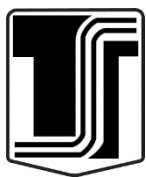


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TAMPINES SECONDARY SCHOOL

Secondary Four Express
PRELIMINARY EXAMINATIONS 2022

NAME

CLASS

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REGISTER
NUMBER

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CHEMISTRY**6092 / 01****Paper 1****14 Sep 2022****1 hour**

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your class, index number and name 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 Multiple Choice Answer Sheet.**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets [] at the end of each question or part question.

Use of calculator is allowed. Each correct answer will score one mark. No marks will be deducted for a wrong answer.

A copy of the Periodic Table is printed on page 17.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use

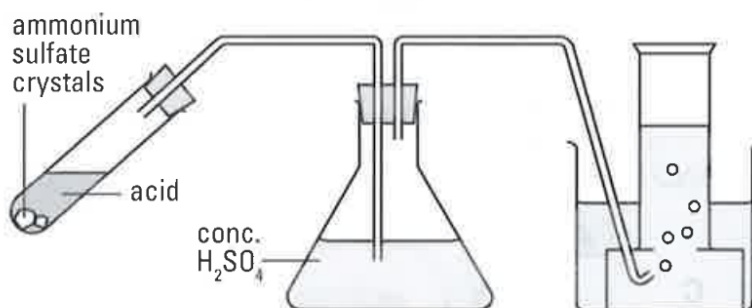
Paper 1 (40 marks)

- 1 A student put exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

- A** balance, measuring cylinder, thermometer
B balance, pipette, stopwatch
C balance, pipette, thermometer
D burette, pipette, thermometer
- 2 The diagram below shows a set-up to prepare a dry sample of ammonia gas.



The experiment failed.

What modifications should be done to correct the set-up?

- 1 An alkali should be placed in the test-tube instead of an acid.
- 2 Anhydrous calcium oxide should be used instead of concentrated sulfuric acid.
- 3 The gas should be collected in a gas syringe instead of by displacement of water.

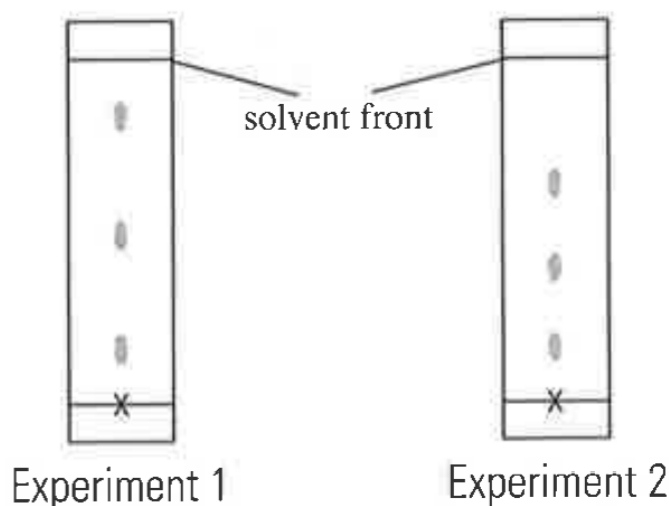
- A** 1 only
B 3 only
C 1 and 2 only
D 1, 2 and 3

3 Which statement best explains why two liquids can be separated by fractional distillation?

- A Both have different boiling points.
- B Both have different densities.
- C Both have different masses.
- D Both have different reactivities.

4 A student carried out a chromatography of a sample to separate amino acids present.

He performed a second chromatography experiment on the sample. The following shows the two chromatograms obtained.



Why do the two chromatograms show different results?

- A The solvent moved up the paper at different speeds.
- B Different solvents were used for the two experiments.
- C The sample for the second experiment was contaminated.
- D The sample for the second experiment was more concentrated.

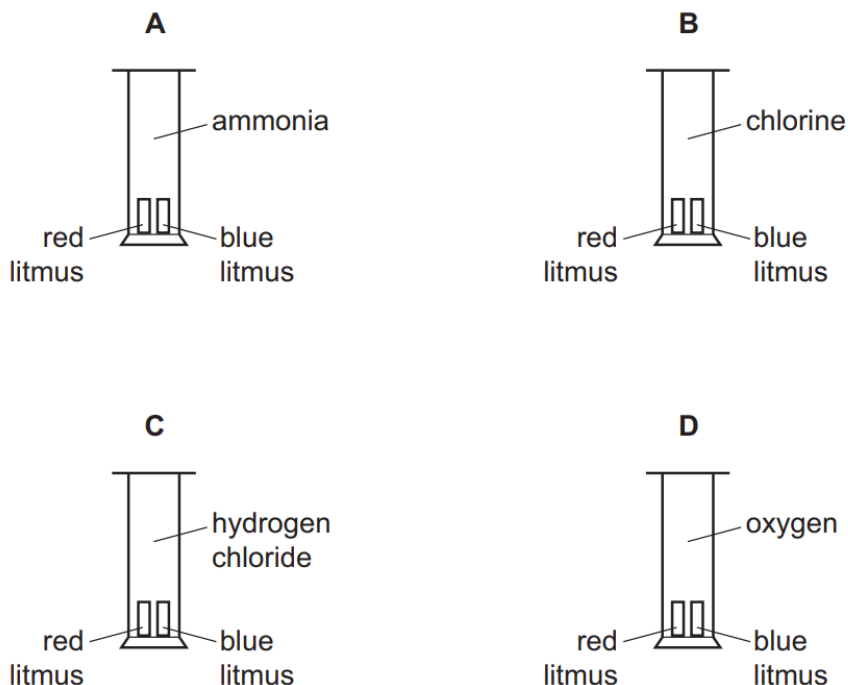
5 Which of the following steps can be used to separate sodium sulfate from calcium sulfate?

- A dissolving in water → filtration → distillation of filtrate
- B dissolving in water → filtration → evaporation of filtrate
- C dissolving in water → distillation → evaporation of filtrate
- D sublimation → dissolving in water → evaporation of filtrate

- 6 Four gas jars each contain one of the gases ammonia, chlorine, hydrogen chloride and oxygen.

A strip of damp blue litmus paper and a strip of damp red litmus paper are placed in each jar.

In which gas jar will both the damp blue litmus paper and the damp red litmus paper change colour?



- 7 An alloy consists of two elements. On addition of concentrated nitric acid, it dissolves completely.

When aqueous sodium hydroxide is added, a blueish-white precipitate is formed. The precipitate turns more bluish when excess sodium hydroxide is added.

Which two elements form the alloy?

- A** copper and ammonium
- B** copper and calcium
- C** copper and iron
- D** copper and zinc

8 Which reagent can be used to differentiate ammonium sulfate from ammonium carbonate?

- A aluminium foil and sodium hydroxide solution
- B aqueous sodium hydroxide
- C aqueous barium nitrate
- D hydrochloric acid

9 The melting and boiling points of four substances are given in the table below.

substance	melting point / °C	boiling point / °C
P	104	128
Q	-18	24
R	20	212
S	545	1713

Based on the data given, which substance is a solid at room temperature and is likely to form a gas upon heating?

- | | | | |
|----------|---|----------|---|
| A | P | B | Q |
| C | R | D | S |

10 An ion, X^{2-} , has 18 neutrons and 18 electrons.

What does its nucleus contain?

- A 16 protons and 16 neutrons
- B 16 protons and 18 neutrons
- C 18 protons and 16 protons
- D 18 protons and 18 neutrons

- 11** Iron has four stable isotopes and the percentage abundance of each isotope is shown below.

isotope	percentage abundance / %
^{54}Fe	5.8
^{56}Fe	91.6
^{57}Fe	2.2
^{58}Fe	0.4

What is the relative atomic mass of iron?

- | | | | |
|----------|------|----------|------|
| A | 55.7 | B | 55.9 |
| C | 56.0 | D | 56.2 |

- 12** Five substances are shown below.

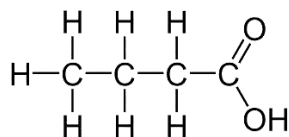
$$\text{Zn (s)}$$
$$\text{NaCl (s)}$$
$$\text{H}_2\text{SO}_4 \text{ (aq)}$$
$$\text{MgCl}_2 (l)$$

graphite

How many of the substances contain delocalised electrons?

- | | | | |
|----------|---|----------|---|
| A | 0 | B | 1 |
| C | 2 | D | 3 |

- 13** An organic compound is shown below.



How many electrons are involved in chemical bonding in the compound?

- | | | | |
|----------|----|----------|----|
| A | 13 | B | 14 |
| C | 26 | D | 28 |

- 14** The physical properties of three substances are shown in the table below.

substance	melting point / °C	boiling point / °C	electrical conductivity		
			solid	liquid	aqueous
X	−114	−85	poor	poor	good
Y	3550	3825	good	good	insoluble
Z	402	953	poor	good	insoluble

Which of the following correctly identifies X, Y and Z?

	X	Y	Z
A	nitrogen dioxide	potassium iodide	silicon dioxide
B	sodium chloride	silicon chloride	zinc
C	hydrogen chloride	graphite	lead(II) iodide
D	sodium	diamond	calcium sulfate

- 15** Which of the following has the same number of molecules as 60 cm^3 of carbon dioxide at room temperature and pressure?

- A** 0.0850 g of ammonia
- B** 25 cm³ of 0.10 mol/dm³ aqueous hydrochloric acid
- C** 60 cm³ of ethanol liquid
- D** 3.0×10^{21} atoms of oxygen

- 16** Ferrite is a mineral that is made of a mixture of the oxides of calcium and iron.

It contains 18.5% calcium and 51.9% iron by mass.

What is the empirical formula of ferrite?

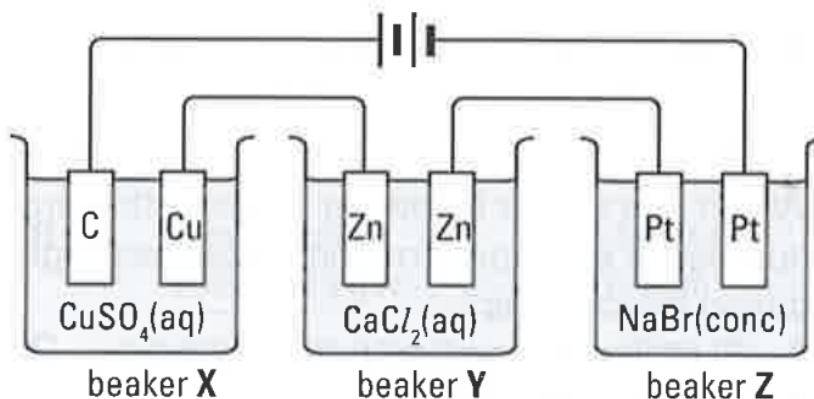
- A** CaFe_2O
- B** CaFe_2O_4
- C** Ca_2FeO_2
- D** $\text{Ca}_4\text{Fe}_2\text{O}$

- 17 Aqueous titanium(III) chloride reacts violently with water to produce a titanium(IV) oxide precipitate, hydrochloric acid and hydrogen gas.

Which of the following shows the correct ionic equation for the reaction?

- A** $2\text{TiCl}_3(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{TiO}_2(\text{s}) + 6\text{HCl}(\text{aq}) + \text{H}_2(\text{g})$
- B** $2\text{Ti}^{3+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{TiO}_2(\text{s}) + 6\text{H}^+(\text{aq}) + \text{H}_2(\text{g})$
- C** $\text{Ti}^{3+}(\text{aq}) + 3\text{Cl}^-(\text{aq}) \rightarrow \text{Ti}^{4+}(\text{aq}) + 3\text{Cl}^-(\text{aq})$
- D** $\text{Ti}^{3+}(\text{aq}) + 3\text{Cl}^-(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ti}^{4+}(\text{aq}) + 3\text{Cl}^-(\text{aq}) + \text{H}_2(\text{g})$

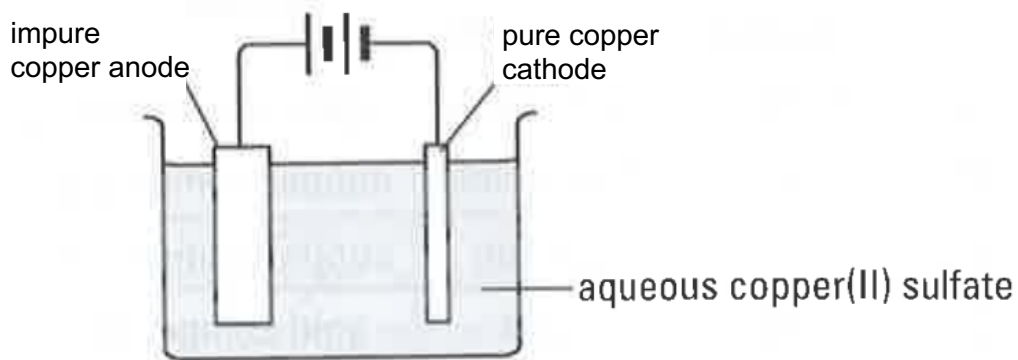
- 18 An electrolytic cell is shown below.



Which beakers show a change in the colour of the electrolyte?

- A** beakers X and Y
- B** beakers Y and Z
- C** beakers X and Z
- D** beakers X, Y and Z

- 19 The purification of copper is shown below.

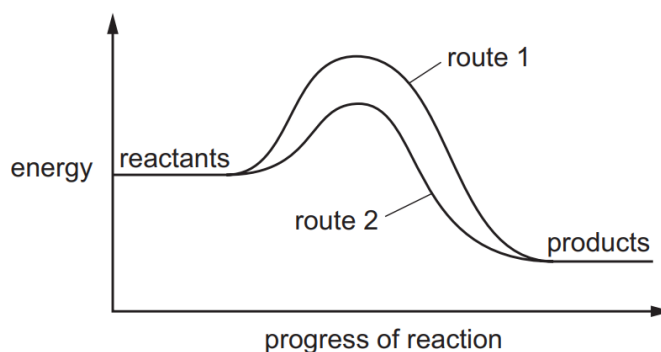


The impure copper anode had an initial mass of 100 g while the pure copper cathode had an initial mass of 10 g. At the end of the purification, the anode weighed 10 g while the cathode weighed 80 g.

What is the percentage impurity of the copper anode?

- A 10%
 - B 20%
 - C 30%
 - D 90%
- 20 Which process is exothermic?
- A Melting of ice
 - B Evaporation of ethanol
 - C Formation of iodine vapour from iodine crystals
 - D Condensation of water vapour to form liquid droplets

- 21 The diagram below shows the energy profile for a reaction.

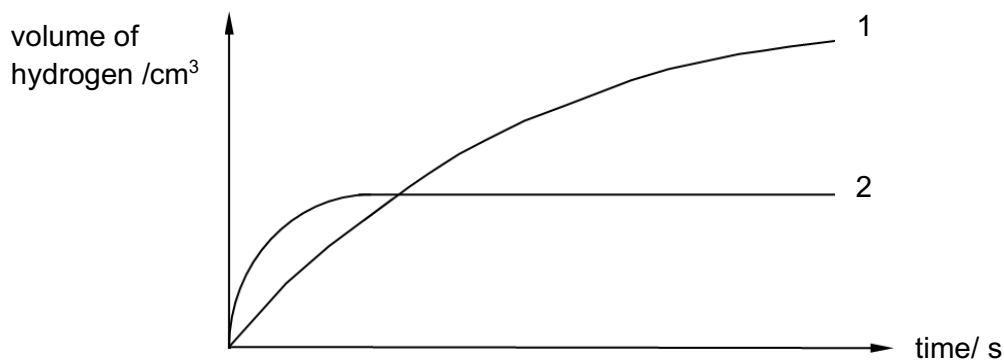


Which statements about this reaction are correct?

- 1 More energy is needed to break the bonds than is released when new bonds are formed.
- 2 Route 1 and route 2 give the same overall equation for the reaction.
- 3 Route 2 uses a catalyst.
- 4 The reaction is exothermic.

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

- 22 In the diagram below, curve 1 represents the volume of hydrogen produced when 6 g of magnesium granules reacts completely with an excess of acid at 40 °C.



Which change could produce curve 2?

- A** decrease the temperature to 20°C
- B** use a catalyst for the reaction
- C** use a more concentrated solution of the acid
- D** use 3 g of magnesium powder

- 23** The nitrogen cycle is a biochemical cycle that occurs naturally. It involves the conversion of nitrogen-containing substances that takes place through biological and physical processes.

Which of the following changes of nitrogen-containing substances shows the greatest increase in oxidation number?

- | | | | |
|----------|------------------------------------|----------|---|
| A | NH_4^+ to NO_3^- | B | NO_2^- to N_2O |
| C | N_2 to NO_3^- | D | N_2O to NO_3^- |

- 24** Element X burns in oxygen to form a white solid.

The white solid is soluble in acid and alkali. What could X be?

- A** aluminium
- B** calcium
- C** copper
- D** silicon

- 25** Which statement about oxides is correct?

- A** A solution of sodium oxide has a pH less than pH 7.
- B** A solution of sulfur dioxide has a pH greater than pH 7.
- C** Magnesium oxide reacts with nitric acid to make a salt.
- D** Sulfur dioxide reacts with hydrochloric acid to make a salt.

- 26** Which method produces the highest yield of calcium sulfate from calcium carbonate?

- A** Addition of aqueous hydrochloric acid
- B** Addition of aqueous sodium sulfate
- C** Addition of hydrochloric acid, followed by barium sulfate
- D** Addition of hydrochloric acid, followed by sulfuric acid

27 Which methods are suitable for preparing both zinc sulfate and copper(II) sulfate?

- 1 reacting the metal oxide with warm dilute aqueous sulfuric acid
- 2 reacting the metal with dilute aqueous sulfuric acid
- 3 reacting the metal carbonate with dilute aqueous sulfuric acid

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

28 Ammonia is produced by a reversible reaction in the Haber process. Which statement is true about a reversible reaction?

- A** A high temperature is needed for the reaction to occur.
- B** A catalyst is needed for a reversible reaction.
- C** The reaction has low activation energy.
- D** The yield of the products will be less than 100%.

29 The melting point of lithium is 181°C. The melting point of sodium is 98°C.

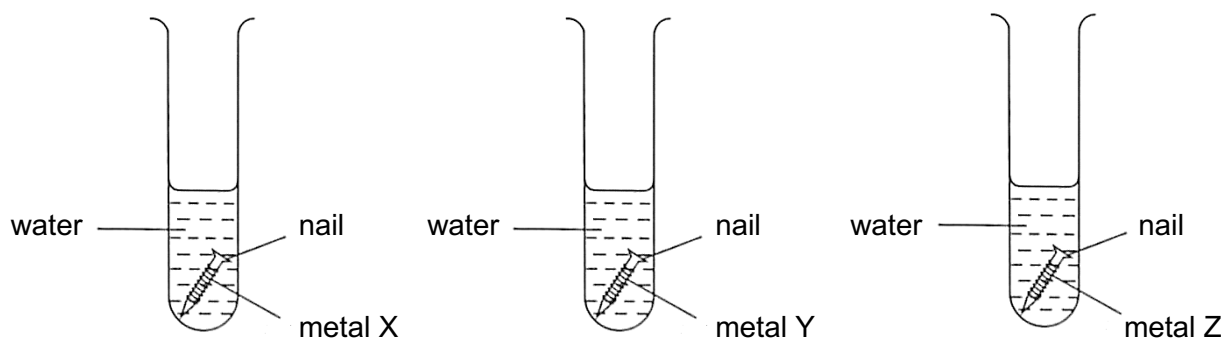
Which statement best explains why lithium has a higher melting point than sodium?

- A** Lithium has fewer electrons than sodium.
- B** Sodium is more reactive than lithium.
- C** The electrostatic forces of attraction between the oppositely charged ions in lithium is stronger than in sodium.
- D** The electrostatic forces of attraction between the positive ions and the 'sea of delocalised electrons' is stronger in lithium than in sodium.

30 Which of the following is not a typical property of the element ${}_{40}^{91}\text{Zr}$?

- A** forms a colourless solution
- B** forms compounds with variable oxidation states
- C** high density
- D** high melting and boiling point

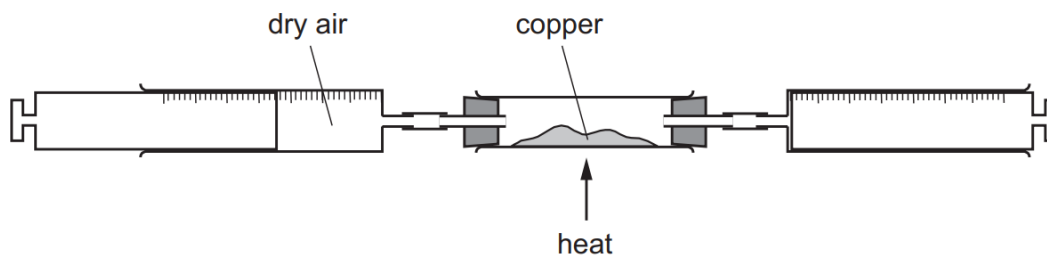
- 31** In an experiment to investigate the properties of three metals in sacrificial protection, the iron nails are found rusted only when they are coiled with metals X and Y as shown below. The iron nail coiled with Z is not rusted.



Which of the following combinations shows the identities of metals X, Y and Z?

	metal X	metal Y	metal Z
A	lead	platinum	zinc
B	tin	nickel	silver
C	gold	silver	copper
D	sodium	lead	chromium

- 32** Dry air is passed over hot copper until all the oxygen has reacted, as shown below.



The volume of gas at the end of the reaction is 120 cm^3 .

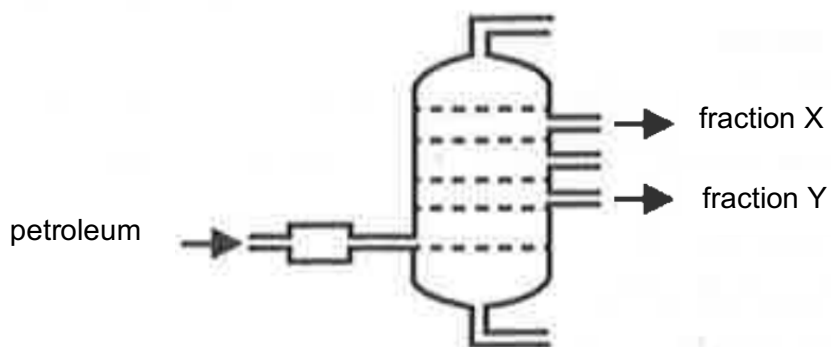
What is the starting volume of dry air?

- A** 132 cm^3 **B** 152 cm^3 **C** 180 cm^3 **D** 570 cm^3

33 Which statement is correct?

- A** Atmospheric carbon dioxide is not a cause of climate change.
- B** Atmospheric methane is produced by respiration.
- C** Burning natural gas decreases the level of carbon dioxide in the atmosphere.
- D** Decomposition of vegetation causes an increase in atmospheric methane.

34 The fractional distillation of crude oil is shown below.



Which statement about fractions X and Y is correct?

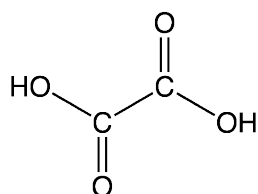
- A** Fraction X has a lower boiling point than fraction Y.
- B** Fraction X is more viscous than fraction Y.
- C** Fraction X has stronger intermolecular forces than fraction Y.
- D** Fraction X produces a smokier flame than fraction Y when burnt.

35 Crude oil is separated into useful fractions in an oil refinery.

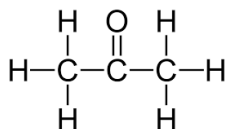
Which of the following shows the correct use of a fraction from crude oil?

	fraction	use of fraction
A	bitumen	for making polishes and waxes
B	lubricating oil	fuel for diesel engines
C	naphtha	feedstock for making plastics
D	petroleum gas	fuel for aircraft engines

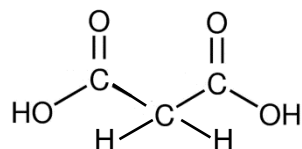
- 36 The structures of some organic compounds are shown below.



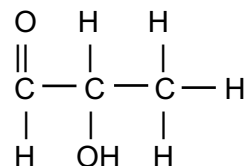
1



2



3



4

Which of the structures belong to the same homologous series?

A 1 and 2

B 1 and 3

C 2 and 3

D 2 and 4

- 37 How many different unsaturated isomers are possible for a compound with the molecular formula C_4H_8 ?

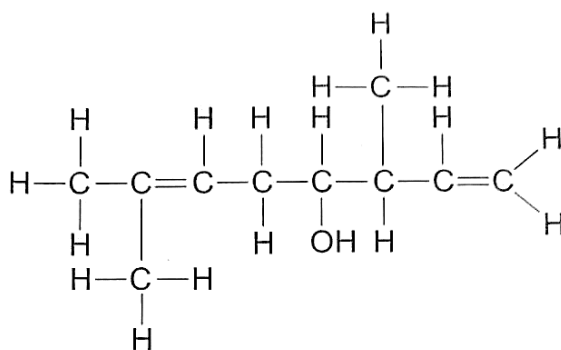
A 3

B 4

C 5

D 6

- 38 Linalool is a naturally-occurring compound found in lavender which gives it a pleasant floral smell. The structure of linalool is shown below.



Given that linalool reacts with chlorine in the dark, what is the volume of chlorine required to react completely with 0.1 moles of linalool, at room temperature and pressure?

A 1.2 dm^3

B 2.4 dm^3

C 3.6 dm^3

D 4.8 dm^3

- 39 An organic substance is found to decolourise bromine water and to react with sodium carbonate, forming a colourless gas which forms a white precipitate in limewater.

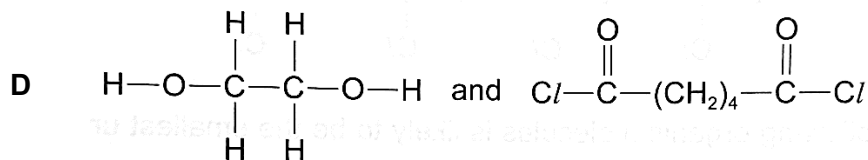
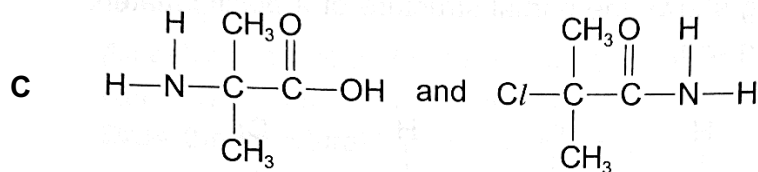
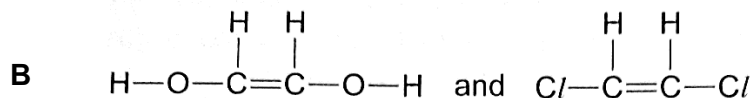
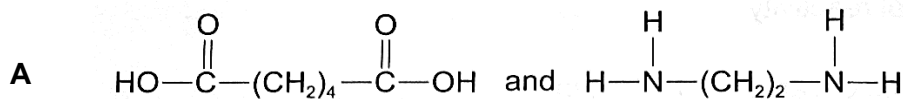
Some functional groups are listed below.

- 1 —OH hydroxyl group
- 2 C=C double bond
- 3 —COOH carboxyl group

Which functional groups could be present in the substance?

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

- 40 Which of the following pairs of organic compounds will most likely form a polyester?



The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		Key proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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 -		
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			
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 -			
actinoids																	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).