# **ST ANDREW'S JUNIOR COLLEGE**



# **JC2 Preliminary Examinations**

CHEMISTRY8872/01Higher 111 September 2008Paper 150 minutes

Additional materials: Data Booklet, Multiple Choice Answer Sheet

# **INSTRUCTIONS TO CANDIDATES**

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 separate answer sheet.

This question paper consists of 13 printed pages including this page —

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#### **Section A**

#### Answer all questions

- 1. Which statement about relative atomic mass is correct?
  - A It is measured in grams.
  - **B** It is a ratio of masses.
  - **C** It is the number of atoms in a molecule.
  - **D** It is the same as the mass of 1 mol of atoms.
- 10 cm<sup>3</sup> of a hydrocarbon C<sub>x</sub>H<sub>y</sub> was exploded with an excess of oxygen. There was a contraction of 30 cm<sup>3</sup>. When the product was treated with a solution of potassium hydroxide, there was a further contraction of 40 cm<sup>3</sup>. What is the molecular formula of the hydrocarbon?
  [All gas volumes are measured at r.t.p.]
  - **A** C<sub>4</sub>H<sub>8</sub>
  - ${\bm B} \quad C_4 H_{10}$
  - **C** C<sub>3</sub>H<sub>6</sub>
  - $\boldsymbol{D} \quad C_3 H_8$
- 3. Nitrogen dioxide reacts with iodide ions under acidic conditions according to the following equation,

 $NO_2$  +  $2I^-$  +  $2H^+ \rightarrow NO$  +  $I_2$  +  $H_2O$ 

How many moles of electrons are gained by one mole of nitrogen dioxide?

- **A** 1
- **B** 2
- **C** 3
- **D** 4

- 4. Which species is formed when bromine molecule undergoes reduction?
  - A HBrO
  - B NaBrO<sub>3</sub>
  - **C** HBrO<sub>4</sub>
  - D BBr<sub>3</sub>
- 5. Which of the following particles, on gaining an electron have a half-filled set of p orbitals?
  - A P
  - **B** N<sup>-</sup>
  - **C** O<sup>2+</sup>
  - D Si<sup>+</sup>
- 6. L and **M** are elements with the following successive ionization energies in kJ mol<sup>-1</sup>.

L	557	1921	2714	11410	13120	16723	19116
М	905	2245	3231	4803	7911	9300	18600

- L and M are likely to form a compound of formula
- **A** L<sub>3</sub>M<sub>2</sub>
- **B** L<sub>2</sub>M<sub>3</sub>
- C LM<sub>4</sub>
- **D** L<sub>4</sub>M
- 7. Which of the following molecules is not planar?
  - A BeCl<sub>2</sub>
  - ${\bf B} \quad XeF_4$
  - **C** SO<sub>2</sub>
  - $\mathbf{D}$  SiC $l_4$

- 8. NH<sub>3</sub> boils at -33.3 °C while PH<sub>3</sub> boils at -87.8 °C. Which of the following best explains the difference in boiling points of NH<sub>3</sub> and PH<sub>3</sub>?
  - **A**  $PH_3$  is non-polar whereas  $NH_3$  is polar.
  - **B** The strength of Van der Waals' forces is weaker in PH<sub>3</sub> than in NH<sub>3</sub>.
  - **C** Van der Waals' forces are present in PH<sub>3</sub> whereas hydrogen bonding is present in NH<sub>3</sub>.
  - **D** The P—H bond is weaker than the N—H bond.
- Given the standard enthalpy change of formation of Fe<sub>3</sub>O<sub>4</sub> (s) and Al<sub>2</sub>O<sub>3</sub> (s) is
  -1117.1 kJ mol<sup>-1</sup> and -1669.8 kJ mol<sup>-1</sup> respectively, what is the standard enthalpy change of reaction for the following reaction?

 $3 \operatorname{Fe_3O_4}(s) + 8 \operatorname{Al}(s) \rightarrow 9 \operatorname{Fe}(s) + 4 \operatorname{Al_2O_3}(s)$ 

- A +3327.9 kJ mol<sup>-1</sup>
- **B** -3327.9 kJ mol<sup>-1</sup>
- **C** -1109.3 kJ mol<sup>-1</sup>
- **D** 552.7 kJ mol<sup>-1</sup>
- 5 x 10<sup>-4</sup> mole of butane was burnt to heat up 100 g of water at room temperature and pressure.
  Assuming that there was negligible heat loss to the surroundings, calculate the final temperature of the water.

Given: Standard enthalpy change of combustion of butane = – 2877.5 kJ mol<sup>-1</sup>

Specific heat capacity of water =  $4.2 \text{ J K}^{-1} \text{ cm}^{-3}$ 

- **A** 28.4 °C
- **B** 33.4 °C
- **C** 61.6 °C
- **D** 86.6 °C

11. Pepsin is a digestive enzyme found in gastric juice that aids in the digestion of proteins. The graph below shows how the rate of a reaction varies with the protein (reactant) concentration for pepsin enzyme.



Which of the following can be deduced from the graph above?

- **A** The rate is first order at low protein concentration and zero order at high protein concentration.
- **B** Increasing the protein concentration will increase the rate of reaction.
- **C** The rate is second order at low protein concentration and zero order at high protein concentration.
- **D** The enzyme is unable to function at high protein concentrations.
- 12. The data in the table below refer to the reaction between acidified iodate (V) ions and iodide ions solution.

$IO_3^{-}(aq) + 5I^{-}(aq) + 6H^{+}(aq)$	>	3I <sub>2</sub> (aq) + 3H <sub>2</sub> O (	l)
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Experiment		Relative			
Experiment	IO <sub>3</sub> <sup>-</sup> (aq)	I <sup>-</sup> (aq)	H⁺ (aq)	Water	initial rate
1	10	50	60	80	1.0
2	20	50	60	70	2.0
3	10	25	60	105	0.5
4	10	50	120	20	4.0

What is the rate equation for the reaction?

- **A** rate = k  $[IO_3^{-1}] [I^{-1}]^5 [H^{+1}]^6$
- **B** rate = k  $[IO_3^{-1}][I^{-1}]$
- **C** rate = k  $[IO_3^{-1}] [I^{-1}]^2 [H^{+1}]^2$
- **D** rate = k  $[IO_3^-] [I^-] [H^+]^2$

13. Which of the following is **incorrect** for the following imposed changes at equilibrium for this reaction?

 $2P(g) + Q(g) \implies 3R(g) \Delta H < 0$ 

	Imposed changes	Position of equilibrium	Forward rate at new equilibrium	Backward rate at new equilibrium
A	Increase total pressure by compression	No change	Increase	Increase
В	Increase temperature	Shifts left	Increase	Increase
С	Adding catalyst	No change	Increase	Increase
D	Adding more R	Shifts left	Increase	Decrease

14. In the mixture containing 0.80 mol of CO and 1.30 mol of H<sub>2</sub>O, the reaction occurs according to the equation below.

$$CO(g) + H_2O(g) \implies CO_2(g) + H_2(g)$$

At equilibrium, 0.35 mol of  $CO_2$  was present. What is the equilibrium constant,  $K_c$ , at the temperature of this experiment?

- **A** 3.49
- **B** 0.82
- **C** 0.29
- **D** 1.22
- 15. What is the final pH of a solution formed by mixing equal volumes of two separate solutions of pH 3.0 and pH 5.0?
  - **A** 3.0
  - **B** 3.3
  - **C** 4.0
  - **D** 4.3

- 16. Which of the following solutions can be used to give an effective buffer solution at pH > 7?
  - **A**  $C_6H_5COOH$  and  $C_6H_5COOK$
  - $\textbf{B} \qquad H_3 PO_4 \text{ and } Na_3 PO_4$
  - **C** KOH and KNO<sub>3</sub>
  - **D**  $CH_3NH_2$  and  $CH_3NH_3Cl$
- 17. Which of the following is unlikely to dissolve in dilute hydrochloric acid?
  - A Na<sub>2</sub>O
  - B MgO
  - **C** Al<sub>2</sub>O<sub>3</sub>
  - D SiO<sub>2</sub>
- 18. Consider the sequence of chlorides NaCl, SiCl<sub>4</sub> and PCl<sub>3</sub>.Which of the following properties **increases** from NaCl to PCl<sub>3</sub>?
  - A Melting point
  - B Covalent character
  - **C** pH of the resultant solution when mixed with water
  - D electrical conductivity of the chloride in liquid state

- 19. A compound has the following properties:
  - It reacts with phosphorus pentachloride, giving off white fumes of HCl.
  - It reacts with aqueous bromine.
  - It reacts with ethanol
  - It reacts with sodium hydroxide to form an ionic compound.

The compound is

- A CH<sub>3</sub>CH=CHCOOH
- B CH<sub>3</sub>CH=CHCH<sub>2</sub>OH
- C CH<sub>3</sub>CH=CHCHO
- D CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COOH
- 20. How many isomers are possible for the unsaturated compound of molecular formula C<sub>3</sub>H<sub>5</sub>F?
  - **A** 3
  - **B** 4
  - **C** 5
  - **D** 6
- 21. Which of the following reagents will distinguish between compounds S and T?



S

- **A** Aqueous bromine
- B Alkaline aqueous iodine
- **C** Acidified potassium dichromate (VI)
- D 2,4 dinitrophenylhydrazine



- 22. Why does the reaction of  $CH_3CH_2CH_2X + OH^- \rightarrow CH_3CH_2CH_2OH + X^-$  take place **more** readily when **X** is Br than when **X** is F?
  - A The C-F bond is more polar than the C-Br bond
  - **B** The C-F bond is stronger than the C-Br bond
  - C The C-F bond is longer than the C-Br bond
  - **D** The  $Br^{-}$  ion is a stronger nucleophile than the  $F^{-}$  ion.
- 23. The process of cracking produces useful substances from crude oil. Which of the following represents a possible reaction for cracking?
  - A  $CH_3(CH_2)_{10}CH_3 \rightarrow CH_3(CH_2)_3CH_3 + CH_3CH=CH_2$
  - **B**  $CH_3(CH_2)_{11}CH_3 \rightarrow CH_3(CH_2)_3CH_3 + 2 CH_3CH=CH_2$
  - **C**  $CH_3(CH_2)_{12}CH_3 \rightarrow CH_3(CH_2)_3CH_3 + 3 CH_3CH=CH_2$
  - **D**  $CH_3(CH_2)_{13}CH_3 \rightarrow CH_3(CH_2)_3CH_3 + 4 CH_3CH=CH_2$
- 24. Vitamin B5, also called pantothenic acid, is one of the eight water soluble B vitamins. Vitamin B5 is critical to the manufacture of red blood cells and sex related hormones produced in the adrenal glands. The structure of Vitamin B5 is as shown below.



#### Vitamin B5

Which reagent would not readily destroy this molecule?

- A Acidified potassium manganate (VII)
- **B** Aqueous sulphuric acid
- C Phosphorous pentachloride
- **D** Silver diammine complex

25. Which of the following will be formed when 4-chloropentane-1,3-diol is refluxed with hot acidified potassium dichromate (VI)?



### Section B

For each of the following questions, one of 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:

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

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

- 26. A student wishes to dissolve a sample of iodine. Which of the following can be suitable solvents for iodine?
  - 1 Tetrachloromethane
  - 2 Hexane
  - 3 Water
- 27. Which of the following reactions are always exothermic?
  - **1**  $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$
  - 2  $K^+(g) + Cl^-(g) \rightarrow KCl(s)$
  - 3 2NaOH (aq) +  $H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2 H_2O(l)$
- 28. Which of the following statements about phosphorus and sulphur are correct?
  - 1 The ionic radius of sulphur is smaller than that of phosphorus.
  - 2 The melting point of sulphur is greater than that of phosphorus.
  - 3 The first ionisation energy of sulphur is numerically smaller than that of phosphorus.

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

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

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

29. What deductions can be made about the psychoactive drug, **W**, in cannabis as shown in the structure below?



- **1 W** reacts with concentrated sulphuric acid at 180°C to form a product that decolourises aqueous bromine at room temperature.
- 2 W can form cis-trans isomers
- **3 W** reacts with sodium metal to form 2 moles of hydrogen gas.
- 30. Which of the following statements about benzene are correct?
  - 1 The carbon atoms form a regular planar hexagon.
  - 2 Addition reactions of benzene take place more easily than substitution.
  - **3** Each carbon-carbon bond in benzene is stronger than a carbon-carbon double bond in ethene.

## Prelims MCQ Answer Key

1	В	11	С	21	С
2	A	12	D	22	В
3	В	13	D	23	С
4	D	14	С	24	D
5	С	15	В	25	В
6	В	16	D	26	В
7	D	17	D	27	А
8	С	18	В	28	А
9	В	19	A	29	В
10	A	20	В	30	D