TEMASEK JUNIOR COLLEGE

2023 JC2 PRELIMINARY EXAMINATION

Higher 2 [Worked Solutions]

CHEMISTRY **9729/01**

Paper 1 Multiple Choice **18 September 2023**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

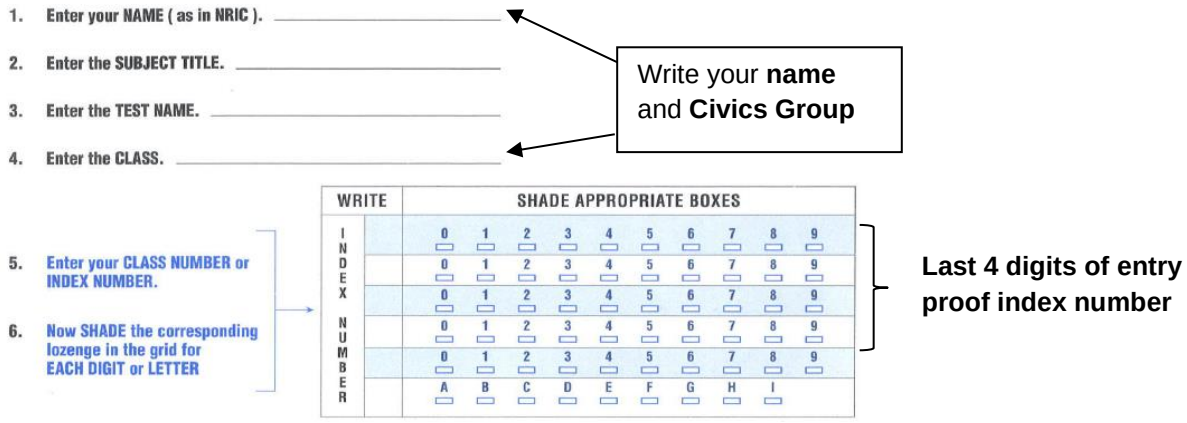
READ THESE INSTRUCTIONS FIRST

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**, **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.

Write your name & Civics Group on the Answer sheet. Shade your index number in the appropriate boxes.



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.

This document consists of **15** printed pages and 1 blank page.

MCQ ANSWERS (A:8, B:8, C:8, D:6)

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

1 Magnesium thiocyanate, $Mg(SCN)_2$, has been found to support heart health by promoting healthy blood circulation and maintaining normal blood pressure levels.

What are the numbers of electrons in the magnesium ion and the thiocyanate ion?

	Magnesium ion	Thiocyanate ion
A	12	29
B	10	29
C	10	30
D	10	31

Answer: **C**

Worked Solution:

No. of electrons in Mg^{2+} ion = 12 – 2 = 10

No. of electrons in SCN^- ion = 16 + 6 + 7 + 1 = 30

2 In which pair of species do both species have only one *unpaired* p electron?

1 Ar^- and F

2 Ar^+ and Si^+

3 Ga and C^-

A 1 and 2 only **B** 2 and 3 only **C** 2 only **D** 3 only

Answer: **C** (2 only)

Worked Solution: Atoms and ions of electronic configuration of Group 13 and 17 elements will have only one unpaired electron.

For reference

Atom	Group	Electronic configuration of atom	Electronic configuration of ion
Ga	13	[Ar] $3d^{10}4s^2$**$4p^1$**	
C/Si	14	s^2p^2	C^-: $1s^2$$2s^2$**$2p^3$** Si^+: [Ne] $3s^2$**$3p^1$**
F	17	$Is^2$$2s^2$**$2p^5$**	
Ar	18	[Ne] $3s^2$$3p^6$	Ar^+: [Ne] $3s^2$**$3p^5$** Ar^-: [Ne] $3s^2$$3p^6$**$4s^1$**

3 The ^{68}Ga isotope is used in positron emission tomography (PET) scan to detect tumors. The radioactive decay of ^{68}Ga isotope has a half-life of 68 days and produces the neutral particle, ^{68}X.

This transformation of ^{68}Ga occurs with a proton changing into a neutron.

Which of the following statement is **incorrect**?

A ^{68}X has 38 neutrons.

B ^{68}X is an isotope of zinc.

C There are 3 electrons in the valence shell of ^{68}X.

D 2.42 % of the original ^{68}Ga isotope remains after a year.

Answer: **C**

Worked Solution:

	^{68}Ga	^{68}X
No. of protons	31	30 (Zinc)
No. of neutrons	68 – 31 = 37	38
No. of electrons	31	30

Options A and B are correct.

Option C: Incorrect. Electronic configuration of Zn: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$. There are only 2 electrons in the valence shell of n=4.

Option D : Correct. No. of half-lives = 365/68 = 5.37

% ^{68}Ga remaining = 100 x $\left(\frac{1}{2}\right)^{5.37}$ = 2.42% (D is correct)

4 Which of the following species contain at least one *unpaired* electron?

1 NO

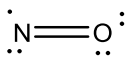
2 NO_2

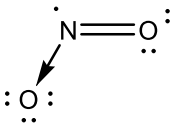
3 NO_2^-

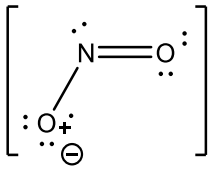
A 1 only **B** 2 only **C** 1 and 2 only **D** 1, 2 and 3

Answer: **C** (1 and 2 only)

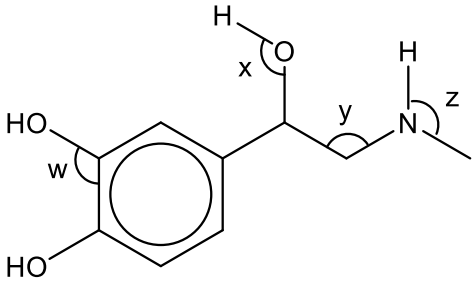
Worked Solution:

1 

2 

3 

5 Adrenaline is a hormone that is produced by the body during times of stress.



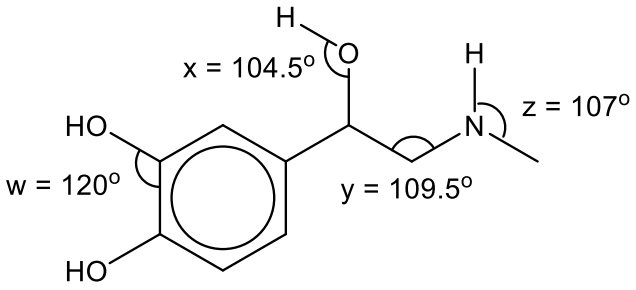
What are the bond angles *w*, *x*, *y* and *z* in adrenaline, from the smallest to the largest?

	Smallest bond angle ⟶ Largest bond angle			
A	*x*	*z*	*y*	*w*

B	*x*	*z*	*w*	*y*
C	*y*	*x*	*z*	*w*
D	*w*	*y*	*z*	*x*

Answer: **A**

Worked Solution:



6 Organic liquids **P** and **Q** have identical boiling points. When equal volumes of **P** and **Q** are mixed together, there is no reaction and liquid mixture **R** is obtained. The vapour pressure of liquid mixture **R** is less than that of liquid **P** or liquid **Q** at the same temperature.

Which of the following statement is **incorrect**?

A **R** is less volatile that **P**.

B **P** and **Q** are constitutional isomers.

C The mixing of **P** and **Q** is exothermic.

D The average intermolecular forces in **R** is stronger than that in **P** or in **Q**.

Answer: **B**

Worked Solution:

Option B: Constitutional isomers have different physical properties like boiling points.

P and **Q** form stronger intermolecular forces with each other upon mixing to give mixture **R** (higher boiling point and less volatile). The amount of energy released is more than that required to overcome the attractions between particles of **P** and between particles of **Q** (exothermic).

7 The following redox reactions have been observed to occur spontaneously.

$$2VO^{2+} + H_2O_2 \longrightarrow 2VO_2^{+} + 2H^{+}$$
$$S_2O_8^{2-} + H_2O_2 \longrightarrow O_2 + 2SO_4^{2-} + 2H^{+}$$

Which of the following shows an increasing order of oxidising power?

A $H_2O_2 < VO^{2+} < S_2O_8^{2-}$

B $S_2O_8^{2-} < H_2O_2 < VO^{2+}$

C $VO^{2+} < H_2O_2 < S_2O_8^{2-}$

D $VO^{2+} < S_2O_8^{2-} < H_2O_2$

Answer: **C**

Worked Solution:

$$\underset{+4}{2\underline{V}O^{2+}} + 2H_2O + \underset{-1}{H_2\underline{O_2}} \longrightarrow \underset{+5}{2\underline{V}O_2^{+}} + \underset{-2}{2H_2\underline{O}} + 2H^{+}$$

VO^{2+} is oxidised by H_2O_2 (H_2O_2 is reduced, it is the Oxidising Agent.)
$\Rightarrow$ oxidising power of $VO^{2+} < H_2O_2$

$$\underset{+7}{\underline{S}_2O_8^{2-}} + \underset{-1}{H_2\underline{O_2}} \longrightarrow \underset{0}{\underline{O_2}} + \underset{+6}{2\underline{S}O_4^{2-}} + 2H^{+}$$

H_2O_2 is oxidised by $S_2O_8^{2-}$ ($S_2O_8^{2-}$ is reduced, it is the Oxidising Agent.)
$\Rightarrow$ oxidising power of $H_2O_2 < S_2O_8^{2-}$

Strength of oxidising power: $VO^{2+} < H_2O_2 < S_2O_8^{2-}$

8 *Use of the Data Booklet is relevant for this question*.

A 20 dm^3 vessel contains 0.25 mol ammonia gas and a 30 dm^3 vessel contains 0.42 mol hydrogen chloride gas. When the two vessels were connected at 500 K, the following chemical reaction occurs :

$$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$$

What is the resultant pressure in Pa in the combined vessel?

A 14127 **B** 20775 **C** 34902 **D** 55677

Answer: **A**

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$
Limiting reagent is ammonia gas. Thus, the resultant pressure of the combined vessel is due to the remaining hydrogen chloride gas.

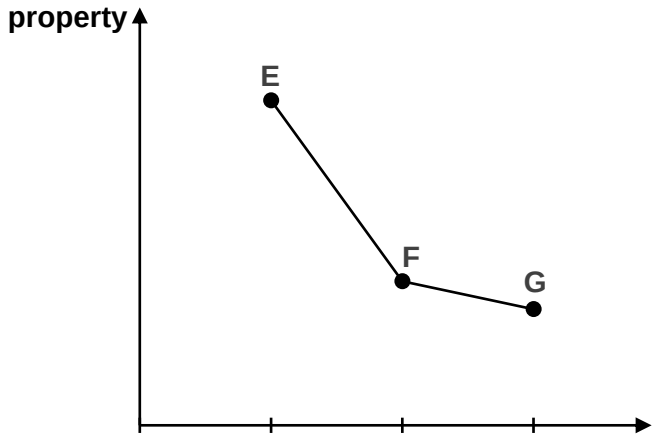
No of moles of hydrogen chloride gas remaining = 0.42-0.25 = 0.17 mol

Resultant volume of combined vessel = 50 dm^3 = 50 x 10^{-3} m^3

$$P = \frac{nRT}{V}$$

$$P = \frac{(^{0.17})(8.31x500)}{50 \times 10^{-3}} = \underline{14127\ Pa}$$

9 Which property of **E**, **F** and **G** will give the trend shown below?



	Property	**E**	**F**	**G**
A	boiling point	$SiCl_4$	PCl_5	BCl_3
B	volatility	HCl	HBr	HF
C	solubility in water	P_4O_{10}	SiO_2	MgO
D	reducing power	Mg	Ca	Ba

Answer: **B**

Worked Solution:

Option A : Incorrect. All three are simple molecular (non-polar).Electron cloud size hence extent of distortion of electron cloud of PCl_5 > $SiCl_4$ > BCl_3. Strength of id-id of PCl_5 > $SiCl_4$ > BCl_3 hence bp of PCl_5 > $SiCl_4$ > BCl_3.

Option B : Correct. All three are simple molecular. Highest bp for HF as largest amount of energy required to overcome stronger hydrogen bonding. Electron cloud

size hence extent of distortion of electron cloud of HBr > HC*l*. Strength of id-id of HBr > HC*l* hence bp of HBr > HC*l*. Volatility of HC*l* > HBr > HF.

Option C: Reaction : $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_4$ Soluble

Reaction: SiO_2 does not react with water. Insoluble due to giant molecular structure

Reaction: $MgO + H_2O \rightleftharpoons Mg(OH)_2$ Sparingly soluble

Option D: Incorrect. Down the group, $E^{\ominus}_{M^{2+}/M}$ becomes more negative.

$\Rightarrow$ more tendency for **M** to be oxidised to M^{2+}

$\Rightarrow$ reducing power of Group 2 metals increases down the group.

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

Element 117, Tennessine, that was discovered in 2010 is named after the state of Tennessee, USA.

Which property is Tennessine, Ts most likely to have?

A The covalent radius of Ts is less than 0.140 nm.

B The 7p orbitals of a Ts atom are completely filled.

C Ts produces bromine from a solution of sodium bromide.

D Ts is a dark coloured solid at room temperature and pressure.

Answer: **D**

Fact: Ts is below At in Group 17.

Option A: Trend: Atomic radii increases down the Group. Since atomic radii of At is 0.140nm, hence atomic radii of Ts > At.

Option B: EC of Ts: [Rn] $6d^{10}\ 7s^2\ 7p^5$ hence 7p is not completely filled,

Option C : Trend: Halogen higher up in the Group 17 displaces halide below from solution of its salt. Since Ts is below bromine, Ts cannot displace bromine from bromide salt.

Option D : Trend: Colour of halogen darkens down Group 17 .Hence, Ts is expected to be a dark coloured solid at r.t.p.

11 The ore iron(II) chromite, $FeCr_2O_4$, is mined in South Africa. The overall reaction for one of the stages in the mining process is as follows:

$$2Cr_2O_4^{2-} + 3O_2 + 4OH^- \longrightarrow 4CrO_4^{2-} + 2H_2O$$

How many oxygen molecules are required to react completely with one mole of chromite ions?

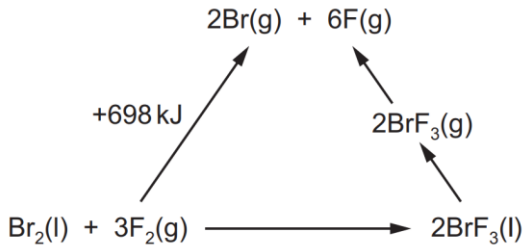
A 4.01×10^{23} **B** 9.03×10^{23} **C** 1.81×10^{24} **D** 5.41×10^{24}

Answer: **B**

$2Cr_2O_4^{2-} + 3O_2 + 4OH^- \rightarrow 4CrO_4^{2-} + 2H_2O$

No of O_2 molecules = Amount x L = 3/2 x 6.02×10^{23} = 9.03×10^{23}

12 An energy cycle is drawn to calculate the average bond energy of Br-F bond in BrF_3.



The enthalpy change of formation of $BrF_3(l)$ = –301 kJ mol^{-1}.

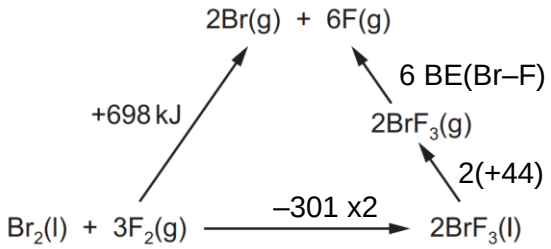
The enthalpy change of vapourisation of $BrF_3(l)$ is +44 kJ mol^{-1}.

What is the average bond energy, in kJ mol^{-1}, of the Br–F bond in BrF_3?

A 152 **B** 202 **C** 304 **D** 404

Answer: **B**

Worked solution:

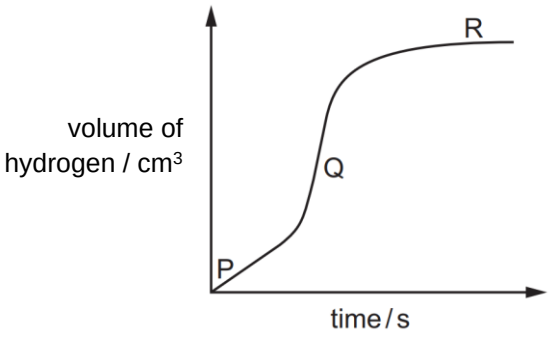


By Hess' Law,

698 = 2(–301) + 2(+44) + 6 BE(Br–F)

BE(Br–F) = +202 kJ mol^{-1}

13 0.05 mol of shiny aluminium foil is added to 0.05 mol of hydrochloric acid and the volume of hydrogen gas produced is measured. The following graph is obtained.



Which of the following best explains the changes in the rate of reaction between points P and Q and between points Q and R?

	between points P and Q	between points Q and R
A	Reaction temperature is increasing	Concentration of HC*l* is decreasing
B	Reaction temperature is increasing	The A*l* foil is used up.
C	Reaction temperature is decreasing	Concentration of HC*l* is decreasing
D	Reaction temperature is decreasing	The A*l* foil is used up.

Answer: **A**

Worked solution:

A*l* + 3HC*l* → A*lCl*$_3$ + 1.5 H_2

Since 0.05 of each is reactant is used, HC*l* is the limiting reagent.

From P to Q, gradient of graph (rate) increases implies that temperature increases.

From Q to R, reaction is complete implies HC*l* (limiting reagent) is used up.

14 The reaction of hydrogen peroxide with iodide ions in acidic solution can be monitored by an initial rate method. The time taken for a fixed amount of iodine to be produced is measured.

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

The table below shows the results obtained from a series of experiments with different volumes of reagent used.

experiment number	volume of H_2O_2 / cm^3	volume of H^+ / cm^3	volume of I^- / cm^3	volume of water / cm^3	time taken / s
1	8	8	4	0	30
2	4	8	4	4	60
3	8	4	6	2	20
4	4	8	6	2	40

Which describes the mechanism of this reaction?

A $H_2O_2 + H^+ \longrightarrow H_2O + OH^+$

$OH^+ + 2I^- + H^+ \longrightarrow H_2O + I_2$ (slow)

B $H_2O_2 + I^- \longrightarrow H_2O + IO^-$ (slow)

$H^+ + IO^- \longrightarrow HIO$

$HIO + H^+ + I^- \longrightarrow I_2 + H_2O$

C $2H^+ + 2I^- \longrightarrow 2HI$

$2HI + H_2O_2 \longrightarrow I_2 + 2H_2O$ (slow)

D $H_2O_2 + I^- + H^+ \longrightarrow H_2O + HIO$

$HIO + I^- \longrightarrow I_2 + OH^-$ (slow)

$OH^- + H^+ \longrightarrow H_2O$

Answer: **B**

Worked solution:

Comparing expt 1 and 2: order of rxn wrt H_2O_2 = 1

Comparing expt 2 and 4: order of rxn wrt iodide = 1

Comparing expt 1 and 3: order of rxn wrt H^+ = 0

Hence, rate = k[H_2O_2][iodide] which fits the slow step of option B

15 Ethanoic acid is mixed with ethanol. The ethanol is found to be contaminated with trace amounts of methanol.

The following equilibria are established.

$CH_3CO_2H(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3CO_2CH_2CH_3(l) + H_2O(l)$ $\quad K_c = K_1$

$CH_3CO_2H(l) + CH_3OH(l) \rightleftharpoons CH_3CO_2CH_3(l) + H_2O(l)$ $\quad K_c = K_2$

Which of the following statements is correct?

A Methyl ethanoate will not be produced as there is more ethanol present.

B The ratio $\frac{[CH_3CO_2CH_2CH_3]}{[CH_3CO_2CH_3]} = \frac{K_1}{K_2}$ in the mixture.

C The $\frac{K_1}{K_2}$ ratio will increase with addition of ethanol.

D Adding methyl ethanoate to the mixture will increase the amount of ethyl ethanoate formed.

Answer: **D**

Worked solution:

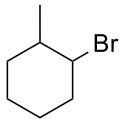
Option A: Incorrect. When there is methanol, position of equilibrium 2 shifts to the right, producing methyl ethanoate, albeit in small amount.

Option B & C: Incorrect. Ratio remains the same as K_1 and K_2 are only temperature dependent.

Option D: Correct. When methyl ethanoate is added, position of equilibrium 2 shifts to left, producing back more ethanoic acid, which in turns shifts position of equilibrium 1 to the right, producing more ethyl ethanoate.

16 Compound **T**, $C_7H_{13}Br$, has two chiral centres.

Hot ethanolic NaOH is added to a sample of compound **T**.



T

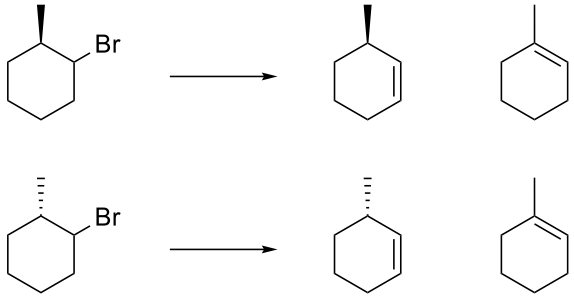
What is the maximum number of stereoisomers that is formed in the sample?

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

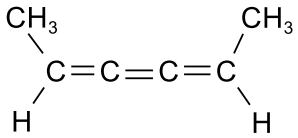
Answer: **C**

Worked solution:

Total of 3 isomers are formed.



17 The structure of compound **K** is given below.



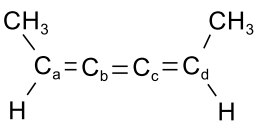
compound **K**

Which of the following correctly describes the properties of **K**?

	number of sp^2 carbon atoms	exhibit cis-trans isomerism	exhibit enantiomerism
A	2	Yes	No
B	4	No	Yes
C	2	No	Yes
D	4	Yes	No

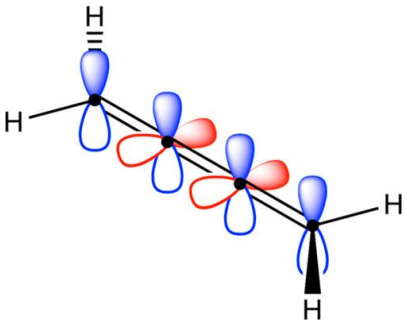
Answer: **A**

Worked solution:



Only C_a and C_d are sp^2 hybridised. C_b and C_c are sp hybridised.

K is planar, similar to alkene, so it can exhibit cis-trans isomerism.



18 Which of the following statements is correct for 1,1-difluoroethane and 1,1-dichloroethane?

1 1,1-difluoroethane is less reactive than 1,1-dichloroethane due to larger bond polarity of the C–F bond.

2 1,1-difluoroethane has zero net dipole moment.

3 At the upper atmosphere, 1,1-difluoroethane releases free radicals which deplete the ozone layer.

A 1 only

B 1 and 3 only

C 2 and 3 only

D None of the above

Answer: **D**

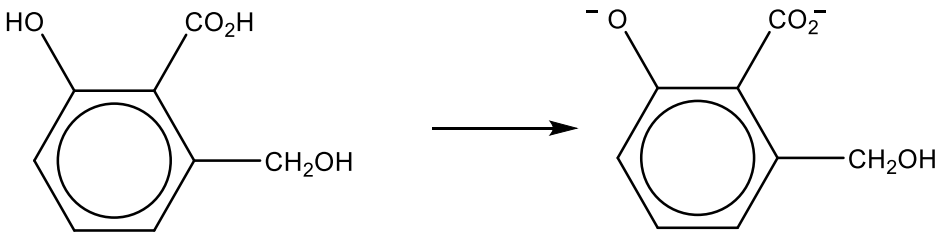
Worked solution:

1: Incorrect. 1,1-difluoroethane is less reactive than 1,1-dichloroethane due to stronger C–F bond (not bond polarity).

2: Incorrect. 1,1-difluoroethane is a polar molecule with a net dipole moment.

3: Incorrect. Due to the strong C–F bond, the bond is unlikely to break to release F free radicals.

19 Which reagent can be used for the following conversion?



A $Na_2Cr_2O_7$ **B** Na_2CO_3 **C** NaOH **D** Na

Answer: **C**

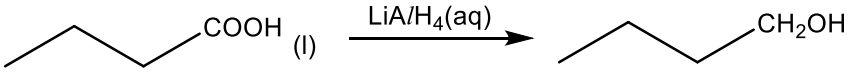
Worked Solution: Phenol and carboxylic acids are acidic enough to undergo neutralisation with NaOH for form salts.

	Carboxylic acid	Phenol	Primary Alcohol
$Na_2Cr_2O_7$	×	×	✓
Na_2CO_3	✓	×	×
NaOH	✓	✓	×
Na	✓	✓	✓

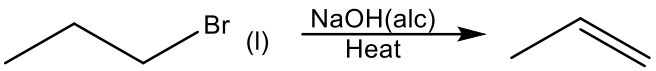
20 The reaction conditions for four different transformations are given.

Which transformation has the correct conditions?
[(alc) indicates an alcoholic solution.]

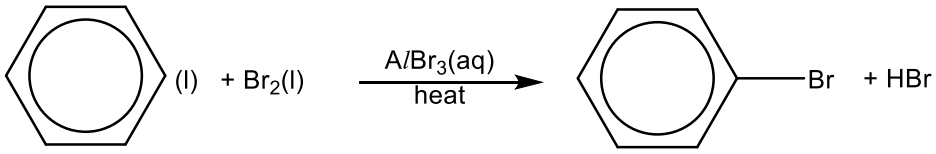
A



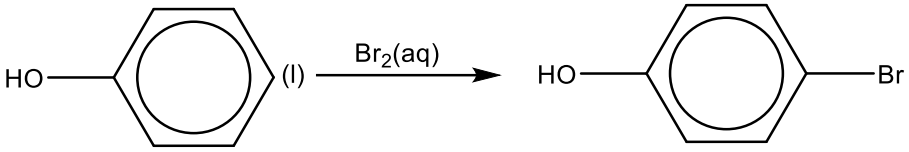
B



C



D



Answer: **B**

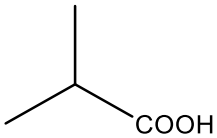
Worked Solution:

Option B : Elimination of RX using alcoholic NaOH, heat forms an alkene.

Option A : $LiAlH_4$ is anhydrous not aqueous as a reducing agent.

Option C : Electrophilic substitution of benzene requires anhydrous $AlBr_3$; hydrated $AlBr_3$ undergoes hydrolysis in aqueous medium.

Option D: Electrophilic substitution of phenol with $Br_2(aq)$ forms the 2,4,6-tribromophenol not the mono-substituted product.

21 Which of the following compounds can be used to synthesise  in a single step?

1 2-methylpropylmethanoate

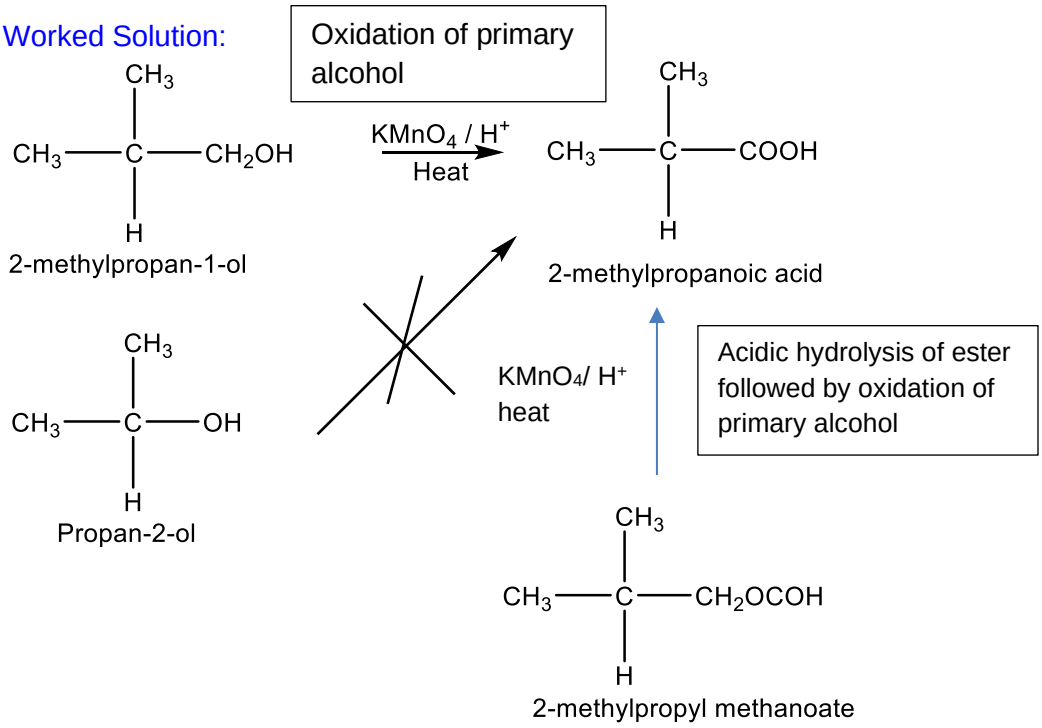
2 2-methylpropan-1-ol

3 propan-2-ol

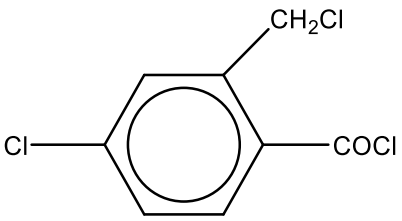
A 1 and 2 **B** 2 and 3 **C** 1 only **D** 2 only

Answer: **A**

Worked Solution:

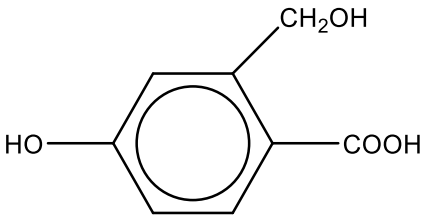


22 Which of the following compounds is expected to be formed in the highest yield when compound **Z** is heated under reflux with aqueous sodium hydroxide followed by acidification?

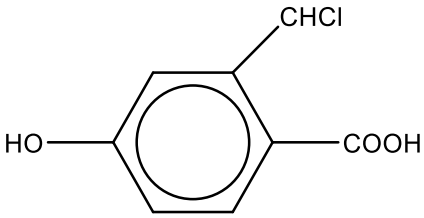


Z

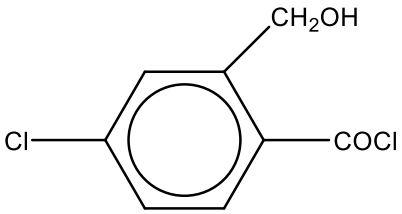
A



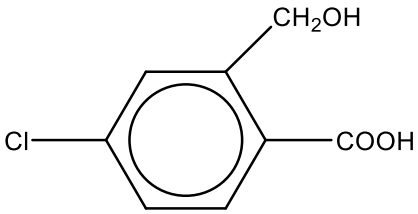
B



C



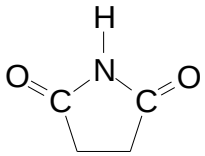
D



Answer: **D**

Worked Solution: Acyl chlorides and RX undergoes nucleophilic substitution with OH^-. Chlorobenzenes are unreactive towards substitution reaction due to the partial double bond character in the C-C*l* bond.

23 Compound **X** has the structural formula as shown below:



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

1 **X** can react with boiling aqueous NaOH with the evolution of NH_3.

2 **X** can react with Li*A*lH_4 in dry ether to form a cyclic secondary amine.

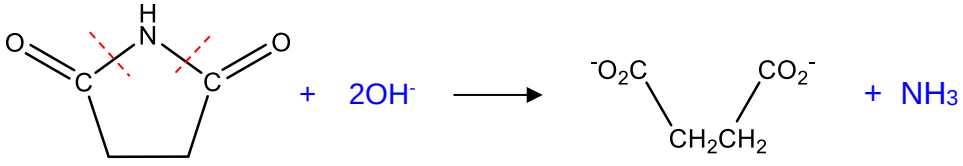
3 **X** can react with hot dilute H*C*l to yield an amino acid.

A 1 and 2 only **B** 2 and 3 only **C** 1 only **D** 1, 2 and 3

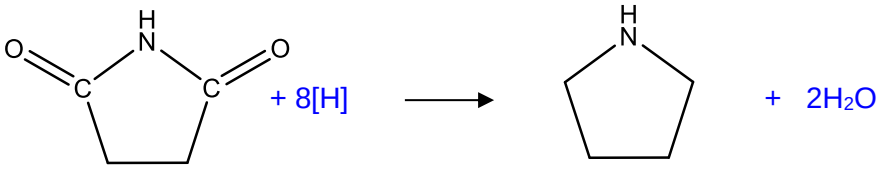
Answer: **A**

Worked Solution:

1 : Alkaline hydrolysis of amide linkages to form $RCOO^-$ and ammonia gas

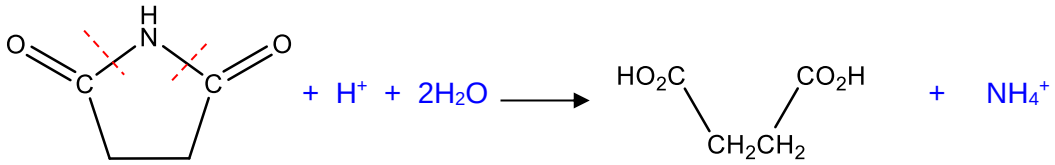


2 : Reduction of amide to amine



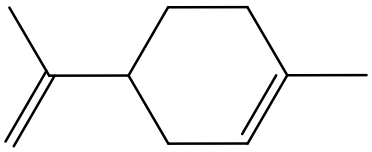
cyclic secondary amine

3: Acidic hydrolysis of amide



Forms dicarboxylic acid (not amino acid)

24 Limonene is a hydrocarbon found in the rind of citrus fruits.



Limonene

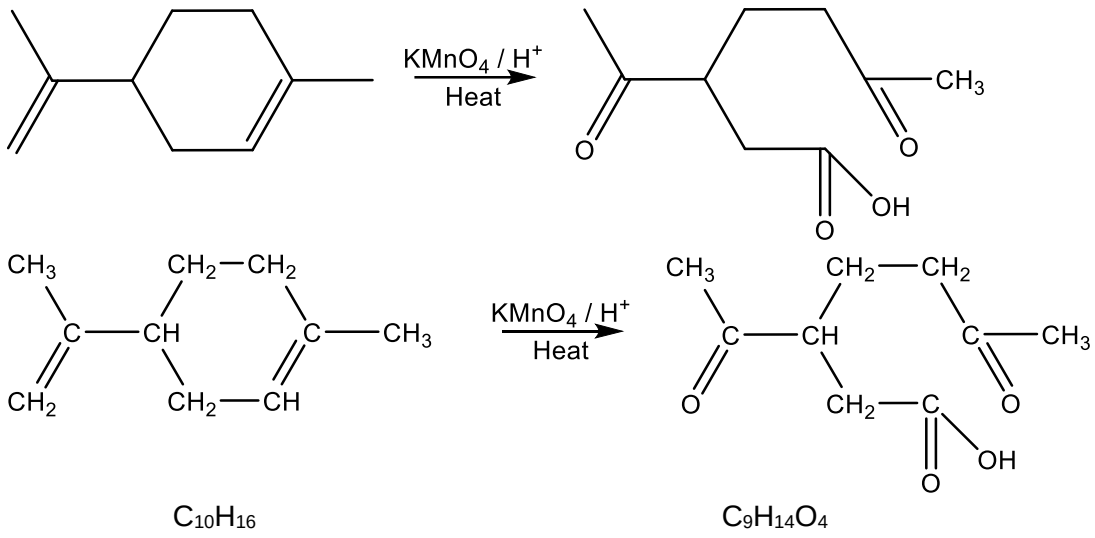
Limonene is treated with hot, concentrated, acidified manganate(VII) ions to form an organic product **M**.

What is the molecular formula of limonene and **M**?

	Molecular formula of Limonene	Molecular formula of organic product, **M**
A	$C_{10}H_{14}$	$C_{10}H_{12}O_4$
B	$C_{10}H_{14}$	$C_{10}H_{14}O_4$
C	$C_{10}H_{16}$	$C_9H_{14}O_3$
D	$C_{10}H_{16}$	$C_9H_{14}O_4$

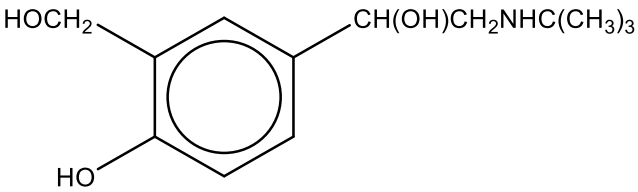
Answer: **D**

Worked Solution:



$C_{10}H_{16}$ $C_9H_{14}O_4$

25 Salbutamol is widely used anti-asthmatic drug. The structure of salbutamol is shown below.



Which of the following is likely to be a property of this drug?

A It will decolourise aqueous bromine.

B It gives a precipitate with hot aqueous alkaline iodine.

C It reacts with hot sodium hydroxide to form two organic products.

D It gives 3 moles of hydrogen chloride gas when reacted with phosphorus pentachloride.

Answer: **A**

Worked Solution:

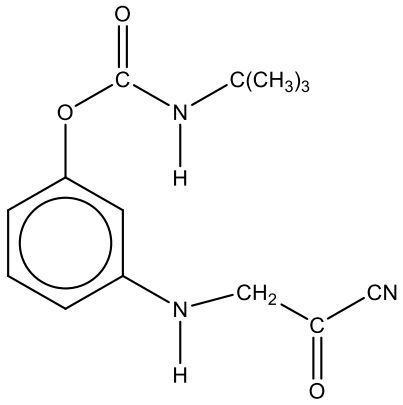
Option A : Correct. Positive chemical test for phenol.

Option B: Incorrect as it does not have the -CH(OH)CH_3 or -$COCH_3$ groups

Option C: Incorrect. No alkaline hydrolysis takes place as no amide or ester groups. Only neutralisation of phenol to form salt occurs.

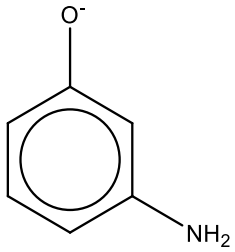
Option D: Incorrect. Only aliphatic alcohols can undergo nucleophilic substitution with PCl_5 hence it should only produce 2 moles of HC*l*(g). Phenols do not undergo nucleophilic substitution with PC*l*$_5$.

26 The structure of **Q** is shown below.

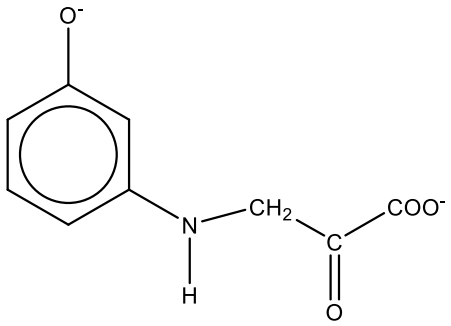


What would be formed by prolonged boiling of **Q** with aqueous sodium hydroxide?

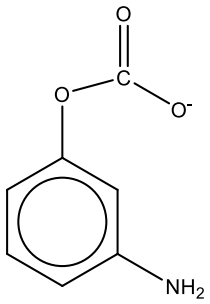
A



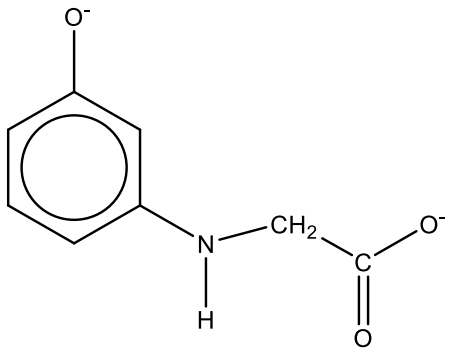
B



C



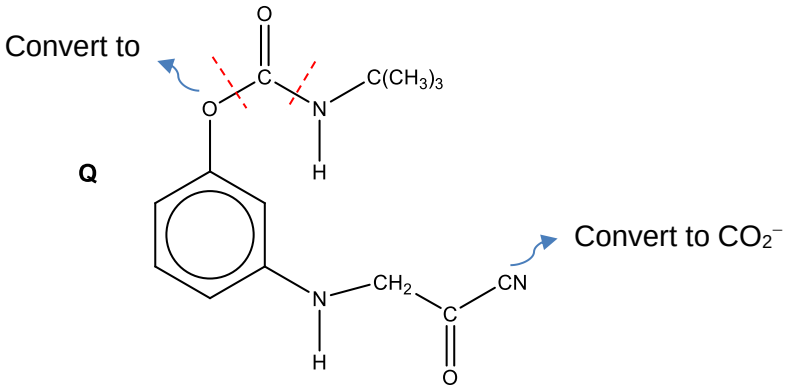
D



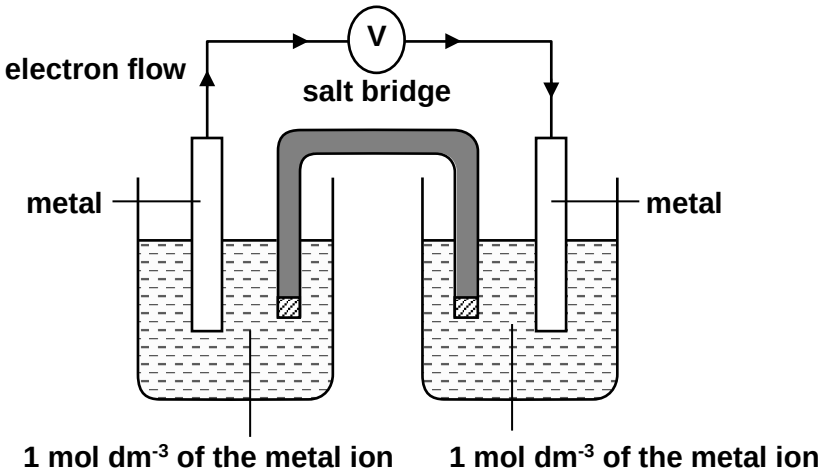
Answer: **B**

Worked Solution:

The ester, amide and nitrile functional groups will undergo alkaline hydrolysis.



27 The half-cells for four metals: Mg, **P**, **Q** and **R** were in turn connected in pairs and the potential difference was recorded at 25°C.



The results obtained are as shown in the table below.

Positive electrode	Negative electrode	e.m.f /V
P	Mg	+2.10
Q	Mg	+2.72
Mg	**R**	+0.33

Which of the following is correct?

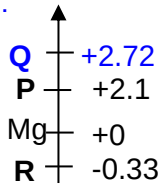
		strongest reducing agent ⟶			*weakest reducing agent*
	A	**Q**	**P**	Mg	**R**
	B	**P**	**Q**	Mg	**R**
	C	**R**	Mg	**P**	**Q**

	D	R	Mg	Q	P

Answer: **C**

Worked Solution:

Using Mg as the reference electrode, the reduction potentials can be arranged as follows :



Concept: The more negative the reduction potential, the greater the tendency to undergo oxidation, the stronger the reducing power.

28 In the electrolysis of a nitrate solution of metal **Y**, 0.76 g of the element was formed at the cathode by the passage of 0.5 A of current for 1930 seconds. Metal **Y** has a relative atomic mass of 152.

Which of the following statements about the above electrolysis are correct?

1 The charge on an ion of **Y** is $\frac{0.5\times1930\times152}{96500\times0.76}$.

2 When the gas at the anode was collected and a glowing splinter was inserted into it, it bursts into flame.

3 The mass of **Y** obtained in 1930 s can be increased by using a more concentrated nitrate solution of metal **Y**.

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

Answer: **A**

Worked Solution:

Option 1 : To calculate charge on ion

Q = It = 0.5 x 1930 C

Amt of e = 0.5 x 1930/96500 mol

$M^{n+} + ne \longrightarrow M$

Amt M deposited = (0.5 x 1930) /(96500 x n)

Amount of M = 0.76/152

$n = \frac{0.5\times1930\times152}{96500\times0.76}$

Option 2 : Water oxidised to O_2 at anode which relights a glowing splinter.

Anode reaction: $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$

Option 3 : Mass deposited is dependent only on current and time.

29 Which solution will form a precipitate when aqueous silver nitrate is added?

A $[Cr(NH_3)_3Cl_3]$

B $[Cr(NH_3)_6]Cl_3$

C $Na_3[CrCl_6]$

D $[Cr(en)(NH_3)_2Cl_2]NO_3$

Answer: **B**

Worked Solution:

Concept: Only the free counterions can form precipitate with the Ag^{+}. The ligands bonded to the central metal atom/ion do not react.

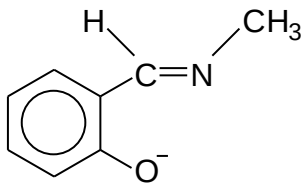
Option A : Cl is datively bonded to Cr^{3+} ion.

Option B : $[Cr(NH_3)_6]^{3+}.3Cl^{-}$. Free Cl^{-} present in solution.

Option C : $[CrCl_6]^{3-}$. Cl^{-} is datively bonded to Cr^{3+}.

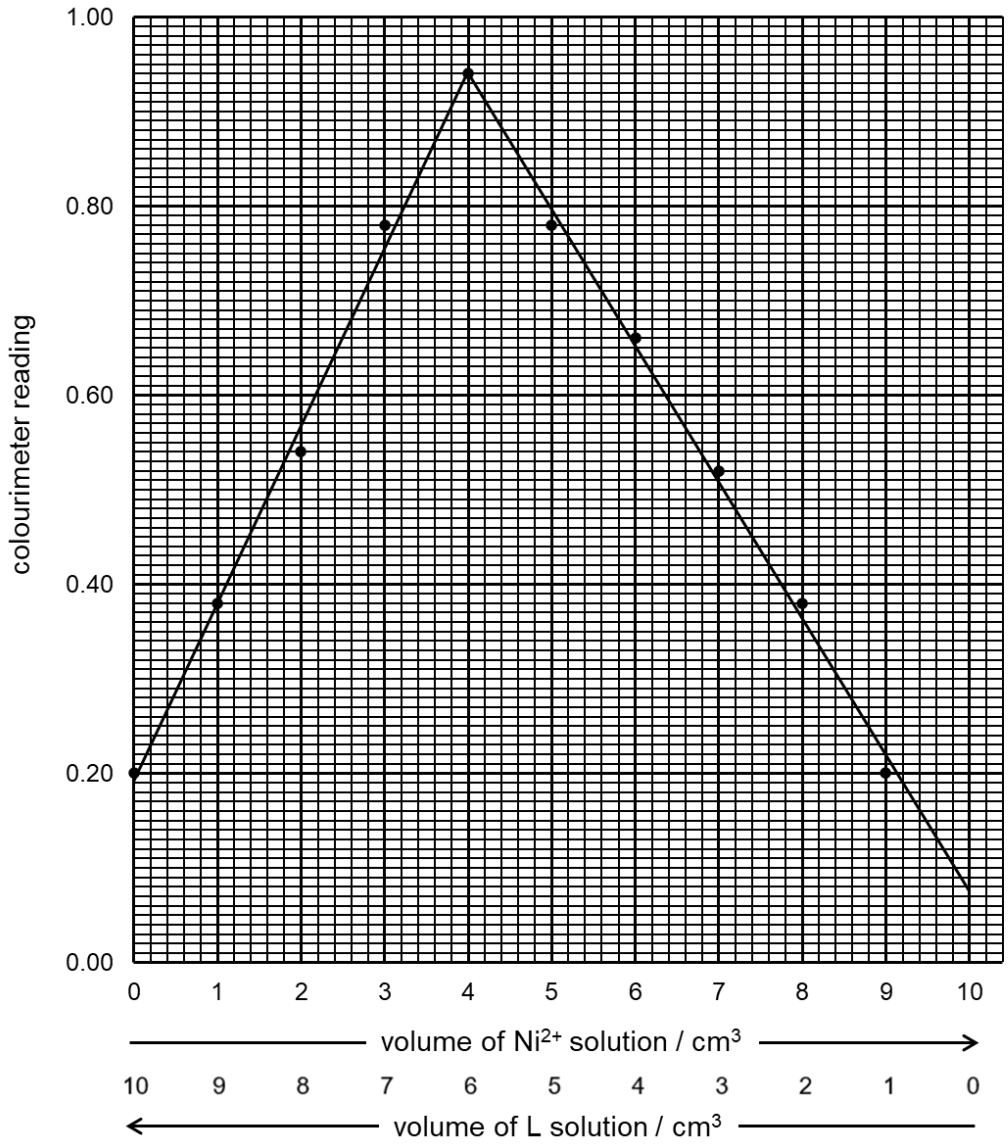
Option D : $[Cr(en)(NH_3)_2Cl_2]^{+}$. Cl^{-} is datively bonded to Cr^{3+}.

30 Nickel(II) ion forms a red complex with ligand **L** at room temperature.



L

The following graph below was obtained when the colour intensities of mixtures of a 4×10^{-3} mol dm^{-3} solution of **L** and a 3×10^{-3} mol dm^{-3} solution of nickel(II) chloride were measured using a colorimeter at room temperature.



Which one of the following statements regarding the ligand **L** or the nickel(II) complex is correct?

A **L** is a monodentate ligand.

B The nickel(II) complex is negatively charged.

C The nickel(II) complex absorbs red light strongly.

D The co-ordination number of nickel in the complex is 4.

Answer: **D**

Worked Solution:

Mole ratio of Ni^{2+} to **L** giving the highest absorbance
= (4.00/1000 x 0.003) : (6.00/1000 x 0.004)
= **1 : 2**

Option A : Incorrect. **L** is a bidentate ligand.

Option B : Incorrect. The formula is the complex is [Ni$\mathbf{L}_2$]. No charge.

Option C : Incorrect. Since the colour is red → the complex reflects red light (but absorbs the complementary colour green)

Option D : Correct. Since the formula of the complex is Ni$\mathbf{L}_2$ →the coordination number is 2 x 2 = 4.