YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	
CG	INDEX NO

CHEMISTRY 9729/01

Paper 1 Multiple Choice **16 September 2021**

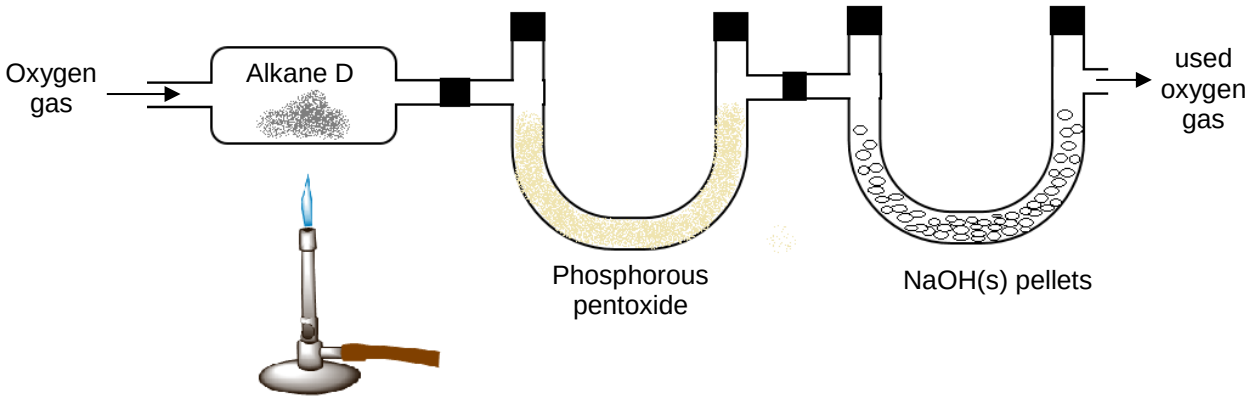
1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

MCQ Answer Key:

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

1 A 1.00 g alkane D was burnt in an excess of oxygen, and the gases that were produced were first passed through a U-tube containing phosphorus pentoxide and another U-tube containing NaOH(s) as shown in the diagram. The phosphorus pentoxide U-tube increased in mass by 1.55 g, and the NaOH(aq) bottle increased in mass by 3.03 g. All volumes were measured at room temperature and pressure. What is the molecular formula of the alkane D?



A CH_4 **B** C_2H_5 **C** C_2H_6 **D** C_4H_{10}

Answer: D

Amount of H atoms = $2 \times 0.0861 = 0.1722$ mol
Amount of C atoms = 0.0689 mol
Ratio of H : C = 0.1722 0.0689 = 2.4992 : 1 = **5 : 2**

Since the molecular formula of an alkane is C_nH_{2n+2}, the molecular formula of alkane D must be **C_4H_{10}**.

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

What do the ions $^{36}S^{2-}$ and $^{37}Cl^-$ have in common?

A Both ions have more electrons than neutrons.

B Both ions have the same electronic configuration.

C Both ions contains the same number of nucleons.

D $^{36}S^{2-}$ has a smaller angle of deflection than $^{37}Cl^-$ in an electric field.

Answer: B

Option A:
$^{36}S^{2-}$ has 16 protons, 20 neutrons and 18 electrons,
$^{37}Cl^-$ has 17 protons, 20 neutrons and 18 electrons.

Option B: Both ions are $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Option C:
$^{36}S^{2-}$ has 16 protons + 20 neutrons = 36 nucleons
$^{37}Cl^-$ has 17 protons + 20 neutrons = 37 nucleons

Option D:
angle of deflection = charge/mass,
$^{36}S^{2-}$= 0.0556 > $^{37}Cl^-$, 0.0270

3 Boyle's law states that at constant temperature, the volume of a fixed mass of gas is inversely proportional to its pressure.

Which of the following statements shows application of Boyle's law?

1 Human lungs, inhalation and exhalation.

2 Spraying paint from a can.

3 Working of hot air balloon.

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

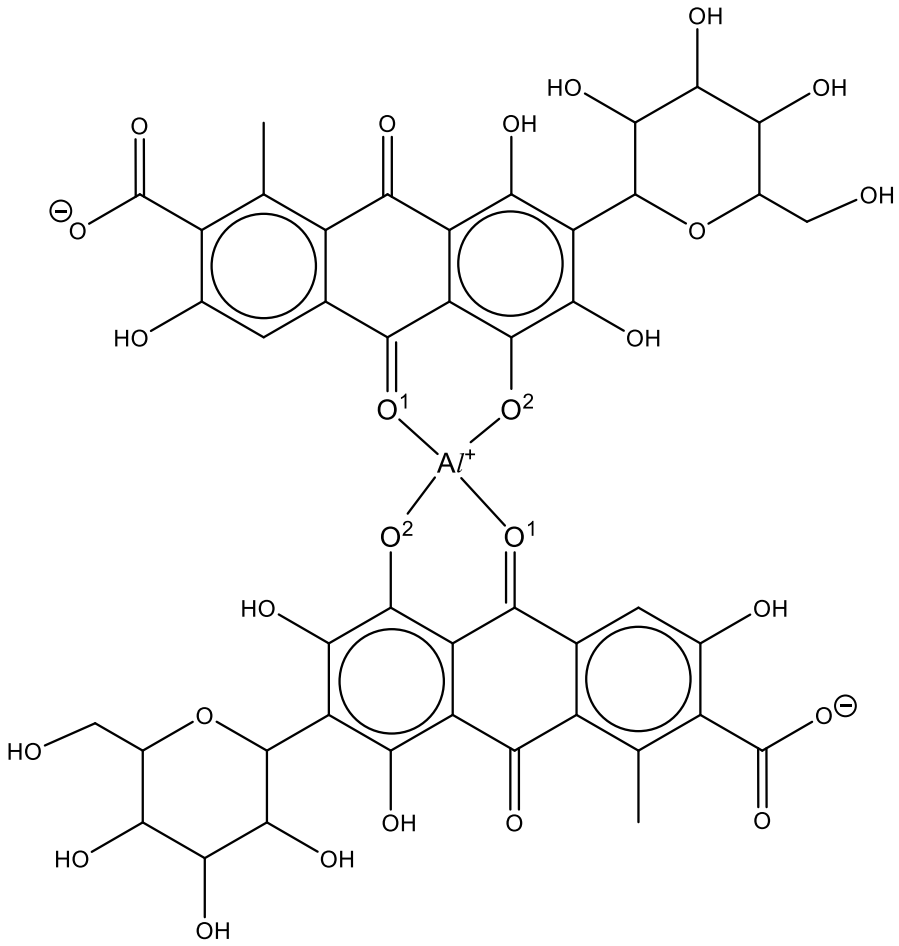
Answer: B

Option 1: correct. While inhaling, the lungs are filled with air; therefore, they expand. The volume increases hence, the pressure level goes down. Similarly, when the lungs are evacuated of air, they shrink; therefore, the volume reduces and the pressure increases.

Option 2: correct. When the top of the can is pressed, the volume inside the can gets reduced and the paint is thrown out with great pressure. Since the pressure has an inverse relationship with the volume, Boyle's law can be observed in action.

Option 3: Incorrect. On ignition of the fuel, the air inside the envelope heats up. This hot air expands as per Charles's law. As the temperature of the air increases, the volume of the air also increases and consequently, the density decreases. This makes the envelope lighter than the atmospheric air surrounding it. The buoyant force pushes the lighter envelope up in the air, and it flies.

4 Carmine is a red colorant extracted from the bodies of dead female insects, used in food colouring and lipsticks. The proposed structure of carmine is as shown.



The Al^+ ion is situated in the centre of a planar arrangement of numbered oxygen atoms.
Which of the following descriptions of the bonds between Al^+ and the numbered O atoms is most likely to be correct?

	O atoms numbered 1	O atoms numbered 2
A	co-ordinate	co-ordinate
B	co-ordinate	ionic
C	ionic	co-ordinate
D	ionic	ionic

Answer: A

Oxygen (in period 2) has 6 valence electrons and it cannot expand its octet. Oxygen 1 has lone pair available to form co-ordinate bond with Al^{3+}, hence oxygen has full octet. Oxygen 2 comes from O^-(phenoxide), forms co-ordinate bond with Al^{3+}*(high charge density)* , hence overall charge on *Al* is 1+. +3 -2(-1)= +1

5 The table shows the boiling point of some halogenoalkanes.

compound	boiling point/ °C
CH_3CH_2Cl	12.3
CH_3CH_2Br	34.8
CH_3CH_2I	70.0

Which of the following correctly explains the difference in the boiling point?

1 the electronegativity difference between the halogen and carbon increases from C−C*l* to C−I

2 the strength of permanent dipole-permanent dipole attraction increases from C−C*l* to C−I

3 the strength of instantaneous dipole-induced dipole attraction increases from CH_3CH_2Cl to CH_3CH_2I

4 the bond energy of C−X bond decreases from C−C*l* to C−I

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

Answer: C

N.B. H-bonding > pd-pd> id-id only if size of electron cloud of molecules are similar.

1 the electronegativity difference between the halogen and carbon should **decrease** from C−C*l* to C−I. Statement **does not** explain for the trend of increasing boiling point from CH_3CH_2Cl to CH_3CH_2I.

2 the strength of permanent dipole-permanent dipole attraction **decreases** from C−C*l* to C−I. The statement of option 2 is **incorrect** and **does not** explain for the trend of **increasing** boiling point from CH_3CH_2Cl to CH_3CH_2I.

3 the strength of instantaneous dipole-induced dipole attraction increases from CH_3CH_2Cl to CH_3CH_2I. Statement is **correct** as the total number of electrons increases from CH_3CH_2Cl to CH_3CH_2I and due to the increase in id-id attraction, the boiling point increases from CH_3CH_2Cl to CH_3CH_2I.

4 the bond energy of C-X bond decreases from C−C*l* to C− I. Statement is correct but boiling does not break the C−X bond, so this **does not** explain for the trend of **increasing** boiling point from CH_3CH_2Cl to CH_3CH_2 I.

6 The radioactive decay of element X is a first-order reaction. It take 16 days for element X to decay to 25% of its initial value.

What fraction of element X would remain after 800 days?

A $\frac{1}{2^{10}}$ **B** $\frac{1}{2^{50}}$ **C** $\frac{1}{2^{80}}$ **D** $\frac{1}{2^{100}}$

Answer: D

Half-life = 8 days (1→0.5→0.25, 16 days 2 half-lives)

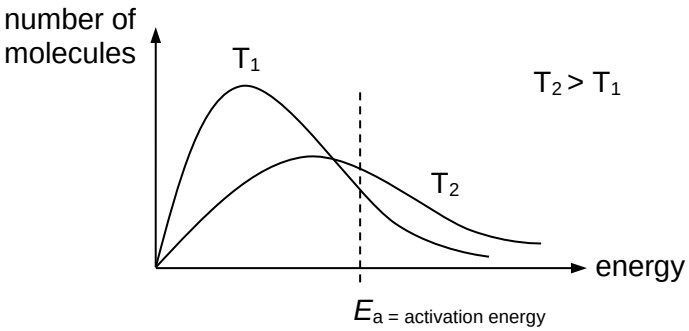
80 days = 100 x 8 days = 100 half-lives

Fraction of isotope remaining = $\left(\frac{1}{2}\right)^{100} = \frac{1}{2^{100}}$

7 The Boltzmann distribution of kinetic energies for the following equilibrium

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \qquad \Delta H = +57 \text{ kJ mol}^{-1}$$

is shown graphically below as temperature is increased.



Which statements can be drawn from the graph?

1 At all energies, the number of molecules of N_2O_4 of a given value increases.

2 The maximum of the curve lowers and shifts to the right.

3 The reaction is first order with respect to $[N_2O_4]$.

4 The number of molecules with energies equal or greater than *Ea* increases.

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

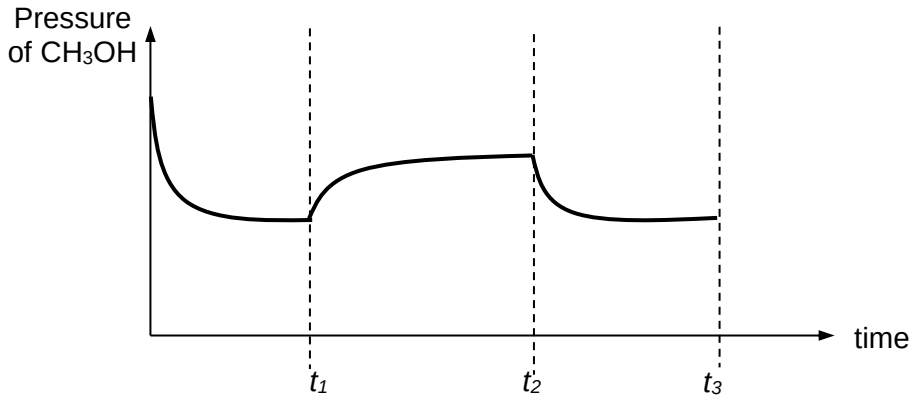
Answer: C

1 Incorrect as at the lower energy regions the number of molecules decreases when the temperature increases.
2 Correct as seen for the graph, at higher temperature, T2, the maximum of the curve lowers and shifts to the right.
3 Incorrect as you cannot deduce order of reaction from Boltzmann curve.
4 Correct. The number of molecules with energies above E_a increases as represented by area under the curve for T_2 is greater than T_1.

8 Methanol can be synthesised from hydrogen and carbon monoxide using a suitable catalyst at 480 K and a pressure of 3 x 10^6 Pa.

$$2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -90.6 \text{ kJ mol}^{-1}$$

The reaction mixture reached equilibrium under the above conditions. The graph below shows how the pressure of CH_3OH varied with time.



What could be the changes made to the system at t_1 and t_2?

	t_1	t_2
A	CH_3OH was added	Temperature was decreased
B	CO was added	Temperature was increased
C	Temperature was decreased	CO was added
D	Temperature was increased	CH_3OH was added

Answer: B

At t_1: There was an increased in pressure of CH_3OH, indicating the position of equilibrium shifts right. This can be caused by either adding CO (POE shift right to remove excess CO) or decrease in temperature (POE shift right to increase heat as right, being exothermic, releases heat). Hence only Option B and C are correct for t_1.

At t_2: There was a decrease in pressure of CH_3OH, indicating the position of equilibrium shifts left. This can be caused by either adding CH_3OH (POE shift left to remove excess CH_3OH) or increase in temperature (POE shift left to decrease heat as left, being endothermic, absords heat). Hence only Option B and D are correct for t_2.

Hence, the answer is B as it is correct for both t_1 and t_2.

9 A quantity of ethanol was burned underneath a copper can containing 400 g of water at 30 °C. The temperature of the water rose to 85 °C after the complete combustion of 5 g of ethanol (M_r = 46.0).

The efficiency of heat transfer to the water will not be 100% after taking into considerations the heat capacity of the copper can and heat loss to surroundings.

Given that the specific heat capacity of water is 4.2 J g^{-1} K^{-1} and the enthalpy change of combustion of ethanol is –1367 kJ mol^{-1}, what is the efficiency of heat transfer to the water?

A 27% **B** 39% **C** 62% **D** 96%

Answer: C

Theoretical heat transferred = ΔH *x* amount of ethanol

= 1367 x 5/46

= 148.58 kJ

Experimental heat released = mcΔT

= 400 x 4.2 x 55

=92400 J = 92.4 kJ

% efficiency of heat transfer = 92.4/148.58 x 100% = 62%

10 Which equation corresponds to the enthalpy change stated?

A	$2Al^{3+}(g) + 3O^{2-}(g) \rightarrow Al_2O_3(s)$	$2\Delta H^{\ominus}_{\text{lattice energy}}(Al_2O_3(s))$
B	$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$	$\Delta H^{\ominus}_{\text{neutralisation}}(H_2O(l))$
C	$CaCl_2(s) \rightarrow Ca^{2+}(aq) + 2Cl^{-}(aq)$	$\Delta H^{\ominus}_{\text{solution}}(CaCl_2(s))$
D	$\frac{1}{4}P_4(s) + \frac{5}{2}O_2(g) \rightarrow \frac{1}{4}P_4O_{10}(s)$	$\Delta H^{\ominus}_{\text{formation}}(P_4O_{10}(s))$

Answer: C

A represents $\Delta H^{\ominus}_{\text{lattice energy}}(Al_2O_3(s))$.

B represents 2 × $\Delta H^{\ominus}_{\text{neutralisation}}$

D represents ¼ $\Delta H^{\ominus}_{\text{formation}}(P_4O_{10}(s))$

11 Calcium reacts with water to form calcium hydroxide and hydrogen.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$$

The standard enthalpy change for this reaction can be measured in the laboratory.

What further information is needed in order to calculate the standard enthalpy change of formation of calcium hydroxide, $\Delta H_f^{\ominus}$?

1 $\Delta H_f^{\ominus}$ for $H_2O(l)$

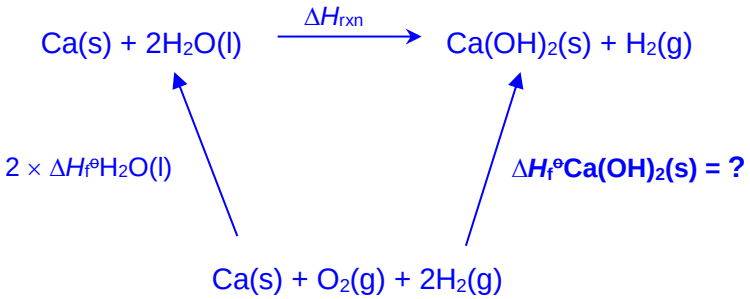
2 $\Delta H_f^{\ominus}$ for $H_2(g)$

3 $\Delta H_{atomisation}^{\ominus}$ for Ca(s)

4 first and second ionisation energies of Ca(s)

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

Answer: D



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

Water undergoes self–ionisation according to the equation:

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

At 60 °C, the ionic product of water, K_w, has the value of 9.5×10^{-14} mol^2 dm^{-6}.

Which statement concerning water at 60°C is correct?

A The pH is 6.51.

B $[OH^-] = 4.75 \times 10^{-7}$ mol dm^{-3}

C The water is slightly acidic.

D Heating water from 25 °C to 60 °C causes water to ionise to a lesser extent.

Answer: A

A is correct as $pH = -\log_{10}[H^+] = -\log_{10}(3.08 \times 10^{-7}) = 6.51$
B is incorrect as $[OH^-] = \sqrt{(9.5 \times 10^{-14})} = 3.08 \times 10^{-7}$ mol dm^{-3}
C is incorrect as water is still neutral as $[OH^-] = [H^+]$
D is incorrect as the ionisation of water is an endothermic process. An increase in temperature causes equilibrium position of $H_2O \rightleftharpoons H^+ + OH^-$ to shift right, causing water to ionise more instead.

13 Values of two solubility products are given

	K_{sp} value at 25 °C
$CaCO_3$	8.7×10^{-9}
CaF_2	4.0×10^{-11}

Solid $CaCO_3$ is shaken with water. The remaining solid is filtered off, leaving behind a saturation solution X.

Drops of $F^-(aq)$ are added to solution X until CaF_2 just precipitates. Which row of the table is correct?

	$[Ca^{2+}(aq)]$ in solution X / mol dm^{-3}	$[F^-(aq)]$ when CaF_2 just precipitates / mol dm^{-3}
A	9.33×10^{-5}	6.55×10^{-4}
B	9.33×10^{-5}	9.67×10^{-3}
C	2.15×10^{-4}	6.55×10^{-4}
D	2.15×10^{-4}	4.31×10^{-4}

Answer: A

$CaCO_3(s) \rightleftharpoons Ca^{2+}(aq) + CO_3^{2-}(aq)$

Let the solubility of $CaCO_3(s) = x$ mol dm^{-3}

$[Ca^{2+}(aq)] = x$ mol dm^{-3}; $[CO_3^{2-}(aq)] = x$ mol dm^{-3}

$K_{sp} = [Ca^{2+}][CO_3^{2-}] = (x) \times (x) = x^2 = 8.7 \times 10^{-9}$

$x = \sqrt{8.70 \times 10^{-9}} = 9.33 \times 10^{-5}$ mol dm^{-3}

$K_{sp} = [Ca^{2+}][F^-]^2 = 4.0 \times 10^{-11}$

$[9.33 \times 10^{-5}] [F^-]^2 = 4.0 \times 10^{-11}$

$[F^-] = 6.55 \times 10^{-4}$

14 Which factors determine the number of atoms of copper deposited on the cathode of an electrolytic cell?

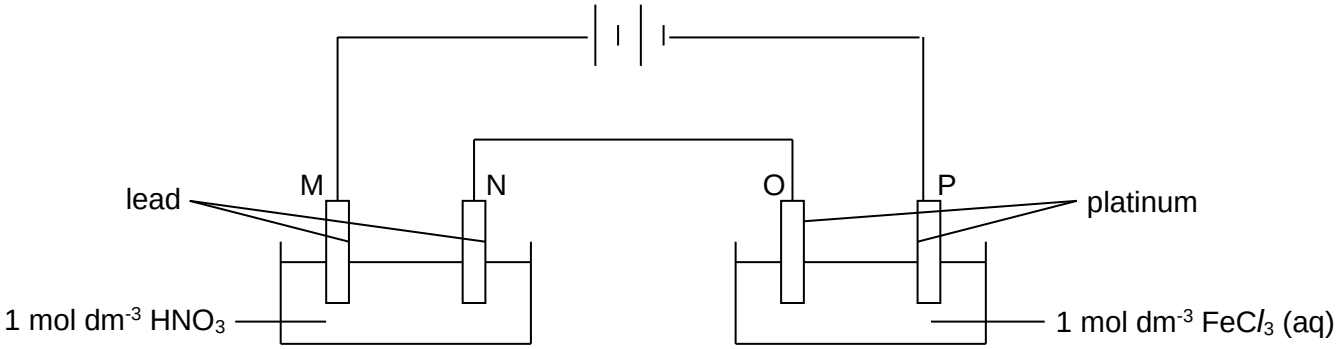
	current	time	$[Cu^{2+}(aq)]$	size of electrode
A	✓	✓	✓	✓
B	×	×	✓	✓
C	✓	✓	×	×
D	×	✓	✓	×

Answer: C

The amount of copper deposited depends on the amount of current and the time duration for the electrical charge to flow into the cathode, hence the formula Q = It.

It is not dependent on $[Cu^{2+}(aq)]$ and the size of electrode.

15 Two cells are connected in series as shown in the diagram where M, N, O and P are the electrodes.



Which of the following correctly shows the products formed at each electrode?

	M	N	O	P
A	O_2	H_2	O_2	Fe^{2+}
B	O_2	Pb	Cl_2	H_2
C	Pb^{2+}	H_2	Cl_2	H_2
D	Pb^{2+}	H_2	O_2	Fe^{2+}

Answer: D

From the battery, we can deduce that M and O are anode, N and P are cathode.

Oxidation will occur at M and O.
At M, Pb will be preferentially oxidised to form Pb^{2+} compared to water.

$Pb^{2+} + 2e^- \rightleftharpoons Pb$	– 0.13
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1.23

At O, water will be preferentially oxidised to from oxygen gas compared to chloride ions.

$Cl_2 + 2e^- \rightleftharpoons 2\ Cl^-$	+1.36
$O_2 + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+1.23

Reduction will occur at N and P.
At N, H^+ will be reduced to form hydrogen gas.

$2H^+ + 2e^- \rightleftharpoons H_2$	0.00
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	– 0.83

At P, Fe^{3+} will be preferentially reduced to form Fe^{2+} compared to water molecules.

$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+0.77
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	– 0.83

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

An excess of zinc reacts with a warm solution containing VO_2^+ ions.

What will be the final oxidation state of vanadium?

A +2 **B** +3 **C** +4 **D** +5

Answer: A

Excess Zn is the reducing agent which can reduce $VO_2^+(aq)$ to $V^{2+}(aq)$

$\mathbf{VO_2^+} + 2H^+ + e^- \rightleftharpoons VO^{2+} + H_2O$ +1.00
$Zn^{2+} + 2e^- \rightleftharpoons Zn$ –0.76
Ecell = +1.00 – (–0.76) =1.76V > 0

Excess Zn can further reduce $VO^{2+}(aq)$ to $V^{3+}(aq)$:
$VO^{2+} + 2H^+ + e \rightleftharpoons V^{3+} + H_2O$ + 0.34
$Zn^{2+} + 2e^- \rightleftharpoons Zn$ –0.76
Ecell = +0.34 – (–0.76) = 1.10V >0

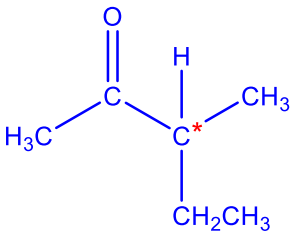
Excess Zn can further reduce $V^{3+}(aq)$ to $V^{2+}(aq)$:
$V^{3+} + e \rightleftharpoons V^{2+}$ -0.26
$Zn^{2+} + 2e^- \rightleftharpoons Zn$ –0.76
Ecell: –0.26 – (–0.76) = 0.50V > 0

Hence the final oxidation product of vanadium is V^{2+}.
i.e. final oxidation state of vanadium is **+2**.

17 What is the lowest number of carbon atoms a ketone molecule must contain to have chiral carbon atom?

A 5 **B** 6 **C** 7 **D** 8

Answer: B



18 When alkane G, C_6H_{14}, was reacted with bromine under ultraviolet light, it produced only three isomeric monobromo compounds.

What is the likely identity of alkane G?

1 $CH_3(CH_2)_4CH_3$

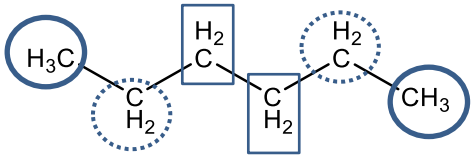
2 $CH_3CH_2CH(CH_3)CH_2CH_3$

3 $CH_3C(CH_3)_2CH_2CH_3$

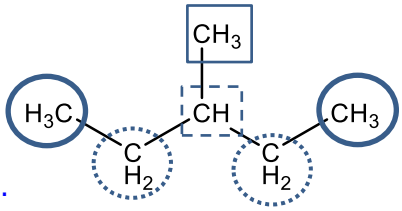
A 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

Answer: B

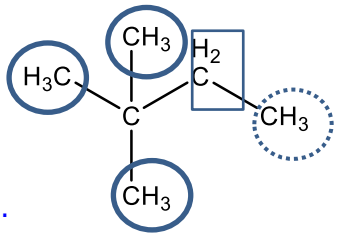
1. hexane can form 3 monobromo products.



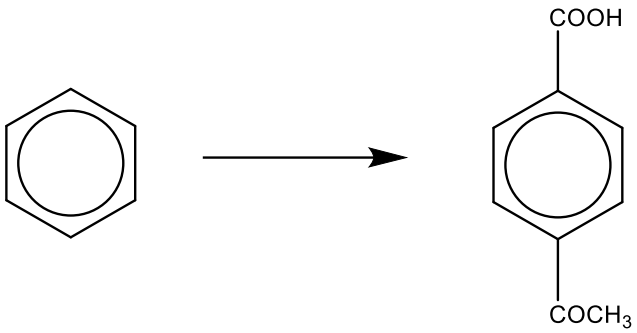
2. 3-methylpentane can form 4 monobromo products.



3. 2,2-dimethylbutane can form 3 monobromo products.



19 4-acetylbenzoic acid can be produced from benzene in three steps.



Which is the best method for this synthesis?

	step 1	step 2	step 3
A	CH_3COCl, anhydrous $FeCl_3$	CH_3Cl, anhydrous $FeCl_3$	dilute H_2SO_4, $KMnO_4$, heat
B	CH_3COCl, anhydrous $FeCl_3$	CH_3Cl, anhydrous $FeCl_3$	dilute H_2SO_4, $K_2Cr_2O_7$, heat
C	CH_3Cl, anhydrous $FeCl_3$	CH_3COCl, anhydrous $FeCl_3$	dilute H_2SO_4, $KMnO_4$, heat
D	CH_3Cl, anhydrous $FeCl_3$	dilute H_2SO_4, $KMnO_4$, heat	CH_3COCl, anhydrous $FeCl_3$

Answer: C

As the 2 substituents in 4-acetylbenzoic acid are on carbon 1 and 4, methyl group should be introduced onto the benzene ring first as it is 2,4-directing. The methyl group is only oxidised after CH_3CO- group is substituted as COOH group is 3-directing.

20 Which of the following property does benzene have because of the delocalised π electrons?

A Benzene is a good electrical conductor.

B Benzene undergoes addition reactions more readily than substitution reactions.

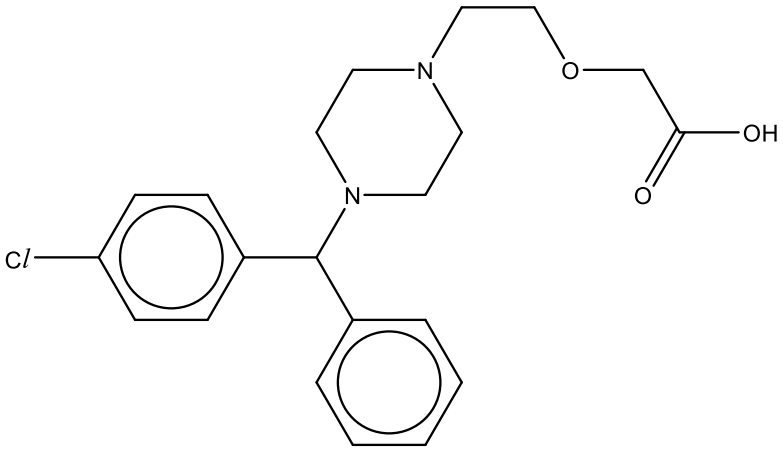
C Substitution in benzene occurs at one particular carbon atom.

D The carbon-carbon bond lengths are between those of C−C bonds and C=C bonds.

Answer: D

A: The electrons are only delocalised among the six carbon atoms, hence benzene cannot conduct electricity across molecules.
B: Benzene undergoes substitution reactions instead of addition to preserve the delocalised π electron cloud.
C: All six carbon atoms in benzene are identical and substitution can occur at any carbon atom.

21 Cetirizine is an antihistamine that is used to relieve allergy symptoms such as runny nose and itching.



cetirizine

The C-O-C bond is inert.
Which of the following statements about cetirizine are correct?

1 After heating with dilute sulfuric acid, 2 organic products are formed.

2 A white precipitate is observed when cetirizine is heated with ethanolic $AgNO_3$.

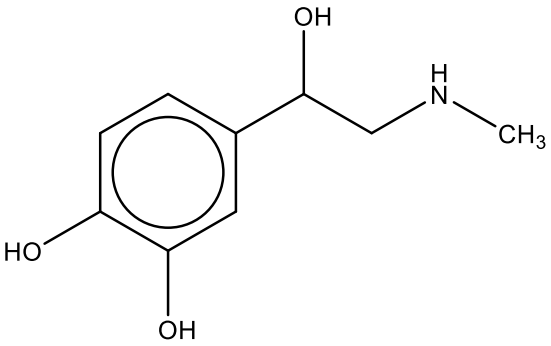
3 The purple colour of acidified $KMnO_4$ is discharged after heating with cetirizine.

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

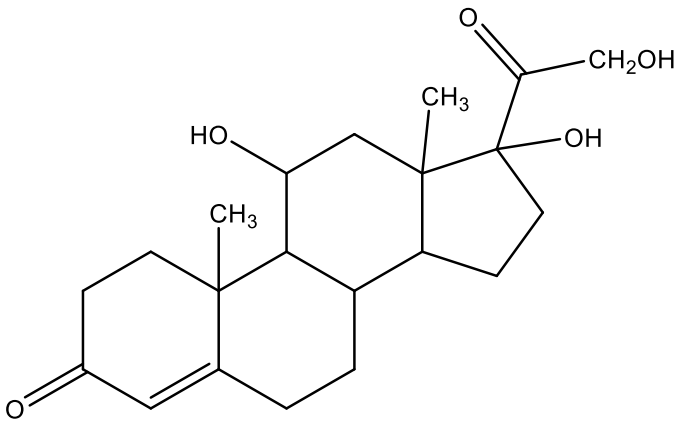
Answer: **A**

1: There are no functional groups that can undergo acidic hydrolysis.
2: Chlorobenzene is resistant towards hydrolysis and no precipitate will be formed.
3: There is a benzylic H that allows for side-chain oxidation to occur.

22 Adrenaline and cortisol are hormones that are produced by the adrenal glands.



adrenaline



cortisol

Which of the following reagents can be used to distinguish the two hormones?

1 neutral iron(III) chloride solution

2 bromine in tetrachloromethane

3 hot aqueous potassium dichromate(VI)

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

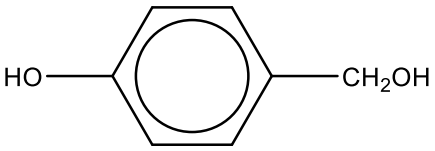
Answer: A

1: Only the phenol in adrenaline will give positive test.
2: The phenol in adrenaline will decolourise orange-red bromine while alkene in cortisol will also decolourise bromine.
3: Both adrenaline and cortisol contain primary or secondary alcohols that will be oxidised by potassium dichromate(VI).

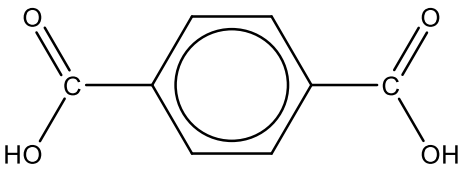
23 1 mole of compound Z reacts with 1 mole of NaOH. 1 mole of Z also reacts with PCl_5 to form 1 mole of HCl.

Which compounds can be Z?

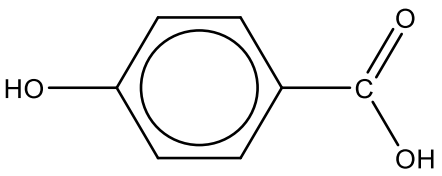
A



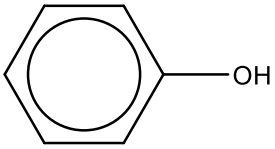
B



C



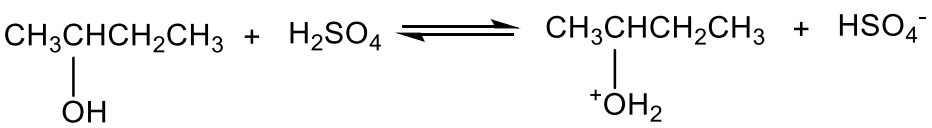
D

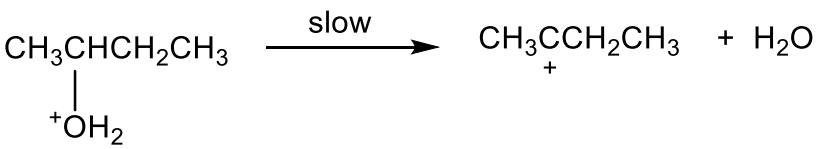


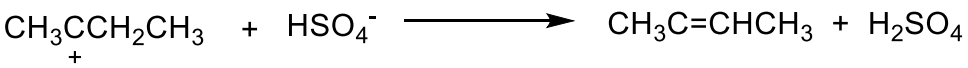
Answer: A

There is only 1 mole of phenol or carboxylic acid to undergo acid-base reaction with 1 mole of NaOH. There is only 1 mole of alcohol or carboxylic acid to undergo nucleophilic substitution with PCl_5.

24 The dehydration of butan–2–ol to form but–2–ene is thought to involve the following steps.

step 1 

step 2 

step 3 

Which of the following statements is incorrect?

A Butan–2–ol serves as a base in step 1.

B H_2SO_4 is a catalyst in the dehydration reaction.

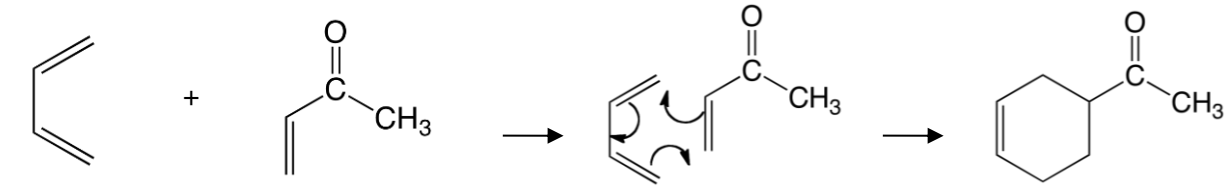
C A possible side product is $CH_3C(OSO_3H)CH_2CH_3$.

D Primary alcohols are more likely to proceed via this mechanism than tertiary alcohols.

Answer: D

A: Butan-2-ol acts as a Brønsted base and accepts a H^+ from H_2SO_4.
B: H_2SO_4 is reacted in step 1 and regenerated at the end of step 3, acting as a catalyst.
C: HSO_4^- can act as a nucleophile and be attracted to the carbocation $CH_3C^+CH_2CH_3$ to form the side product.
D: Tertiary carbocations are more stable than primary carbocations due to the presence of more electron-donating alkyl groups to disperse the positive charge on C^+, hence tertiary alcohols are more likely to react via this mechanism (E1).

25 The Diels–Alder reaction is an organic reaction between a conjugated diene and a substituted alkene to form a substituted cyclohexene system. One such reaction between buta–1,3–diene and but–3–en–2–one is shown below.

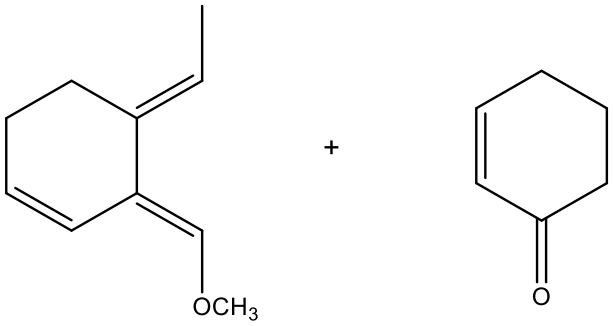


buta–1,3 –diene

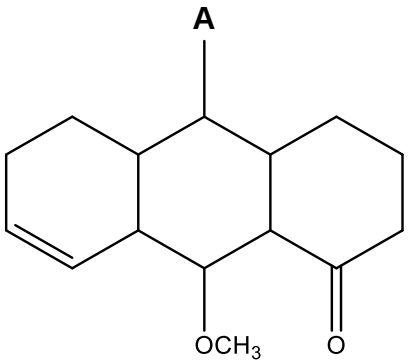
but–3–en–2–one

substituted cyclohexene

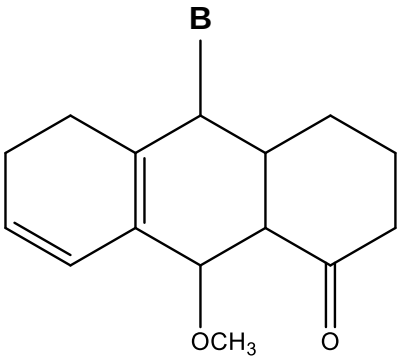
What would be the product formed when the following diene and substituted alkene reacts in a 1:1 ratio?



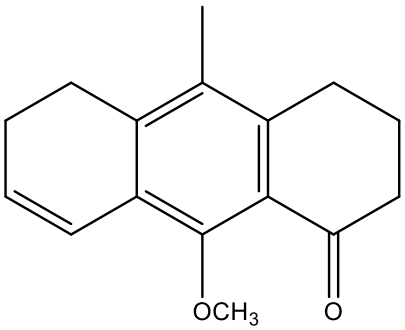
A



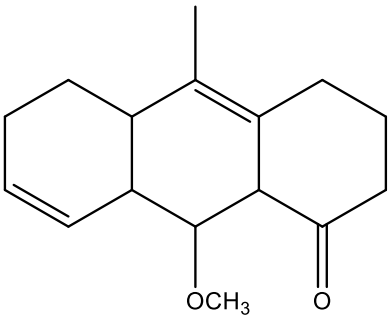
B



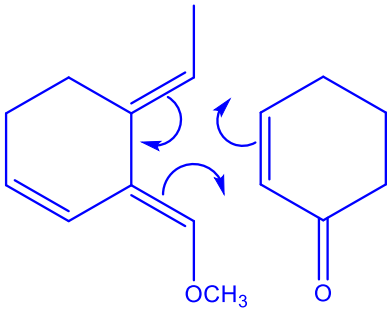
C



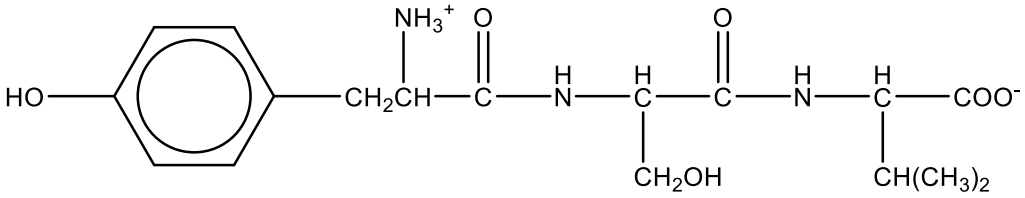
D



Answer: B

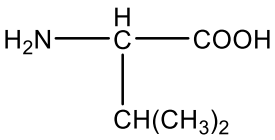


26 The therapeutic effect of tyroserleutide on lung cancer is currently being studied. It has the following structure:

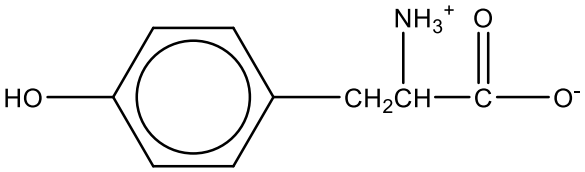


Which compound can be obtained when tyroserleutide reacts with hot dilute NaOH?

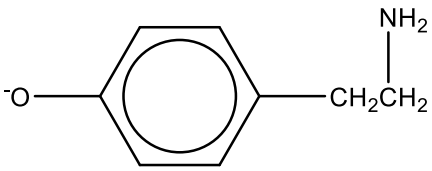
A



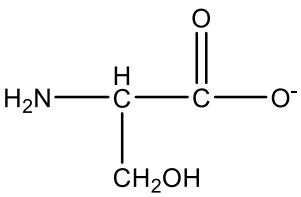
B



C

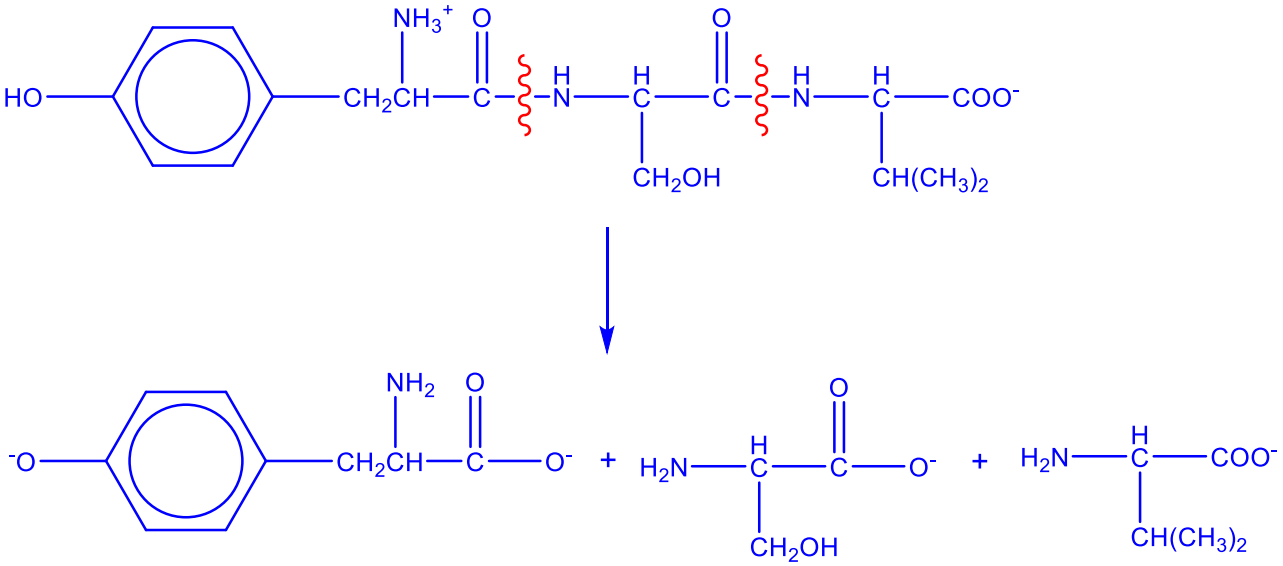


D

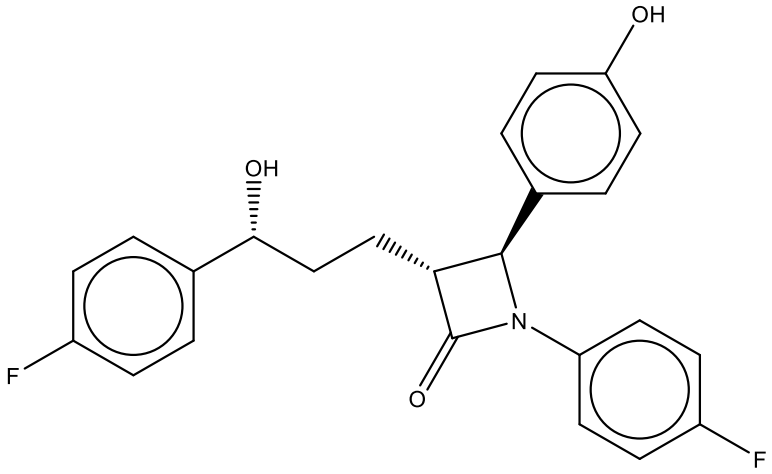


Answer: D

The amide functional groups will undergo alkaline hydrolysis to form amine and carboxylate ion. Phenol will undergo acid-base reaction to form phenoxide while alcohol is too weak of an acid and will not react with NaOH.



27 Ezetimibe is a medication used to treat high blood cholesterol.



Ezetimibe

When Ezetimibe is reacted with anhydrous $SOCl_2$, which groups will react?

A phenolic OH group

B halogenoarene

C alcoholic OH group

D amide group

Answer: C

The phenolic OH group does not undergo nucleophilic substitution as the C-O bond is strong.
The alcoholic OH undergoes nucleophilic substitution.
The halogenoarene and amide does not react.

28 Compounds of Period 3 elements dissolve in water to form aqueous solutions that are acidic, basic or neutral.

Which of the following sequence shows the order of increasing resultant pH when the compounds are added to water?

A NaCl, $MgCl_2$, $SiCl_4$

B $AlCl_3$, $SiCl_4$, PCl_5

C Al_2O_3, MgO, SO_2

D P_4O_{10}, SiO_2, MgO

Answer: D
pH 2, pH 7, pH 9

29 Element Z is in Period 3 of the Periodic Table. The oxide of Z has a giant molecular structure while the chloride of Z is a simple molecule.

Which of the following statements about element Z and its compounds are correct?

1 Element Z is a solid at room temperature.

2 The oxide of Z reacts with water to give an acidic solution.

3 Element Z forms two chlorides with different oxidation states.

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

Answer: A

Since the oxide of **Z** has a giant molecular structure, **Z** must be **silicon**. Hence, the chloride of **Z** is silicon tetrachloride which is indeed a simple molecule.

Silicon has a high melting point so it is a solid at room temperature.
Silicon oxide is insoluble in water.
Silicon forms only one chloride, $SiCl_4$.
Thus, statements 2 and 3 are incorrect.

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

Some data relating to calcium and calcium chloride are as follows:

$Ca^{2+} + 2e^- \rightleftharpoons Ca$	$E^{\ominus} = -2.87$ V
Melting point of calcium chloride	782 °C

Which of the following is the most suitable method for extracting calcium metal from its ore?

A Electrolysis of aqueous calcium chloride.

B Electrolysis of molten calcium chloride.

C Reduction of calcium chloride with hydrogen.

D Reduction of calcium chloride with aluminium.

Answer: B

The large negative electrode potential of Group 2 elements makes it difficult to reduce their positive ions into metal by chemical agents since the group 2 metals are strong reducing agents.

	$E^{\ominus}$/V
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	– 2.87
$Al^{3+} + 3e^- \rightleftharpoons Al$	– 1.66
$2H^+ + 2e^- \rightleftharpoons H_2$	0.00
$2H_2O + 2e^- \rightleftharpoons H_2 + 2OH^-$	– 0.83

Electrolysis of aqueous solution of calcium chloride results in preferential discharge of water at the cathode instead of calcium since reduction potential of water occurs with more positive standard $E^{\ominus}$ value, $E^{\ominus}H_2O/H_2$= -0.83V