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 4E CHEMISTRY Paper 1	HUA YI SECONDARY SCHOOL Preliminary Examination	4E 6092/1 24 August 2023 1 hour
	Candidates answer on the Multiple Choice Answer Sheet Additional Materials: Multiple Choice Answer Sheet	

READ THESE INSTRUCTIONS FIRST

Write your Name, Index Number and Class on all the work you have done.
Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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 17.

For Examiner's Use	
Paper 1	

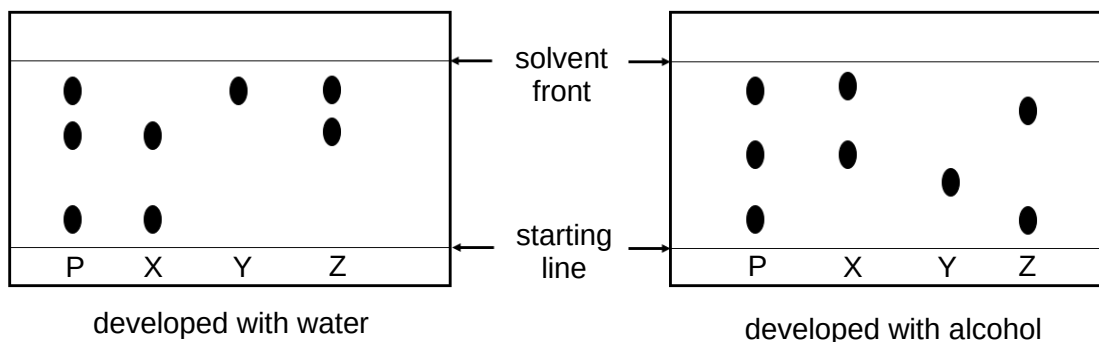
This document consists of **17** printed pages including the cover page.

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[Turn Over

- 1 Which apparatus is the most suitable to measure 37.7 cm^3 of a solution accurately?
- A beaker
B burette
C measuring cylinder
D pipette
- 2 The diagrams show the chromatograms of an ink sample P using two different solvents.



Which substance does ink **P** contain?

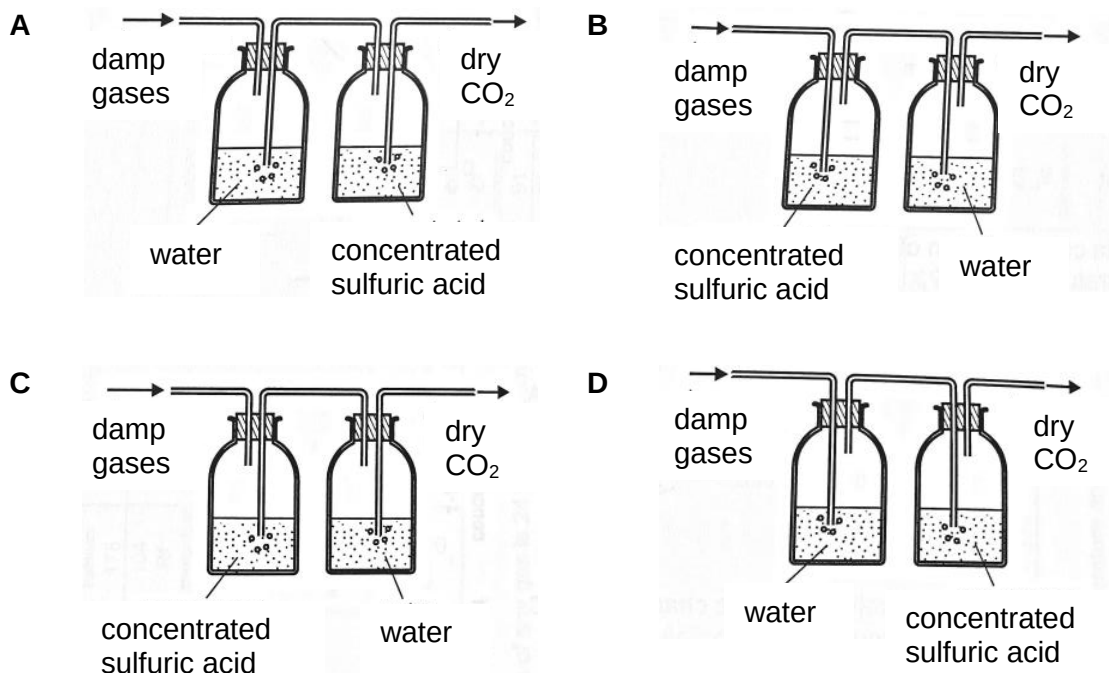
- A X only
B X and Z only
C Y and Z only
D X, Y and Z
- 3 The properties of some substances are shown in the table.

	T	R	S	U
melting point/ $^{\circ}\text{C}$	3600	-101	4000	714
boiling point/ $^{\circ}\text{C}$	4200	-34	4830	1412
electrical conductivity	yes	no	no	yes
soluble in water	no	no	no	yes

Which row identifies the correct substance?

	magnesium chloride	diamond	graphite	chlorine
A	T	U	R	S
B	T	S	U	R
C	U	T	R	S
D	U	S	T	R

- 4 Which diagram shows the correct way to obtain dry carbon dioxide, CO_2 , from a mixture of damp ammonia and carbon dioxide gas?



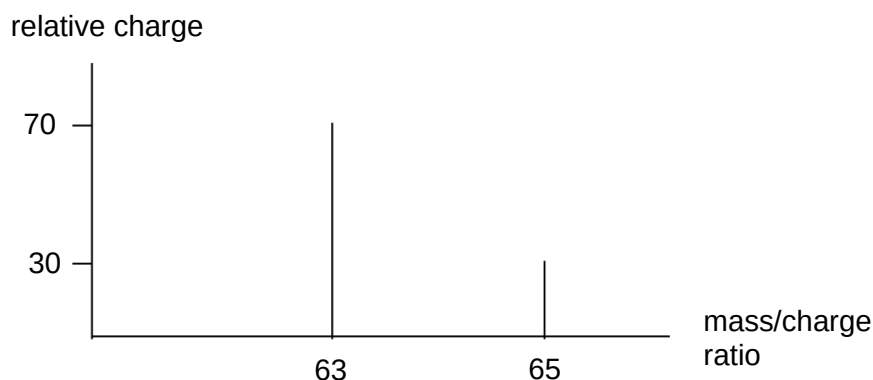
- 5 The following describes the reactions between a sample of solution X and various reagents.

test	result
add aqueous sodium hydroxide drop-wise and then in excess	white precipitate forms that is insoluble in excess sodium hydroxide
add aqueous ammonia drop-wise and then in excess	no precipitate is formed
heat with aluminium foil and sodium hydroxide	effervescence of colourless, pungent gas that turns moist red litmus paper blue

What is solution X?

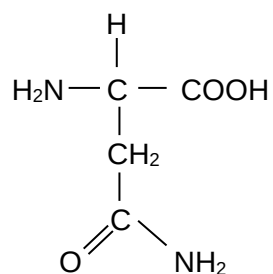
- A ammonium chloride
- B calcium nitrate
- C lead(II) nitrate
- D nitric acid

- 6 Which pair of gases would diffuse at the same rate, under the same temperature and pressure?
- A carbon dioxide and oxygen
 B oxygen and methane
 C oxygen and nitrogen
 D nitrogen and ethene
- 7 A sample of Y was analysed and found to contain only two isotopes, Y-63 and Y-65. The graph below shows the relative abundances of the two isotopes.



What is the relative atomic mass of Y?

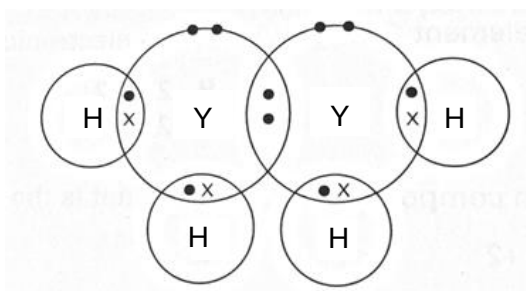
- A 63.2
 B 63.4
 C 63.6
 D 64.0
- 8 The structural formula of asparagine, a protein, is shown.



What is the total number of valence electrons **not** involved in bonding in the nitrogen and oxygen atoms?

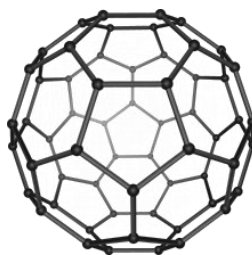
- A 6
 B 8
 C 16
 D 20

- 9 Compound Y has the chemical formula Y_2H_4 . The dot-and-cross diagram is shown.



Which group of the Periodic Table does element Y belong?

- A Group V
 - B Group VI
 - C Group VII
 - D Group 0
- 10 The structure of fullerene, C_{60} , is shown.

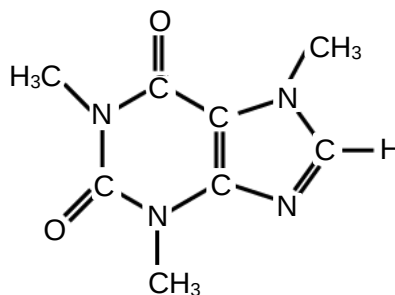


● carbon

Which of the following statements is true?

- A Fullerene is a giant covalent compound.
- B During melting and boiling, a large amount of energy is used to overcome the strong covalent bonds between carbon atoms.
- C Fullerene has high thermal conductivity.
- D Fullerene is an allotrope of carbon.

- 11 The structural formula of caffeine is shown.

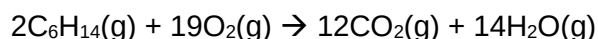


What is the empirical formula of caffeine?

- A CHNO
 B $C_4H_5N_2O$
 C $CH_3NCOCNCH_3CHNCNCH_3CO$
 D $C_7H_{10}N_4O_2$
- 12 Trinitrotoluene, also known as TNT, is a chemical used to make explosives. TNT has the chemical formula $C_6H_2(NO_2)_3CH_3$.

What is the percentage by mass of nitrogen in TNT?
 [Ar: C, 12; H, 1; N, 14; O, 16]

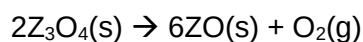
- A 10.4%
 B 18.5%
 C 25.8%
 D 30.8%
- 13 Hexane undergoes complete combustion as shown in the equation.



Which volume of gaseous product, at room temperature and pressure, is produced when 0.2 mol of hexane is burnt completely?

- A 2.6 dm^3
 B 28.8 dm^3
 C 33.6 dm^3
 D 62.4 dm^3

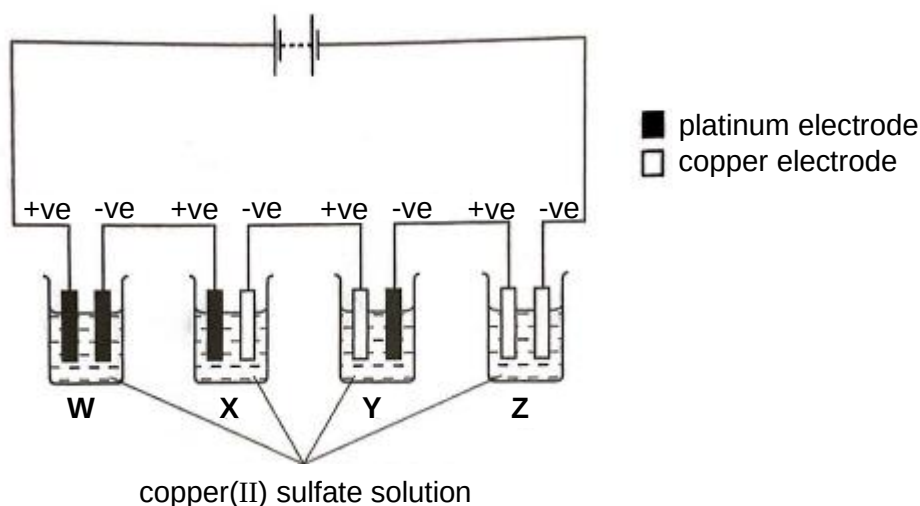
- 14 When heated strongly, the oxide of element Z decomposes.



When 10 g of Z_3O_4 is heated strongly, 0.233 g of oxygen is evolved.

What is the relative atomic mass, A_r , of element Z?

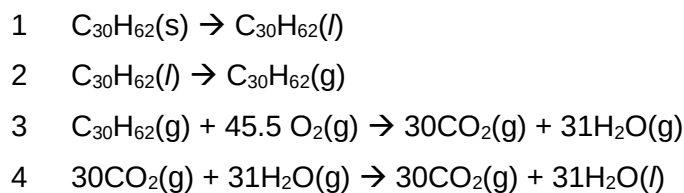
- A 21
B 47
C 208
D 435
- 15 Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?
- A Electricity is generated directly.
B Electricity is used to produce water.
C Hydrogen is burned to form steam.
D Hydrogen reacts to form a hydrocarbon fuel.
- 16 The circuit shown is set up and an electric current is pass through the four cells, W, X, Y and Z.



In which cells is the intensity of the blue colour of the solution unchanged?

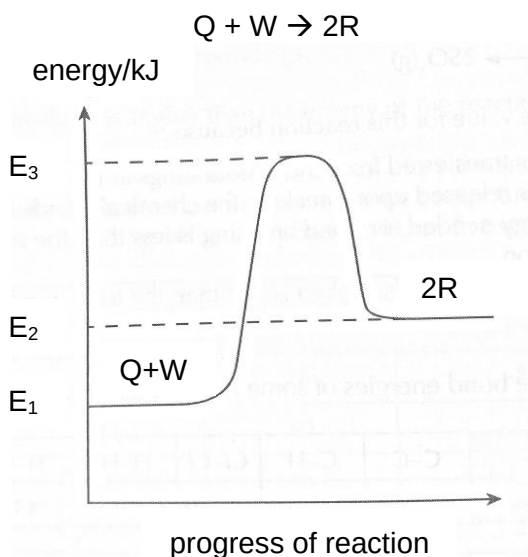
- A W and Z
B Z and Y
C X and Z
D Y and Z

- 17 The scheme shows four stages, 1 to 4, in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.



Which stages are exothermic?

- A 1 and 2
B 1 and 4
C 2 and 3
D 3 and 4
- 18 The energy profile diagram for the formation of substance R is shown.



Which of the following statements is correct?

- | | |
|---|--|
| 1 | The reaction is an exothermic reaction. |
| 2 | The ΔH for the reaction is $E_3 - E_1$. |
| 3 | The activation energy for the reaction is $E_2 - E_1$. |
| 4 | The activation energy for the reverse reaction is $E_3 - E_2$. |

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

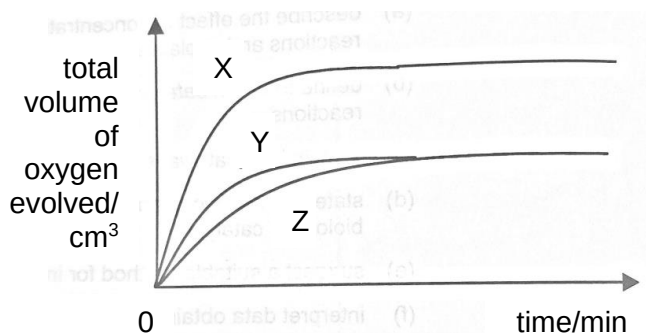
- 19** In the presence of a manganese(IV) oxide catalyst, hydrogen peroxide decomposes into water and oxygen.

A student conducted three experiments and the diagram shows the total volume of oxygen evolved against time.

experiment 1: 50 cm³ of 2.0 mol/dm³ hydrogen peroxide

experiment 2: 50 cm³ of 1.0 mol/dm³ hydrogen peroxide

experiment 3: 25 cm³ of 2.0 mol/dm³ hydrogen peroxide



Which row correctly shows the volume of oxygen obtained from the experiments?

	1	2	3
A	X	Y	Z
B	X	Z	Y
C	Z	X	Y
D	Z	Y	X

- 20** Hydrogen peroxide was added to separate samples of aqueous potassium iodide and acidified potassium manganate(VII). The iodide ions are oxidised and the manganate(VII) ions are reduced.

What colour changes are seen?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	brown to colourless	orange to green
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	colourless to brown	purple to colourless

- 21** The equations represent some chemical reactions that occur in the blast furnace.

Which of the following is **not** a redox reaction?

- A** $\text{C(s)} + \text{CO}_2\text{(g)} \rightarrow 2\text{CO(g)}$
B $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$
C $\text{Fe}_2\text{O}_3\text{(s)} + 3\text{CO(g)} \rightarrow 2\text{Fe(l)} + 3\text{CO}_2\text{(g)}$
D $\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$

- 22** Dilute hydrochloric acid is added to samples of solid substances separately.

Which row is correct?

	lead	lead(II) oxide	aluminium	aluminium oxide
A	✓	✓	✓	✓
B	✓	×	×	×
C	×	✓	✓	✓
D	×	×	✓	×

✓ = gas is evolved
 × = no gas is evolved

- 23** Which of the following correctly describes how pure sodium chloride can be safely prepared in a laboratory?

- A** react excess sodium with dilute hydrochloric acid
B react excess hydrochloric acid with sodium carbonate
C titrate hydrochloric acid against sodium hydroxide
D precipitate sodium chloride using sodium hydroxide and calcium chloride

- 24** Which statement about metals is correct?

- A** All metals have high melting and boiling points.
B All metals have high densities.
C All metals conduct heat.
D All metals can form coloured compounds.

- 25 The table shows the results of adding weighted pieces of lead to solutions Q and R.

solution	initial mass of lead/g	mass of lead after 15 min/g
Q	5	4
R	5	4

Which row correctly identifies the two solutions?

	Q	R
A	copper(II) nitrate	silver nitrate
B	dilute hydrochloric acid	sodium chloride
C	iron(II) chloride	calcium chloride
D	magnesium chloride	dilute sulfuric acid

- 26 The diagram shows part of the Periodic Table.

T																	J
																M	
								U									
S																N	

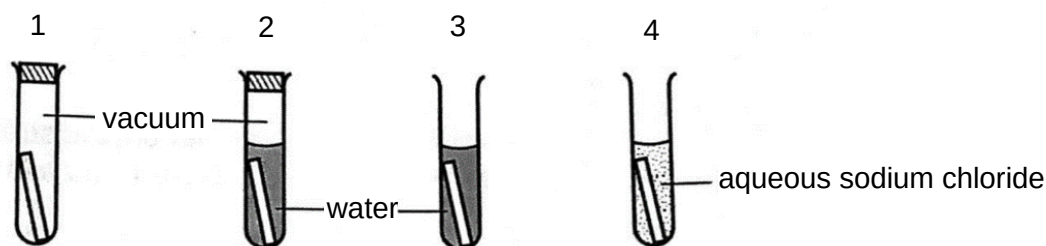
Which two elements would react together most vigorously?

- A S and M
 B S and N
 C T and N
 D T and U
- 27 Three elements, X, Y and Z, have consecutive, increasing proton numbers. If X is a noble gas, what can be inferred about Y and Z?
- A Y and Z belong to the same period in the Periodic Table.
 B Y and Z belong to the same group in the Periodic Table.
 C Y and Z are transition elements.
 D Y has a greater number of valence electrons than Z.

28 Which of the following is **not** a reason why alloys are used?

- A to make metals harder and stronger
- B to improve the appearance of metals
- C to increase the melting points of metals
- D to make metals more resistant to corrosion

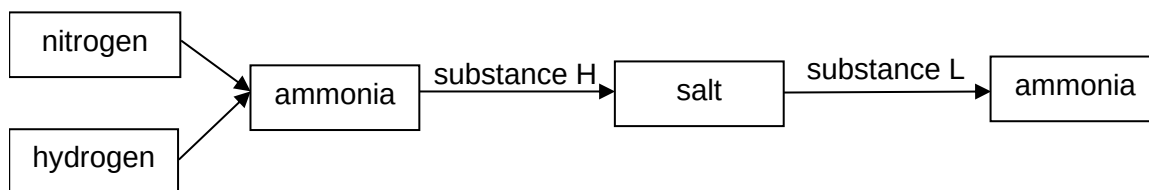
29 The diagrams show an experiment which investigated the rusting process using identical iron bars.



In which test tube would the iron bar take the shortest time to rust?

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

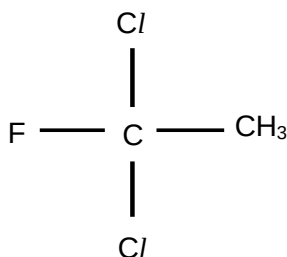
30 Hydrogen is reacted with nitrogen to produce ammonia. Ammonia is then reacted with substance H to form a salt. The salt is reacted with substance L to again produce ammonia.



Which row is correct?

	element obtained from crude oil	substance H	substance L
A	hydrogen	sodium hydroxide	nitric acid
B	hydrogen	nitric acid	sodium hydroxide
C	nitrogen	sodium hydroxide	nitric acid
D	nitrogen	nitric acid	sodium hydroxide

- 31** CFC compounds were previously used as aerosol propellants. The structure of one CFC compound is shown.



Which element in this compound can cause a depletion of ozone?

- A** carbon
B chlorine
C fluorine
D hydrogen
- 32** To reduce atmospheric pollution, the waste gases from a coal-burning power station, are passed through powdered calcium carbonate.

Which waste gases will not be removed by the powdered calcium carbonate?

- A** carbon monoxide
B nitrogen dioxide
C phosphorus(V) oxide
D sulfur dioxide
- 33** Four new planets were discovered. The table describes the composition of the planets' atmospheres.

planet	composition of atmosphere
α	argon, carbon dioxide and oxygen
β	argon, nitrogen and oxygen
γ	argon, carbon dioxide and methane
δ	nitrogen and oxygen

Which planets are likely to experience the greenhouse effect?

- A** α and γ
B β and δ
C β , γ and δ
D α , β , γ and δ

- 34** In an experiment, 10 cm³ of 1.0 mol/dm³ iron(III) chloride solution is mixed with 20.0 cm³ of 2.0 mol/dm³ sodium hydroxide.

What will the reaction mixture contain?

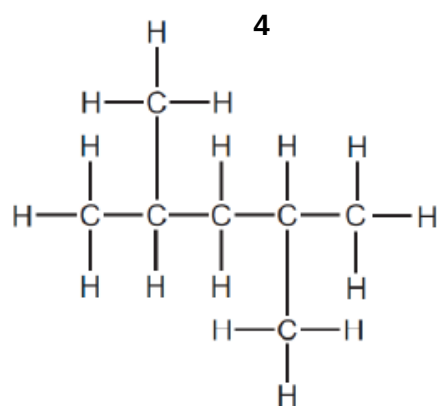
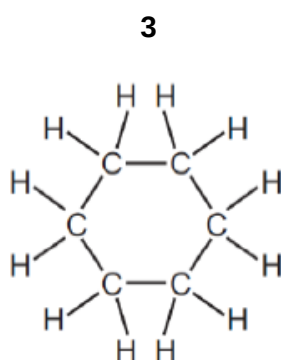
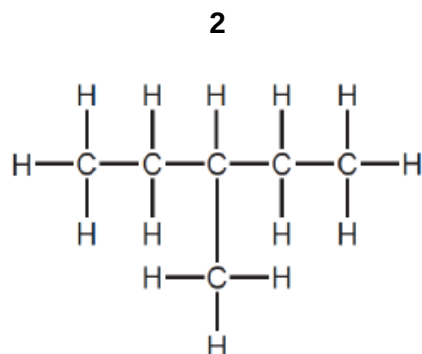
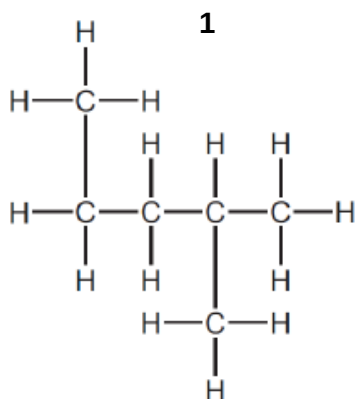
- A** a reddish-brown precipitate and a brown solution
B a reddish-brown precipitate and a colourless solution
C a green precipitate and a green solution
D a green precipitate and a colourless solution
- 35** Petroleum is separated into useful fractions by fractional distillation. Some properties of three of these fractions are shown.

fraction	boiling point range/ °C	number of carbon atoms in the molecules
1	350 - 575	>50
2	180 - 260	
3		>80

Which statement about the three fractions is correct?

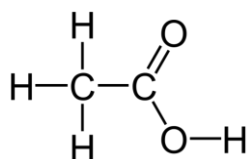
- A** Molecules in fraction 2 have about 50-80 carbon atoms.
B Fraction 3 has a lower boiling point range than fraction 2.
C Fraction 1 is removed from a higher point in the fractioning tower than fraction 2.
D None of the fractions are gases at room temperature.

36 Which of the following compounds are isomers of each other?



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

37 The diagram shows the structure of ethanoic acid.



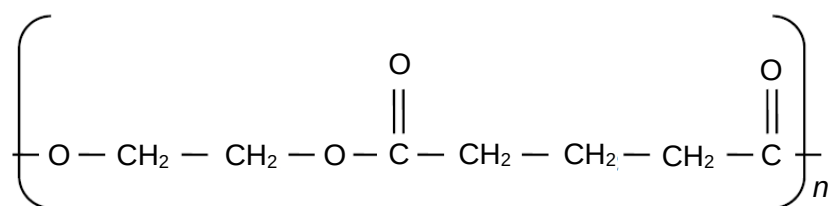
How many moles of ethanoic acid react with one mole of calcium?

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

- 38 What is the formula of the ester formed from the reaction between methanol and butanoic acid?

A $\text{C}_2\text{H}_5\text{CO}_2\text{C}_2\text{H}_5$
 B $\text{C}_3\text{H}_7\text{CO}_2\text{C}_2\text{H}_5$
 C $\text{CH}_3\text{CO}_2\text{C}_3\text{H}_7$
 D $\text{C}_3\text{H}_7\text{CO}_2\text{CH}_3$

- 39 The structure of a polymer is represented as shown.



Which two monomer units could be used to produce this polymer?

	monomer 1	monomer 2
A	$\text{OH}-\text{CH}_2-\text{CH}_2-\text{OH}$	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$
B	$\text{OH}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$	$\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$
C	$\text{OH}-\text{CH}_2-\text{CH}_2-\text{COOH}$	$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$
D	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{COOH}$	$\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$

- 40 Ethanol can be manufactured from ethene or from glucose. The table gives statements about the processes involved.

In which row are both statements **incorrect**?

	process using ethene	process using glucose
A	conversion to ethanol needs temperatures greater than 100°C	conversion to ethanol produces carbon dioxide
B	conversion to ethanol uses yeast as catalyst	conversion to ethanol is carried out at 100°C
C	ethene is obtained by cracking	glucose obtained from fruits, vegetables or grains
D	the conversion reaction is carried out with the reactants as gases	the conversion reaction is carried out in aqueous solution

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
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 -