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CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/12**

Paper 1 Multiple Choice **February/March 2026**

1 hour 15 minutes

0953874203

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.
- Important values, constants and standards are printed in the question paper.

This document has **20** pages. Any blank pages are indicated.

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[Turn over

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1 Which statement about p orbitals is correct?

A All p orbitals are ∞ shaped.

B All p orbitals have a lower energy than an s orbital of the same principal quantum number.

C Each of the first four quantum shells contain p orbitals.

D Each p orbital can contain a maximum of six electrons.

2 The first four ionisation energies for phosphorus, in $kJ\,mol^{-1}$, are shown.

1st	2nd	3rd	4th
1060	1900	2920	4960

Which row gives the 5th to 14th ionisation energies for phosphorus?

	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
A	6270	8410	21 270	25 400	29 800	35 870	40 100	46 300	59 000	271 800
B	6270	21 270	25 400	29 860	35 870	40 100	46 300	54 070	59 000	271 800
C	6270	21 270	25 400	29 860	35 870	40 100	46 300	59 000	271 800	301 400
D	21 270	25 400	29 860	35 870	40 100	46 300	54 070	59 000	271 800	301 400

3 Sodium carbonate neutralises phosphoric acid to produce sodium phosphate, carbon dioxide and water only.

Which volume of $0.50\,mol\,dm^{-3}$ sodium carbonate is needed to exactly neutralise $40.0\,cm^3$ of $0.25\,mol\,dm^{-3}$ phosphoric acid?

A $10.0\,cm^3$ **B** $13.3\,cm^3$ **C** $20.0\,cm^3$ **D** $30.0\,cm^3$

4 Which equation describes the complete combustion of an alkene, C_nH_{2n}?

A $C_nH_{2n} + 2nO_2 \rightarrow nCO_2 + nH_2O$

B $C_nH_{2n} + 2nO_2 \rightarrow nCO_2 + 2nH_2O$

C $C_nH_{2n} + 1.5nO_2 \rightarrow nCO_2 + 2nH_2O$

D $C_nH_{2n} + 1.5nO_2 \rightarrow nCO_2 + nH_2O$

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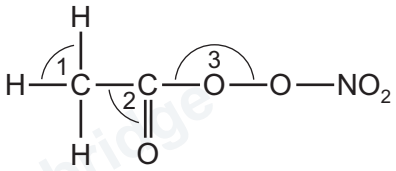
5 Organic nitrates in photochemical smog can cause breathing difficulties.

The diagram shows an example of an organic nitrate molecule.

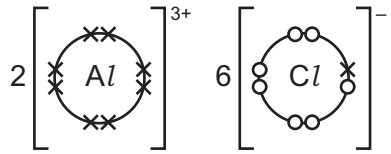


What is the correct order of the bond angles shown in ascending order (smallest first)?

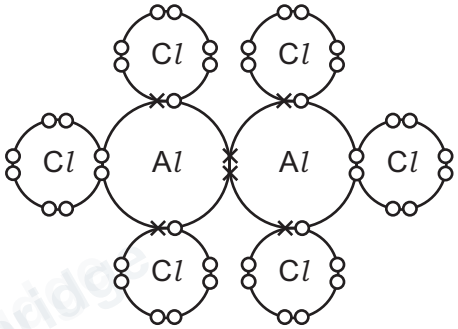
A $1 \rightarrow 2 \rightarrow 3$ **B** $2 \rightarrow 1 \rightarrow 3$ **C** $3 \rightarrow 1 \rightarrow 2$ **D** $3 \rightarrow 2 \rightarrow 1$

6 Which dot-and-cross diagram is correct for Al_2Cl_6?

A



B

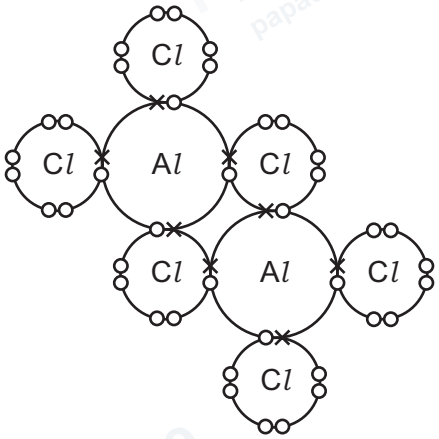


key

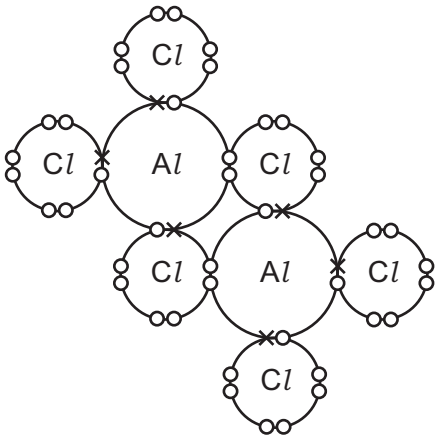
× electrons from Al

○ electrons from Cl

C



D



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7 In this question you should assume methane behaves as an ideal gas.

The gas laws can be summarised in the ideal gas equation.

$$pV = nRT$$

The volume of a sample of methane is measured at a temperature of 60 °C and a pressure of 103 kPa. The volume measured is 5.37×10^{-3} m^3.

What is the mass of the sample of methane, given to two significant figures?

A 0.0032 g **B** 0.018 g **C** 3.2 g **D** 18 g

8 The equation for the formation of ammonia is shown.

$$3H_2(g) + N_2(g) \rightarrow 2NH_3(g) \qquad \Delta H = -92.2\ \text{kJ mol}^{-1}$$

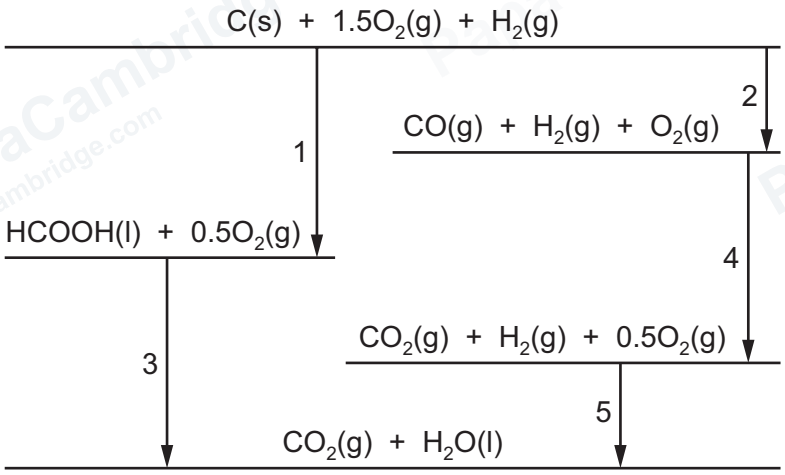
Some bond energy data is given.

bond	bond energy / kJ mol^{-1}
H–H	436
N–H	388

What is the bond energy of the N≡N bond in the nitrogen molecule?

A 248 kJ mol^{-1} **B** 928 kJ mol^{-1} **C** 1392 kJ mol^{-1} **D** 1848 kJ mol^{-1}

9 The diagram shows an energy cycle with a series of reactions.



Which reactions have an enthalpy change that is an enthalpy of formation?

A 1, 2 and 5 **B** 1 only **C** 2, 3 and 4 **D** 3, 4 and 5

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10 Which reaction is an example of disproportionation?

A $2H_2O_2 \rightarrow 2H_2O + O_2$

B $2KHCO_3 \rightarrow K_2CO_3 + CO_2 + H_2O$

C $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

D $2NaNO_3 \rightarrow 2NaNO_2 + 3O_2$

11 Compound W contains chlorine in an oxidation state of +7.

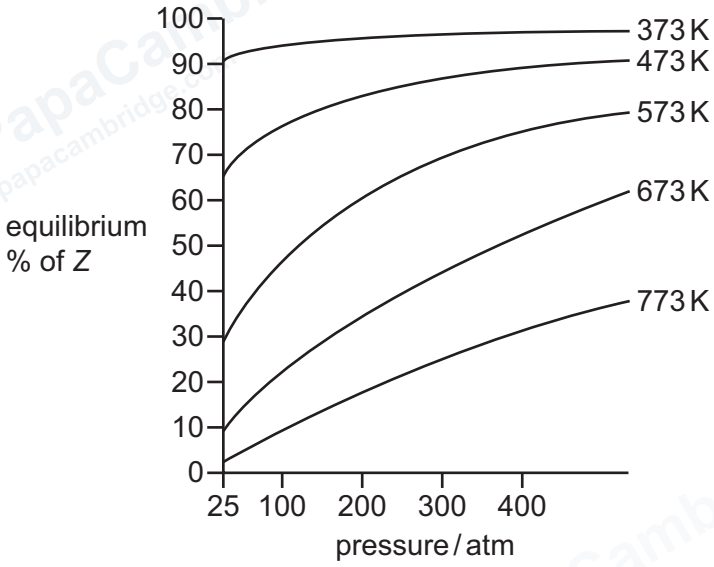
What is compound W?

A NH_4Cl **B** NH_4ClO_3 **C** NH_4ClO_4 **D** N_2H_5Cl

12 In an industrial process, two gases X and Y react together to form a single gaseous product Z.

$$X(g) + Y(g) \rightleftharpoons Z(g)$$

The equilibrium percentage of product Z varies according to the pressure and the temperature as shown in the graphs.



Which statement about this equilibrium reaction is correct?

A Decreasing the temperature decreases the value of the equilibrium constant.

B Decreasing the temperature increases the rate of this reaction.

C Increasing the pressure increases the value of the equilibrium constant.

D The reaction is exothermic in the forward direction.

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13 The Contact process involves an equilibrium reaction.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Which row gives the K_p expression and the pressure conditions used for this reaction?

	K_p expression	pressure / atm
A	$\frac{p^2SO_3}{p^2SO_2 \times pO_2}$	2
B	$\frac{p^2SO_2 \times pO_2}{p^2SO_3}$	2
C	$\frac{p^2SO_3}{p^2SO_2 \times pO_2}$	200
D	$\frac{p^2SO_2 \times pO_2}{p^2SO_3}$	200

14 When nitrogen monoxide gas is mixed with oxygen gas, the molecules collide with each other. Some of these collisions are effective and lead to a reaction.

The pressure of the mixture was increased at constant temperature.

Which row correctly describes how the frequency of effective and non-effective collisions changed?

	frequency of effective collisions	frequency of non-effective collisions
A	increased	decreased
B	increased	increased
C	increased	unchanged
D	unchanged	decreased

15 A reversible chemical reaction is studied.

The forward reaction has an activation energy E_a = 50 kJ mol^{-1} and an enthalpy change of reaction ΔH_r = +20 kJ mol^{-1}.

When a catalyst is added, the activation energy of the forward reaction decreases by 50%.

What is the activation energy of the backwards reaction when the catalyst is present?

A 45 kJ mol^{-1} **B** 25 kJ mol^{-1} **C** 15 kJ mol^{-1} **D** 5 kJ mol^{-1}

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16 Which substance does **not** give HCl(g) when water is added to it?

A MgCl_2 **B** Al_2Cl_6 **C** SiCl_4 **D** PCl_5

17 For Groups 1 and 2, metallic bonding is stronger in metals that have a smaller atomic radius.

X and Y are both metals.

ΔH_{at} is the energy required to produce 1.0 mol of gaseous atoms from the solid.

ΔH_{at}X = +107 kJ mol^{-1}; ΔH_{at}Y = +148 kJ mol^{-1}

What are X and Y?

	X	**Y**
A	Na	K
B	Na	Mg
C	Mg	Na
D	Mg	K

18 The elements in Period 3 and their compounds show trends across the period from sodium to sulfur.

Which row is correct?

	electronegativity of the elements	**acid–base behaviour of the oxides of the elements**
A	decreases	basic → amphoteric → acidic
B	decreases	acidic → amphoteric → basic
C	increases	basic → amphoteric → acidic
D	increases	acidic → amphoteric → basic

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19 This question is about the hydroxides and carbonates of magnesium and barium.

Which row is correct?

	the more soluble hydroxide	the carbonate with the greater thermal stability
A	$Ba(OH)_2$	$BaCO_3$
B	$Mg(OH)_2$	$BaCO_3$
C	$Ba(OH)_2$	$MgCO_3$
D	$Mg(OH)_2$	$MgCO_3$

20 When 3.00 g of an anhydrous nitrate of a Group 2 metal is decomposed, 1.53 g of gas is produced.

What is the nitrate compound?

A beryllium nitrate

B calcium nitrate

C magnesium nitrate

D strontium nitrate

21 When concentrated sulfuric acid is added to crystals of sodium bromide, the products include a colourless gas and a brown-coloured substance.

The colourless gas gives a cream precipitate with $AgNO_3(aq)$.

Which row describes the reactions that produce the colourless gas and the brown-coloured substance?

	reaction that produces colourless gas	reaction that produces brown-coloured substance
A	acid–base	acid-base
B	acid-base	redox
C	redox	acid-base
D	redox	redox

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22 X and Y are halogens.

The following reaction occurs in an aqueous solution.

$$2NaX + Y_2 \rightarrow 2NaY + X_2$$

Which row is correct?

	X	Y	behaviour of NaX
A	bromine	chlorine	as an oxidising agent
B	bromine	chlorine	as a reducing agent
C	chlorine	bromine	as an oxidising agent
D	chlorine	bromine	as a reducing agent

23 Mohr's salt is a pale green crystalline solid which is soluble in water. It contains two cations, one of which is Fe^{2+}, and one anion which is SO_4^{2-}.

The identity of the second cation was determined by heating Mohr's salt with aqueous sodium hydroxide. A colourless gas was evolved which readily dissolved in water giving an alkaline solution.

A green precipitate was also formed.

What are the identities of the gas and the precipitate?

	gas	precipitate
A	NH_3	$Fe(OH)_2$
B	NH_3	Na_2SO_4
C	SO_2	$Fe(OH)_2$
D	SO_2	Na_2SO_4

24 The amount of each gas in the exhaust gases from an internal combustion engine is determined.

The exhaust gases are then passed through the exhaust catalyst, known as a catalytic converter.

Which statements about the effect of the catalytic converter are correct?

1 The amount of nitrogen increases.

2 The amount of carbon dioxide decreases.

3 The amount of carbon monoxide does **not** change.

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

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25 In this question, alkenes and cyclic alkanes should be considered.

How many **structural** isomers of C_4H_8 are there?

A 3 **B** 4 **C** 5 **D** 6

26 Which pair of molecules are positional isomers?

A $CH_3CH_2CH_2CH_3$ and $CH_3CH(CH_3)CH_3$

B $CH_3CH_2CHCl CH_3$ and $CH_3CH_2CH_2CH_2Cl$

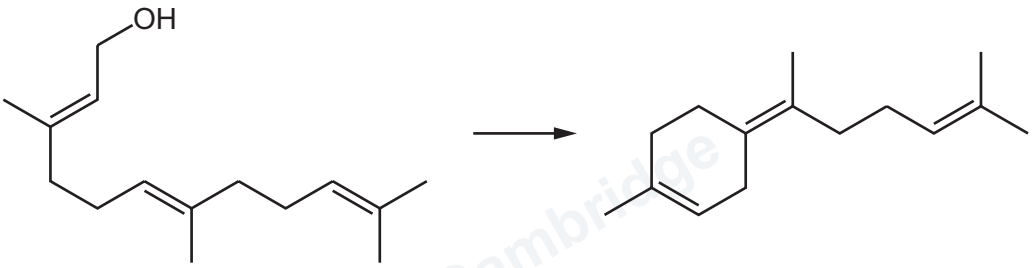
C $CH_3CH_2CH_2CHO$ and $CH_3CH_2COCH_3$

D $CH_2CHCH_2CH_3$ and $CH_3CH_2CHCH_2$

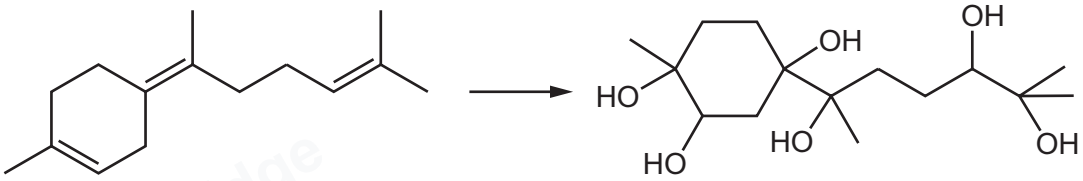
27 The reaction sequence shown takes place in two stages.

The reagent for stage 1 is concentrated H_2SO_4.

stage 1



stage 2



Which type of reaction is carried out in the two stages?

	stage 1	stage 2
A	condensation	hydrolysis
B	reduction	hydrolysis
C	condensation	oxidation
D	reduction	oxidation

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28 Three halogenoalkanes are listed.

1 1-bromopropane

2 2-chloropropane

3 1-bromo-2-chloropropane

Which of these halogenoalkanes could be produced when propene is reacted with a mixture of HCl(g) and HBr(g)?

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

29 2-bromomethylpropane is heated with concentrated NaOH in ethanol under reflux.

Which statement about the major product of this reaction is correct?

A Methylpropene is produced in an elimination reaction.

B Methylpropene is produced in a condensation reaction.

C Methylpropan-2-ol is produced in an S_N1 reaction.

D Methylpropan-2-ol is produced in an S_N2 reaction.

30 Which reagents react with ethanol?

1 Na

2 SOCl_2

3 PCl_5

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

31 Three alkenes are listed.

1 hex-1-ene

2 cis-hex-2-ene

3 trans-hex-3-ene

Which alkenes can be formed by the dehydration of hexan-2-ol?

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

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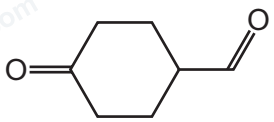
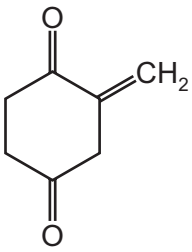
32 Which compound would give positive tests with alkaline I_2(aq) and with Fehling's reagent?

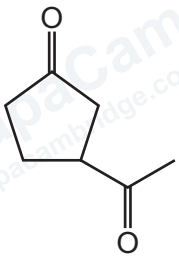
A



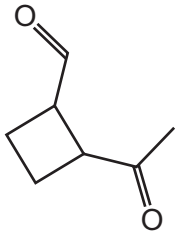
B



C



D



33 Compound Y is heated with a mild oxidising agent. One of the products of the reaction reacts with hydrogen cyanide, forming 2-hydroxybutanenitrile.

What is compound Y?

A butan-1-ol

B butan-2-ol

C propan-1-ol

D propan-2-ol

34 An ester of structural formula $CH_3CO_2CH_3$ is heated with aqueous sodium hydroxide.

What are the two organic products of this reaction?

A ethanoic acid and methanol

B methanoic acid and ethanol

C sodium ethanoate and methanol

D sodium methanoate and ethanol

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35 A student suggests two uses of $LiAlH_4$.

reaction 1 $CH_3–CH=CH_2 \xrightarrow{LiAlH_4} CH_3–CH_2–CH_3$

reaction 2 $CH_3CO_2H \xrightarrow{LiAlH_4} CH_3CH_2OH$

Which reactions would give the product shown?

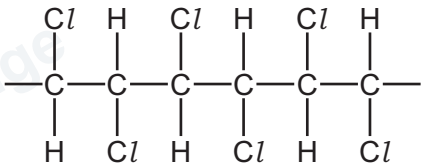
A both reaction 1 and reaction 2

B reaction 1 only

C reaction 2 only

D neither reaction 1 nor reaction 2

36 The diagram shows a section of an addition polymer.



What is the name of this polymer?

A poly(1,2-dichloroethane)

B poly(1,2-dichloroethene)

C poly(1,2,3-trichloropropane)

D poly(1,2,3-trichloropropene)

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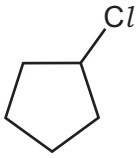
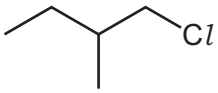
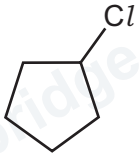
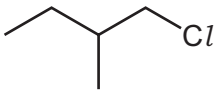
37 0.20 mol of P reacts to form 7.83 g of primary amine Q.

The percentage yield of Q is 45.0%.

[A_r: C, 12.0; H, 1.0; Cl, 35.5; N, 14.0]

Which row is correct?

	reagent and conditions for reaction	structure of P
A	KCN in ethanol with heat	
B	KCN in ethanol with heat	
C	NH_3 in ethanol heated under pressure	
D	NH_3 in ethanol heated under pressure	

38 Bromine reacts with ethene in the dark.

Which description of the organic intermediate of this reaction is correct?

A It has a negative charge.

B It is a free radical.

C It is a nucleophile.

D It is an electrophile.

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39 When 1-bromopropane is treated in succession with two reagents, X and Y, it produces propanoic acid.

What are reagents X and Y?

	reagent X	reagent Y
A	NaOH(aq)	$H^+ / Cr_2O_7^{2-}$(aq)
B	NaOH(aq)	CO_2
C	KCN in ethanol	HC*l*(aq)
D	KCN in ethanol	NaOH(aq)

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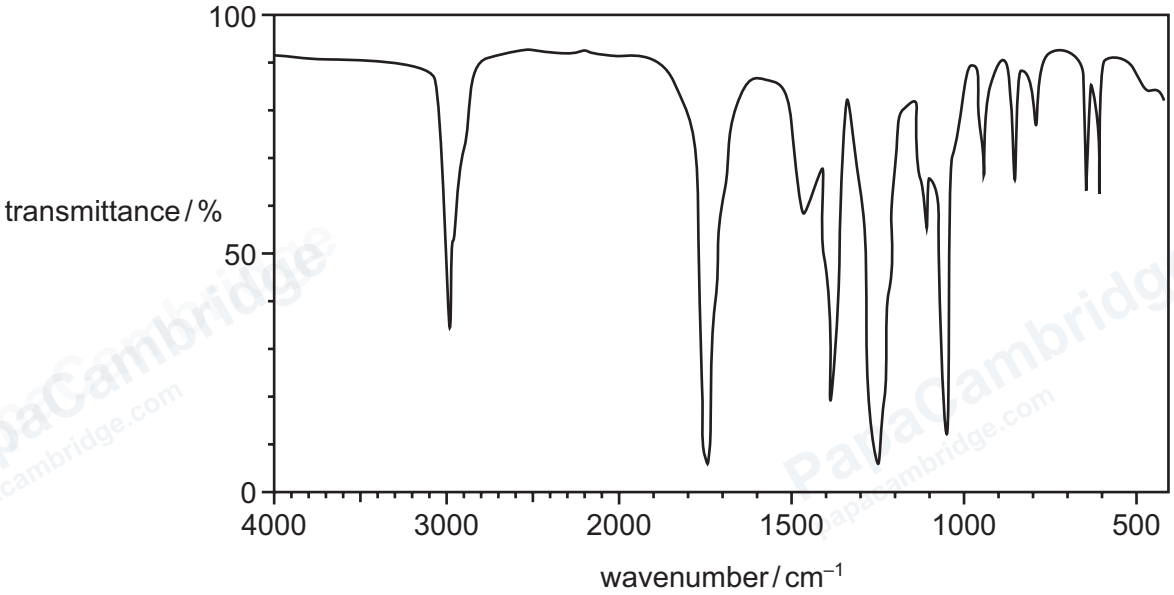
40

bond	functional groups containing the bond	characteristic infrared absorption range (in wavenumbers) / cm^{-1}
C–O	hydroxy, ester	1040–1300
C=C	aromatic compound, alkene	1500–1680
C=O	amide carbonyl, carboxyl ester	1640–1690 1670–1740 1710–1750
C≡N	nitrile	2200–2250
C–H	alkane	2850–2950
N–H	amine, amide	3300–3500
O–H	carboxyl hydroxy	2500–3000 3200–3650

An organic compound, X, has the composition shown.

C, 54.54%; H, 9.09%; O, 36.37%

The infrared spectrum of X is shown.



What is compound X?

A butanoic acid

B ethanoic acid

C ethyl ethanoate

D methyl methanoate

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Important values, constants and standards

molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^{4}\,\text{C mol}^{-1}$
Avogadro constant	$L = 6.022 \times 10^{23}\,\text{mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,\text{C}$
molar volume of gas	$V_m = 22.4\,\text{dm}^3\,\text{mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0\,\text{dm}^3\,\text{mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,\text{mol}^2\,\text{dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18\,\text{kJ kg}^{-1}\,\text{K}^{-1}$ ($4.18\,\text{J g}^{-1}\,\text{K}^{-1}$)

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The Periodic Table of Elements

Group																		
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3											13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	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

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	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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