ST ANDREW'S JUNIOR COLLEGE



JC2 Preliminary Examinations CHEMISTRY Higher 2 Paper 1 Multiple Choice

9746/01 11 September 2008 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 name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **fourty** 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 Answer Sheet.

Read the instructions on the 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 booklet.

Section A

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

- In an experiment, 15 cm³ of a hydrocarbon underwent complete combustion in 75 cm³ of oxygen. The final gaseous mixture contained 30 cm³ of carbon dioxide and 30 cm³ of unreacted oxygen. All gaseous volumes were measured under room temperature and pressure. What is the molecular formula of the hydrocarbon?
 - **A** CH₄
 - ${\bm B} \quad C_2 H_4$
 - $\boldsymbol{C} \quad C_2 H_6$
 - $\boldsymbol{D} \quad C_3H_6$
- 2. $50.0 \text{ cm}^3 \text{ of } 0.0500 \text{ mol } \text{dm}^{-3} \text{ KC}/O_4(aq) \text{ requires } 50.0 \text{ cm}^3 \text{ of } 0.200 \text{ mol } \text{dm}^{-3} \text{ Ti}Cl_3(aq) \text{ to}$ reach end-point. Given that Ti(III) is oxidized to Ti(IV) in this reaction, what is the oxidation state of the reduced product of the C/O_4^- ion?
 - **A** -1
 - **B** +1
 - **C** +3
 - **D** +5
- 3. A flask **L** containing an unknown volume of neon gas at a pressure of 2 kPa was connected to a flask **M** containing 3 dm³ of helium gas at 4 kPa. The final pressure in the connected flasks was found to be 3.5 kPa. What was the volume of flask **L**, assuming that the temperature was constant throughout?
 - **A** 1.0 dm³
 - **B** 1.5 dm³
 - $C 2.0 \text{ dm}^3$
 - \mathbf{D} 2.5 dm³

4.	Particle	Number of neutrons	Number of nucleons
	Q ⁻	16	33
	R⁺	19	39
	S ²⁻	17	33
	T ²⁺	18	35

Which of the following pairs consists of particles that are isoelectronic?

- **A** \mathbf{Q}^{-} and \mathbf{S}^{2-}
- **B** \mathbf{R}^+ and \mathbf{S}^{2-}
- C S²⁻ and T²⁺
- **D** \mathbf{Q}^{-} and \mathbf{T}^{2+}
- An element X has the electronic configuration [Kr] 4d¹⁰ 5s² 5p³.
 What is the likely formula for the fluoride of X?
 - A X₃F
 - B XF₂
 - $\boldsymbol{C} \quad XF_5$
 - \mathbf{D} XF₆
- 6. Which of the following ions will be deflected the **most** when passed through an electric field?
 - **A** $^{23}_{11}Na^+$
 - **B** ${}^{16}_{8}O^{2-}$
 - **C** $^{24}_{12}Mg^{2+}$
 - **D** $^{35}_{17}Cl^{-}$

- 7. Which of the following molecules is linear?
 - A Cl-S-Cl
 - B O=N-Br
 - С Н-О-О-Н
 - **D** O=C=C=C=O
- 8. Which of the following sets of compounds all contain the same type of forces of attraction between molecules of their own?
 - **A** CO₂, NO₂, SO₂
 - B NaCl, MgCl₂, AlCl₃
 - **C** BF₃, CH₄, SF₆
 - $\textbf{D} \quad AgC\mathit{l},\, I_2,\, SiO_2$
- 9. The heat changes of the corresponding reactions are given as follows:

$$C(s) + \frac{1}{2}O_{2}(g) \rightarrow CO(g) \qquad \qquad \Delta H^{e} = -110 \text{ kJ mol}^{-1}$$

$$2Cr(s) + \frac{3}{2}O_{2}(g) \rightarrow Cr_{2}O_{3}(s) \qquad \qquad \Delta H^{e} = -1120 \text{ kJ mol}^{-1}$$

What is the enthalpy change for the following reaction?

 $3C(s) + Cr_2O_3(s) \rightarrow 2Cr(s) + 3CO(g)$

- A +590 kJ mol⁻¹
- **B** +790 kJ mol⁻¹
- **C** -870 kJ mol⁻¹
- **D** -940 kJ mol⁻¹

10. Phosphorus can react with chlorine to form phosphorus pentachloride and phosphorus trichloride. Some thermochemical data related to these compounds are shown below:

Enthalpy change of atomisation of phosphorus	+315 kJ mol ⁻¹
Enthalpy change of atomisation of chlorine	+122 kJ mol ⁻¹
Enthalpy change of formation of PCl ₅	-440 kJ mol ⁻¹

What is the bond energy for the P-Cl bond in PCl_5 ?

- A 273 kJ mol⁻¹
- **B** 485 kJ mol⁻¹
- **C** 925 kJ mol⁻¹
- **D** 1365 kJ mol⁻¹
- 11. The decomposition of compound ${f W}$ is shown below.

$$\mathbf{W}(g) \rightarrow \mathbf{Y}(g) + \mathbf{Z}(g)$$

The rate equation for the decomposition is found to be:

rate = k[**W**] where rate constant, $k = 0.45 \text{ s}^{-1}$.

What is the time taken for W(g) to reach one third of its initial concentration of 1.8 mol dm⁻³?

- A 1.54 s
- **B** 2.44 s
- **C** 2.98 s
- **D** 3.08 s

12. Hydrogen peroxide reacts with acidified iodide ions liberating iodine according to the equation below:

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

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

rate = k [H₂O₂] [I⁻]

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**?

apii D
dm⁻³
lm⁻³
lm⁻³
dm⁻³

13. Chlorine dioxide, ClO₂, is a yellow gas which can be synthesised in the laboratory by the following reaction:

 $2AgClO_3(s) + Cl_2(g) \implies 2AgCl(s) + 2ClO_2(g) + O_2(g)$ $\Delta H = 0$ Which of the following statements is **incorrect** about the above reaction?

- **A** The addition of a catalyst will increase the rates of both the forward and the reverse reactions.
- **B** The equilibrium constant is dependent on temperature.
- **C** The rate constants vary with temperature.
- **D** Increasing the pressure decreases the equilibrium yield of ClO₂. [Turn Over

- 14. What is the final pH of the solution formed by mixing equal volumes of two separate solutions of pH 1.0 and pH 2.0?
 - **A** 0.66
 - **B** 0.96
 - **C** 1.26
 - **D** 1.56
- 15. The table below contains the standard reduction potential data for the species of copper and mercury.

	E ^e / V
$Cu^{2+}(aq) + e \longrightarrow Cu^{+}(aq)$	+0.15
$Cu^{+}(aq) + e \longrightarrow Cu(s)$	+0.52
$Hg^{2+}(aq) + e \longrightarrow Hg^{+}(aq)$	+0.91
$Hg^{+}(aq) + e \longrightarrow Hg(l)$	+0.80

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

- **A** Neither Cu^+ nor Hg^+ undergoes disproportionation.
- **B** Only Cu⁺ undergoes disproportionation.
- **C** Only Hg^+ undergoes disproportionation.
- **D** Both Cu^+ and Hg^+ undergo disproportionation.

16. Three electrochemical cells are set up as shown below. The e.m.f in volts is shown below for each cell.



From these e.m.f. values, what is the order of reducing power?

	Most Least			
Α	Y	W	Z	Х
В	Y	Х	W	Z
С	Z	Х	Y	W
D	Z	Х	W	Y

17. Compounds of Period 3 elements dissolve in water to form aqueous solutions that are acidic, basic or neutral.

Which of the following sequence shows the order of **increasing** pH of the resultant solutions formed when the compounds are dissolved in water?

- A NaCl, MgCl₂, SiCl₄
- B AlCl₃, SiCl₄, PCl₅
- $\boldsymbol{C} \quad Al_2O_3, \, MgO, \, SO_2$
- $\boldsymbol{D} \quad P_4O_{10},\,SiO_2,\,MgO$

- 18. On descending Group II elements from magnesium to barium, which statement about the trend in properties is **incorrect**?
 - **A** The reducing power of the elements increase down the group.
 - **B** The thermal stability of the nitrates increases.
 - **C** The magnitude of the lattice energy of the oxides increases.
 - **D** The ionic radii increases.
- 19. Which ions containing chlorine are formed when chlorine is bubbled in **hot** aqueous sodium hydroxide?
 - A Cl⁻ and ClO⁻
 - **B** Cl^{-} and ClO_{3}^{-}
 - **C** Cl^{-} and ClO_{4}^{-}
 - **D** ClO^{-} and ClO_{3}^{-}
- 20. Which of the following ions contains 3 unpaired electrons in the d orbitals?
 - A Cr³⁺
 - **B** Fe³⁺
 - **C** Mn³⁺
 - **D** Ni²⁺

21. The table below shows the possible oxidation states of four d-block elements in the Periodic Table. (The elements are represented by letters which are not their chemical symbols.)

Element	Possible oxidation states
W	+2, +3, +4
X	+1,+2,+3,+4,+5
Y	+3,+4, +5
Z	+2, +4, +5, +6, +7

Which of the following ions is likely to exist?

- A WO⁻
- **B** X₂O₇²⁻
- **C** YO₃²⁻
- \mathbf{D} ZO⁺
- 22. Menthol is a cyclohexane derivative that is found in skin lotion. Its structural formula is shown below:



menthol

How many stereoisomers can menthol exhibit?

- **A** 4
- **B** 8
- **C** 16
- **D** 32

- 23. When 0.05 mol of an organic compound **M** was completely combusted in excess oxygen, it produced 0.20 mol of carbon dioxide and 0.20 mol of water. When **M** is heated with a few drops of acidified potassium dichromate, the solution remained orange in colour. Which of the following could be **M**?
 - A CH₃CH₂CH₂CH₃
 - B CH₃CH₂CH₂CH₂OH
 - C CH₃CH₂CH₂CHO
 - D CH₃CH₂CH₂COOH
- 24. An alkene, with a general formula of $C_n H_{2n}$, reacts with hot acidified potassium manganate(VII). The products of this reaction gave the following observations:

test	<u>observations</u>
2,4-dinitrophenylhydrazine	Orange ppt observed
Limewater	No white ppt observed

What is the **least** number of *n* for such an alkene?

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

25. 3-chlorobenzoic acid can be synthesized from benzene in 3 steps.



Which of the following is the **best** method for this synthesis?

	<u>Step 1</u>	<u>Step 2</u>	<u>Step 3</u>
Α	Cl ₂ ; FeCl ₃	CH_3Cl ; FeC l_3 ,	MnO₄⁻; H⁺
В	Cl_2 ; FeC l_3	MnO₄⁻; H⁺	CH ₃ C <i>l</i> ; FeC <i>l</i> ₃
С	CH_3Cl ; $FeCl_3$	MnO₄⁻; H⁺	Cl ₂ ; FeCl ₃
D	CH_3Cl ; $FeCl_3$	Cl_2 ; FeC l_3	MnO₄⁻; H⁺

26. 1.00 mol of dichloromethane underwent a reaction when heated with excess NaOH(aq).
When acidified AgNO₃ is added after the reaction, *x* moles of AgC*l* is obtained.
The same reaction was carried out with 1.00 mol of the molecule below.



In terms of x, how many moles of AgCl was obtained?

- **A** 0.5 *x*
- **B** *x*
- **C** 1.5*x*
- **D** 2*x*

- NH_2 NH₂ Α CH₃CH₂CH₂CONH₂ NH_3 $\rm NH_2$ NH_{2} В NH_3 $CH_3CH_2CH_2CONH_2$ NH_{2} NH_{2} С CH₃CH₂CH₂CONH₂ NH_3 NH_2 NH_2 D NH_3 CH₃CH₂CH₂CONH₂
- 27. Which of the following order is in increasing pK_b values?

- 28. Hydrogen bonding does not exist between the molecules of
 - **A** C_6H_5COOH
 - $\textbf{B} \quad C_6H_5NH_2$
 - $\boldsymbol{C} \quad C_6H_5COOCH_3$
 - $\textbf{D} \quad C_6H_5CONHCH_3$

29. Lovastatin is often prescribed to patients suffering from cardiovascular disease because it helps to lower the cholesterol level in bloodstream. Which of the following statements about Lovastatin is **false**?



Lovastatin

- A It has seven chiral centres.
- **B** 1 mole of Lovastatin reacts with 2 moles of 2,4-dinitrophenylhydrazine to form an orange precipitate.
- **C** 1 mole of Lovastatin reacts with 2 moles of bromine dissolved in tetrachloromethane.
- **D** Upon adding phosphorus pentachloride, the gas evolved turns moist, blue litmus paper red.
- 30. It has been reported that some cases of acute liver failure could have been caused by an overdose of Paracetamol. Which of the following statements about Paracetemol is **incorrect**?



Paracetemol

- **A** It reacts with hot, aqueous sodium hydroxide to give sodium ethanoate.
- **B** There is no yellow precipitate observed on adding aqueous, alkaline iodine.
- **C** The colourless gas evolved on adding sodium metal extinguished a lighted splinter with a "pop" sound.
- **D** An aqueous solution of Paracetamol is alkaline.

Section B

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 that you consider to be 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 used as a correct response.

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

Magnesium oxide is a stable ionic compound where $\Delta H_f < 0$.

$Mg(s) \rightarrow Mg^{2+}(g) + 2e$	∆H = +2353 kJ mol⁻¹
1	

$$\frac{1}{2}O_2(g) + 2e \rightarrow O^{2-}(g)$$
 $\Delta H = +897 \text{ kJ mol}^{-1}$

Which of the following statements are correct?

- 1 The enthalpy change of atomisation of magnesium is +167 kJ mol⁻¹.
- 2 The lattice energy of magnesium oxide is more exothermic than -3250 kJ mol⁻¹.
- 3 The sum of the first and second electron affinities of oxygen is $+649 \text{ kJ mol}^{-1}$.
- 32. Compound V can be produced from compounds S and T, as shown in the following equation:

$$S + T \rightarrow V$$

The mechanism for the reaction is shown below:

$2\mathbf{S} \rightarrow \mathbf{U}$	(fast)
$U + T \rightarrow W$	(slow)
$W \rightarrow V + S$	(fast)

Which of the following are consistent with the mechanism?

- **1** The overall order of reaction is 3.
- 3 The rate of reaction is independent of the concentration of U. [Turn Over

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

A	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 used as a correct response.

33. The most common coal gasification process involves the reaction of carbon, the primary constituent of coal, with steam to produce carbon monoxide and hydrogen as shown below:

 $H_2O(g) + C(s) = H_2(g) + CO(g)$

The table below shows how the value of equilibrium constant, K_p , varies with temperature for the reaction:

Temperature / °C	K _p	
300	3.40	
800	58.0	

Which of the following statements about the reaction are correct?

- **1** The reverse reaction is exothermic.
- **2** The equilibrium yield of $H_2(g)$ decreases with an increase in pressure.
- **3** K_p is dimensionless.
- 34. The numerical values of the solubility product of calcium carbonate and calcium fluoride are 8.0×10^{-7} and 4.5×10^{-11} respectively at 30°C.

Which of the following statements are **correct**?

- 1 Calcium carbonate is more soluble than calcium fluoride.
- 2 Addition of calcium nitrate solution to a solution containing equal concentrations of fluoride and carbonate ions causes calcium carbonate to precipitate out first.
- **3** The solubility products of calcium carbonate and calcium fluoride have the same units.

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

A	В	C	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 used as a correct response.

35. Under standard conditions, the reaction shown below is not feasible.

 $2NO_3(aq) + 8H^+(aq) + 6Cl(aq) \rightarrow 2NO(g) + 4H_2O(l) + 3Cl_2(g)$

However, under non-standard conditions, the reaction may take place. Which of the following would help the reaction to proceed?

- 1 Addition of NaCl
- 2 Increase in acidity
- 3 Increase in pressure
- 36. Which of the following statements about bromine and its compounds are correct?
 - 1 Pure hydrogen bromide can be prepared by reacting sodium bromide with concentrated sulphuric acid.
 - **2** Brown colouration in trichloromethane is seen when chlorine is bubbled into aqueous sodium bromide and the mixture is shaken with an equal volume of trichloromethane.
 - **3** Oxidation number of sulphur changes from +2 to +6 when bromine reacts with thiosulphate ion.
- 37. Which of the following statements concerning the transition metals are **correct**?
 - 1 They are the only metals which can give coloured ions in aqueous solutions.
 - 2 They are the only metals with variable oxidation states.
 - **3** They are the only metals which have complete 4s-orbitals in their atoms.

The responses ${\bf A}$ to ${\bf D}$ should be selected on the basis of

A	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 used as a correct response.

Which of the following compounds exhibit both cis-trans and optical isomerism? 38.



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

A	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 used as a correct response.

39. On adding aqueous sodium hydroxide, ethanal can be converted to an aldol according to the mechanism shown below:



Which of the following statements are correct?

- 1 2 moles of ethanal reacts to form 1 mole of an aldol.
- 2 The product, an aldol, is both an aldehyde and an alcohol.
- **3** Sodium hydroxide acts as a catalyst in this reaction.

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

Α		В	С	D
1, 2 ar	nd 3 1	and 2	2 and 3	1 only
are cor	rrect only a	are correct	only are correct	is correct

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

- 40. The cause of chemical poisoning can be detected via protein precipitation in blood. Which of the following reagents cause protein precipitation?
 - 1 Aqueous sodium hydroxide
 - 2 Ethanol
 - **3** Aqueous cadmium (II) nitrate

Prelims MCQ Answer Key

-							
1	В	11	В	21	С	31	A
2	С	12	A	22	С	32	A
3	A	13	В	23	D	33	В
4	A	14	С	24	С	34	D
5	С	15	В	25	С	35	В
6	В	16	С	26	В	36	С
7	D	17	D	27	A	37	D
8	С	18	С	28	С	38	D
9	В	19	В	29	В	39	A
10	А	20	А	30	D	40	A