GradeMax

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Wednesday 6 May 2026

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WCH11/01**

Chemistry

International Advanced Subsidiary/Advanced Level
UNIT 1: Structure, Bonding and Introduction to Organic Chemistry

You must have:
Scientific calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 7 9 2 1 8 A 0 1 2 4

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SECTION A

Answer ALL the questions in this section.

You should aim to spend no more than 20 minutes on this section.

For each question, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 How many **atoms** are there in 17.0 g of hydrogen peroxide, H_2O_2?

[Data: Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}]

☒ **A** 3.01×10^{23}

☒ **B** 6.02×10^{23}

☒ **C** 1.20×10^{24}

☒ **D** 2.41×10^{24}

(Total for Question 1 = 1 mark)

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2 A sample of gas was prepared for use in helium-neon lasers.
The sample contained 5.0 g of helium and 5.0 g of neon.

What is the ratio of helium atoms to neon atoms in the sample?

[Data: A_r values He = 4.0 Ne = 20.2]

☒ **A** 1 : 1

☒ **B** 5 : 2

☒ **C** 1 : 5

☒ **D** 5 : 1

(Total for Question 2 = 1 mark)

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3 A sample of 5.72 g of hydrated sodium carbonate, $Na_2CO_3 \cdot 10H_2O$, was dissolved in deionised water to form 250 cm^3 of solution.

What is the concentration, in mol dm^{-3}, of the solution formed?

[Data: A_r values H = 1.0 C = 12.0 O = 16.0 Na = 23.0]

☒ **A** 0.020

☒ **B** 0.080

☒ **C** 0.054

☒ **D** 0.220

(Total for Question 3 = 1 mark)

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4 The element iron has the atomic number $Z = 26$.

What are the numbers of s, p and d electrons in an Fe^{2+} ion?

		s electrons	p electrons	d electrons
☒	**A**	6	12	6
☒	**B**	6	18	0
☒	**C**	8	12	4
☒	**D**	8	12	6

(Total for Question 4 = 1 mark)

5 A sample of bromine contains two isotopes, ^{79}Br and ^{81}Br.

Which *m* / *z* peaks due to singly-charged ions will be in the mass spectrum of this sample?

☒ **A** 79 and 81 only

☒ **B** 79, 81 and 160 only

☒ **C** 79, 81, 158 and 162 only

☒ **D** 79, 81, 158, 160 and 162

(Total for Question 5 = 1 mark)

6 The two electrons in a 1s orbital are represented by arrows pointing in opposite directions.



Why are the electrons represented in this way?

☒ **A** electrons in the same orbital have opposite spins

☒ **B** electrons move round the nucleus in opposite directions

☒ **C** the 1s orbital of an atom has the lowest energy

☒ **D** the electrons in the orbital have different energies

(Total for Question 6 = 1 mark)

Use this space for any rough working. Anything you write in this space will gain no credit.

7 The melting temperature of lithium is higher than that of sodium.

What is the **best** explanation for this statement?

☒ **A** lithium ions have a smaller ionic radius than sodium ions

☒ **B** lithium atoms have fewer outer shell electrons than sodium atoms

☒ **C** lithium ions have a lower charge density than sodium ions

☒ **D** lithium has a higher electrical conductivity than sodium

(Total for Question 7 = 1 mark)

8 A few drops of an aqueous solution of green copper(II) chromate(VI) are placed at the centre of a strip of damp filter paper.

The ends of the paper are connected to opposite electrodes of a DC supply.

What colours would be seen at each electrode after a few minutes?

	Colour at negative electrode	Colour at positive electrode
☒ **A**	blue	yellow
☒ **B**	colourless	green
☒ **C**	blue	colourless
☒ **D**	yellow	blue

(Total for Question 8 = 1 mark)

9 What bonding is present in ammonium bromide?

☒ **A** ionic only

☒ **B** ionic and covalent only

☒ **C** covalent and dative covalent only

☒ **D** covalent, dative covalent and ionic

(Total for Question 9 = 1 mark)

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10 (a) Which gaseous molecule is polar?

(1)

- ☒ **A** BF_3
- ☒ **B** CO_2
- ☒ **C** NH_3
- ☒ **D** SF_6

(b) Which bond is the most polar?

(1)

- ☒ **A** B—F
- ☒ **B** C—O
- ☒ **C** Si—Cl
- ☒ **D** P—S

(Total for Question 10 = 2 marks)

11 Which compound has the greatest covalent character?

- ☒ **A** LiBr
- ☒ **B** LiI
- ☒ **C** KF
- ☒ **D** KCl

(Total for Question 11 = 1 mark)

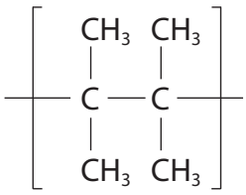
12 What is the main reason for metals being good conductors of electricity?

- ☒ **A** metal ions are free to move through the lattice
- ☒ **B** metal ions are very close to each other
- ☒ **C** some outer shell electrons are free to move through the lattice
- ☒ **D** all electrons are free to move through the lattice

(Total for Question 12 = 1 mark)

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13 The repeat unit of a polymer is shown.



Which monomer forms this polymer?

- ☒ **A** 1,2,3,4-tetramethylethene
- ☒ **B** 1,1,2-trimethylpropene
- ☒ **C** 2,3-dimethylbut-1-ene
- ☒ **D** 2,3-dimethylbut-2-ene

(Total for Question 13 = 1 mark)

14 Methane reacts with carbon dioxide as shown.

$$CH_4(g) + CO_2(g) \rightarrow 2CO(g) + 2H_2(g)$$

What is the atom economy, by mass, for the formation of carbon monoxide?

- ☒ **A** 47%
- ☒ **B** 50%
- ☒ **C** 93%
- ☒ **D** 97%

(Total for Question 14 = 1 mark)

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15 (a) A mixture of 60 cm^3 of methane and 30 cm^3 of oxygen reacts in a sealed container. The equation for the reaction is shown.

$$2CH_4(g) + 3O_2(g) \rightarrow 2CO(g) + 4H_2O(l)$$

When the reaction is complete, the reaction mixture is allowed to return to room temperature and pressure.

What is the **total** volume of **gas**, in cm^3, at the end of the reaction?

(1)

☒ **A** 20

☒ **B** 40

☒ **C** 60

☒ **D** 100

(b) What is the **most** significant environmental hazard associated with the pollutant carbon monoxide?

(1)

☒ **A** it is a major contributor to acid rain

☒ **B** it is toxic at low concentrations

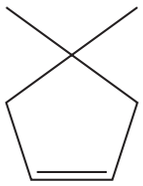
☒ **C** it is a major contributor to global warming

☒ **D** it is the main cause of ozone layer depletion

(Total for Question 15 = 2 marks)

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16 The structure of a hydrocarbon, C_7H_{12}, is shown.



(a) What is the name of this hydrocarbon according to IUPAC rules?

(1)

- ☒ **A** 1,1-dimethylcyclopentene
- ☒ **B** 2,2-dimethylcyclopentene
- ☒ **C** 3,3-dimethylcyclopentene
- ☒ **D** 4,4-dimethylcyclopentene

(b) What is the **total** number of **sigma** (σ) bonds in this molecule?

(1)

- ☒ **A** 6
- ☒ **B** 7
- ☒ **C** 13
- ☒ **D** 19

(c) This hydrocarbon reacts with acidified potassium manganate(VII) at room temperature.

Which functional group is formed?

(1)

- ☒ **A** alcohol
- ☒ **B** aldehyde
- ☒ **C** carboxylic acid
- ☒ **D** ketone

(Total for Question 16 = 3 marks)

TOTAL FOR SECTION A = 20 MARKS

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SECTION B

Answer ALL the questions. Write your answers in the spaces provided.

17 This question is about some elements in Group 0 of the Periodic Table.

(a) (i) Write the equation for the first ionisation energy of neon.
Include state symbols.

(1)

(ii) Explain why the first ionisation energy of neon is greater than that of fluorine, and much greater than that of sodium.

(5)

(b) A sample of the element krypton contained five isotopes with the abundances shown.

Isotope	Abundance (%)
^{80}Kr	2.350
^{82}Kr	11.610
^{83}Kr	11.500
^{84}Kr	56.900
^{86}Kr	17.680

(i) Calculate the relative atomic mass of this sample of krypton.
Give your answer to **four** significant figures.

(2)

(ii) The ions formed in the mass spectrometer are deflected by a magnetic field.

Identify the isotope from the table which produces an ion with the greatest deflection. Justify your answer.

(2)

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(c) The electronic configuration of a xenon atom is shown.

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^6$

Xenon reacts with fluorine gas to form a number of xenon fluorides. The 5s and 5p electrons are involved in the bonding of these fluorides.

(i) State the number of bond pairs and lone pairs around the xenon atom in xenon difluoride, XeF_2.

(1)

bond pairs ..... lone pairs .....

(ii) Suggest why the XeF_2 molecule is linear.

(3)

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(Total for Question 17 = 14 marks)

18 This question is about sodium and some of its compounds.

(a) Sodium reacts with chlorine to produce sodium chloride.

Write an equation for the reaction. State symbols are not required.

(1)

(b) Metals such as sodium can be hammered into different shapes.
However, sodium chloride will break into small pieces when hammered.

Explain how this difference in physical property results from differences in their bonding.

(4)

(c) Explain why the melting temperatures of the sodium halides decrease down the group.

(2)

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(d) Baking powder was invented in 1843 by Alfred Bird.
It is used as an alternative to yeast.
Baking powder contains three main ingredients:
sodium hydrogencarbonate, $NaHCO_3$, a solid acid and starch.

A sample of baking powder was analysed to determine the percentage by mass of sodium hydrogencarbonate.

Excess dilute hydrochloric acid was added to 1.10 g of the sample.
The volume of carbon dioxide produced was found to be 74.0 cm^3 at room temperature and pressure (r.t.p.).

(i) Write an **ionic** equation for the reaction between dilute hydrochloric acid and sodium hydrogencarbonate.
Include state symbols.

(2)

(ii) Calculate the percentage by mass of sodium hydrogencarbonate in the sample of baking powder.

[Data: molar volume of a gas at r.t.p. = 24.0 $dm^3\,mol^{-1}$]

(3)

(Total for Question 18 = 12 marks)

19 (a) The successive ionisation energies of carbon are shown.

Ionisation number	First	Second	Third	Fourth	Fifth	Sixth
Ionisation energy / kJ mol^{-1}	1086	2353	4621	6223	37 832	47 278

Explain how these values show that carbon is a Group 4 element.

(2)

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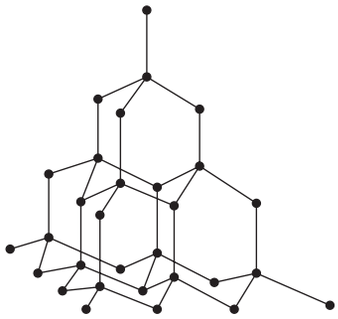
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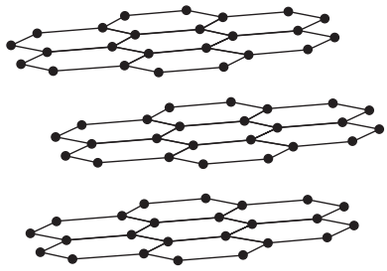
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(b) Diagrams of the structures of diamond and graphite are shown.



diamond



graphite

Diamonds are used in high-speed drill tips.
Graphite is used as a high-temperature lubricant.

Explain how the different structure and bonding of these two forms of carbon makes each suitable for the stated use.

(4)

(c) Graphene has been developed for use as transparent electrodes in solar cells.

Explain how the structure and bonding of graphene makes it suitable for this use.

(2)

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(Total for Question 19 = 8 marks)

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20 The fractional distillation of crude oil produces fuels.

(a) A hydrocarbon, **X**, present in crude oil, contains 83.7% carbon by mass.

(i) Calculate the **empirical** formula of **X**. You **must** show your working.

(2)

(ii) The M_r of **X** is 86.

Deduce the **molecular** formula of **X**.

(1)

(iii) Give the reason why the name of **X** cannot be deduced from its molecular formula.

(1)

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(b) Straight-chain alkanes are reformed into branched-chain alkanes to improve fuel octane rating.

Write an equation, using **skeletal** formulae, to show the reforming of heptane into 2,2,3-trimethylbutane.
State symbols are not required.

(1)



(c) E10 fuels are produced by replacing 10% by mass of the hydrocarbon components of petrol with bioethanol.
An E10 fuel contains C_8H_{18} and bioethanol only.

Bioethanol has been described as a carbon-neutral fuel.

(i) State what is meant by the term 'carbon-neutral'.

(1)

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(ii) Write the equation for the complete combustion of C_8H_{18}.
State symbols are not required.

(1)

(iii) Calculate the mass, in kg, of CO_2 emitted per kg of the E10 fuel by the combustion of the hydrocarbon component, C_8H_{18}, of this fuel only.

(3)

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(iv) Suggest **one** reason why no fuel is carbon-neutral.

(1)

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(Total for Question 20 = 11 marks)

21 This question is about two homologous series, alkanes and alkenes.

(a) State **two** characteristics of a homologous series.

(2)

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(b) Propane reacts with bromine in the presence of ultraviolet radiation.
One possible product is 1-bromopropane.

(i) Draw the initiation step for this reaction using appropriate curly arrows.

(2)

(ii) Give an equation for each of the first **two** propagation steps in the formation of 1-bromopropane.
Curly arrows are **not** required.

(2)

First propagation step

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Second propagation step

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(iii) Give one reason why this method has limited use in the synthesis of 1-bromopropane.

(1)

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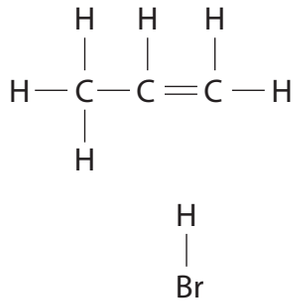
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(c) 1-Bromopropane is also formed in the reaction between propene and hydrogen bromide.

(i) Draw the mechanism for this reaction.
Include curly arrows and relevant lone pairs and dipoles.

(3)



(ii) State why 1-bromopropane is the minor product of this reaction.

(1)

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(d) Unripe bananas are harvested, shipped and then transferred to ripening rooms.

One ripening room has a volume of 45.0 m^3 and is kept at a temperature of 18.5 °C and a pressure of 101 kPa. The concentration of the ethene ripening agent in this room is 100 ppm.

Calculate the mass of ethene in this room.
Use the ideal gas equation, $pV = nRT$.

[Data: $R = 8.31\ J\,mol^{-1}\,K^{-1}$]

(4)

(Total for Question 21 = 15 marks)

TOTAL FOR SECTION B = 60 MARKS
TOTAL FOR PAPER = 80 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
																	(18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

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