1 An experiment is carried out to determine the rate of thermal decomposition of zinc carbonate.

$$ZnCO_3 \rightarrow ZnO + CO_2$$

Which set of measuring apparatus is necessary for the experiment?

A burette, gas syringe, pipette

B electronic balance, gas syringe, stopwatch

C electronic balance, pipette, thermometer

D measuring cylinder, stopwatch, gas syringe

2 An organic solvent, hexane and aqueous sodium chloride are accidentally mixed together.

Which methods of separation are needed to obtain pure samples of hexane and solid sodium chloride?

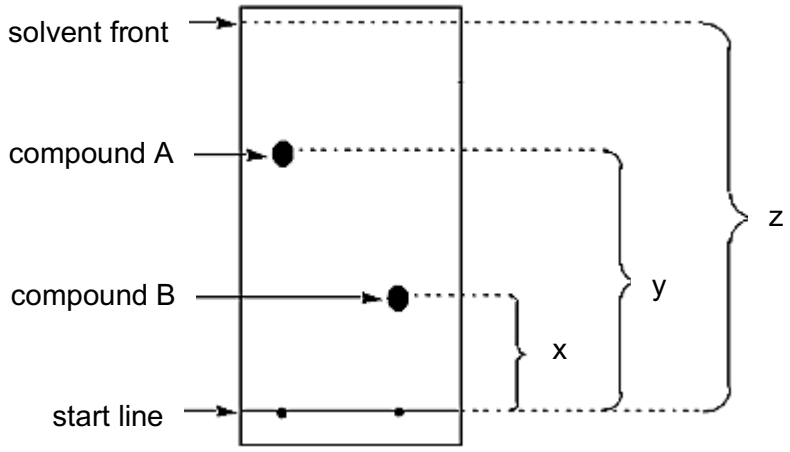
A filtration followed by crystallisation

B fractional distillation followed by evaporation to dryness

C simple distillation followed by crystallisation

D using a separating funnel followed by evaporation to dryness

3 A paper chromatogram is shown in the diagram below.



Which of the following statements is true?

A Compound A is heavier than B.

B Compound A is more soluble in solvent than B.

C The R_f value of compound A, y, is greater than compound B, x.

D The solvent level is placed above the starting line.

4 Which statement is correct about a solid being heated to become a liquid?

A The forces of attraction between the particles decreases.

B The speed of the particles decreases.

C The size of the particles decreases.

D The strength of the covalent bonds within each particle decreases.

5 The rate of diffusion of nitrogen and ammonia gases were compared at 50 °C and 25 °C.

Which would have the slowest rate of diffusion?

A Nitrogen gas at 50 °C.

B Nitrogen gas at 25 °C.

C Ammonia gas at 50 °C.

D Ammonia gas at 25 °C.

6 C*l*-35 and C*l*-37 are two isotopes of chlorine.

Which statements are correct?

1 They have the same atomic number.
2 They have the same mass number.
3 They have the same physical properties.
4 They have the same chemical properties.

A 1 and 2 only

B 1 and 4 only

C 2 and 3 only

D 2 and 4 only

7 Which statement(s) correctly describe(s) properties of a compound, copper(II) sulfide and a mixture of copper and sulfur?

	compound copper(II) sulfide	mixture of copper and sulfur
1	copper and sulfur react when heated to form copper(II) sulfide	copper and sulfur mix together without any heat involved
2	the ratio of copper to sulfur is always 1:1	the ratio of copper to sulfur in the mixture can vary
3	copper(II) sulfide has the properties of copper and sulfur	the mixture does not have the properties of copper and sulfur

A 1 only

B 1 and 2

C 2 and 3

D 1,2 and 3

8 The table shows four elements, P, Q, R and S with their atomic numbers.

element	P	Q	R	S
atomic number	6	8	13	17

Which row shows the formulae of the compounds formed from the four elements?

	formula of ionic compound formed	formula of covalent compound formed
A	PR_2	QS_2
B	PS_2	R_2Q
C	R_2Q_3	PS_4
D	RS_2	PQ_2

9 Silver, graphite, silver nitrate and sulfur dioxide show different physical properties.

Which statement is correct?

A Silver and silver nitrate can conduct electricity in water due to their free moving ions.

B Graphite can conduct electricity within each layer in its structure due to free moving electrons.

C Sulfur dioxide has a low boiling point as weak forces of attraction between its atoms are overcome during boiling.

D Silver has high melting point due to the strong electrostatic forces of attraction between oppositely charged ions in its structure.

10 Caffeine, $C_8H_{10}N_4O_2$, is present in coffee and tea.

[A_r: C, 12; H, 1; N, 14; O, 16]

What is the percentage by mass of nitrogen in caffeine?

A 7%

B 14%

C 29%

D 58%

11 8 g of X_2O_3, an oxide of element X, contains 70 % of X.

How many moles of X does 8 g X_2O_3 contain?

A $\frac{8}{16} \times \frac{3}{2}$

B $\frac{8}{16} \times \frac{2}{3}$

C $\frac{2.4}{16} \times \frac{3}{2}$

D $\frac{2.4}{16} \times \frac{2}{3}$

12 When 42.0 g of lead(II) carbonate (M_r = 267) is strongly heated, 2.5 dm^3 of carbon dioxide, measured at room temperature and pressure, is produced.

$$PbCO_3 \rightarrow PbO + CO_2$$

What is the percentage yield of carbon dioxide?

A 15%

B 28%

C 35%

D 66%

13 The information about two indicators is given.

indicator	description
Thymol blue	• red in colour when pH is less than 3. • colour changes to yellow around pH 3, and changes colour a second time to blue around pH 9.
Phenolphthalein	• colourless when pH is less than 10 • changes colour to red at about pH 10

What would be the colour of aqueous potassium chloride solution when both indicators are added to the solution?

A blue

B green

C orange

D yellow

14 H, J and L are in the same period in the Periodic Table.

- The oxide of H dissolves in water to form a solution with a pH of 12.5.
- The oxide of J forms a solution with a pH less than 4.5.
- The oxide of L is soluble in both aqueous potassium hydroxide and dilute nitric acid.

Which option shows the position of the elements in order of decreasing atomic number?

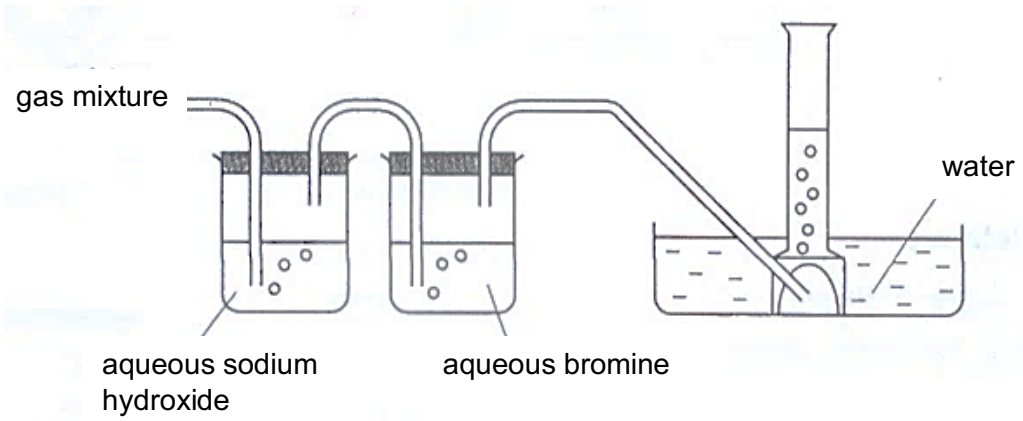
A H, J, L

B H, L, J

C J, L, H

D L, J, H

15 A gaseous mixture of propene, carbon dioxide, oxygen and sulfur dioxide is passed through the apparatus shown. Only one of the gases is collected.



A Gas relights a glowing splint.

B Gas forms a white precipitate with limewater.

C Gas turns moist blue litmus paper red.

D Gas decolourises purple acidified potassium manganate(VII).

16 Silver nitrate is made by reacting an excess of a powdered solid with an aqueous solution.

The mixture is filtered and the filtrate crystallised.

Which row identifies a powdered solid and an aqueous solution that can be used to prepare a pure sample of silver nitrate?

	powdered solid	aqueous solution
A	silver	zinc nitrate
B	silver oxide	sodium nitrate
C	silver carbonate	dilute nitric acid
D	silver chloride	zinc nitrate

17 Which statement about transition metals is **incorrect**?

A Only transition metals or their compounds are used as catalyst.

B Transition metals form coloured compounds.

C Transition metals conduct electricity due to free-moving electrons.

D Transition metals have variable oxidation states.

18 Which of the following statements regarding caesium are correct?

1 It reacts with water to form a metal oxide and hydrogen gas.
2 It reacts with dilute acid to release more heat than potassium.
3 It has a lower density than sodium.
4 It has a lower melting point than lithium.

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

19 P, Q and R are elements found in Group 17 of the Periodic Table.

Three reactions are carried out to determine the reactivity of P, Q and R.

1 $P_2\,(aq) + 2R^-\,(aq) \rightarrow R_2\,(aq) + 2P^-\,(aq)$
2 $Q_2\,(aq) + 2P^-\,(aq) \rightarrow$ no reaction
3 $Q_2\,(aq) + 2R^-\,(aq) \rightarrow R_2\,(aq) + 2Q^-\,(aq)$

Which statement about P, Q and R is correct?

A Q is more reactive than P.
B P has a darker colour than R.
C Q is a stronger oxidising agent than R.
D R is a gas at room temperature and pressure.

20 Which statement about the industrial production of ammonia is correct?

A The production of ammonia is an exothermic reaction.
B The hydrogen used is obtained from the fractional distillation of liquefied air.
C 1 mole of hydrogen reacts with 3 moles of nitrogen to give 2 moles of ammonia.
D Adding iron will provide an alternative pathway with higher activation energy.

21 An aqueous solution containing two salts is found.

A series of tests is carried out to identify the ions present. The results are shown.

test	observations
Add dilute nitric acid followed by aqueous lead(II) nitrate.	No effervescence and white precipitate is observed.
Add aqueous sodium hydroxide followed by warming.	White precipitate is formed and dissolves in excess sodium hydroxide to form a colourless solution. No effervescence is observed.
Add aluminium foil followed by warming.	Effervescence is observed and gas turns moist red litmus paper blue.
Add aqueous ammonia.	White precipitate is formed. The mass of the white precipitate decreases by half when excess ammonia is added.

Which of the following salts are present in the aqueous solution?

A zinc sulfate and aluminium nitrate

B zinc sulfate and calcium nitrate

C ammonium chloride and aluminium sulfate

D calcium chloride and ammonium sulfate

22 When aqueous potassium iodide is added to hydrogen peroxide, the following reactions are observed.

$$H_2O_2\,(aq) + I^-\,(aq) \rightarrow IO^-\,(aq) + H_2O\,(l)$$

$$H_2O_2\,(aq) + IO^-\,(aq) \rightarrow I^-\,(aq) + H_2O\,(l) + O_2\,(g)$$

There is a vigorous reaction and energy is liberated very rapidly, leading to a rise in temperature of the reaction mixture.

What is the role of aqueous potassium iodide in the overall reaction?

A as a base

B as a catalyst

C as a reducing agent

D as an oxidising agent

23 Which process does **not** involve either oxidation or reduction?

A formation of zinc from zinc sulfide

B formation of sulfuric acid from sulfur

C formation of nitrogen monoxide from ammonia

D formation of ammonium nitrate from ammonia and nitric acid

24 In an electrolysis experiment, the same amount of charge deposited 54.0 g of silver and 8.5 g of vanadium.

What is the formula of the vanadium ion?

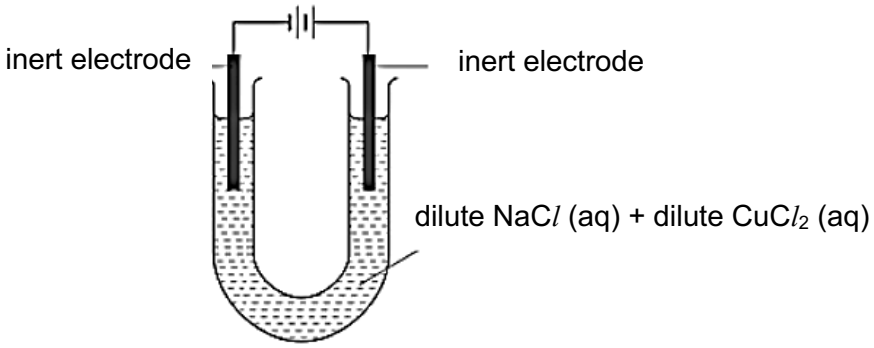
A V^{+}

B V^{2+}

C V^{3+}

D V^{4+}

25 The diagram shows an electrolysis of dilute aqueous sodium chloride and dilute aqueous copper(II) chloride.



Which statement(s) about the experiment is/are correct?

1 Green-yellow gas can be observed at the anode.
2 Reddish-brown solid deposit on the surface of the cathode.
3 The colour intensity of the solution remains unchanged.

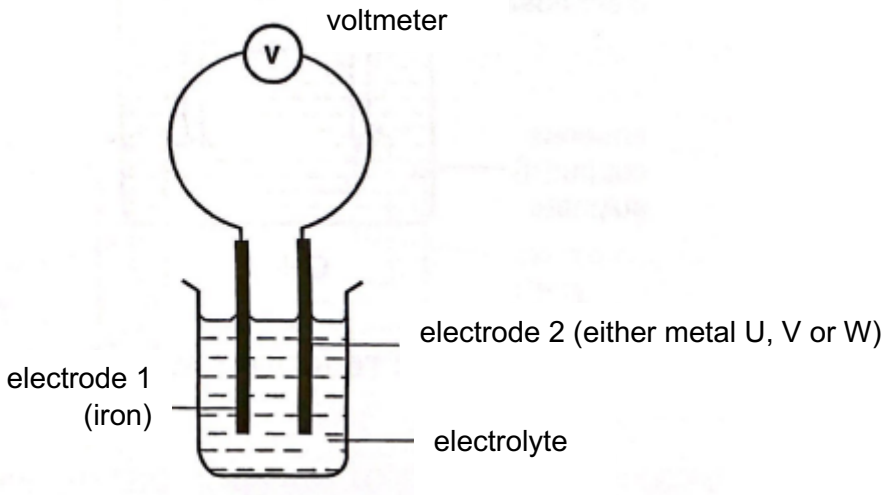
A 1, 2 and 3

B 1 and 2 only

C 2 only

D 3 only

26 Three simple cells are set up using iron metal as electrode 1 and three other unknown metals, U, V and W, separately as electrode 2.



The results of the experiments are shown in the table.

metal used as electrode 2	voltmeter reading/ V	positive electrode
U	-1.93	Fe
V	+0.78	V
W	+1.09	W

Which row shows the correct metal for U, V and W?

	metal U	metal V	metal W
A	copper	lead	magnesium
B	lead	magnesium	copper
C	magnesium	copper	lead
D	magnesium	lead	copper

27 Metal Q is above zinc and below magnesium in the reactivity series.

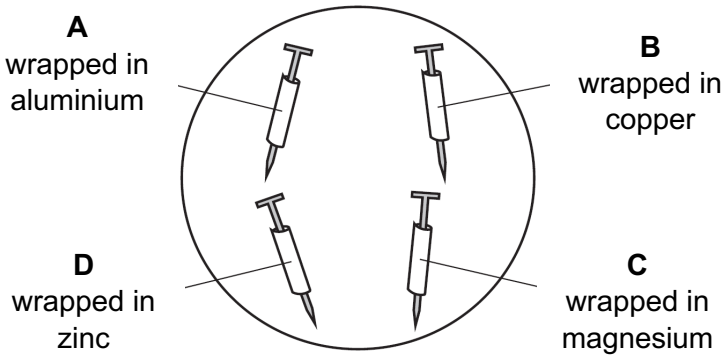
Which row correctly shows how metal Q can be obtained from its oxide?

	heating with carbon	heating with hydrogen	by electrolysis
A	✓	×	✓
B	✓	×	×
C	×	✓	×
D	×	×	✓

28 Four iron nails had different metals wrapped around them.

The nails were placed in an open dish filled with water and left for a week.

Which iron nail has no protection against rusting?



29 For which does 10 g of the metal have the most electrons in its sea of electrons?

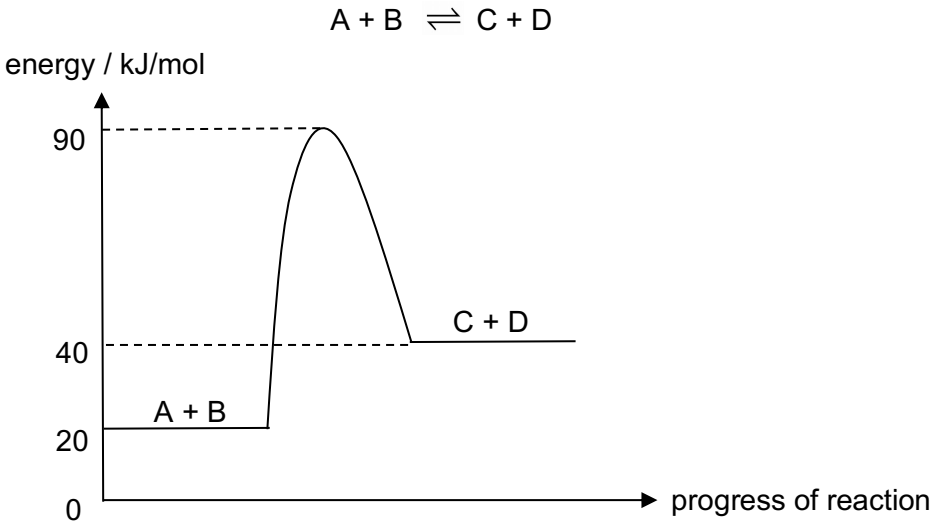
A aluminium

B lithium

C magnesium

D sodium

30 The energy profile diagram of a reversible reaction is shown below.



What is the value of the activation energy for the backward reaction?

A 90 kJ/mol

B 70 kJ/mol

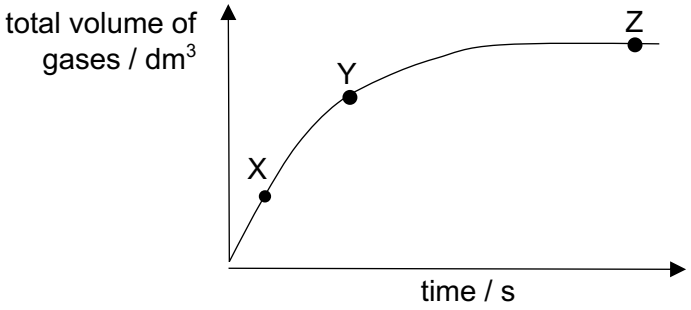
C 50 kJ/mol

D 20 kJ/mol

31 In a water gas shift reaction, excess carbon monoxide can react with 1.5 dm^3 of steam in a fixed volume reactor to produce the hydrogen required for Haber process.

$$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$$

The graph shows the total volume of gases evolved plotted against time.



Which of the following statements about the reaction and graph is correct?

A The speed of reaction decreases from point X to point Y and then first reaches completion at point Z.

B The total volume of gases evolved at point Z increases if a catalyst is added.

C The time taken to reach completion increases if the temperature of the reaction is increased.

D The total volume of gases evolved is greater if a larger volume of steam is used.

32 If a strip of magnesium is dropped into an excess hydrochloric acid, an exothermic reaction occurs.

Why does the rate of reaction increase during the first few seconds?

A the solution is becoming hotter

B the amount of magnesium is decreasing

C the magnesium is acting as a catalyst

D the surface area of the magnesium is increasing

33 Which of the following are correct about the effect of changing pressure in a chemical reaction?

1 Decreasing pressure leads to a decrease in the kinetic energy of the reacting particles.
2 Decreasing pressure leads to lower frequency of effective collisions between reacting particles.
3 Increasing pressure of a chemical reaction always increases the rate of reaction.
4 Increasing pressure leads to an increase in number of gaseous reacting particles per unit volume.

A 1 and 3 only

B 2 and 4

C 1, 2 and 4

D 2, 3 and 4

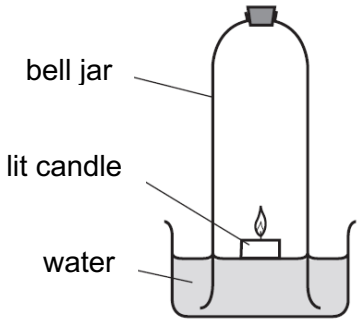
34 Which row correctly shows both the source and effect of the named pollutant?

	pollutant	source	effect
A	methane	incomplete combustion of carbon-containing substances	irritation to eyes
B	oxides of nitrogen	volcanic emission	acid rain
C	ozone	photochemical reactions	irritation to eyes
D	sulfur dioxide	lightning activity	acid rain

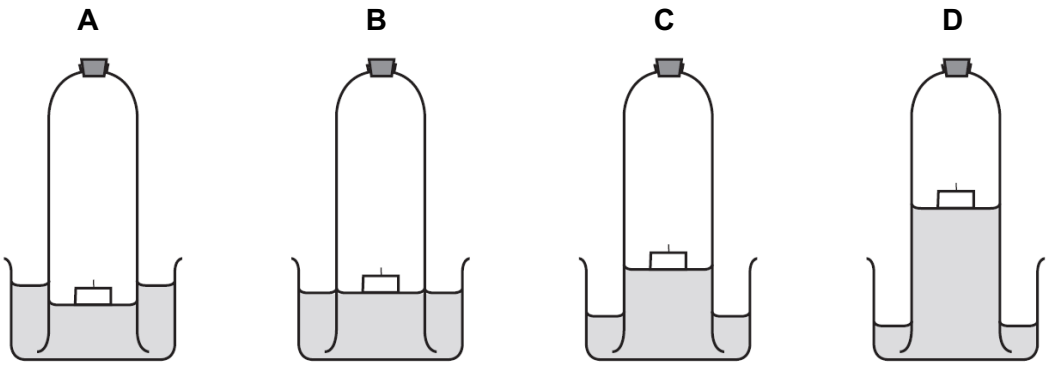
35 The atmosphere of a newly discovered planet contains the following gases:

carbon dioxide	15%
nitrogen	10%
noble gases	20%
oxygen	55 %

The apparatus below was set up with a 100 cm^3 sample of the atmosphere of the planet in the bell jar. The volume of the sample was measured at intervals until no further change in volume took place.



Which diagram shows the correct level of water after the candle stops burning?



36 Four alkanes, P, Q, R, S, were extracted from a fractional distillation sample of crude oil.

- P is less flammable than S.
- S is more viscous than Q.
- R is denser than Q and S.

Which of the following shows the sequence in which the alkanes were collected, in order of increasing boiling point?

A P, Q, R, S

B P, R, S, Q

C R, S, Q, P

D Q, S, R, P

37 When dodecane, $C_{12}H_{26}$, is cracked, only three compounds are formed.

The compounds are ethene, ethane and propene.

What is the ratio of the compounds formed?

	ethene	ethane	propene
A	1	1	2
B	1	2	2
C	2	2	1
D	2	1	2

38 Which organic compound is used as a solvent, a renewable fuel and in the production of vinegar?

A CH_3CH_2OH

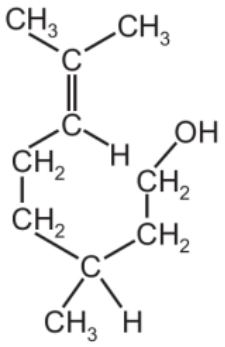
B CH_3COOH

C $CH_3CH_2CH_2OH$

D CH_3CH_2COOH

39 Citronellol is found in rose oil.

The structure of citronellol is shown.



Which statement about citronellol is correct?

A Citronellol dissolves in water to give an alkaline solution.

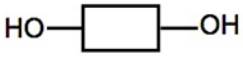
B Citronellol forms a polymer with the same empirical formula as the monomer.

C Citronellol reacts with zinc at room temperature to give a salt and a colourless gas.

D Citronellol reacts with hydrogen in the presence of a catalyst to give an unsaturated compound.

40 The structure of five monomers are shown.

1



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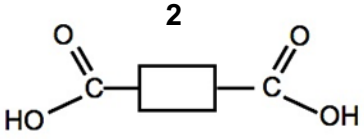

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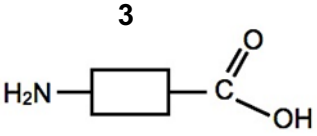

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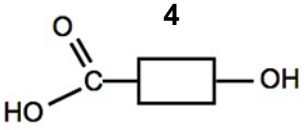

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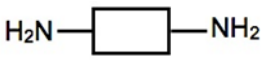
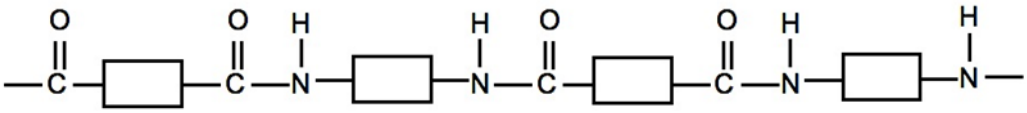


Which pair of monomers will form a polyamide with the structure shown below?



A 1 and 2

B 2 and 3

C 2 and 5

D 4 and 5

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		**Key** proton (atomic) number atomic symbol name relative atomic mass									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 –

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}