ST JOSEPH'S INSTITUTION
PRELIMINARY EXAMINATION 2023
(YEAR 4)

CANDIDATE NAME			
CLASS		INDEX NUMBER	

CHEMISTRY **6092/01**

Paper 1 **29 August 2023**

Additional Materials: **1 hour**
Multiple Choice Answer Sheet **(08:05 – 09:05)**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, index number and class on the Answer Sheet in the spaces provided.

There are **forty** 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.
A copy of the Periodic Table is printed on page 2 of this question paper.
The use of an approved scientific calculator is expected, where appropriate.

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

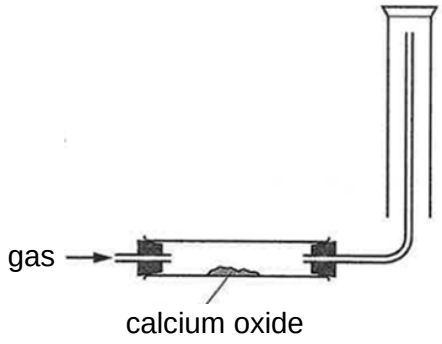
lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

1 A gas dissolves readily in water, turns moist blue litmus paper red, and is denser than air.

Which set-up should be used to dry and collect this gas?

A



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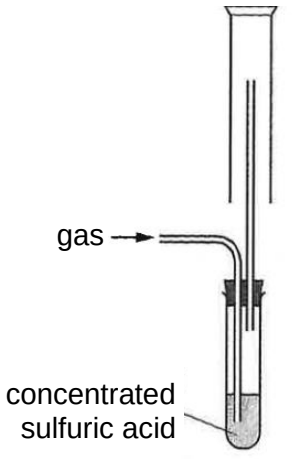

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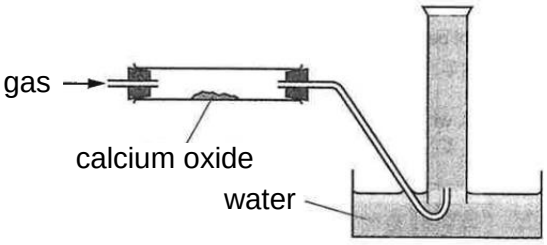

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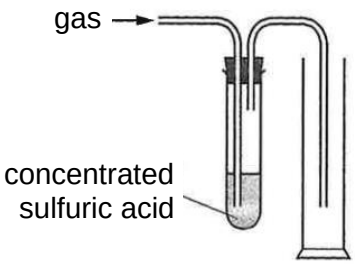


2 Leo accidentally contaminated a sample of pure lead(II) sulfate with a small amount of lead(II) carbonate.

Which sequence of steps would help Leo re-obtain pure lead(II) sulfate?

A add excess hydrochloric acid, filter, crystallise, then rinse and dry

B add excess hydrochloric acid, filter, then rinse and dry

C add excess nitric acid, filter, crystallise, then rinse and dry

D add excess nitric acid, filter, then rinse and dry

3 Excess aqueous ammonia is added to a solution containing aluminium ions, copper(II) ions and zinc ions. The mixture is then filtered.

Which ion(s) will be found in the resulting residue?

A aluminium ions

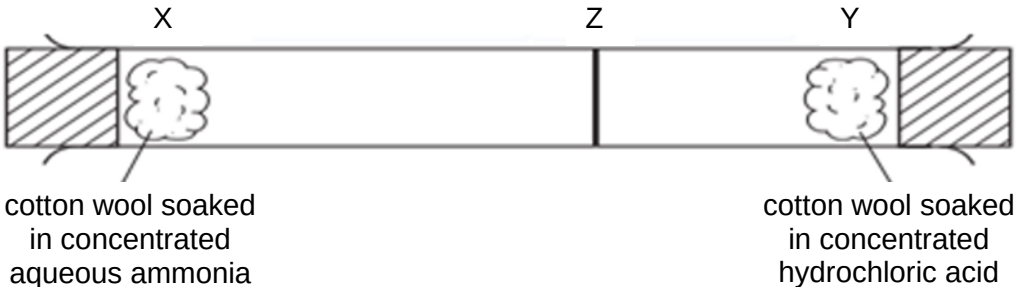
B aluminium ions and zinc ions

C copper(II) ions

D copper(II) ions and zinc ions

4 Billy studied the rate of diffusion of ammonia gas and hydrogen chloride gas using the set-up shown below.

A white ring of solid was formed at position Z.



Billy repeated the experiment using concentrated hydrobromic acid instead of hydrochloric acid. A white ring of solid was formed at another position, W.

Which statement is **not** true?

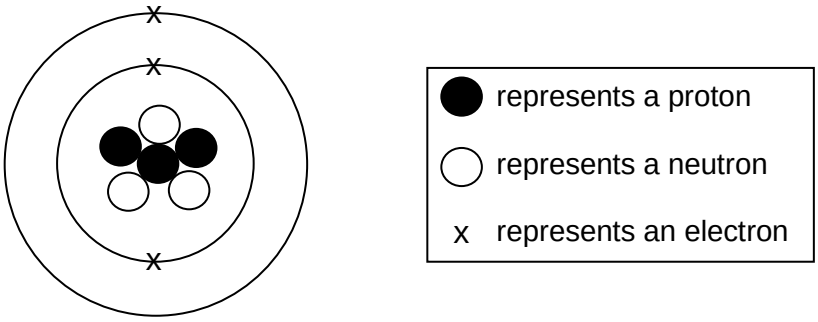
A Ammonia gas diffuses faster than hydrogen chloride gas.

B Conducting both experiments at a higher temperature will not change positions W and Z.

C Hydrogen bromide gas is denser than hydrogen chloride gas.

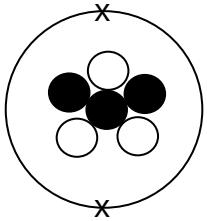
D Position W is located between positions X and Z.

5 The diagram shows the atomic structure of an element.



Which diagram below shows the atomic structure of an isotope of this element?

A



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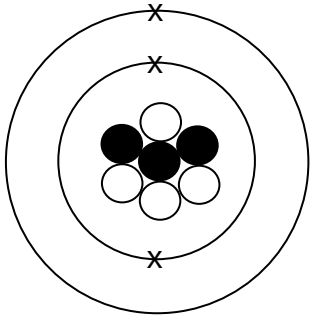

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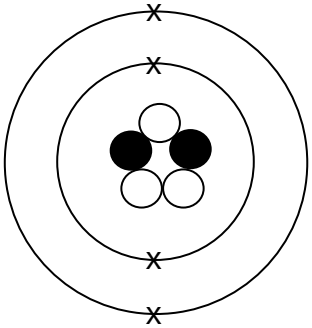

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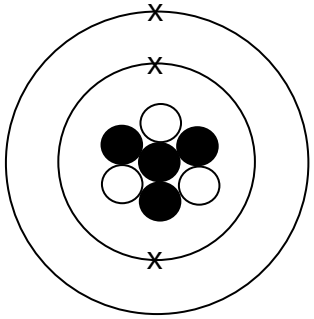


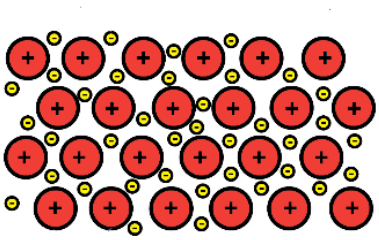
6 A compound contains metal P and non-metal Q.

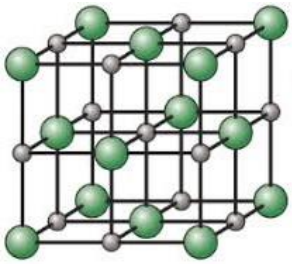
In the lattice structure, each positive ion is surrounded by four negative ions and each negative ion is surrounded by eight positive ions.

Which ions are present in the compound and what is its formula?

	formula of ion of P	formula of ion of Q	formula of compound
A	P^{+}	Q^{2-}	P_2Q
B	P^{2+}	Q^{-}	PQ_2
C	P^{-}	Q^{2+}	QP_2
D	P^{2-}	Q^{+}	Q_2P

7 The structures of two materials are shown below.





Which statement is correct?

A Both substances are hard and rigid.

B Both substances are pure compounds.

C Both substances can be electrolysed in the liquid state.

D Both substances contain particles held together by strong electrostatic forces of attraction.

8 What is the mass of one molecule of hydrogen?

A 1.7×10^{-24} g

B 3.3×10^{-24} g

C 1.0 g

D 2.0 g

9 Iron(II) sulfate is commonly used to treat iron-deficiency anaemia.

A 5.00 g tablet containing iron(II) sulfate was dissolved in water. When excess barium chloride solution was added, 2.89 g of barium sulfate precipitated out.

What is the percentage by mass of iron(II) ions present in the tablet?

A 13.9 %

B 14.5 %

C 37.7 %

D 84.5 %

10 Compound X is made up of carbon, hydrogen and oxygen.

It contains 54.55% of carbon and 9.09% of hydrogen by mass.

Which of the following could compound X be?

A CH_3OH

B C_2H_5COOH

C C_3H_7COOH

D C_4H_9OH

11 The compound S_2O_7 reacts with water to produce sulfuric acid and oxygen gas.

$$2S_2O_7 + 4H_2O \rightarrow 4H_2SO_4 + O_2$$

What volume of oxygen, measured at room temperature and pressure, is evolved when 0.704 g of S_2O_7 reacts with excess water?

A 0.0240 dm^3

B 0.0480 dm^3

C 0.0960 dm^3

D 0.192 dm^3

12 In an electrolysis experiment, the same amount of charge deposited 32.5 g of zinc and 10.2 g of vanadium.

What was the charge on the vanadium ion?

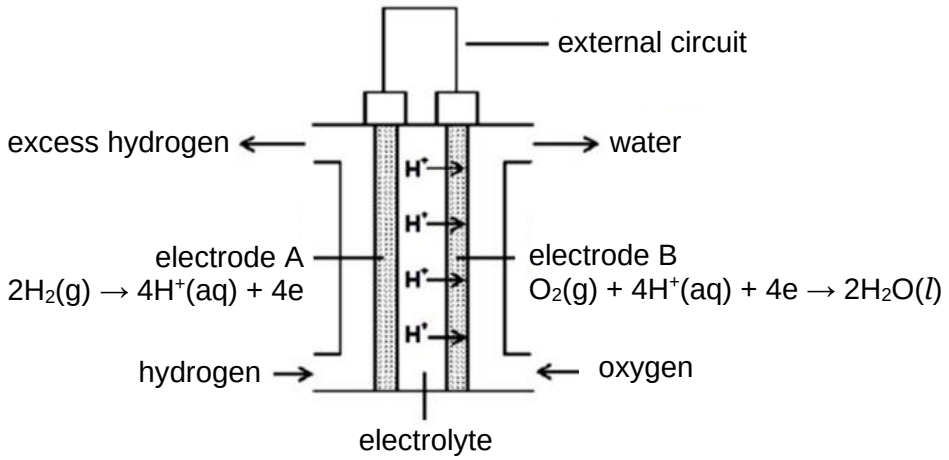
A 2+

B 3+

C 4+

D 5+

13 The hydrogen-oxygen fuel cell generates electricity under a continuous supply of hydrogen gas and oxygen gas, as shown in the diagram.



Which of the following correctly shows the direction of electron flow and a suitable electrolyte which can be used in the fuel cell?

	direction of electron flow	electrolyte
A	from electrode A to B	aqueous sodium hydroxide
B	from electrode B to A	aqueous sodium hydroxide
C	from electrode A to B	dilute sulfuric acid
D	from electrode B to A	dilute sulfuric acid

14 Which process is endothermic?

A $C(s) + O_2(g) \rightarrow CO_2(g)$

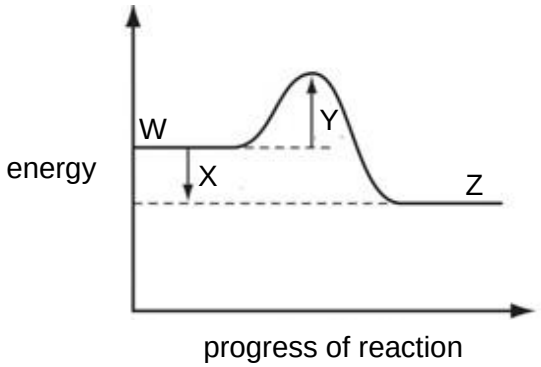
B $H_2O(g) \rightarrow H_2O(l)$

C $HCl(g) \rightarrow H(g) + Cl(g)$

D $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

15 The energy profile diagram for the Haber process is shown below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$



Which statement is correct?

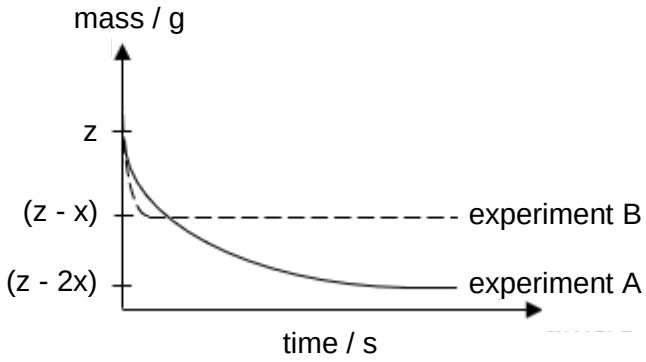
A The activation energies of the forward and reverse reactions are equal to Y.

B The activation energy of the reverse reaction is greater than that of the forward reaction.

C The enthalpy change of the forward reaction is equal to (W – Z).

D The reverse reaction is exothermic.

16 In experiments A and B, excess calcium carbonate was added to dilute hydrochloric acid. The graphs show how the masses of both reaction mixtures varied with time.



In experiment A, 100 g of calcium carbonate lumps was added to 100 cm^3 of 1.0 mol/dm^3 dilute hydrochloric acid.

Which change to the experimental conditions will give the graph for experiment B?

A using 50 g of calcium carbonate powder

B using 12.5 cm^3 of 2.0 mol/dm^3 dilute sulfuric acid

C using 25 cm^3 of 2.0 mol/dm^3 dilute hydrochloric acid

D using 100 cm^3 of 0.5 mol/dm^3 dilute hydrochloric acid

17 Which process is a redox reaction?

A formation of ammonium sulfate from aqueous ammonia and sulfuric acid

B formation of calcium oxide from calcium carbonate

C formation of silver chloride from aqueous silver nitrate and aqueous sodium chloride

D formation of sulfuric acid from sulfur dioxide

18 Which statement about a dilute solution of a strong acid, HX, is **incorrect**?

A The solution contains OH^- ions.

B The solution contains a low concentration of HX molecules.

C The solution contains more water molecules than hydrogen ions.

D The solution turns blue litmus paper red.

19 Excess magnesium powder is added to 25 cm^3 of 0.10 mol/dm^3 solutions of three different acids.

experiment	acid
1	methanoic acid
2	hydrochloric acid
3	sulfuric acid

Which statement is correct?

A Experiment 1 produced the smallest volume of gas.

B Experiments 1 and 2 produced the same volume of gas.

C Experiments 1 and 2 had the same speed of reaction.

D Experiments 2 and 3 had the same speed of reaction.

20 In an experiment, 4.0 cm^3 of 1.0 mol/dm^3 aqueous copper(II) sulfate and 8.0 cm^3 of 1.0 mol/dm^3 aqueous sodium carbonate are mixed.

After the completion of the reaction, a particular step is carried out, and an observation is made accordingly.

Which row shows the step performed and the corresponding observation?

	step	observation
A	add a few drops of acidified barium nitrate	no visible reaction
B	add a few drops of aqueous sodium hydroxide	light blue precipitate formed
C	filter the mixture	filtrate is a light blue solution
D	filter the mixture, then add a few drops of dilute acid to filtrate	effervescence of colourless, odourless gas

21 An aqueous solution of a chloride is made by reacting dilute hydrochloric acid with the hydroxide of metal M.

$$M(OH)_2(s) + 2HCl(aq) \rightarrow MCl_2(aq) + 2H_2O(l)$$

Which metal **cannot** be M?

A copper

B iron

C lead

D magnesium

22 Which statement correctly describes the general trend of Period 3 elements from sodium to chlorine?

A The electrical conductivities of the elements increase.

B The elements become stronger reducing agents.

C The melting points of their oxides increase then decrease.

D The oxides of the elements show a trend from acidic to amphoteric and then to basic.

23 Which statement about halogens is **incorrect**?

A Bromine exists as a reddish-brown liquid at room temperature.

B Chlorine forms a silver salt that is insoluble in water.

C Fluorine has a lower boiling point than iodine.

D Iodine gas is obtained when chlorine gas is bubbled into aqueous potassium iodide.

24 Which pair of elements, when reacted together, would give the most violent reaction?

A caesium and fluorine

B lithium and iodine

C potassium and bromine

D sodium and chlorine

25 Which statement about transition elements is correct?

A A transition element has variable oxidation states because it can lose different numbers of electrons into the 'sea of electrons' in the metallic lattice.

B All coloured compounds contain transition elements.

C The highest oxidation state that a transition element can show is +6.

D Transition elements have high melting points due to the strong attraction between positive ions and 'sea of electrons'.

26 Which statement about metals and their compounds is **incorrect**?

A A lower temperature is needed to reduce copper(II) oxide to copper than to reduce zinc oxide to zinc.

B Heating magnesium powder with iron(III) oxide produces iron and a white smoke containing magnesium oxide.

C The addition of lead to aqueous zinc nitrate is an example of a metal displacement reaction.

D Unreactive metals are likely to be found as elements in soils or rocks.

27 Metal Z and its compounds undergo the following reactions.

- The carbonate of Z decomposes on heating to form a black solid.
- The oxide of Z can be reduced by both carbon and hydrogen gas.
- Z reacts fairly quickly when added to dilute sulfuric acid.
- Z displaces silver from aqueous silver nitrate solution.

What could metal Z be?

A aluminium
B copper
C iron
D zinc

28 Some statements about iron and steel are shown below.

1 High carbon steel is more brittle than low carbon steel.
2 Iron can be obtained by electrolysis of its molten ore.
3 Limestone reacts with silicon dioxide in the iron from the blast furnace.
4 Recycling iron uses less energy than extracting from its ore.

Which statements are correct?

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

29 Which pair of gases are involved in the formation of acid rain?

A CO and CO_2
B CH_4 and NO_2
C NO_2 and CO
D SO_2 and NO_2

30 How many of the following processes will lead to an increase in greenhouse gas emissions?

- decomposition of vegetation
- fermentation of glucose
- photosynthesis
- polymerisation
- respiration

A 1

B 2

C 3

D 4

31 Ethanol is either a reactant or a product in the following reactions.

1 combustion of ethanol

2 conversion of ethene to ethanol

3 fermentation of glucose

4 oxidation of ethanol to ethanoic acid

In which reactions is water present either as a reactant or a product?

A 3 only

B 1 and 2 only

C 1, 2 and 4 only

D 1, 3 and 4 only

32 One mole of each of the compounds below is completely combusted.

$C_5H_{12}O$ C_6H_{12} C_6H_{14} $C_6H_{14}O$

How many compounds need exactly nine moles of oxygen for complete combustion?

A 1

B 2

C 3

D 4

33 When a molecule of a hydrocarbon contains more atoms, burning it produces a greater amount of energy.

Which of the following shows the molecules arranged in order of increasing energy released?

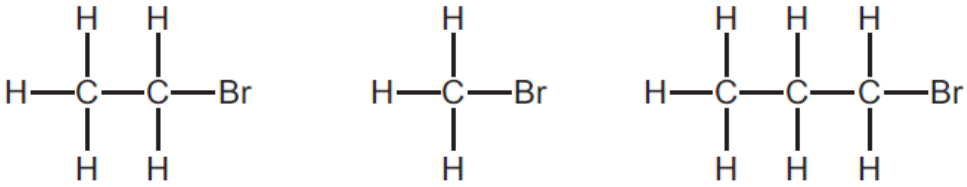
A ethene, ethane, methane

B ethene, methane, ethane

C methane, ethane, ethene

D methane, ethene, ethane

34 The structures of three compounds are shown.



Which statement best explains why these three compounds have similar chemical properties?

A They are formed by addition reactions.

B They are made up of the same elements.

C They are saturated hydrocarbons.

D They have the same functional group.

35 The cracking of the hydrocarbon $C_{12}H_{26}$ is represented by the equation below.

$$C_{12}H_{26} \rightarrow X + Y$$

Which statement is correct?

A If X is C_6H_{12}, Y can react with aqueous bromine in the absence of light.

B If X is $C_{10}H_{22}$, Y can be polymerised and used to manufacture clingfilm.

C If X is hydrogen gas, Y is a saturated molecule.

D X and Y can be structural isomers.

36 Which alkenes produce only one alcohol on addition of steam?

1 $CH_3CH=CH_2$

2 $CH_3CH_2CH=CH_2$

3 $CH_3CH=CHCH_3$

4 $(CH_3)_2C=C(CH_3)_2$

A 2 only

B 3 only

C 1 and 2 only

D 3 and 4 only

37 Q is an organic compound that forms a gas when added to aqueous sodium carbonate.

Which statement about Q is true?

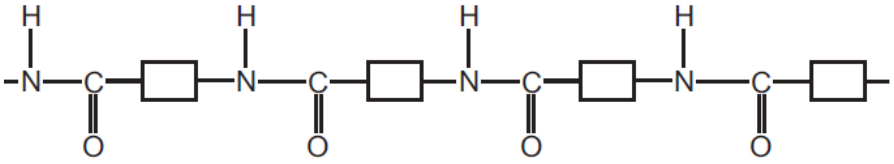
A It can be formed by reducing ethanol.

B It can form an ester with ethanoic acid.

C It can have the empirical formula C_2H_4O.

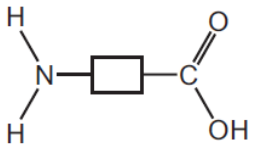
D It can have the molecular formula C_2H_4O.

38 The partial structure of a polymer is shown below.



Which monomers would form the above polymer?

1



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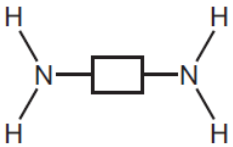

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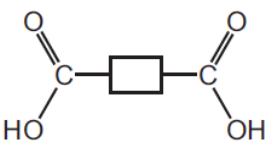


A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

39 Which esters have the molecular formula $C_3H_6O_2$?

1 methyl ethanoate
2 ethyl propanoate
3 ethyl methanoate
4 propyl methanoate

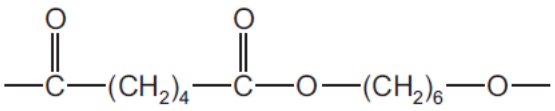
A 1 and 3 only
B 1 and 4 only
C 2 and 4 only
D 3 and 4 only

40 Polymer P is formed from two different monomers that

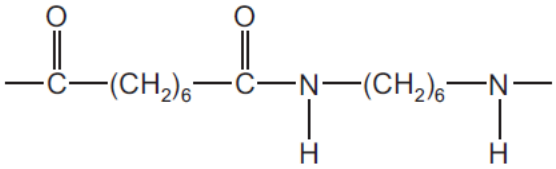
- contain six carbon atoms each,
- do not contain the alcohol functional group.

What is the partial structure of P?

A



B



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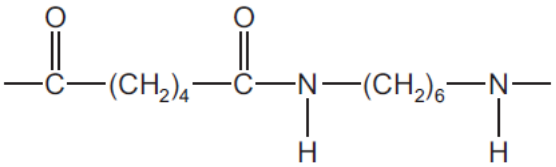

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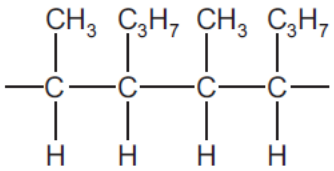

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