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ST ANDREW'S JUNIOR COLLEGE



JC2 Preliminary Examinations

Chemistry

8872/1

Higher 1

18 Sep 2017

Paper 1

1300 – 1350

Candidates answer on separate paper.

Additional Materials: Writing paper, Data Booklet, OAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, civics group and index number on the OAS provided unless this has been done for you.

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 OAS.

Read the instructions on the OAS 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.

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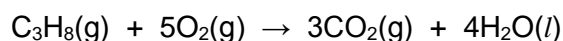
Section A

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

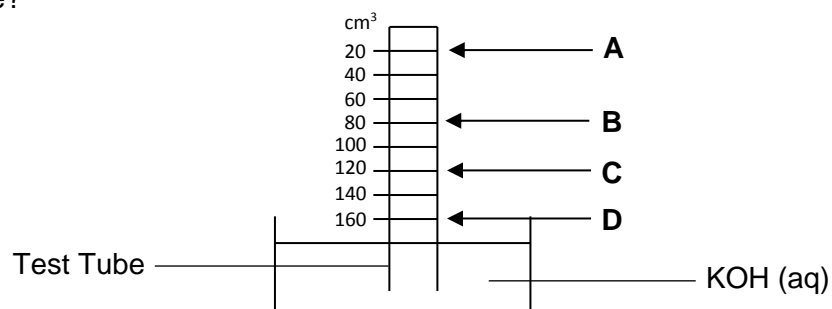
- 1 How many carbon atoms are present in 4.0 g of ethanoic acid? [L = Avogadro constant]

A $L/12$
B $L/15$
C $2L/15$
D $2/15L$

- 2 A test tube is filled with 20 cm³ of propane and 160 cm³ of oxygen at room temperature. The open end of the test tube is placed in a beaker of KOH (aq) as shown. The gas mixture was sparked according to the following reaction.



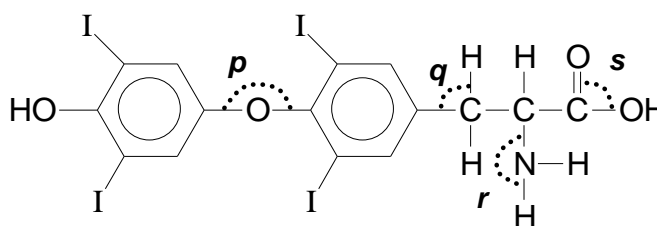
What will be the final level of liquid in the test tube after it has cooled back to room temperature?



- 3 A sample containing ammonium sulfate ($M_r = 132$) was warmed with 100 cm³ of 0.500 mol dm⁻³ sodium hydroxide. When the evolution of ammonia ceased, the excess sodium hydroxide solution was neutralised with 25.00 cm³ of 0.500 mol dm⁻³ hydrochloric acid. What was the mass of ammonium sulfate in the sample?

A 2.48 g
B 4.95 g
C 6.60 g
D 13.20 g

- 4 Which of the following ions has two more electrons in the third quantum shell than in the second quantum shell?
- A Ca^{2+}
 B K^+
 C Ti^+
 D V^{2+}
- 5 Which of the following ions would be deflected in an electric field to the same extent as CO^+ under the same conditions?
- A OF^-
 B Ca^{2+}
 C OH^-
 D BeF^+
- 6 Which of the following sets of compounds consists of a simple molecular structure, giant ionic structure and giant molecular structure?
- A SiO_2 , HBr , BeCl_2
 B SiCl_4 , AlF_3 , $\text{C}_{(\text{graphite})}$
 C SrO , ICl_3 , SnCl_2
 D $\text{C}_6\text{H}_5\text{CO}_2\text{H}$, P_4O_{10} , SiO_2
- 7 The thyroid gland concentrates iodine and uses it to produce thyroxine, which is a hormone that controls the metabolic rate.



Thyroxine

What are the values of the bond angles p , q , r and s ?

	p	q	r	s
A	180°	90°	180°	90°
B	105°	90°	107°	180°
C	180°	90°	120°	180°
D	105°	109.5°	107°	120°

- 8 Which of the following reactions can the bond energy of the Si–Cl bond be determined by using the standard enthalpy change of the reaction?
- A $\text{SiCl}_4(l) \rightarrow \text{SiCl}_4(g)$
 B $\text{SiCl}_4(g) \rightarrow \text{Si}(g) + 4\text{Cl}(g)$
 C $\text{SiCl}_4(g) \rightarrow \text{SiCl}_2(g) + \text{Cl}_2(g)$
 D $2\text{Cl}_2(g) + \text{Si}(s) \rightarrow \text{SiCl}_4(g)$
- 9 Which of the following shows the sequence of the magnitude of lattice energies of the following compounds in ascending order?
- I NaCl
 II RbCl
 III MgS
 IV BaS
- A I, II, III, IV
 B II, I, IV, III
 C III, IV, I, II
 D IV, III, II, I
- 10 The table below shows the standard enthalpy change of neutralisation, ΔH , for the various acids and bases listed.

Acid	Base	$\Delta H / \text{kJ mol}^{-1}$
hydrobromic acid	sodium hydroxide	–57.0
P	sodium hydroxide	less exothermic than –57.0
hydrofluoric acid	potassium hydroxide	less exothermic than –57.0
Q	potassium hydroxide	–57.0

What could be **P** and **Q**?

	P	Q
A	hydrochloric acid	nitric acid
B	ethanoic acid	hydrofluoric acid
C	hydrogen cyanide	ethanoic acid
D	ethanoic acid	hydrobromic acid

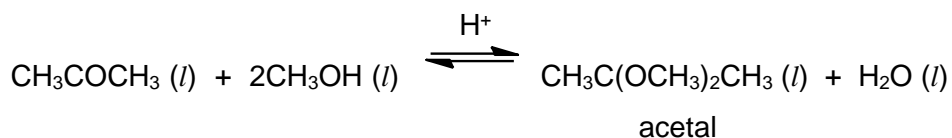
- 11 A chemical plant illegally dumped two radioactive isotopes **P** and **Q** in a landfill. The amount of **P** is 4 times the amount of **Q**. The radioactive decay of isotopes follows first-order kinetics. The half-life of **P** is 2 days whereas that of **Q** is 8 days. By the time the authorities found out about this illegal dumping and analysed a sample of the waste, the ratio of **P** to **Q** was found to be **1:2**. How long was the waste in the landfill before the authorities arrived?
- A** 8 days
B 16 days
C 32 days
D 64 days
- 12 The table below gives data for the reaction between **A** and **B** at a constant temperature.

Experiment	[A] / mol dm ⁻³	[B] / mol dm ⁻³	Initial rate / mol dm ⁻³ s ⁻¹
1	0.3	0.2	4.0 x 10 ⁻⁴
2	0.6	0.2	4.0 x 10 ⁻⁴
3	0.6	0.8	6.4 x 10 ⁻³

Which of the following correctly represents the units of the rate constant, k , in the rate equation?

- A** mol⁻¹ dm³ s⁻¹
B mol dm⁻³ s⁻¹
C mol s⁻¹
D s⁻¹

- 13 At 298 K, 0.20 mol dm^{-3} of propanone reacts with 0.30 mol dm^{-3} of methanol to form 0.04 mol dm^{-3} of acetal as shown below.



What is the equilibrium constant of the reaction at 298 K?

- A 0.0385
B 0.0455
C 0.148
D 0.207
- 14 Fe^{3+} and SCN^- react in a closed system to give the complex, $[\text{Fe}(\text{SCN})]^{2+}$, which is blood-red in colour.
- $$\text{Fe}^{3+}(\text{aq}) + \text{SCN}^-(\text{aq}) \rightleftharpoons [\text{Fe}(\text{SCN})]^{2+}(\text{aq}) \quad \Delta H < 0$$
- Which one of the following changes will result in the solution turning pale red?
- A Increase the concentration of SCN^-
B Decrease the pressure of the system
C Decrease the temperature of the system
D Add a small amount of dilute NaOH to the resulting mixture
- 15 A mixture was made by adding 10 cm^3 of a solution of pH 1 to 30 cm^3 of another solution of pH 5. What is the final pH of the mixture?
- A 1.6
B 2.5
C 3.0
D 4.0
- 16 Which of the following is a general trend from left to right of the elements in the third period of the Periodic Table?
- A The radii of the atoms increase.
B The melting points of the chlorides decrease.
C The electrical conductivity of the elements decrease.
D The first ionisation energies of the elements increase.

- 17 Which element has a chloride with a simple molecular structure that is readily hydrolysed in water?
- A sodium
 - B magnesium
 - C aluminium
 - D silicon
- 18 Which property decreases from Na_2O to P_4O_{10} for the oxides of period 3 elements?
- A melting point
 - B covalent character
 - C solubility in aqueous alkali
 - D pH when mixed with water
- 19 Linoleic acid is an essential fatty acid with the structural formula.
 $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{CO}_2\text{H}$
Which of the following statements about linoleic acid is correct?
- A It undergoes electrophilic substitution with liquid bromine.
 - B It undergoes oxidation with acidified potassium dichromate(VI) solution.
 - C 1 mole of linoleic acid requires 48 dm^3 of hydrogen for hydrogenation at room temperature.
 - D 1 mole of linoleic acid reacts with 1 mole of sodium carbonate to form 24 dm^3 of carbon dioxide at room temperature.
- 20 Which property of benzene is reflected as a consequence of the delocalised electrons in its molecule?
- A Benzene is a planar molecule.
 - B Benzene is a good conductor of electricity.
 - C Substitution in benzene takes place at a carbon atom.
 - D Addition reactions of benzene take place more easily than substitution.
- 21 The volatile liquid, fluothane, CF_3CHBrCl , is a widely used anaesthetic.
Which statement about fluothane is **incorrect**?
- A It has a simple molecular structure.
 - B It may cause depletion of ozone layer.
 - C It may undergo substitution with chlorine.
 - D It can form hydrogen bonds between its molecules.

- 22** A compound **V** gives yellow precipitate with alkaline aqueous iodine. One mole of **V** liberates one mole of hydrogen when it reacts with excess sodium.

What could be the formula of **V**?

- A** $\text{CH}_3\text{CH}(\text{OH})\text{CHO}$
- B** $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$
- C** $\text{HOCH}_2\text{CH}_2\text{CO}_2\text{H}$
- D** $\text{HOCH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{OH}$

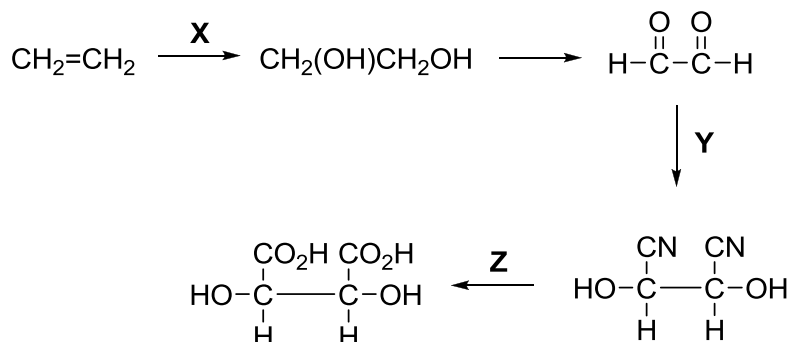
- 23** A compound, **W**, has the following properties.

- It reacts with hydrogen in the presence of nickel catalyst.
- It reacts with phosphorus pentachloride to give off HCl fumes.
- It reacts with sodium hydroxide to form an ionic compound.
- It reacts with ethanol.

What formula could represent **W**?

- A** CH_3CHO
- B** CH_3COCH_3
- C** $\text{CH}_2=\text{CHCO}_2\text{H}$
- D** $\text{CH}_2=\text{CHCH}_2\text{OH}$

- 24 The following is a method of synthesising tartaric acid, a compound found in wine.



Which set of reagents and conditions can be used for the synthesis?

	X	Y	Z
A	cold concentrated H_2SO_4 , followed by boiling H_2O	cold HCN , NaOH(aq)	hot $\text{K}_2\text{Cr}_2\text{O}_7$, $\text{H}_2\text{SO}_4(\text{aq})$
B	cold KMnO_4 , $\text{H}_2\text{SO}_4(\text{aq})$	cold HCN , NaOH(aq)	HCl(aq) , heat
C	cold concentrated H_2SO_4 , followed by boiling H_2O	ethanolic KCN , heat	hot $\text{K}_2\text{Cr}_2\text{O}_7$, $\text{H}_2\text{SO}_4(\text{aq})$
D	cold KMnO_4 , NaOH(aq)	ethanolic KCN , heat	HCl(aq) , heat

- 25 Which of the following shows the descending order of acid strength?

- A** $\text{CH}_3\text{CO}_2\text{H} > \text{CH}_2\text{ClCO}_2\text{H} > \text{CH}_3\text{CH}_2\text{OH}$
B $\text{CH}_3\text{CH}_2\text{OH} > \text{CH}_2\text{ClCO}_2\text{H} > \text{CH}_3\text{CO}_2\text{H}$
C $\text{CH}_2\text{ClCO}_2\text{H} > \text{CH}_2\text{FCO}_2\text{H} > \text{CH}_3\text{CH}_2\text{OH}$
D $\text{CH}_2\text{ClCO}_2\text{H} > \text{CH}_2\text{BrCO}_2\text{H} > \text{CH}_3\text{CO}_2\text{H}$

Section B

For each of the following questions, 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

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

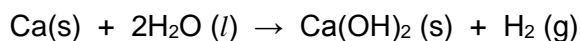
No other combination of statements is used as a correct response.

- 26** Materials are insulators when the outer shells of electrons of all the constituent particles are completely filled and there is a considerable energy gap before the next unoccupied shell.

Which compounds have completely filled shells and might therefore act as insulators?

- 1** MgO
- 2** SiO₂
- 3** SiC (diamond structure)

- 27** Calcium reacts with water to form calcium hydroxide and hydrogen.



The standard enthalpy change for this reaction can be determined experimentally.

What further information are needed to calculate the standard enthalpy change of formation of calcium hydroxide, ΔH_f^\ominus ?

- 1** ΔH_f^\ominus for H₂O(l)
- 2** ΔH_f^\ominus for H₂(g)
- 3** First and second ionisation energies for Ca

- 28** Which of the following pairs would form an acidic buffer when mixed together?

- 1** CH₃CO₂H and NaCl
- 2** HCN and KCN
- 3** C₆H₅CO₂H and (C₆H₅CO₂)₂Ca

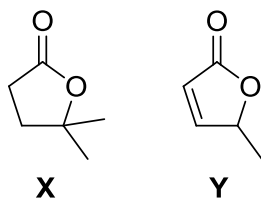
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

29 A halogenoalkane has the formula of $C_3H_5Cl_3$.

Which of the isomers have the correct IUPAC name?

- 1 1,1,1-trichloropropane
- 2 1,2,2-trichloropropane
- 3 2,2,3-trichloropropane

30 Below are the structures of compounds **X** and **Y**.



Which sets of reagents and conditions can be used to distinguish between them?

- 1 aqueous bromine
- 2 acidified $K_2Cr_2O_7$, heat
- 3 alkaline aqueous iodine, heat

--- End of Paper ---