EUNOIA JUNIOR COLLEGE
JC2 Preliminary Examination 2019
General Certificate of Education Advanced Level
Higher 1

# CHEMISTRY

**8873/01**

Paper 1 Multiple Choice

**24 September 2019**
**1 hour**

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, civics group and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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

**Read the instructions on the Answer Sheet very carefully.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **12** printed pages.

**1** Beams of charged particles are deflected by an electric field.

In an experiment, protons are deflected by an angle of +15º. In another experiment, under identical conditions, particle **X** is deflected by an angle of –5º.

What could be the composition of particle **X**?

| | protons | neutrons | electrons |
|---|---|---|---|
| **A** | 1 | 2 | 2 |
| **B** | 2 | 3 | 3 |
| **C** | 3 | 3 | 4 |
| **D** | 4 | 5 | 1 |

Answer: **A**

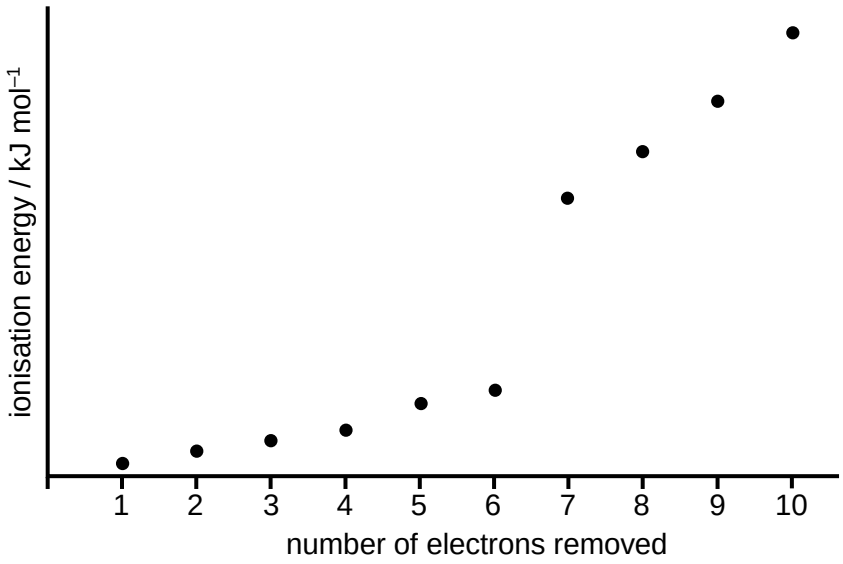
Angle of deflection, $\theta \propto \frac{z}{m}$

For a proton, ${}^{1}_{1}H^{+}$, $\frac{z}{m} = \frac{+1}{1} = +1$

For particle **X**, $\frac{z}{m} = \frac{-5°}{+15°}(+1) = -\frac{1}{3}$

**A** : ${}^{3}_{1}\mathbf{A}^{-}$ ; **B** : ${}^{5}_{2}\mathbf{B}^{-}$ ; **C** : ${}^{6}_{3}\mathbf{C}^{1-}$ ; **D** : ${}^{9}_{4}\mathbf{D}^{3+}$

**2** The graph represents the first ten ionisation energies of an element.



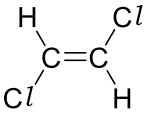
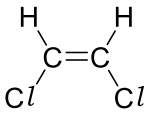
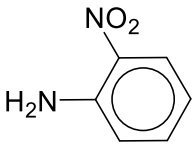

What is the element?

**A** C **B** S **C** Ne **D** C*l*

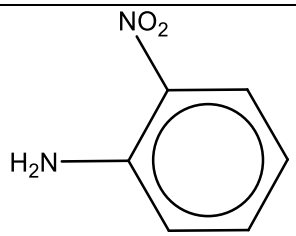
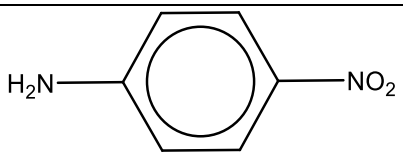
Answer: **B**

The element is from group 16 as there are 6 electrons in the outermost principal quantum shells. The 7th electron is removed from the inner principal quantum shell, hence the more significant increase in energy required to remove the 7th electron.

**3** In which of the following pairs would compound **I** have a higher solubility in water than compound **II**?

| | **I** | **II** |
|---|---|---|
| **A** |  |  |
| **B** | $CH_3COCH_3$ | $CH_3CH_2Cl$ |
| **C** | $CH_3CH_2CH_2CH_2CH_2CO_2H$ | $CH_3CH_2CH_2CHClCH_2CO_2H$ |
| **D** |  |  |

Answer: **B**

| | **I** | **II** |
|---|---|---|
| **A** | *trans*-CHCl=CHCl<br>non-polar so lower solubility | *cis*-CHCl=CHCl<br>polar so higher solubility |
| **B** | $CH_3COCH_3$<br>O in propanone can form H-bond with water – so higher solubility | $CH_3CH_2Cl$ |
| **C** | $CH_3CH_2CH_2CH_2CH_2COOH$ | $CH_3CH_2CH_2CHClCH_2COOH$<br>More polar |
| **D** |  <br>Intramolecular hydrogen bonding between $-NO_2$ and $-NH_2$ group; leading to less extenstive intermolecular hydrogen bonding with water, hence lower solubility |  |

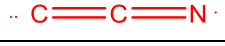
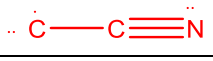
**4** $C_2N$ is a very unstable molecule.
Assume that this molecule

- has a carbon-carbon-nitrogen sequence of atoms,
- is linear,
- has two π bonds.

What is the number of bonded pairs of electrons and unpaired electrons in one molecule of $C_2N$?

| | bonded pairs of electrons | unpaired electrons |
|---|---|---|
| **A** | 2 | 1 |
| **B** | 2 | 2 |
| **C** | 3 | 2 |
| **D** | 4 | 1 |

Answer: **D**

| | Proposed structures | |
|---|---|---|
| | C=C=N  | C-C≡N  |
| Bonded pairs | 4 | 4 |
| Unpaired electron | 1 | 1 |

**5** Which trends are correct across period 3 (from Na to C*l*)?

1 atomic radius decreases
2 melting point increases
3 electronegativity increases
4 pH of the oxide solution increases

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

Answer: **A**
Across the period 3 elements,

- Number of protons increases, nuclear charge increases
- Shielding effect is negligible as electrons are added to the same shell
- Increase in electrostatic forces of attraction between the nucleus and valence electrons increases

Resulting in decrease in atomic radii, increase in electronegativity. Hence statement 1 and 3 is correct.
Statement 2 is wrong as the melting point of the element decreases across the period as the elements change from giant metallic to giant molecular and simple molecular structure.
Statement 4 is wrong as the pH of the oxide decreases across the period as oxides change from basic ionic oxides to acidic covalent oxides.

**6** The standard enthalpy change of formation of HC$l$ and HI are –92 kJ mol$^{-1}$ and +26 kJ mol$^{-1}$ respectively.

Which statement best accounts for the difference?

**A** Chlorine is more electronegative than iodine.

**B** The activation energy for the reaction between $H_2$ and C$l_2$ is much less than that between $H_2$ and $I_2$.

**C** The bond energy of HI is smaller than the bond energy of HC$l$.

**D** The bond energy of $I_2$ is smaller than the bond energy of C$l_2$.

Answer: **C**
The bond energy of X-X bond does not account for the increase in value of enthalpy change of formation from HC$l$ to HI. In fact, less energy is released from formation of H-X bond account for the increase in value of enthalpy change of formation from HC$l$ to HI.

**7** The relative atomic mass of antimony, which consist of the isotopes $^{121}$Sb and $^{123}$Sb, is 121.8. Calculate the percentage of $^{123}$Sb in the isotopic mixture.

**A** 40% **B** 45% **C** 50% **D** 60%

Answer: **A**
Let the percentage of $^{123}$Sb in the isotopic mixture be $x$%

$$\frac{x}{100}123 + \frac{100-x}{100}121 = 121.8$$

$123x - 121x = 80$

$x = 40\%$

**8** A barium salt, $BaFeO_n$, reacts with hydrochloric acid to produce iron(III) ions and chlorine gas. In an experiment, 2 moles of $BaFeO_n$ is reacted with excess hydrochloric acid to produce 3 moles of chlorine.

What is the value of $n$?

**A** 1 **B** 2 **C** 4 **D** 6

Answer: **C**
1 mol of $BaFeO_n$ reacted to yield 1.5 mol of chlorine.
$2Cl^- \rightarrow Cl_2 + 2e$ x1.5
According to above, 3 mol of electrons is loss from the oxidation of $Cl^-$.
Thus, 3 mol of electrons is gained by $FeO_n^{2-}$
$Fe^{x+} + 3e \rightarrow Fe^{3+}$
x = 6
Hence +6 + n (-2) = -2 and **n = 4**

**9** Two 100 $cm^3$ aqueous solutions, one containing 0.10 mol NaOH and the other 0.010 mol HC$l$ have the same initial temperature.

When the two solution are mixed, the temperature rises by **z** ºC. You may assume the specific heat capacity, *c*, of the reaction mixture is 4.18 J $g^{-1}$ $K^{-1}$ and the density of the reaction mixture is 1.00 g $cm^{-3}$.

What is the enthalpy change of neutralisation in kJ $mol^{-1}$?

**A** $\dfrac{200 \times 4.18 \times \mathbf{z}}{1000 \times 0.11}$

**B** $\dfrac{200 \times 4.18 \times \mathbf{z}}{1000 \times 0.010}$

**C** $\dfrac{100 \times 4.18 \times \mathbf{z}}{1000 \times 0.010}$

**D** $\dfrac{200 \times 4.18 \times (\mathbf{z} + 273)}{1000 \times 0.010}$

Answer: **B**

$$\Delta \boldsymbol{H} = + \frac{\boldsymbol{q}}{\boldsymbol{n_{H_2O}}} = + \frac{\boldsymbol{(100 + 100) \times 4.18 \times z}}{\boldsymbol{1000 \times 0.010}}$$

**10** Phosphorus exists as different allotropes.

The enthalpy change for the conversion from white phosphorus to red phosphorus is –17.6 kJ $mol^{-1}$.

Which statements are correct?

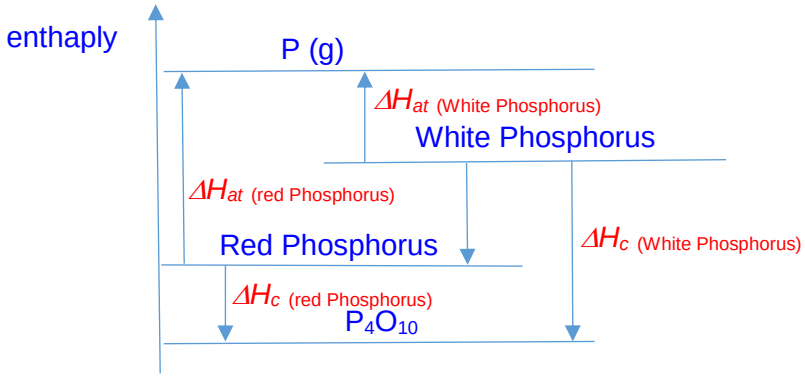
1 The enthalpy change of atomisation of white phosphorus is more endothermic than that of red phosphorus.

2 The enthalpy change of combustion of white phosphorus is more exothermic than that of red phosphorus.

3 White phosphorus is more stable than red phosphorus.

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

Answer: **B**




**11** The rate equation for the reaction $\mathbf{W}(g) + 2\mathbf{X}(g) \rightarrow 3\mathbf{Y}(g)$ is $\text{rate} = k[\mathbf{W}][\mathbf{X}]^2$.

By which factor will the rate of reaction increase when the concentration of **W** and **X** are each increased by a factor of 3?

**A** 9 **B** 27 **C** 81 **D** 108

Answer: **B**
Let the initial concentration of **W** and **X** be a and b mol $dm^{-3}$ respectively
Initial Rate = k[**W**][**X**]$^2$ = kab$^2$
New rate = k (3a)(3b)$^2$ = 27 kab$^2$

**12** Sodium carbonate and hydrochloric acid reacted in separately in two reactions.

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow CO_2(g) + 2NaCl(aq) + H_2O(l)$$

Reaction 1: 1.0 g $Na_2CO_3(s)$ added to 100 $cm^3$ of 0.50 mol $dm^{-3}$ $HCl(aq)$

Reaction 2: 1.0 g $Na_2CO_3(s)$ added to 100 $cm^3$ of 2.0 mol $dm^{-3}$ $HCl(aq)$

Given $\text{rate} = k[HCl]$, which of the following is the same for both reactions?

**A** Average rate of production of $CO_2$

**B** Initial rate of reaction

**C** Total mass of $CO_2$ produced

**D** Total reaction time

Answer: **C**
Since the reaction is 1$^{st}$ order w.r.t HC*l*, change in [HC*l*] affects rate of reaction as well as reaction time.
The sodium carbonate is the limiting reagent in both reactions, hence the amount and mass of $CO_2$ produce is the same.

**13** Two equilibria are shown.

Reaction 1: $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightleftharpoons CaCO_3(s)$

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

The numerical value of $K_c$ for reaction 1 is $2.2 \times 10^{-8}$.
Given the same conditions, what is the numerical value for $K_c$ for reaction 2?

**A** $2.2 \times 10^{-8}$ **B** $2.2 \times 10^{8}$ **C** $4.5 \times 10^{-7}$ **D** $4.5 \times 10^{7}$

Answer: **D**
Reaction 2 is the reverse of reaction 1.
Hence $K_c\ of\ reaction\ 2 = \frac{1}{K_c\ of\ reaction\ 1} = \frac{1}{2.2 \times 10^{-8}} = 4.5 \times 10^{7}$

**14** At 700 ºC, the equilibrium constant for the following reaction is $1.08 \times 10^{8}$.

$$2H_2(g) + S_2(g) \rightleftharpoons 2H_2S(g)$$

Which relationship is always correct for the equilibrium at this temperature?

**A** $[S_2] = 2[H_2S]$ **B** $[S_2] = [H_2S]^2$
**C** $[H_2S]^2 < [H_2]^2[S_2]$ **D** $[H_2S]^2 > [H_2]^2[S_2]$

Answer: **D**
Since $K_c$ is very large, it means the forward reaction is very close to completion. There is more products than reactants.

**15** Which is an example of an Arrhenius acid and Arrhenius base reaction?

**A** $2CH_3COOH(aq) + Ca(OH)_2(aq) \rightarrow Ca(CH_3COO)_2(aq) + 2H_2O(l)$

**B** $CO_2(aq) + 2NaOH(aq) \rightarrow Na_2CO_3(aq) + H_2O(l)$

**C** $2HCl(aq) + Na_2O(s) \rightarrow 2NaCl(aq) + H_2O(l)$

**D** $HCl(g) + NH_3(g) \rightarrow NH_4Cl(g)$

Answer: **A**
An Arrhenius acid dissociates and releases $H^+$ when dissolved in water e.g $HCl(aq)$
An Arrhenius base dissociates and releases $OH^-$ when dissolved in water e.g $Ca(OH)_2(aq)$

**16** The values of ionic product of water, $K_w$, at two different temperatures are given below.

| temperature / ºC | $K_w$ / mol$^2$ dm$^{-6}$ |
|---|---|
| 25 | $1.00 \times 10^{-14}$ |
| 100 | $5.50 \times 10^{-13}$ |

Which of the following statement is true for water at 100 ºC?

**A** $[H^+] > [OH^-]$ **B** $[H^+] < [OH^-]$ **C** pH > 7 **D** pH < 7

Answer**: D**

A higher temperature favour the forward reaction according to the larger $K_w$ value. Hence this means $[H^+]$ will increase to higher than 7.00 x $10^{-7}$ moldm$^{-3}$, causing pH to be less than 7.

$[H^+] = \sqrt{5.50 \times 10^{-13}}$ = 7.42 x $10^{-7}$ moldm$^{-3}$

**17** The table shows the enthalpy change of neutralisation, $\Delta H_{neu}$, for the various acids and bases listed.

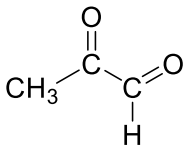
| acid | base | $\Delta H_{neu}$ / kJ mol$^{-1}$ |
|---|---|---|
| hydrobromic acid | sodium hydroxide | –57.0 |
| hypochlorous acid | potassium hydroxide | less exothermic than –57.0 |
| **P** | sodium hydroxide | less exothermic than –57.0 |
| **Q** | potassium hydroxide | –57.0 |

What are **P** and **Q**?

| | **P** | **Q** |
|---|---|---|
| **A** | hydrochloric acid | nitric acid |
| **B** | ethanoic acid | hypochlorous acid |
| **C** | hydrocyanic acid | carbonic acid |
| **D** | ethanoic acid | hydrobromic acid |

Answer: **D**
From the table, it can be deduced that hydrobromic acid is a strong acid since the enthalpy change of neutralisation is –57 kJ mol$^{-1}$. Hypochlorous acid is a weak acid since the enthalpy change of neutralisation is less exothermic than –57 kJ mol$^{-1}$.
Hence, **P** and **Q** must be weak and strong acid respectively.

**18** 2-Oxopropanal is one of the compounds responsible for the characteristic smell of burnt sugar.




2-oxopropanal

How many σ and π bonds are there in a molecule of 2-oxopropanal?

| | σ | π |
|---|---|---|
| **A** | 5 | 2 |
| **B** | 7 | 0 |
| **C** | 8 | 2 |
| **D** | 10 | 0 |

Answer**: C**

**19** The three statements that follow are all true.

Which of these can be explained 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.

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

**Ans: A**

- Statement 1: 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]. Due to its open structure, ice is **less dense** than water and so, **floats** on water.
- 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).
- In benzene, ethanoic acid exists as a dimer. Hence its apparent Mr is 120, instead of 60.

**20** How many dichlorinated structural isomers can be formed by the chlorination of butane in the presence of UV light?

**A** 4 **B** 5 **C** 6 **D** 7

Answer**: C**

**21** Muscalure is a sex hormone found in fruit flies and has the structure below.

$$CH_3(CH_2)_7CH=CH(CH_2)_{12}CH_3$$

Which of the following about muscalure is correct?

**A** It reacts with $LiAlH_4$.

**B** It reacts with 2 moles of $H_2$.

**C** It exists as a pair of *cis-trans* isomers.

**D** It reacts with HBr to give $CH_3(CH_2)_7CH_2CHBr(CH_2)_{12}CH_3$ only.

Answer**: C**
The rest of the statements are incorrect.

- Statement A: $LiAlH_4$ is unable to reduce alkenes.
- Statement B: It reacts with 1 mol of $H_2$, not 2mol.
- Statement D: It reacts with hot acidified $KMnO_4$ to give $CH_3(CH_2)_7CO_2H$ as one of the products

**22** Complete combustion of a sample of a hydrocarbon gave 0.132 g of carbon dioxide and 0.054 g of water. Which of the following formulae could correctly represent this hydrocarbon?

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

1 $CH_2=CH_2$

2 $CH_3CH=CH_2$

3 $CH_3CH=CHCH_3$

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

Answer: **A**

$C_xH_y + (x+y/4)\ O_2 \rightarrow x\ CO_2 + y/2\ H_2O$

Amt. of $CO_2$ = 0.132/44 = 0.003 mol
Amt. of $H_2O$ = 0.054/18 = 0.003 mol

Therefore, x = y/2. y=2x

**23** The following table shows the time taken for the appearance of precipitate after adding ethanolic $AgNO_3$ to three halogen derivatives separately.

| halogen derivative | time for precipitate to appear |
|---|---|
| 2-chloropropane | 10 minutes |
| 2-bromopropane | 2 minutes |
| 2-iodopropane | instantaneous |

Which of the following would be the best explanation for the observation?

**A** The bond polarity of the carbon-halogen bond increases from 2-iodopropane to 2-chloropropane.

**B** The lattice energy of AgX precipitate becomes more exothermic from AgC*l* to AgI.

**C** The carbon–halogen bond strength decreases from 2-chloropropane to 2-iodopropane.

**D** The intermolecular permanent dipole attraction increases from 2-iodopropane to 2-chloropropane.

Answer: **C**

The reaction involves breaking of the C – X bond.

$$RX + H_2O \rightarrow ROH + HX$$

$\therefore$ Rate of hydrolysis depends on strength of C – X bond.

Once the C – X bond is broken, precipitation of AgX(s) occurs.

$$Ag^+(aq) + X^-(aq) \rightarrow AgX(s)$$

The time taken for silver halide precipitates to form indicates the strength of the C – X bond, where X is C*l*, Br or I.

Time taken for ppt. to appear:

2-chloropropane > 2-bromopropane > 2-iodopropane

Bond strength: C – C*l* > C – Br > C – I

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

Infra-red absorptions can be used to identify functional groups in organic compounds. For example, ethyl ethanoate shows absorptions at 1050–1330 $cm^{-1}$ and 1710–1750 $cm^{-1}$ as shown in the *Data Booklet*.

Compound **S** contains four carbon atoms. **S** is heated under reflux with an excess of acidified dichromate(VI) until no further reaction occurs. An organic compound **T** is formed in good yield. Some of the absorptions found in the infra-red spectra of **S** and **T** are described.

**S** has **no** strong absorption between 1670 and 1740 $cm^{-1}$.

**T** has strong absorptions both at approximately 1710 $cm^{-1}$ and at approximately 3400 $cm^{-1}$.

From this information, what could be the structure of **S**?

**A** $HOC(CH_3)_2CHO$

**B** $HOC(CH_3)_2CH_2OH$

**C** $HO(CH_2)_2COCH_2OH$

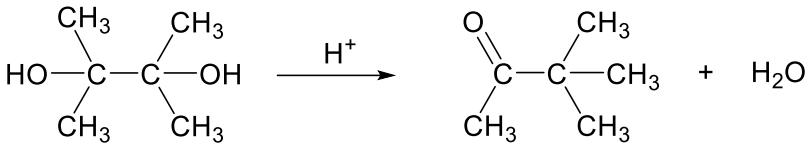
**D** $HO(CH_2)_2CH(OH)CH_2OH$

Answer**: B**

Based on data given for **S** (**no** strong absorption between 1670 and 1740 $cm^{-1}$), absence of aldehydes and ketones in S. *Not Option A or C*.

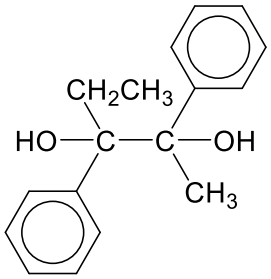
Based on data given for **T** (strong absorptions both at approximately 1710 $cm^{-1}$ and at approximately 3400 $cm^{-1}$), presence of alcohol group even after oxidation. Presence of tertiary alcohol. Thus, **option B is correct**.

**25** The pinacol rearrangement involves the reaction of a diol in acidic conditions to form a carbonyl compound as shown below.



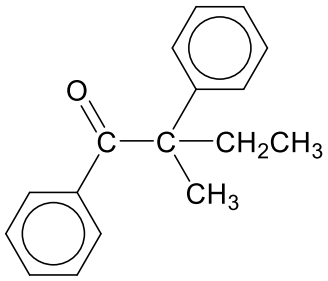

2,3-dimethylbutane-2,3-diol  3,3-dimethylbutan-2-one

Which of the following structural formulae is **not** a product of the pinacol rearrangement of 2,3-diphenylpentane-2,3-diol?

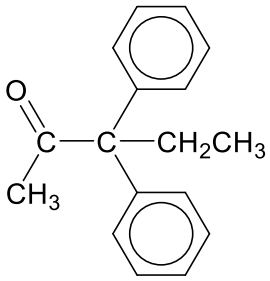



2,3-diphenylpentane-2,3-diol

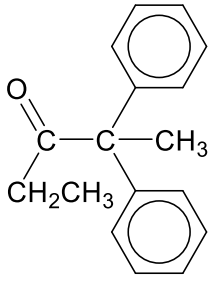
**A**



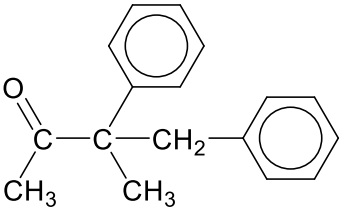

**B**




**C**

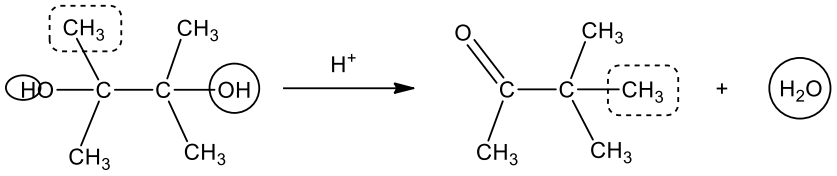



**D**



Answer: **D**

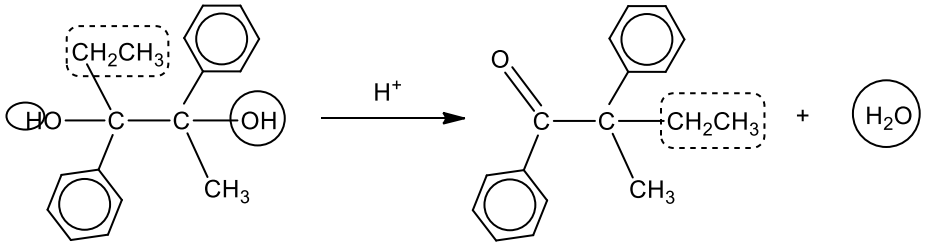
Observe the following pattern in the given equation.



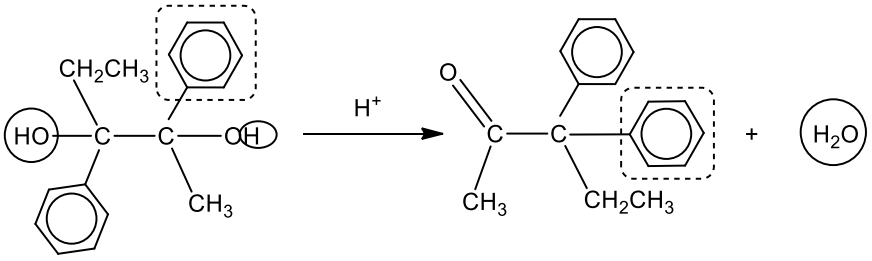

2,3-dimethylbutane-2,3-diol  3,3-dimethylbutan-2-one

By applying the above pattern to 2,3-diphenylpentane-2,3-diol, option **D** is **not** a possible product of this reaction.

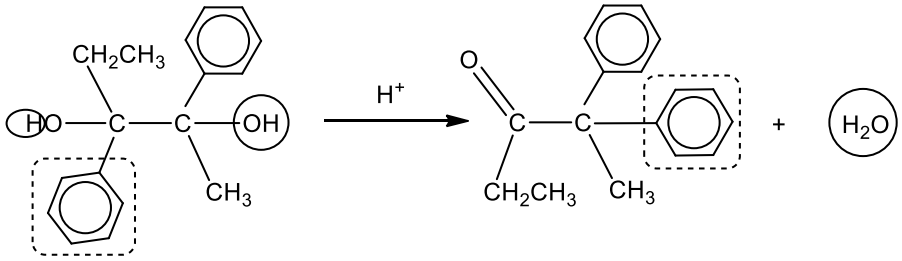
**A** : (×)

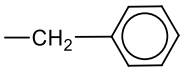



**B** : (×)

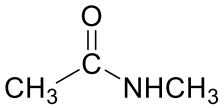



**C** : (×)




**D** : (✓) **Not** a possible product since  group is absent in 2,3-diphenylpentane-2,3-diol.

**26** Which molecules are best used for the synthesis of *N*-methylethanamide, in the presence of DCC?




*N*-methylethanamide

**A** $CH_3COOH$ and $CH_3NH_2$

**B** $CH_3CONH_2$ and $CH_3OH$

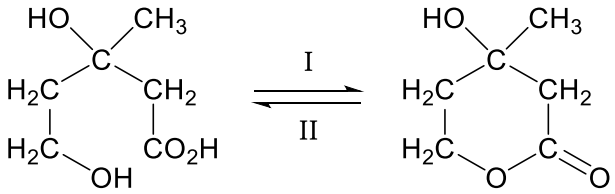
**C** $CH_3CHO$ and $CH_3NH_2$

**D** $CH_3CHO$ and $CH_3Br$

Answer: **A**

To form an amide, the reagents needed are a carboxylic acid and an amine, in the presence of DCC.

**27** Mevalonic acid, 3,5-dihydroxy-3-methylpentanoic acid, is involved in cholesterol formation in the body. It is an oil that occurs as a mixture of the two interchanging molecules shown in the diagram.




What names are used to describe the pair of interchanging reactions I and II respectively?

**A** condensation and addition

**B** condensation and hydrolysis

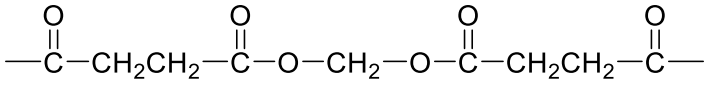
**C** neutralisation and acidification

**D** reduction and addition

Answer: **B**

Reaction I involves forming an ester bond ⇒ condensation
Reaction II involves breaking an ester bond ⇒ hydrolysis

**28** Part of the structure of the polymer is shown below.



Which monomers could be used to make the polymer?

1 $HO_2C-CH_2CH_2-CO_2H$

2 $HO-CH_2-OH$

3 $HO_2C-CH_2CH_2-OH$

4 $HO_2C-CH_2-CO_2H$

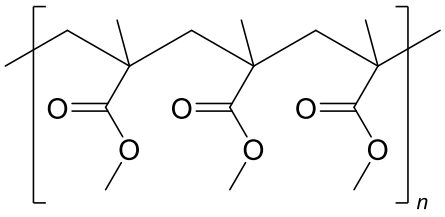
**A** 1 and 2 only **B** 2 and 3 only **C** 3 only **D** 4 only

Answer: **A**

The polymer is formed via condensation polymerisation given the presence of ester linkages. The original monomers were an acid and alcohol.

Looking at the centre segment of the polymer chain, it can be seen that the monomers were made up of a diol and dicarboxylic acid.

**29** Poly(methyl methacrylate) is used to make hard contact lenses. Part of its polymer chain is shown.



Which statement about poly(methyl methacrylate) is correct?

**A** It is a polyester.

**B** It is a condensation polymer.

**C** It is resistant to alkaline hydrolysis.

**D** Its monomer is $CH_2=C(CH_3)CO_2CH_3$.

Answer: **D**

**A:** It has ester linkages but it is not a polyester where the ester linkage is not part of the polymeric chain.
**B:** It is an addition polymer
**C:** The ester linkage can be hydrolysed.

**30** Catalytic converters make use of platinum, rhodium and palladium to speed up the conversion of pollutants into non-toxic emissions.

In 2007, Mazda Motor developed a new generation of catalytic converters that halved the size of metal nanoparticles (10 nm to 5 nm) utilised in conventional ones. A key benefit of this new technology was cost savings for car manufacturers, since these metals are expensive due to their limited supplies.

Based on your own knowledge and the information above, which statement about nanoparticle-based catalytic converters is **not** correct?

**A** Nanoparticles are good catalysts due to its large surface area to volume ratio.

**B** Less of these metals is needed to produce these catalytic converters, resulting in cost savings.

**C** With the reduced size of nanoparticles, they could be more safely used in catalytic converters because it has less harmful effects on human health.

**D** The metal nanoparticles catalyse the conversion of nitrogen oxides and hydrocarbons into nitrogen and carbon dioxide gases respectively.

Answer: **C**

**A:** The smaller the size of the particle, the larger the surface area to volume ratio.

**B:** With the reduced size of nanoparticles, due to the increased surface area to volume ratio, a larger proportion of the metal is present on the surface of the given catalyst, leading to greater no. of active sites and hence increasing catalytic efficiency.

Less metal is needed for a smaller size nanoparticle to produce the same surface area over the catalyst for the same catalytic efficiency.

**C:** Smaller nanoparticles pose a more serious issues since they could penetrate even more in-depth into the interior of the body tissues and cell membranes, which can cause potential harmful effects within the human body.

**D:** Correct. **Pd(s) & Pt(s)** promote the **oxidation** of CO and unburnt hydrocarbons to $CO_2$ & $H_2O$. **Rh(s)** promotes the **reduction** of NO to $N_2$.

**2019 H1 P1 Answer :**

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