YISHUN SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY 4 EXPRESS

CANDIDATE NAME							
CLASS					INDEX NUMBER		

CHEMISTRY **6092/01**

Paper 1 Multiple Choice **28 August 2024**

1 hour

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** or **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.

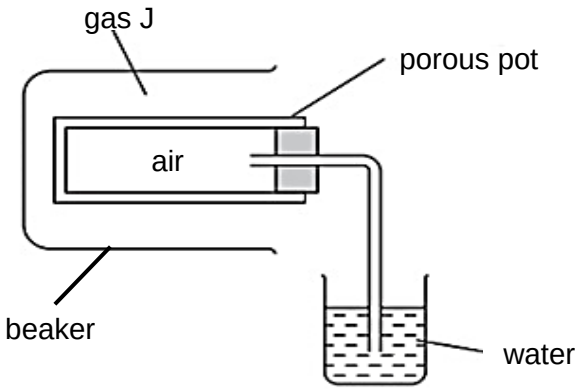
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

1 A student wants to investigate if dissolving 2.35 g of a salt in 25.0 cm^3 of water is an endothermic process.

Which pieces of apparatus are required?

	electronic balance	measuring cylinder	stopwatch	thermometer
A	✓	✓	×	✓
B	✓	×	×	✓
C	×	✓	×	✓
D	✓	×	✓	×

2 The apparatus shown was used to compare the rate of diffusion between gas J and air.



A beaker containing the gas was placed over the porous pot.

Which gas would cause bubbles to be observed in the beaker of water?

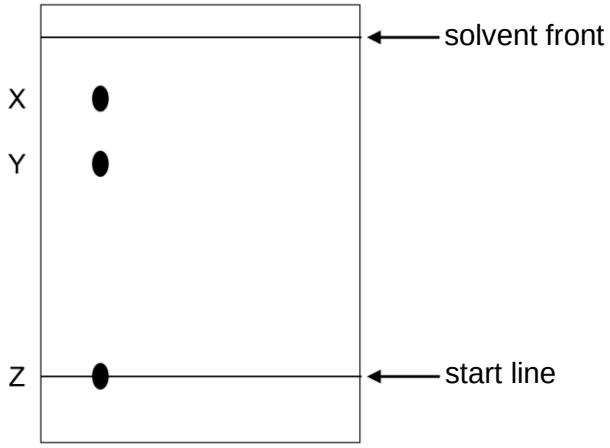
A carbon monoxide

B ethane

C helium

D sulfur dioxide

3 A paper chromatogram was prepared using a mixture of coloured substances.
After drying, the chromatogram is shown.



Which statement is correct?

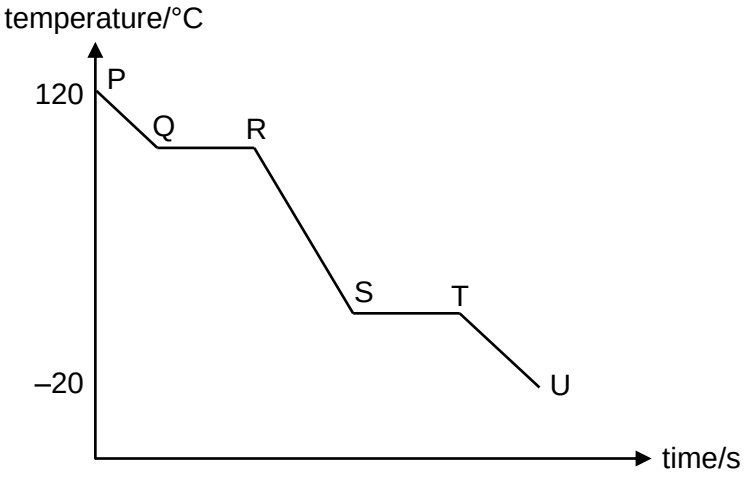
A Locating agents are always needed to interpret a chromatogram.

B The chromatography paper must have been placed with the solvent above level Z.

C The substance at level X has a lower R_f value than the substance at level Y.

D The substance at level X is more soluble than the substance at level Y in the solvent.

4 The graph shows the change in temperature with time when steam is cooled from 120 °C to –20 °C.



Which row shows the correct change taking place between different points of the graph?

	points	change
A	P to Q	kinetic energy of particles remains constant
B	Q to R	water boiling
C	R to S	volume of liquid is decreasing
D	T to U	water freezing

5 Particles of four elements are shown.

$^{20}_{10}Ne$ $^{15}_{7}N^{3-}$ $^{16}_{8}O^{2-}$ $^{17}_{9}F^{-}$

Which statement about all four particles is correct?

A They have the same number of electrons.

B They have the same number of neutrons.

C They have the same number of nucleons.

D They have the same number of protons.

6 The compound $C_2H_3Br_3$ contains only the ^{12}C isotope of carbon and the ^{1}H isotope of hydrogen. The two stable isotopes of bromine are ^{79}Br and ^{81}Br.

Using these two isotopes of bromine, how many different relative molecular masses are possible for $C_2H_3Br_3$?

A 2 **B** 3 **C** 4 **D** 5

7 Some properties of four substances are shown in the table.

Which substance is silver chloride?

	state at room temperature	electrical conductivity at room temperature	electrical conductivity when molten	electrical conductivity when added to water
A	liquid	×	×	✓
B	solid	✓	✓	insoluble
C	solid	×	✓	✓
D	solid	×	✓	insoluble

8 Which two substances have similar three-dimensional arrangements of their atoms?

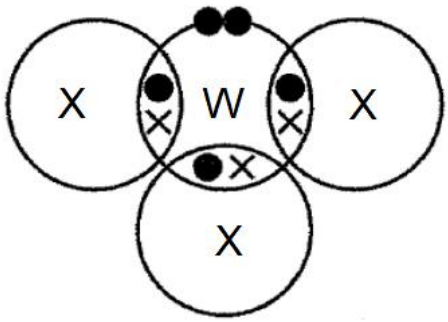
A diamond and silicon dioxide

B graphite and diamond

C carbon dioxide and graphite

D silicon dioxide and carbon dioxide

9 Two elements, W and X, form a compound of formula WX_3.
A 'dot-and-cross' diagram of a molecule of WX_3 is shown. Only the outer shell electrons are shown.



Which statement is **not** correct?

A The molecule contains a total of eight electrons.
B W and X are both non-metals.
C W is in Group 15 of the Periodic Table.
D X is hydrogen.

10 In the liquid state, which substance conducts electricity using mobile electrons?

A ammonia
B ammonium bromide
C copper
D copper(II) chloride

11 Which substance has 7.2×10^{23} atoms?

A 0.2 mol of magnesium metal
B 0.3 mol of ammonia gas
C 0.4 mol of hydrogen chloride
D 1.2 mol of carbon dioxide gas

12 Which compound contains the highest percentage of sulfur by mass?

A SO_2 **B** H_2SO_4 **C** Na_2S **D** PbS_2

13 The empirical formula of cyanogen gas is CN.

1.3 g of cyanogen gas occupied 600 cm^3 at room temperature and pressure.

What is the molecular formula of cyanogen?

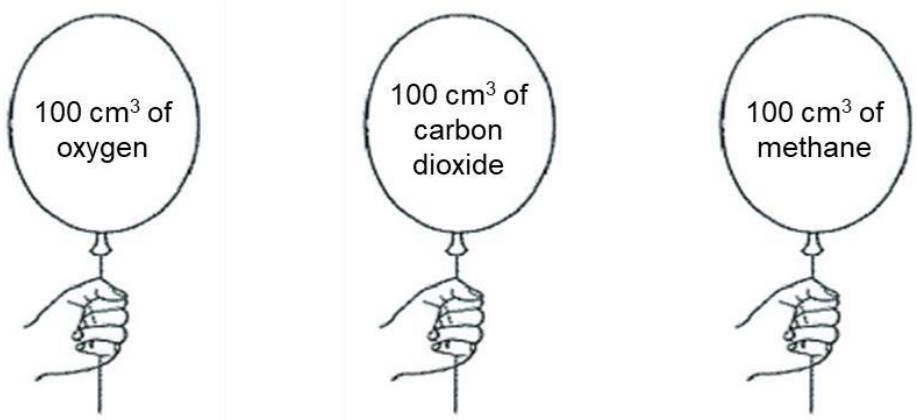
A CN

B C_2N_2

C C_3N_3

D C_4N_4

14 The diagram shows three balloons filled with different gases at room temperature and pressure.



Three statements were made about the balloons.

1 The number of moles of gases in the 3 balloons is the same.
2 The number of molecules in the 3 balloons is different.
3 The mass of gases in the 3 balloons is different.

Which statements are correct?

A 1 and 2

B 1 and 3

C 2 and 3

D 1, 2 and 3

15 When excess aqueous barium chloride is added to 25.0 cm^3 of 1.00 mol/dm^3 sodium sulfate, a white precipitate of barium sulfate is formed.

$$Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$$

The precipitate is filtered off, washed, dried and weighed. 5.36 g barium sulfate is obtained.

What is the percentage yield of barium sulfate?

A 2.3 %

B 27 %

C 92 %

D 97 %

16 Which equation represents the ionic equation of the reaction between zinc and dilute hydrochloric acid?

A $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$

B $Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + 2H(aq)$

C $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(s) + H_2(g)$

D $Zn(s) + 2HCl(aq) \rightarrow Zn^{2+}(aq) + 2Cl^-(aq) + H_2(g)$

17 Excess aqueous ammonia is added to a solution containing aluminium ions, copper(II) ions and zinc ions. The mixture is then filtered.

Which ions will be found in the resulting residue?

A aluminium ions

B aluminium ions and zinc ions

C copper(II) ions

D copper(II) ions and zinc ions

18 Which three salts are all prepared by precipitation?

A barium sulfate, calcium nitrate, silver chloride

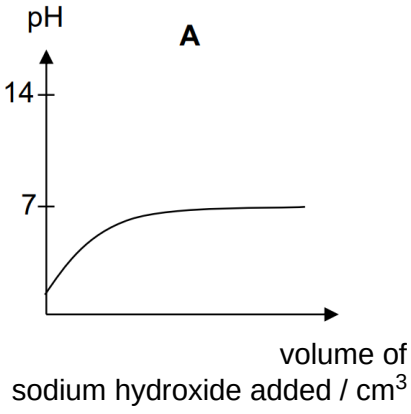
B barium sulfate, lead(II) chloride, silver nitrate

C calcium sulfate, lead(II) sulfate, silver chloride

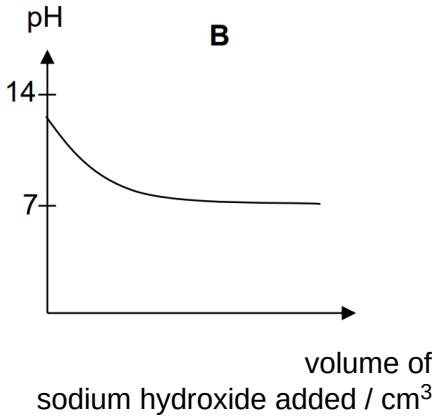
D calcium sulfate, lead(II) sulfate, silver nitrate

19 Which graph shows the changes in pH as an excess of aqueous sodium hydroxide is added gradually to hydrochloric acid solution?

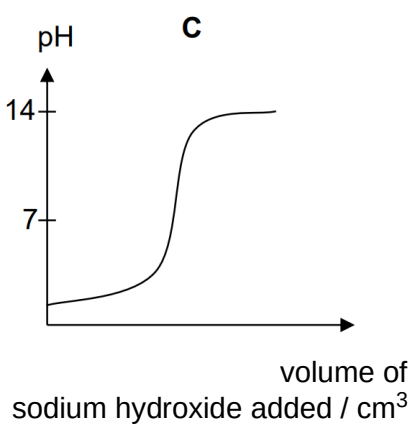
A



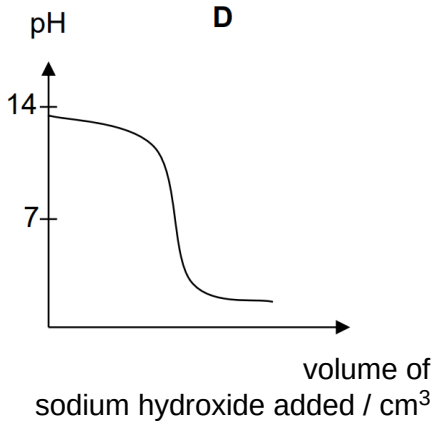
B



C



D



20 In the manufacture of ammonia, which action will help to reduce costs while maintaining a good yield of ammonia?

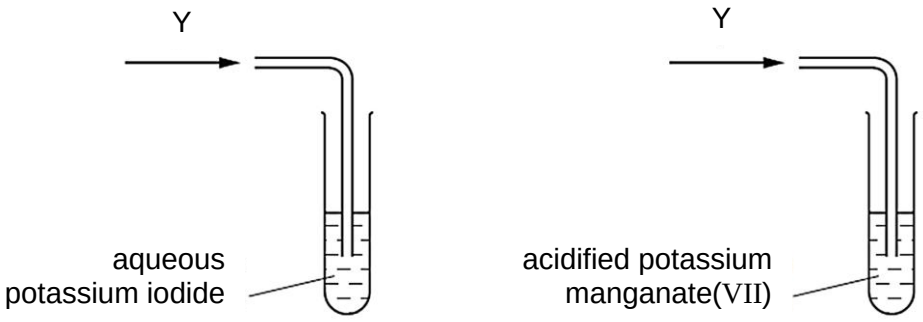
A adding more iron catalyst to the reaction mixture

B decreasing the volumes of nitrogen and hydrogen gases added

C increasing the pressure exerted on the reaction mixture

D pumping unreacted nitrogen and hydrogen gases back for further reaction

21 Gaseous compound Y is an oxidising agent.
Y is bubbled through separate solutions of potassium iodide and acidified potassium manganate(VII).



Which row shows the colour changes when Y is bubbled through these two solutions?

	potassium iodide solution	acidified potassium manganate(VII) solution
A	colourless to brown	purple to colourless
B	colourless to brown	solution remains purple
C	solution remains colourless	solution remains purple
D	solution remains colourless	purple to colourless

22 Sulfur dioxide is an atmospheric pollutant that causes acid rain.
One of the reactions in this process is the conversion of sulfur dioxide to sulfur trioxide by two stages.

stage 1: $2NO + O_2 \rightarrow 2NO_2$

stage 2: $NO_2 + SO_2 \rightarrow SO_3 + NO$

Which statement is correct?

A Nitrogen dioxide is a reducing agent in stage 2.

B Nitrogen monoxide is reduced in stage 1.

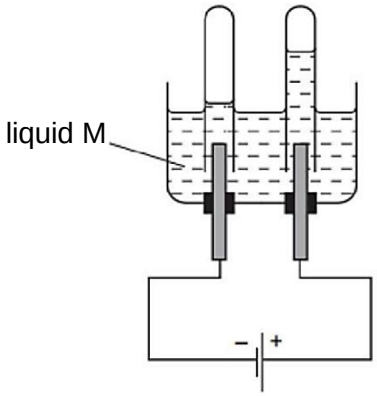
C Oxygen is reduced in stage 1 due to a decrease in its oxidation state.

D Sulfur dioxide is an oxidising agent in stage 2.

23 In which electrolysis experiment would there be **no** change in the concentration of the electrolyte?

	electrolyte	electrodes
A	aqueous copper(II) sulfate	carbon
B	aqueous copper(II) sulfate	copper
C	concentrated aqueous potassium chloride	carbon
D	dilute sulfuric acid	platinum

24 The diagram shows the electrolysis of liquid M using inert electrodes.



Which row does **not** show the products formed at the electrodes from the electrolyte?

	products formed at		electrolyte
	negative electrode	positive electrode	
A	hydrogen	chlorine	concentrated sodium chloride
B	hydrogen	chlorine	concentrated hydrochloric acid
C	hydrogen	oxygen	dilute copper(II) chloride
D	hydrogen	oxygen	dilute sulfuric acid

25 Which pair of metals S and T will produce the highest voltage when used as electrodes in a simple cell?

	S	T
A	copper	silver
B	magnesium	silver
C	magnesium	zinc
D	zinc	copper

26 Some properties of elements in the same group of the Periodic Table are listed.

1 charge on the ion
2 number of outer shell electrons
3 number of protons
4 total number of inner shell electrons

Which properties show an increase as the group is descended?

A 1 and 2

B 1 and 3

C 2 and 4

D 3 and 4

27 In the equation shown, X and Y represent elements in Group 17 of the Periodic Table.

$$X_2 + 2KY \rightarrow Y_2 + 2KX$$

Which pair of elements could be X and Y?

	X	Y
A	chlorine	iodine
B	bromine	chlorine
C	iodine	bromine
D	iodine	fluorine

28 Sodium reacts with water to form solution L and gas M. When solution L reacts with dilute sulfuric acid, salt N is formed.

What are the formulae of L, M and N?

	L	M	N
A	NaOH	H_2	Na_2SO_4
B	NaOH	O_2	$NaSO_4$
C	$Na(OH)_2$	H_2	$NaSO_4$
D	$Na(OH)_2$	O_2	Na_2SO_4

29 Which property is **not** typical of transition metals?

A They form coloured compounds.

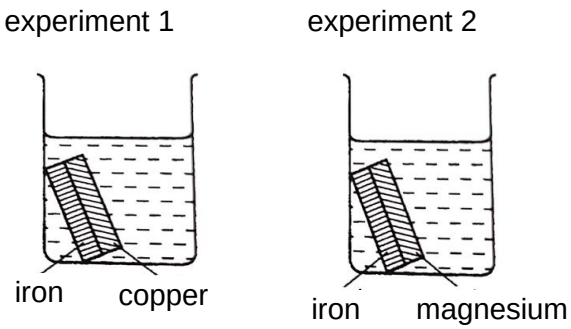
B They have high melting points.

C They have low densities.

D They show variable oxidation states.

30 Two large pieces of iron are placed in water.

In experiment 1, a piece of copper is attached to the iron.
In experiment 2, a piece of magnesium is attached to the iron.



Which pair of equations represent the reactions in experiment 1 and 2?

	reaction in experiment 1	reaction in experiment 2
A	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
B	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$	$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$
C	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
D	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$	$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

31 When ammonia is burnt in oxygen, it produces nitrogen and water vapour.

$$4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(g)$$

The bond energies of the reactants and products of a reaction are shown in the table.

bond	bond energy in kJ/mol	bond	bond energy in kJ/mol
N-H	391	O–O	204
N=N	418	O=O	498
N≡N	945	O–H	467

What is the enthalpy change of the reaction?

A +4692 kJ

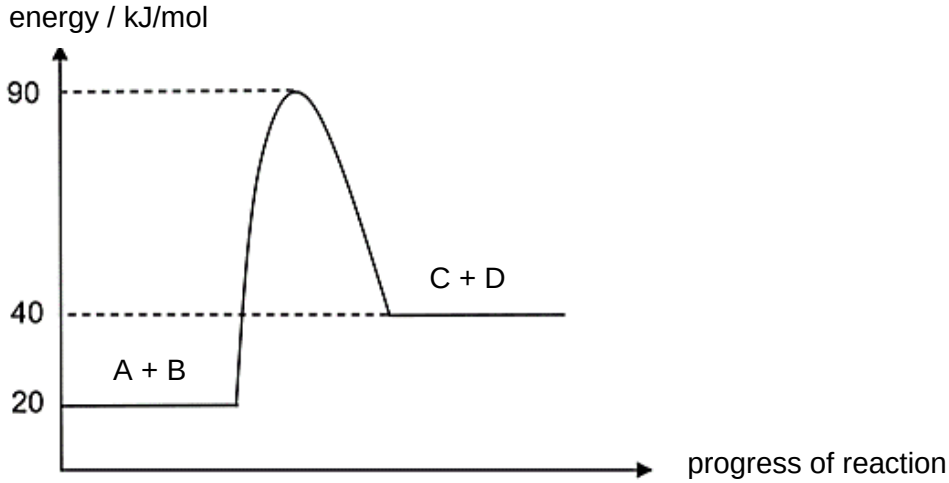
B –2025 kJ

C –1308 kJ

D +2667 kJ

32 The energy profile diagram of a reversible reaction is shown.

$$A + B \rightleftharpoons C + D$$



Which statement is correct about the reaction?

A Activation energy of the forward reaction is given by +90 kJ/mol.

B Enthalpy change of the forward reaction is given by −20 kJ/mol.

C Activation energy of the backward reaction is given by +50 kJ/mol.

D Enthalpy change of the backward reaction is given by +20 kJ/mol.

33 The table shows the results of an experiment to show the rate of decomposition of aqueous hydrogen peroxide under different conditions.

experiment	concentration of aqueous hydrogen peroxide/ moldm^{-3}	manganese(IV) oxide
1	0.1	powder
2	0.3	lumps
3	0.1	lumps
4	0.2	powder

Which experiments are used to investigate how surface area of reactants affect the rate of decomposition?

A 1 and 2

B 1 and 3

C 1 and 4

D 2 and 4

34 Which statement about the fractional distillation of petroleum is correct?

A At each level in the distillation column, only one compound is collected.

B The higher up the distillation column, the higher the temperature.

C The molecules collected at the bottom of the distillation column are the most flammable.

D The molecules reaching the top of the distillation column have the smallest relative molecular masses.

35 A molecule of tricosane, $C_{23}H_{48}$, undergoes cracking to produce one molecule of propane, four molecules of ethene and the rest are propene molecules.

How many propene molecules are produced?

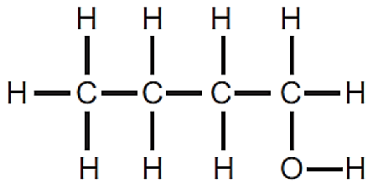
A 2

B 4

C 8

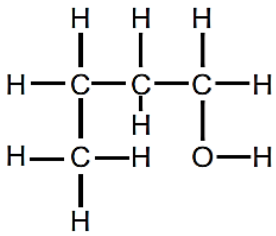
D 12

36 Compound Q has the structure shown.



Which structure is an isomer of Q?

A



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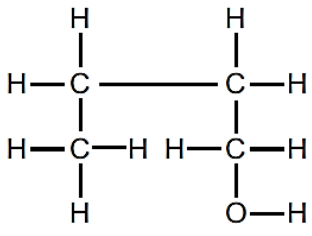
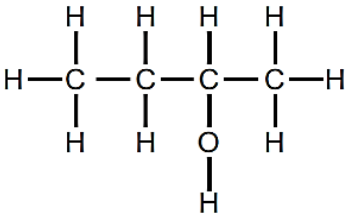
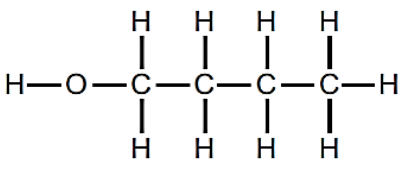


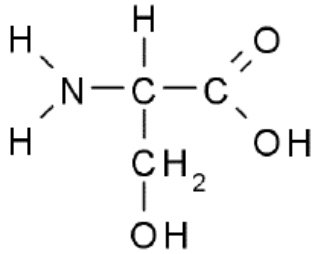
C



D



37 The structure of an amino acid, serine, is shown.



Which statement about serine is true?

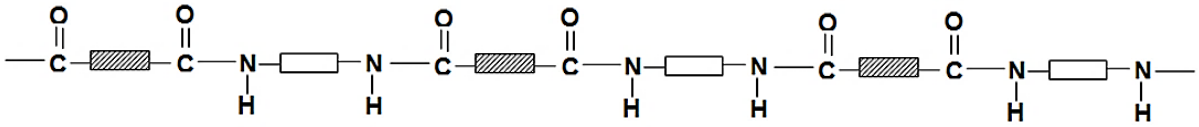
A It burns in air to produce carbon dioxide and water only.

B It can undergo addition polymerisation with other amino acids.

C It does not decolourise acidified potassium manganate(VII).

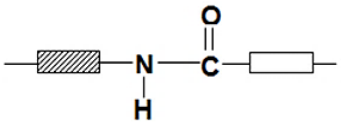
D It produces carbon dioxide when reacted with sodium carbonate.

38 The diagram shows part of a nylon molecule.



What is the simplest repeat unit in the structure of nylon?

A



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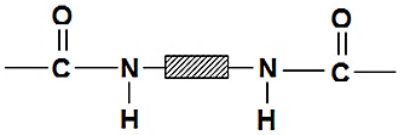
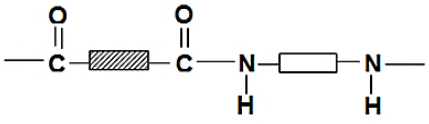
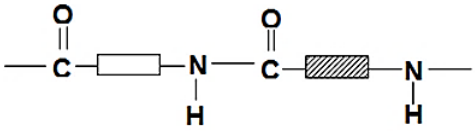


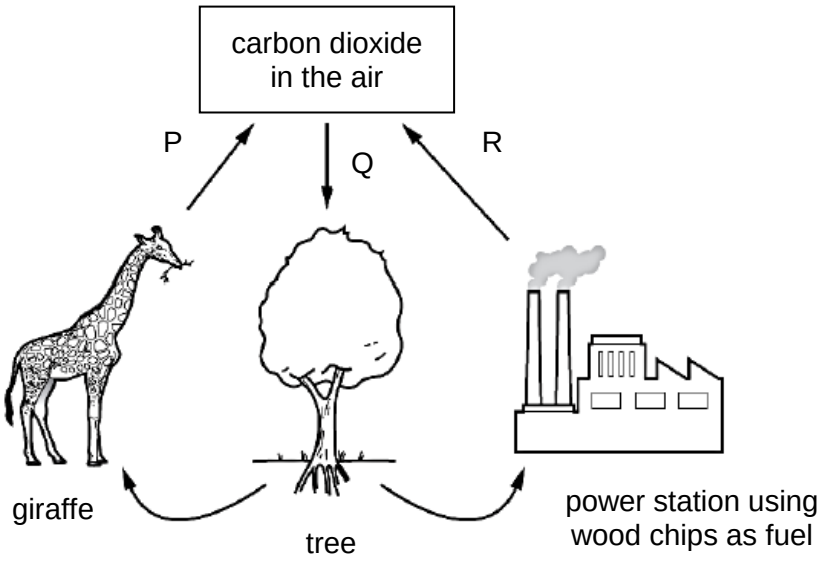
C



D



39 The diagram shows part of the carbon cycle.



Which row correctly identifies P, Q and R as exothermic or endothermic reactions?

	P	Q	R
A	endothermic	exothermic	exothermic
B	exothermic	exothermic	exothermic
C	exothermic	endothermic	exothermic
D	exothermic	endothermic	endothermic

40 A student wrote the following statements on catalytic converters in his notebook.

1 It converts nitrogen oxide into nitrogen as the only product.
2 It is a device that uses basic redox reactions to reduce the pollutants the car makes.
3 It produces a greenhouse gas that contributes significantly to global warming.
4 The converter contains transition metals which catalyses the reaction between polluting gases produced by the car engine.

Which statements about catalytic converter are correct?

A 2 and 4

B 1, 2 and 4

C 2, 3 and 4

D 1, 2, 3 and 4

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The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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 –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).
The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}