TAMPINES MERIDIAN JUNIOR COLLEGE

2019 JC2 H2 Chemistry Prelim Exam Paper 1

1 Some data of the ions of four unknown elements are given in the table below.

	A^+	B^-	D^{2-}	E^{3-}
mass number	21	20	20	21
number of protons	–	11	9	–
number of electrons	9	–	–	12

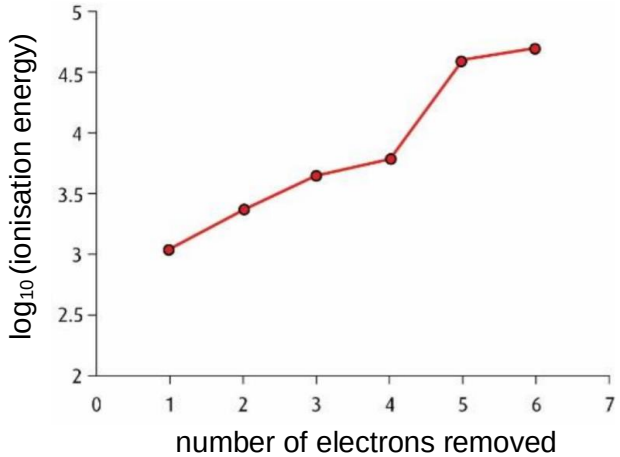
Which of the following correctly shows pairs of isotopic and isoelectronic species?

	isotopic	isoelectronic
A	D^{2-}, E^{3-}	B^-, E^{3-}
B	B^-, D^{2-}	A^+, B^-
C	B^-, D^{2-}	B^-, E^{3-}
D	D^{2-}, E^{3-}	A^+, B^-

Answer: A

	A^+	B^-	D^{2-}	E^{3-}
mass number	21	20	20	21
number of protons	**10**	11	9	**9**
			D^{2-} and E^{3-} are isotopic	
number of electrons	9	**12**	**11**	12
		B^- and E^{3-} are isoelectronic		

2 The first six ionisation energies of element **G** are plotted in the graph below**.**



Which of the following can be deduced from the graph?

A There are 2 quantum shells in element **G**.

B Element **G** is from Group 2 in the Periodic Table.

C The fifth and sixth electrons are removed from the same subshell.

D The identity of element **G** is carbon.

Answer: C

With limited information from the graph, it is unclear if the jump from the 4th to the 5th I.E. is a change in subshell or quantum shell. Hence, options A, B and D cannot be concluded using the graph. Then only conclusion which can be made is that the 5th and 6th electrons are in the same subshell.

3 For which of the following pairs does the first molecule have a higher polarity than the second molecule?

1 CH_3OH, CH_3I

2 CF_4, CCl_4

3 *cis*-CHF=CHF, *trans*-CHF=CHF

A 1 only

B 1 and 3

C 2 and 3

D 1, 2 and 3

Answer: B

1 Although both CH_3OH and CH_3I are polar, CH_3OH has higher polarity because O is more electronegative than I, hence the C–O bond is more polar than the C–I bond.

2 Both CF_4 and CCl_4 are non-polar as both have net zero dipole moment.

3 *trans*-CHF=CHF is non-polar as both C–F dipole moment cancels out, hence net zero dipole moment. *cis*-CHF=CHF is polar.

4 Three substances **H**, **I** and **J** have physical properties shown in the table below.

substance	melting point/ °C	boiling point/ °C	electrical conductivity	
			of solid	of liquid
H	801	1413	poor	good
I	2852	3600	poor	good
J	3500 at very high pressure	unable to determine	poor	unable to determine

What are the possible identities for substances **H**, **I** and **J**?

	H	**I**	**J**
A	NaC*l*	A*l*C*l*$_3$	C (diamond)
B	MgO	A*l*C*l*$_3$	C (graphite)
C	NaC*l*	MgO	C (graphite)
D	NaC*l*	MgO	C (diamond)

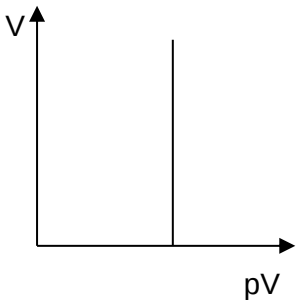
Answer: D

- Substance **H** should have a **giant ionic structure**, where NaCl or MgO are possible identities.
- Substance **I** should also have a **giant ionic structure but with larger lattice energy** compared to substance **H**. A*l*C*l*$_3$ cannot be substance **H** because it is a simple molecule. Hence, **H** must be MgO.
- Substance **J** should have a **giant molecular structure, which does not conduct electricity**. Hence, **J** must be diamond.

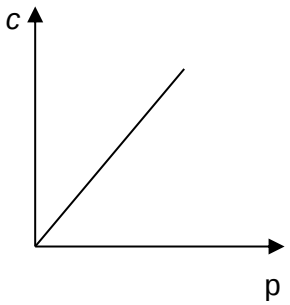
5 Which of the following diagrams correctly describe the behaviour of a fixed mass of an ideal gas at constant temperature?

[*c* is concentration]

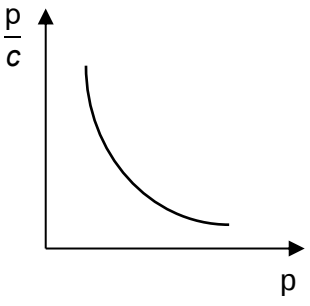
graph 1



graph 2



graph 3



A 2 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

Answer: B

✓	1	pV = nRT pV = constant (T is constant) pV plotted on horizontal axis ⇒ graph resembles "x = constant" graph.
✓	2	pV = nRT $pV = \frac{m}{M}RT$ (where m is mass and M is molar mass) $p = \frac{m}{V} \times$ constant (T and M are constant) p = c × constant ⇒ c = p × constant ⇒ graph resembles "y = constant × x" graph.
×	3	p = c × constant $\frac{p}{c}$ = constant ⇒ graph resembles "y = constant" graph. 

6 In which of the following reactions is the underlined reactant acting as a Lewis acid?

A $\underline{BF_3} + F^- \longrightarrow BF_4^-$

B $AlCl_3 + \underline{Cl_2} \longrightarrow AlCl_4^- + Cl^+$

C $Ag^+ + 2\underline{NH_3} \longrightarrow [Ag(NH_3)_2]^+$

D $H_2O + \underline{HSO_3^-} \longrightarrow H_2SO_3 + OH^-$

Answer: A

Lewis acid: species (molecule or ion) that can **accept** a pair of electrons

✓	A	In the formation of BF_4^-, F^- donates a pair of electrons for dative bond formation to B in BF_3 (B here is electron-deficient, with only 6 electrons around it).
×	B	Cl in Cl_2 donates a pair of electrons for dative bond formation to Al in $AlCl_3$ (Al here is electron-deficient, with only 6 electrons around it) ⇒ $AlCl_3$ is the Lewis acid.
×	C	NH_3 donates a pair of electrons for dative bond formation to Ag^+.
×	D	HSO_3^- donates a pair of electrons for dative bond formation to H^+ (from H_2O) ⇒ H^+ is the Lewis acid.

7 Which of the following statements is true of the Period 3 chlorides, $NaCl$ to PCl_5?

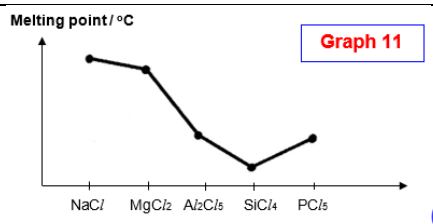
A The melting points of the chlorides show a continuously decreasing trend.

B The pH of the solutions formed when the chlorides are added to water range from alkaline to acidic.

C Three of the chlorides have simple molecular structures.

D The only chlorides which undergo hydrolysis in water are $AlCl_3$ and $MgCl_2$.

Answer: C

×	A	 *(pg 15 of Periodic Table lecture notes)*
×	B	The pH of aqueous $NaCl$ is 7, not alkaline.
✓	C	$NaCl$ and $MgCl_2$ are both ionic while the other 3 chlorides are covalent. The covalent chlorides have simple molecular structure.
×	D	All the chlorides, except for $NaCl$ undergo slight or complete hydrolysis.

8 The relative abundances of the isotopes of a sample of titanium are shown in the table below.

relative isotopic mass	46	47	48
relative abundance	11.2	10.1	*z*

Given that the relative atomic mass of the sample is 47.862, what is the value of *z*?

A 214.2 **B** 79.1 **C** 78.7 **D** 26.6

Answer: A

$$\frac{(46 \times 11.2) + (47 \times 10.1) + (48 \times z)}{11.2 + 10.1 + z} = 47.862 \qquad \Rightarrow z = \underline{\mathbf{214.2}}$$

9 A metallic salt was found to react exactly with sulfite ions in a 2 : 1 ratio.

In this reaction, the sulfite ion is oxidised as follows.

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

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

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

Answer: B

Since SO_3^{2-} lost e^-, the metallic salt gained e^-.

Let the moles of e^- gained by 1 mole of metallic salt be *y*

Total moles of e^- gained = Total moles of e^- lost

$2 \times y = 1 \times 2$

$\Rightarrow y = 1$

$\Rightarrow$ new ox. state is **+2**

10 The enthalpy changes for the following reactions are given:

$2Cr(s) + \frac{3}{2}O_2(g) \rightarrow Cr_2O_3(s)$ $\quad\quad$ $\Delta H_f(Cr_2O_3(s)) = -1120$ kJ mol^{-1}

$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$ $\quad\quad$ $\Delta H_f(CO(g)) = -110$ kJ mol^{-1}

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

$$3C(s) + Cr_2O_3(s) \rightarrow 2Cr(s) + 3CO(g)$$

A – 940 $\quad$ **B** – 870 $\quad$ **C** + 590 $\quad$ **D** + 790

Answer: D

$\Delta H_{rxn} = 3(-110) - (-1120) =$ **+ 790 kJ mol^{-1}**

11 An experiment was conducted by reacting propyne with hydrogen gas in a shock tube.

$$CH_3C{\equiv}CH(g) + 2H_2(g) \rightarrow CH_3CH_2CH_3(g)$$

The value of ΔG for the reaction is found to be negative at low temperature.

What is the sign of ΔH and ΔS for the above reaction?

	ΔH	ΔS
A	–	–
B	+	–
C	–	+
D	+	+

Answer: A

There is a decrease in number of moles of gaseous particles (from 3 moles to 1 mole) after the reaction, thus ΔS is negative.

$\Delta G = \Delta H - T\Delta S$

Since ΔG is negative and $-T\Delta S$ is positive, ΔH should be negative.

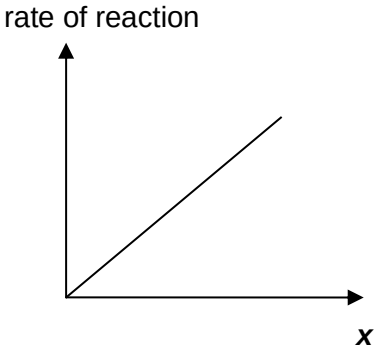
12 The kinetics of the reaction between hydrogen peroxide and acidified iodide ions were investigated.

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

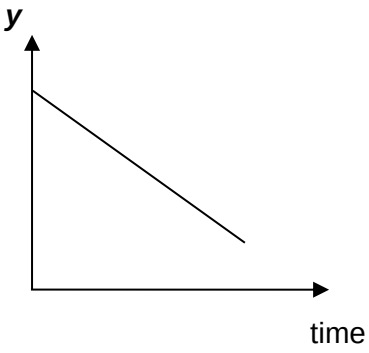
The rate equation was found to be: rate = $k[H_2O_2][I^-]$

Which of the following shows the correct labelling of the ***x***-axis for **Graph I** and ***y***-axis for **Graph II**?

Graph I



Graph II



	x-axis for **Graph I**	***y***-axis for **Graph II**
A	$[I^-]$	$[H_2O_2][I^-]$
B	$[H^+]$	$[I_2]$
C	$[H_2O_2][I^-]$	$[H^+]$
D	$[H_2O_2][H^+]$	$[I^-]$

Answer: C

Graph I : $\underbrace{\text{Rate}}_{y} = k\underbrace{[H_2O_2][I^-]}_{x}$ (similar to y=mx graph)

Graph II : gradient of the graph shows that rate is independent [reactant]

13 The reaction between HBr and O_2 is thought to occur via a multi-step mechanism:

$HBr + O_2 \rightarrow HO_2Br$ (slow)

$HO_2Br + HBr \rightarrow 2HOBr$ (fast)

$HOBr + HBr \rightarrow Br_2 + H_2O$ (fast)

The overall reaction is given to be $4HBr + O_2 \rightarrow 2Br_2 + 2H_2O$.

Which of the following statements are true?

1 The overall order of reaction is 2.

2 HO_2Br is the only intermediate in the reaction.

3 HOBr acts as a catalyst in the reaction.

A 1 only

B 3 only

C 1 and 2

D 1, 2 and 3

Answer: A

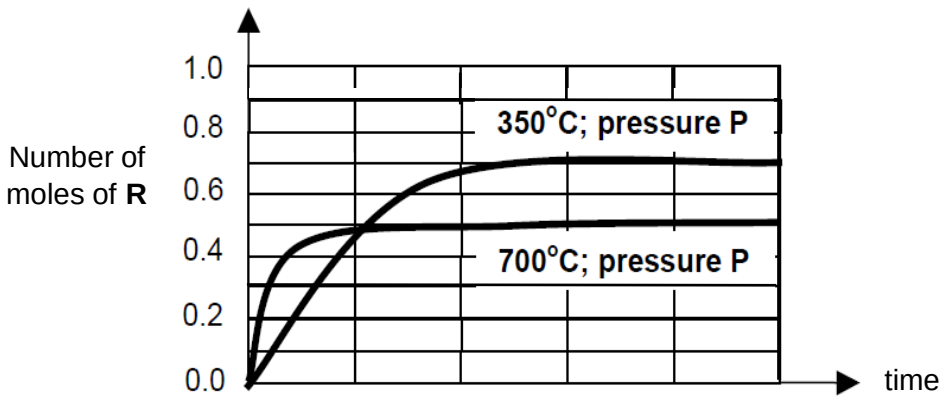
Rate = $k[HBr][O_2] \Rightarrow$ overall order of reaction is 2

HO_2Br and HOBr are the intermediates in the reaction (they do not appear in the overall equation).

14 **L** and **M** can react together to reach equilibrium in the reaction below.

$$\mathbf{L}(g) + \mathbf{M}(g) \rightleftharpoons \mathbf{Q}(g) + \mathbf{R}(g)$$

In an experiment, 1.0 mole each of **L** and **M** were reacted at constant pressure P and temperature 350 ºC. The amount of **R** present in the mixture at intervals of time was recorded. The experiment was repeated at the same pressure P, but at a temperature of 700 ºC. The results for both experiments are shown below.



Which one of the following information **cannot** be deduced from the graph?

A The value of K_c decreases with an increase in temperature.

B The equilibrium is achieved at a faster rate at higher temperatures.

C The enthalpy change for the forward reaction is negative.

D The activation energy of the forward reaction is high.

Answer: D

From the graph,
Amount of product R decreases when temperature is increased from 350°C to 700°C => K_c decreases.
Rate of reaction increases with increase in temperature.

By Le Chatelier's Principle, when temperature increases, equilibrium position shifts towards the endothermic reaction to absorb heat. From graph, equilibrium position shifts to the left.
⇨ Backward reaction is endothermic
⇨ Forward reaction is exothermic.
⇨ Enthalpy change for the forward reaction is negative.

The graph does not provide any information about the activation energy for the reaction.

15 The dissociation constants, K_w, for the ionisation of water at different temperatures are given below.

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

temperature / °C	K_w / mol^2 dm^{-6}
0	1.15×10^{-15}
25	1.00×10^{-14}
50	5.50×10^{-14}

What can be deduced from this information?

A Only at 25 °C are $[H^+]$ and $[OH^-]$ equal.
B K_w is not affected by changes in temperature.
C The forward reaction is exothermic.
D The pH of water decreases as temperature increases.

Answer: D

- Option **A** is incorrect. $[H^+]$ and $[OH^-]$ are equal at all temperature for pure water.
- Option **B** is incorrect. K_w is an equilibrium constant thus it is affected by changes in temperature as shown in the different K_w values at various temperatures.
- Option **C** is incorrect. When temperature increases, K_w increases. This shows that position of equilibrium shifts to the right towards the forward reaction which is endothermic.
- Option **D** is correct. $K_w = [H^+][OH^-]$. By inspection, when temperature rises, $[H^+]$ increases. Hence, pH of water decreases.

16 The following tests were performed on an aqueous solution containing chloride and iodide ions.

step	test	observations
1	Add excess $AgNO_3(aq)$.	Mixture of white and yellow precipitates is formed.
2	To the mixture from step 1, add excess $NH_3(aq)$.	White precipitate dissolves to form a colourless solution. Yellow precipitate is insoluble.
3	Filter the mixture from step 2.	Filtrate was a colourless solution. Residue was a yellow solid.

Which of the following statements are correct?

1 The K_{sp} for AgCl is lower than that for AgI.

2 There are no $Ag^+(aq)$ and $Cl^-(aq)$ present in the filtrate formed in Step 3.

3 In step 2, the addition of $NH_3(aq)$ results in the formation of $[Ag(NH_3)]_2^+$ that momentarily decreases the ionic product of AgCl.

A 3 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

Answer: A

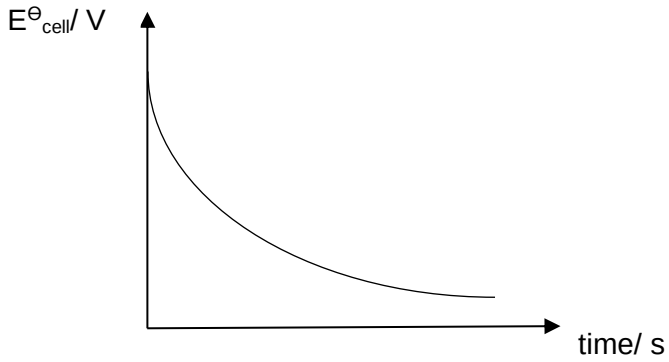
Statement 1 is incorrect as K_{sp} for AgCl is higher than that for AgI.

Statement 2 is incorrect. The filtrate contains saturated solution of $Ag^+(aq)$ and $Cl^-(aq)$ as well as $I^-(aq)$ that is not precipitated.

Statement 3 is correct. The complex formation $[Ag(NH_3)]^{2+}$ reduces the concentration of $Ag^+(aq)$ which decreases ionic product of AgCl.

17 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.



What continuous change could produce this graph?

A add aqueous cobalt(II) ions to the cobalt half-cell

B add aqueous ammonia to the cobalt half-cell

C add water to the iron half-cell

D increase the mass of solid iron immersed in the solution

Answer: **B**

$E_{cell} = E_{red} - E_{oxd} = E_{Co^{2+}/Co} - E_{Fe/Fe^{2+}}$

Option **A** is incorrect.

$Co^{2+} + 2e \rightleftharpoons Co \qquad E^{\theta} = -0.28V$

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} increases.

Option **B** is correct.

When aqueous ammonia is added to the cobalt half-cell, complex $[Co(CN)_6]^{2+}$ is formed. This complex 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} decreases.

Option **C** is incorrect.

$Fe^{2+} + 2e \rightleftharpoons Fe \qquad E^{\theta} = -0.44V$

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} increases.

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

18 Which of the following statements about octahedral complexes is correct?

A The ratio of hexadentate ligands to the central metal ion is 6:1.

B The d_{xz}, d_{yz} and d_{xy} orbitals are higher in energy than the $d_{x^2-y^2}$ and d_{z^2} orbitals.

C The d orbitals are split into different energy levels due to different orientation of the orbitals to the ligands.

D The same transition metal with different oxidation states displays the same colour with the same ligands.

Answer: C

A is not correct as the coordination number of octahedral complexes is 6; as each hexadentate ligands can form 6 dative bonds per ligand, the ratio of hexadentate ligands to complex should thus be 1:1 (not 6:1).

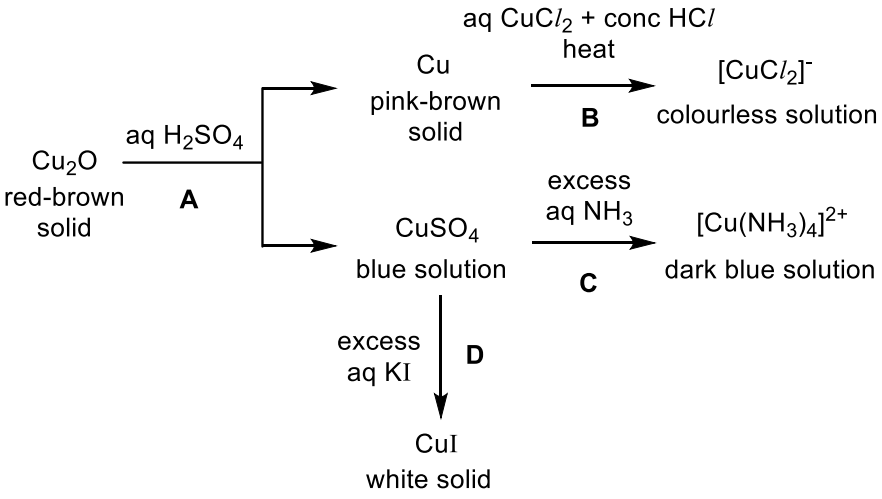
B is not correct as electrons in the d orbitals lying along the bonding axes (ie. x, y and z axes) would experience greater repulsion with the ligands, the $d_{x^2-y^2}$ and d_{z^2} orbitals are higher in energy in octahedral complex.

C is correct as the ligand field splitting arises from the repulsion of the electrons in the d orbitals with the ligands and this would be influenced by the orientation of the orbitals and the ligands.

D is not correct as different complexes with the same metal but different oxidation states will have with different d electronic configurations, hence even though the ligands may be same, the colours will be different.

19 The diagram below shows some reactions involving copper and its compounds.

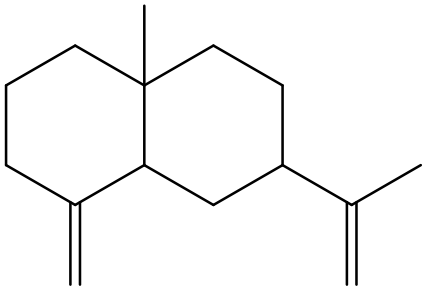
Which reaction involves ligand exchange only?



Answer: C

- **A** is a disproportionation (redox) reaction where Cu_2O (O.S.= +1) forms Cu metal (O.S. = 0) and $CuSO_4$ (O.S. = +2).
- **B** is a redox (comproportionation) reaction where Cu metal (O.S. = 0) and $CuCl_2$ (O.S. = +2) forms $[CuCl_2]^-$ (O.S. = +1).
- **C** is a **ligand exchange** where H_2O ligands in $[Cu(H_2O)_6]^{2+}$ complex is replaced with NH_3 ligands to form a new complex $[Cu(NH_3)_4]^{2+}$.
- **D** is a redox reaction involving Cu^{2+} (O.S. = +2) reducing to form CuI in the presence of excess I^-; $2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$

20 β-selinene is a molecule that can be isolated from plants. It has the following structural formula.



β-selinene

Which of the following statements about this molecule is correct?

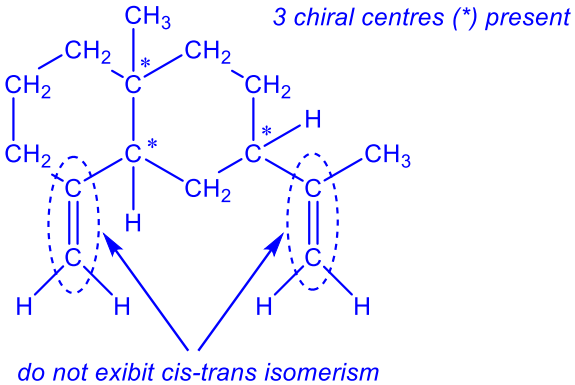
A It has a plane of symmetry.

B It does not contain any sp hybridised carbon.

C It has one chiral centre.

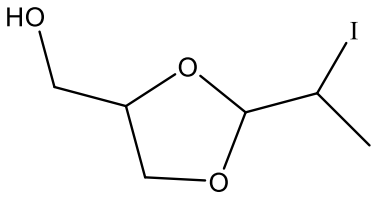
D It exhibits cis-trans isomerism.

Answer: B



Based on the options, only constitutional isomers possible.

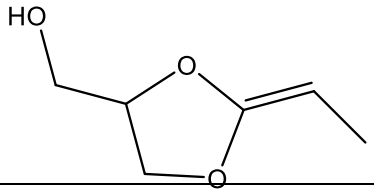
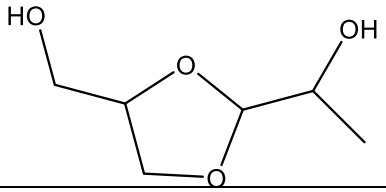
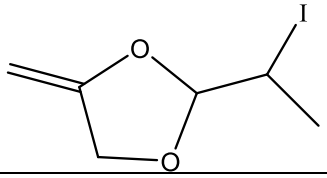
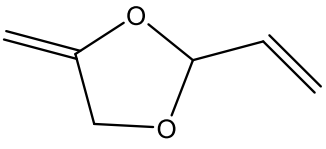
21 Iodinated glycerol is used in the symptomatic treatment of patients with chronic obstructive pulmonary disease.



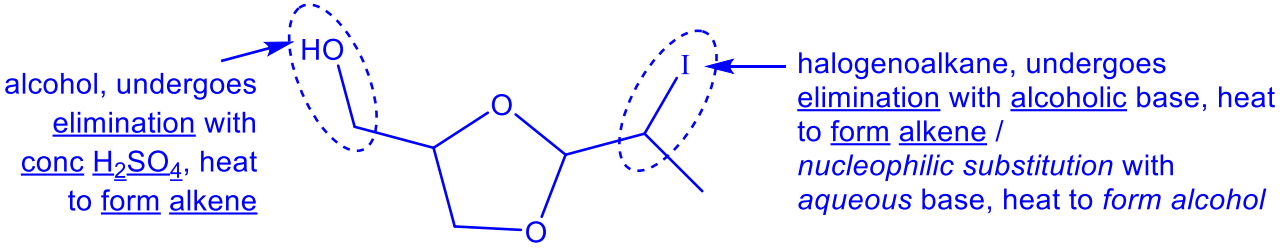
iodinated glycerol

Which of the following correctly shows the product formed when iodinated glycerol is reacted with the given reagents and conditions?

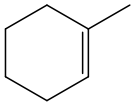
[The C–O–C bond in the structure is inert to the reagents.]

	reagent & conditions	*product*
A	alcoholic KOH, heat	
B	alcoholic KOH, heat	
C	aqueous KOH, heat	
D	concentrated H_2SO_4, heat	

Answer: A



22 Which of the following compounds react with HBr in an addition reaction to give a major chiral product?

1 

2 $CH(Br)=CH_2$

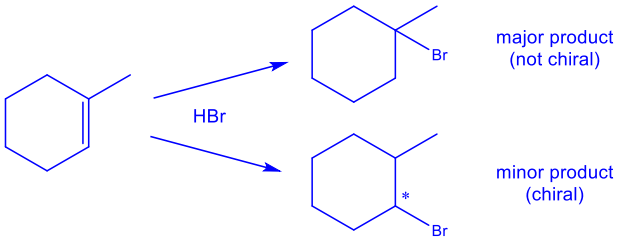
3 $CH_3CH=C(CH_3)CH_2CH_3$

4 $CH_2=CHCH_2CH_3$

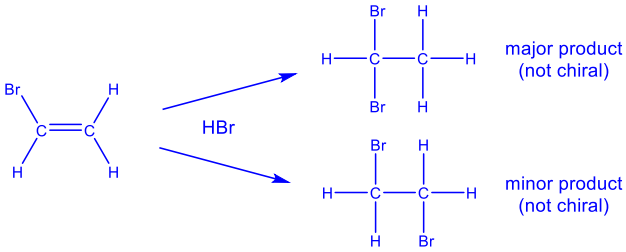
A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 4 only

Answer: D

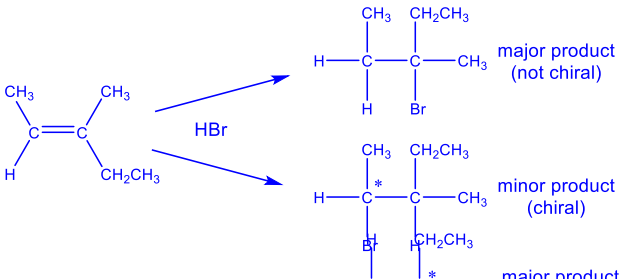
Compound 1



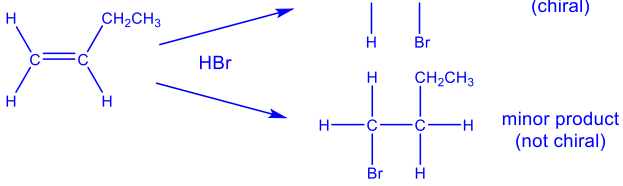
Compound 2



Compound 3

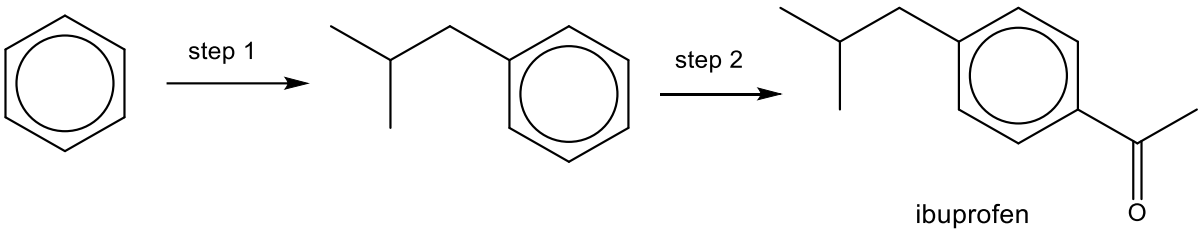


Compound 4



Only Compound 4 gives a major product upon electrophilic addition that is chiral.

23 Two of the steps in the manufacture of the pain-relief drug, ibuprofen are shown below.



Which statement is correct?

A Both steps involve the use of catalyst.

B The sequence of the steps are interchangeable.

C Both steps involve different types of reaction.

D Only step 2 involves the use of a halogen-containing reagent.

Answer: A

Both reactions are electrophilic substitution (Friedel-Crafts Alkylation and Friedel-Crafts Acylation respectively) and both require the use of $AlCl_3$ catalyst.

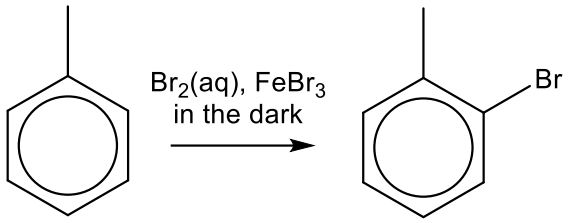
The reagents required for alkylation and acylation are halogenalkane, $CH_3CH(CH_2Cl)CH_3$ and acyl chloride, CH_3COCl respectively and both contain halogen.

As the desired product contains a benzene ring that is 1,4-disubstituted, it is necessary to carry out alkylation first followed by acylation as alkyl group is 2,4-directing whereas $–COCH_3$ group is 3-directing.

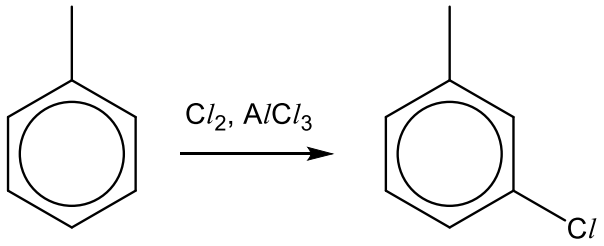
24 The reaction conditions for four electrophilic substitution reactions are given below.

Which reaction would yield the product stated?

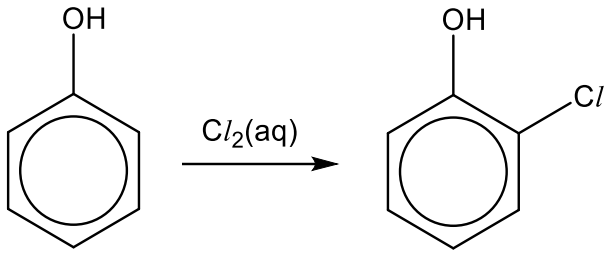
A



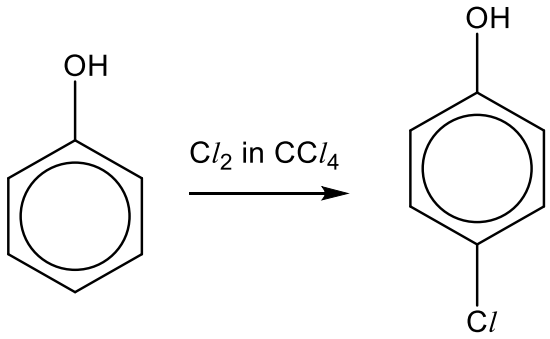
B



C



D



Answer: D

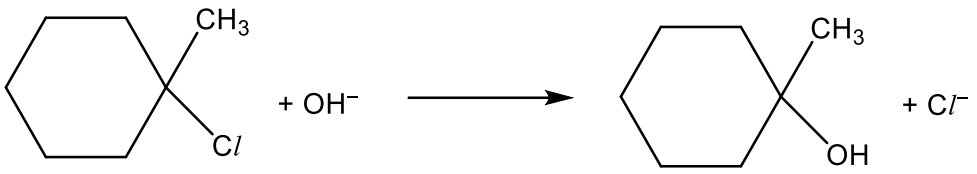
A: As aqueous Br_2 is used, $FeBr_3$ may not be formed.

B: as $–CH_3$ is 2,4-directing thus 3-chloromethylbenzene formed is a minor product

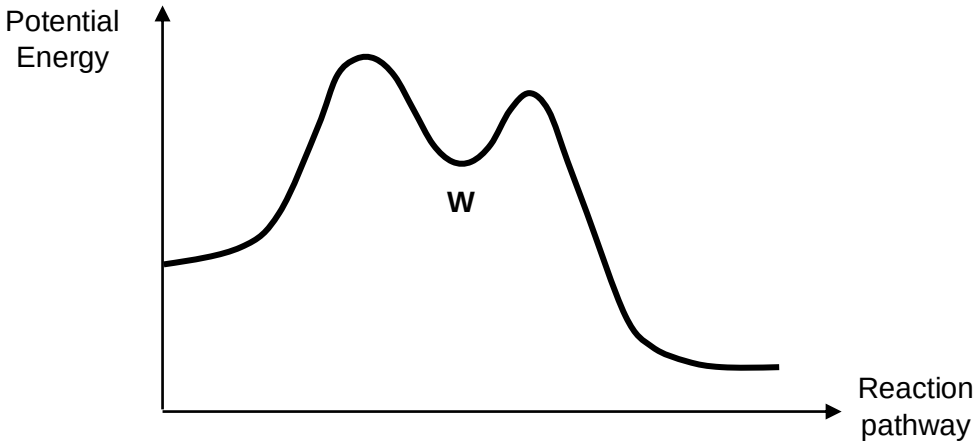
C: use of aqueous chlorine should result in a multi-substituted product for phenol

D: use of chlorine in organic solvent will result in a mono-substituted product for phenol

25 1-chloro-1-methylcyclohexane is hydrolysed by heating with NaOH(aq).



The energy profile diagram for this reaction is shown below.



Which statements regarding this reaction are correct?

1 The species at point **W** bears a positive charge.

2 The reaction proceeds via S_N2 mechanism since it is a two-step mechanism.

3 The same energy profile diagram would be obtained if chloromethane undergoes the same reaction.

A 1 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

Answer: A

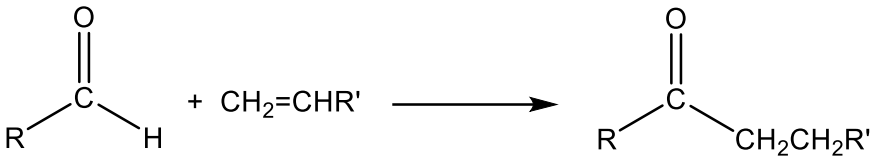
The mechanism shown is S_N1

1 **W** is an intermediate which is a carbocation.

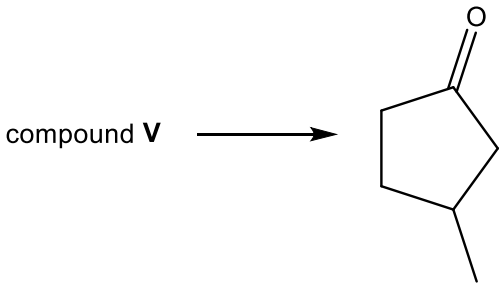
2 The energy profile diagram depicts the S_N1 mechanism which is two-step

3 Chloromethane is a primary halogenoalkane and should undergo S_N2 mechanism.

26 Hydroacylation is a reaction in which an alkene is 'inserted' into the C–H bond of an aldehyde to form a ketone.



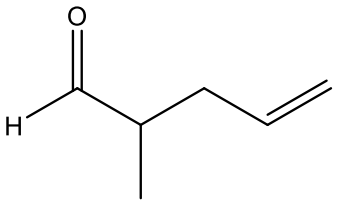
Compound **V** could be converted to 3-methylcyclopentanone using the above reaction.



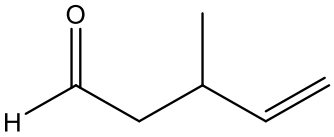
3-methylcyclopentanone

What could compound **V** be?

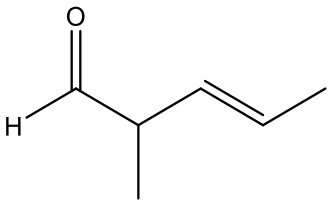
A



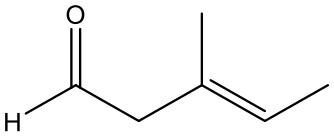
C



B

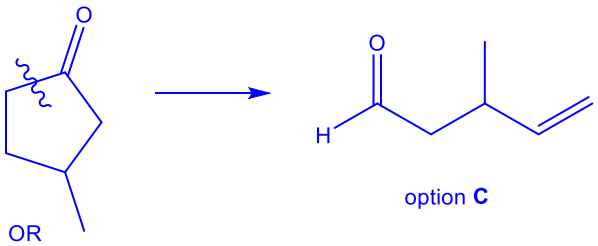


D



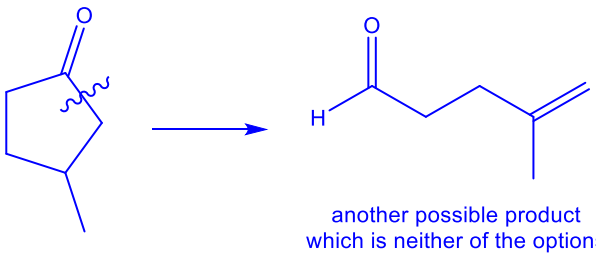
Answer: C

working backwards,



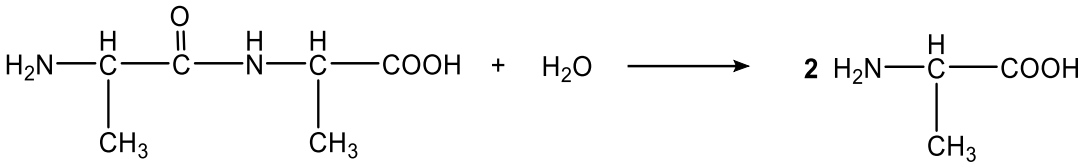
option **C**

OR

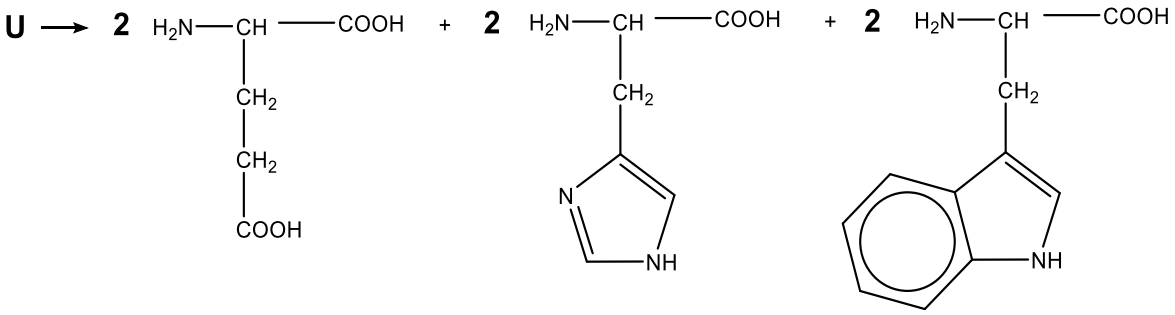


another possible product
which is neither of the options

27 Peptidases are enzymes that hydrolyse the peptide bonds that bind amino acids together in the polypeptide chain of a protein.



Partial hydrolysis of a small peptide, **U**, by a peptidase, produces the following amino acids.



glutamic acid
M_r = 147

histidine
M_r = 155

tryptophan
M_r = 204

What is the M_r of the peptide **U**?

A 904

B 922

C 1012

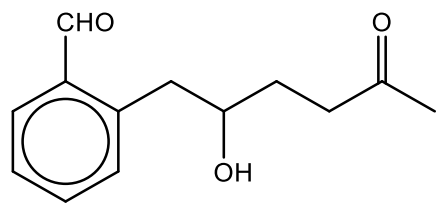
D 1102

Answer: B

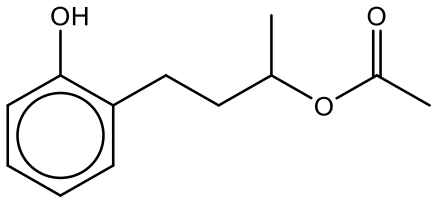
Since there are 6 amino acids, there are 6 –1 = 5 amide bonds

M_r of the peptide **U** = (147 x 2) + (155 x 2) + (204 x 2) – ({6–1} x 18) = **922**

28 Which of the following reagents could be used to distinguish between compounds **S** and **T**?



Compound **S**



Compound **T**

A I_2 in aqueous NaOH

B Cu^{2+} in alkaline solution

C aqueous NH_3 with $AgNO_3$

D acidified potassium dichromate

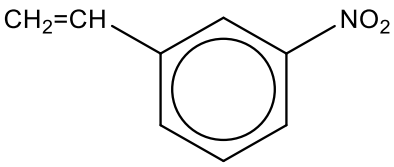
Answer: C

Aromatic aldehyde on compound **S** – positive test for Tollens' Reagent. (aqueous NH_3 with $AgNO_3$)

Both will give a positive test for iodoform test and oxidation reaction.

Both will give a negative test Fehling's solution.

29 3-nitrostyrene is an aromatic organic compound.



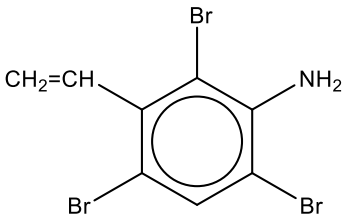
3-nitrostyrene

It is subjected to the following reactions:

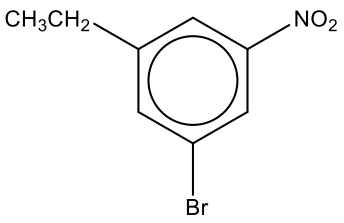
- heat with Sn in concentrated HC*l* followed by careful addition of cold NaOH(aq)
- then the addition of Br_2(aq)

What is the product obtained after the above reactions?

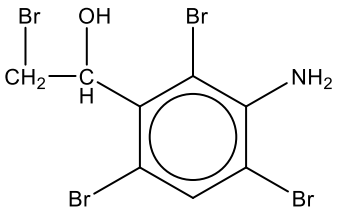
A



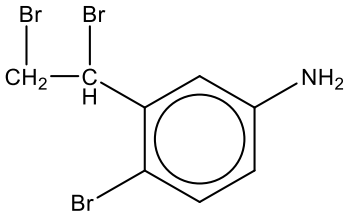
B



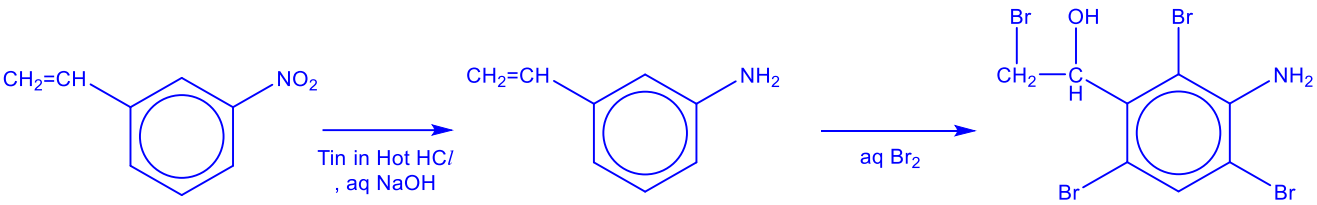
C



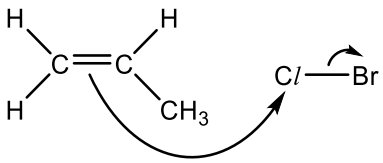
D

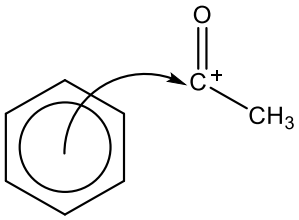


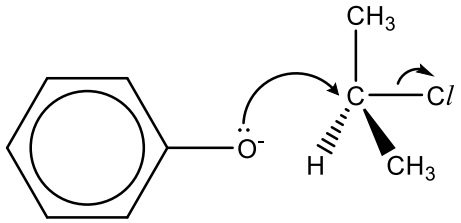
Answer: C



30 Which of the following show a correct mechanistic step in the reaction between the reagents?

1 

2 

3 

A 3 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

Answer: C

Option 1 is wrong as the alkene should attack the electron poor bromine atom instead.

Answers

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