ST. ANDREW'S JUNIOR COLLEGE

Higher 1

PRELIMINARY EXAMINATION 2009

CHEMISTRY **8872/ 01**

PAPER 1 **17 September 2009**

50 minutes

Candidates answer all the questions on the Optical Answer Sheet

Additional Materials: Optical 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 name and civics group on the Answer Sheet.

There are **thirty** questions in these sections. 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 Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

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Section A (25 marks)

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

1 Which of the following statements is **not** true?

A One mole of water contains 2 moles of hydrogen atoms.

B One mole of chlorine gas contains 6.02×10^{23} atoms of chlorine.

C One mole of ammonia has a mass of 17.0 g.

D One mole of sodium chloride contains 1.204×10^{24} ions.

2 In an experiment, 0.0013 mole of a metallic salt, reacted completely with 20.80 cm^3 of 0.025 mol dm^{-3} MnO_4^-.

The half equation for the reduction of MnO_4^- is shown below:

$$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$$

Given the final oxidation number of the metal in the salt was +5, what would the original oxidation number of the metal be?

A +1

B +2

C +3

D +4

3 In which of the compound does sulfur show the lowest oxidation state?

A H_2S

B SCl_2

C SO_3^{2-}

D $S_2O_3^{2-}$

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

Which of the following species has more electrons than protons and more protons than neutrons?

[D = $^{2}_{1}H$]

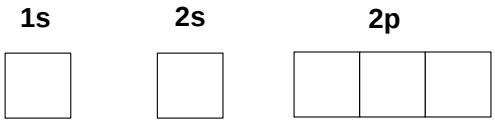
A D^-

B OH^-

C OD^-

D He^+

5 The orbitals of a carbon atom may be represented as shown.



Which diagram represents the arrangement of electrons in the ground state of the atom?

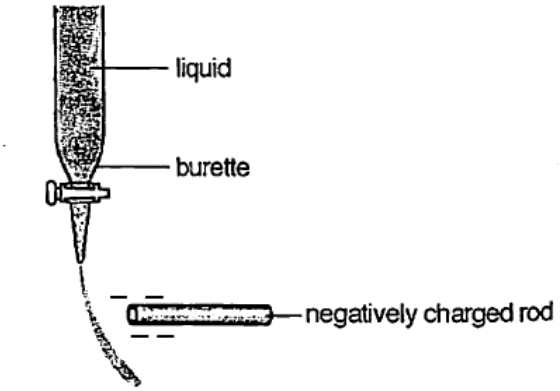
A

B

C

D

6 The diagram shows a liquid flowing from a burette and a charged rod is brought close to the flow.



Which could **not** be a possible identity of the liquid?

A $CHCl_3$

B C_2H_6

C C_2H_5OH

D C_2H_5Br

7 How many **σ** and **π** bonds are there in the molecule, $CH_3CH{=}CH_2$?

	σ	**π**
A	4	0
B	4	1
C	7	1
D	8	1

8 Which of the following compounds consists of atoms or molecules held together only by van der Waals' forces?

A Sodium

B Silicon

C Iodine

D Water

9 The radius and charge of each of the five ions are shown in the table below.

Ion	M^+	Q^+	R^{2+}	T^-	W^{2-}
radius / nm	0.13	0.19	0.16	0.13	0.16

The ionic solids ***MT***, ***QT*** and ***RW*** are of the same lattice type.

What is the correct order of their lattice energies placing the one with the highest numerical value first?

A ***MT*** > ***QT*** > ***RW***

B ***MT*** > ***RW*** > ***QT***

C ***RW*** > ***MT*** > ***QT***

D ***RW*** > ***QT*** > ***MT***

10 Which of the following has a positive ΔH value?

A $Na(s) \rightarrow Na(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

C $NaOH(aq) + CH_3COOH(aq) \rightarrow CH_3COO^-Na^+(aq) + H_2O(l)$

D $2O(g) \rightarrow O_2(g)$

11 When 1.00 g of 1,2-ethanediol was burned under a container of water, it was found that 100 g of water was heated from 25°C to 70°C.

If the specific heat capacity of water is 4.2 J K^{-1} cm^{-3}, what is the enthalpy change of combustion of 1,2-ethanediol in kJ mol^{-1}?

A -18.90

B -133.60

C -1172

D -8281

12 The enthalpy change of neutralisation between 1 mole of HC*l* and 1 mole of NaOH is given below.

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) \qquad \Delta H = -57.3 \text{ kJ mol}^{-1}$$

The enthalpy change of neutralisation between 1 mole of CH_3COOH and 1 mole of NaOH is less than -57 kJ mol^{-1}.

$$NaOH(aq) + CH_3COOH(aq) \rightarrow CH_3COO^-Na^+(aq) + H_2O(l) \qquad \Delta H < -57.3 \text{ kJ mol}^{-1}$$

Which statement best explains the difference between these two values?

A Heat is lost to the surroundings.

B Less than 1 mole of H_2O is formed.

C Dissociation of CH_3COOH is endothermic.

D CH_3COOH can form hydrogen bonds with water but not HC*l*.

13 The rate equation for the reaction

$$2I^-(aq) + H_2O_2(aq) + 2H^+(aq) \rightarrow I_2(aq) + 2H_2O(l)$$

is:

rate = $k [H_2O_2] [I^-]$, where k is the rate constant.

Which of the following conclusions **cannot** be drawn from the above information?

A The value of k is independent of the concentrations of H_2O_2 and I^-.

B The reaction is first order with respect to H_2O_2.

C The reaction is second order overall.

D H^+ acts as a catalyst in the reaction.

14 Which of the following statements about the forward and reverse reactions of a system at dynamic equilibrium is correct?

A The rate constant for the forward reaction equals the rate constant for the reverse reaction.

B Both the forward and reverse reactions have stopped.

C The rates of both forward and reverse reactions are equal to zero.

D The ratio of the rate constant for the forward reaction to that of the reverse reaction

equals the equilibrium constant.

[Turn Over

15 An equilibrium is represented by the following equation:

$$C\,(s) + H_2O\,(g) \rightleftharpoons H_2\,(g) + CO\,(g); \quad \Delta H > 0$$

Which of the following changes would result in an increase in yield of H_2 (g)?

A adding a catalyst

B increasing the temperature of the system

C adding more solid carbon

D increasing the pressure of the system

16 What is the pH of the resulting mixture after 10.00 cm^3 of 0.025 mol dm^{-3} of hydrochloric acid is added to 15.00 cm^3 of 0.015 mol dm^{-3} of sodium hydroxide?

A 2.00

B 3.00

C 11.00

D 12.00

17 Which of the following statements represents the correct changes when water is added to a sample of aqueous propanoic acid?

A degree of dissociation, α, increases as more water is added

B degree of dissociation, α, decreases as more water is added

C acid dissociation constant, K_a, increases as more water is added

D acid dissociation constant, K_a, decreases as more water is added

18 Which of the following mixtures, mixed at equal volumes, would result in a buffer solution?

A 0.05 mol dm^{-3} CH_3COONa and 0.10 mol dm^{-3} HC*l*

B 0.10 mol dm^{-3} CH_3COOH and 0.05 mol dm^{-3} NaOH

C 0.10 mol dm^{-3} CH_3COOH and 0.05 mol dm^{-3} NaC*l*

D 0.05 mol dm^{-3} HC*l* and 0.05 mol dm^{-3} NaOH

19 Na_2O, Al_2O_3 and P_4O_{10} are dissolved separately in water and the pH of the resulting solutions was measured.

What is the order of increasing pH value of the resulting solutions formed by these oxides?

A Al_2O_3, P_4O_{10}, Na_2O

B Al_2O_3, Na_2O, P_4O_{10}

C Na_2O, Al_2O_3, P_4O_{10}

D P_4O_{10}, Al_2O_3, Na_2O

20 Aluminium chloride, $AlCl_3$ can form a dimer, Al_2Cl_6, under certain conditions. Which statement best explains why it can form Al_2Cl_6?

A Al can expand its octet of eight valence electrons.

B Al has an empty orbital.

C $AlCl_3$ has a lower energy content than Al_2Cl_6.

D Weak van der Waals' forces exist between $AlCl_3$ molecules.

21 Muscalure is a sex hormone found in fruit flies and has the structure below.

$$CH_3(CH_2)_7CH{=}CH(CH_2)_{12}CH_3$$

Which of the following about muscalure is correct?

A It can turn orange potassium dichromate (VI) green on warming.

B It reacts with 2 moles of hydrogen.

C It has a pair of geometric isomers.

D It reacts with hot acidified potassium manganate (VII) to give $CH_3(CH_2)_7CHO$ as one of the products

22 In which of these processes is at least one product a gas at room temperature and pressure?

A dehydration of 2-bromopropan-1-ol

B neutralisation of propanoic acid with sodium hydroxide

C oxidation of methanal with acidified potassium manganate(VII)

D substitution of propanol by hydrogen bromide

23 A student wants to produce propanone and ethanoic acid from 2-chloro-3-methylbutane. Which of the following gives the correct reagents used, base on the following synthesis?

2-chloro-3-methylbutane $\xrightarrow{\text{J}}$ **X** $\xrightarrow{\text{K}}$ propanone and ethanoic acid

	Reagent J	**Reagent K**
A	alcoholic NaOH	acidified $K_2Cr_2O_7$
B	alcoholic NaOH	acidified $KMnO_4$
C	aqueous NaOH	acidified $K_2Cr_2O_7$
D	aqueous NaOH	acidified $KMnO_4$

24 Which of the following reagents could be used to distinguish $CH_3COCH_2CHClCH_3$ from $CH_3CH(OH)CH_2CHBrCH_3$?

A Ethanolic silver nitrate solution

B Aqueous bromine

C Alkaline iodine solution

D Tollen's reagent

25 A food chemist wants to create the odour of green apples for a product. An ester with this odour has the formula $C_2H_5CO_2CH(CH_3)_2$. In which of the following will the substances react together to produce this ester?

A C_2H_5OH and $(CH_3)_2CHCOOH$

B CH_3COOH and $CH_3CH(OH)CH_2CH_3$

C C_2H_5COOH and $(CH_3)_2CHOH$

D C_2H_5COOH and $C_2H_5CH_2OH$

Section B (5marks)

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 put a tick against the statements which you consider to be correct).

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

A	B	C	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 Which of the following contains an unpaired electron?

1 C*l*

2 P

3 S^{2-}

27 Which of the following compounds has a giant structure?

1 Silicon (IV) chloride

2 Silicon (IV) oxide

3 Magnesium

[Turn Over

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

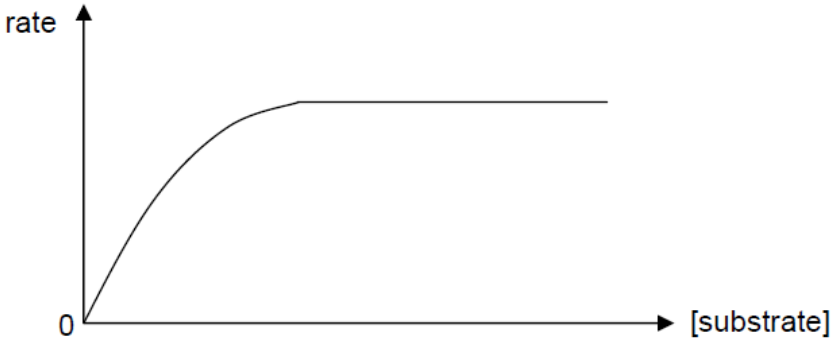
A	B	C	D
1,**2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

28 In the following enzyme-catalysed reaction,

enzyme + substrate → enzyme + product,

the rate of reaction is affected by the concentration of the substrate as shown in the graph below.



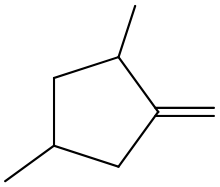
Which of the following conclusions can be drawn?

1 When [substrate] is low, the rate is first order with respect to [substrate].

2 When [substrate] is high, the rate is zero order with respect to [substrate].

3 When [substrate] is high, the rate is independent of [enzyme].

29 Compound **L** has the structural formula as shown below:



Which of the following regarding **L** is correct?

1 **L** decolourises acidified potassium manganate(VII) solution.

2 **L** reacts with 2,4-dinitrophenylhydrazine and Tollen's reagent.

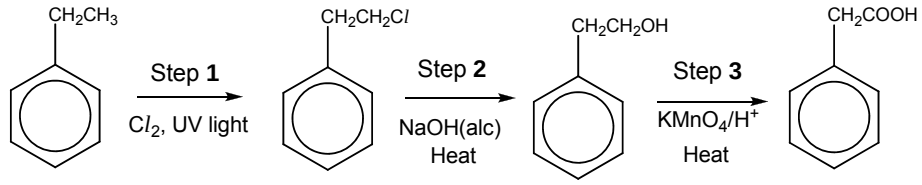
3 **L** reacts with vaporised bromine in the presence of ultra-violet light.

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

A	B	C	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 A student proposed the following reaction scheme for the preparation of 2-phenylethanoic acid.



Which of the following steps would lead to unsuccessful synthesis?

1 Step **1**

2 Step **2**

3 Step **3**

End of Paper 1