

Name: ()

Class: Sec 4GR

Queenstown Secondary School



Preliminary Examination 2023 Secondary Four Express Chemistry 6092/01

30 August 2023
Wednesday

Time: 1200 – 1300h
Duration: 1 hour

Setter:

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and index number 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 booklet.

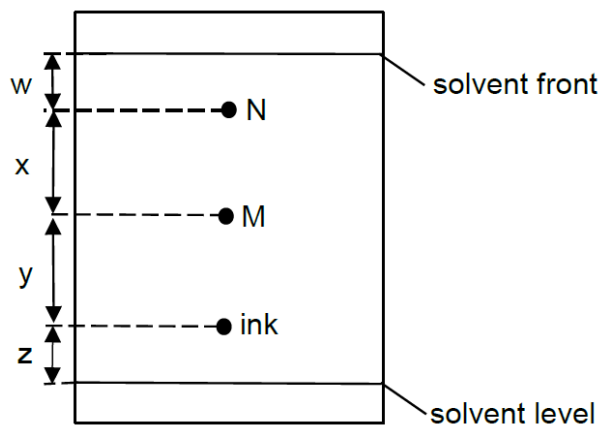
A copy of the Periodic Table is printed on page 18.

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

- 1 A student wants to show that the speed of reaction between 2.00 g of zinc carbonate and 30.00 cm³ of dilute nitric acid doubles for every 5°C rise in temperature. He measures the volume of carbon dioxide produced at regular intervals.

Which of the following apparatus should the student use to carry out the experiment?

- A burette, electronic mass balance, thermometer, gas syringe
 B burette, electronic mass balance, thermometer, measuring cylinder
 C pipette, electronic mass balance, thermometer, gas syringe
 D pipette, electronic mass balance, thermometer, measuring cylinder
- 2 The chromatogram result below shows dyes, M and N present in an ink sample.

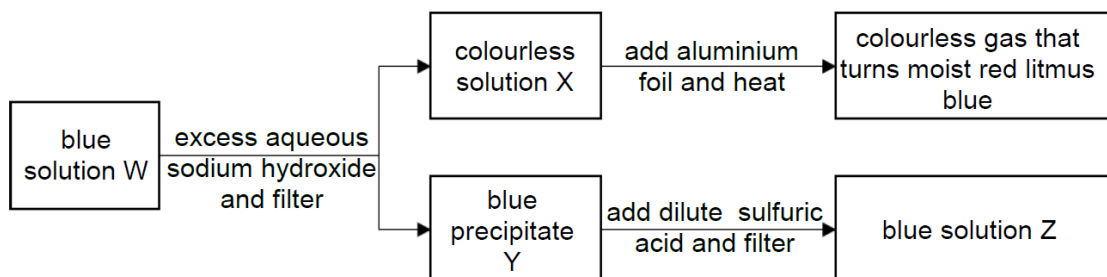


What is the R_f value of the more soluble dye?

- A $\frac{y}{w+x+y}$ B $\frac{y}{w+x+y+z}$ C $\frac{x+y}{w+x+y}$ D $\frac{x+y}{w+x+y+z}$
- 3 Which of the following tests would be able to distinguish between carbon dioxide gas and sulfur dioxide gas?
- 1 Insert a lighted splinter into the test-tube.
 - 2 Place a piece of damp blue litmus paper at the mouth of the test-tube.
 - 3 Bubble the gas into a test-tube containing limewater.
 - 4 Bubble the gas into a test-tube containing aqueous acidified potassium manganate(VII).

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

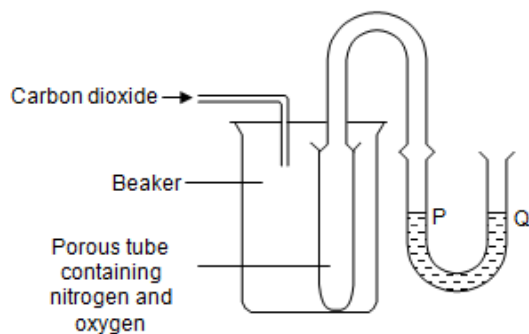
- 4 The flow chart below shows some reactions that blue solution W undergoes.



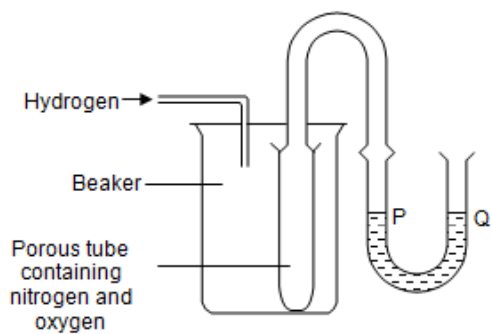
What are the identities of W, X, Y and Z?

	W	X	Y	Z
A	$\text{Cu}(\text{NO}_3)_2$	NaNO_3	$\text{Cu}(\text{OH})_2$	CuSO_4
B	CuSO_4	Na_2SO_4	$\text{Cu}(\text{OH})_2$	CuSO_4
C	$\text{Fe}(\text{NO}_3)_2$	NaNO_3	$\text{Fe}(\text{OH})_2$	FeSO_4
D	$(\text{NH}_4)_2\text{SO}_4$	NH_4OH	$\text{Cu}(\text{OH})_2$	CuSO_4

- 5 Two experimental set-ups used to demonstrate diffusion of gases are shown in the diagram below.



experiment 1



experiment 2

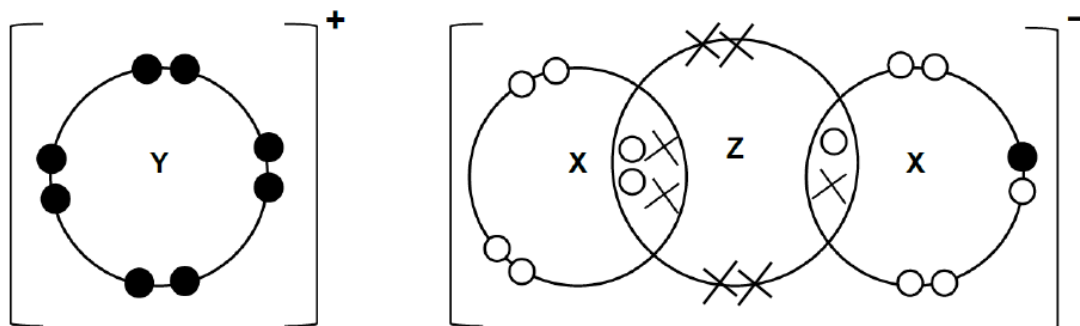
What changes, if any, to the water levels at P and Q would you expect to see in both experiments?

	experiment 1	experiment 2
A	P and Q remain the same	P and Q remain the same
B	P and Q remain the same	Q is higher than P
C	P is higher than Q	Q is higher than P
D	Q is higher than P	Q is higher than P

- 6 A particle contains 31 protons, 40 neutrons and 28 electrons.
Which symbol is correct for this particle?

A ${}^{59}_{28}\text{Ni}^{3+}$ **B** ${}^{59}_{28}\text{Ni}^{3-}$ **C** ${}^{71}_{31}\text{Ga}^{3+}$ **D** ${}^{71}_{31}\text{Ga}^{3-}$

- 7 X, Y and Z are 3 different elements in the Periodic Table.
The 'dot-and-cross' diagram of the compound formed between X, Y and Z is shown below. Only the valence electrons are shown.



Which statements are correct?

- 1 Element Y could be lithium.
 - 2 Element X belongs to Group VII of the Periodic Table.
 - 3 Elements X and Z are bonded together by covalent bonds.
 - 4 There are more electrons than protons in ZX_2^- .
- A** 1 and 2 only **B** 3 and 4 only **C** 1, 3 and 4 **D** 2, 3 and 4
- 8 How many electrons in total are shared between the atoms in a molecule of ethene, C_2H_4 , and in a molecule of water, H_2O ?

	ethene	water
A	6	2
B	10	4
C	12	4
D	14	8

- 9 Diamond, graphite, iodine and silicon dioxide all contain covalent bonds.

Which statement is correct?

- A Diamond has atoms that are arranged in a tetrahedral structure.
- B Graphite is used as a lubricant because each layer in its structure is held to the next layer by strong covalent bonds.
- C Iodine changes from solid to gas upon gentle warming as its covalent bonds are weak.
- D Silicon dioxide and graphite both can conduct electricity due to the presence of mobile electrons.

- 10 Which statements about metals are correct?

- 1 Metals are not malleable.
- 2 Metals conduct thermal energy.
- 3 Metals have a lattice of positive ions in a 'sea of electrons'.

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

- 11 Vanillin is the main chemical compound present in vanilla bean extract.

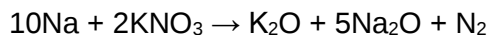
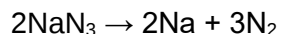
It contains 63.16% of carbon, 5.26% of hydrogen and 31.58% of oxygen by mass.

What is the empirical formula of vanillin?

- A C_3H_3O B $C_5H_5O_2$ C $C_8H_8O_3$ D $C_8H_8O_6$

- 12 The airbag in a car contains sodium azide, NaN_3 and potassium nitrate, KNO_3 .

During a car accident, two reactions take place, producing nitrogen gas which allows the airbag to inflate rapidly.



What is the volume of nitrogen produced when 13.0 g of sodium azide decomposes in the airbag?

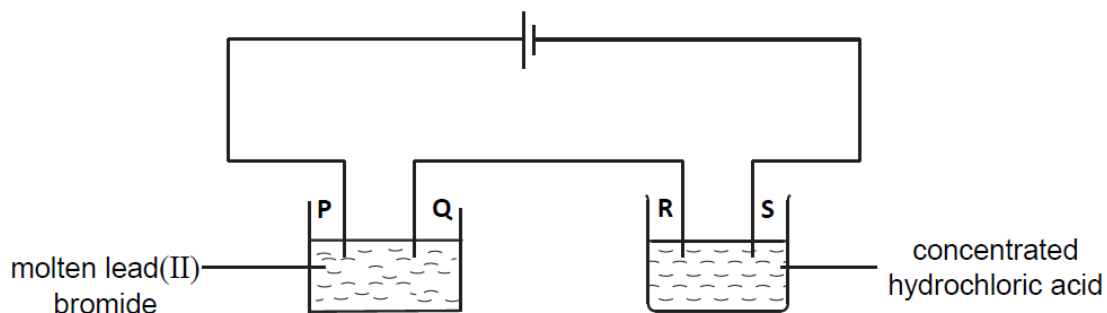
- A 0.32 dm^3 B 0.48 dm^3 C 7.68 dm^3 D 9.60 dm^3

- 13** A washing powder contains sodium hydrogencarbonate, NaHCO_3 as one of its ingredients. In a titration, a solution containing 1.00 g of the washing powder was found to react completely with 7.15 cm^3 of 0.100 mol/dm^3 of dilute hydrochloric acid.



Assuming that sodium hydrogen carbonate is the only ingredient that reacts with the acid, what is the percentage by mass of sodium hydrogencarbonate in the washing powder?

- A** 3.0% **B** 6.0% **C** 12.0% **D** 24.0%
- 14** An electrolytic circuit is set up using inert electrodes P, Q, R and S.



At which of the electrodes is a Group VII element produced?

- A** P only **B** P and R **C** Q only **D** Q and S
- 15** Three electrochemical cells are set up using zinc metal and three other unknown metals P, Q and R as electrodes.

The results of the experiment are shown in the table below.

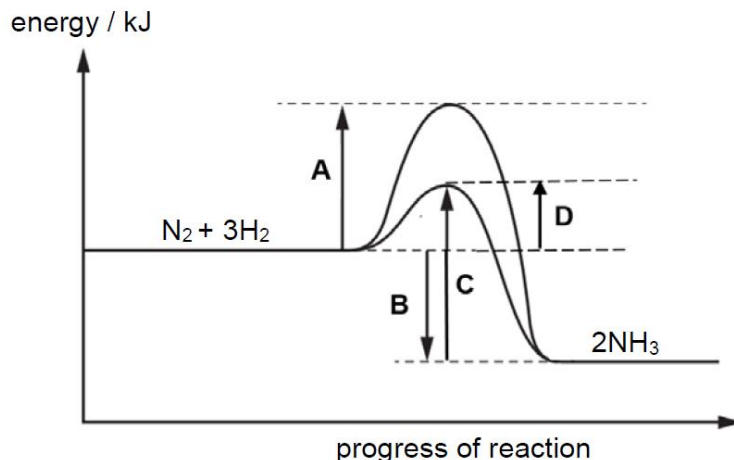
metal tested	voltmeter reading / V	direction of electron flow
P	0.200	zinc to metal P
Q	0.500	metal Q to zinc
R	1.100	zinc to metal R

Which of the following shows the three unknown metals in increasing order of reactivity?

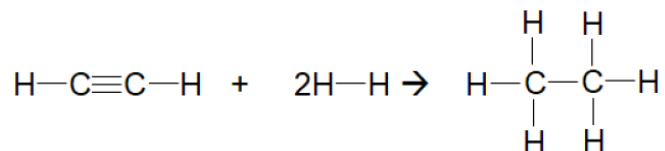
- A** P, Q, R **B** Q, P, R **C** R, P, Q **D** R, Q, P

- 16 The energy profile diagram for both the catalysed and uncatalysed reactions in the production of ammonia is shown below.

What is the activation energy for the decomposition of ammonia in the presence of a catalyst?



- 17 A molecule of ethyne undergoes addition of hydrogen to form ethane.



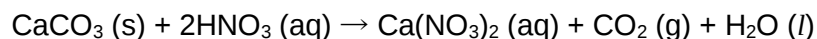
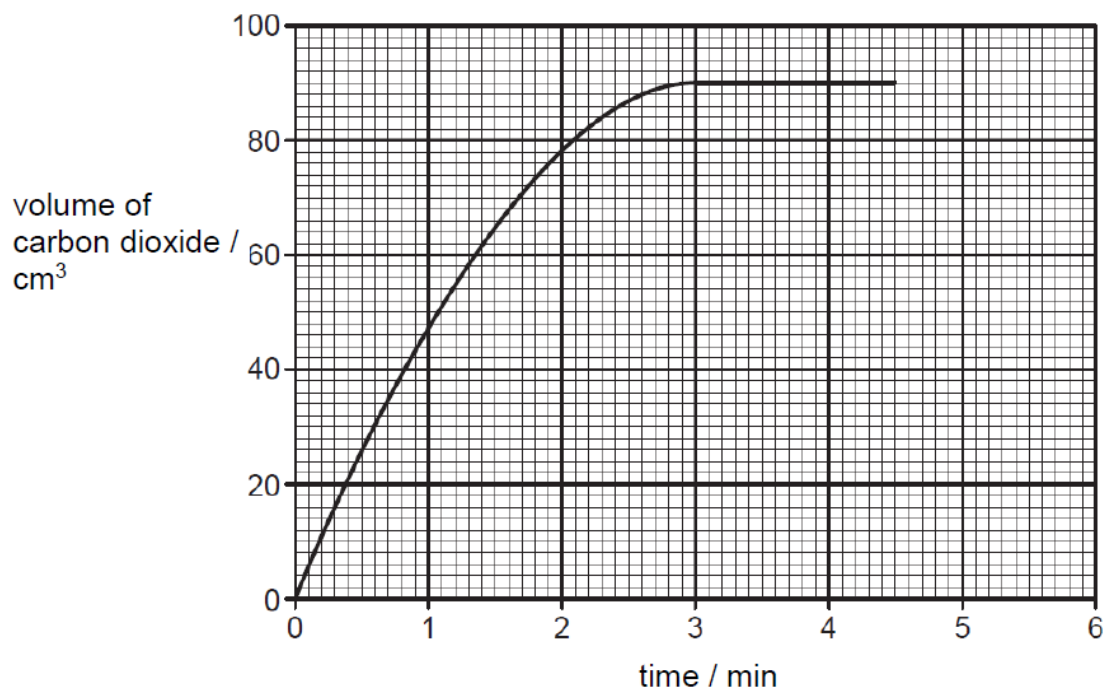
Given the following information of the bond energies, calculate the enthalpy change of the reaction.

bond	C — H	C — C	C = C	C ≡ C	H — H
bond energy / kJmol ⁻¹	413	347	612	839	432

- A -296 kJ/mol B -176 kJ/mol C +176 kJ/mol D +296 kJ/mol
- 18 Which statement about the hydrogen-oxygen fuel cell is **incorrect**?
- A It produces electricity, water and heat.
 B Hydrogen and oxygen are used as the main reactants.
 C The net reaction produces water and hydrogen gas only.
 D It is made up of an electrolyte between the anode and cathode.

- 19 A given mass of calcium carbonate is reacted with excess nitric acid. As the reaction proceeds, the volume of carbon dioxide is measured, at room temperature and pressure, in a graduated syringe.

The results are shown in the graph.



What can be concluded from the information?

- 1 The number of moles of calcium carbonate used was 0.375.
- 2 During the reaction, the rate steadily decreased.
- 3 The reaction stopped at 4.5 min.

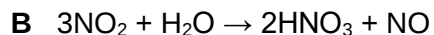
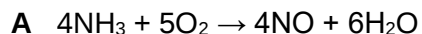
A 1, 2 and 3

B 1 and 2

C 1 and 3

D 2 only

- 20 Ammonia manufactured from the Haber Process can be converted into nitric acid. The following equations show the different reactions that can take place during this conversion. In which reaction does nitrogen have the greatest change in oxidation number?



- 21 Solution T has the following properties.

- It reacts with magnesium forming a gas.
- It reacts with ammonium carbonate forming a gas.

Which statement about solution T is correct?

- A It contains more OH^- ions than H^+ ions.
 B It has pH 9.
 C Its reaction with ammonium carbonate produces ammonia.
 D It reacts with aqueous ammonia.
- 22 In which of the following reaction is zinc hydroxide **not** behaving as a base?
- A $\text{Zn}(\text{OH})_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{Zn}(\text{OH})_4$
 B $\text{Zn}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{ZnCl}_2 + 2\text{H}_2\text{O}$
 C $\text{Zn}(\text{OH})_2 + (\text{NH}_4)_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + 2\text{NH}_3 + 2\text{H}_2\text{O}$
 D $3\text{Zn}(\text{OH})_2 + 2\text{H}_3\text{PO}_4 \rightarrow \text{Zn}_3(\text{PO}_4)_2 + 6\text{H}_2\text{O}$

- 23 Which of the following salts can be prepared using the methods shown?

	method	
	prepared by adding acid to an insoluble carbonate	prepared by mixing two aqueous salt solutions
A	lead(II) sulfate	silver chloride
B	magnesium nitrate	barium sulfate
C	sodium chloride	lead(II) chloride
D	zinc nitrate	potassium sulfate

[illegible]

A R has a lower melting point than S. **C** T has a darker colour than U.

B S has a higher reactivity than R. **D** T has a lower reactivity than U.

27 Some properties of silver and its compounds are stated below.

- 1 Silver can form compounds like Ag_2O and AgF_2 .
- 2 Silver has a high melting point of 962°C .
- 3 Silver is an important catalyst in the production of formaldehyde.
- 4 Silver reacts with chlorine to form a white crystalline solid of silver chloride.

Which of the above statements do **not** agree with the typical properties of transition metals?

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

28 The carbonates of three metals, X, Y and Z, are heated and the results are shown.

metal carbonate	result
X	• carbon dioxide given off • the colour of solid remained the same
Y	• carbon dioxide given off • the green solid turned black
Z	• no visible change

Based on the results above, the following statements were made:

- 1 Metal X is more reactive than metal Z.
- 2 Metal Y is a transition metal.
- 3 If dilute nitric acid is added to all three carbonates, carbon dioxide is given off from the carbonates of X and Y but not from the carbonate of Z.

Which statement(s) is/are true?

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

29 Read the following statements about metals X, Y and Z.

- When heated strongly, metal X turns red hot and reacts slowly with steam.
- Metal Y reacts slowly with dilute sulfuric acid and stops reacting halfway through the reaction.
- Metal Z reacts very slowly with cold water but reacts violently with steam.

Which method of metal extraction from its ores is most likely to be used?

	electrolysis of molten ore	reduction by carbon
A	Z	X and Y
B	Y	X and Z
C	X and Z	Y
D	Y and Z	X

30 Which statements about the extraction of iron from haematite is correct?

- A** At the bottom of the furnace, molten slag floats on top of molten iron.
- B** At the top of the furnace, hot waste gases such as oxygen escape.
- C** Carbon monoxide acts as the oxidising agent in the process.
- D** The other raw materials used are coke and quicklime.

31 Stainless steel is an alloy of iron, carbon and chromium. It does not rust easily. It is known that chromium is more difficult to extract from its ore than iron.

How does chromium protect the iron in stainless steel from rusting?

- A** Chromium, being reactive, forms a protective oxide layer around iron.
- B** Chromium, being less reactive, reacts with water or oxygen in place of iron.
- C** Chromium, being less reactive, does not react with water or oxygen easily.
- D** Chromium reacts with iron to form an alloy which does not allow iron to react with air and water.

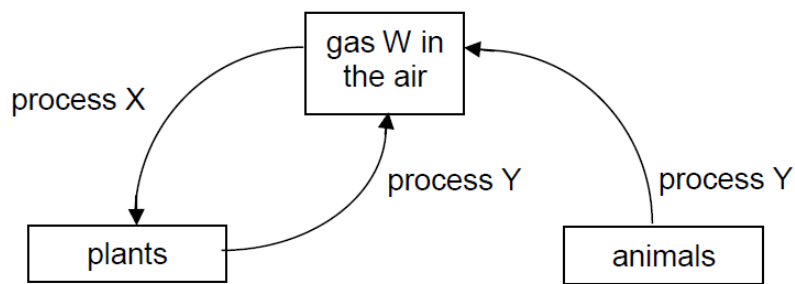
- 32** Diesel and petrol are fuels used commonly in cars.

The combustion of these fuels produces air pollutants. The table below shows the mass of air pollutants found in the exhaust fumes when 1 kg of each fuel is burnt under identical conditions.

air pollutant	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

Which of the following can be inferred from the data given above?

- A** The burning of petrol contributes more towards the formation of acid rain.
B The burning of petrol is more exothermic than that of diesel.
C Petrol requires less oxygen for complete combustion.
D A diesel engine operates at a higher temperature than a petrol engine.
- 33** The diagram below shows part of the carbon cycle.



What is the correct combination of the identity of gas W and processes X and Y?

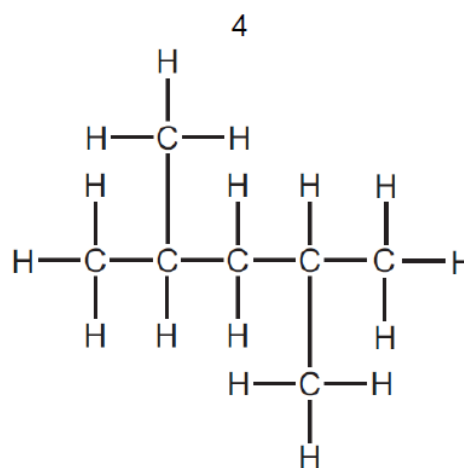
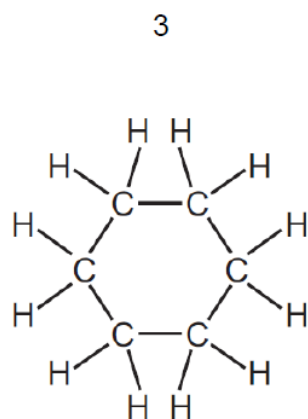
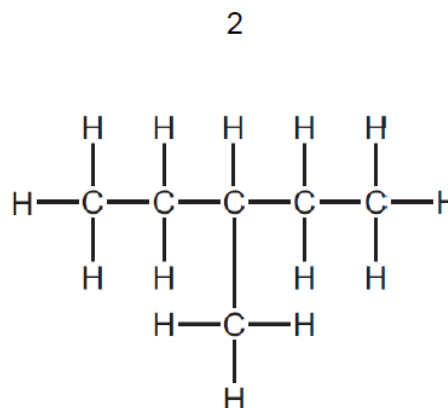
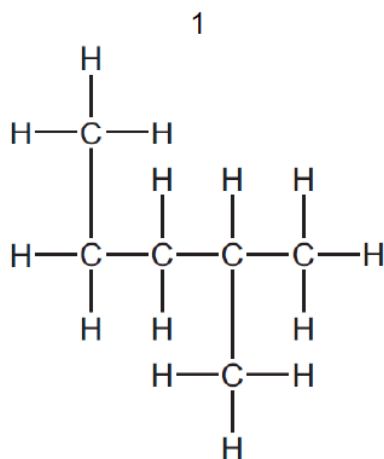
	gas W	process X	process Y
A	carbon dioxide	photosynthesis	respiration
B	carbon dioxide	respiration	photosynthesis
C	carbon monoxide	photosynthesis	respiration
D	carbon monoxide	respiration	photosynthesis

34 Which statement about the fractional distillation of petroleum is **incorrect**?

- A The hydrocarbons collected in each fraction have similar boiling points.
- B The fractions collected at the top are the most flammable.
- C The fractions collected at the bottom are the most viscous.
- D The fractions are separated according to their melting points.

35 Alkanes are saturated compounds containing carbon and hydrogen only.

Structures 1, 2, 3 and 4 are saturated hydrocarbons.



Which pair of structures are isomers?

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

- 36** 0.025 mole of a vegetable oil was found to increase its mass by 25.4 g when shaken with an excess of iodine solution.

How many C=C bonds are there in one molecule of the vegetable oil?

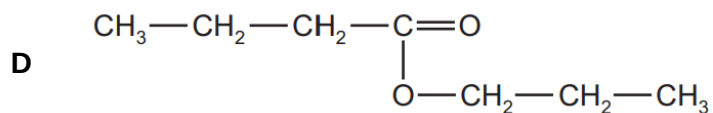
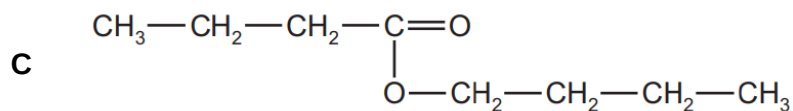
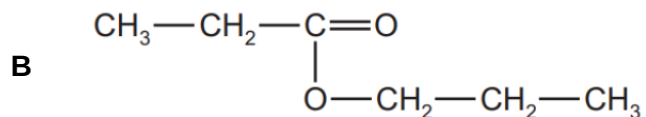
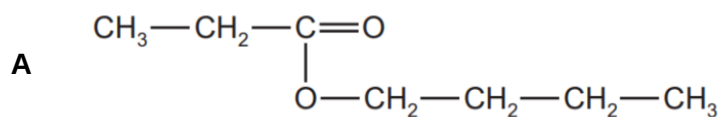
A 1 **B** 2 **C** 3 **D** 4

- 37** Which statements about alcohols are correct?

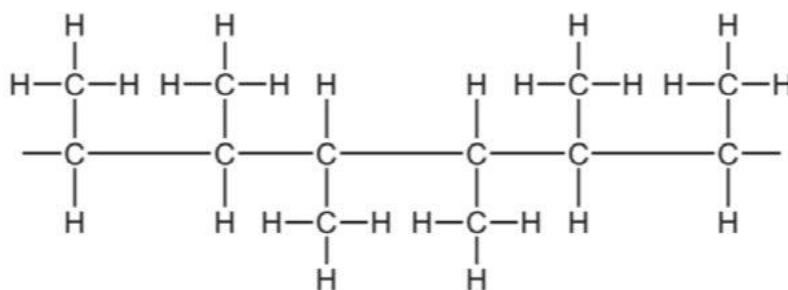
- 1 Alcohols decolourise aqueous acidified potassium manganate(VII).
- 2 Alcohols contain the hydroxide ion, OH⁻.
- 3 Ethanol can be formed from ethene using a reaction catalysed by yeast.
- 4 Propanol can be oxidised to propanoic acid.

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

- 38** A carboxylic acid of molecular formula C₄H₈O₂ reacts with an alcohol of molecular formula C₃H₈O to form an ester. What could be the formula of the ester formed?

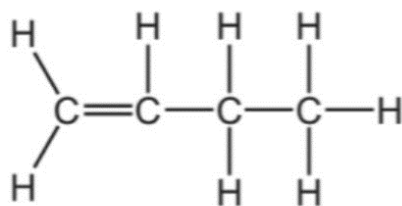


- 39 The diagram below shows the structure of a polymer.

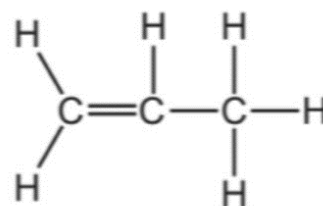


Which of the following monomers was used to form the polymer?

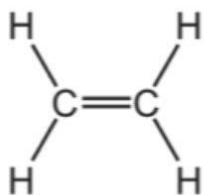
A



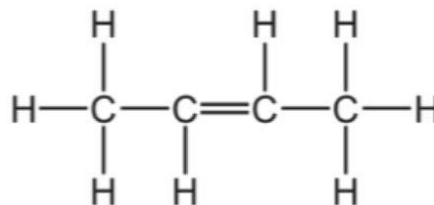
B



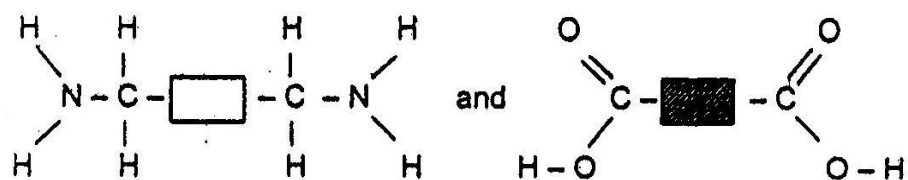
C



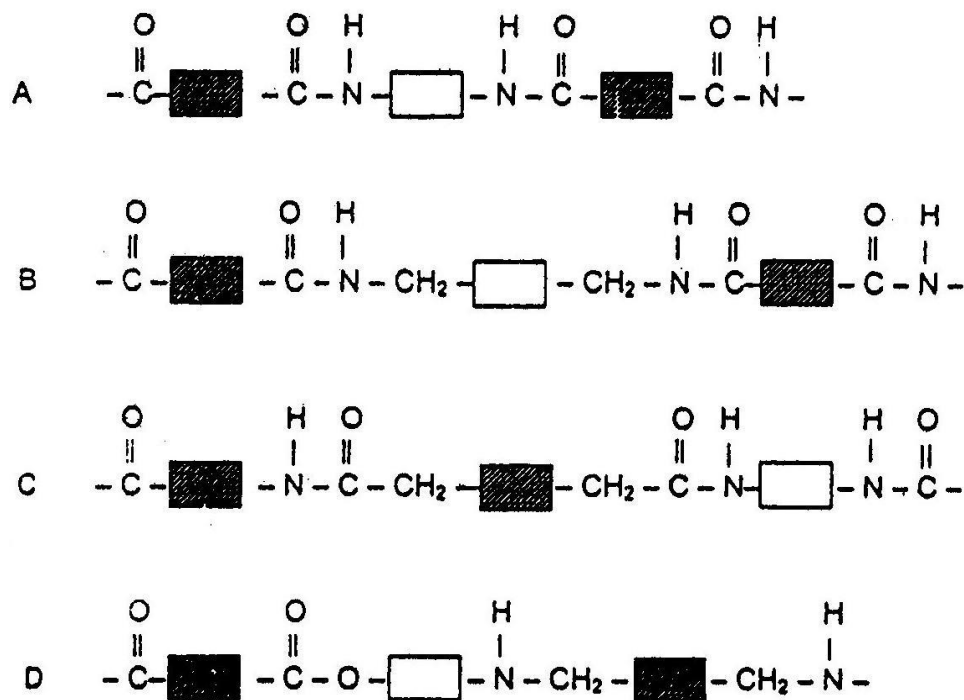
D



- 40 Condensation polymerisation occurs when the following monomers react:



Which diagram represents the structure of the polymer formed?



The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
Key proton (atomic) number atomic symbol name relative atomic mass 1 H hydrogen 1																	
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 138 139 140 141	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 140 141 142 143	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	euroium	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	yterbium	173	71	Lu	lutetium	175
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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	—
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The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

MARK SCHEME

1	2	3	4	5	6	7	8	9	10
A	C	D	A	C	C	B	C	A	C
11	12	13	14	15	16	17	18	19	20
C	C	B	B	C	C	A	C	D	A
21	22	23	24	25	26	27	28	29	30
D	A	B	A	B	B	B	B	D	A
31	32	33	34	35	36	37	38	39	40
A	D	A	D	A	D	B	D	D	B

Tally

A – 10

B – 11

C – 10

D – 9