YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	**TEACHER'S COPY**

CG		INDEX NO	

CHEMISTRY 9729/01

Paper 1 Multiple Choice **15 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, highlighters, glue or correction fluid/tape.
Write your name and class on the Answer Sheet in the spaces 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 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.

This document consists of **16** printed pages.

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1 A medal has a total surface area of 150 cm^2. It is evenly coated with silver by electrolysis. Its mass increases by 0.216 g.

How many atoms of silver are deposited per cm^2 on the surface of the medal?

A 8.0×10^{18} **B** 1.8×10^{19} **C** 8.7×10^{20} **D** 1.2×10^{21}

Answer: A

Amount of Ag = 0.216 / 107.9
$= 2.00185 \times 10^{-3}$ mol
Number of Ag = $2.00185 \times 10^{-3} \times 6.02 \times 10^{23}$
$= 1.20511 \times 10^{21}$
Number of atom per cm^2 = 1.20511×10^{21} / 150
$= 8.03 \times 10^{18}$

2 Which gas would behave most like an ideal gas under room conditions?

A ammonia

B helium

C krypton

D nitrogen

Answer: B

Ideal gas should have negligible intermolecular forces of attraction.
Ammonia has hydrogen bonding which has the strongest IMF.
Between helium, krypton and nitrogen, helium has the smallest electron cloud size so weakest id-id.

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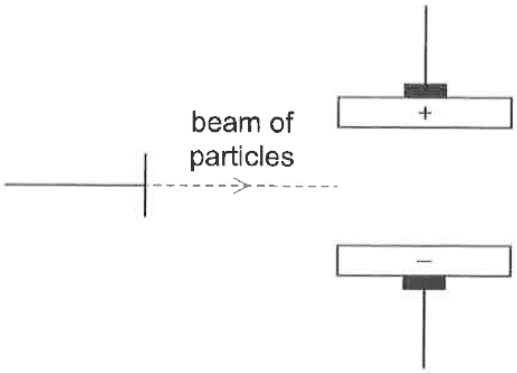
3 In two separate experiments a beam of protons and a beam of $^{4}_{2}He^{2+}$ particles, travelling at the same velocity, pass through an electric field as shown.



Which statements are correct?

1 Both beams are deflected in the same direction.

2 The proton beam travels in a straight path towards the negatively charged plate.

3 The protons are deflected to a larger extent than the $^{4}_{2}He^{2+}$ particles.

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

Answer: B

Statement 1 is correct. Both protons and $^{4}_{2}He^{2+}$ particles are positively charged, they will be deflected in the same direction, towards the negatively charged plate.

Statement 2 is incorrect. The proton beam travels in an angle similar to a circular path after deflection.

Statement 3 is correct. Since $\theta \propto \frac{e}{m}$, protons have charge/mass ratio of 1 whereas $^{4}_{2}He^{2+}$ particles have a charge/mass ratio of ½ , protons will have a larger angle of deflection.

4 The table shows some properties of four substances.

Which substance could be potassium iodide?

	Melting point of solid / °C	Electrical conductivity when molten
A	–66	poor
B	–39	good
C	680	good
D	1600	poor

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Answer: C

Potassium iodide has a giant ionic structure hence it will have a high melting point due to strong ionic bond and high lattice energy.
The ions can also act as mobile charge carrier in molten state hence it will have good electrical conductivity.

5 A carbon monoxide molecule, CO, has three bonds between the carbon atom and the oxygen atom.

Which features are present in one CO molecule?

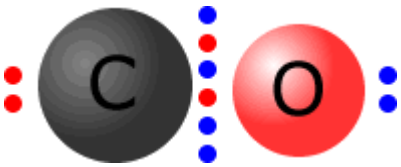
1 Three lone pairs of electrons

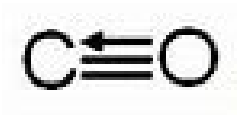
2 A co-ordinate bond from oxygen to carbon

3 Two π bonds

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

Answer: B





1 is incorrect as there's only two lone pairs of electrons.
2 is correct as the dative bond allows both carbon and oxygen to achieve 8 electrons around the atom.
3 is correct as CO bond has 1 sigma and the next two are pi bonds

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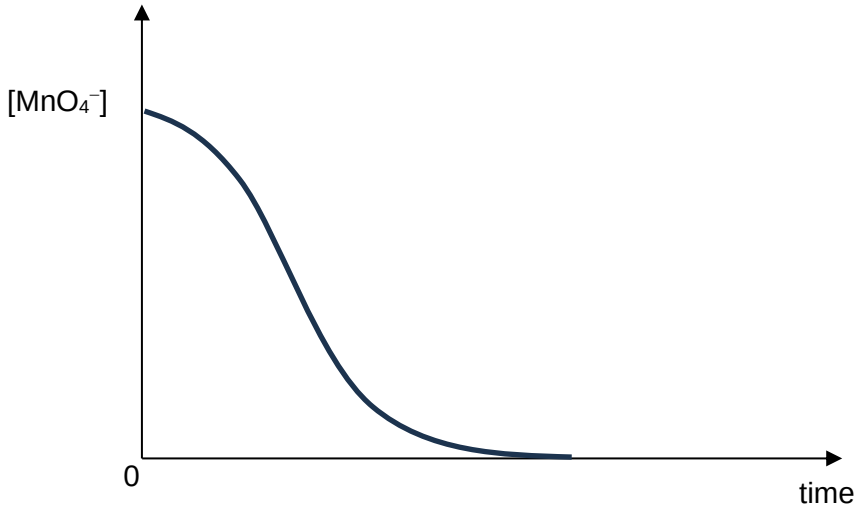
6 The reaction of manganate(VII) ions with ethanedioate ions in acid solution may be represented by the following equation.

$$2MnO_4^-(aq) + 16H^+(aq) + 5C_2O_4^{2-}(aq) \rightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 10CO_2(g)$$

The graph shows concentration of manganate(VII) ions against time for this reaction.



What does the shape of the graph suggest about this reaction?

A The rate of reaction decreases with time.

B The reaction is endothermic.

C The reaction shows first order kinetics.

D The reaction is catalysed by a product.

Answer: D

The gradient of the graph increases as time increases indicating that the products formed catalyse the reaction. Hence the products are present in the rate equation.

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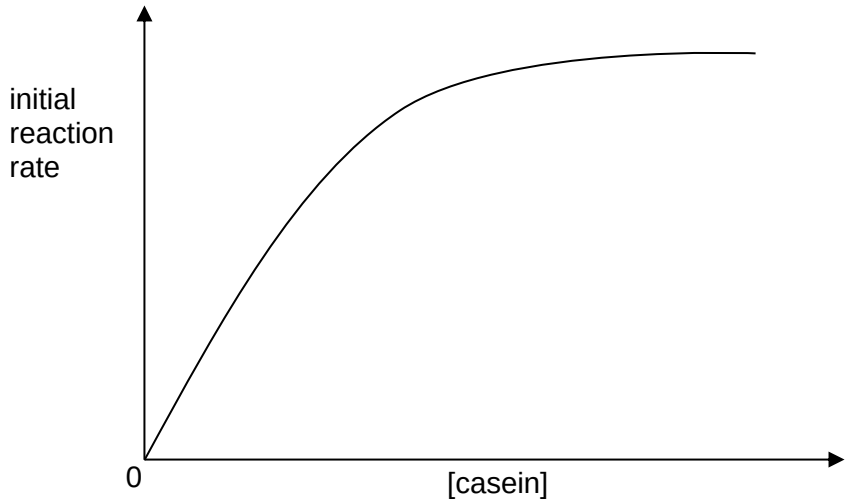
7 The graph shows the results of an investigation of the initial rate of hydrolysis of casein by the enzyme trypsin. In the experiments, the initial concentration of casein was varied but that of trypsin was kept constant.



Which conclusions can be deduced from these results?

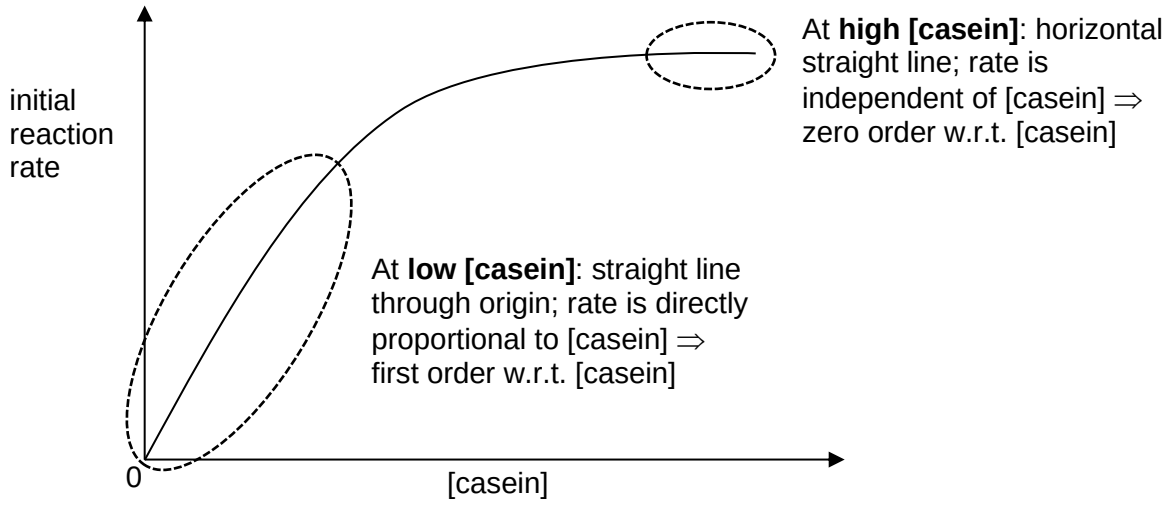
1 When [casein] is high, the rate is independent of [trypsin].

2 When [casein] is high, the rate is independent of [casein].

3 When [casein] is low, the rate is first order with respect to [casein].

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

Answer: C



The relationship between reaction rate and [trypsin] cannot be deduced from the graph.

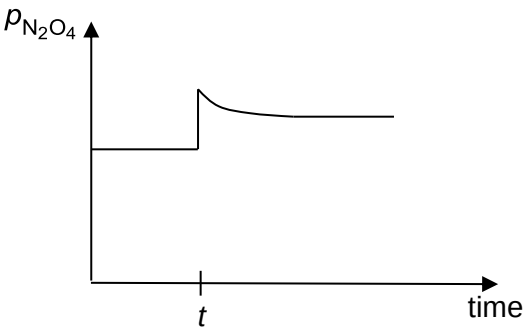
8 An equilibrium is set up, in a vessel at constant temperature and atmospheric pressure, according to the following reaction.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

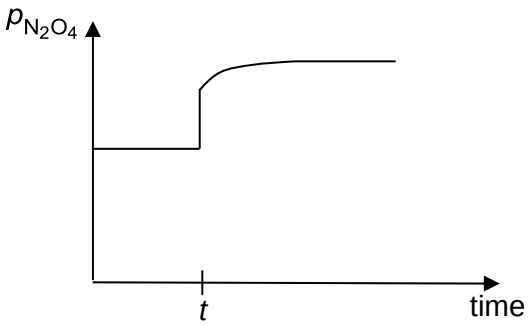
The vessel is attached to a plunger which can alter the pressure inside the vessel. At a time *t*, the plunger is pushed in quickly to increase the pressure and an new equilibrium is established. The temperature is maintained constant throughout.

Which graph shows the change in partial pressure of N_2O_4, $p_{N_2O_4}$, during this process?

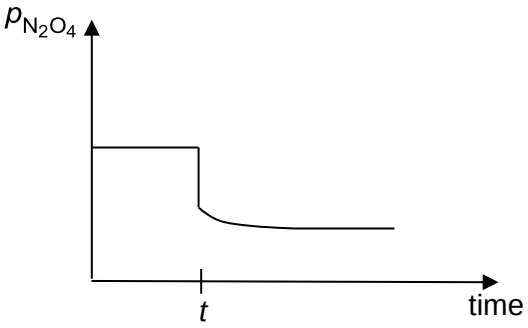
A



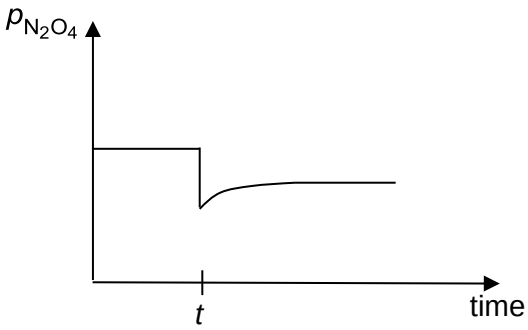
B



C



D



Answer: B

At *t*, when compressed (vol decrease while temp is constant), partial pressure of N_2O_4 will increase.

As the pressure of the system increases, by Le Chateliers' Principle, position of above equilibrium will shift to the right to favor the formation of fewer gaseous molecules, so as to decrease the pressure.

Hence, more N_2O_4 will be produced, resulting in increasing partial pressure of N_2O_4 after *t*.

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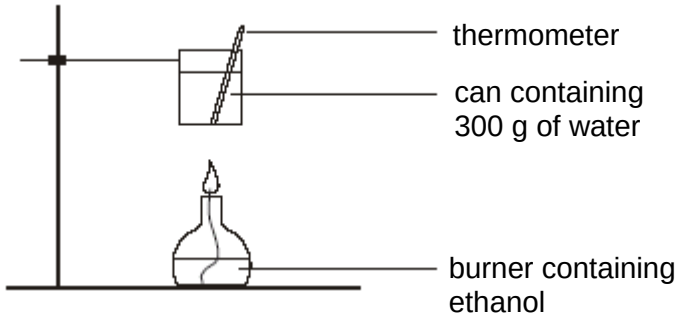
9 An experiment was conducted to determine the efficiency of the heating of a can of water using a spirit burner.



The following data were recorded:
Mass of ethanol burnt = m g
Change in temperature of water = ΔT ^{o}C

You are also given that:
Relative molecular mass of ethanol = 46.0
Enthalpy change of combustion of ethanol = –1371 kJ mol^{-1}
Specific heat capacity of water = c J g^{-1} K^{-1}

Which expression below gives the efficiency of this heating process?

A $\dfrac{300 \times c \times \Delta T \times 46.0}{m \times 1371 \times 1000} \times 100\%$

B $\dfrac{m \times c \times \Delta T \times 46.0}{300 \times 1371 \times 1000} \times 100\%$

C $\dfrac{300 \times c \times \Delta T \times 46.0}{m \times 1371} \times 100\%$

D $\dfrac{m \times 1371 \times 1000}{300 \times c \times \Delta T \times 46.0} \times 100\%$

Answer: A

Total amount of heat evolved $= \dfrac{m}{46.0} \times 1371$ **kJ**

Total amount of heat transferred $= 300 \times c \times \Delta T$ J $= \dfrac{300 \times c \times \Delta T}{1000}$ **kJ**

$\therefore$ efficiency $= \dfrac{300 \times c \times \Delta T}{1000} \div \dfrac{m \times 1371}{46.0} \times 100\% = \dfrac{300 \times c \times \Delta T \times 46.0}{1000 \times m \times 1371} \times 100\%$

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10 The enthalpy changes involving some oxides of nitrogen are given below:

	enthalpy change / kJ mol^{-1}
$N_2(g) + O_2(g) \rightarrow 2NO(g)$	+180
$N_2(g) + \frac{5}{2}O_2(g) \rightarrow N_2O_5(g)$	+11
$2NO_2(g) + \frac{1}{2}O_2(g) \rightarrow N_2O_5(g)$	–55

What is the enthalpy change, in kJ mol^{-1}, of the following reaction?

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

A –114 **B** +114 **C** –136 **D** +136

Answer: **A**

Reverse Equation 1: $2NO(g) \rightarrow N_2(g) + O_2(g)$ $\Delta H = -180$ kJ mol^{-1}

Reverse Equation 3: $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ $\Delta H = +55$ kJ mol^{-1}

Equation 2 remains: $N_2(g) + \frac{5}{2}O_2(g) \rightarrow N_2O_5(g)$ $\Delta H = +11$ kJ mol^{-1}

Sum up these 3 equations: $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta H = -180+55+11$
$= -114$ kJ mol^{-1}

11 The conversion of graphite into diamond is a non–spontaneous reaction at 298 K. The entropy change of this reaction is negative at 298 K.

$$C(\text{graphite}) \rightarrow C(\text{diamond}) \qquad \Delta G = +3.08 \text{ kJ mol}^{-1},\ \Delta S = -3.3 \text{ J mol}^{-1} \text{ K}^{-1}$$

With reference to the enthalpy change, ΔH, of the reaction above, which statements are correct?

1 Enthalpy change of atomisation of diamond is less endothermic than that of graphite.

2 Enthalpy change of atomisation of diamond is more endothermic than that of graphite.

3 Enthalpy change of combustion of diamond is less exothermic than that of graphite.

4 Enthalpy change of combustion of diamond is more exothermic than that of graphite.

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

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Answer: B

The ΔH of the reaction is +2.0966 kJ mol^{-1}. This means that C(diamond) is at a higher energy level than C(graphite).

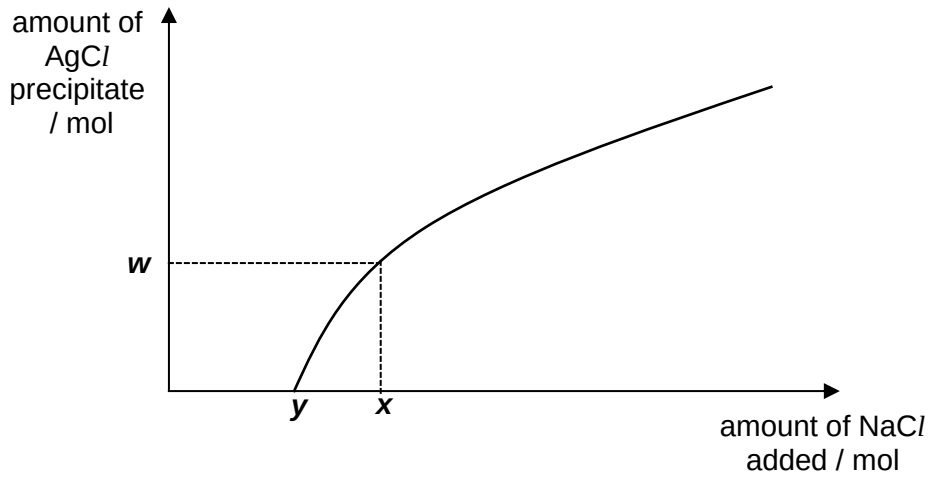
Atomisation is an endothermic process.
C(graphite) $\rightarrow$ C(g)
C(diamond) $\rightarrow$ C(g)

The enthalpy change of atomisation of diamond will be less endothermic than that of graphite as C(diamond) is at a higher energy level.

Combustion is an exothermic process.
C(graphite) + O_2(g) $\rightarrow$ CO_2(g)
C(diamond) + O_2(g) $\rightarrow$ CO_2(g)

The enthalpy change of combustion of diamond will be more exothermic than that of graphite as C(diamond) is at a higher energy level.

12 Solid NaC*l* was continuously added to a 1 dm^3 solution containing ***z*** mol of Ag^+ ions and the amount of AgC*l* precipitated was found to change, as shown in the graph below.



When ***x*** mol of NaC*l* was added, ***w*** mole of AgC*l* precipitate was formed.

Which of the following gives the correct expression for the solubility product of AgC*l*?

A **(*z*)(*y*)** **B** **(*w*)(*x*)** **C** **(*z*)(*x*)** **D** **(*y*)(*y*)**

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Answer: **A**

Solubility product, K_{sp}, means the product of the maximum concentration of Ag^+ and Cl^- that can be dissolved to form a saturated solution.

➔ Need to find the point just before AgCl precipitate is formed: When amount of NaCl is *y*
When amount of NaCl is y → $[Cl^-] = y$; and $[Ag^+] = z$

Therefore, $K_{sp} = (z)(y)$

13 Two experiments were conducted.

In the first set-up, 0.1 mol dm^{-3} of sodium ethanoate and 0.1 mol dm^{-3} silver nitrate was mixed and a white precipitate was obtained. On adding potassium bromide, the precipitate turns cream.

In the second set-up, 0.1 mol dm^{-3} of silver nitrate was added to potassium bromide and a cream precipitate was obtained. On adding sodium ethanoate, there is no further change.

What can be deduced from these observations?

A The cream precipitate is due to the silver ethanoate.

B Silver bromide is more soluble than silver ethanoate.

C The white precipitate in the first set-up is silver ethanoate.

D Ethanoate ions can oxidise bromide.

Answer: **C**

First Set-up

$CH_3COO^-Na^+(aq) + AgNO_3(aq) \rightarrow CH_3COO^-Ag^+(s)$ (white ppt)

↓ On adding KBr(aq) into mixture

$AgBr(s) + CH_3COO^-K^+(aq)$
cream ppt

When potassium bromide is added to this mixture, the ppt turns cream. This means that AgBr is now formed and the $AgCH_3COO$ formed earlier dissolved. This shows that **AgBr is less soluble than $AgCH_3COO$, hence Option A and B are incorrect.**

When mixing sodium ethanoate and silver nitrate, we get Na^+, CH_3COO^-, Ag^+ and NO_3^-.
But since **all sodium salts and nitrate salts are soluble**, the white precipitate that formed must be due to **$AgCH_3COO$. Option C is correct.**

When silver nitrate is added to potassium bromide, a cream ppt is obtained. This ppt is AgBr. When sodium ethanoate is added, there is no further change. This meant that $AgCH_3COO$ is NOT formed. This once again shows that AgBr is less soluble than $AgCH_3COO$.

Second set-up

$KBr(aq) + AgNO_3(aq) \rightarrow AgBr(s)$ (cream ppt) $\xrightarrow{\text{On adding } CH_3COO^-Na^+(aq) \text{ into mixture}}$ No further change

There is no redox reaction happening. There is no change in oxidation state for any element, hence **Option D is incorrect.**

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

In the electrolysis of molten aluminium oxide, 0.27 g of aluminium is liberated when 0.8 A of current is passed through the molten aluminium oxide for 1 hour.

Which is the value of Avogadro's constant derived from this experiment?

A 1.00×10^{22} **B** 6.00×10^{23} **C** 6.05×10^{23} **D** 5.40×10^{24}

Answer: **B**

No. of moles of Al = 0.27 / 27 = 0.0100 mol
$Al^{3+} + 3e^- \rightarrow Al$
No.of moles of e^- = 3 x 0.0100 = 0.0300 mol

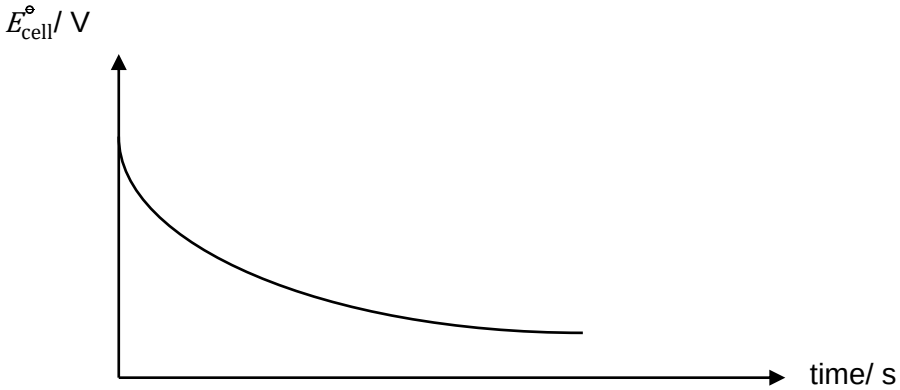
$F = \frac{Q}{\eta e} = \frac{0.8 \times 60 \times 60}{0.0300} = 96000$

$L = \frac{F}{e} = \frac{96000}{1.60 \times 10^{-19}} = 6.00 \times 10^{23}$

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

An experiment is carried out between the Fe^{2+}/Fe and Co^{2+}/Co half cells.

The following graph of cell potential against time was obtained when a change was continuously made to the half-cell.



Which of the following can explain the graph?

A Adding Co^{2+}(aq) to the Co^{2+}/Co half cell.

B Adding NaOH(aq) to the Co^{2+}/Co half cell.

C Adding water to the Fe^{2+}/Fe half cell.

D Increasing the mass of iron electrode used

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Answer: **B**

$E_{cell} = E_{red} - E_{oxd} = E\ (Co^{2+} / Co) - E\ (Fe^{2+} / Fe)$

Option **A** is incorrect.

$Co^{2+} + 2e \rightleftharpoons Co$ $\quad E^{\ominus} = -0.28V$
When cobalt (II) ions is added to the cobalt half-cell, $[Co^{2+}]$ increases. Position of eqm shifts right which causes $E_{Co^{2+}/Co}$ (E_{red}) to be more positive. Thus, E_{cell} becomes more positive.

Option **B** is correct.

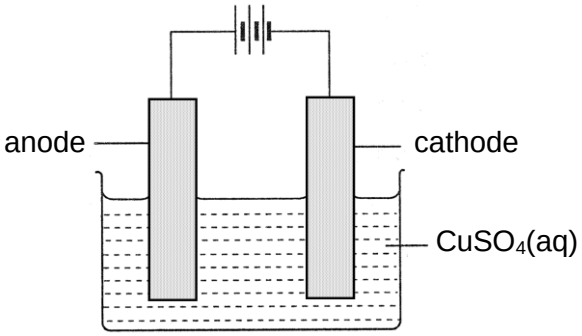
When aqueous hydroxide is added to the cobalt half-cell, the precipitate, $Co(OH)_2$, is formed. This precipitate formation decreases the concentration of aqueous Co^{2+} which causes the position of eqm to shift left leading to $E\ (Co^{2+} / Co)$ (E_{red}) becoming less positive. Thus, E_{cell} becomes less positive.

Option **C** is incorrect.

$Fe^{2+} + 2e \rightleftharpoons Fe$ $\quad E^{\ominus} = -0.44V$
When water is added to the iron half-cell, $[Fe^{2+}]$ decreases. Position of eqm shift left causing $E\ (Fe^{2+} / Fe)$ (E_{oxd}) to be less positive. Thus, E_{cell} becomes more positive increases.

Option **D** is incorrect as an increase in the mass of solid iron does not affect E values.

16 In an experiment, a cell was set up to obtain pure copper from a copper-silver alloy as shown below. Pure copper is used as the cathode and the copper-silver alloy is used as the anode.



When a current of 30.0 A flows through the electrolyte for 31.4 minutes, silver deposit underneath the anode was collected and weighed. During this time, the mass of the anode changes by 26.47 g.

What is the mass of the silver collected underneath the anode?

A 7.874 g **B** 18.60 g **C** 37.20 g **D** 61.70 g

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Answer: **A**

$Ag^+(aq) + e^-$	⇌	Ag(s)	+0.80
$Cu^{2+}(aq) + 2e^-$	⇌	Cu(s)	+0.34

At the anode, Cu is being oxidised to Cu^{2+}
So silver will fall of as anode sludge.

$I \times t = n_e \times F$
$30 \times 31.4 \times 60 = n_e \times 96500$
$n_e = 0.58569$ mol

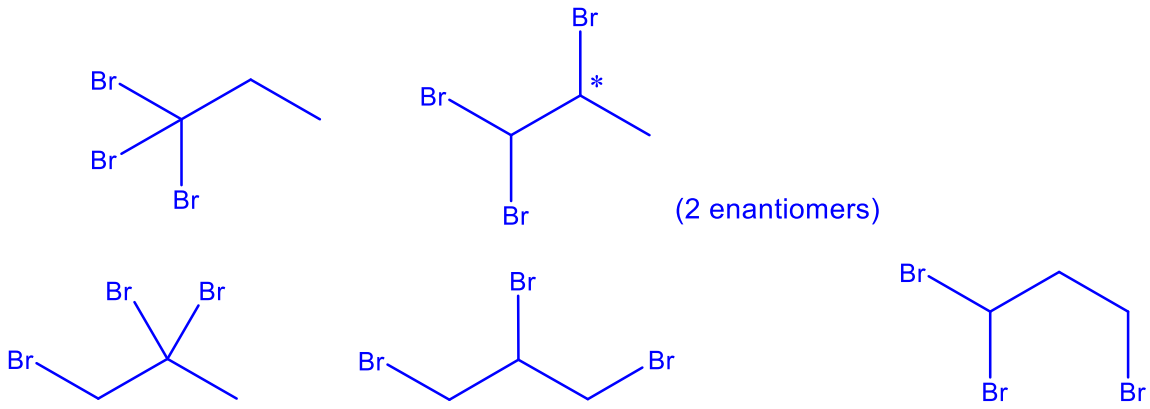
Since Cu : e = 1 : 2,
Amount of Cu oxidised = ½ x 0.58569 = 0.29284 mol
Mass of Cu oxidised = 0.29284 x 63.5 = 18.595 g

Mass of silver in collected = 26.47 – 18.596 = 7.874 g

17 How many isomers, including stereoisomers, are there of $C_3H_5Br_3$?

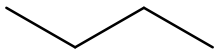
A 3 **B** 4 **C** 5 **D** 6

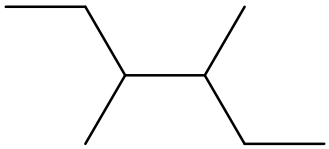
Answer: D

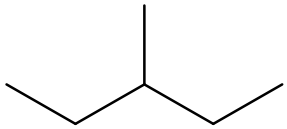


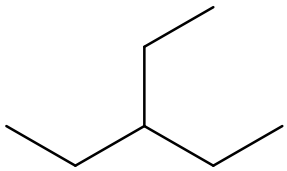
18 Ethane undergoes free-radical substitution when mixed with chlorine and exposed to ultra-violet light.

Which compounds are possible products from this reaction?

1 

2 

3 

4 

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 2 only **D** 2 and 3 only

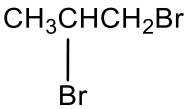
Answer: **A**

Option 4 will not be formed as the hydrocarbon radicals will contain 2 carbon atoms thus the hydrocarbons formed will contain carbon atoms in multiples of 2

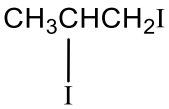
19 Hydrogen iodide undergoes an addition reaction with propene forming 2-iodopropane. When propene is bubbled through iodine monobromide, IBr, dissolved in a suitable solvent, a similar reaction occurs.

Which product will be present in the greatest yield?

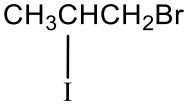
A



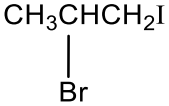
B



C

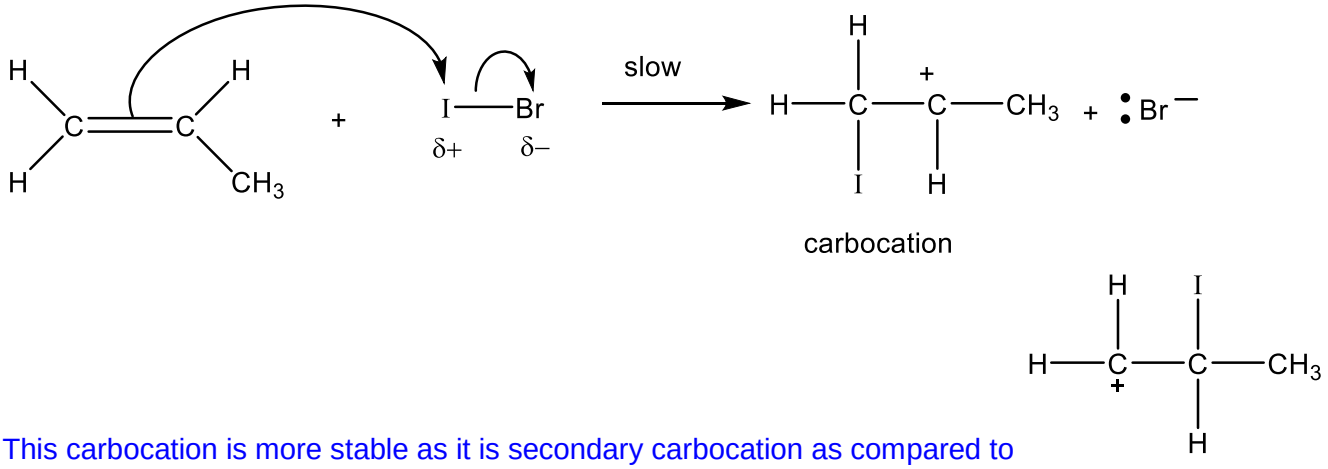


D

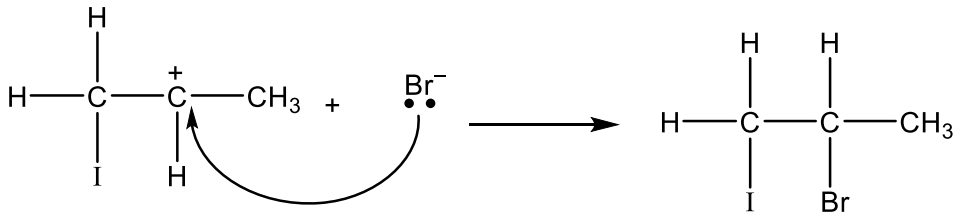


Answer: **D**

In IBr, I is less electronegative than Br and hence it will have a partial positive charge while the more electronegative Br will have the partial negative charge.



This carbocation is more stable as it is secondary carbocation as compared to which is a primary carbocation.



20 The molecule of benzene, C_6H_6 is a regular hexagon in which the π electrons are described as delocalised.

Which of the following statements are true for benzene?

1 Benzene favours substitution reactions.

2 All C–C bonds lengths in benzene are intermediate between C–C bond in an alkane and C=C bond in an alkene.

3 The presence of π electrons enables benzene to be a good electrical conductor.

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

Answer: **A**

Option 1 is correct. Benzene undergoes substitution reaction to remain its aromaticity.

Option 2 is correct. As the π electrons are delocalised in the benzene ring, all the C-C bonds have partial double bond character.

Option 3 is wrong. Although the π electrons are delocalised in the benzene ring, there is no free mobile electrons and ions in liquid benzene, thus benzene is not a good conductor of electricity.

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21 Which compound is least reactive with a few drops of ethanolic silver nitrate under the same conditions?

A benzoyl bromide

B 2-bromo-2-methylpropane

C bromobenzene

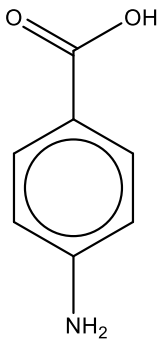
D 1-bromobutane

Answer: **C**

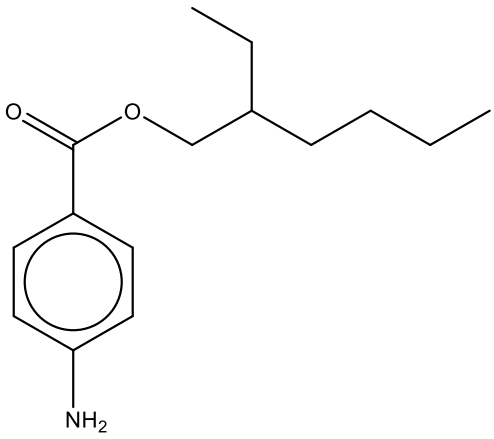
Ethanolic silver nitrate is a reagent for nucleophilic substitution or hydrolysis. The ease of hydrolysis increases in the order of bromobenzene < bromoalkane < acyl bromide.

bromobenzene does not undergo nucleophilic substitution at all due to the strengthened C-Br bond as the lone pair of electrons on bromine atom delocalise into the benzene ring, as well as steric hindrance caused by the presence of the benzene ring.

22 PABA and Padimate O are both effective sunscreen ingredients that absorb UVB light. What is the type of reaction occurring when PABA is converted to Padimate O?



PABA



Padimate O

A electrophilic addition

B condensation

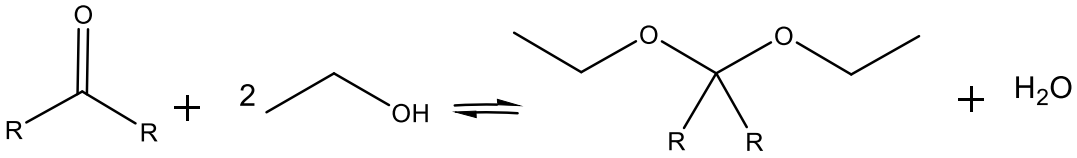
C hydrolysis

D electrophilic substitution

Answer: **B**

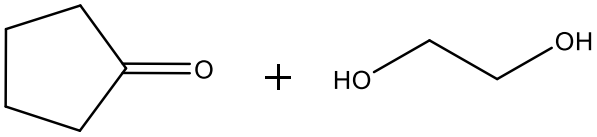
Acid reacts with alcohol via condensation to form ester.

23 Acetals are formed by the reaction of aldehydes or ketones with alcohols in the presence of an acid catalyst. The resulting compound contains a carbon atom bonded to two alkoxy groups (OR) and two carbon atoms, forming a tetrahedral structure.

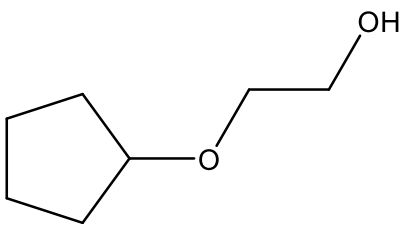


Acetal

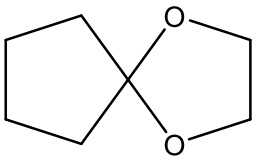
Which of the acetal is formed using the following reagents?



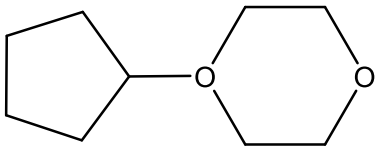
A



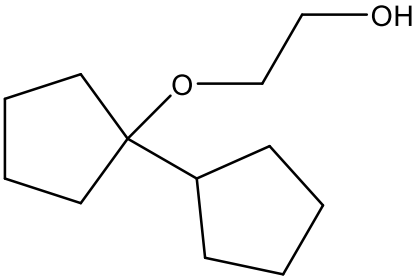
B



C



D



Answer: **B**

Apply the reaction scheme given. Note that one molecule of diol provides both-OH groups. The acetal product where two separate oxygen atoms are single bonded to a central carbon atom.

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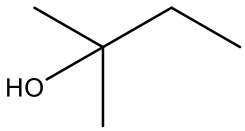
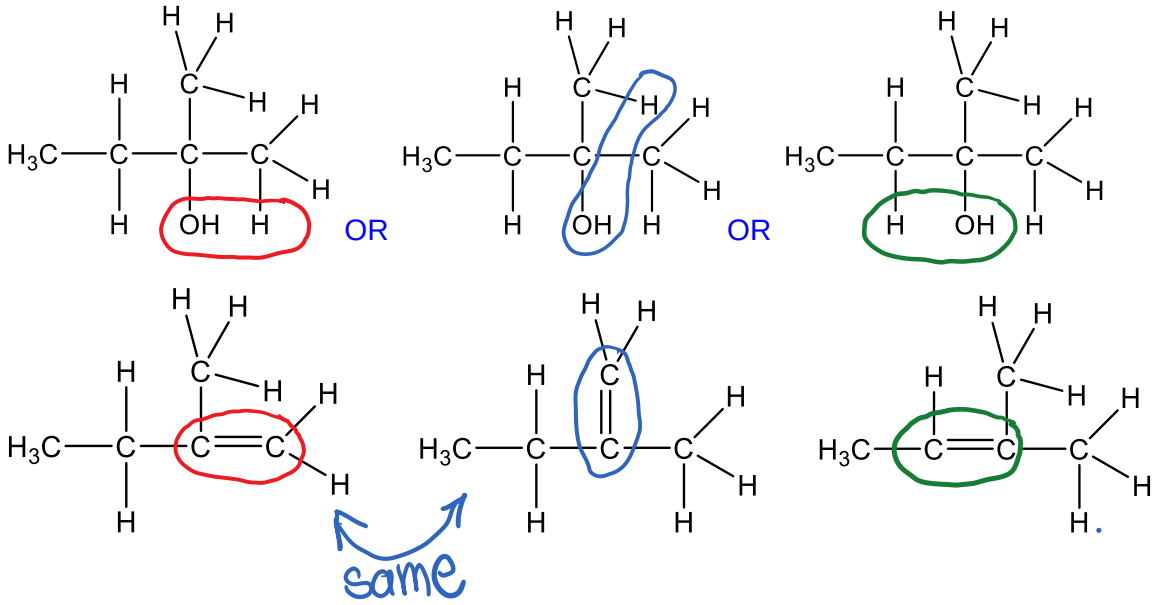
24 What is the total number of isomers that can be obtained when the alcohol as shown below is dehydrated?

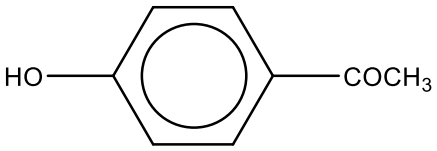


A 1 **B** 2 **C** 3 **D** 4

Answer: **B**



25 The diagram shows the structure of a compound **X.**



compound **X**

Which statements are correct?

1 **X** undergoes nucleophilic addition with HCN in the presence of NaOH(aq).

2 **X** undergoes electrophilic addition with Br_2(aq).

3 **X** undergoes nucleophilic substitution with PCl_5(s).

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

©YIJC

Answer: **D**

1 Correct. Ketone reacts to form cyanohydrin.

2 Incorrect. Benzene does not undergo electrophilic addition to preserve its aromaticity.

3 Incorrect. C–C*l* bond has partial double bond, hard to break

26 Consider the following four compounds.

1 phenol

2 propan-1-ol

3 2-chloropropanoic acid

4 3-chloropropanoic acid

What is the relative order of **decreasing** acidity of these compounds?

A 3, 4, 1, 2

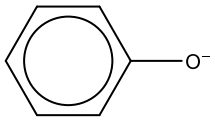
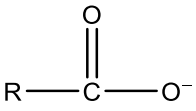
B 4, 3, 1, 2

C 2, 1, 4, 3

D 4, 3, 2, 1

Answer: **A**

Strength of acidity based on functional groups: carboxylic acid > phenol > aliphatic alcohol

	aliphatic alcohol	phenol	carboxylic acid
conjugate base	R–O$^-$		
stability of conjugate base	least stable		most stable
factor affecting stability of conjugate base	presence of electron−donating alkyl groups intensified the negative charge on the oxygen atom	the negative charge on the O atom is partially delocalised into the benzene ring	the negative charge on the O atom is completely delocalised between the two electronegative oxygen atoms
extent of dissociation	less than phenol	more than ethanol but less than ethanoic aicd	more than phenol

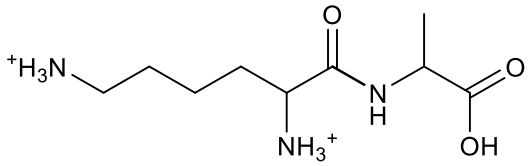
Comparing 3-chloropropanoic acid and 2-chloropropanoic acid, dispersion of negative charge by electronegative atom **declines with distance**.

The **negative charge on the O** atom in $CH_3CHClCH_2CO_2^-$ is **dispersed to a greater extent** because the electron-withdrawing C*l* atom is **closer** to the $-CO_2^-$ group and hence **more stable** than $CH_2ClCH_2CH_2CO_2^-$ since the C*l* atom is further away. Hence, $CH_3CHClCH_2CO_2H$ **dissociates to a greater extent** than $CH_2ClCH_2CH_2CO_2H$.

Relative order of **decreasing** acidity :

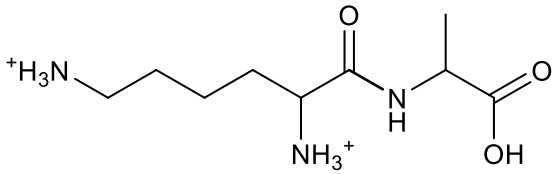
2-chloroethanoic acid > 3-chloropropanoic acid > phenol > propan-1-ol

27 A dipeptide lys–ala has pK_a values of 2.35, 8.95 and 10.53.

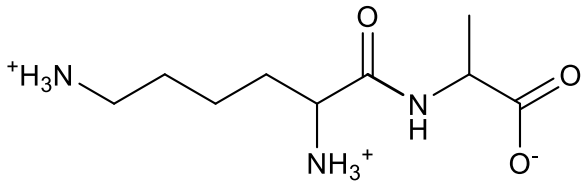


What is the structure of the major species in a solution of lys–ala at pH 7?

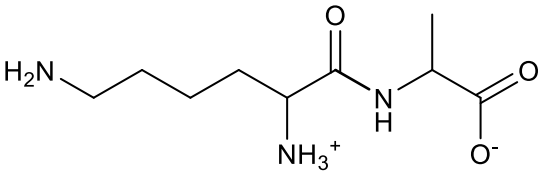
A



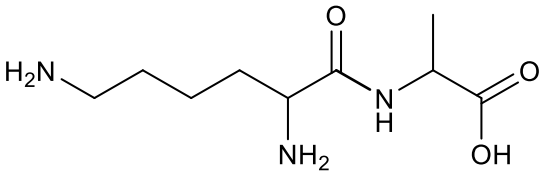
B



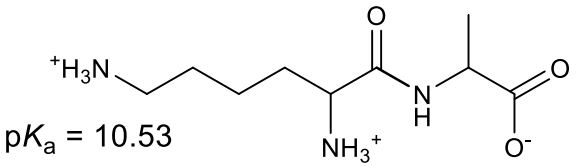
C



D



Answer: **B**



28 Which statements on boiling point and thermal stability of hydrogen halides down group 17 are correct?

1 Boiling point of hydrogen halides decreases due to weaker hydrogen-halogen bonds.

2 Boiling point of hydrogen halides increases due to stronger intermolecular forces of attraction.

3 Thermal stability decreases due to weaker hydrogen-halogen bonds.

4 Thermal stability increases due to stronger intermolecular forces of attraction.

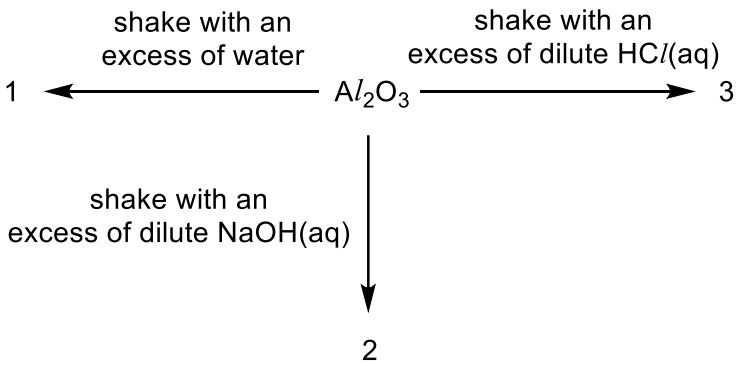
A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

Ans: C

Boiling point increases due to increasing electron cloud size. Hence, HX is more polarisable down the group and forms stronger instantaneous dipole-induced dipole attraction.

Thermal stability decreases due to larger more diffused valence orbital. Hence, less effective orbital overlap between valence orbitals of H and halogen, resulting in a weaker H-X covalent bond. Less energy is needed to break HX and hence, a lower thermal stability.

29 A student carries out an investigation using aluminium oxide. All experiments are carried out at room temperature.



Which observations would the student make of the results of these experiments?

A No solid remains in any experiment.

B A solid remains in one experiment only.

C A solid remains in two experiments only.

D Solid remains in all three experiments.

Answer: **B**

Al_2O_3 has a giant ionic structure, hence it is unable to dissolve in water.

It is an ionic oxide with covalent character, hence it is amphoteric and react with both dilute HCl and dilute NaOH to form soluble $AlCl_3(aq)$ and $NaAl(OH)_4(aq)$ respectively.

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

The table shows some physical properties of metals.

One row of the table shows two properties of calcium. Another row shows two properties of chromium. The other two rows of the table each show one property of calcium and one property of chromium.

Which row shows two properties of chromium?

	density / g cm^{-3}	melting point / °C
A	1.6	842
B	1.6	1910
C	7.2	842
D	7.2	1910

Ans: D

Transition elements (e.g. chromium) have higher melting point (stronger metallic bond as 4s and 3d electrons can be delocalised into sea of electrons) and higher density (due to higher Ar and smaller atomic radius) than Group 2 elements (e.g. calcium).

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ANSWER KEY

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

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