



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY

Paper 2 Multiple Choice (Extended)

0620/21

May/June 2016

45 Minutes

Additional Materials: Multiple Choice Answer Sheet
 Soft clean eraser
 Soft pencil (type B or HB is recommended)



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

DO NOT WRITE IN ANY BARCODES.

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 20.

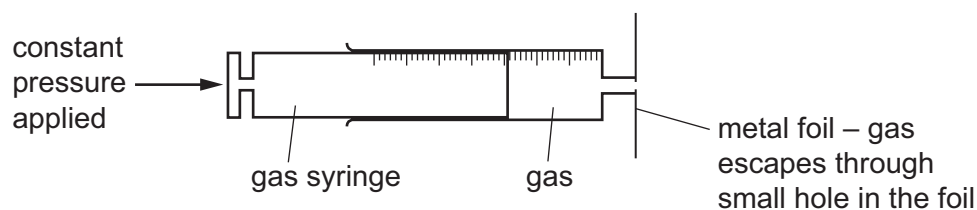
Electronic calculators may be used.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **17** printed pages and **3** blank pages.



- 1 The rate of diffusion of two gases, methane, CH_4 , and ethene, C_2H_4 , is measured using the apparatus shown.



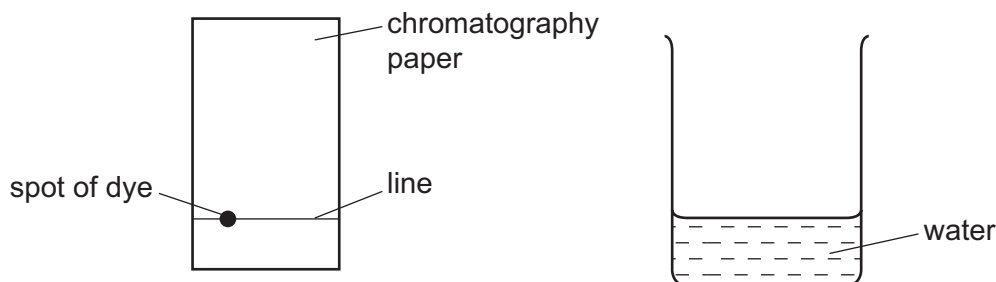
Which gas diffuses faster and why?

	gas that diffuses faster	reason
A	ethene	Ethene molecules are heavier and so move faster.
B	ethene	Ethene molecules have a double bond which makes them more reactive.
C	methane	Methane molecules are lighter and so move faster.
D	methane	Methane molecules are smaller so they can get out of the small hole more easily.

- 2 A sample of a dye is investigated by chromatography.

A line is drawn across a piece of chromatography paper and a spot of the dye is placed on it.

The paper is placed in water.

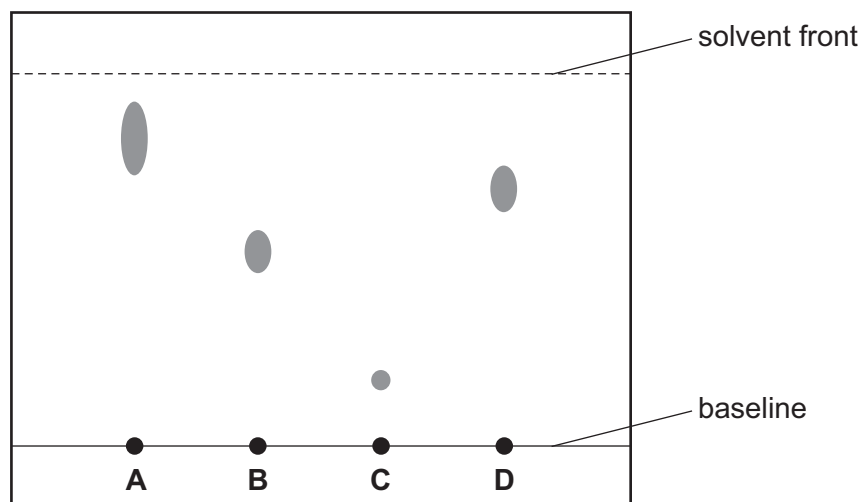


Which row is correct?

	what is used to draw the line	position of spot
A	ink	above the level of the water
B	ink	below the level of the water
C	pencil	above the level of the water
D	pencil	below the level of the water

- 3 The paper chromatogram below was obtained from four different dyes.

Which dye has an R_f value of 0.7?



- 4 Which statements about isotopes of the same element are correct?

- 1 They are atoms which have the same chemical properties because they have the same number of electrons in their outer shell.
- 2 They are atoms which have the same number of electrons and neutrons but different numbers of protons.
- 3 They are atoms which have the same number of electrons and protons but different numbers of neutrons.

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

- 5 The table shows the electronic structure of four atoms.

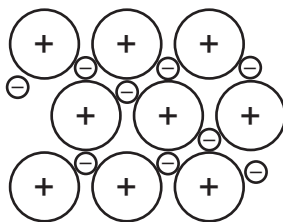
atom	electronic structure
W	2,8,1
X	2,8,4
Y	2,8,7
Z	2,8,8

Which two atoms combine to form a covalent compound?

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

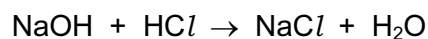
- 6 Which statement describes the attractive forces between molecules (intermolecular forces)?
- A They are strong covalent bonds which hold molecules together.
 - B They are strong ionic bonds which hold molecules together.
 - C They are weak forces formed between covalently-bonded molecules.
 - D They are weak forces which hold ions together in a lattice.

- 7 The diagram represents the general structure of a solid Z.



What is Z?

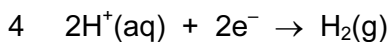
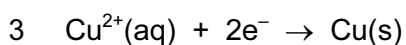
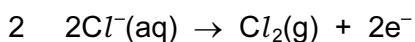
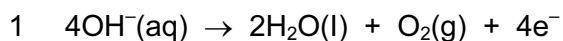
- A aluminium
 - B iodine
 - C silicon dioxide
 - D sulfur
- 8 A compound, X, contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.
The relative molecular mass, M_r , of X is 60.
What is the molecular formula of X?
- A CH_2O
 - B CH_4O
 - C $\text{C}_2\text{H}_4\text{O}$
 - D $\text{C}_2\text{H}_4\text{O}_2$
- 9 25 cm^3 of 0.1 mol/dm^3 hydrochloric acid exactly neutralise 20 cm^3 of aqueous sodium hydroxide.
The equation for this reaction is:



What is the concentration of the sodium hydroxide solution?

- A 0.080 mol/dm^3
- B 0.800 mol/dm^3
- C 0.125 mol/dm^3
- D 1.25 mol/dm^3

10 Which reactions could take place at the anode during electrolysis?



A 1 and 2

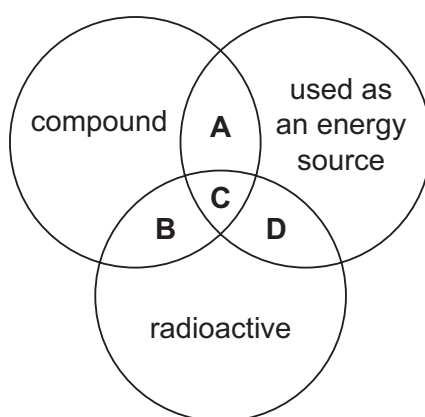
B 1 and 4

C 2 and 4

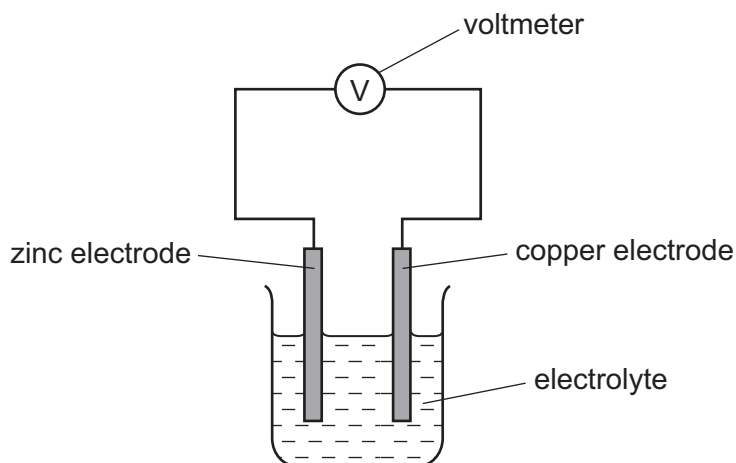
D 3 and 4

11 The diagram shows some properties that substances may have.

To which labelled part of the diagram does ^{235}U belong?



12 The diagram shows a simple cell.



Which statement about the process occurring when the cell is in operation is correct?

A Cu^{2+} ions are formed in solution.

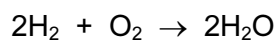
B Electrons travel through the solution.

C The reaction $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ occurs.

D The zinc electrode increases in mass.

13 Hydrogen burns exothermically in oxygen.

The equation for the reaction is:



The table shows the bond energies involved.

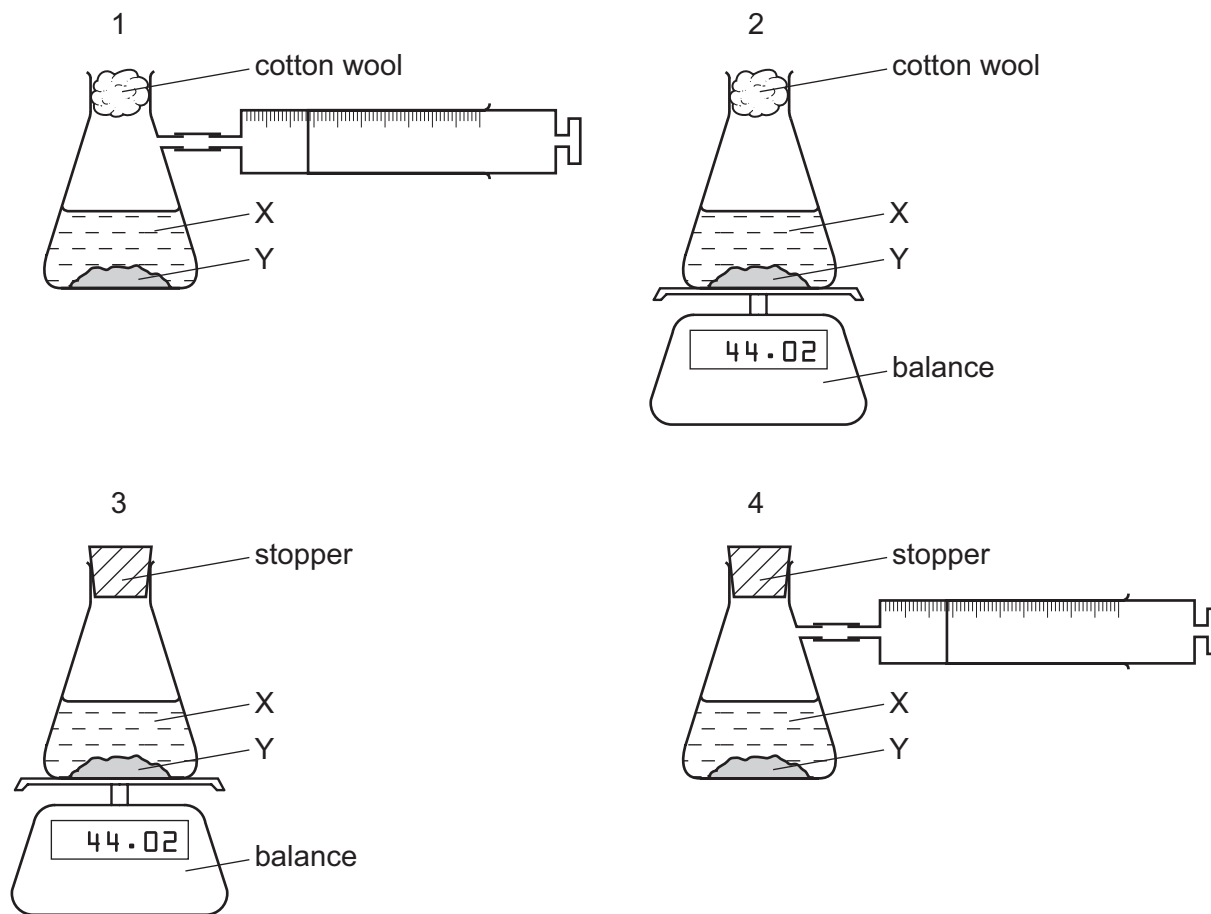
bond	bond energy in kJ/mol
H–H	436
O=O	498
O–H	464

What is the energy given out during the reaction?

- A** –3226 kJ/mol
- B** –884 kJ/mol
- C** –486 kJ/mol
- D** –442 kJ/mol

14 A liquid X reacts with solid Y to form a gas.

Which two diagrams show suitable methods for investigating the rate (speed) of the reaction?



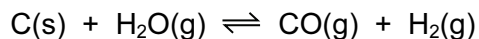
- A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

15 Which statements explain why increasing temperature increases the rate of a chemical reaction?

- 1 Heat makes the molecules move faster and collide more often.
- 2 Heat makes the molecules collide with more energy so they are more likely to react.
- 3 Increasing temperature lowers the activation energy for the reaction.

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

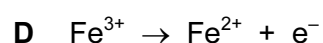
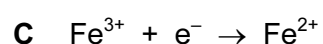
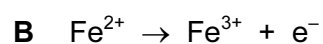
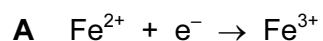
- 16 Steam reacts with carbon in an endothermic reaction.



Which conditions of temperature and pressure would give the largest yield of hydrogen?

	temperature	pressure
A	high	high
B	high	low
C	low	high
D	low	low

- 17 Which equation represents a reduction reaction?



- 18 Which statements are properties of an acid?

1 reacts with ammonium sulfate to form ammonia

2 turns red litmus blue

	1	2
A	✓	✓
B	✓	✗
C	✗	✓
D	✗	✗

- 19 Which row describes whether an amphoteric oxide reacts with acids and bases?

	reacts with acids	reacts with bases
A	no	no
B	no	yes
C	yes	no
D	yes	yes

20 Which substance reacts with dilute sulfuric acid to form a salt that can be removed from the resulting mixture by filtration?

- A** aqueous barium chloride
- B** aqueous sodium hydroxide
- C** copper
- D** copper(II) carbonate

21 Where in the Periodic Table is the metallic character of the elements greatest?

	left or right side of a period	at the top or bottom of a group
A	left	bottom
B	left	top
C	right	bottom
D	right	top

22 Some properties of four elements, P, Q, R and S, are shown in the table.

Two of these elements are in Group I of the Periodic Table and two are in Group VII.

element	reaction with water	physical state at room temperature
P	reacts vigorously	solid
Q	does not react with water	solid
R	reacts explosively	solid
S	dissolves giving a coloured solution	liquid

Which statement is correct?

- A** P is below R in Group I.
- B** Q is above R in Group I.
- C** Q is below S in Group VII.
- D** R is below S in Group VII.

23 Which of the following could be a transition element?

	melting point in °C	density in g/cm ³	colour	electrical conductor
A	114	4.9	purple	no
B	659	2.7	grey	yes
C	1677	4.5	grey	yes
D	3727	2.3	black	yes

24 Two statements about argon are given.

- 1 Argon has a full outer shell of electrons.
- 2 Argon is very reactive and is used in lamps.

Which is correct?

- A** Both statements are correct and statement 2 explains statement 1.
- B** Both statements are correct but statement 2 does not explain statement 1.
- C** Statement 1 is correct but statement 2 is incorrect.
- D** Statement 2 is correct but statement 1 is incorrect.

25 A student investigated the reactions of four metals, R, S, T and U, with solutions of their salts.

The results are given in the table.

metal	metal salt	result
R	S nitrate	reacts
R	T nitrate	reacts
S	U nitrate	no reaction
T	U nitrate	reacts
U	R nitrate	no reaction

What is the order of reactivity of the metals, most reactive first?

- A** R → S → U → T
- B** R → T → U → S
- C** S → U → T → R
- D** U → R → T → S

- 26 Three students, X, Y and Z, were told that solid P reacts with dilute acids and also conducts electricity.

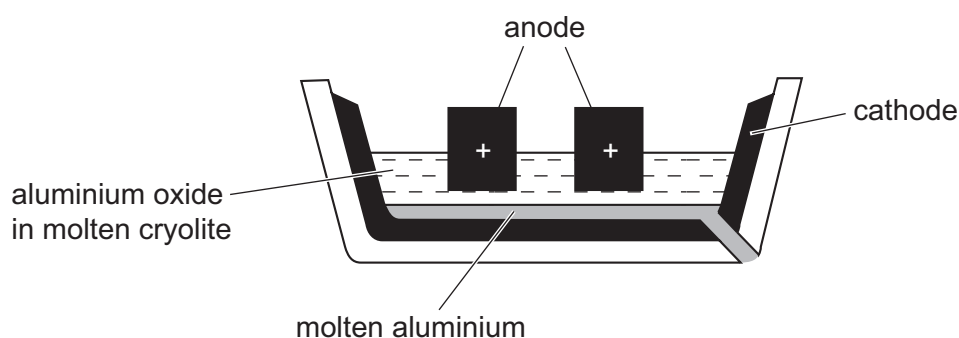
The table shows the students' suggestions about the identity of P.

X	Y	Z
copper	iron	graphite

Which of the students are correct?

- A X, Y and Z B X only C Y only D Z only
- 27 Which statement about the uses of metals is correct?
- A Aluminium is used in the manufacture of aircraft because of its strength and high density.
- B Copper is used in electrical wiring because of its strength and high density.
- C Mild steel is used in the manufacture of car bodies because of its strength and resistance to corrosion.
- D Stainless steel is used in the construction of chemical plant because of its strength and resistance to corrosion.
- 28 Aluminium is manufactured by electrolysis of aluminium oxide.

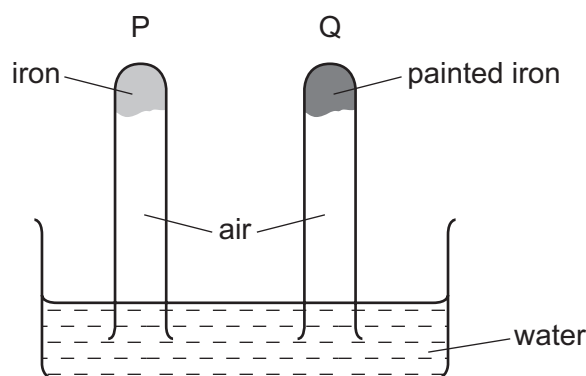
The diagram shows the electrolysis cell.



Which statement about the process is **not** correct?

- A Aluminium ions gain electrons during the electrolysis and are reduced.
- B Cryolite is added to reduce the melting point of the aluminium oxide.
- C The anode and cathode are made of graphite.
- D The cathode has to be replaced regularly because it is burnt away.

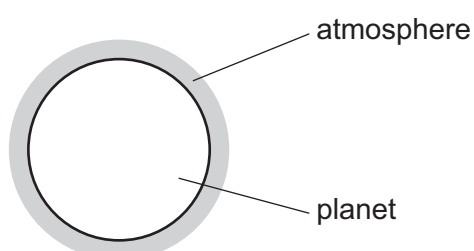
29 The diagram shows an experiment to investigate how paint affects the rusting of iron.



What happens to the water level in tubes P and Q?

	tube P	tube Q
A	falls	rises
B	no change	rises
C	rises	falls
D	rises	no change

30 A new planet has been discovered and its atmosphere has been analysed.



The table shows the composition of its atmosphere.

gas	percentage by volume
carbon dioxide	4
nitrogen	72
oxygen	24

Which gases are present in the atmosphere of the planet in a higher percentage than they are in the Earth's atmosphere?

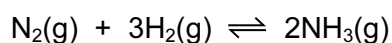
- A** carbon dioxide and oxygen
- B** carbon dioxide only
- C** nitrogen and oxygen
- D** nitrogen only

31 Many car exhaust systems contain a catalytic converter.

Which change does **not** occur in a catalytic converter?

- A carbon dioxide → carbon
- B carbon monoxide → carbon dioxide
- C nitrogen oxides → nitrogen
- D unburnt hydrocarbons → carbon dioxide and water

32 Ammonia is formed by a reversible reaction.

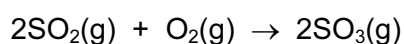


The forward reaction is exothermic.

Which changes in conditions would increase the yield of ammonia?

	increase in pressure	increase in temperature
A	✓	✓
B	✓	x
C	x	✓
D	x	x

33 The equation for an exothermic reaction in the Contact process is shown.



Which effects do increasing the temperature and using a catalyst have on the rate of formation of sulfur trioxide, SO_3 ?

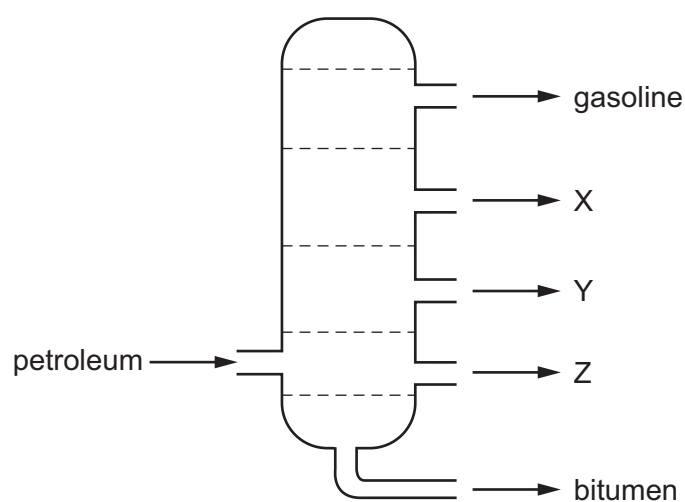
	increasing the temperature	using a catalyst
A	rate decreases	rate decreases
B	rate decreases	rate increases
C	rate increases	rate decreases
D	rate increases	rate increases

34 A farmer's soil is very low in both nitrogen (N) and phosphorus (P).

Which fertiliser would improve the quality of this soil most effectively?

	percentage		
	nitrogen (N)	phosphorus (P)	potassium (K)
A	11	11	27
B	12	37	10
C	28	10	10
D	31	29	9

35 The diagram shows the separation of petroleum into fractions.



What could X, Y and Z represent?

	X	Y	Z
A	diesel oil	lubricating fraction	paraffin
B	lubricating fraction	diesel oil	paraffin
C	paraffin	lubricating fraction	diesel oil
D	paraffin	diesel oil	lubricating fraction

36 Which of the compounds shown are in the same homologous series?

- 1 CH_3OH
- 2 $\text{CH}_3\text{CH}_2\text{OH}$
- 3 CH_3COOH
- 4 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

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

37 Which compounds contain the same number of carbon, hydrogen and oxygen atoms?

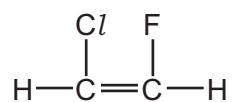
W	X	Y	Z
ethyl methanoate	methyl ethanoate	methyl methanoate	ethyl ethanoate

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

38 What is an advantage of producing ethanol by fermentation of sugar compared to the catalytic addition of steam to ethene?

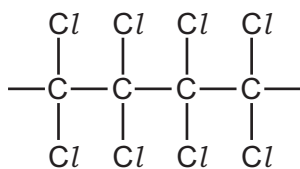
- A** The alcohol produced is purer.
- B** The process is faster.
- C** The process uses high temperature.
- D** The process uses renewable raw materials.

39 The structure of a monomer is shown.

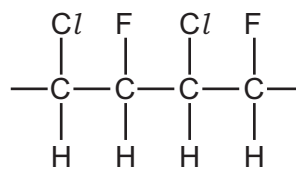


Which polymer can be made from this monomer?

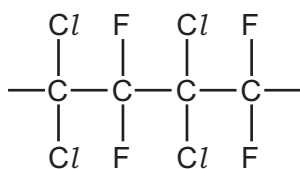
A



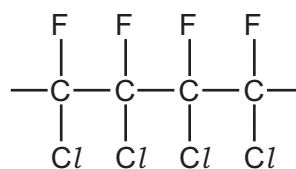
B



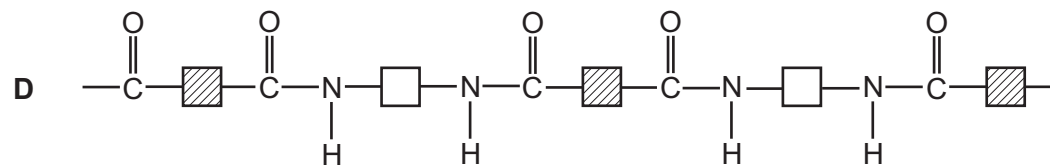
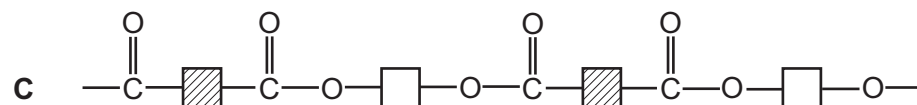
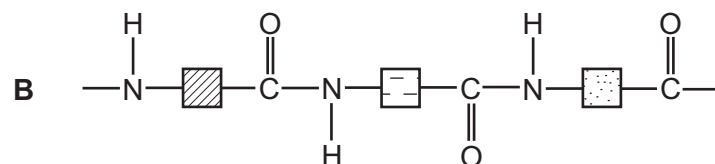
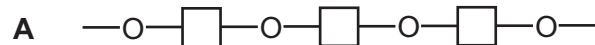
C



D



40 Which formula represents a polyester?



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The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
		1Hhydrogen1																	
		Key atomic number atomic symbol name relative atomic mass																	
3Li lithium 7	4Be beryllium 9													5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	10Ne neon 20
11Na sodium 23	12Mg magnesium 24													13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84		
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131		
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids		72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —	
87Fr francium —	88Ra radium —	89–103 actinoids		104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	114Fl flerovium —	116Lv livermorium —	118Og oganeson —	119Ts tennessine —	120Nh nihonium —	121Og oganeson —	

lanthanoids

actinoids

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