SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 1

Candidate Name

Class

CHEMISTRY 8872/01

JC2 Preliminary Examination 23 September 2016
Paper 1 Multiple Choice 50 minutes
Additional Materials: Data Booklet
Optical Mark Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

On the separate multiple choice OMS given, write your name, subject title and class in the spaces provided.
Shade correctly your FIN/NRIC number.

There are **30** questions in 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 using a **soft pencil** on the separate OMS.
Each correct answer will score one mark.
A mark will not be deducted for a wrong answer.

You are advised to fill in the OMS as you go along; no additional time will be given for the transfer of answers once the examination has ended.

Any rough working should be done in this question paper.

Answer all questions

1	Which statement about one mole of a metal is always correct?	
	A	It contains the same number of atoms as 16g of oxygen atoms.
	B	It contains the same number of atoms as 1/12 mol of ^{12}C.
	C	It has the same mass as 1 mol of hydrogen atoms.
	D	It is liberated by 1 mol of electrons.

Answer: A

Statement A is correct.
Statement B is wrong as 1/12 mol of ^{12}C contains (1/12) x 6.02 x 10^{23} atoms as for one mole of a metal it contains 1 x 6.02 x 10^{23}.
Statement C is wrong as the mass is different as it is dependent on the A_r or M

2	To identify an oxide of nitrogen, 0.10 mol of the oxide is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature. $N_xO_y \xrightarrow{H_2(g)} x\,NH_3 + yH_2O$ The water produced weighs 7.20 g. The ammonia produced is neutralised by 200 cm^3 of 1.0 mol dm^{-3} HC*l*. What is the formula of the oxide of nitrogen?	
	A	N_2O
	B	NO
	C	NO_2
	D	N_2O_4

Answer: D

Amt of H_2O = $\frac{7.2}{18} = 0.40$ mol

Amt of NH_3 = $\frac{200}{1000} \times 1 = 0.20$ mol

Assuming all gases and using Avogadro's Law
Comparing mole ratio of N_xO_y with NH_3

$\frac{1}{x} = \frac{0.10}{0.20}$ Hence, x = 2

Comparing mole ratio of N_xO_y with H_2O

$\frac{1}{y} = \frac{0.10}{0.40}$ Hence, y = 4

Formula is N_2O_4

3 50 cm^3 of a 0.10 mol dm^{-3} solution of a metallic salt was found to react exactly with 25.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium sulfite. In this reaction, the sulfite ion is oxidised as follows:

$$SO_3^{2-}(aq) + H_2O(l) \longrightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e$$

What is the new oxidation number of the metal in the salt if its original oxidation number was +3?

	A	+1
	B	+2
	C	+4
	D	+5

Answer: B

Amount of sulphite ions = $\frac{25}{1000} \times 0.10 = 0.0025$ mol

Amount of metallic salt = $\frac{50}{1000} \times 0.10 = 0.005$ mol

Let x be the new oxidation no of metal in salt.

[R]: $M^{3+} + (3-x)e \rightarrow M^x$

Since moles of electrons gained = moles of electrons lost in a redox reaction,

$$\frac{3-x}{2} = \frac{0.0025}{0.005}$$

x = +2

4 Under the same conditions, which of the following ions would be deflected in a mass spectrometer to the same extent as $^{12}_{6}C^{2+}$?

(i) $^{6}_{3}Li^{+}$

(ii) $^{12}_{6}C^{+}$

(iii) $^{12}_{7}N^{2+}$

(iv) $^{13}_{6}C^{2+}$

	A	(i), (ii), (iii) and (iv)
	B	(i) and (iii) only
	C	(ii) only
	D	None of the above.

Answer: B

Angle of deflection α e/m

e/m ($^{12}_{6}C^{2+}$) = 2/12 = 1/6

e/m ($^{6}_{3}Li^{+}$) = 1/6

	e/m ($^{12}_{6}C^{+}$) = 1/12 e/m ($^{12}_{7}N^{2+}$) = 2/12 =1/6 e/m ($^{13}_{6}C^{2+}$) = 2/13

5	Paramagnetism refers to the magnetic state of an atom with one or more unpaired electrons. The greater the number of unpaired electrons in an atom, the greater the paramagnetism. Which atom has the greatest paramagnetism?		
	A	Oxygen	
	B	Chlorine	
	C	Scandium	
	D	Arsenic	

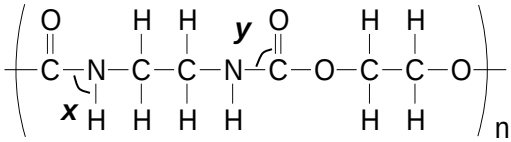
Answer: D

O: $1s^2 2s^2 2p^4$ → 2 unpaired electrons in the 2p orbital

Cl: $[Ne]3s^2 3p^5$ → 1 unpaired electron in the 3p orbital

Sc: $[Ar]3d^1 4s^2$ → 1 unpaired electron in the 3d orbital

As: $[Ar]3d^{10} 4s^2 4p^3$ → **<u>3 unpaired electrons</u>** in the 4p orbital

6	Polyurethane is used in coatings, insulators and adhesives.  ***Polyurethane*** What are the values of the bond angles marked ***x*** and ***y*** in polyurethane?			
			x	**y**
	A		90	90
	B		120	120
	C		107	120
	D		109.5	90

Answer:C
Around **N**: 3 bond pair and 1 lone pair
∴ shape is **trigonal pyramidal** and bond angle is **107°**
Around **C**: 3 bond pair and 0 lone pair
∴ shape is **trigonal planar** and bond angle is **120°**

7 The Valence Shell Electron Pair Repulsion Theory (VSEPR) is used to predict the shapes of molecules.

Which shape is correctly predicted by VSEPR?

	number of regions of electron density	number of lone pairs	shape
A	3	1	Tetrahedral
B	3	1	Trigonal pyramidal
C	5	1	See-saw
D	5	1	Square pyramidal

Answer: C

5 regions of electron density consisting of 1 lone pair → see-saw shape

For example,  has a see-saw shape

8 Consider the following four compounds.

1) 1-chlorobutane

2) pentane

3) 2,2-dimethylpropane

4) butan-2-ol

What is the order of increasing boiling point of these compounds?

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

Answer: C

3 → 2 → 1 → 4

1-chlorobutane has intermolecular **permanent dipole – permanent dipole** interaction.

2,2-dimethylpropane and pentane have intermolecular **instantaneous dipole – induced dipole interaction**. However, **pentane is linear while 2,2-dimethylpropane is branched**. Thus, the extensiveness of the instantaneous dipole – induced dipole interaction is more extensive in pentane than in 2,2-dimethylpropane as the electron cloud in 2,2-dimethylpropane is more polarisable.

Butan-2-ol has intermolecular **hydrogen bonding**.

9 *Use of Data Booklet is relevant to this question.*

Propane, C_3H_8, is the most common liquefied petroleum gas.

When propane was burnt under a vessel containing 200 g of water. The following data were collected.

Mass of propane tank before burning	1000.00 g
Mass of propane tank after burning	998.90 g
Initial temperature	25 °C
Final temperature	65 °C
Process efficiency	85%

Which value of the enthalpy change of combustion of propane is given by these result?

A $-1137\ kJmol^{-1}$

B $-1338\ kJmol^{-1}$

C $-1574\ kJmol^{-1}$

D $-1864\ kJmol^{-1}$

Answer: C

$Q' = mc\Delta T$
$= 200\ (4.18)(65-25)$
$= 33440\ J$

$Q' = \frac{85}{100}Q$

$Q = 33440 \div \frac{85}{100}$
$= 39341.18\ J$

$\Delta H = -\frac{39341.18}{\frac{1000-998.90}{44.0}}$
$= -1574\ kJ\ mol^{-1}$

10 A $0.080\ mol\ dm^{-3}$ solution of an acid has a pH of 3.00.
25 cm^3 of this acid was completely reacted by 25 cm^3 of $0.080\ mol\ dm^{-3}$ of sodium hydroxide
Which is the acid?

A HC*l*

B H_2SO_4

C $C_2H_2O_4$

D $C_2H_4O_2$

Answer: D

$[H]^+ = 10^{-3.00} = 0.001$
Since $[H^+]$ is not the same as the [acid], this implies that the acid is a weak acid.

$HA + NaOH \rightarrow NaA + H_2O$
Equal volume of the same concentration of acid and base neutralised one another
This means the acid is a monobasic acid.

Option A and B are out as they are strong acid
Option C is out as it is a di-acid. 25 cm^3 of this di-acid required 50 cm^3 of $0.08\ mol\ dm^{-3}$ of NaOH.

Option D which is ethanoic acid is the correct answer.

11	Which aqueous mixtures will maintain a fairly constant pH when small amount of acid is added?	
	A	Sodium hydroxide + hydrochloric acid
	B	Ethanoic acid + ammonia
	C	Citric acid + potassium citrate
	D	Potassium chloride + sodium carbonate

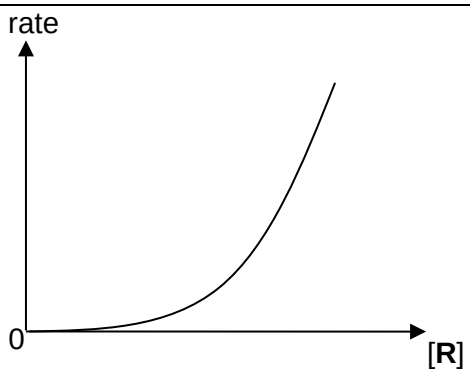
Answer: C
Only Option C shows a combination of salt of the conjugate base with its weak acid.
Option A will not produce a buffer solution as it involves strong acid and strong base
Option B will not p produce a buffer solution as it involves weak acid and weak base
Option D is out as it is a salt mixture.

12 The rate equation for the reaction below is rate = k[**R**][**T**]

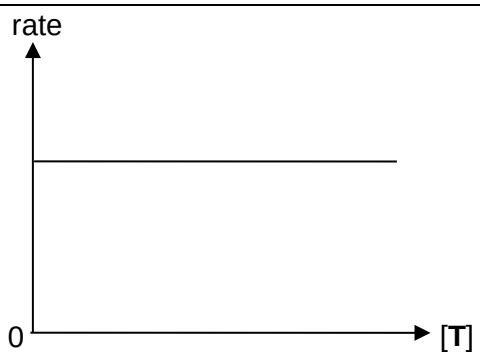
U + **R** + **T** → **J** + **K**

Which of the following graphs is correct for the above reaction, when **T** is in excess?

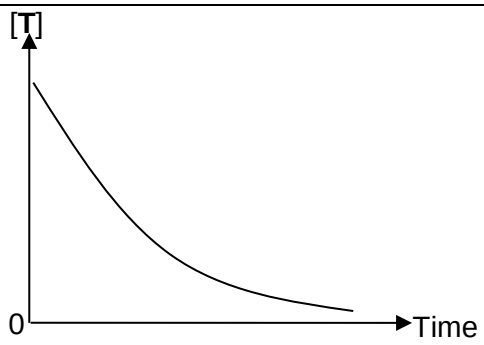
A



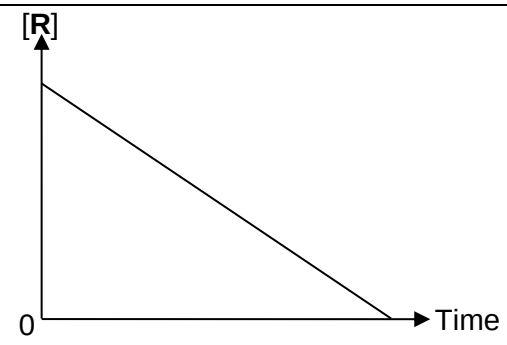
B



C



D



Answer: B

B is correct. If **T** is in excess, rate will be independent of [T], thus,

rate = k' **[R]**, where k'=k **[T].** Pseudo-order first order reaction wrt **R**.

A and **D** are incorrect (**A** should be upward sloping straight line; **D** should be a downward sloping curve).

C is incorrect (should be horizontal straight line). Zero order wrt to T since T is in excess.

13	Hydrogen and nitrogen monoxide can react to form nitrogen and steam. $2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O$ The rate of this reaction is first order with respect to hydrogen and second order with respect to nitrogen monoxide. When 1.5 mol of H_2 and 1.5 mol of NO were initially placed in a $5dm^3$ flask, the initial rate is 3.0×10^{-4} $moldm^{-3}s^{-1}$. What will be the value of rate constant *k*?	
	A	0.0000889
	B	0.000178
	C	0.0222
	D	0.0111

Answer: D

Rate = $k[H_2][NO]^2$
$3.0 \times 10^{-4} = k\ (1.5/5)(1.5/5)^2$
$k = 0.0111\ mol^{-2}dm^6s^{-1}$

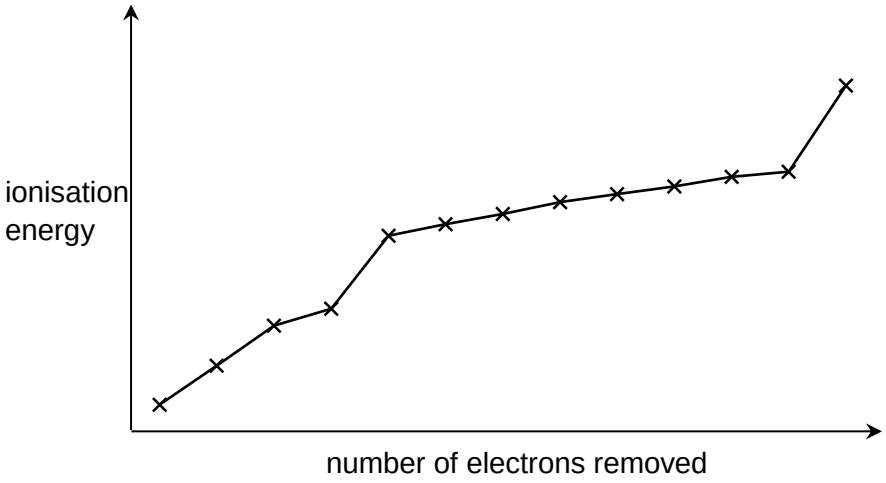
14	What can be deduced from the following equilibrium? $2\ SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g) \quad \Delta H = -98\ kJ\ mol^{-1}$	
	A	Adding a catalyst increases the amount of $SO_3(g)$.
	B	Decreasing the pressure will cause the position of equilibrium to shift to the right.
	C	Decreasing the temperature will cause the position of equilibrium to shift to the left.
	D	The maximum theoretical mass of $SO_3(g)$ that can be made from 64 g of $SO_2(g)$ is 80 g

Answer: D
Adding catalyst only increase rate of forward and backward reaction equally. It does not affect the amount of SO_3.
Decreasing pressure will favour **backward** reaction which produces greater moles of gas.
Decreasing temperature will favour **forward** reaction which produces heat.

Amount of SO_2 in 64 g = 1 mol
Mole ratio: $SO_2 \equiv SO_3$
Maximum mass of SO_3 produced = 1 x (32 +16x3) = **<u>80g</u>**

15	$SiCl_4$ is known to hydrolyse readily in water but CCl_4 is inert to water. Which statement best explains this observation?	
	A	CCl_4 has a giant molecular structure, large amount of energy is required to overcome the strong covalent bond to allow solvation.
	B	There are vacant orbitals to accommodate additional electrons in $SiCl_4$ but not in CCl_4.
	C	CCl_4 has weaker van der Waals' forces of attraction which cannot displace the stronger hydrogen bonding in water.
	D	Si^{4+} has high charge density to polarise the large chlorine electron cloud.

Answer: B
A is wrong as CCl_4 is not a giant molecular structure.
C is wrong as this statement explain physical property of hydration rather than relating to the inertness of CCl_4
D is wrong as $SiCl_4$ is not ionic and thus concept of high density is not applicable.

16	The graph below shows the first thirteen ionisation energies for element **J**.  What can be deduced from the graph about element **J**?	
	A	It is a d-block element.
	B	It has one electron in its outermost shell.
	C	It has an electronic configuration of $1s^2 2s^2 2p^6 3s^2 3p^2$.
	D	The large difference in the 4th ionisation energy and 5th ionisation energy is due to inter-electronic repulsion.

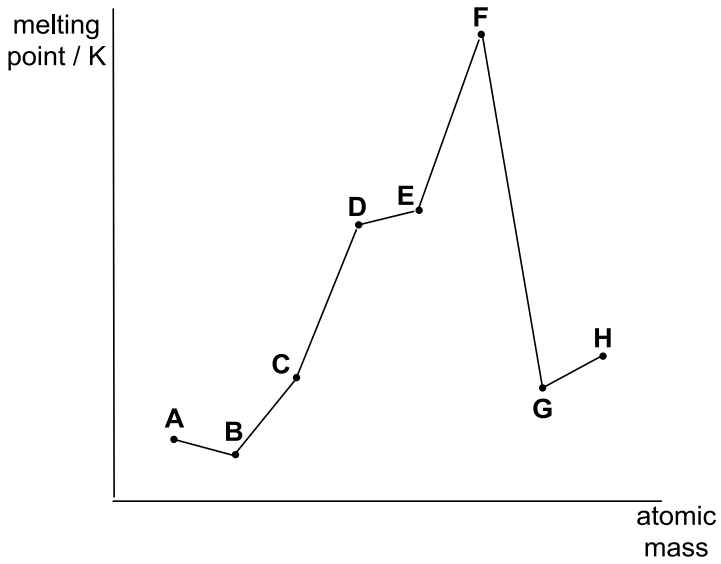
Answer: C
It is not a d-block element as there is no indication of 3d electrons which should account by 10 plotted points before transiting to the 4s electrons.

It has 4 electrons in the outermost shell as indicated by the first four plotted points.

The large difference in the 4th ionisation energy and 5th ionisation energy is due to distance not inter-electronic repulsion since the electronic configuration of element J is $1s^2 2s^2 2p^6 3s^2 3p^2$. Removal of 5th electron ($1s^2 2s^2 2p^6 \rightarrow 1s^2 2s^2 2p^5 + e^-$) involves large amount of energy.

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

The graph below shows the variation in the melting points for eight consecutive elements in the Periodic Table, all with atomic number below 20.



What statement is correct?

	A	Element **E** forms amphoteric oxide.
	B	Element **B** exists as diatomic molecules.
	C	Atomic radius of element **C** is smaller than element **D**.
	D	Element **H** has a higher melting point than elements **A**, **B**, **C** and **G** due to intermolecular hydrogen bonding.

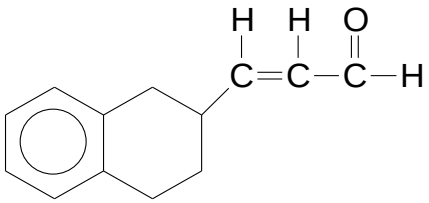
Answer: A

Locate the highest melting point that will be silicon. Trace back left and right of the periodic table you will be able to deduce the following:

A is F, **B** is Ne, **C** is Na, **D** is Mg, **E** is Al, **F** is Si, **G** is P, **H** is S.
(Remember to account for the noble gas Ne.)

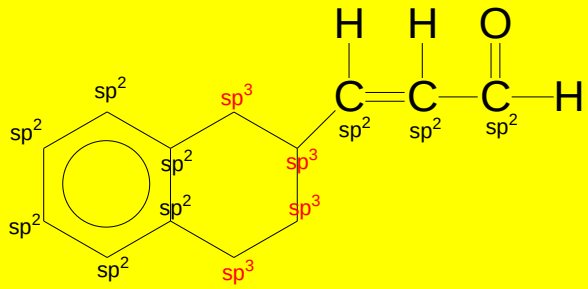
Al_2O_3 is amphoteric this statement A is correct.
Ne is monoatomic not diatomic.
Na has a larger atomic radius than Mg as the nuclear charge of Mg is higher.
S has a higher melting point because it exists as S_8 in nature and its induced dipole-instantaneous dipole interaction is very extensive due to the large polarisable electron cloud present.

18 Identify the number of sp^2 and sp^3 carbon atoms in the given structure:



		sp^2	sp^3
	A	8	5
	B	9	4
	C	2	5
	D	3	4

Answer: B



All carbon atoms in benzene ring, C=C, C=O are sp^2 hybridised (total: 9)
Remaining carbon atoms in the cyclohexane are sp^3 hybridised (total: 4)

19 In the reduction of $CH_2=CHCH_2CH=CH_2$ using nickel catalyst, the volume of hydrogen that reacts with 1 mole of the compound at standard temperature and pressure is

	A	22.4 dm^3
	B	24.0 dm^3
	C	44.8 dm^3
	D	67.2 dm^3

Answer: C

$CH_2=CHCH_2CH=CH_2 + 2H_2 \rightarrow CH_3CH_2CH_2CH_2CH_3$

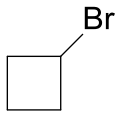
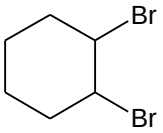
1 mol of $CH_2=CHCH_2CH=CH_2$ required 2 mol of H_2 gas

Volume of H_2 gas required at s.t.p = 22.4 x 2 = 44.8 dm^3

20	Which reagent could be used to distinguish between butan-2-ol and butanone?	
	A	bromine solution
	B	alkaline aqueous iodine
	C	acidified potassium manganate(VII)
	D	sodium carbonate

Answer: C

Both do not react with aqueous bromine.
Both react with aq I_2.
Both do not react with Na_2CO_3.
Butan-2-ol, a 2^o alcohol can be oxidized by acidified potassium manganate(VII) to form a ketone.

21	Ten grams of each of the following compounds were heated for a prolong period of time with NaOH(aq), before dilute HNO_3(aq) and $AgNO_3$(aq) were added. Which compound will produce the greatest mass of silver halides precipitate?	
	A	 (M_r = 134.9)
	B	CH_3CH_2CI (M_r = 64.5)
	C	CH_2CICH_2CI (M_r = 99.0)
	D	 (M_r = 241.8)

Answer: C

Upon heating with NaOH (aq), nucleophilic substitution will occur and all possible halides will be substituted.

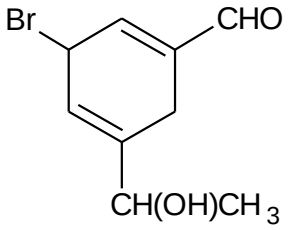
For Option A
Amount of organic cpd = 10/134.9 = 0.074 mol
Amt of Br^- substituted = 0.074 mol
Mass of AgBr ppted = 0.074 x (108+ 79.9) = 13.9 g

For Option B
Amount of organic cpd = 10/64.5 = 0.155 mol
Amt of Cl^- substituted = 0.155 mol
Mass of AgCl ppted = 0.155 x (108+ 35.5) = 22.3g

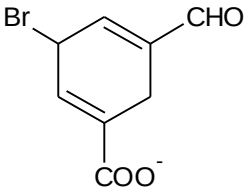
For Option C
Amount of organic cpd = 10/99 = 0.101 mol
Amt of Cl^- substituted = 0.101 x 2 = 0.202 mol
Mass of AgCl ppted = 0.202 x (108+ 35.5) = 29.0g

For Option D
Amount of organic cpd = 10/241.8 = 0.0414 mol
Amt of Br^- substituted = 0.0414 x 2 = 0.0827 mol
Mass of AgBr ppted = 0.0827 x (108+ 79.9) = 15.5g

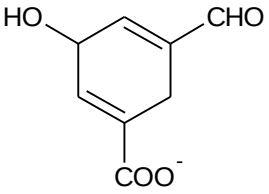
22 What are the organic products formed upon addition of NaOH(aq), I_2 (aq), heat?



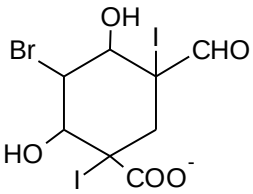
A



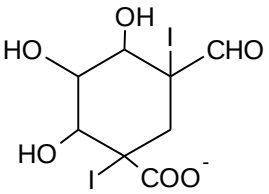
B



C



D



Answer: D
NaOH, I_2 (aq) → mild oxidation at $-CH(OH)CH_3$
NaOH, heat → nucleophilic substitution at R-Br
I_2 (aq) → electrophilic addition at the C=C

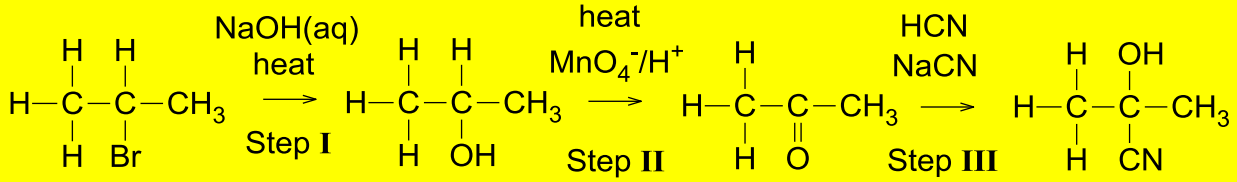
23 The reaction scheme below shows the formation of compound **Y**:

$$C_3H_7Br \xrightarrow[\text{Step I}]{} \mathbf{X} \xrightarrow[\text{Step II}]{\text{heat, } MnO_4^-/H^+} CH_3COCH_3 \xrightarrow[\text{Step III}]{HCN,\ NaCN} \mathbf{Y}$$

The reagent and condition required in **Step I** and the structure of **Y** are:

	Reagent and condition in **Step I**	Structure of **Y**
A	aqueous KOH, heat	$(CH_3)_2COHCN$
B	alcoholic KOH, heat	$(CH_3)_2CHCN$
C	alcoholic KOH, heat	$(CH_3)_2COHCN$
D	aqueous KOH, heat	$(CH_3)_2CHCN$

Answer: A



24 Which of the following shows the correct order of acidity.

	Strongest Acid			Weakest Acid
A	$CH_3CH_2CH_2COOH$	CH_3CH_2COOH	$CH_3CH(Cl)COOH$	$CH_3C(Cl)_2COOH$
B	$CH_3C(Cl)_2COOH$	$CH_3CH(Cl)COOH$	CH_3CH_2COOH	$CH_3CH_2CH_2COOH$
C	CH_3CH_2COOH	$CH_3CH(Cl)COOH$	$CH_3C(Cl)_2COOCH_3$	$CH_3CH_2CH_2COOH$
D	$CH_3C(Cl)_2COOCH_3$	$CH_3CH(Cl)COOH$	$CH_3CH_2CH_2COOH$	CH_3CH_2COOH

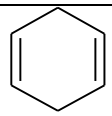
Answer: B

Strongest Acid			weakest acid
$CH_3C(Cl)_2COOH$	$CH_3CH(Cl)COOH$	CH_3CH_2COOH	$CH_3CH_2CH_2COOH$

$CH_3C(Cl)_2COOCH_3$ is an ester and not carboxylic acid, thus it's neutral.

25 Deuterium, D, is an isotope of hydrogen, H

Which reaction will not yield a stable organic compound containing deuterium?

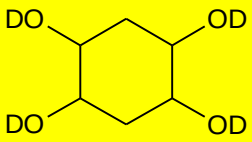
A  $\xrightarrow{KMnO_4, NaOD, cold}$

B $CH_3CH_2OH \xrightarrow{CD_3COOD, \text{ conc. } D_2SO_4}$

C $NH_3 \xrightarrow{CD_3Br}$

D $CH_3CH_2CHO \xrightarrow{Cu^{2+}, NaOD, heat}$

Answer: D

 $\xrightarrow{KMnO_4, NaOD, cold}$ 

$CH_3CH_2OH \xrightarrow{CD_3COOD, \text{ conc. } D_2SO_4}$ $CD_3COOCH_2CH_3$

$NH_3 \xrightarrow{CD_3Br}$ CD_3NH_2

$CH_3CH_2CHO \xrightarrow{Cu^{2+}, NaOD, heat}$ $CH_3CH_2COO^-$

For **questions 26 – 30**, one or more of the 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

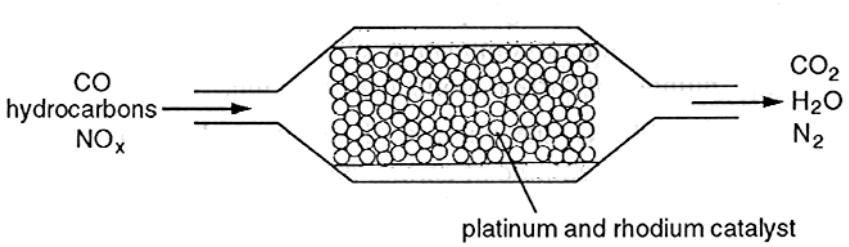
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is to be used as correct response.

26	Why is a solution of aluminium chloride acidic?	
	1	Aluminium ions have a high charge density.
	2	The H-O bonds are weaker in $[Al(H_2O)_6]^{3+}$ than in H_2O.
	3	Chloride ions react with water to form hydrochloric acid.
	Answer: B $[Al(H_2O)_6]^{3+} \rightleftharpoons [Al(H_2O)_5(OH)]^{2+} + H^+$ Al^{3+} has high charge density to polarise the water molecules and thus the H-O bonds will then be weaken to cause the release of the H^+.	

27	The gallium hydrate hydrolyses as shown below. $[Ga(H_2O)_6]^{3+}$ (aq) $\rightleftharpoons$ $[Ga(H_2O)_5OH]^{2+}$ (aq) + H_3O^+ (aq) $\triangle H$ = positive Which of the following statements about the equilibrium are **<u>true</u>**?	
	1	$[Ga(H_2O)_6]^{3+}$ is more stable at low pH values.
	2	Increasing the temperature will favour the formation of $[Ga(H_2O)_5OH]^{2+}$
	3	Increasing the concentration of $[Ga(H_2O)_6]^{3+}$ will increase K_c as the forward reaction is favoured.
	Answer: B At low pH (high $[H_3O^+]$), equilibrium position shifts left to form $[Ga(H_2O)_6]^{3+}$ Increasing temperature will favour the endothermic (forward) reaction. K_c remains unchanged when concentration of $[Ga(H_2O)_6]^{3+}$ is increased as K_c only changes with temperature.	

28 The diagram represents a section of a catalytic converter on the exhaust system of a car. Harmful gases are converted into carbon dioxide, nitrogen and water vapour.



Which processes take place in its catalytic converter?

	1	Carbon monoxide and hydrocarbons react together.
	2	Carbon monoxide and nitrogen oxide react together.
	3	Platinum and rhodium catalyse redox reactions.

Answer: C

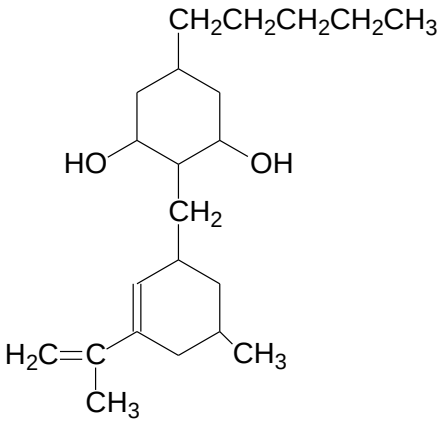
NO is reduced to N_2 by the excess CO present, with Rh as the catalyst.

$2NO\ (g) + 2CO\ (g) \rightarrow 2CO_2\ (g) + N_2\ (g)$

Unburnt hydrocarbons are oxidized to CO_2 and H_2O while CO is oxidized to CO_2, with Pt as the catalyst.

$C_xH_y\ (g) + (x + y/4)O_2\ (g) \rightarrow xCO_2\ (g) + y/2\ H_2O\ (g)$

$2CO\ (g) + O_2\ (g) \rightarrow 2CO_2\ (g)$

29	A psychoactive drug commonly found in cannabis is shown below.  What conclusion can be made about this drug?	
	1	Cis-trans isomerism is not present.
	2	It reacts with sodium metal to form 2 moles of hydrogen gas.
	3	It can undergo electrophilic substitution with chlorine under appropriate condition.
	Answer: D Option 1 is correct as the alkenes present are not capable of forming cis-trans isomers Option 2 is wrong as it reacts with sodium metal to form 1 mol of hydrogen gas. Option 3 is wrong. There is no benzene ring to warrant electrophilic substitution.	

30	When ethanoic acid is esterified with methanol enriched with ^{18}O, the water produced is **not** enriched with ^{18}O. Which of the following conclusions can be drawn from this observation?	
	1	The oxygen in the water is derived from the ethanoic acid.
	2	The O–H bond in the methanol breaks during the reaction.
	3	The carbon–to–oxygen single bond of the –COOH group in the acid breaks during the reaction.
	Answer: A $CH_3COOH + CH_3{}^{18}OH \rightleftharpoons CH_3CO^{18}OCH_3 + H_2O$	

END OF PAPER 1