Catholic Junior College

JC 2 Preliminary Examinations

Higher 1

CHEMISTRY

8872/01

Paper 1 Multiple Choice

Tuesday 29 August 2017
50 minutes

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name, HT group and NRIC/FIN number on the Answer Sheet in the spaces provided.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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.

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.
The use of an approved scientific calculator is expected, where appropriate.

WORKED SOLUTIONS

This document consists of **17** printed pages and 1 blank page

[Turn over

Section A

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

1 A giant molecule contains a large amount of carbon; mainly of isotopes ^{12}C and ^{13}C. It was found that the relative atomic mass of carbon in the molecule is 12.2.
What is the ratio of ^{12}C to ^{13}C?

A 4:1 **B** 3:1 **C** 3:4 **D** 1:4

Answer: A

Let the percentage of ^{12}C be x.

Hence, the percentage of ^{13}C is $(100 - x)$

$\left(\frac{x}{100} \times 12\right) + \left(\frac{100-x}{100} \times 13\right) = 12.2$

x = 80%

Hence, ^{12}C to ^{13}C is 80:20 which is 4:1

2 10 cm^3 of a pure hydrocarbon **X** was completely burnt in 80 cm^3 of excess oxygen to give carbon dioxide gas and water vapour. After cooling to room temperature, the volume of gaseous mixture decreased from 105 cm^3 to 55 cm^3. A further reduction of 40 cm^3 was observed when the residual gas was passed through aqueous sodium hydroxide.
All gas volumes were measured at the same temperature and pressure.
What is the formula of **X**?

A C_2H_6 **B** C_3H_8 **C** C_4H_{10} **D** C_5H_{12}

Answer: C

$$C_xH_y(g) + (x + \tfrac{y}{4})O_2(g) \rightarrow xCO_2(g) + \tfrac{y}{2}H_2O(l)$$

Initial (cm^3)	10	80	0	0
Final (cm^3)	0	55-40 = 15	40	105-55 = 50 cm^3 after cooling
Vol used (cm^3)	10	80-15=65	40	50
Ratio	1	6.5	4	5

By inspection, x = 4.

$\therefore \frac{y}{2} = 5 \quad \therefore y = 10$

$\therefore$ molecular formula of the hydrocarbon is C_4H_{10}.

3 A plasma is a gaseous mixture in which atoms have been completely stripped of their electrons, leaving bare nuclei. When passed through an electric field, the ^{1}H nucleus is deflected at an angle of $+4^{o}$. What will be the angle of deflection for the ^{3}H nucleus in the same plasma?

A $+0.75^{o}$ **B** $+1.3^{o}$ **C** $+4^{o}$ **D** $+12^{o}$

Answer: B

angle of deflection = $k\left(\frac{\text{charge}}{\text{mass}}\right)$

For the ^{1}H nucleus, $4 = k\left(\frac{+1}{1}\right)$. Hence k is 4.

For the ^{3}H nucleus, angle = $4\left(\frac{+1}{3}\right) = 1.3^{o}$.

4 *Use of the Data Booklet is relevant to this question.*
What do the ions $^{23}Na^{+}$ and $^{24}Mg^{2+}$ have in common?

A Both ions have more electrons than neutrons.
B Both ions have 12 neutrons in their nuclei.
C Both ions contain the same number of nucleons in their nuclei.
D Both ions have an outer electronic configuration of $3s^2\,3p^6$.

Answer: B

	$^{23}Na^{+}$	$^{24}Mg^{2+}$
No. of protons	11	12
No. of electrons	11 – 1 = 10	12 – 2 = 10
No. of neutrons	23 – 11 = 12	24 – 12 = 12
No. of nucleons (protons + neutrons)	23	24
Electronic Configuration	$1s^2\ 2s^2 2p^6$	$1s^2\ 2s^2 2p^6$

5 *Use of the Data Booklet is relevant to this question.*

Which of the following particles would, on losing an electron, have a half-filled set of p orbitals?

A C^- **B** N **C** N^- **D** O^+

Answer: C

	Full electronic configuration of species	Full electronic configuration after losing an electron
C^-	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^1$ (already has half filled set of p orbitals)	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^0$
N	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^1$ (already has half filled set of p orbitals)	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^0$
N^-	$1s^2\ 2s^2 2p_x^2 2p_y^1 2p_z^1$	$1s^2\ 2s^2$ **$2p_x^1 2p_y^1 2p_z^1$** (has half filled set of p orbitals)
O^+	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^1$ (already has half filled set of p orbitals)	$1s^2\ 2s^2 2p_x^1 2p_y^1 2p_z^0$

6 The first seven successive ionisation energies (in kJ mol^{-1}) of an element **J** are given below:

1020 1950 2730 4580 6020 12300 15400

Which of the following statements about **J** is correct?

A It has a valence shell electronic configuration of $ns^2\ np^4$

B Its atomic radius is larger than its ionic radius.

C It has a lower second ionisation energy than that of its preceding element.

D It can form a chloride that has a trigonal pyramidal shape.

Answer: D

Most significant increase in IE is between 6020 and 12300 (5^{th} and 6^{th} IE). Hence element **J** is from Group 15 with 5 valence electrons.

A Incorrect. The valence shell configuration is **ns^2np^3.** (5 valence electrons)

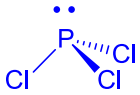
B Incorrect. It is likely to gain 3 electrons to form J^{3-} anion and hence the atomic radius is expected to be smaller than the anionic radius.

C Electronic configuration of $J^+(g)$: **ns^2np^2**

Electronic configuration of the singly charged preceding element: **ns^2np^1**

Element **J** is NOT expected to have a lower second ionisation energy than that of its preceding element.

D Correct. With 5 valence electrons, **J** is likely to form a chloride with 3 bond pairs and 1 lone pair (for central atom **J** to achieve octet). Hence **J** can form a chloride that has as trigonal pyramidal shape. Eg: phosphorus is a group 15 element:



7 In which of the following pairs of compounds is the bond angle in particle **I** greater than that in particle **II**?

	I	II
A	PH_3	BH_3
B	NO_3^-	ClO_2^-
C	SF_6	I_3^-
D	ClF_3	$BeCl_2$

Answer: B

This qns can be done by counting the number of bond pairs and lone pair of electrons.

	I	Bp and lp	Shape and angle	II	Bp and lp	Shape and angle
A	PH_3	3 bp 1 lp	Trigonal pyramidal < 109^o	BH_3	3 bp 0 lp	Trigonal planar 120^o
B	NO_3^-	3 bp 0 lp	Trigonal planar 120^o	ClO_2^-	2 bp 2 lp	Bent < 109^o
C	SF_6	6 bp 0 lp	Octahedral 90^o	I_3^-	2 bp 3 lp	Linear 180^o
D	ClF_3	3 bp 2 lp	T shaped < 90^o	$BeCl_2$	2 bp 0 lp	Linear 180^o

8 Which one of the following statements about aluminium chloride is correct?

A $AlCl_3$ is pyramidal.

B $AlCl_3$ has a higher melting point than Al_2O_3.

C The Al_2Cl_6 dimer contains hydrogen bonding.

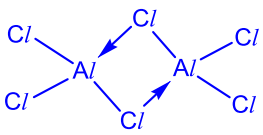
D The $AlCl_3$ is known as a halogen carrier in the chlorination of benzene.

Answer: D

A $AlCl_3$ has 3 bond pairs and no lone pairs. It is trigonal planar in shape.

B $AlCl_3$ is simple molecular and hence will have a lower melting point than Al_2O_3 which is giant ionic.

C The Al_2Cl_6 dimer **<u>contains</u>** two co-ordinate bonds, not hydrogen bonds.



D The $AlCl_3$ catalyst is also known as a halogen carrier in the chlorination of benzene.

9 Which of the following processes is endothermic?

A $H_2O(l) \rightarrow H^+(aq) + OH^-(aq)$

B $SO_2(g) + ½O_2(g) \rightarrow SO_3(g)$

C $2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

D $Li^+(g) + Cl^-(g) \rightarrow LiCl(s)$

Answer: A

A This shows bond breaking / dissociation which is endothermic.

B SO_2 undergoes combustion and combustion reactions are exothermic.

C Neutralisation reaction is exothermic as the ionic eqution is $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. Bond formation (to form the molecule from the ions) is exothermic.

D Electrostatic forces of attraction between oppositely charged ions result in the formation of ionic bonds. Bond formation is exothermic. Also, the equation represent lattice energy of LiCl where 1 mol of ionic solid LiCl is formed from its separate gaseous ions.

10 Iron can be obtained by the reduction of its oxide by carbon monoxide:

$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g) \qquad \Delta H = -27 \text{ kJ mol}^{-1}$$

By using the data (enthalpy change of formation) given in the table, find the enthalpy change of formation of $Fe_2O_3(s)$.

	ΔH_f / kJ mol^{-1}
CO(g)	–111
CO_2(g)	–394

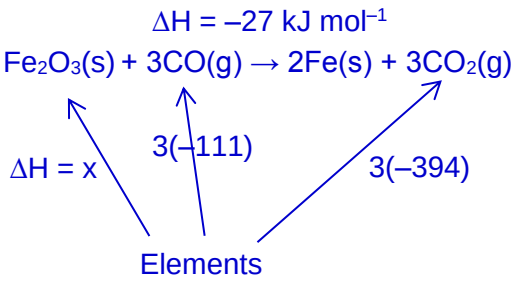
A –310 kJ mol^{-1}

B –411 kJ mol^{-1}

C –822 kJ mol^{-1}

D –849 kJ mol^{-1}

Answer: C



Using Hess' Law,

$x + 3(-111) + (-27) = 3(-394)$

$x = -822$ kJ mol^{-1}

11 Which of the following options is correct for the following equilibrium?

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -950 \text{ kJ mol}^{-1}$$

	Condition	Position of equilibrium	K_c
A	Increase in temperature	Right	Increase
B	Addition of catalyst	Right	No change
C	Addition of HC*l*(g)	No change	No change
D	Decrease in pressure	Right	No change

Answer: D

	Condition	Position of equilibrium	K_c
A	Increase in temperature	Right (False) Position of eqm will shift to favour the endothermic side which is the left hand side.	Increase (False) K_c should decrease.
B	Addition of catalyst	Right (False) No change in position of equilibrium	No change (True) K_c is independent of catalyst.
C	Addition of HCl (g)	Right (False) Basic NH_3 gas reacts with HCl gas to form a white solid of NH_4Cl. Hence, some $NH_3(g)$ is removed from the equilibrium mixture and the position of equilibrium shifts left.	No change (True)
D	Decrease in pressure	Right (True) Position of eqm will shift to favour the side with greater no. of moles of gaseous molecules which is the right hand side.	No change (True)

12 The Haber process is the industrial manufacture of ammonia. The following equilibrium exists at the expected conditions needed for the Haber process:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Which of the following changes would increase both the proportion of ammonia present at equilibrium and the value of equilibrium constant, K_c?

A adding more finely divided iron

B changing the temperature to 100 ^oC.

C changing the temperature to 600 ^oC.

D setting the total pressure to 400 atm

Answer: B

As this reaction is in the syllabus, students are expected to know that the reaction is exothermic.

Typical conditions used in the Haber process are

- a pressure of 200-300 atm.
- a moderate temperature of *about* 450 - 500 ^{o}C.
- Iron *catalyst* (finely-divided)

	Change	Proportion of ammonia present	K_c
A	adding more finely divided iron	Not affected	Not affected
B	changing the temperature to 100 ^{o}C	The drop in temperature would favour the forward exothermic reaction and hence increase the proportion of ammonia	Increases
C	changing the temperature to 600 ^{o}C.	The increase in temperature would favour the backward endothermic reaction and hence decrease the proportion of ammonia	Decreases
D	setting the total pressure to 400 atm	The increase in pressure would favour the formation of newer number of moles of gas (forward reaction) and hence increase the proportion of ammonia.	Not affected

13 0.100 moles of HC*l* was mixed with 0.300 moles of NaOH and the total volume was 2 dm^3. What is the pH of the resulting solution?

A 13.3 **B** 13.0 **C** 1.0 **D** 0.7

Answer: B

HC*l* + NaOH → NaC*l* + H2O

Since HC*l* ≡ NaOH, NaOH is present in excess by 0.300 – 0.100 = 0.200 moles.

NaOH → $Na^+ + OH^-$

$[OH^-] = \frac{0.200}{2} = 0.100$ mol dm^{-3}

pOH = -lg(0.100) = 1.0

pH = 14 – pOH (at 25 ^{o}C) = 13.0

14 For the reaction **L**(aq) + **2M**(aq) → **N**(aq), the rate equation is

$$\text{Rate} = k\,[H^+][\mathbf{M}]^2$$

Which of the following is **false**?

A H^+ is a catalyst in the reaction.

B When the concentration of **L** is halved, the rate remains unchanged.

C The unit for the rate constant is mol^{-2} dm^6 s^{-1}.

D If the concentration of **M** is doubled, the rate of the experiment increases by two times.

Answer: D

A True. It is not a reagent as seen in the overall reaction, but it affects the rate.

B True. Reaction is zero order wrt [**L**] as [**L**] is not involved in the rate equation. Hence, any change in [**L**] will not affect the rate.

C True.

$$\text{Rate} = k\,[H^+][\mathbf{M}]^2$$

$$\text{mol dm}^{-3}\ \text{s}^{-1} \qquad \text{mol dm}^{-3} \qquad (\text{mol dm}^{-3})^2$$

Hence units of k has to be $\text{mol}^{-2}\ \text{dm}^6\ \text{s}^{-1}$ in order for the units on the left and the right of the equal sign to be the same.

D False. Reaction is second order wrt [**M**]. So when [**M**] is doubled, the rate of the reaction should increase by 4 times.

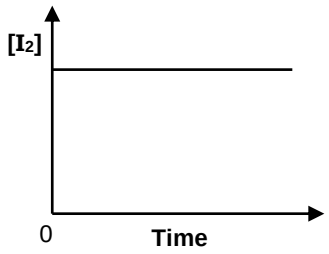
15 Iodine reacts with propanone according to the following equation.

$$I_2 + CH_3COCH_3 \rightarrow CH_3COCH_2I + HI$$

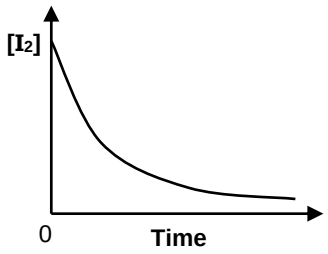
The reaction of iodine with propanone is found to be zero order with respect to iodine.

Which graph correctly shows how the $[I_2]$ changes with time?

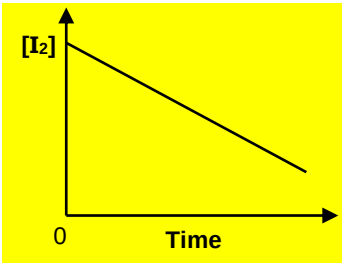
A



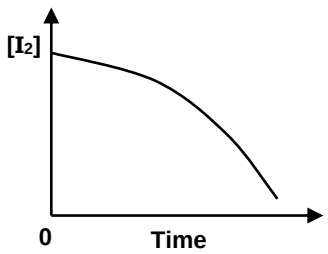
C



B



D



Answer: B

Zero order with respect to iodine means that the rate of the reaction (gradient in the $[I_2]$ – time graph) is constant.

Incorrect answers:

A Gradient is zero. It means that rate of reaction is zero.

C Gradient (rate) is decreasing as [I_2] decreases.

D Gradient (rate) is increasing as [I_2] decreases.

16 An unknown element **X** undergoes radioactive decay to form element **Y**. The radioactive decay is a first-order reaction with a half-life of 47.0 minutes.
How long will it take for the molar proportion of **X** to **Y** to be 1:7?

A 23.5 min **B** 47.0 min **C** 94.0 min **D** 141.0 min

Answer: D

Let a be the initial amt of X

X: $a \longrightarrow \frac{1}{2}a \longrightarrow \frac{1}{4}a \longrightarrow \frac{1}{8}a$

Y: $0 \longrightarrow \frac{1}{2}a \longrightarrow \frac{3}{4}a \longrightarrow \frac{7}{8}a$

Thus, 3 half-lives have passed. Time taken = 47 × 3 = 141 min

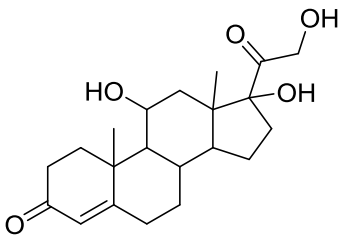
17 The proton number of the element **E** is less than 20.
When the chloride of **E** is dissolved in water, a slightly acidic solution is obtained.
When the oxide of **E** is dissolved in water, an alkaline solution is obtained.
In which Group of the Periodic Table is **E** likely to be found?

A 1 **B** 2 **C** 13 **D** 14

Answer: B

Chlorides that dissolve to give acidic solution → $MgCl_2$, $AlCl_3$, $SiCl_4$, PCl_5
Oxides that dissolves to give alkaline solution → Na_2O MgO
Thus the element E is most likely Mg, a Group 2 element.

18 Cortisol is a hormone that can increase blood sugar and aids in the metabolism of fat, protein, and carbohydrates.



cortisol

Which of the following will not react with cortisol?

A solid sodium carbonate

B red phosphorus and excess Br_2

C cold, alkaline potassium managate(VII)

D 2,4-dinitrophenylhydrazine

Answer: A

Cortisol contains alcoholic –OH groups, ketone functional groups and an alkene functional group. It does not have a carboxylic acid functional group. Thus,

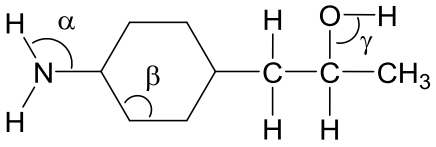
A no reaction

B PBr_3 formed will react with –OH groups

C mild oxidation of alkene functional group to form diol

D condensation reaction with ketone to form orange crystals

19 What are the angles α, β and γ in the following molecule?



	α	β	γ
A	120	120	90
B	109	109	107
C	107	120	105
D	107	109	105

Answer: D

α: There are 3 bond pairs, 1 lone pair around N central atom $\rightarrow$ 107°
β: There are 4 bond pairs, no lone pair around C central atom $\rightarrow$ 109°
γ: There are 2 bond pairs, 2 lone pair around O central atom $\rightarrow$ 105°

20 A catalytic converter is part of the exhaust system of many modern cars. Which one of the following reactions occurs in the catalytic converter?

A $2C_xH_y + (4x + y)NO \rightarrow 2xCO_2 + yH_2O + (2x + \frac{y}{2})N_2$

B $2SO_2 + 2NO \rightarrow 2SO_3 + N_2$

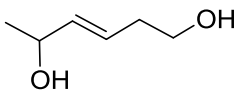
C $CO_2 + NO \rightarrow CO + NO_2$

D $2C + O_2 \rightarrow 2CO$

Answer: A

Catalytic converters convert harmful exhaust gases into inert ones, such as carbon dioxide and water vapor. Thus options **B** – **C** are incorrect as harmful gases such as SO_3, NO_2 and CO are formed.

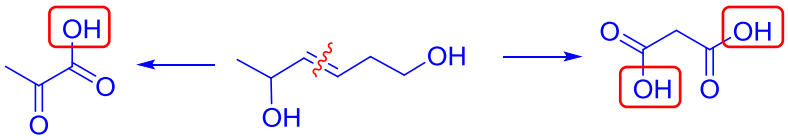
21 Hex-3-en-1,5-diol has the following structure.



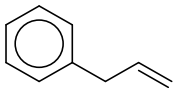
How many moles of PCl_5 will react with the products formed from heating 1 mole of hex-3-en-1,5-diol in the presence of acidified potassium manganate(VII)?

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

Answer: C

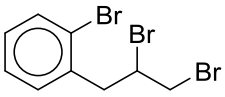
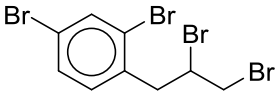


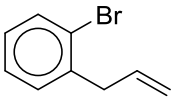
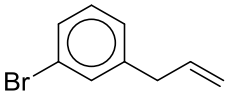
22 Bromine, along with iron(III) bromide, is dissolved in compound **P** and left to stand in the dark.

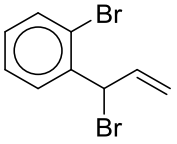
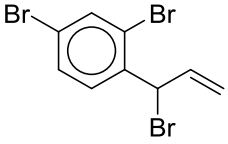


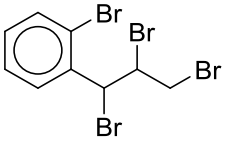
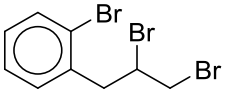
compound **P**

Which of the following pairs is likely to be the major products formed?

A  and 

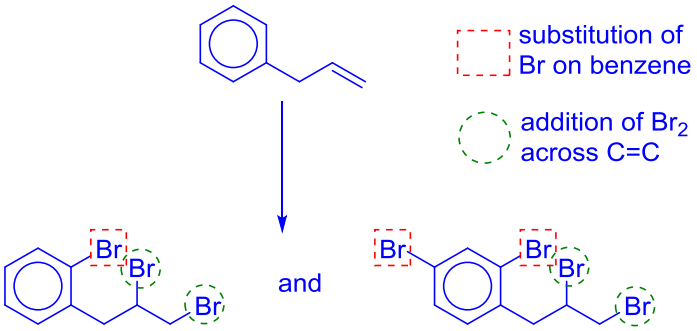
B  and 

C  and 

D  and 

Answer: A

When **P** is reacted with bromine in the dark, addition across the C=C occurrs. In the presence of $FeBr_3$ catalyst, substitution of the benzene will occur too. To form the major product from the substitution of Br on the benzene, Br has to be at position 2 and/or 4 with respect to the alkyl sidechain. Substitution of the alkyl group will not occur due to the absence of UV light.



23 Chlorofluorocarbons (CFCs) have been widely used in aerosol sprays, refrigerators and in making foamed plastics, but are now known to destroy ozone in the upper atmosphere. Which of the following will not destroy ozone, and therefore can be used as a replacement for CFCs?

A $CHBr_2CH_2CH_2CCl_3$

B $CH_3CHFCH_2CH_2F$

C $CH_2ClCH_2CHFCH_3$

D $CHF_2CH_2CH_2CHBr_2$

Answer: B

CFCs will release C*l* or Br radicals when exposed to UV light in the upper atmosphere (stratosphere) as the C-C*l* bonds and C-Br bonds will break (homolytically). These radicals are responsible for the breaking down of the ozone layer. Only C-F bonds are not broken when exposed to UV light in the stratosphere. Thus, a suitable CFC replacement would be option B where there is no C*l* or Br in the molecule.

24 A glass of wine was exposed to air for a period of time. This causes the wine to have a sour taste. A student proposed that a portion of ethanol present in the wine has been oxidised, thus giving rise to the sour taste.

Which of the following reagents can be used to confirm the above hypothesis?

A Na **B** NaOH **C** K_2CO_3 **D** $KMnO_4$

Answer: C

To prove the hypothesis correct, the student has to test for the presence of carboxylic acid (ethanol is oxidised to ethanoic acid, giving rise to the sour taste).

A Na : both ethanol and ethanoic acid will result in effervescence of $H_2(g)$

B NaOH : only ethanoic acid will react, however, there is no observable change and thus cannot be used as a distinguishing test

C K_2CO_3 : ethanoic acid reacts and the effervescence released (CO_2) produce white ppt when passed through $Ca(OH)_2$ solution.

D $KMnO_4$: only ethanol will decolourise purple $KMnO_4$

25 Butanoic acid was heated under reflux with a mixture of ethanol and propanol in the presence of concentrated sulfuric acid. Which of the following is a possible product of this reaction?

A ethyl propanoate

B propyl butanoate

C butyl butanoate

D propyl ethanoate

Answer: B

The only two possible products are ethyl butanoate and propyl butanoate.

alcohol carboxylic acid

alcohol carboxylic acid

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

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 Chlorine gas reacts with sodium hydroxide according to the following equation.

$$3Cl_2 + 6OH^- \rightarrow 5Cl^- + ClO_3^- + 3H_2O$$

Which of the following statements is true for this reaction?

1 C*l* is oxidised.

2 C*l* is reduced.

3 Oxidation state of O does not change.

Answer: A

Statement 1 is true. C*l* is oxidised from 0 in Cl_2 to +5 in ClO_3^-.

Statement 2 is true. C*l* is reduced from 0 in Cl_2 to –1 in Cl^-.

Statement 3 is true. Oxidation state of O is is –2 in OH^-, H_2O and ClO_3^-.

27 Which of the following shows a correct example of a conjugate acid / base pair?

1 CH_3CO_2H, $CH_3CO_2^-Na^+$

2 CH_3NH_2, $CH_3NH_3^+Cl$

3 H_2O, OH^-

Answer: A (1, 2 and 3)

1 CH_3CO_2H (acid), $CH_3CO_2^-Na^+$ (conjugate base)

2 CH_3NH_2 (base), $CH_3NH_3^+Cl$ (conjugate acid)

3 H_2O (acid), OH^- (conjugate base)

28 *Use of the Data Booklet is relevant to this question.*

Based on its position in the Periodic Table, which properties will element **X** (atomic number 14) have?

1 Its oxide has a simple molecular structure.

2 Its chloride hydrolyses in water to give an acidic solution.

3 Element **X** has high melting and boiling point.

Answer: C (2 and 3 only)

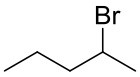
Element X is silicon.

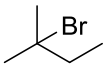
Statement 1: False. SiO_2 is a giant covalent compound.

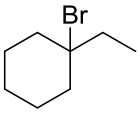
Statement 2: True. $SiCl_4$ hydrolyses complete in water to give a pH 2 solution.

Statement 3: True. Si has a giant covalent structure, thus have high m.p. and b.p.

29 An unknown halogen derivative, **Q**, was heated with alcoholic potassium hydroxide. A product that exhibits geometric isomerism is obtained. Which of the following is a possible identity of compound **Q**?

1 

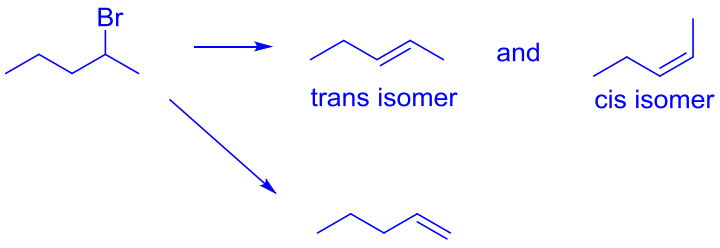
2 

3 

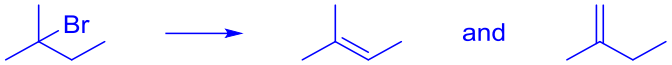
Answer: D (1 only)

Compound Q undergoes elimination to form alkene.

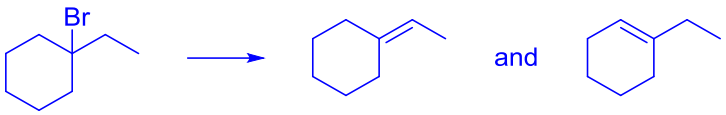
Option 1: 2 different alkenes are produced. One of the alkenes exhibits geometric isomerism.



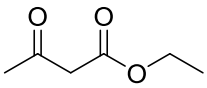
Option 2: Both alkenes formed do not exhibit geometric isomerism.



Option 3: Both alkenes formed do not exhibit geometric isomerism.



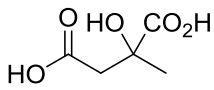
30 Compound **Y** is reacted with aqueous hydrogen cyanide in alkaline condition at 20 °C to produce compound **Z**. Compound **Z** is then heated under reflux with dilute sulfuic acid and the products isolated.

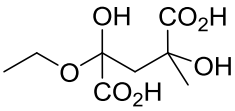


Compound **Y**

Which of the following are the possible products from the above reaction?

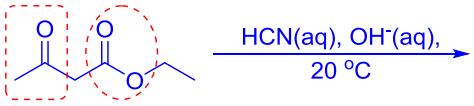
1 CH_3CH_2OH

2 

3 

Answer: B

addition of HCN across C=O (nucleophilic addition)

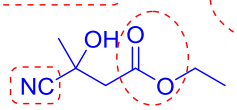


Y

ester does not undergo addition with HCN

acid hydrolysis of nitrile to form carboxylic acid

acid hydrolysis of ester to form carboxylic acid and alcohol



Z