

JURONG SECONDARY SCHOOL
2022 GRADUATION EXAMINATION 2
SECONDARY 4 EXPRESS

**CANDIDATE
NAME**

CLASS

**INDEX
NUMBER**

CHEMISTRY
PAPER 1

6092/01
29 August 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

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

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 to be found on page 19.

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
TOTAL [40 marks]	

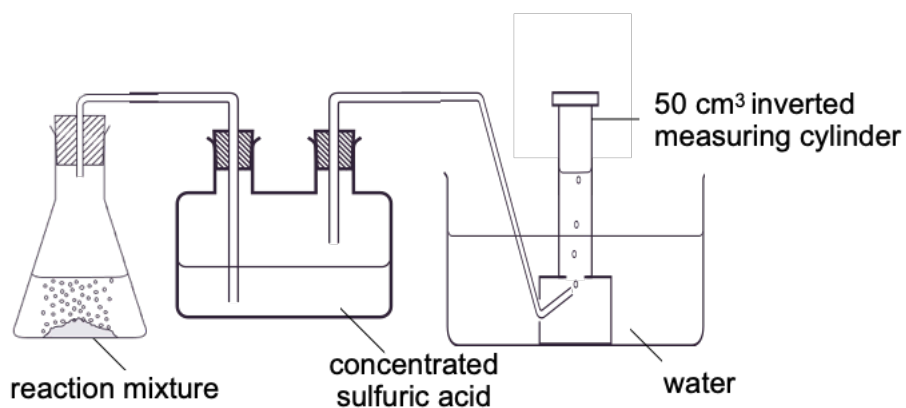
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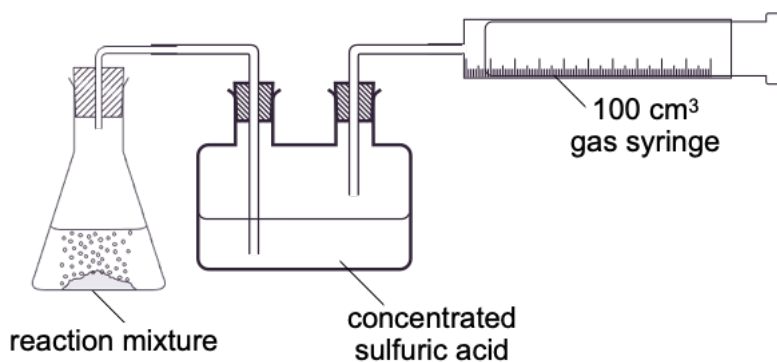
- 1 An experiment is designed to collect a dry sample of carbon dioxide produced when an excess dilute acid is added to 0.35 g of calcium carbonate.

Which apparatus set-up is most suitable for this experiment?

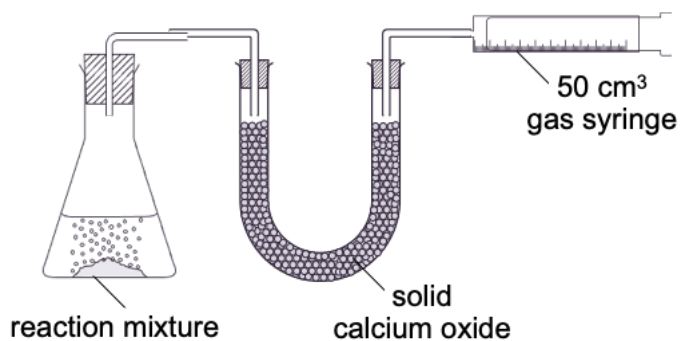
A



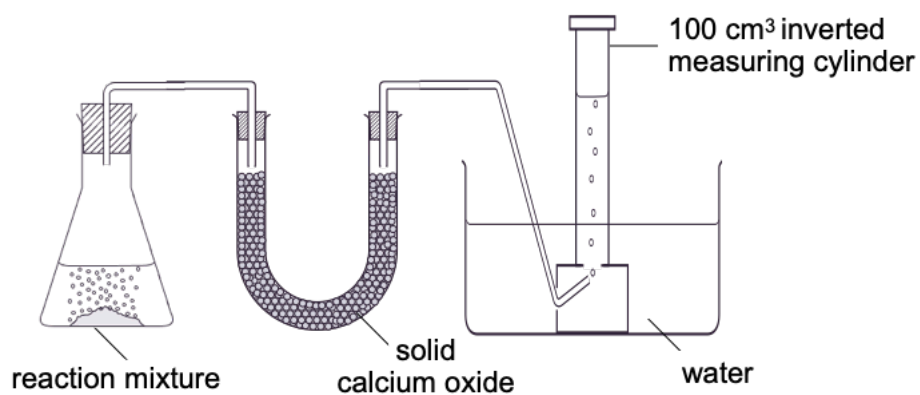
B



C



D



- 2 The melting and boiling points of some substances are given in the table.

Which substance may be condensed using a water-cooled condenser?

	substance	melting point / °C	boiling point / °C
A	ammonia	−78	−33
B	ethylamine	−81	16.6
C	methane	−182.5	−162
D	pentane	−130	36

- 3 The following shows some common cations.

- 1 Ca^{2+}
- 2 Cu^{2+}
- 3 Fe^{3+}
- 4 Pb^{2+}

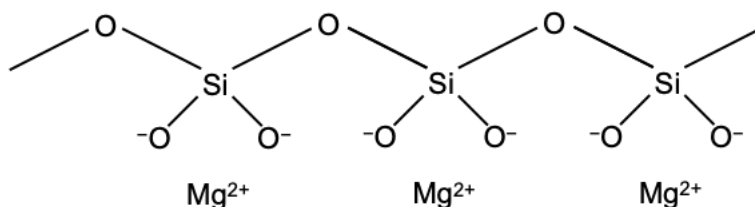
Which cations will produce a precipitate when mixed with excess aqueous ammonia?

- A** 1 and 2 only
 - B** 2 and 3 only
 - C** 3 and 4 only
 - D** all of the above
- 4 Which statement explains why carbon monoxide and ethene diffuse at the same rate?
- A** They are both gases at room temperature.
 - B** They both contain the element carbon.
 - C** They both react with oxygen.
 - D** They have the same relative molecular mass.

- 5 Two naturally occurring isotopes of uranium can be represented as ${}^{235}_{92}\text{U}$ and ${}^{238}_{92}\text{U}$.

Which statement is true?

- A ${}^{238}_{92}\text{U}$ has 92 electrons and 146 neutrons.
 B ${}^{235}_{92}\text{U}$ has 92 protons and 144 neutrons.
 C ${}^{235}_{92}\text{U}$ has the same number of neutrons as the ${}^{238}_{92}\text{U}$ atom.
 D ${}^{235}_{92}\text{U}$ has fewer electrons than the ${}^{238}_{92}\text{U}$ atom.
- 6 The diagram below shows a simplified structure for asbestos.



What are the bonds present in asbestos?

- A covalent and ionic bonds
 B covalent and metallic bonds
 C covalent bonds and intermolecular forces of attraction
 D ionic bonds
- 7 The following shows some simple covalent compounds.

- | | |
|---|-----------------|
| 1 | CO ₂ |
| 2 | CH ₄ |
| 3 | NH ₃ |

Which contains valence electrons that are **not** used for bonding?

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

8 Which statements about metals are correct?

- 1 Metals form only basic oxides.
- 2 Metals conduct thermal energy.
- 3 Metals are lustrous and ductile.

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

9 5.0 g of an oxide of bismuth contains 4.48 g of bismuth.

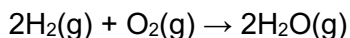
What is the molecular formula of this oxide?

- A BiO
- B Bi₂O₃
- C Bi₃O₄
- D Bi₄O₃

10 Which compound does **not** have the empirical formula CH₂O?

- A ethanoic acid, CH₃CO₂H
- B ethanol, CH₃CH₂OH
- C glucose, C₆H₁₂O₆
- D methyl methanoate, HCO₂CH₃

11 Hydrogen reacts with oxygen to form steam according to the equation below.

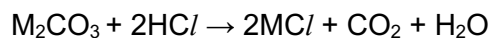


Which statement is correct?

- A 1 mol of steam is formed if 1 mol of oxygen reacts completely in excess hydrogen.
- B 4 g of hydrogen completely reacts with 16 g of oxygen.
- C 16 g of oxygen would produce 18 g of steam.
- D 36 g of steam is formed if 2 g of hydrogen reacts completely in excess oxygen.

- 12 The formula of a metal carbonate is M_2CO_3 . 0.69 g of the carbonate requires 50 cm³ of 0.20 mol/dm³ hydrochloric acid for complete reaction.

The equation for the reaction is shown.



What is the relative atomic mass of metal M?

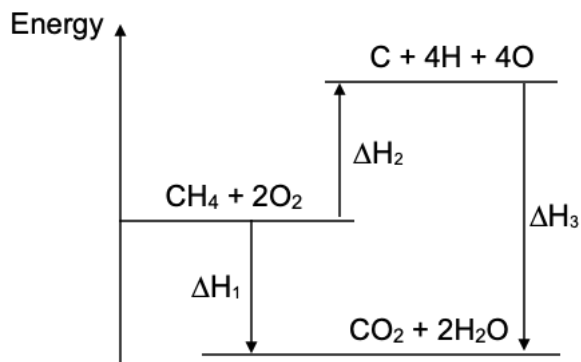
- A 19
B 23
C 39
D 78
- 13 The list shows the electrolytes in three electrolytic cells with inert electrodes.
- | | |
|---|---------------------------------------|
| 1 | aqueous sodium chloride solution |
| 2 | concentrated sodium chloride solution |
| 3 | concentrated hydrochloric acid |
| 4 | dilute hydrochloric acid |

In which cells will chlorine gas be **first** produced?

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

- 14 Methane burns in oxygen to form carbon dioxide and water.

The following energy level diagram represents this reaction.



Which row correctly identifies the energy involved in respective bond breaking and bond forming processes?

	energy involved in bond breaking only	energy involved in bond forming only
A	ΔH_1	ΔH_2
B	ΔH_1 and ΔH_3	ΔH_2
C	ΔH_2	ΔH_1 and ΔH_3
D	ΔH_2	ΔH_3

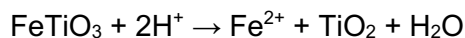
- 15 Zinc reacts with dilute hydrochloric acid at a constant temperature of 25 °C.

Which statement about the rate of this reaction is correct?

- A** It decreases and the reaction stops within 2 seconds.
- B** It decreases then increases as the reaction proceeds.
- C** It increases at the start then decreases as the reaction proceeds.
- D** It remains the same as the reaction proceeds.

- 16** Ilmenite is a mineral containing iron(II) titanate, FeTiO_3 . It is the main source of titanium dioxide which is used mainly in paints, sunscreens and cosmetics.

The equation shows the reaction to obtain titanium dioxide from ilmenite.



Which statement about this reaction is correct?

- A** Ilmenite is the reducing agent in this reaction because it has been reduced.
 - B** The acid used in the reaction has been oxidised because it gained oxygen.
 - C** This is not a redox reaction.
 - D** Titanium in ilmenite has been reduced because it has gained electrons.
- 17** Aluminium, magnesium and sulfur are elements from Period 3 of the Periodic Table.

Which row shows the nature of the oxides formed by these three elements?

	aluminium	magnesium	sulfur
A	amphoteric	basic	neutral
B	amphoteric	basic	acidic
C	basic	amphoteric	acidic
D	basic	amphoteric	neutral

- 18** When compound X is added to ammonium nitrate solution, a gas with a pungent smell is produced. The gas turns damp red litmus paper blue.

What could compound X be?

- A** potassium oxide
- B** magnesium carbonate
- C** sodium nitrate
- D** zinc sulfate

- 19 The table shows the solubility of some mercury(I) salts.

salt	solubility in water
HgC/	very slightly soluble in water
Hg ₂ CO ₃ , Hg ₂ SO ₄	insoluble
HgNO ₃	soluble

Which is most suitable in making a sample of mercury(I) chloride?

- A Add dilute hydrochloric acid to aqueous mercury(I) nitrate and filter.
 B Add excess mercury(I) carbonate to cold dilute hydrochloric acid and filter.
 C Heat mercury(I) sulfate with dilute hydrochloric acid, cool and filter.
 D Heat liquid mercury with dilute hydrochloric acid, cool and filter.
- 20 The decomposition of sulfur trioxide to sulfur dioxide is a reversible reaction.



This reaction is endothermic in the forward direction and the heat absorbed is 196 kJ/mol.
 The activation energy for the forward reaction is 271 kJ/mol.

What is the activation energy of the **reverse** reaction?

- A 75 kJ/mol
 B 121 kJ/mol
 C 196 kJ/mol
 D 271 kJ/mol
- 21 Element Y is in the second period of the Periodic Table.
 An atom of element Z has six more protons than an atom of element Y.

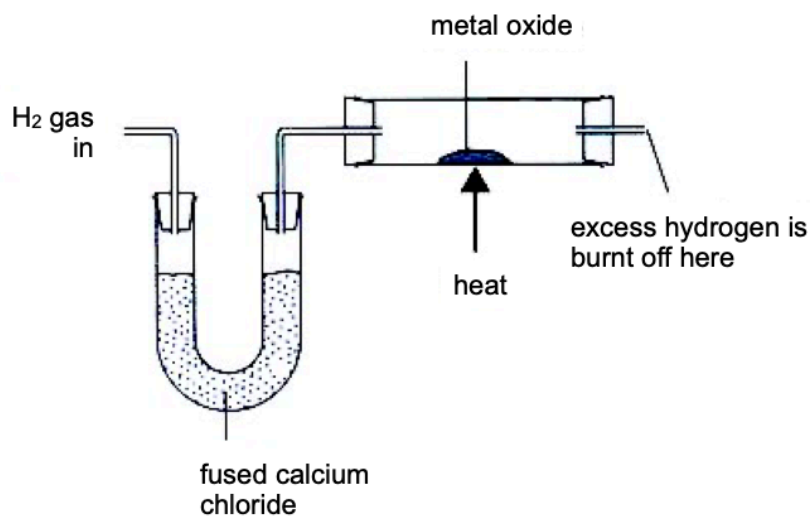
Which statement must be correct?

- A Elements Y and Z are in the same period.
 B Elements Y and Z have the same number of electrons in the first shell.
 C Element Z has six more electrons in its outer shell than element Y.
 D The nucleon number of element Z is six more than that of element Y.

- 25 Bronze is a copper-based alloy that is typically harder than its constituent elements of copper and tin. Trace amounts of other metals may also be present in the alloy.

Which difference between the elements explains the hardness?

- A atomic size
 - B density
 - C proton number
 - D relative atomic mass
- 26 A yellow coloured metal oxide was placed into a glass tube and heated strongly while hydrogen gas was passed over it.



The metal oxide dissolved partially when excess dilute sulfuric acid was added to it.

What is the identity of the metal oxide?

- A copper(II) oxide
- B lead(II) oxide
- C potassium oxide
- D iron(II) oxide

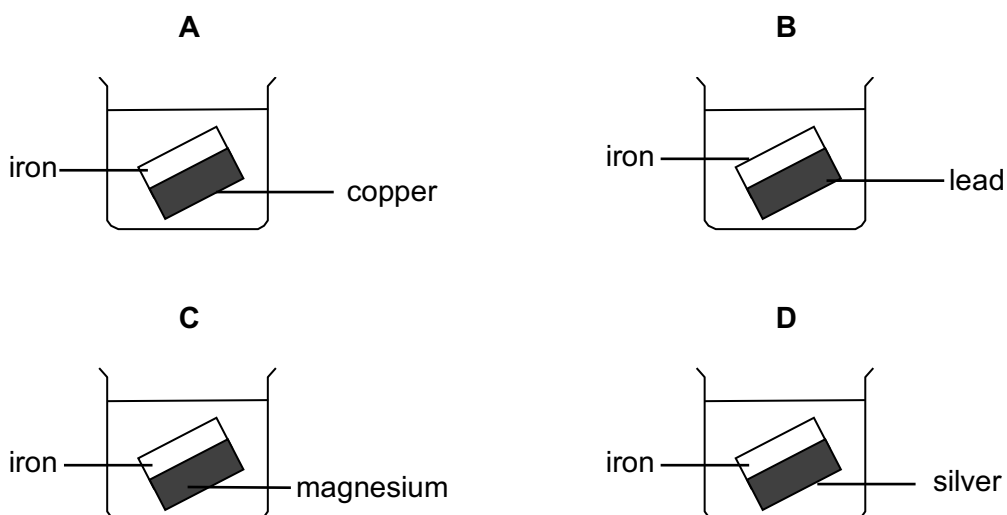
- 27 The table below shows the temperature at which thermal decomposition occurs for some metal carbonates.

metal carbonate	temperature / °C
copper(II) carbonate	220
iron(II) carbonate	?
magnesium carbonate	402
zinc carbonate	300

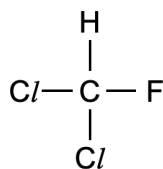
What is the temperature at which iron(II) carbonate undergoes thermal decomposition?

- A 200
 B 280
 C 320
 D 480
- 28 Each beaker contains two strips of metals fastened together and immersed in hydrochloric acid. All the strips are of the same size.

After 5 minutes, which beaker contains the **least** amount of iron ions?



- 29 Freon-12 is a chlorofluorocarbon. The full structural formula of Freon-12 is shown.



Which statement about Freon-12 is correct?

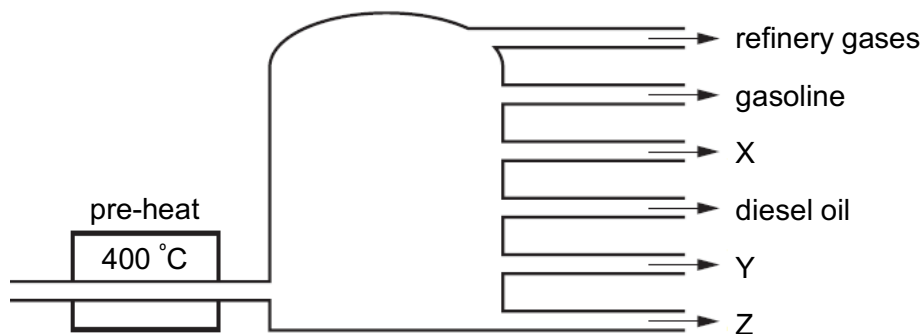
- A It is a very reactive compound.
 - B It reacts with water to form acid rain.
 - C Its fluorine atom is responsible for global warming.
 - D Its chlorine atom is responsible for the depletion of the ozone layer.
- 30 Which statements about air pollutants are correct?
- 1 Carbon monoxide is responsible for the production of acid rain.
 - 2 Oxides of nitrogen are produced in car exhausts.
 - 3 Sulfur dioxide can be produced by the combustion of coal.
 - 4 Methane is produced from the incomplete combustion of fossil fuels.
- A 1 and 2 only
 - B 2 and 3 only
 - C 2, 3 and 4 only
 - D all of the above
- 31 An excess of iron(II) chloride is added to acidified potassium manganate(VII).

Which statements are correct for this reaction?

- 1 iron(II) is reduced to iron(III)
 - 2 manganate(VII) ions are oxidised to manganese(II) ions
 - 3 potassium manganate(VII) is an oxidising agent
 - 4 the purple colour disappears
- A 1 and 2
 - B 1 and 4
 - C 2 and 3
 - D 3 and 4

- 32** In an oil refinery, petroleum is separated into useful fractions.

The diagram shows some of these fractions.

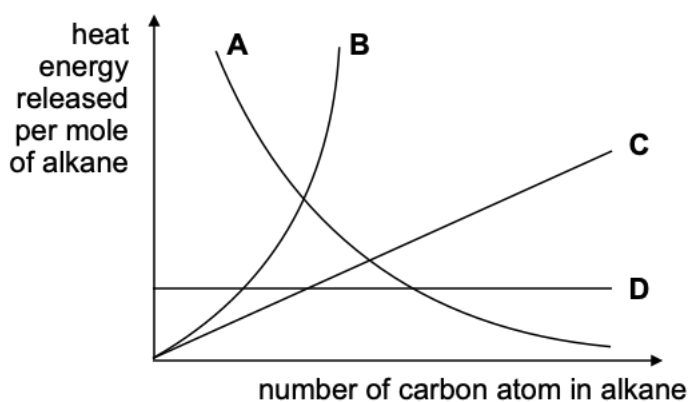


What are fractions X, Y and Z?

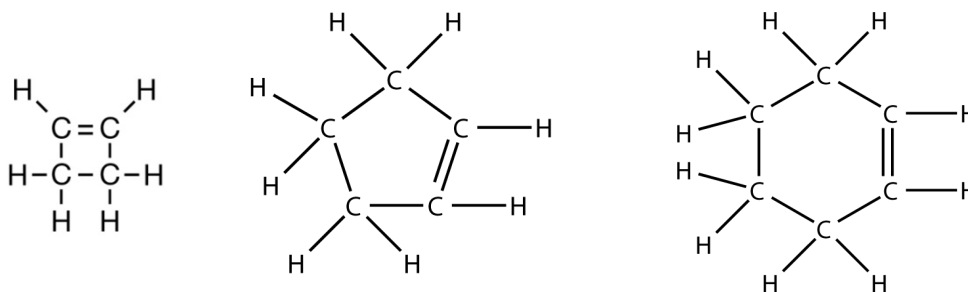
	X	Y	Z
A	lubricating oil	bitumen	paraffin
B	lubricating oil	paraffin	bitumen
C	paraffin	bitumen	lubricating oil
D	paraffin	lubricating oil	bitumen

- 33** The complete combustion of alkanes to produce carbon dioxide and water is an important exothermic reaction.

Which graph shows the relationship between the heat energy released per mole of alkane and the number of carbon atoms in the alkane?

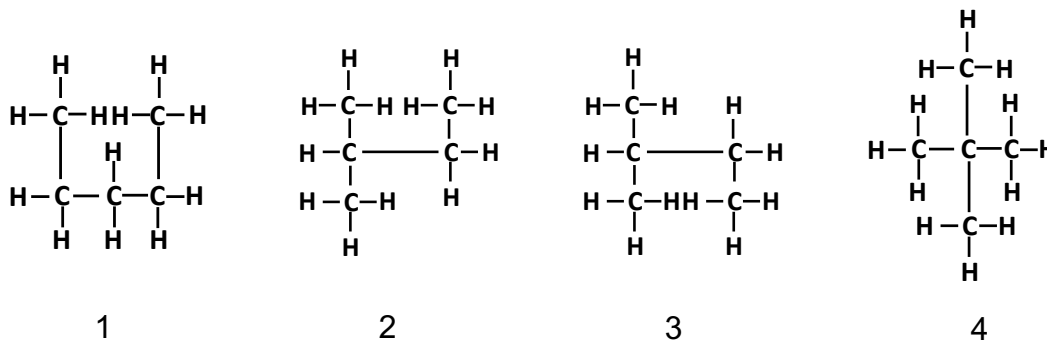


- 34** Three members of the cycloalkene homologous series are:



The general formula for this homologous series is

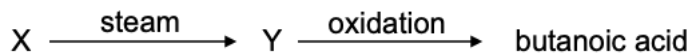
- A** C_nH_{2n-2}
B C_nH_{2n-1}
C C_nH_{2n}
D C_nH_{2n+2}
- 35** Four structural formulae are shown below.



Which structural formulae represents the same compound?

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

- 36** Butanoic acid is produced via a two-step process as shown.



Which statements are correct for this process?

- 1 X is a saturated hydrocarbon.
- 2 Phosphoric(V) acid is used as a catalyst in synthesising Y from X.
- 3 The formula for Y is C_4H_9OH .

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

- 37** Addition of hydrogen to alkenes produces alkanes.

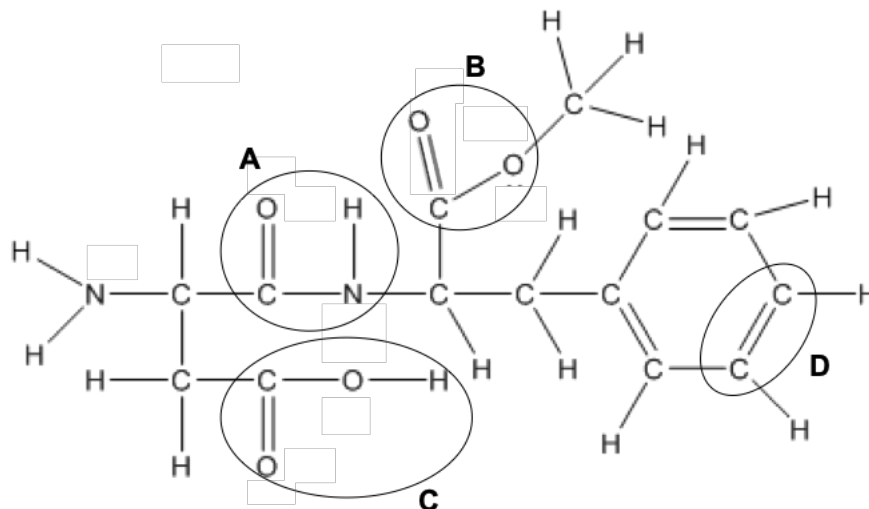
Which pair of alkenes will give the same product on addition of hydrogen?

- A**
- $$\begin{array}{c} \text{H} - \text{C} = \text{C} - \text{H} \\ | \quad | \\ \text{H} \quad \text{H} \end{array} \quad \text{and} \quad \begin{array}{c} \text{H} \\ | \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- B**
- $$\begin{array}{c} \text{H} \\ | \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array} \quad \text{and} \quad \begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{C} - \text{H} \\ | \quad | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- C**
- $$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{C} - \text{H} \\ | \quad | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} \quad \text{and} \quad \begin{array}{c} \text{H} \quad \quad \text{H} \\ | \quad \quad | \\ \text{H} - \text{C} - \text{C} = \text{C} - \text{C} - \text{H} \\ | \quad | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array}$$
- D**
- $$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{H} - \text{C} = \text{C} - \text{C} - \text{H} \\ | \quad | \\ \text{H} - \text{C} - \text{H} \quad \text{H} \\ | \\ \text{H} \end{array} \quad \text{and} \quad \begin{array}{c} \text{H} \\ | \\ \text{H} - \text{C} - \text{C} = \text{C} - \text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$$

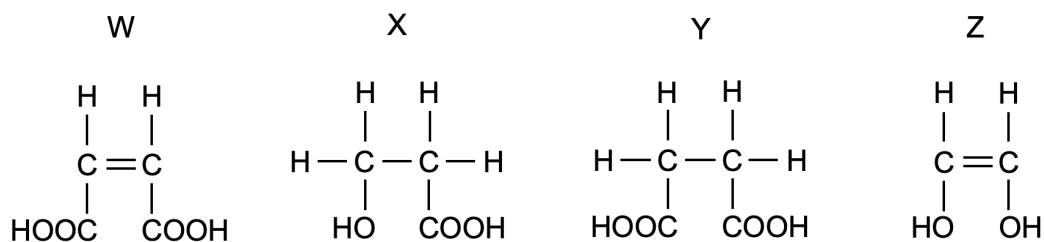
- 38** Aspartame is a widely used artificial sweetener and a popular sugar substitute in low-calorie food and drinks, including diet sodas.

The structural formula of aspartame is shown.

Which part of the structure shows the functional group that accounts for its sweet smell?



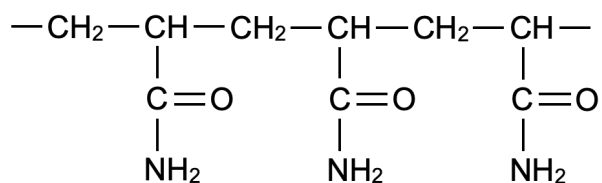
- 39** Four organic compounds, W, X, Y and Z are shown below.



What are the reactions of compounds W, X, Y and Z?

	decolourise aqueous bromine	reacts with carboxylic acid	has pH less than 7
A	X and Y	W, X and Y	W, X, Y and Z
B	X and Y	X and Z	X and Z
C	W and Z	W, X and Y	X and Z
D	W and Z	X and Z	W, X and Y

- 40** Polyacrylamide is used to manufacture soft contact lenses. Part of the polymer is shown below.



- 1 It contains amide linkages.
- 2 The molecular formula of its monomer is $\text{C}_3\text{H}_5\text{NO}$.
- 3 It is an addition polymer.

Which statements about polyacrylamide are correct?

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

END OF PAPER

Group

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	euporium	152	64	Gd	gadolinium	157	65	Tb	terbium	159	66	Dy	dysprosium	162	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	—

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