INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION 2
in preparation for General Certificate of Education Advanced Level
Higher 1

CANDIDATE NAME			
CLASS		INDEX NUMBER	

CHEMISTRY 8872/01

Paper 1 Multiple Choice **21 September 2015**

50 minutes

Additional Materials: *Data Booklet*
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and class on all the work you hand in.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Section A

For each question there are four possible answers, **A, B, C,** and **D**. Choose the **one** you consider to be correct.

1 An exciting chemical demonstration is the 'barking dog'. An equation which describes the reaction is shown.

$$6NO + 2CS_2 \longrightarrow 3N_2 + 2CO + 2SO_2 + \frac{1}{4}S_8$$

Carbon disulfide, CS_2, is a liquid with a density of 1.26 g cm^{-3}.

Which mass of sulfur would be formed from 5.00 cm^3 of CS_2 if the reaction proceeded with 80% yield?

[M_r of CS_2 = 76.2; S_8 = 256.8]

A 1.67 g **B** 2.12 g **C** 2.65 g **D** 3.32 g

Mass of CS_2 = 1.26 x 5

= 6.30g

Amount of CS_2 = 6.30 / (12.0 + 32.1 + 32.1)

= 0.08268 mol

Amount of S = 0.08268 / 2 x ¼ = 0.01033

Mass of S formed = 0.01033 x 80/100 x 32.1 x 8 = 2.12g

2 The following half-reactions occur when potassium iodate(V), KIO_3, in hydrochloric acid solution oxidises iodine to ICl_2^-.

$$IO_3^- + 2Cl^- + 6H^+ + 4e^- \longrightarrow ICl_2^- + 3H_2O$$
$$I_2 + 4Cl^- \longrightarrow 2ICl_2^- + 2e^-$$

What is the ratio of IO_3^- to I_2 in the balanced chemical equation for the overall reaction?

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

$IO_3^- + 2Cl^- + 6H^+ + 4e^- \longrightarrow ICl_2^- + 3H_2O$
$I_2 + 4Cl^- \longrightarrow 2ICl_2^- + 2e^-$ ----------x2

$\mathbf{IO_3^-} + 6H^+ + \mathbf{2I_2} + 10Cl^- \longrightarrow 4ICl_2^- + ICl_2^- + 3H_2O$

Answer = 1:2

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

In which pairs do both species have different number of unpaired electrons?

A O and Cl^+

B F^+ and Ga^-

C P and Ne^+

D Ga^+ and Ne

O: $1s^2\ 2s^2\ 2p^4$ -- 2 unpaired electrons

Cl^+ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 2p^4$ -- 2 unpaired electrons

F^+ : $1s^2\ 2s^2\ 2p^4$ -- 2 unpaired electrons

Ga^- : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^2$ -- 2 unpaired electrons

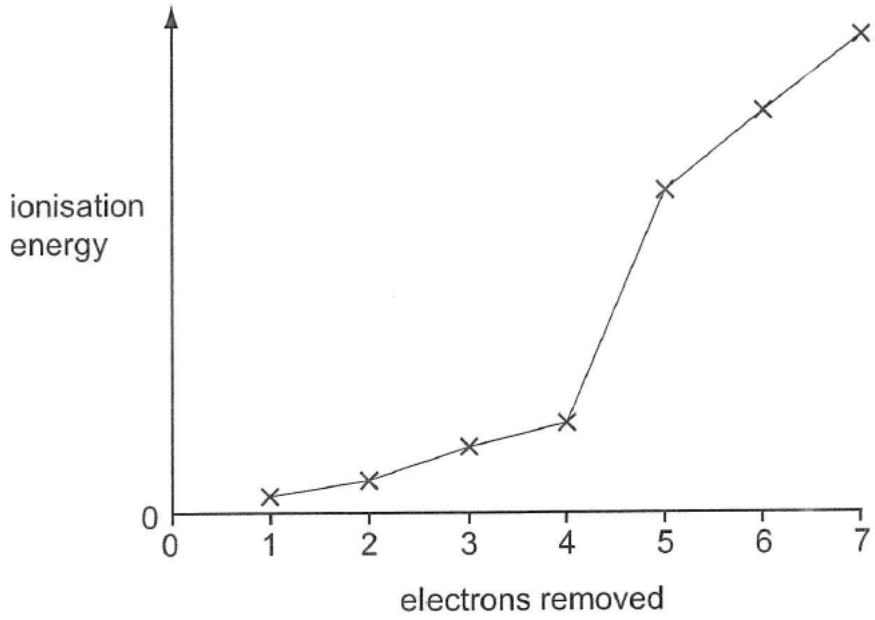
P: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ -- 2 unpaired electrons

Ne^+ : $1s^2\ 2s^2\ 2p^5$ -- 1 unpaired electrons

Ga^+ : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$ -- 0 unpaired electrons

Ne: $1s^2\ 2s^2\ 2p^6$ -- -- 0 unpaired electrons

4 The first seven ionisation energies of an element **M** are shown in the sketch graph.



What could be the identity of element M?

A aluminium

B magnesium

C phosphorus

D silicon

Biggest jump is from the 4th IE to the 5th IE. This shows that the 5th electron is removed from an inner quantum shell. Hence, there are 4 valence electrons and the element will be in group IV.

5 Ions of the two most common isotopes of zinc are shown below:

$^{64}_{30}Zn^{2+}$ $^{66}_{30}Zn^{2+}$

Which of the following statements is correct?

A Both Zn^{2+} ions have the same number of electrons but different number of protons.

B Both Zn^{2+} ions have the same electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$.

C The $^{64}_{30}Zn^{2+}$ ion has fewer neutrons in its nucleus than the $^{66}_{30}Zn^{2+}$ ion.

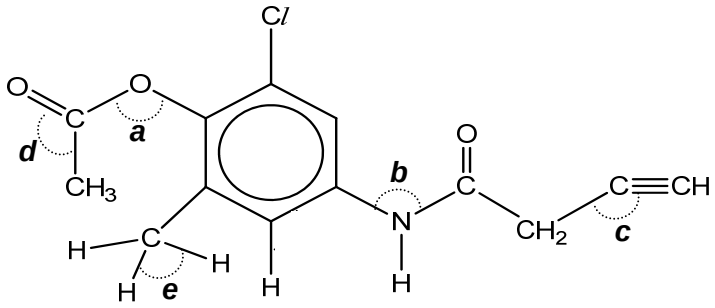
D The $^{66}_{30}Zn^{2+}$ ion will be deflected more than the $^{64}_{30}Zn^{2+}$ ion in an electric field of the same strength.

A) Isotopes: **Same** number of protons but **different number of neutrons**.
B) Since they have same number of electrons, they will have same electronic configuration. However, the electronic configuration should be $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$.
C) $^{64}_{30}Zn^{2+}$ Number of neutrons = 64 – 30 = 34

$^{66}_{30}Zn^{2+}$ Number of neutrons = 66 – 30 = 36

D) Charge over mass ratio of $^{64}_{30}Zn^{2+}$ is smaller than charge over mass ratio of $^{66}_{30}Zn^{2+}$.
$^{66}_{30}Zn^{2+}$ should deflect less.

6 Refer to the molecule below.



Which one of the following shows the correct information with regard to the various labelled bond angles?

	smallest bond angle	⟶	largest bond angle
A	***c***	***d***	***e***
B	***d***	***a***	***c***
C	***e***	***b***	***a***
D	***b***	***e***	***d***

a = 105° , b = 107°, c = 180°, d = 120°, e = 109.5°

7 Three substances, **X**, **Y** and **Z**, have the physical properties shown in the table.

substance	melting point / °C	boiling point / °C	density / g cm^{-3}	conductivity (solid)	conductivity (liquid)
X	114	184	4.93	poor	poor
Y	993	1695	2.56	poor	good
Z	650	1755	1.74	good	good

What could be the identities of **X**, **Y** and **Z**?

	X	Y	Z
A	I_2	SiO_2	Ca
B	I_2	NaF	Mg
C	Si	Mg	NaF
D	Ca	KCl	SiO_2

Substance X has low mp and bp and poor conductivity, this shows that X will be a simple molecular structure.

Substance Y has high mp and bp with good conductivity when it is in the liquid (molten) state, this shows that Y will have a giant ionic structure.

Substance Z has high mp and bp with good conductivity in both solid and liquid state, this shows that it has a giant metallic structure.

8 Consider the following four compounds.

1	$(CH_3)_3CH$
2	$CH_3CH_2CH_2CH_3$
3	$CH_3CH_2CH_2OH$
4	CH_3CH_2Cl

What is the order of **decreasing** boiling point of the compounds?

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

3 will have the highest boiling point due to hydrogen bonding followed by 4 with pd – pd.

1 and 2 will only have Td – Id as the forces of attraction which is the weakest IMF. 1 will have the lowest Td – Id as it is spherical in shape while 2 is linear in shape so the surface area of contact between molecules 1 will be smaller.

9 What does the following equation represents?

$$H_2(g) + O_2(g) \longrightarrow H_2O_2(g)$$

A standard enthalpy change of combustion of H_2

B standard enthalpy change of formation of H_2O_2

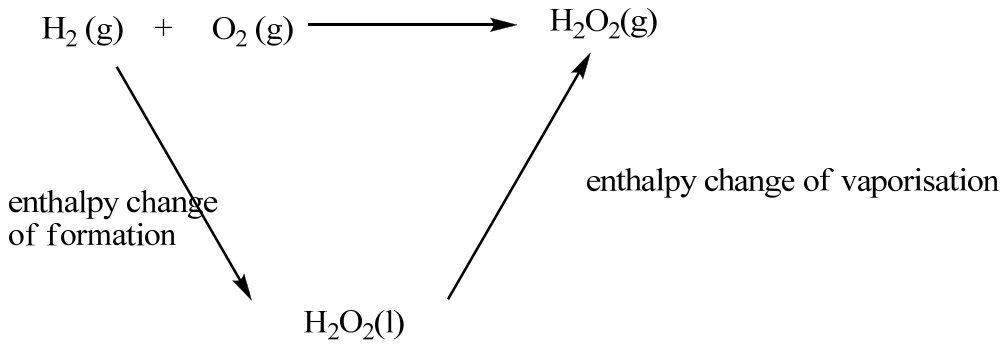
C sum of standard enthalpy change of formation of H_2O_2 and the enthalpy change of vaporisation of H_2O_2.

D sum of standard enthalpy change of combustion of H_2 and the enthalpy change of vaporisation of H_2O_2.

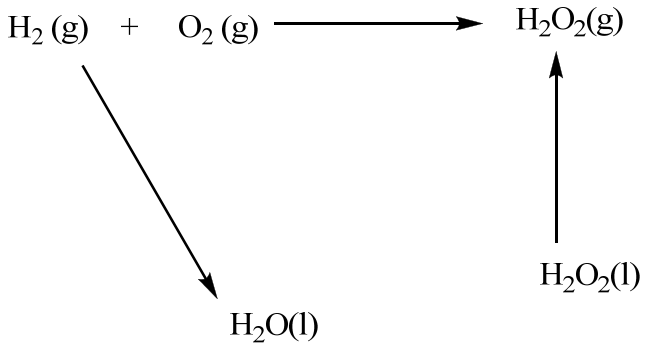
A) Std enthalpy change of combustion of H_2 ➔ H_2 + ½ O_2 → H_2O

B) standard enthalpy change of formation of H_2O_2 ➔ H_2 + O_2 → H_2O_2

C)



D)



Cycle will be incomplete to use Hess Law

10 In an experiment, 1.00 g of solid K_2CO_3 was added to a polystyrene cup containing 25.0 cm^3 of 1.0 mol dm^{-3} aqueous HC*l*. It was found that the temperature of the solution rose by 2.1 °C.

The equation for the reaction is as follows.

$$K_2CO_3(s) + 2HCl(aq) \longrightarrow 2KCl(aq) + CO_2(g) + H_2O(l)$$

What is the correct value for the enthalpy change of reaction above?
(Assume that the heat capacity of the solution is 4.2 J K^{-1} cm^{-3})

A –8.82 kJ mol^{-1}

B +8.82 kJ mol^{-1}

C –30.5 kJ mol^{-1}

D +30.5 kJ mol^{-1}

Amount of K_2CO_3 = 1.00 / (39.1x 2 + 12.0 + 3 x 16.0)

= 0.007236 mol

Amount of HCl = 1.0/1000 x 25.0 = 0.0250 mol

K_2CO_3 is limiting reagent.

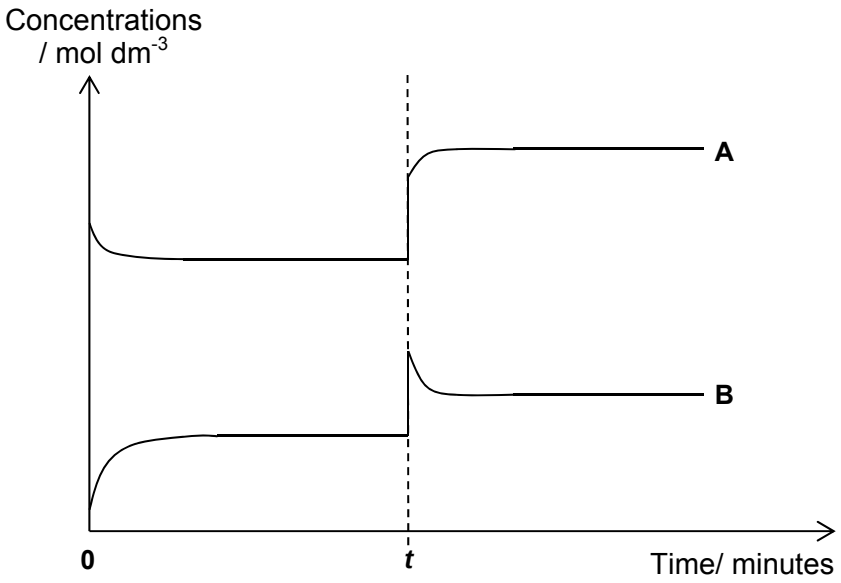
Enthalpy change of reaction = - (25.0) (4.2)(2.1) / 0.007236

= - 30.5 kJ mol^{-1}

11 The decomposition of compound **A** to form compound **B** can be represented by the following equation:

$$\mathbf{A}(g) \rightleftharpoons 2\mathbf{B}(g)$$

An enclosed system initially containing some quantities of **A** and **B** are allowed to reach equilibrium. At *t* minutes, a change has been introduced to the system. The graphs of the concentrations of **A** and **B** against time is plotted.



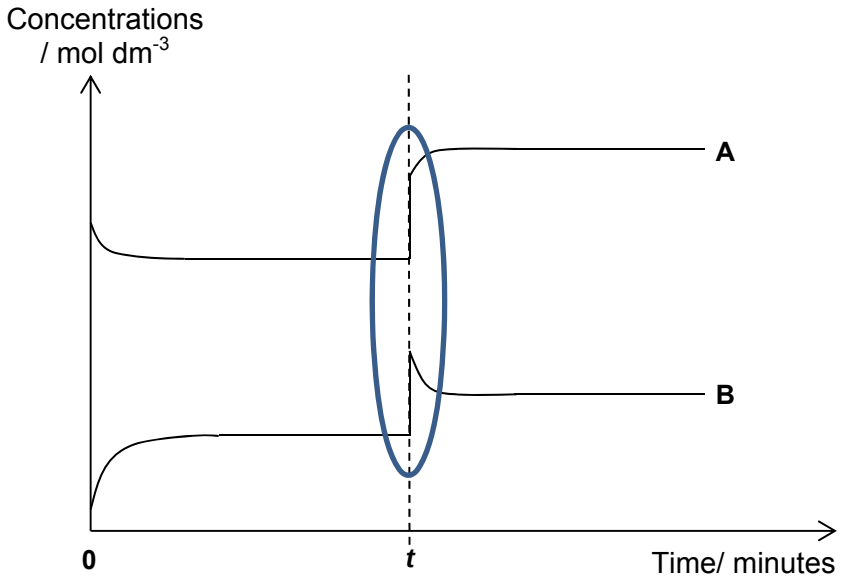
Which of the following could result in the change in concentrations of **A** and **B** as represented by the graph at *t* minutes?

A increase in concentration of **A**

B decrease in concentration of **A**

C decrease in volume of the system

D decrease in pressure of the system



Both the concentration of A and B increases at time t indicates that there is a change in a certain factor that causes it. B should be the first to be eliminated since it opposes the graph shown. An increase in A only will not explain the sharp increase in [B] at time t. A decrease in pressure will result in an increase in volume which will further result in a drop in concentration of both A and B.

12 An aqueous solution was prepared containing 1.0 mol of $AgNO_3$ and 1.0 mol of $FeSO_4$ in 2.00 dm^3 of water. When equilibrium was established, there was 0.44 mol of $Ag^+(aq)$ in the mixture.

$$Ag^+(aq) + Fe^{2+}(aq) \rightleftharpoons Ag(s) + Fe^{3+}(aq)$$

What is the numerical value of K_c?

A 1.35

B 1.62

C 2.89

D 5.79

	$Ag^+(aq)$	$+ Fe^{2+}(aq)$	$\rightleftharpoons$	$Ag(s)$	$+ Fe^{3+}(aq)$
Initial amt / mol	1.0	1.0		0	0
Change in amt / mol	- 0.56	- 0.56		+0.56	+0.56
Equilibrium amt/ mol	0.44	0.44		0.56	0.56
Equilibrium concentration/ mol dm^{-3}	0.44/2	0.44/2		-	0.56/2

$K_c = (0.56/2) / (0.44/2)^2 = 5.785 = 5.79$

13 What is the pH of a solution containing 0.0100 mol dm^{-3} of $Ba(OH)_2$ at 298K?

A 2.0

B 1.70

C 12.0

D 12.3

$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

0.0100 0.0200

pH = 14 – pOH

= 14 – (-lg 0.02)

= 14 – 1.698 = 12.3

14 Bromine and methanoic acid react as follows:

$$Br_2(aq) + HCOOH(aq) \longrightarrow 2Br^-(aq) + 2H^+(aq) + CO_2(g)$$

The rate of reaction is found to be first order with respect to both bromine and to methanoic acid.

Which of the following statements about the above reaction is **incorrect**?

A The units of the rate constant is $mol^{-1}\ dm^3\ s^{-1}$.

B The half-life of the reaction can be found using $t_{1/2} = \frac{\ln 2}{k}$.

C The rate of formation of $H^+(aq)$ is twice the rate of disappearance of $Br_2(aq)$.

D Doubling the concentration of methanoic acid doubles the rate of evolution of gas.

A is correct.
Rate = k[Br2][HCOOH]
k = Rate / [Br2][HCOOH]

For units:
mol dm^{-3} s^{-1}/(mol dm^{-3})^2 = mol^{-1} dm^3 s^{-1}

B is incorrect as the overall order of reaction is 2. The formula is only applicable for first order reaction.

C is correct as the mole ratio of Br_2 : H^+ = 1 : 2

D is correct.

Rate = k[Br2][HCCOH]

New Rate = k[Br2][2 x HCOOH]
= 2k[Br2][HCOOH]
= 2 x Rate

The rate doubles when concentration of methanoic acid doubles so the rate of product formed will also be doubled.

15 Which of the following elements forms an oxide with a giant structure and a chloride which is readily hydrolysed?

A aluminium

B carbon

C phosphorus

D silicon

Answer: D
Aluminium: Al_2O_3 has giant covalent structure and $AlCl_3$ undergoes **partial hydrolysis**
Carbon: Both oxide and chloride are simple molecular structure.
Phosphorus: Both oxide and chloride are simple molecular structure.
Silicon: SiO_2 has giant covalent structure and $SiCl_4$ gets **completely hydrolysed** to form SiO_2 easily.

16 For the elements in the third period of the Periodic Table, which property decreases consistently from sodium to chloride?

A electrical conductivity

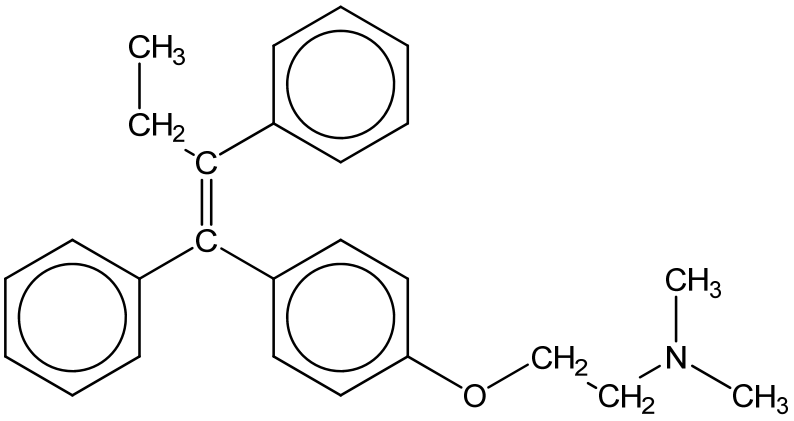
B ionisation energy

C melting point

D radius of the atom

Answer: D
Electrical conductivity increases from sodium to aluminium, drops to Si, and drops to zero for P, S and *Cl*
Ionisation energy generally increases from sodium to chlorine, with anomalies at *Al* and S
Melting point increases from sodium to silicon, and drops to P, S and *Cl*
Radius decreases continuously from sodium to chlorine due to increase in ENC

17 Tamoxifen is widely used in the treatment of breast cancer.



Tamoxifen

What is the number of sp^2 and sp^3 hybridised carbon atoms respectively after subjecting Tamoxifen to hydrogen gas under heat and in the presence of nickel.

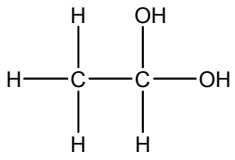
	sp^2	sp^3
A	6	20
B	8	18
C	18	8
D	20	6

18 Which formula could represent a compound which has *cis-trans* isomers?

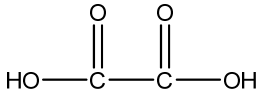
A $C_2H_6O_2$ **B** $C_2H_2O_4$

C C_2H_3Cl **D** $C_2H_2Cl_2$

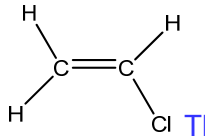
Answer: D



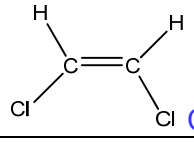
A: All the bonds are saturated so no cis- trans isomerism can occur.



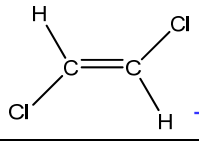
B: C – C bond is saturated so no cis- trans isomerism can occur.



C: There is no two different groups on each carbon of the C=C double bond.



D: Cis

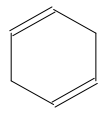


Trans

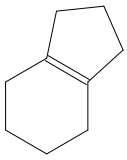
19 Which of the following compound forms two organic products when it is heated with acidified potassium manganate(VII) solution?

A $CH_2=CHCH_2CH=CH_2$

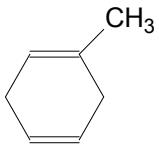
B



C

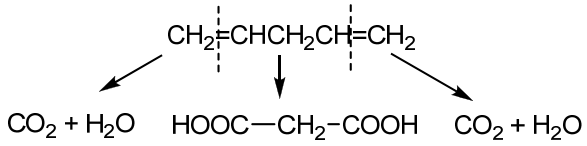


D



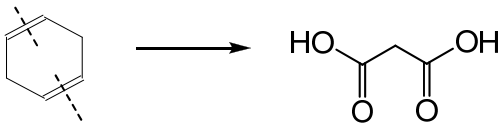
Answer: D

Option A



1 organic pdt

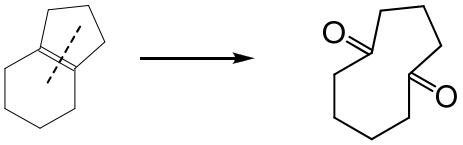
Option B



x 2

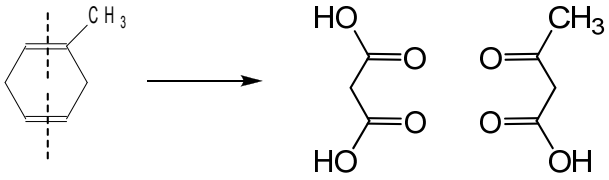
1 organic pdt

Option C



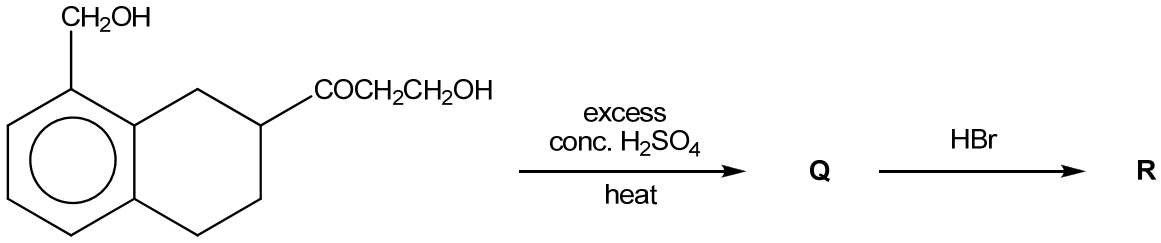
1 organic pdt

Option D



2 organic pdts

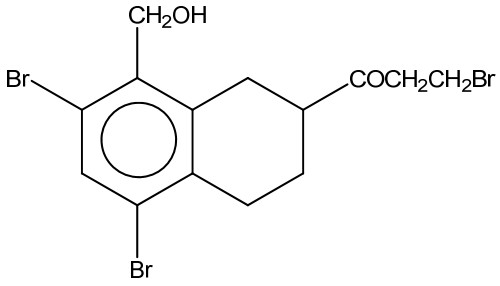
20 Compound **P** is used in the following synthesis.



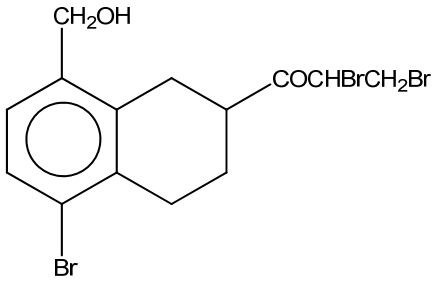
P

What is the likely structure of the final product **R**?

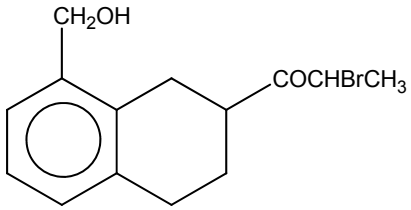
A



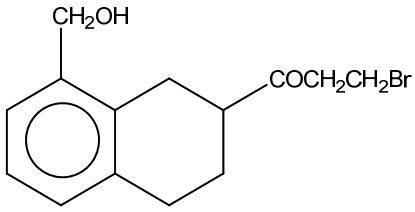
B



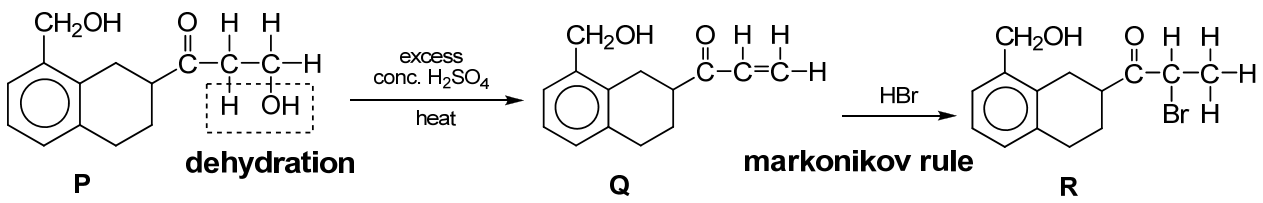
C



D



Answer: C



P **dehydration** **Q** **markonikov rule** **R**

21 Which of the following gives the compounds in order of decreasing K_a?

A CH_3CH_2OH > CH_3CO_2H > CH_2FCO_2H

B $BrCH_2CO_2H$ > $ClCH_2CO_2H$ > CH_3CO_2H

C $CH_3CH_2CO_2H$ > CH_3CO_2H > HCOOH

D $CH_3CCl_2CO_2H$ > $ClCH_2CHClCO_2H$ > $Cl_2CHCH_2CO_2H$

Answer: D

Decreasing Ka → most acidic to least acidic

Option A: CH_3CH_2OH > CH_3CO_2H > CH_2FCO_2H

Least acidic most acidic

Option B: $BrCH_2CO_2H$ > $ClCH_2CO_2H$ > CH_3CO_2H

Most acidic least acidic

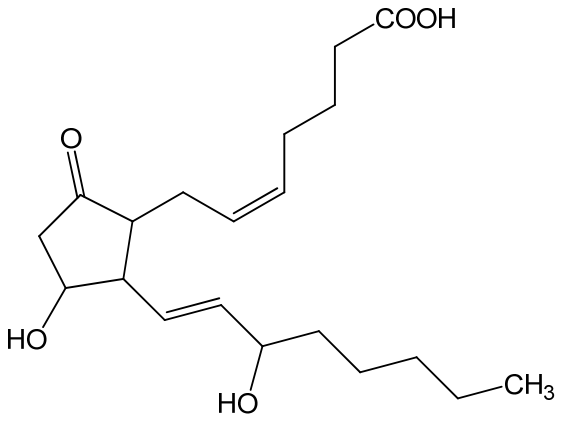
Option C: $CH_3CH_2CO_2H$ > CH_3CO_2H > HCOOH

Least acidic most acidic

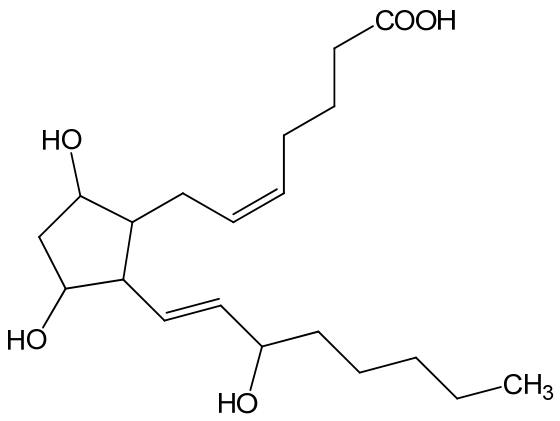
Option D: $CH_3CCl_2CO_2H$ > $ClCH_2CHClCO_2H$ > $Cl_2CHCH_2CO_2H$

Most acidic least acidic

22 PGE_2 and $PGF_{2\alpha}$ are two prostaglandins, both with pharmacological activity.



PGE_2



$PGF_{2\alpha}$

Which reagent will convert PGE_2 into $PGF_{2\alpha}$ efficiently?

A H_2/Ni **B** $LiAlH_4$

C H_2O/H^+ **D** $NaBH_4$

Answer: D

H_2/ Ni will reduce both C=C bond in alkenes and C=O bond in carbonyl compounds.
$LiAlH_4$ will reduce both COOH bond in acids and C=O bond in carbonyl compounds.
H_2O / H^+ is the reagent and condition for hydration.
$NaBH_4$ is a specific reducing agent for reduction of carbonyl group.

23 Which pair of compounds can be produced when ester **G**, $C_3H_7OCOC_3H_7$ is refluxed with dilute sulfuric acid?

A $CH_3CH_2CH_2COOH$ and $(CH_3)_2CO$

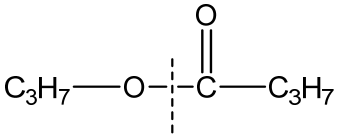
B $(CH_3)_2CHCOOH$ and $CH_3CH_2CH_2OH$

C CH_3CH_2COOH and $CH_3CH_2CH_2OH$

D CH_3CH_2COOH and $(CH_3)_2CHOH$

Answer: B

Hydrolysis of $C_3H_7OCOC_3H_7$ will give C_3H_7COOH with a total of 4 carbons and C_3H_7OH which should be an alcohol with 3 carbons.

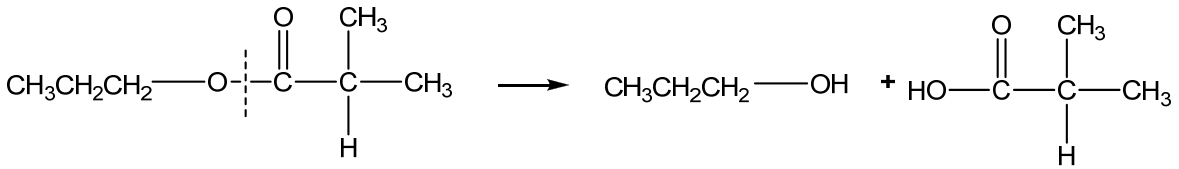


C_3H_7 can be linear or branched chain

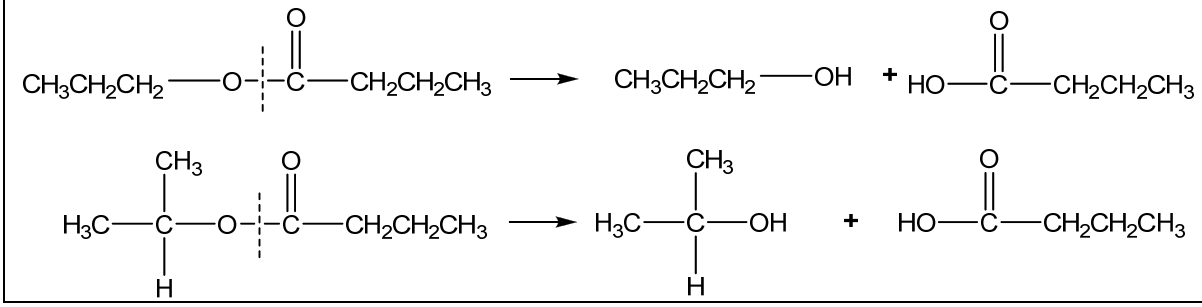
Hence **option C and D are wrong.**

It is impossible to get only a ketone functional group after hydrolysis of ester.
Hence **option A is wrong.**

Option B is obtained from



Other possible combinations (for your information):



24 Treatment of 2,4-dibromoheptane with hot alcoholic NaOH produces a mixture of dienes with the molecular formula C_7H_{12}.

$$CH_3CHBrCH_2CHBrCH_2CH_2CH_3 + 2KOH \longrightarrow C_7H_{12} + 2KBr + 2H_2O$$

Which diene would **not** be produced in this reaction?

A $CH_3–CH=CH–CH_2–CH=CH–CH_3$

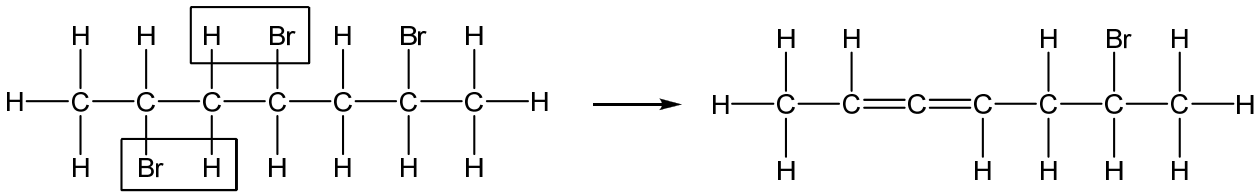
B $CH_3–CH=C=CH–CH_2–CH_2–CH_3$

C $CH_3–CH=CH–CH=CH–CH_2–CH_3$

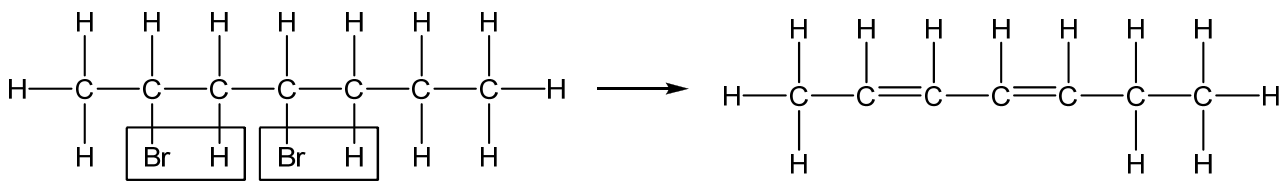
D $CH_2=CH–CH_2–CH=CH–CH_2–CH_3$

Answer: A

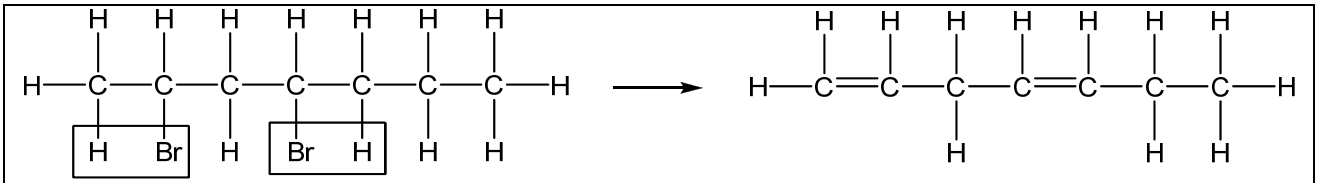
Option B:



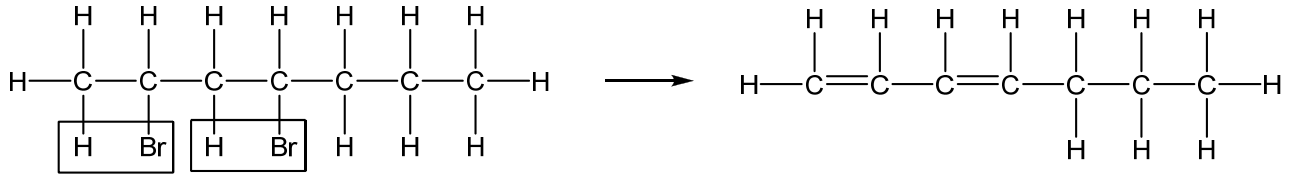
Option C



Option D:

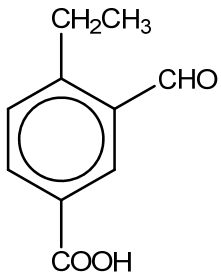


Another alternative:

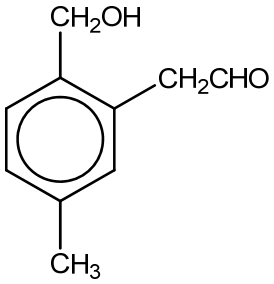


Hence, Option A is impossible to obtain.

25 Which of the following reagents can be used to distinguish between compounds **S** and **T** shown below?



compound **S**



compound **T**

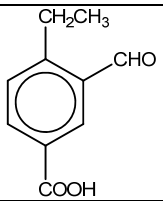
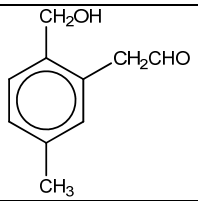
A 2,4-dinitrophenylhydrazine

B hot acidified $KMnO_4$

C Na_2CO_3

D Tollens' reagent

Answer: C

		
	FG present: - Aromatic aldehyde - Carboxylic acid	FG present: - Aliphatic aldehyde - Primary alcohol
2,4-dinitrophenylhydrazine	Condensation rxn with aldehyde (orange ppt formed)	Condensation rxn with aldehyde (orange ppt formed)
hot acidified $KMnO_4$	Oxidise alkyl side chain and aldehyde (observe purple $KMnO_4$ decolourise)	Oxidise alkyl side chain, primary alcohol and aldehyde (observe purple $KMnO_4$ decolourise)
Na_2CO_3	Acid-carbonate rxn with COOH	**No rxn**

	(Effervescence. Gas forms white ppt with $Ca(OH)_2$)	
Tollens' reagent	Mild oxidation of aldehyde (silver mirror formed)	Mild oxidation of aldehyde (silver mirror formed)

Hence option C is correct.

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct.)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

26 The three statements that follow are all true.

Which of these can be explained, at least in part, by reference to hydrogen bonding?

1 Ice floats on water.

2 Propan-2-ol is less volatile than propanone.

3 The relative molecular mass of ethanoic acid in benzene is higher than expected.

Answer: A

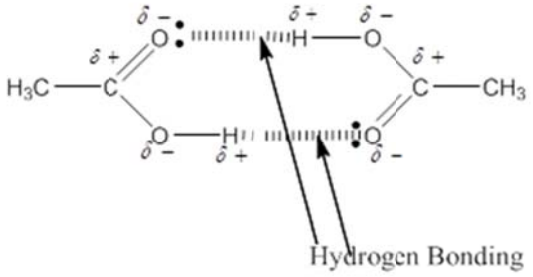
Option 1: Recall from Chem Bonding lecture notes:

- In ice, each H_2O molecule forms the maximum of **four** hydrogen bonds with 4 other H_2O molecules.
- This results in a **tetrahedral arrangement** and **open structure** of ice [with empty spaces between some H_2O molecules].
- The H_2O molecules in ice are **spaced out further** than that in liquid water.
- Due to its open structure, ice is **less dense** than water and so, **floats** on water.

Option 2: Propan-2-ol is an alcohol, it can form **intermolecular hydrogen bonds**. Propanone is a ketone. It has a polar C=O bond and can form **intermolecular permanent-dipole permanent dipole interactions**. More energy is required to overcome stronger hydrogen bonding, hence **propan-2-ol has higher boiling point, i.e. less volatile (less likely to evaporate)**.

Option 3:

In benzene, ethanoic acid exists as a dimer. Hence its apparent Mr is 120, instead of 60.



(You must know how to draw this diagram!)

27 The following equilibrium exists between sulfur dioxide and sulfur trioxide:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -98 \text{ kJ mol}^{-1}$$

Which of the following are correct?

	changes made	K_c
1	add catalyst	no change
2	add more SO_2	no change
3	reduce temperature	increase

Answer: A

Option 1: Adding a catalyst increases the rate at which the equilibrium is achieved, by increasing the rate of the forward and backward reaction by the same extent, but **does not** change the equilibrium position. Hence Kc remains unchanged (also because temp is constant, Kc remains unchanged).

Option 2: Kc value is only dependent on temperature. Since temp is constant, Kc remains unchanged.

Option 3: When temp is reduced, the equilibrium position will shift to the right to favour the exothermic reaction to release heat. Hence more $[SO_3]$ will be formed, and $[SO_2]$ and $[O_2]$ will decrease. Since Kc = $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$, Kc value increases (also because the rate of the forward reaction (right) increases more than the backward reaction).

28 Which of the following statements are correct for the sequence of compounds below considered from left to right?

NaF MgO AlN SiC

1 The electronegativity difference between the elements in each compound increases.

2 The formula units of these compounds are isoelectronic.

3 The bonding becomes increasingly covalent.

Answer: C

Option 1 and 3:
NaF: metal and non-metal
MgO: metal and non-metal
AlN: metal and non-metal
SiC: non-metal and non-metal

Based on their relative positions in the Periodic Table, the electronegativity difference between Na and F is the largest, followed by Mg and O, Al and N, and Si and C (which has the smallest electronegativity difference). **Hence option 1 is wrong.**

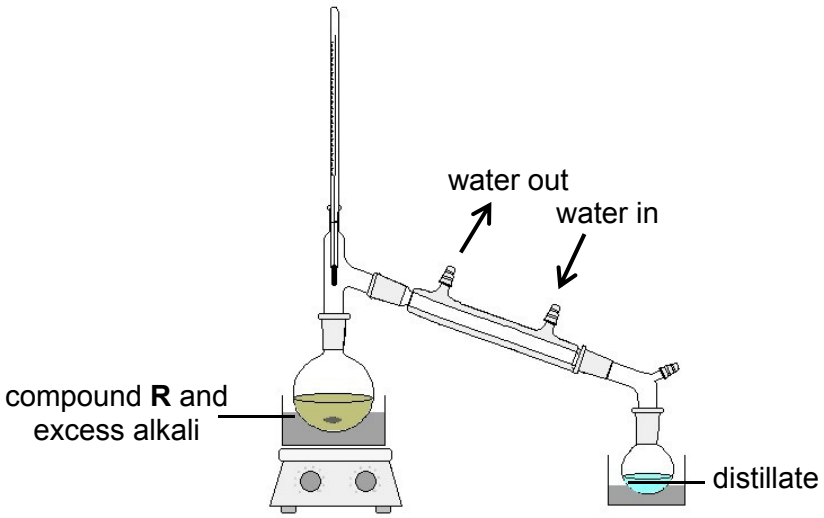
The smaller the electronegativity difference, the more covalent character the bond will have. **Hence, option 3 is correct.**

Option 2:
A **formula unit** in chemistry is the empirical **formula** of **any ionic or covalent** network solid compound used as an independent entity for stoichiometric calculations.

NaF is made up of **Na^+ and F^- ions**: 10e + 10e = 20e
MgO is made up of **Mg^{2+} and O^{2-} ions**: 10e + 10e = 20e
AlN is made up of **Al^{3+} and N^{3-} ions**: 10e + 10e = 20e
SiC is made up of **Si and C atoms**: 14e + 6e = 20

Since all formula units have the same number of electrons, they are isoelectronic.

29 Compound **R** is heated under reflux in the presence of excess alkali. The distillate forms a yellow precipitate with hot aqueous alkaline iodine.



Which of the following could be **R**?

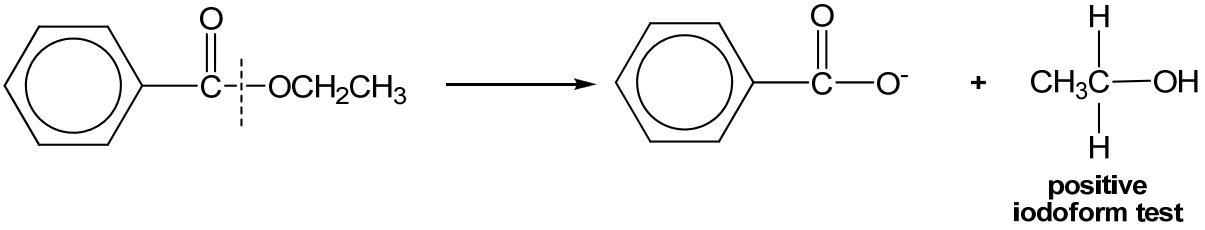
1 ethylbenzoate

2 2-iodobutane

3 butanoic acid

Answer: B

Option 1: Alkaline hydrolysis



positive iodoform test

Option 2: Substitution

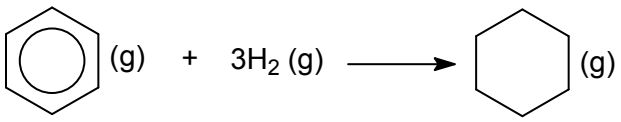
$CH_3CH_2CHICH_3 + OH^- \rightarrow \mathbf{CH_3CH_2CH(OH)CH_3} + I^-$

positive iodoform test

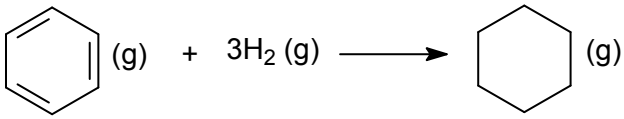
Option 3: Acid-base/Neutralisation

$CH_3CH_2CH_2COOH + OH^- \rightarrow CH_3CH_2CH_2COO^- + H_2O$

30 Under high pressure and in the presence of a catalyst, benzene and a hypothetical compound cyclo-1,3,5-hexatriene undergo hydrogenation to form cyclohexane in the reactions shown.



$\Delta H = -132$ kJ mol^{-1}



$\Delta H = -372$ kJ mol^{-1}

Which of the following statements are **incorrect**?

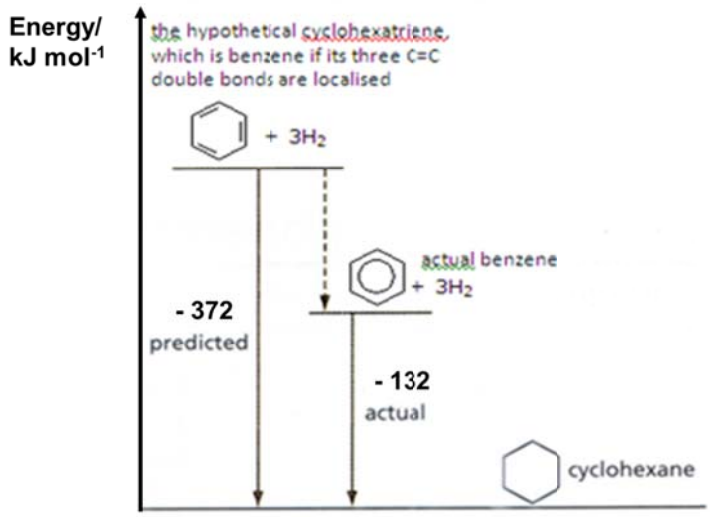
1 Benzene is more stable than cyclo-1,3,5-hexatriene.

2 Benzene undergoes substitution reaction to form cyclohexane.

3 The enthalpy change of combustion of benzene is more exothermic than that of cyclo-1,3,5-hexatriene.

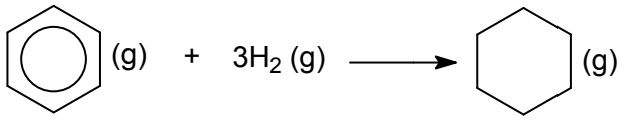
Answer: C

Option 1: From the energy level diagram that **you can draw on your own quickly**, you can see that benzene is at a lower energy level than cyclo-1,3,5-hexatriene. Hence Option 1 is correct.

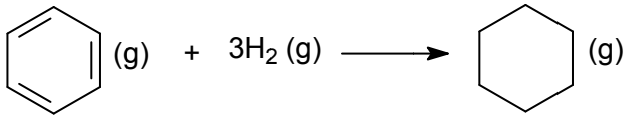


Option 2:
Benzene undergoes **addition** reaction to form cyclohexane. Hence Option 2 is incorrect. Substitution will keep the benzene ring intact.

Option 3:
We can use the formula ΔH_r^{θ} = $\sum n\Delta H_c^{\theta}$ **(reactants) -** $\sum m\Delta H_c^{\theta}$ **(products)**



ΔH = –132 kJ mol^{-1}



ΔH = –372 kJ mol^{-1}

ΔHr = **–132** = ΔHc(benzene) + 3 ΔHc(H_2) – ΔHc(cyclohexane)

ΔHr = **–372** = ΔHc(cyclo-1,3,5-hexatriene) + 3 ΔHc(H_2) – ΔHc(cyclohexane)

Observing both equations, ΔHc(cyclo-1,3,5-hexatriene) must have a more negative value (more exothermic) than ΔHc(benzene).

Hence Option 3 is incorrect.