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CLASS:	
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YISHUN TOWN SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2023

SEC 4 EXPRESS

CHEMISTRY

(6092/1)

DATE : 30 Aug 2023

DAY : Wednesday

DURATION: 1 hr

MARKS: 40 marks

ADDITIONAL MATERIALS

Multiple Choice Answer Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces provided at the top of this page.

There are forty questions. 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. Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

INFORMATION FOR CANDIDATES

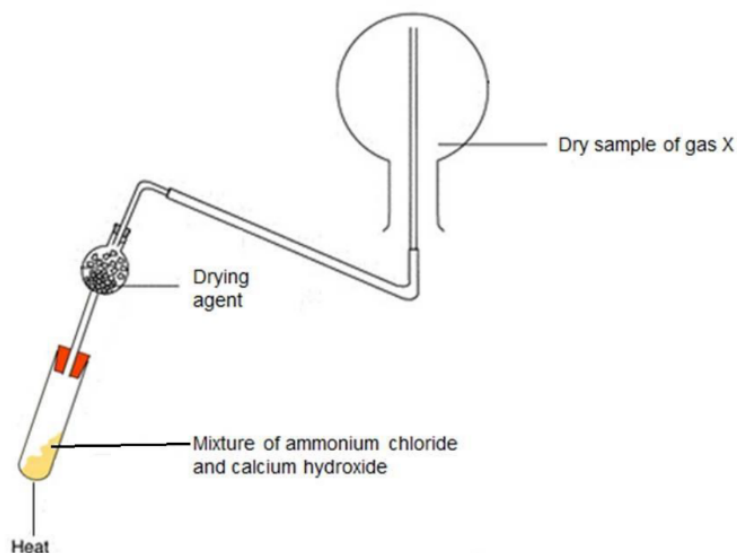
Any rough working should be done in this booklet.

You may use an approved calculator.

A copy of the Periodic Table is printed on the last page.

This question paper consists of **16** printed pages

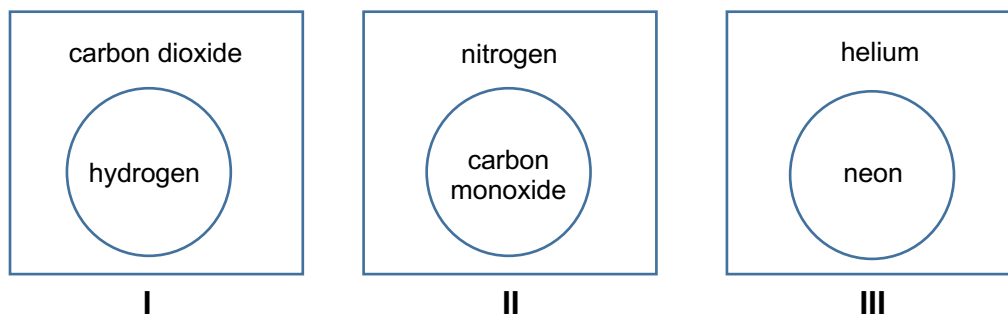
1 A student wanted to collect a dry sample of gas **X** using the reactants and apparatus below.



What is gas **X** and a suitable drying agent that can be used?

- | | <u>Gas X</u> | <u>Drying agent</u> |
|----------|-------------------|----------------------------|
| A | hydrogen chloride | calcium oxide |
| B | ammonia | concentrated sulfuric acid |
| C | hydrogen chloride | concentrated sulfuric acid |
| D | ammonia | calcium oxide |

- 2** Three balloons are placed inside plastic containers containing different gases at room temperature and pressure as shown below.



Which correctly describes the balloon in each set up after a while?

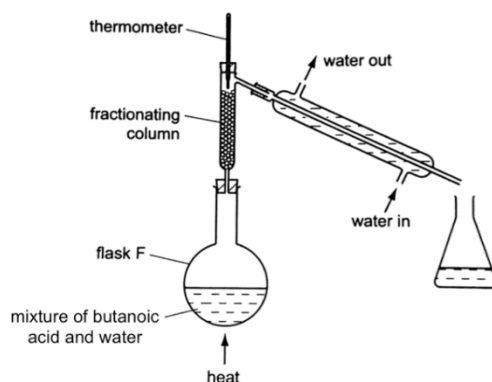
	I	II	III
A	becomes bigger	remains the same	deflates
B	becomes bigger	becomes bigger	becomes bigger
C	deflates	remains the same	becomes bigger
D	deflates	becomes bigger	becomes bigger

- 3 The atmosphere of Venus contains mainly oxygen, argon and nitrogen. The melting and boiling points of these gases are shown in the table below.

gas	melting point / °C	boiling point / °C
oxygen	-219	-183
argon	-189	-186
nitrogen	-210	-196

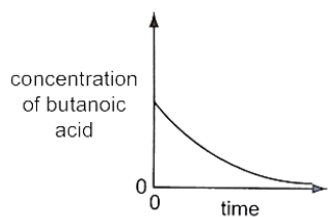
What temperature should the sample of air be decreased to in order to obtain only liquid oxygen?

- A** -180°C **B** -185°C
C -187°C **D** -198°C
- 4 The apparatus shown is used to distil butanoic acid (boiling point 164°C) from a mixture of butanoic acid and water.

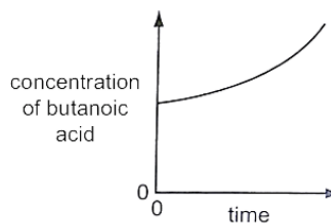


Which graph best shows the change in the concentration of the butanoic acid in flask F during the distillation process?

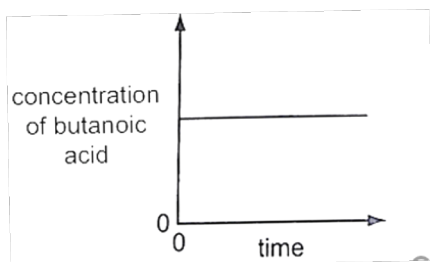
A



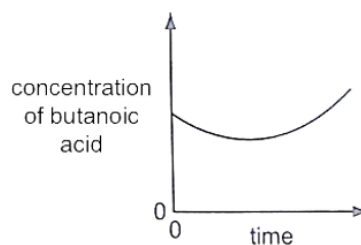
B



C



D



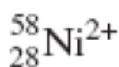
5 Which solution when added to both the reagents below will produce a gas?

- ☐ Sodium carbonate
- ☐ Aqueous sodium hydroxide with aluminium foil

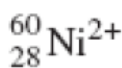
A dilute nitric acid
C dilute sulfuric acid

B aqueous ammonium nitrate
D aqueous potassium sulfate

6 Ions of two isotopes of nickel are shown below. They are labelled as **X** and **Y**.



X

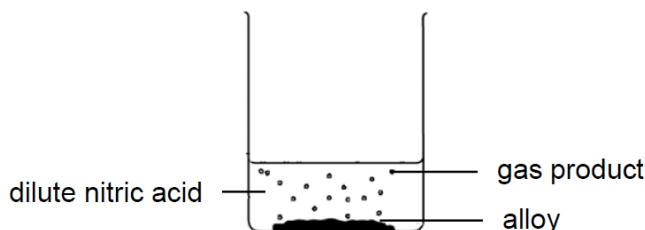


Y

Which statement is correct about these ions?

- A** Both ions have the same number of electrons but different number of neutrons.
B In both ions, there are more electrons than protons.
C Ion **X** has the same mass as ion **Y**.
D Each ion has more protons than neutrons in its nucleus.

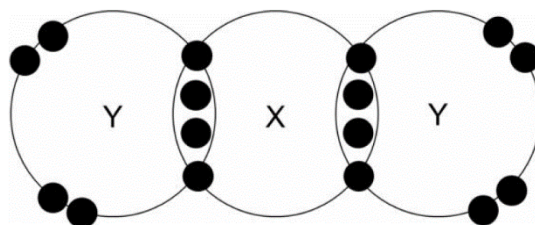
7 An alloy of iron and carbon was added to a beaker of dilute nitric acid as shown in the diagram below.



Which row correctly shows the type of particles present in the substances as shown in the diagram?

	iron	carbon	dilute nitric acid	gas product
A	ions and electrons	atoms	ions and molecules	molecules
B	ions	molecules	ions	molecules
C	ions	molecules	ions and molecules	atoms
D	ions and electrons	atoms	ions	atoms

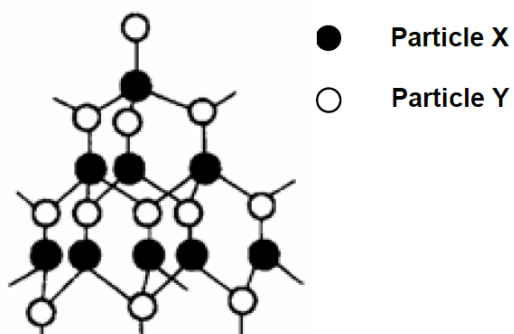
- 8 The outer electronic structure of a molecule is shown below.



What could elements **X** and **Y** be?

	X	Y
A	magnesium	oxygen
B	carbon	oxygen
C	lead	oxygen
D	silicon	chlorine

- 9 A substance has the following structure.

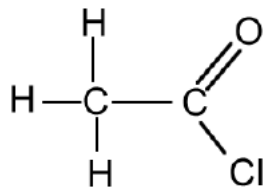


Which of the following statements about this structure are correct?

- I Particle **X** may be a silicon atom.
- II This is a simple molecular compound with strong covalent bonds between atoms.
- III This substance is soluble in organic solvents.
- IV This substance is stable to heat.

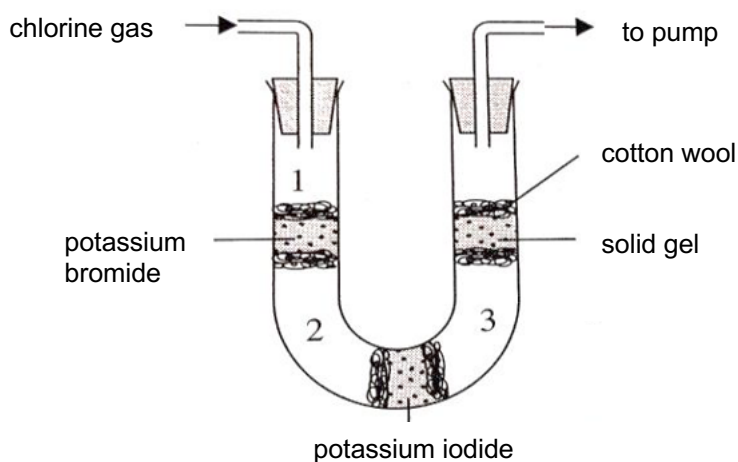
A	I and II only	B	I and IV only
C	II and III only	D	II and IV only

- 10 The diagram shows the structure of ethanoyl chloride.



What is the total number of valence electrons **not** used for bonding?

- A 5
B 10
C 14
D 26
- 11 Gaseous chlorine was passed through the following apparatus. The apparatus was continuously heated.



What observations would be made at regions 1, 2 and 3?

	Region 1	Region 2	Region 3
A	reddish brown gas	black solid	violet gas
B	reddish brown gas	violet gas	black solid
C	yellow gas	reddish brown gas	violet gas
D	yellow gas	reddish brown gas	black solid

- 12** **P** is a Group I element. What would happen when a small piece of **P** is put into a bowl that contains water and a few drops of litmus solution?

- I Heat is released.
- II An electrolyte is formed.
- III The solution turns blue.
- IV A gas is given off.

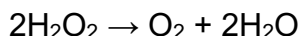
- | | |
|-----------------------------|----------------------------|
| A I and III only | B III and IV only |
| C I, III and IV only | D I, II, III and IV |

- 13** In an experiment, 1 cm³ of a gaseous hydrocarbon, **Z**, requires 4 cm³ of oxygen for complete combustion to give 3 cm³ of carbon dioxide. All gas volumes are measured at r.t.p.

Which formula represents **Z**?

- | | |
|--|--|
| A C ₂ H ₂ | B C ₂ H ₄ |
| C C ₃ H ₄ | D C ₃ H ₈ |

- 14** 68 g of impure hydrogen peroxide decomposes in the presence of manganese (IV) oxide to give 1.2 dm³ of oxygen gas as follows.



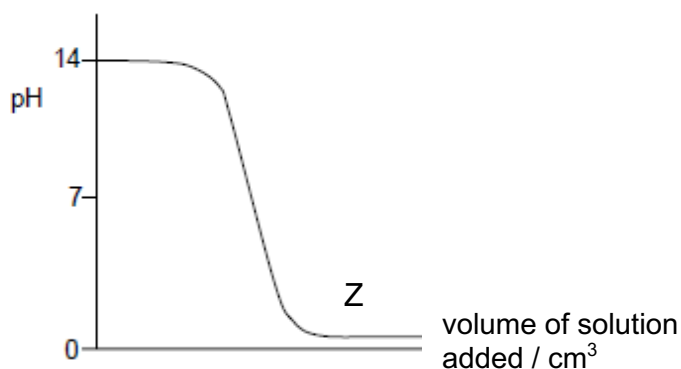
What is the percentage purity of the hydrogen peroxide?

- | | |
|----------------|----------------|
| A 2.5% | B 5.0% |
| C 10.0% | D 15.0% |

- 15** A chloride of iron contains 55.9% of chlorine by mass. What is the empirical formula of this chloride?

- | | |
|--|----------------------------|
| A Fe ₂ Cl ₆ | B FeCl |
| C FeCl ₂ | D FeCl ₃ |

- 16 The graph shows how the pH changes in a reaction between an acid and an alkali.

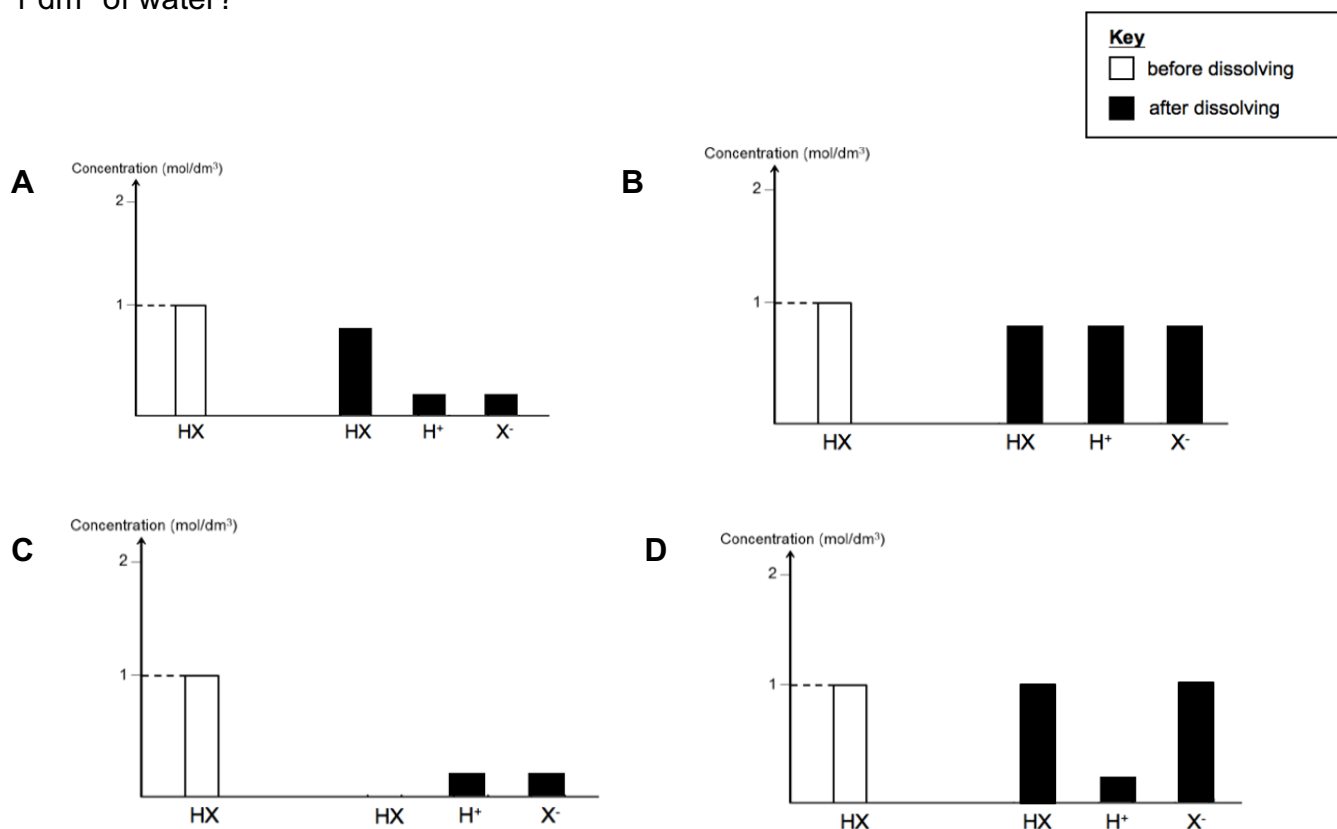


What conclusions can be deduced from the graph?

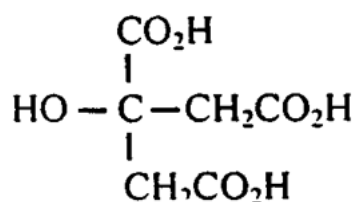
- 1 An acid is added to a fixed volume of an alkali.
- 2 Only salt and water are present at part Z of the graph.
- 3 Neutralisation occurs at about pH 7.
- 4 A weak acid was added to a strong alkali.

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

- 17 Which graph shows the solution formed when one mole of a **weak acid**, HX is dissolved in 1 dm³ of water?



18 The structure below is citric acid.



How many moles of sodium hydroxide are needed to neutralise one mole of citric acid?

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

19 Which of these sequences of reaction produces the best yield of calcium sulfate?

- A** Adding dilute nitric acid to calcium carbonate followed by dilute sulfuric acid.
B Mixing solid calcium nitrate and solid potassium sulfate.
C Addind calcium carbonate to dilute sulfuric acid.
D Adding calcium oxide solid to dilute sulfuric acid.

20 Which statement about metals and their compounds is **not** correct?

- A** Unreactive metals are likely to be found as elements in soil or rocks.
- B** Metals low in the reactivity series are generally extracted from their oxides by heating with carbon.
- C** Heating magnesium with iron (III) oxide produces iron and magnesium oxide.
- D** A higher temperature is needed to reduce copper (II) oxide to copper than zinc oxide to zinc by hydrogen.

21 A metal consists of a lattice of positive ions in a 'sea of electrons'.

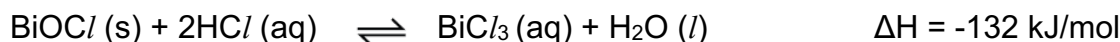
What happens to the electrons and positive ions in a metal wire when an electric current is passed through it?

	electrons	positive ions
A	replaced by new electrons	replaced by new ions
B	replaced by new electrons	unchanged
C	unchanged	replaced by new ions
D	unchanged	unchanged

22 Steel is an alloy of iron with a very small percentage of carbon. Which statement is **incorrect**?

- A** An increase in the percentage of carbon makes the steel more brittle.
- B** A decrease in the percentage of carbon makes the steel less malleable.
- C** Carbon disrupts the orderly arrangement of iron.
- D** Iron atoms are of different size from carbon atoms.

23 Bismuth (III) oxychloride dissolves in concentrated hydrochloric acid to give a colourless solution of bismuth (III) chloride. This reaction is reversible.



The activation energy for the forward reaction is 45 kJ/mol.

What is the activation energy for the reverse reaction?

- | | | | |
|----------|-------------|----------|-------------|
| A | - 45 kJ/mol | B | +87 kJ/mol |
| C | - 87 kJ/mol | D | +177 kJ/mol |

24 Which statements about the Haber Process are true?

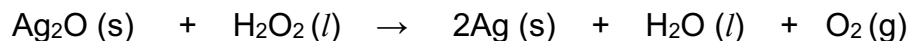
- 1 Nitrogen is reduced to form ammonia.
- 2 Hydrogen is obtained from the fractional distillation of air.
- 3 A high temperature will increase the yield of ammonia
- 4 A high pressure will increase the yield of ammonia

- | | | | |
|----------|---------|----------|---------|
| A | 2 and 4 | B | 3 and 4 |
| C | 2 and 3 | D | 1 and 4 |

25 Which changes include both oxidation and reduction?

- A** $\text{C} \rightarrow \text{CO} \rightarrow \text{CO}_2$
- B** $\text{N}_2 \rightarrow \text{NH}_3 \rightarrow \text{NO}$
- C** $\text{PbO}_2 \rightarrow \text{PbO} \rightarrow \text{Pb}$
- D** $\text{Fe} \rightarrow \text{FeCl}_2 \rightarrow \text{FeCl}_3$

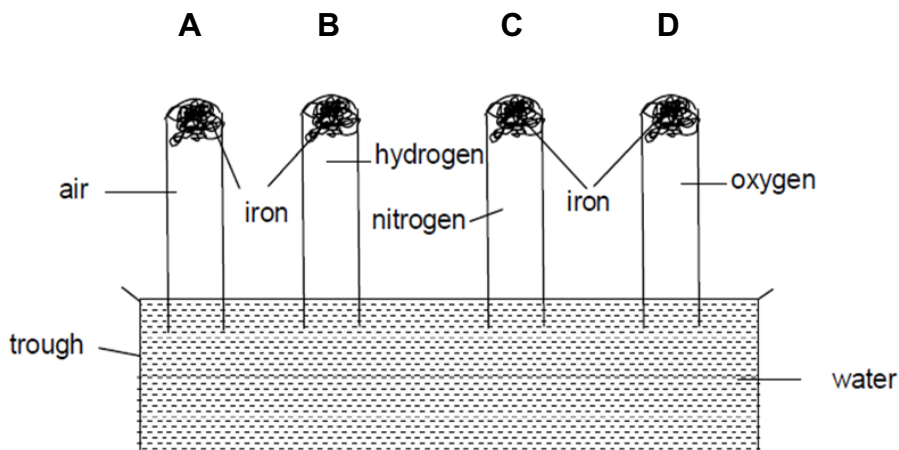
26 Hydrogen peroxide, H_2O_2 , reacts with silver oxide according to the following equation.



In this reaction, what is hydrogen peroxide behaving as?

- | | | | |
|----------|------------------|----------|---------------------|
| A | An acid | B | An oxidizing agent |
| C | A reducing agent | D | A dehydrating agent |

- 27 An experiment was set up as shown in the diagram below. Which tube will have the highest water level after one month?



- 28 Diesel and petrol are commonly used as fuels for cars. The combustion of these fuels produces air pollutants. The table below shows the mass of air pollutants found in exhaust fumes when 1 kg of each fuel is combusted under identical conditions.

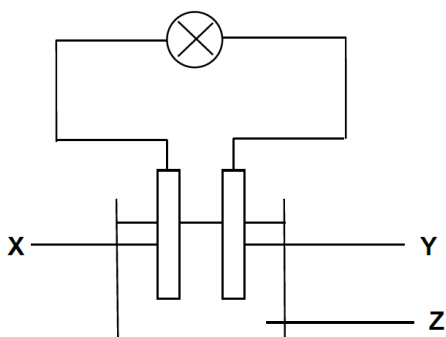
air pollutant produced	mass of air pollutant after diesel is combusted / g	mass of air pollutant after petrol is combusted / g
carbon monoxide	15	300
unburnt hydrocarbons	20	25
oxides of nitrogen	95	40

What can be inferred from the data given in the table?

- A Burning of petrol contributes more towards acid rain.
 B Petrol requires less oxygen for complete combustion.
 C Combustion of petrol is more exothermic than that of diesel.
 D A diesel engine has a higher temperature than a petrol engine.
- 29 10 g each of zinc and copper powder were burnt in excess oxygen. Which row correctly states the volume of oxygen reacted and the rate of the reaction?

	volume of oxygen reacted	rate of reaction
A	same for both	faster with zinc
B	smaller with zinc	faster with zinc
C	smaller with zinc	faster with copper
D	smaller with copper	faster with zinc

- 35 A simple cell was set up to light up a bulb as shown in the diagram below.



What should **X**, **Y** and **Z** be for the bulb to light up the brightest?

	X	Y	Z
A	magnesium	iron	ethanoic acid
B	magnesium	iron	sulfuric acid
C	magnesium	zinc	ethanoic acid
D	magnesium	zinc	sulfuric acid

- 36 How many of the statements below correctly describe the petroleum gas fraction obtained after crude oil undergoes fractional distillation?

- ☐ Its molecules are hydrocarbons.
- ☐ Its molecules have a variable number of carbons.
- ☐ The fraction has a fixed boiling point.
- ☐ The fraction is collected below petrol.

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

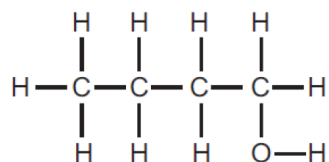
- 37 Compound **X** has the following properties.

- ☐ **X** can be made by a fermentation process.
- ☐ **X** when added to acidified potassium manganate (VII), forms **Y**.
- ☐ **X** can react with **Y** to form **Z** and water.

To which homologous series do **X**, **Y** and **Z** belong?

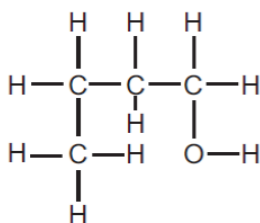
	X	Y	Z
A	alcohol	carboxylic acid	ester
B	alcohol	ester	carboxylic acid
C	carboxylic acid	alcohol	ester
D	carboxylic acid	ester	alcohol

38 Compound **Q** has the structure shown.

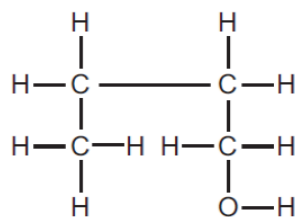


Which structure is an isomer of **Q**?

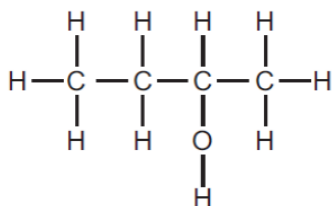
A



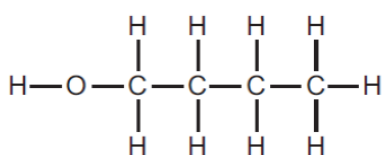
B



C



D



39 The hydrocarbon $\text{C}_{17}\text{H}_{36}$ can be cracked. Which compound is least likely to be produced in this reaction?

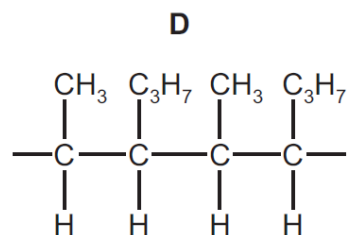
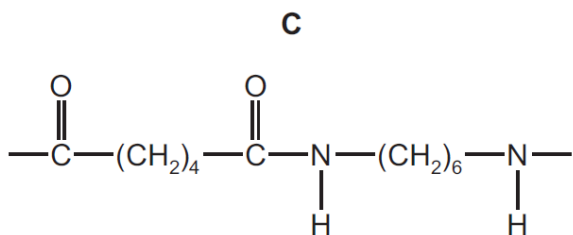
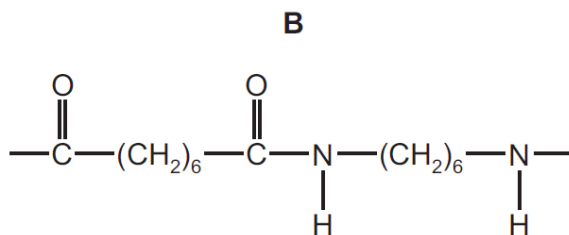
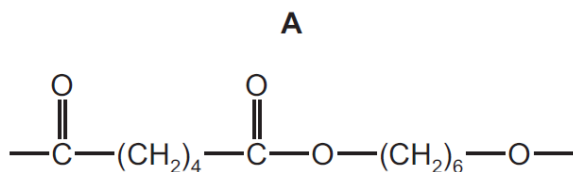
A C_3H_8
C C_8H_{18}

B C_4H_8
D $\text{C}_{16}\text{H}_{34}$

40 **P** is a polymer that

- ☐ has six carbon atoms in each of the monomers from which it was formed.
- ☐ is not a polyester.
- ☐ is formed by condensation polymerisation.

What is a possible structure of **P**?



Group

Key

proton (atomic) number	atomic symbol	name	relative atomic mass
1	H	hydrogen	1.0079
2	He	helium	4.0026
3	Li	lithium	6.941
4	Be	beryllium	9.0122
5	B	boron	10.811
6	C	carbon	12.011
7	N	nitrogen	14.0064
8	O	oxygen	15.9994
9	F	fluorine	18.9984
10	Ne	neon	20.1797
11	Na	sodium	22.989769
12	Mg	magnesium	24.3047
13	Al	aluminium	26.981538
14	Si	silicon	28.0858
15	P	phosphorus	30.973762
16	S	sulphur	32.06
17	Cl	chlorine	35.453
18	Ar	argon	39.948
19	K	potassium	39.0983
20	Ca	calcium	40.078
21	Sc	scandium	44.955912
22	Ti	titanium	47.88
23	V	vanadium	50.9415
24	Cr	chromium	51.9961
25	Mn	manganese	54.938045
26	Fe	iron	55.845
27	Co	cobalt	58.933195
28	Ni	nickel	58.6934
29	Cu	copper	63.546
30	Zn	zinc	65.38
31	Ga	gallium	69.723
32	Ge	germanium	72.64
33	As	arsenic	74.9216
34	Se	seelenium	78.96
35	Br	bromine	79.904
36	Kr	krypton	83.80
37	Rb	rubidium	85.4678
38	Sr	strontium	87.62
39	Y	yttrium	88.90584
40	Zr	zirconium	91.224
41	Nb	niobium	92.90638
42	Mo	molybdenum	95.94
43	Tc	technetium	98
44	Ru	ruthenium	101.07
45	Rh	rhodium	102.9055
46	Pd	palladium	106.42
47	Ag	silver	107.8682
48	Cd	cadmium	112.411
49	In	indium	114.818
50	Sn	tin	118.710
51	Sb	antimony	121.757
52	Te	tellurium	127.6
53	I	iodine	126.9054
54	Xe	xenon	131.29
55	Ba	barium	137.327
56	La	lanthanum	138.90547
57	Ce	cerium	140.12
58	Pr	praseodymium	140.90765
59	Nd	neodymium	144.242
60	Pm	promethium	145
61	Sm	samarium	150.36
62	Eu	eulanium	151.964
63	Gd	gadolinium	157.25
64	Tb	terbium	158.92532
65	Dy	dysprosium	162.5001
66	Ho	holmium	164.93032
67	Er	erbium	167.259
68	Tm	thulium	168.93032
69	Yb	ytterbium	173.054
70	Lu	lutetium	174.967
71	Hf	hafnium	178.49
72	Ta	tantalum	180.94788
73	W	tungsten	183.84
74	Re	rhenium	186.207
75	Os	osmium	190.23
76	Ir	iridium	192.222
77	Pt	platinum	195.084
78	Au	gold	196.966569
79	Hg	mercury	200.59
80	Tl	thallium	204.38
81	Pb	lead	207.2
82	Bi	bismuth	208.9804
83	Po	polonium	209
84	At	astatine	210
85	Rn	radon	222
86	Fr	francium	223
87	Ra	radium	226
88	Ac	actinium	227
89	Th	thorium	232.0377
90	Pa	protactinium	231.03688
91	U	uranium	238.02891
92	Np	neptunium	237
93	Pu	plutonium	244
94	Am	americium	243
95	Cm	californium	247

$$1 \text{ H hydrog}$$

lanthanoids

actinoids

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