Suggested Answers

TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

H2 CHEMISTRY **9729/01**

Paper 1 Multiple Choice **23 September 2021**

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the Answer Sheet in the spaces provided.

There are **thirty** questions in this paper. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read very carefully the instructions on the use of Answer Sheet.

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

Use of Answer Sheet
Ensure you have written your name, class register number and class on the Answer Sheet.
Use a **2B** pencil to shade your answers on the Answer Sheet; erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.
For shading of class register number on the **Answer Sheet**, please follow the given examples:
If your register number is **1**, then shade **01** in the index number column.
If your register number is **21**, then shade **21** in the index number column.

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

In research on the atomic nucleus, scientists have been comparing the stability of isotopes with the same neutron : proton ratio.

Which isotope has the same neutron : proton ratio as ^{14}N?

A ^{35}S **B** ^{35}Cl **C** ^{40}K **D** ^{40}Ca

Answer: D

	No of neutron	No of protons	Neutron proton ratio
^{14}N	7	7	1
^{35}S	19	16	1.19
^{35}Cl	18	17	1.06
^{40}K	21	19	1.11
^{40}Ca	20	20	1

2 A stream of gaseous $^{16}_{8}O^{2-}$ ions was passed between two oppositely charged plates. Analysis of the deflection shows that these ions deflected at an angle of 10.0°.

Under the same electric field, an unknown gaseous ion Z^- is deflected at an angle of 2.58°.

What is the isotopic mass of Z?

A 8 **B** 15 **C** 16 **D** 31

Answer: D

q/m. ∝ Angle of deflection θ
2/16 ➔ 10
1/M ➔2.58
1/M = 2.58/10 x (2/16) = 0.03225
M is 31.0 (isotopic mass)

3 In which pair of molecules is the bond angle in the first molecule smaller than that in the second molecule?

A BF_3 and PH_3

B $BeCl_2$ and H_2S

C SO_3 and CCl_4

D F_2O and SO_2

Answer: D

A	BF_3	120°	PH_3	107°
B	$BeCl_2$	180°	H_2S	104.5°
C	SO_3	120°	CCl_4	104.5°
D	F_2O	104.5°	SO_2	119°

4 What is the most predominant forces formed when each of the following compounds is dissolved in water?

	HNO_3	CH_3OH	HCOONa
A	hydrogen bonds	hydrogen bonds	ion-dipole interactions
B	hydrogen bonds	ion-dipole interactions	hydrogen bonds
C	ion-dipole interactions	hydrogen bonds	ion dipole interactions
D	ion-dipole interactions	ion-dipole interactions	hydrogen bonds

Answer: C

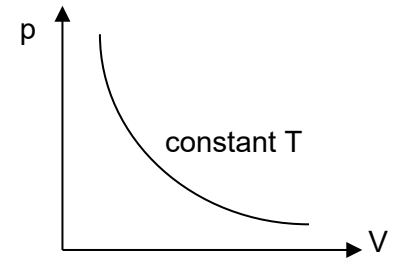
HNO_3 is a strong acid that fully dissociates to form H^+ and NO_3^- ions thus forming ion-dipole interactions with H_2O molecules.

CH_3OH is a simple molecule that forms hydrogen bonds with H_2O molecules

HCOONa is an ionic salt that forms $HCOO^-$ and Na^+ ions thus forming ion dipole interactions with H_2O molecules.

5 Which of the following diagrams correctly describes the behaviour of a fixed mass of an ideal gas?

1



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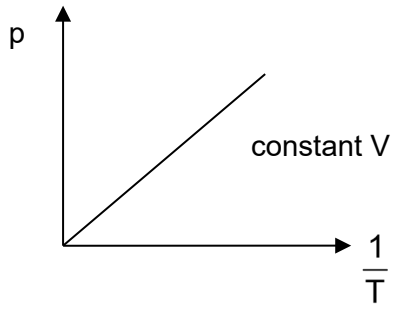

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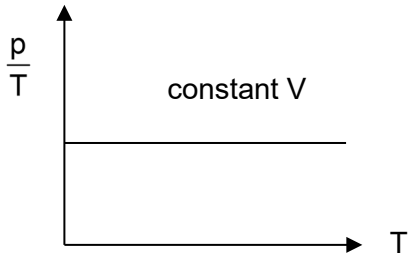

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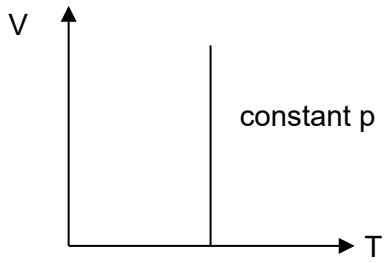


A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1 only

Answer: B

$pV = nRT$ (fixed mass of an ideal gas $\Rightarrow$ n is constant)

At constant T, $p = nRT\left(\frac{1}{V}\right)$ so $p \propto \left(\frac{1}{V}\right)$ so plotting p against V gives a "$y = \left(\frac{1}{x}\right)$" graph shape.
1 is correct.

At constant V, $p = \left(\frac{nR}{V}\right) T$ so $p \propto T$ so plotting p against $\left(\frac{1}{T}\right)$ gives a "$y = \left(\frac{1}{x}\right)$" graph shape.
2 is incorrect.

At constant V, $\left(\frac{P}{T}\right) = \left(\frac{nR}{V}\right)$= constant, so plotting $\left(\frac{P}{T}\right)$ against T gives a "y = constant" graph shape.
3 is correct.

At constant P, $V = \left(\frac{nR}{P}\right) T$ so plotting V against T gives a "y = mx" graph shape.
4 is incorrect.

6 Element G is one of the first five elements in Period 3 of the Periodic Table. The following four statements were made about the properties of element G or its compounds.

Three statements are correct descriptions and one is false.

Which statement does **not** fit with the other three?

A The oxide of G dissolves in excess dilute NaOH(aq).

B G exhibits only one possible oxidation number in its chloride, which is not a solid at room temperature.

C The oxide of G has a very high melting point.

D The chloride of G reacts with water to give an acidic solution of pH 2.

Answer: A

Options B, C and D apply to Si while Option A does not (SiO_2 does not dissolve in dilute acid).

7 Fluorine, chlorine and bromine react with sulfur to form SF_6, SCl_2 and S_2Br_2 respectively.

Which of the following trends can be deduced from the above information?

1 Sulfur has variable oxidation states.

2 Oxidising strength decreases from fluorine to bromine.

3 Covalent bond strength decreases from fluorine to bromine.

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

Answer: B

From the given information, S is oxidised from oxidation state 0 to +6 by fluorine, from 0 to +2 by bromine and from 0 to +1 by chlorine. (statements 1 & 2 correct)

Statement 3 is a correct statement but the information cannot be deduced from the given information.

8 In an experiment, 0.0050 mol of a metallic salt reacted with 0.0025 mol of aqueous sodium sulfite, Na_2SO_3.

The half-equation for the oxidation of sulfite ion is shown below.

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

If the original oxidation number of the metal in the salt was +3, what would be the new oxidation number of the metal?

A 0 **B** +1 **C** +2 **D** +4

Answer: C

	Reduction (gain e^-)	**Oxidation (lose e^-)**
Species involved	Metallic salt reduced	SO_3^{2-} oxidised
Reacting **Moles**	0.0050	0.0025
Total amount of electrons gained or lost	0.0050 × n = 0.0050n (each metallic salt gains n e^-)	0.0025 × 2 = 0.0050 (from data in qn, each SO_3^{2-} loses 2 e^-)

Equating moles of electrons gained and lost, n = 1

Since 1 mol of the metallic salt gained 1 mol e^-, new oxidation state of metal = +3 + (−1) = +2

9 The reaction between compounds E and F is found to follow the rate equation rate = $k[E]^m[F]$ where k is the rate constant and has units of $mol^{-2}\ dm^6\ s^{-1}$ and m is the order of reaction with respect to E.

Two experiments were carried out to study the kinetics of this reaction and the data obtained are tabulated below.

experiment	initial [E] / mol dm^{-3}	initial [F] / mol dm^{-3}	initial rate / mol $dm^{-3}\ s^{-1}$
1	0.040	0.080	X
2	0.020	Y	$\frac{1}{2}X$

What is the value of Y in experiment 2?

A 0.020 **B** 0.040 **C** 0.160 **D** 0.320

Answer: C

Given that units of k: $mol^{-2}\ dm^3\ s^{-1}$, equating units for the given rate equation:

$$\frac{\text{mol}}{\text{dm}^3 \times \text{s}} = \left(\frac{\text{dm}^6}{\text{mol}^2 \times \text{s}}\right) \times \left(\frac{\text{mol}}{\text{dm}^3}\right)^m \times \left(\frac{\text{mol}}{\text{dm}^3}\right)$$

In order for units on LHS to balance those on RHS, $m = 2$

∴ Order of reaction with respect to [**C**] is 2.

$\frac{\text{rate1}}{\text{rate2}} = \frac{S}{\frac{1}{2}S} = \frac{(0.040)^2(0.080)}{(0.020)^2 y} \Rightarrow y = 0.160$

10 Which equation corresponds to the enthalpy change stated?

A	standard enthalpy change of formation of iodomethane $C(s) + \frac{1}{2} H_2(g) + \frac{3}{2} I_2(s) \rightarrow CHI_3(s)$
B	standard enthalpy change of solution of ammonia $NH_3(g) \rightarrow NH_3(l)$
C	bond energy of C–C*l* bond in tetrachloromethane $CCl_4(l) \rightarrow C(g) + 4Cl(g)$
D	standard enthalpy change of neutralisation $Ba(OH)_2(aq) + 2HCl(aq) \rightarrow BaCl_2(aq) + 2H_2O(l)$

Answer: A

Option B is incorrect as the ammonia formed should be in aqueous form.

Option C is incorrect as the CCl_4 should be gaseous. Moreover the equation shows 4 moles of C–C*l* bonds being broken instead of just 1 mole.

Option D is incorrect as there should be 1 mole of water formed.

11 With self-heating technology, instant food becomes more portable and convenient. Self-heating hot pots allow heating of food content without any external heat source. The bottom of the hot pot contains a packet of quicklime (CaO) which will release heat when mixed with water. This reaction provides adequate heat for cooking the food content in the hot pot.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s)$$

What are the signs of ΔH, ΔS and ΔG for the overall process?

	ΔH	ΔS	ΔG
A	–	–	–
B	–	+	–
C	+	–	–
D	+	+	+

Answer: A

From the question,
ΔH = –ve (because heat is given off to the surroundings)
ΔS = –ve (because change in state from liquid to solid)
ΔG = –ve (because reaction is spontaneous)

12 Nitrogen dioxide can decompose to form nitrogen monoxide and oxygen as shown by the equation.

$$\rightleftharpoons$$

When 4.0 mol of nitrogen dioxide is allowed to undergo decomposition in a container of volume 0.5 dm^3, 0.8 mol of oxygen was present in the equilibrium mixture.

What is the numerical value of the equilibrium constant, K_c, for this reaction?

A 0.357 **B** 0.711 **C** 1.41 **D** 2.80

Answer: B

	$2NO_2(g)$	$2NO(g)$	$O_2(g)$
Initial amt / mol	4.0	0	0
Change in amt / mol	–1.6	+1.6	+0.8
Eqm amt / mol	2.4	1.6	0.8

$K_c = \frac{[NO]^2[O_2]}{[NO_2]^2}$

$K_c = \frac{(1.6/0.5)^2\,(0.8/0.5)}{(2.4/0.5)^2}$

$K_c = 0.711$

13 The following reaction takes place in a suitable solvent.

$$Na^+NH_2^- + NH_4^+Cl^- \rightarrow Na^+Cl^- + 2NH_3$$

Which statements explain why this reaction should be classified as a Brønsted-Lowry acid-base reaction?

1 NH_2^- is an electron pair acceptor.

2 NH_2^- and NH_3 are a conjugate acid-base pair.

3 The ammonium ion acts as a proton donor.

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

Answer: C

Option 1: Brønsted-Lowry acid is defined as a proton donor while Brønsted-Lowry base is a proton acceptor.
Option 2: NH_2^- accepts a proton (H^+) to form NH_3.
Option 3: In this reaction, NH_4^+ is the proton donor while NH_2^- is the proton acceptor.

14 In an experiment, 500 cm^3 of 0.020 mol dm^{-3} of silver nitrate, $AgNO_3$, and 500 cm^3 of 0.050 mol dm^{-3} of calcium nitrate, $Ca(NO_3)_2$, were added to a 1 dm^3 solution containing 0.200 mol dm^{-3} of sulfuric acid, H_2SO_4.

The solubility product of Ag_2SO_4 is 1.20×10^{-5} mol^3 dm^{-9} and that of $CaSO_4$ is 7.10×10^{-5} mol^2 dm^{-6}.

Which statement is correct?

A No precipitate is formed.

B Only $CaSO_4$ is precipitated.

C $CaSO_4$ is precipitated followed by Ag_2SO_4.

D Ag_2SO_4 is precipitated followed by $CaSO_4$.

Answer: B

Total volume of solution = 0.5+0.5+1 = 2 dm^3

New $[Ag^+] = \frac{0.02 \times 0.5}{2} = 0.005$ mol dm^{-3}

New $[Ca^{2+}] = \frac{0.05 \times 0.5}{2} = 0.0125$ mol dm^{-3}

New $[SO_4^{2-}] = \frac{0.2 \times 1}{2} = 0.1$ mol dm^{-3}

IP ($CaSO_4$) $= [Ca^{2+}][SO_4^{2-}]$
$= 0.0125 \times 10^{-3} \times 0.1$
$= 1.25 \times 10^{-3} > Ksp\ (CaSO_4)$ ➔ ppt of $CaSO_4$ formed.

IP (Ag_2SO_4) $= [Ag^+]^2[SO_4^{2-}]$
$= (0.005)^2 \times 0.1$
$= 2.5 \times 10^{-6} < Ksp\ (Ag_2SO_4)$ ➔ ppt of Ag_2SO_4 not formed.

15 Citric acid is a weak monobasic acid. Which of the following pair of solutions, when mixed in equal volumes, will give the best buffer solution that resists pH changes when a small amount of acid or base is added?

A 0.50 mol dm^{-3} of citric acid and 0.50 mol dm^{-3} of sodium hydroxide

B 0.25 mol dm^{-3} of citric acid and 0.50 mol dm^{-3} of sodium hydroxide

C 0.50 mol dm^{-3} of sodium citrate and 0.25 mol dm^{-3} of hydrochloric acid

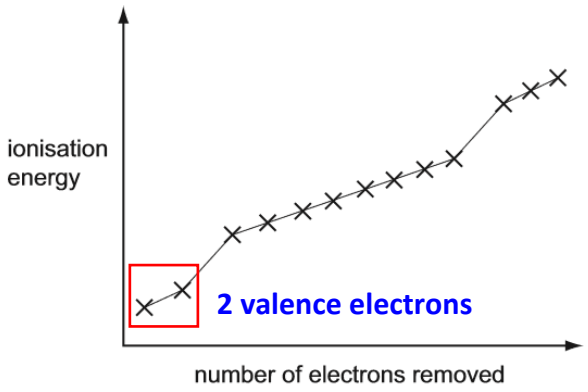
D 1.00 mol dm^{-3} of sodium citrate and 0.50 mol dm^{-3} of citric acid

Answer: C

On mixing, the following compositions will result for each of the options:

A	0.25 mol dm^{-3} sodium citrate only	only salt ⇒ buffer
B	0.25 mol dm^{-3} sodium hydroxide + 0.25 mol dm^{-3} sodium citrate	Strong base + salt ⇒ not buffer
C	0.25 mol dm^{-3} of sodium citrate + 0.25 mol dm^{-3} citric acid (H^+ from HC*l* reacts with citrate ions to form citric acid)	Weak acid + conjugate ⇒ acidic buffer, ALSO in equal concentrations ⇒ 'best buffer'
D	1.0 mol dm^{-3} of sodium citrate + 0.5 mol dm^{-3} citric acid	Weak acid + conjugate ⇒ acidic buffer, BUT not in equal concentrations, so not 'best buffer'

16 The graph shows the first thirteen successive ionisation energies for element Q.



What can be deduced about element Q from the graph?

1 Q is in Group 2 of the Periodic Table.

2 Q is in Period 3 of the Periodic Table.

3 Q is a p−block element.

4 Q is aluminum.

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

Answer: D

- There were 2 valence electrons in Q as shown by the two lowest ionization energies. Hence, Q should be in Group 2 with **ns^2** as the electronic configuration.
- Since the graph only showed 13 successive electrons being removed, more electrons could be removed. The element should not be in Period 3 as the group 2 element in Period 3 is Mg with a total of **12 electrons**.

17 Consider the chlorides of Period 3 elements.
Which factor generally decreases across the period?

A covalent character

B melting point

C solubility in water

D pH when mixed with water

Answer: D

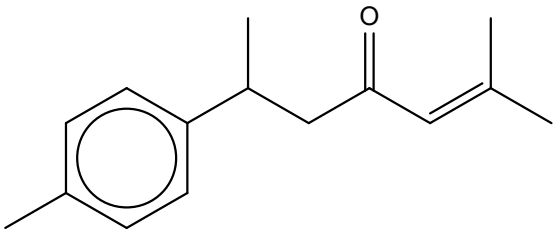
✖**A** The covalent character increases across the period.

✖**B** The melting point decreases until $SiCl_4$ and then increases for PCl_5.

✖**C** All the period 3 chlorides are soluble in water.

✓**D** pH when mixed with water decreases from pH 7 to pH 2

18 Turmerone is a compound present in turmeric spice.



turmerone

Which of the following statements about this molecule is correct?

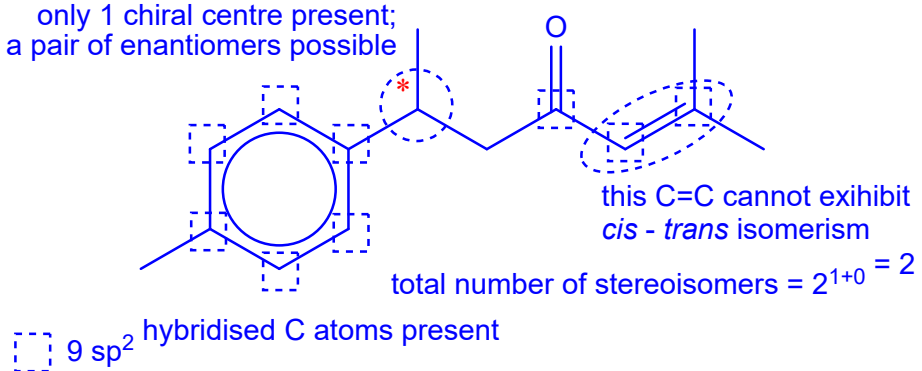
A It has two stereoisomers.

B It has two chiral centres.

C It has eight sp^2 hybridised carbon atoms.

D It can exhibit *cis* – *trans* isomerism.

Answer: A



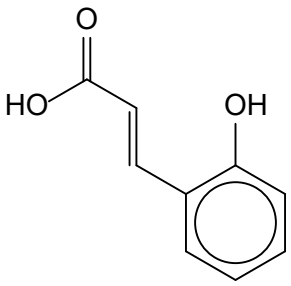
Option **A** is correct as the total possible stereoisomers present = 2 (based on the pair of enantiomers)

Option **B** is incorrect as there is only one chiral centre.

Option **C** is incorrect as there are nine sp^2 hybridised carbon atoms.

Option **D** is incorrect as the double bond in turmerone cannot exhibit cis – trans isomerism (2 similar methyl groups on 1 of the C atoms of C=C).

19 *Ortho*-coumaric acid is an antioxidant in pomegranate juice.



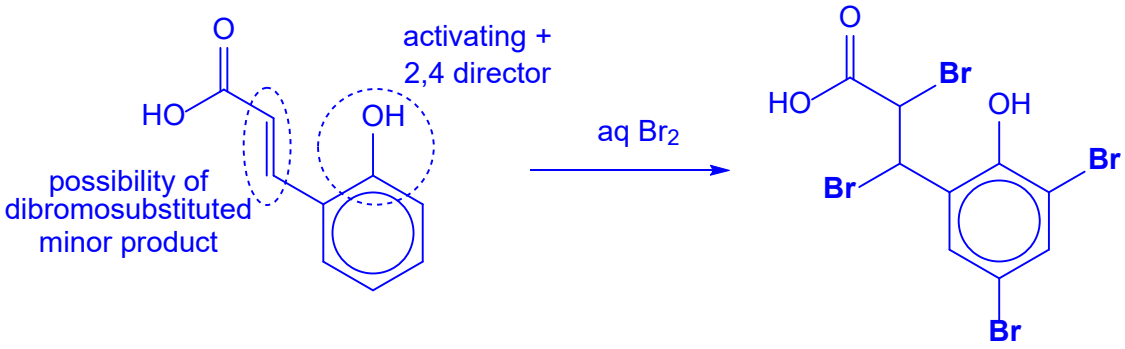
ortho-coumaric acid

When treated with aqueous bromine, what is the maximum number of bromine atoms that can be incorporated into a molecule of *ortho*-coumaric acid?

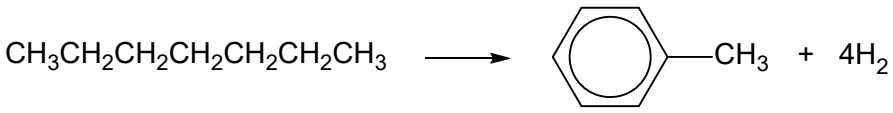
A 2 **B** 3 **C** 4 **D** 6

Answer: C

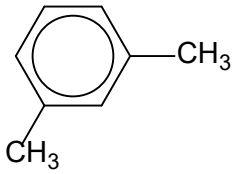
Electrophilic substitution w.r.t. phenol + electrophilic addition of alkene (minor product of dibromosubstitution) ⇒ **max 4 Br atoms**



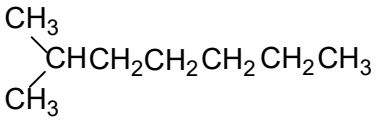
20 In an industrial process, heptane vapour is passed over a heated catalyst to make methylbenzene.

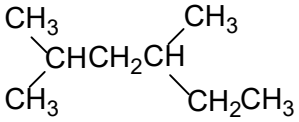


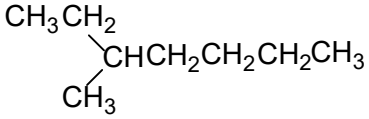
Under similar conditions, which of the C_8H_{18} isomers could give 1,3-dimethylbenzene?

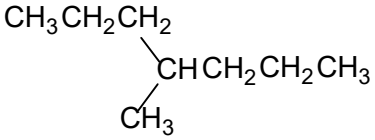


1,3-dimethylbenzene

1 

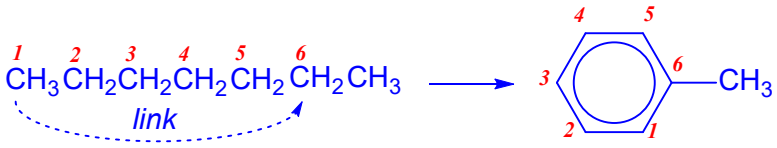
2 

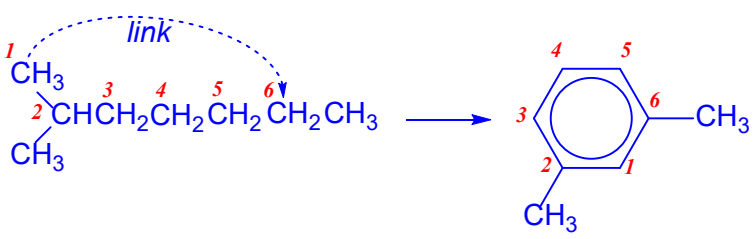
3 

4 

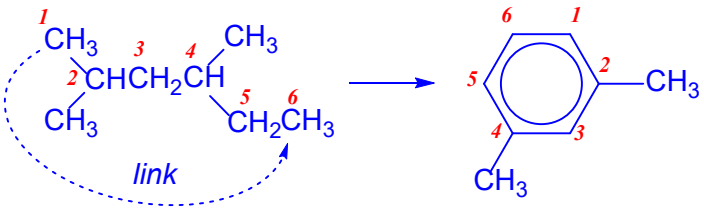
A 1, 2 and 3 **B** 1, 2 and 4 **C** 1 and 4 **D** 2 and 3

Answer: B

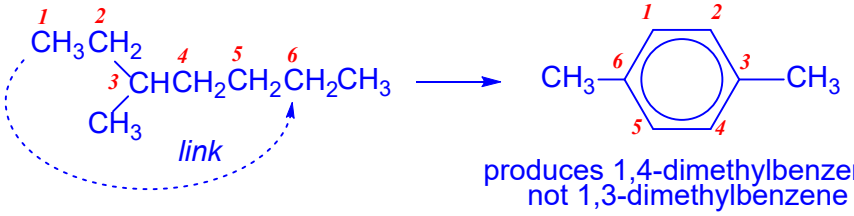
Observe the pattern: 

Option 1 is possible 

Option 2 is possible

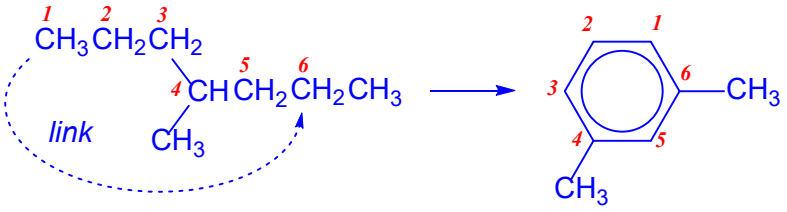


Option 3 is not possible



produces 1,4-dimethylbenzene, not 1,3-dimethylbenzene

Option 4 is possible



21 Which property does benzene have as a consequence of the delocalisation of electrons in the benzene molecule?

A The carbon-carbon bond lengths are between those of C–C bonds and C=C bonds.

B Addition reactions of benzene take place more easily than substitution.

C Benzene is commonly used as a non-polar solvent.

D Benzene is a good conductor of electricity.

Answer: A

Option **A** is correct;
the delocalisation of electrons in benzene gives rise to C–C bonds lengths that are intermediate between a single and a double bond.

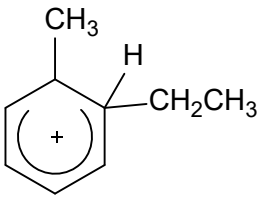
Option **B** is incorrect;
benzene undergoes substitution (rather than addition) reactions more readily to preserve the resonance structure.

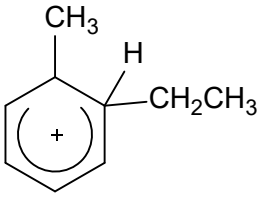
Option **C** is incorrect;
while benzene can act as a non-polar solvent, the reason is due to the presence of its hydrophobic simple molecular structure and ability to form weak intermolecular instantaneous dipole – induced dipole forces of attraction with solutes, rather than due to the delocalisation of electrons in benzene.

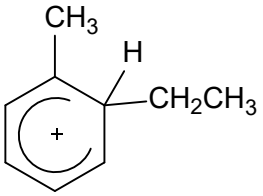
Option **D** is incorrect;
benzene is not a good conductor of electricity as the electrons within its molecule are not able to delocalise across to other molecules.

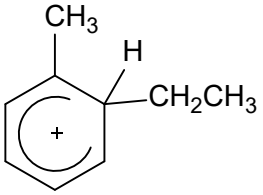
22 The reaction between methylbenzene and chloroethane proceeds via several stages with two successive intermediates in the presence of $AlCl_3$.

What could be the intermediates for this reaction?

A $CH_3CH_2^-$ and 

B $CH_3CH_2^+$ and 

C $CH_3CH_2^-$ and 

D $CH_3CH_2^+$ and 

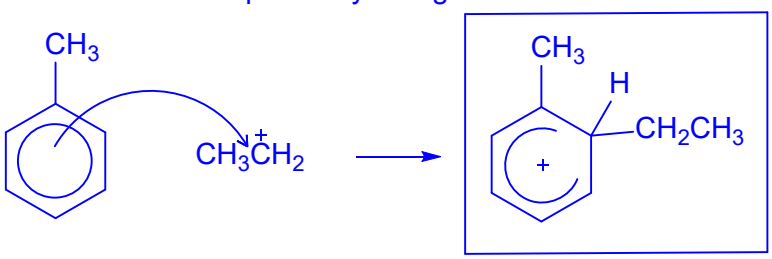
Answer: D

Reaction of methylbenzene (arene) with chloroethane (halogenoalkane) in the presence of $AlCl_3$ (Lewis acid catalyst): electrophilic substitution (Friedel-Crafts alkylation)

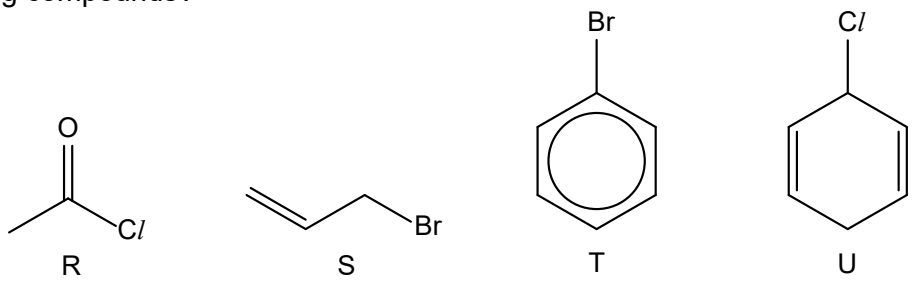
Step 1 involves the formation of the electrophile intermediate:

$$CH_3CH_2Cl + AlCl_3 \rightarrow \boxed{\mathbf{CH_3CH_2^+}} + AlCl_4^-$$

Step 2 involves the formation of the positively-charged carbocation intermediate:



23 Which sequence shows the correct order of decreasing ease of hydrolysis of the following compounds?



A R > U > T > S

B R > S > U > T

C U > R > T > S

D U > S > T > R

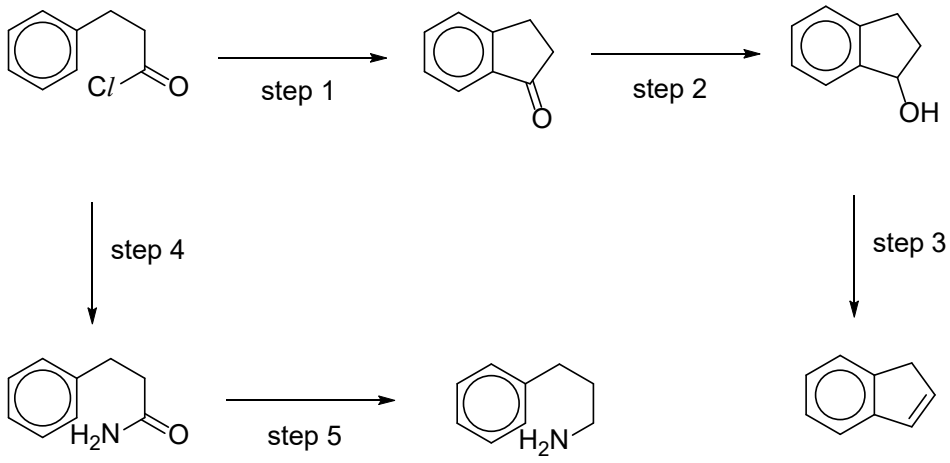
Answer: B

Ethanoyl chloride (**R**) is the most reactive towards hydrolysis due to the electron deficient carbonyl atom. (connected to 2 electronegative atoms)

Bromobenzene (**T**) is the least reactive towards hydrolysis due to partial double bond between C and Br atom. (delocalisation of the lone pair of electrons into the benzene ring)

S is more reactive than **U** as the bond strength of C-Br is weaker than C-Cl, thus require less energy and more reactive.

24 Consider the following reaction scheme.



Which of the following statements about the above reaction scheme is correct?

A Step 4 requires alcoholic NaCN.

B Steps 2 and 5 require aqueous lithium aluminium hydride.

C Step 3 can be carried out by using hot ethanolic KOH.

D Step 1 requires the presence of $AlCl_3$.

Answer: D

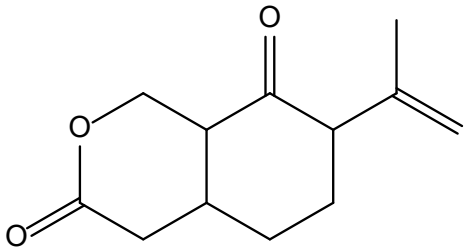
Statement A is wrong as it requires only NH_3 gas.

Statement B is wrong as it requires anhydrous condition, not aqueous.

Statement C is wrong as hot ethanolic KOH is for the elimination of HX from halogenoalkane

Statement D is correct as it is an electrophilic substitution reaction and requires a catalyst.

25 Compound X has the following structure.



compound X

Compound X undergoes a complete reaction with reagent Y. The product of this reaction has the same number of chiral centres as compound X.

Which of the following could be reagent Y?

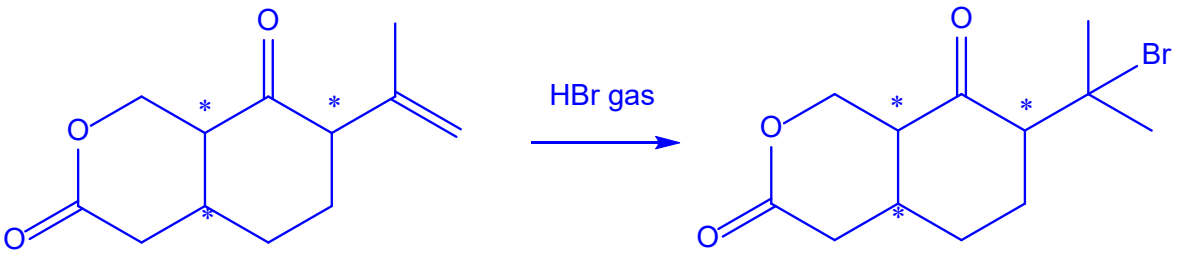
A cold alkaline $KMnO_4$

B H_2, Ni, heat

C HBr gas

D $LiAlH_4$

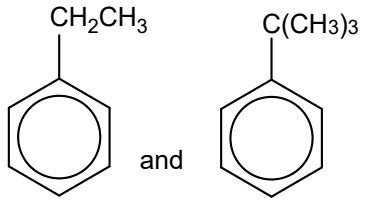
Answer: C

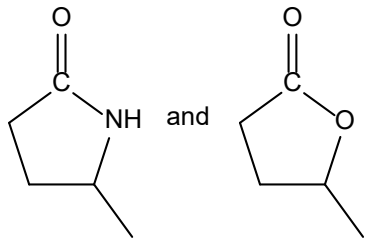


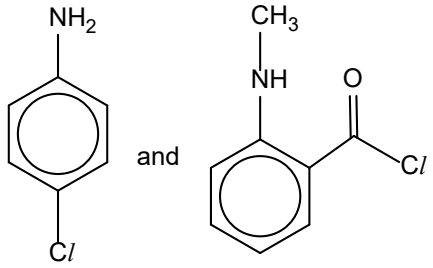
compound X

Same number of chiral carbon atoms: 3

26 Which pair of organic compounds can be distinguished by a chemical test?

1 

2 

3 

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

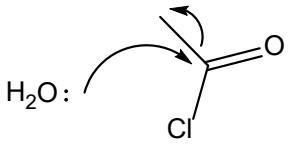
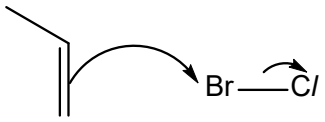
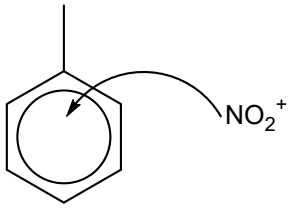
Answer: A

Statement 1 is correct as 1st compound can undergoes side chain oxidation with hot acidified $KMnO_4$ but 2nd compound can't as the immediate carbon atom to the benzene ring does not have any hydrogen atom bonded to it.

Statement 2 is correct as 2nd compound will give a positive iodoform test with hot alkaline I_2. Basic hydrolysis due to the alkaline medium breaks the ester bond and forms the carboxylic acid and the $RCH(CH_3)OH$ group.

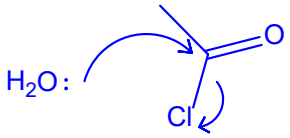
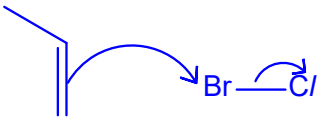
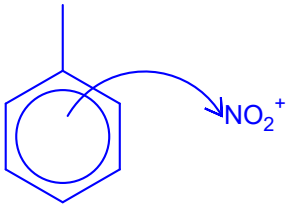
Statement 3 is correct as 2nd compound will form white precipitate with aqueous silver nitrate.

27 Which of the following shows the correct movement of electrons between the pairs of reagents?

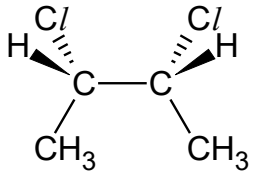
	reagents	step
1	ethanoyl chloride and water	
2	CH_3 radical with Br atom	
3	propene and bromine monochloride	
4	methylbenzene and nitric acid	

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

Answer: C

reagents	Correct step
ethanoyl chloride and water (nucleophilic acyl substitution)	
CH_3 radical with Br atom (homolytic fusion)	
propene and bromine monochloride (E.A.)	
methylbenzene and nitric acid (E.S.)	

28 The structure below represents *meso*-2,3-dichlorobutane.



meso-2,3-dichlorobutane

Which of the following statements explains why this isomer of 2,3-dichlorobutane does not show optical activity?

A The compound exists as a racemic mixture.

B The molecule does not contain any chiral carbon atoms.

C The molecule has a net dipole moment which cancels out the rotation of plane-polarised light.

D The molecule has an internal plane of symmetry.

Answer: D

Statement **A** is not correct as it is already existing as a type of stereoisomer.

Statement **B** is not correct and statement **D** is correct as it contains 2 chiral carbon atoms and an internal plane of symmetry and thus it does no show optical activity.

Statement **C** is not correct as dipole moment has nothing to do with optical activity.

29 Three half-cells are constructed as follows.

Half-cell E1: an electrode of metal F in a 1.0 mol dm^{-3} solution of $F^+(aq)$ ions

Half-cell E2: an electrode of metal G in a 1.0 mol dm^{-3} solution of $G^+(aq)$ ions

Half-cell E3: an electrode of metal H in a 1.0 mol dm^{-3} solution of $H^{2+}(aq)$ ions

The half cells are connected in pairs, as shown below, to form a series of galvanic cells. For each cell, the polarity of the electrodes and the $E^{\ominus}_{cell}$ generated are recorded as shown.

Pair of half cells	negative electrode	positive electrode	$E^{\ominus}_{cell}$ / V
E1 and E2	F	G	+1.10
E2 and E3	H	G	+0.47
E1 and E3	F	H	+0.63

Which one of the following lists the metals in order of increasing strength as reducing agents?

A G, H, F

B F, H, G

C H, G, F

D H, F, G

Answer: A

In a galvanic cell the reducing agent is oxidised; oxidation occurs at the anode; the anode is the negative electrode. In each cell the stronger reducing agent is at the negative electrode.

According to the data relative strength of the reducing agents are:

For half cells:

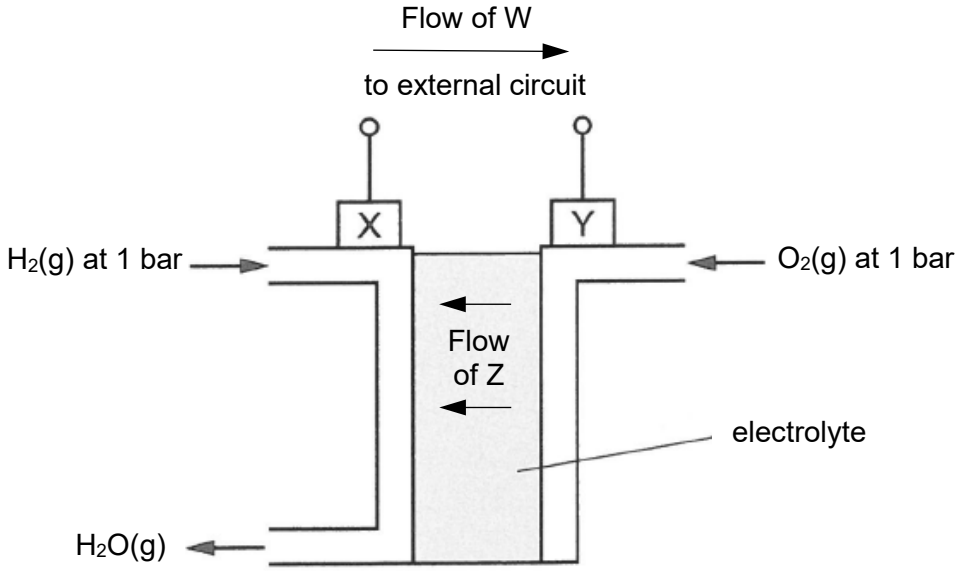
E1 and E2 F > G

E2 and E3 H > G;

E1 and E3 F > H

Hence, the order of increasing strength of the reducing agents is G < H < F

30 A hydrogen-oxygen fuel cell is shown.



Which of the following shows the correct identities of W, X, Y and Z?

	W	X	Y	Z
A	H^+	anode	cathode	OH^-
B	electrons	anode	cathode	OH^-
C	electrons	cathode	anode	H^+
D	OH^-	cathode	anode	electrons

Answer: B

Anode (oxidation):
H_2 (g) + $2OH^-$ (aq) → $2H_2O$ (*l*) + $2e^-$

Cathode (reduction):
O_2 (g) + $2H_2O$ (*l*) + $4e^-$ → $4OH^-$ (aq)

OH- passes through the electrolyte while the electrons generated from oxidation at the anode passes through the external circuit.

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