. n-Acetylglucosamine (NAG) is the major component of the crustacean skin. Its structural formula is CH₃CONHCH(CHO)(CHOH)₃CH₂OH.

Which of the functional group(s) of NAG reacts with aqueous NaOH?

I	Amino			II	Carbonyl		
	Hydroxyl			IV	Carboxami	de	
A	l only	B	IV only	С	I and IV	D	III and IV

- 25. The cleavage of the C-O bond in ethanol involves specific reagents and reaction conditions. Which of the following reagents and reaction conditions is true of the reaction?
 - A Acidified potassium dichromate (VI), heat
 - **B** Sodium metal, room temperature
 - **C** Excess concentrated sulfuric acid, heat
 - **D** Ethanoic acid, concentrated sulfuric acid, reflux

26. Which of the following carboxylic acids will decolourise potassium manganate (VII)?

A	НСООН	В	C ₆ H₅COOH
С	CH₃COOH	D	CH₃CH₂COOH

- 27. Which one of the following statements explains best why fluoroalkanes are the least reactive haloalkanes?
 - **A** Fluorine is much more electronegative than carbon.
 - **B** The F^- ion is the most stable halide ion.
 - **C** The C–F bond is the most polar carbon–halogen bond.
 - **D** The C–F bond is the strongest carbon–halogen bond.
- 28. Which one of the following reactions will produce an organic compound that has optical isomers?
 - A Heating butan-2-ol with concentrated sulphuric acid
 - **B** Warming pentan-3-one with NaBH₄
 - **C** Br₂ with 3-bromopropene
 - **D** Heating 2,3-dimethylpent-2-ene with H_2 in the presence of a nickel catalyst
- 29. Which of the following statement is *incorrect* about denaturation of proteins?
 - **A** R-groups interactions such as hydrogen bonding and disulphide linkages are disrupted.
 - **B** Chains of peptides are unfolded and rearranged.
 - **C** It can be caused by change in pH and temperature.
 - **D** Only peptide linkages in the primary structure are destroyed.

30. In the following reaction pathway, which of the reagents is **not** suitable for the step indicated?



- A Step 1: HCN (NaCN then dilute HCI)
- B Step 2: hot ethanolic KOH
- **C** Step 3: warm aqueous H₂SO₄
- **D** Step 4: CH₃OH with an acid catalyst

SECTION B (10 MARKS)

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

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

No other combination of statements is to be used as a correct response

31. The table below shows the changes in pressure with temperature at constant volume for three gases P, Q and R.

Cas	Pressure / atm				
Gas	300K	350K	400K	450K	
Р	1.00	1.17	1.33	1.50	
Q	1.00	1.51	2.10	2.32	
R	1.00	1.87	2.35	2.93	

Which of the gases show significant deviation from the ideal gas behaviour?

1 P 2 Q 3 R

- 32. Which of the bonding is/are found in methylammonium chloride?
 - 1 ionic bond
 - 2 co-ordinate bond
 - 3 hydrogen bond
- 33. The following information concerns the gas-phase reaction of nitrogen monoxide with hydrogen.

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

A series of experiments was carried out in a reaction vessel at constant temperature.

The initial rate of reaction increased by a factor of 2 when the initial pressure of NO was doubled and that of H_2 was halved.

When both pressures were halved, the initial rate decreased by a factor of 8.

From the above information, which of the following is/are correct?

- the overall order of reaction is 3.
- 2 the reaction is first order with respect to hydrogen.
- 3 the reaction is first order with respect to nitrogen monoxide.
- 34. The equilibrium constant, K_c for the reaction $P(aq) + Q(aq) \implies R(aq) + S(aq)$ determined at various temperature are as follows:

Temperature / K	Кс
283	0.142
293	0.142
303	0.142

Based on the data, it can be concluded that

- 1 the reaction happens without heat changes
- 2 the forward and reverse reactions have the same activation energy
- 3 the forward and reverse reactions have the same overall order of reaction
- 35. Which of the following substance can form hydrogen bonds with itself and with water?
 - 1 Ethanal 2 Ethanol 3 Ethylamine
- 36. Refer to the following reaction sequence.

 $(CH_3)_2C(CH_2NH_2)CH_2CH_3 \leftarrow (CH_3)_2C(CN)CH_2CH_3$

The type(s) of reaction mechanism involved in the above sequence is/are

- 1 Electrophilic addition.
- 2 Nucleophilic substitution.
- **3** Free-radical substitution.
- 37. Which of the following statements is true when ethene reacts with hydrogen halides?
 - 1 Rate of reaction increases in the order: HF, HCI, HBr, HI
 - **2** H^+ is the electrophile generated.
 - **3** The pi electrons in ethene are used to form a bond with the electrophile.
- 38. Which of the substituents group(s) in phenylamine decreases its basicity?
 - **1** NO₂ **2** CI **3** CH₃
- 39. Chlorine is used to make hexachlorophene which is a type of compound found in mouthwash that kills bacteria. The structural formula of hexachlorophene is shown below.



Which of the following statement regarding hexachlorophene is/are correct? (Assume all volumes of gases measured under r.t.p conditions)

- 1 The mass of 1 mole of hexachlorophene is 407g
- 2 72dm³ of chlorine gas measured at room temperature is required to produce 1 mole of hexachlorophene.
- **3** 3 dm³ of 2 moldm⁻³ sodium hydroxide is required to react with 1 mole of hexachlorophene.

40. The structural formula of a certain molecule is given below:



Which of the following are correct about the above molecule?

- 1 It can act as a buffer.
- **2** It contains the peptide bond.
- 3 It is amphoteric.

~ All the Best! ~