Name: ..... ( ) Class: .....

MONTFORT SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2025

Secondary 4 Express

CHEMISTRY
Paper 1

6092/01
29 Aug 2025 (Fri)
1 hour

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.

There are **forty** questions in this section. 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.

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

This document consists of **20** printed pages.

Setter: Ms Celine Peh

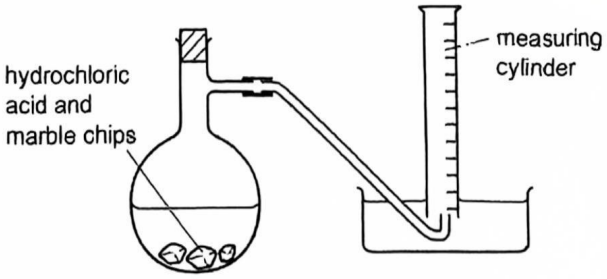
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1 A student wants to carry out an experiment to follow the rate of the reaction between hydrochloric acid and marble chips.

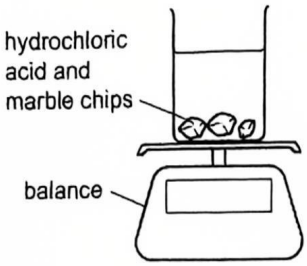
$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Which diagrams show apparatus that is suitable for this experiment?

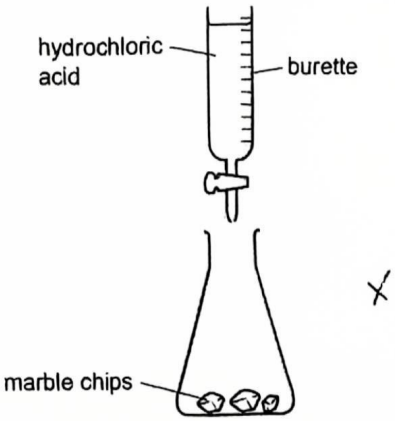
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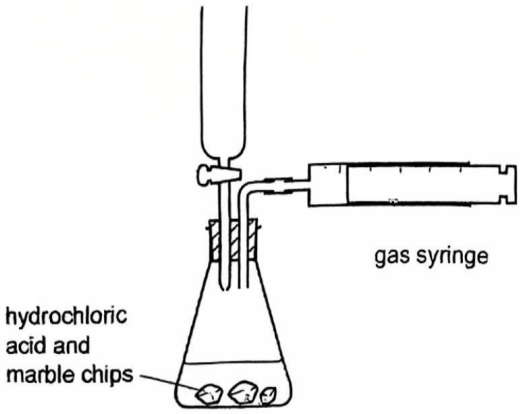
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3



4



A 1 and 2 only

B 1 and 3 only

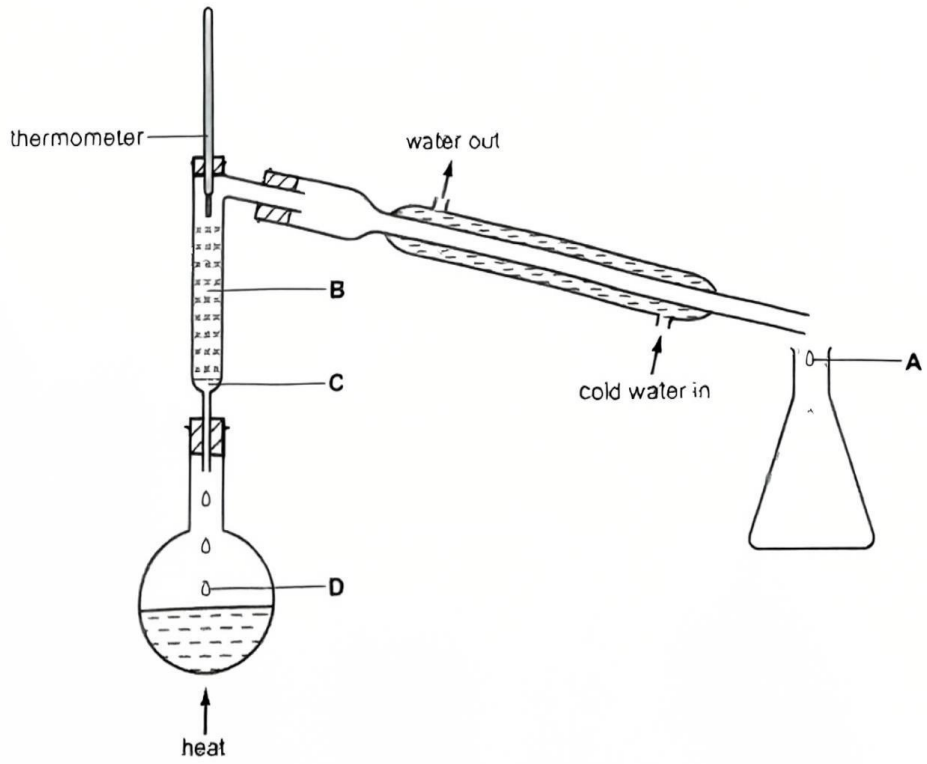
C 1 and 4 only

D 1, 2 and 4

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2 A mixture containing equal volumes of two liquids that mix completely but do not react together is placed in the apparatus shown and heated until the thermometer first shows a steady reading.

At which position will there be the highest proportion of the liquid with the higher boiling point?



3 In which pair of particles is:

- the sum of their charges equal to zero
- the sum of their masses almost the same as $\frac{1}{12}$ of the mass of an atom of ^{12}C?

A one electron and one neutron

B one electron and one proton

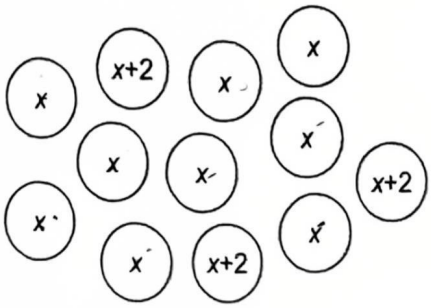
C one neutron and one proton

D two neutrons

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4 An element has two isotopes of relative isotopic masses x and $x+2$. The diagram shows the composition of atoms in a sample of the element.



What is the relative atomic mass of this element?

A $x + 0.5$

B $x + 1.0$

C $x + 1.5$

D $x + 2.0$

5 X and Y are both elements, one of which is a non-metal.

1 mole of X is added to 1 mole of Y and they are heated together.

X and Y react completely to form substance Z.

Substance Z cannot be easily separated to form X and Y.

Three statements are given.

1 Y must be the non-metal.
2 X and Y formed a compound on heating.
3 Substance Z has the empirical formula XY.

Which statements are correct?

A 1 and 3

B 1 only

C 2 and 3

D 2 only

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6 Which molecule has only four electrons involved in covalent bonds?

A
B
C
D

A. Cl2
B. CO2
C. H2S
D. N2

7 The melting points and boiling points of four compounds, W, X, Y and Z, are given in the table.

	melting point /°C	boiling point /°C
W	63	354
X	–7	59
Y	1728	2230
Z	–183	–89

The four compounds are silicon(IV) oxide, ethane, bromine and a carboxylic acid of formula $C_{16}H_{32}O_2$.

Which row identifies W, X, Y and Z?

	silicon(IV) oxide	ethane	bromine	carboxylic acid $C_{16}H_{32}O_2$
A	W	X	Z	Y
B	W	Y	Z	X
C	Y	Z	W	X
D	Y	Z	X	W

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8 The formula of ammonium metavanadate is NH_4VO_3. It consists of NH_4 ions and VO_3 ions.

What are the charges on these ions?

	NH_4 ion	VO_3 ion
A	1+	1–
B	2+	2–
C	3+	3–
D	4+	4–

9 When a strip of copper is placed in aqueous silver nitrate, a displacement reaction takes place.

What is the ionic equation for the reaction which takes place?

A $Ag^+ (aq) + Cu (s) \rightarrow Ag (s) + Cu^{2+} (aq) + e^-$

B $2Ag^+ (aq) + Cu (s) \rightarrow 2Ag (s) + Cu^{2+} (aq)$

C $2AgNO_3 (aq) + Cu (s) \rightarrow 2Ag (s) + Cu(NO_3)_2(aq)$

D $2Ag (s) + Cu^{2+} (aq) \rightarrow 2Ag^+ (aq) + Cu (s)$

10 Which statement is correct?

A If the relative formula mass of hydrated sodium carbonate, $Na_2CO_3 \cdot xH_2O$, is 286, then x is 10.

B Phosphoric(V) acid, H_3PO_4, has a relative molecular mass of 50.

C The relative atomic mass of a sample of an element with isotopes of masses 20 and 22 can only be equal to 21.

D The relative atomic mass of an element is the average mass of atoms of isotopes of the element compared with the mass of a hydrogen atom.

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11 Two aqueous solutions, Q and R, have the same concentration in mol / dm^3 .

Solution Q contains 4.0 g of NaOH in 500 cm^3 of solution.

Which solution could be solution R?

[A_r: Na, 23; O, 16; H, 1]

A 0.2 mol of $Ca(OH)_2$ in 250 cm^3 of solution

B 0.2 mol of HCl in 100 cm^3 of solution

C 0.05 mol of H_2SO_4 in 250 cm^3 of solution

D 0.1 mol of KOH in 1000 cm^3 of solution

12 The equation for the reaction between magnesium and dilute hydrochloric acid is shown.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Which mass of magnesium chloride is formed when 48.0 g of magnesium completely reacts with excess dilute hydrochloric acid?

A 23.8 g

B 47.5 g

C 95.0 g

D 190 g

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13 Three compounds are listed.

copper(II) nitrate, $Cu(NO_3)_2$

zinc sulfate, $ZnSO_4$

sodium thiosulfate, $Na_2S_2O_3$

Which row shows the element that is present in the greatest percentage by mass in each compound?

[relative formula masses, M_r: $Cu(NO_3)_2$, 188; $ZnSO_4$, 161; $Na_2S_2O_3$, 158]

	copper(II) nitrate	zinc sulfate	sodium thiosulfate
A	copper	oxygen	oxygen
B	copper	oxygen	sulfur
C	oxygen	zinc	sodium
D	oxygen	zinc	sulfur

14 Samples of two hydrated compounds are weighed and then dehydrated by heating.

The anhydrous compounds are weighed and the results are shown.

3.97 g $FeSO_4 \cdot xH_2O$ gives 2.17 g anhydrous $FeSO_4$.

2.88 g $CaSO_4 \cdot yH_2O$ gives 2.27 g anhydrous $CaSO_4$.

What are the values of x and y?

[M_r: $FeSO_4$, 152; $CaSO_4$, 136; H_2O, 18]

	x	y
A	5	2
B	5	5
C	7	5
D	7	2

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15 Aqueous copper(II) sulfate is electrolysed with copper electrodes.

What is the equation for the reaction occurring at the anode?

A $Cu \rightarrow Cu^{2+} + 2e^-$

B $Cu^{2+} + 2e^- \rightarrow Cu$

C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

D $2SO_4^{2-} + 2H_2O \rightarrow 2H_2SO_4 + O_2 + 4e^-$

16 Three statements about fuel cells are given.

1 A hydrogen-oxygen fuel cell requires a continuous input of fuel and oxygen.
2 In a hydrogen-oxygen fuel cell, hydrogen is burned in oxygen to produce electricity.
3 When a hydrogen-oxygen fuel cell is operating, water is the only chemical product.

Which statements are correct?

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

17 Which statements about the energy changes during a chemical reaction are correct?

1 The activation energy, Ea, is the maximum energy the colliding particles must have in order to react.
2 During an endothermic reaction, thermal energy is taken in from the surroundings leading to a decrease in the temperature of the surroundings.
3 The making of chemical bonds is an exothermic process.

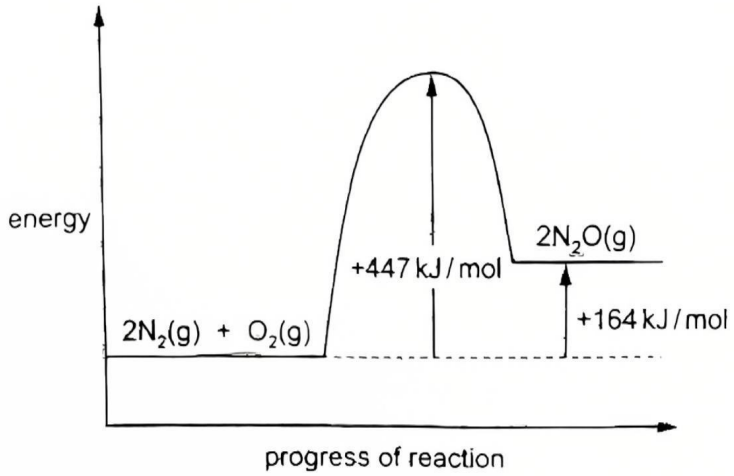
A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

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18 Under certain conditions, nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightarrow 2N_2O(g)$$

The reaction pathway diagram is shown.



What is the activation energy of the reverse reaction?

A – 447kJ / mol

B – 283 kJ /mol

C + 141.5 kJ /mol

D + 283 kJ / mol

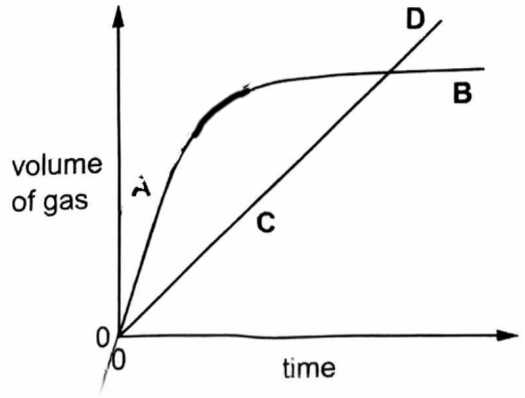
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19 Two reactions each produce a gaseous product.

The reactions are performed separately using the same conditions of temperature and pressure.

The volume of gas formed in each experiment is measured over time and the results are plotted in the graph shown.

At which point is the rate of production of gas the greatest?



20 Copper forms a red oxide, Cu_2O, and a black oxide, [illegible]

In the presence of a catalyst, aqueous hydrogen peroxide, H_2O_2, decomposes to form water.

The black oxide has copper in a .....1..... oxidation state than in the red oxide.

In forming water, hydrogen peroxide is .....2..... .

Which words correctly complete gaps 1 and 2?

	1	2
A	higher	reduced
B	higher	oxidised
C	lower	reduced
D	lower	oxidised

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21 Universal indicator contains several dyes. The reversible reaction of one dye, IndOH, is shown.

$$\underset{\text{colour X}}{\text{IndOH(aq)}} + \text{H}^+\text{(aq)} \leftrightarrow \underset{\text{colour Y}}{\text{Ind}^+\text{(aq)}} + \text{H}_2\text{O}(l)$$

A few drops of Universal indicator solution are added to 50 cm^3 of water.

A few drops of dilute hydrochloric acid are added to the solution.

Which row describes what happens when the acid is added?

	pH	colour of solution shifts towards
A	decreases	colour X
B	decreases	colour Y
C	increases	colour X
D	increases	colour Y

22 Samples of HC*l* (aq) and HNO_3 (aq) are tested using Universal indicator paper.

The sample of HC*l* (aq) has a pH of 4 and the sample of HNO_3 (aq) has a pH of 2.

Which statement is correct?

A HC*l* (aq) is a weak acid and HNO_3 (aq) is a strong acid.

B HNO_3 (aq) has a lower formula mass than HC*l* (aq).

C The HNO_3 (aq) is more concentrated than the HC*l* (aq).

D The HC*l* (aq) has dissociated more than the HNO_3 (aq).

23 Which statement about oxides is correct?

A All acidic oxides are gases at room temperature.

B All basic oxides dissolve in water to give alkalis.

C Amphoteric oxides react with acids, alkalis and water.

D Potassium oxide is a basic oxide.

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24 A student is provided with suitable apparatus, distilled water and the following reagents.

solid magnesium hydroxide solid lead carbonate dilute nitric acid

aqueous sodium chloride aqueous sodium sulfate

Which salts can the student prepare as a pure dry sample?

A lead nitrate, magnesium nitrate, lead chloride, lead sulfate and magnesium sulfate
B lead nitrate, magnesium nitrate, lead chloride and lead sulfate only
C lead nitrate, magnesium nitrate and lead chloride only
D lead nitrate and magnesium nitrate only

25 One mole of compound X gives two moles of ions in aqueous solution.

X reacts with ammonium carbonate to give an acidic gas. What is compound X?

A calcium hydroxide
B ethanoic acid
C nitric acid
D sodium hydroxide

26 The elements are arranged in groups and periods in the Periodic Table.

Which row is correct?

	group determined by	period determined by	elements in the Periodic Table are arranged by
A	the number of electrons in the outer shell	the number of occupied shells	increasing proton number
B	the number of occupied shells	the number of electrons in the outer shell	increasing mass number
C	the number of electrons in the outer shell	the number of occupied shells	increasing mass number
D	the number of occupied shells	the number of electrons in the outer shell	increasing proton number

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27 Element X is in Group 1.

Some statements about element X are given.

- X is not the least dense element in Group 1.
- X is more reactive than potassium.
- X has an A_r value less than 100.

Which element is X?

A lithium
B sodium
C rubidium
D caesium

28 Three statements about the properties of metals are shown.

1 All metals conduct electricity.
2 All metals have two electrons in their innermost shell.
3 All metals have high melting points.

Which statements are correct?

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

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29 Group 1 elements and transition elements are metals.

Student X suggests that the Group 1 elements are above hydrogen in the reactivity series but that not all transition elements are above hydrogen.

Student Y suggests that the densities of Group 1 elements are lower than those of the transition elements.

Which students are correct?

A both X and Y

B X only

C Y only

D neither X nor Y

30 The equations for some of the reactions of metals Q, R and T are shown.

$$2QNO_3\,(aq) + Cu\,(s) \rightarrow 2Q\,(s) + Cu(NO_3)_2\,(aq)$$

$$R\,(s) + TSO_4\,(aq) \rightarrow T\,(s) + RSO_4\,(aq)$$

$$T\,(s) + H_2SO_4\,(aq) \rightarrow TSO_4(aq) + H_2(g)$$

Using the equations, what is the order of reactivity of Q, R and T?

	most reactive →		least reactive
A	Q	T	R
B	R	Q	T
C	R	T	Q
D	T	R	Q

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31 Zinc is used to galvanise iron, which prevents the iron from rusting. Which statements are correct?

1 The layer of zinc forms a barrier between the iron and the oxygen and water in the atmosphere.
2 Zinc will oxidise before the iron does, even if the layer of zinc is scratched.
3 When iron rusts, atoms of iron gain electrons to form ions.

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

32 Some metals and the compounds in their ores are shown.

metal	Al	Ca	Pb	Na	Fe	Mg
compound in ore	Al_2O_3	$CaCO_3$	PbS	NaCl	Fe_2O_3	$MgCO_3$

Which type of reaction occurs in the extraction of each of these metals from its ore?

A decomposition by heat
B electrolysis
C precipitation
D reduction

33 What are the **main** products obtained by the fractional distillation of liquid air?

A carbon dioxide and oxygen
B carbon dioxide and water vapour
C nitrogen and oxygen
D nitrogen and water vapour

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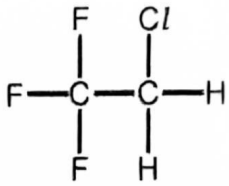
34 Three statements about the carbon cycle are given.

1 The carbon cycle regulates the amount of carbon dioxide in the atmosphere.
2 During photosynthesis, carbon dioxide is produced.
3 Combustion of hydrocarbons requires oxygen.

Which statements are correct?

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

35 CFC compounds were used as aerosol propellants. The structure of one CFC compound is shown.



Which element in this compound causes a depletion of ozone in the atmosphere?

A carbon
B chlorine
C fluorine
D hydrogen

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36 In the fractional distillation of petroleum, different fractions are obtained at the top and bottom of the fractionating column.

Which properties does the fraction obtained at the top of the fractionating column have, compared with the fraction obtained at the bottom?

1 higher viscosity
2 lower boiling point
3 lower volatility
4 shorter chain length

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

37 Compound Q is a hydrocarbon that has no structural isomers.

Compound Q does not decolourise bromine in the dark.

Which compound is Q?

A C_3H_6
B C_3H_8
C C_4H_8
D C_4H_{10}

38 Alkenes can be produced by the cracking of alkanes, such as decane, $C_{10}H_{22}$.

Which equation shows the cracking of decane to produce two different alkenes and at least one other product?

A $C_{10}H_{22} \rightarrow 2C_2H_4 + C_3H_6 + C_4H_{10}$
B $C_{10}H_{22} \rightarrow H_2 + 2C_2H_4 + C_3H_6 + C_5H_{10}$
C $C_{10}H_{22} \rightarrow 2C_3H_6 + C_4H_{10}$
D $C_{10}H_{22} \rightarrow H_2 + 2C_2H_4 + 2C_3H_6$

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39 Two statements are shown.

1 When ethanol is made from glucose by fermentation, each glucose molecule produces three molecules of ethanol.

2 When ethanoic acid is made from ethanol, the ethanol acts as an oxidising agent.

Which row about these statements is correct?

	statement 1	statement 2
A	✓	
B	✓	
C	×	
D	×	

key
✓ = true
× = false

40 An ester is formed from a carboxylic acid and an alcohol.

How does the number of carbon, hydrogen and oxygen atoms in an ester differ from the total number of these atoms in the carboxylic acid and alcohol from which the ester is formed?

	carbon atoms	hydrogen atoms	oxygen atoms
A	fewer	fewer	fewer
B	fewer	same	fewer
C	same	fewer	fewer
D	same	same	same

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