



ZHONGHUA SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2023
SECONDARY 4 EXPRESS

Candidate's Name	Class	Register Number
	4E	

CHEMISTRY

6092/01

25 Aug 2023
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS 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 OTAS.

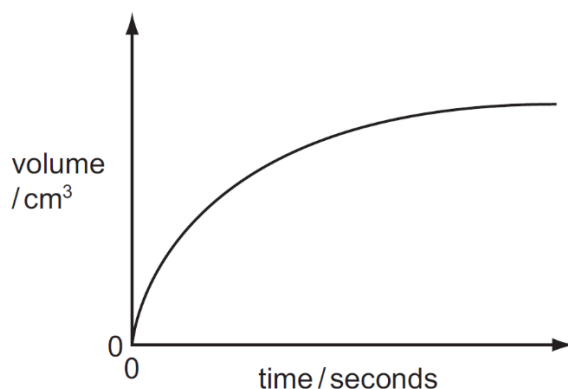
Read the instructions on the OTAS very carefully.

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.

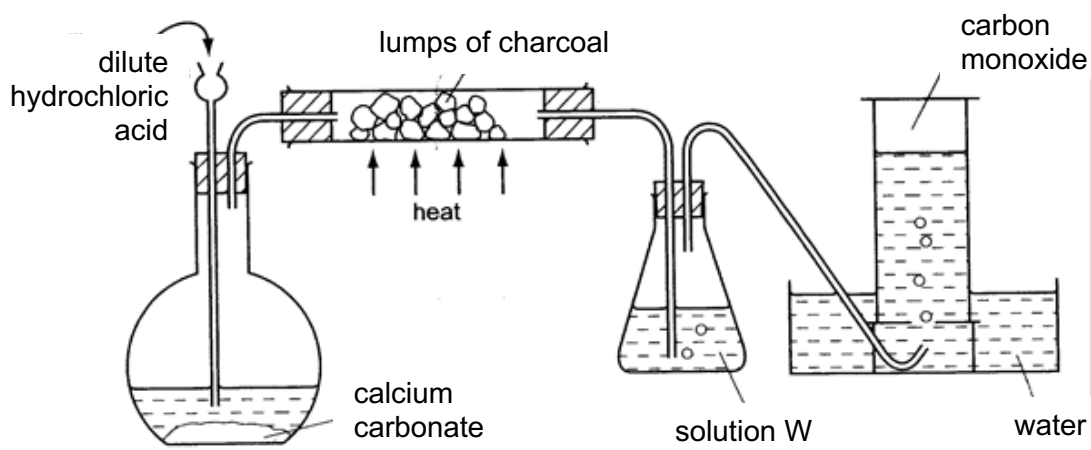
A copy of the Periodic Table is printed on page 16.

- 1 A student measured the rate of reaction between calcium carbonate and dilute hydrochloric acid. A graph showing the volume of gas produced against time is shown.



Which apparatus was used to measure the variables shown on the graph?

- A burette and stopwatch
 - B electronic balance and burette
 - C electronic balance and gas syringe
 - D gas syringe and stopwatch
- 2 The diagram below shows the apparatus used to obtain the gas carbon monoxide.

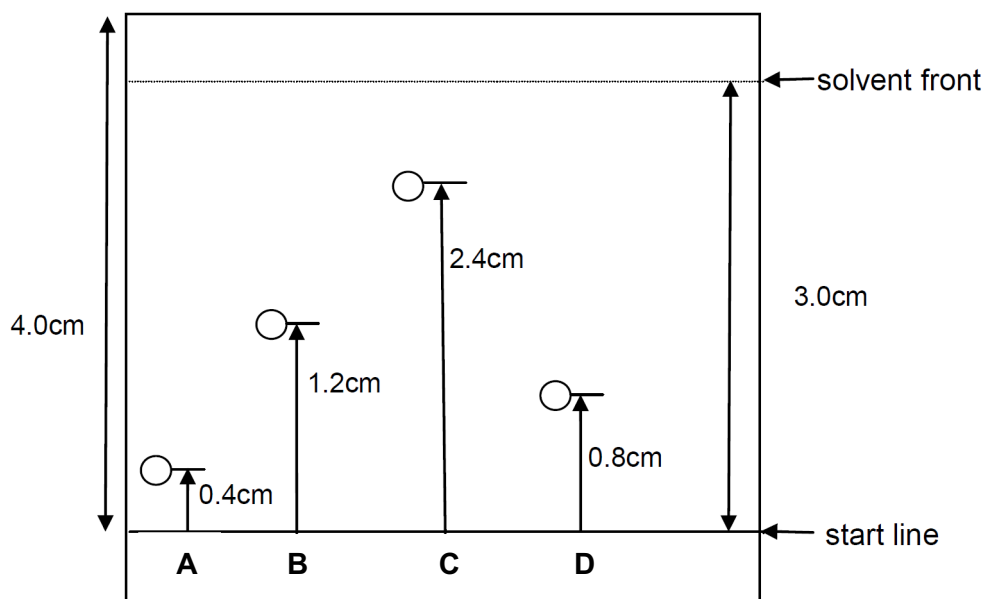


What is the main purpose of solution W?

- A It is to remove carbon dioxide from the gas.
- B It is to remove hydrogen chloride from the gas.
- C It is to remove nitrogen from the gas.
- D It is to remove water vapour from the gas.

- 3 The diagram below shows the chromatogram of some metal ions during an investigation.

Which spot corresponds to Cu^{2+} if it has a R_f value of 0.4?



- 4 Which reagent(s) can be used to distinguish between aqueous zinc nitrate and aqueous calcium chloride?

- 1 aqueous sodium carbonate
- 2 aqueous lead(II) nitrate
- 3 dilute sulfuric acid

A 1 only

B 1 and 3

C 2 and 3

D 1, 2 and 3

- 5 The table shows the melting points and boiling points of some substances.

substance	melting point / °C	boiling point / °C
S	8	79
T	660	1314
U	-3	105
V	-185	-84

Which statement on the physical state of the substance is correct?

- A** S is a solid at 25 °C.
- B** T is a liquid at 25 °C.
- C** U is a gas at 100 °C.
- D** V is a gas at 100 °C.
- 6 Which set of three particles have the same total number of electrons?
- A** Cl^- Br^- I^-
- B** F^- Ne Na^+
- C** K^+ Ca^{2+} Br^-
- D** Li^+ Na^+ K^+
- 7 Unknown elements X and Y form an ionic compound X_2Y .

What is the correct electron arrangement of the atoms X and Y?

	atom X	atom Y
A	2,1	2,6
B	2,2	2,6
C	2,2	2,7
D	2,6	2,1

8 Silicon carbide has a similar structure to diamond.

What are the advantage(s) of using a silicon carbide ceramic compound instead of steel?

- 1 Silicon carbide has a higher melting point.
- 2 Silicon carbide is more resistant to oxidation.
- 3 Silicon carbide is less likely to deform under compression.

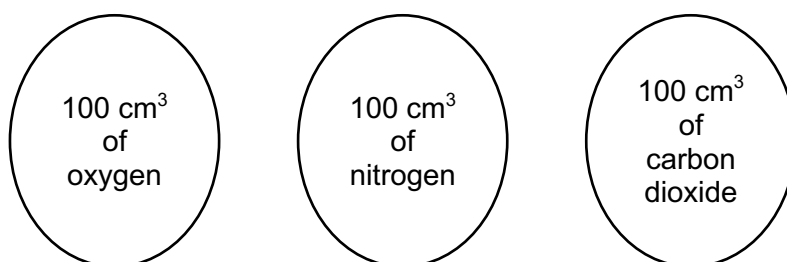
A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

9 The diagram shows three balloons filled with different gases.



Which statements about the gases in the balloons are correct?

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

A 1 and 2

B 1 and 3

C 2 and 3

D 1, 2 and 3

10 An oxide of titanium is used as a white pigment for paint. 32 g of this oxide was found to contain 19.2 g of titanium.

What is the empirical formula of the pigment?

A **TiO**

B TiO_2

C Ti_2O_3

D Ti_2O_3

D 10.0 cm³

- 13** 216 g of silver is deposited when an electric current is passed through a solution of silver nitrate using graphite electrodes.

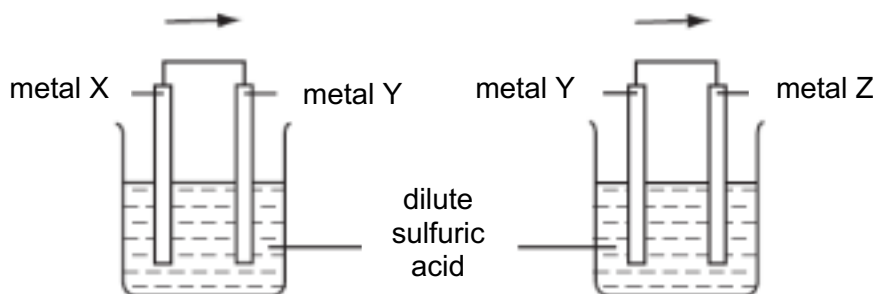
What is the mass of magnesium formed when the same amount of current is passed through molten magnesium chloride using graphite electrodes?

- | | | | |
|----------|------|----------|------|
| A | 24 g | B | 48 g |
| C | 72 g | D | 96 g |

- 14** Which pair of electrolyte and electrodes will not result in a change in the concentration of the solution during electrolysis?

	electrolyte	electrodes
A	copper(II) nitrate	carbon
B	copper(II) nitrate	copper
C	sodium nitrate	carbon
D	sodium nitrate	copper

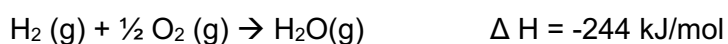
- 15** Two cells were set up as shown in the diagram. The arrows show the direction of electron flow in the external circuits.



Which set of metals would give the electron flows in the directions shown?

	metal X	metal Y	metal Z
A	copper	silver	zinc
B	silver	copper	zinc
C	silver	zinc	copper
D	zinc	copper	silver

- 16 Which statement is true about the formation of water shown?



- A** The energy content of the products is 244 kJ.
- B** The energy content of the products is 244 kJ greater than that of the reactants.
- C** 244 kJ of energy is given out when one mole of water is formed.
- D** 244 kJ of energy is given out because more energy is involved in bond-breaking.
- 17 The rate of reaction between excess calcium carbonate and 1.0 mol/dm^3 hydrochloric acid was determined by collecting the carbon dioxide gas released.

How would the volume of carbon dioxide collected and the rate of reaction change if the experiment was repeated using the same mass of calcium carbonate but half the volume of hydrochloric acid which has a concentration of 2.0 mol/dm^3 ?

	volume of carbon dioxide collected	rate of reaction
A	greater	faster
B	greater	slower
C	remain the same	faster
D	remain the same	slower

- 18 Copper(II) oxide catalyses the decomposition of aqueous hydrogen peroxide to give oxygen and water. In a laboratory experiment, aqueous hydrogen peroxide was shaken with copper(II) oxide in a test-tube.

What can be observed in the test-tube when the reaction was completed?

- A** a blue solution
- B** a black solid and a colourless liquid
- C** a light blue precipitate and a colourless liquid
- D** a reddish-brown solid and a colourless liquid

- 19** When ammonia is converted into nitric acid on a commercial scale, the following reactions can occur.

In which reaction does the greatest change in oxidation number of the nitrogen occur?

- A** $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$
- B** $2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$
- C** $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$
- D** $4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3$

- 20** Small portions of aqueous potassium iodide and acidified aqueous potassium manganate(VII) were added to three solutions. The colour changes seen are shown in the table.

solution number	potassium iodide	potassium manganate(VII)
1	colourless to brown	purple to colourless
2	no change	purple to colourless
3	colourless to brown	no change

Which solutions contained an oxidising agent?

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

- 21** Q is a mixture of two white solids. When dilute hydrochloric acid is added to Q, a colourless gas is evolved. Some, but not all, of the mixture dissolves even though the acid is added in excess.

Which mixture could be Q?

- A** barium nitrate and calcium hydroxide
- B** barium sulfate and calcium carbonate
- C** calcium carbonate and magnesium sulfate
- D** calcium hydroxide and magnesium carbonate

- 22** Which of the following combinations of reactants is most suitable in the preparation of the given salt?

	reactants	salt
A	calcium carbonate and sulfuric acid	calcium sulfate
B	copper(II) oxide and hydrochloric acid	copper(II) chloride
C	magnesium nitrate and sulfuric acid	magnesium sulfate
D	zinc and carbonic acid	zinc carbonate

- 23** An element T burns in oxygen to produce an oxide which, when shaken with water, gives a solution with a pH less than 7.

Which could be element T?

- | | | | |
|----------|---------|----------|----------|
| A | calcium | B | hydrogen |
| C | sodium | D | sulfur |

- 24** Elements X and Y are in Group VII of the Periodic Table.

X is a liquid at room temperature. Y is a solid at room temperature.

Which statement(s) is/are correct?

- 1 Atoms of X have more protons than atoms of Y.
- 2 X displaces Y from aqueous solutions of Y^- ions.
- 3 Y has a darker colour intensity than X.

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

- 25** Which statement about the elements across Period 3 in the Periodic Table is correct?

- A** Elements become more metallic with increasing atomic number.
- B** Elements have similar chemical properties.
- C** The number of valence electrons in the atom of each element increases.
- D** The oxides of each element changes from acidic to basic.

26 In the manufacturing of iron in the blast furnace, what are the main gases that escape from the top of the blast furnace?

- A** carbon dioxide, oxygen and sulfur dioxide
- B** carbon monoxide, carbon dioxide and nitrogen
- C** carbon monoxide, sulfur dioxide and hydrogen
- D** nitrogen, oxygen and hydrogen

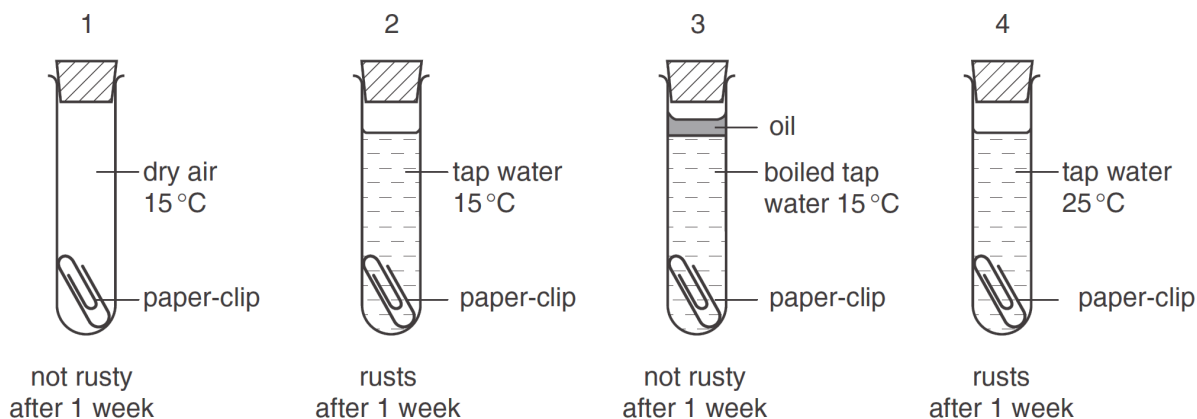
27 A piece of calcium metal is added to a beaker of aqueous copper(II) sulfate solution.

Which observations can be made from the reaction?

- 1 Effervescence is observed.
- 2 Reddish-brown deposit is formed.
- 3 Blue solution fades in colour.

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

28 Four experiments of rusting are shown.



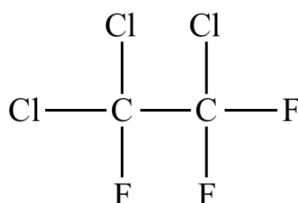
Which two experiments can be used to show that oxygen is needed for iron to rust?

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

29 Which gas cannot be removed from the exhaust gases of a petrol powered car by its catalytic converter?

- | | |
|-------------------------|---------------------------|
| A carbon dioxide | B carbon monoxide |
| C hydrocarbons | D nitrogen dioxide |

30 In the past, CFC compounds were used as aerosol propellants. The structure of one CFC compound is shown.



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

- | | |
|------------------------|--------------------------------|
| A carbon only | B chlorine only |
| C fluorine only | D chlorine and fluorine |

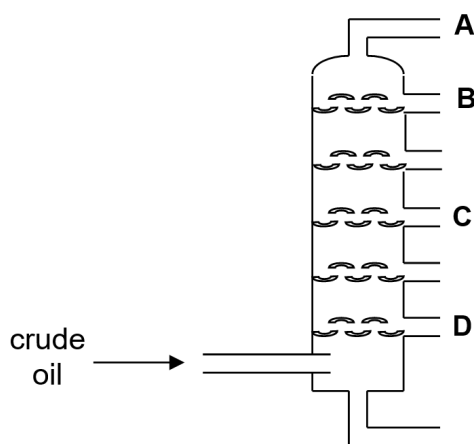
31 Which change(s) will increase the yield of ammonia formed in the Haber Process?

- 1 increasing the pressure
- 2 increasing the temperature
- 3 adding finely-divided iron

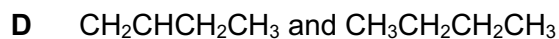
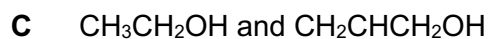
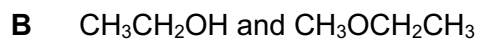
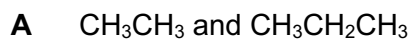
- | | |
|------------------|---------------------|
| A 1 only | B 1 and 2 |
| C 2 and 3 | D 1, 2 and 3 |

32 The diagram shows the fractional distillation of crude oil.

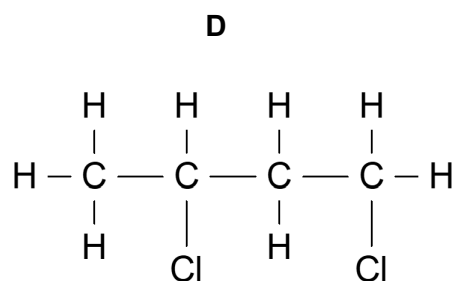
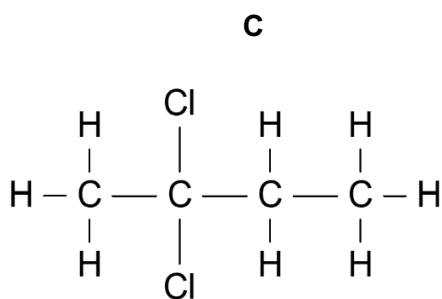
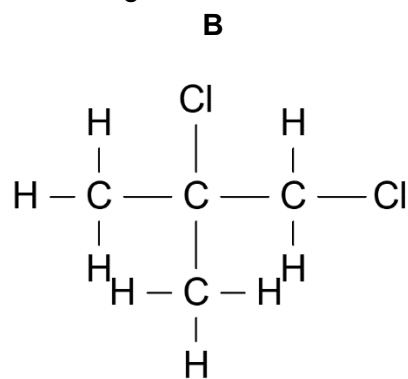
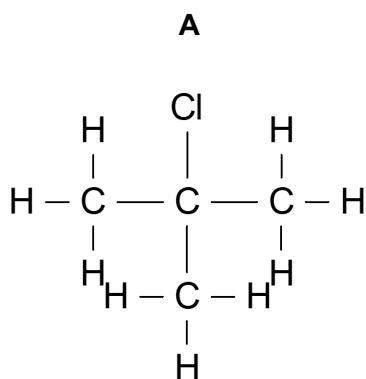
Which fraction is most likely to undergo cracking so as to increase the supply of kerosene?



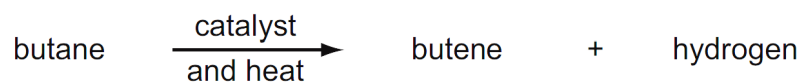
- 33** Which pair of compounds belong to the same homologous series?



- 34** Which product can be formed when chlorine gas is bubbled through butene?



- 35** Butane undergoes a reaction as shown.



What is the type of reaction?

- A** addition

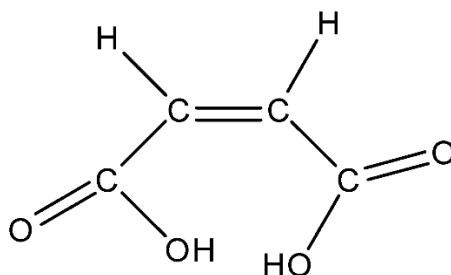
- B** combustion

- C** cracking

- ### D substitution

[Turn Over

36 The diagram shows the structural formula of maleic acid.



Which statements about maleic acid are correct?

- 1 It can decolourise aqueous bromine.
- 2 It can react with calcium carbonate to produce a gas.
- 3 It can undergo condensation polymerisation with diamine monomers.
- 4 It can turn acidified potassium manganate(VII) from purple to colourless.

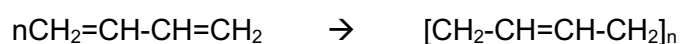
A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

37 Butan-1,3-diene forms a polymer according to the equation below.



Which row correctly states the characteristic of the monomer and polymer?

	monomer	polymer
A	saturated	saturated addition polymer
B	saturated	saturated condensation polymer
C	unsaturated	unsaturated addition polymer
D	unsaturated	unsaturated condensation polymer

38 The polymer, poly(ethene) is formed from the monomer, ethene.

What do poly(ethene) and ethene have in common?

- 1 chemical properties
- 2 empirical formula
- 3 percentage composition
- 4 relative molecular mass

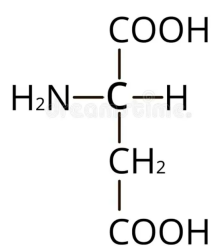
A 1 and 2

B 1 and 4

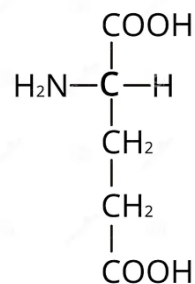
C 2 and 3

D 3 and 4

- 39 The amino acids aspartic acid and glutamic acid can react with each other to form amide linkages.



aspartic acid

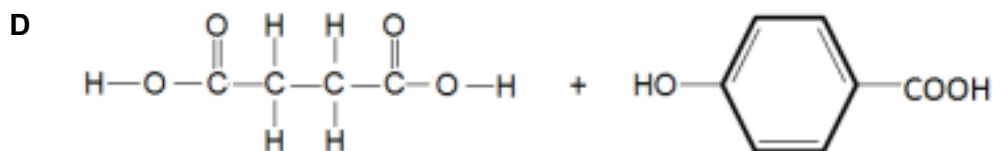
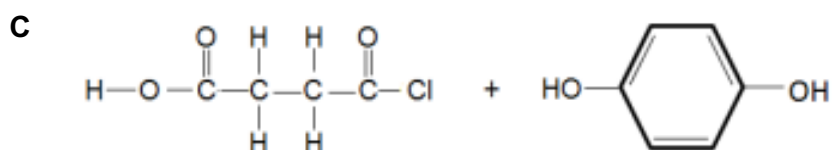
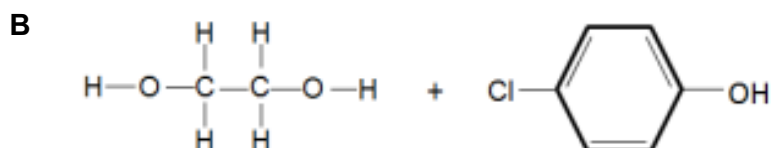
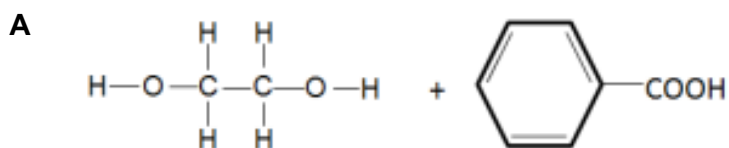


glutamic acid

What is the maximum number of different compounds, each containing one amide linkage, that can be formed from one molecule of aspartic acid and one molecule of glutamic acid?

- | | | | |
|----------|---|----------|---|
| A | 2 | B | 4 |
| C | 6 | D | 8 |

- 40 Which pair of monomers can react together to form a polyester?



End of paper

[Turn Over

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											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											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 -		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			
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 -			
actinoids																	

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