Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | Candidate Number

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Monday 20 May 2019

Morning (Time: 1 hour 30 minutes) | Paper Reference **WCH11/01**

Chemistry

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

Candidates must have: Scientific calculator
Ruler

Total Marks

Instructions

- Use **black** ink or **black** ball-point pen.
- **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.
- There is a Periodic Table on the back page 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.
- Check your answers if you have time at the end.

Turn over ▶

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P 6 1 4 7 6 A 0 1 2 8

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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 Which statement is **not** true for sodium chloride?

☒ **A** sodium chloride conducts electricity in aqueous solution

☒ **B** sodium chloride conducts electricity when molten

☒ **C** sodium chloride has a molecular structure

☒ **D** sodium chloride has a giant structure

(Total for Question 1 = 1 mark)

2 Which of these molecules is the **most** polar?

☒ **A** H—H

☒ **B** H—F

☒ **C** H—Cl

☒ **D** H—Br

(Total for Question 2 = 1 mark)

3 Covalent bonding is best described as the electrostatic attraction between

☒ **A** oppositely charged ions

☒ **B** positive ions and delocalised electrons

☒ **C** a shared pair of electrons

☒ **D** two nuclei and a shared pair of electrons

(Total for Question 3 = 1 mark)

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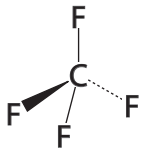
4 Which is correct for tetrafluoromethane (CF_4)?



	Bonds	Molecule
☒ **A**	polar	polar
☒ **B**	non-polar	polar
☒ **C**	polar	non-polar
☒ **D**	non-polar	non-polar

(Total for Question 4 = 1 mark)

5 Which pair of ions gives the strongest ionic bonding?

☒ **A** Na^+ and F^-

☒ **B** K^+ and Br^-

☒ **C** Mg^{2+} and O^{2-}

☒ **D** Ca^{2+} and S^{2-}

(Total for Question 5 = 1 mark)

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6 In 1.31 g of a chloride of titanium, there is 0.528 g of titanium.

What is the empirical formula of this titanium chloride?

[A_r values: Ti = 47.9 Cl = 35.5]

☒ **A** $TiCl$

☒ **B** $TiCl_2$

☒ **C** $TiCl_3$

☒ **D** Ti_2Cl_4

(Total for Question 6 = 1 mark)

7 Which isotope is used as the standard in the definition of relative atomic mass?

☒ **A** ^{1}H

☒ **B** ^{12}C

☒ **C** ^{13}C

☒ **D** ^{16}O

(Total for Question 7 = 1 mark)

8 Which statement about subatomic particles is correct?

☒ **A** neutral atoms always contain the same number of protons and electrons

☒ **B** neutral atoms always contain the same number of protons and neutrons

☒ **C** electrons have a relative mass of 1 and a charge of −1

☒ **D** protons have a relative mass of 1 and no charge

(Total for Question 8 = 1 mark)

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9 Which sketch graph shows the trend in first ionisation energy values going down Group 1 in the Periodic Table?

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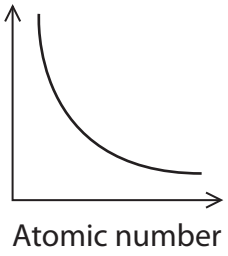
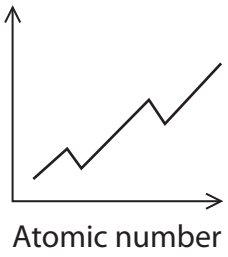
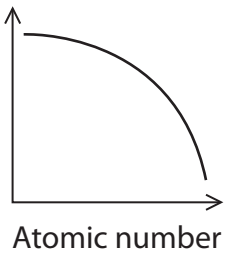
☒ **A**



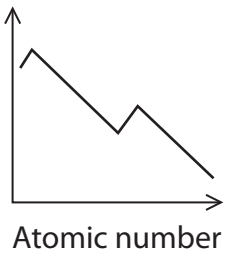
☒ **B**



☒ **C**



☒ **D**



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10 Isotopes are atoms of an element that have different

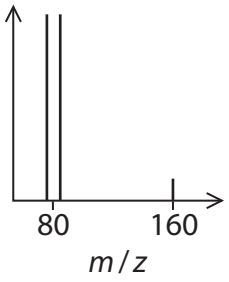
- ☒ **A** electronic structures
- ☒ **B** numbers of electrons
- ☒ **C** numbers of protons
- ☒ **D** numbers of neutrons

(Total for Question 10 = 1 mark)

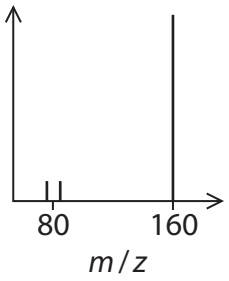
11 The two stable isotopes of bromine have relative masses of 79 and 81.

Which is the correct pattern of peaks in the mass spectrum of molecular bromine?

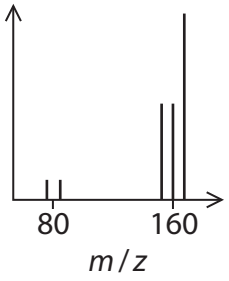
☒ **A**



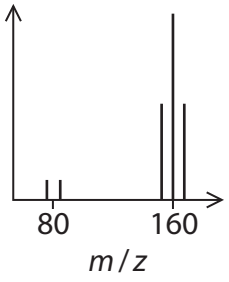
☒ **B**



☒ **C**



☒ **D**



(Total for Question 11 = 1 mark)

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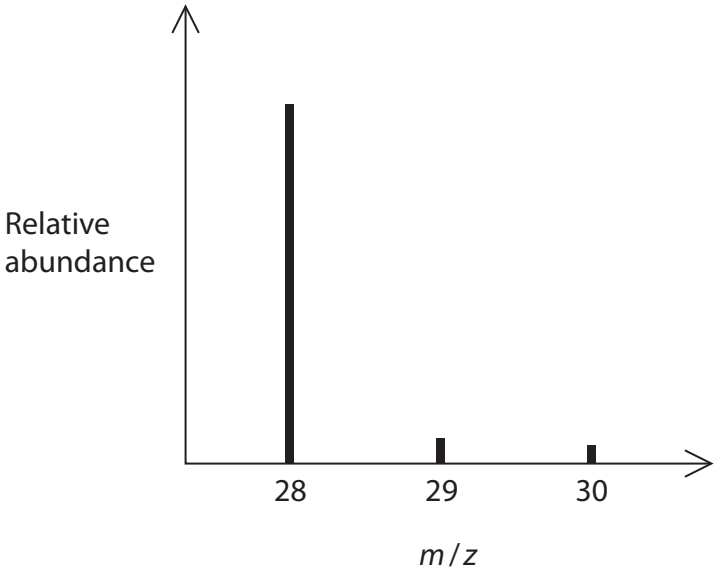
12 The mass spectrum of a sample of silicon is shown.



What is the **best** estimate for the relative atomic mass of silicon in this sample?

☒ **A** 28.0

☒ **B** 28.2

☒ **C** 28.8

☒ **D** 29.0

(Total for Question 12 = 1 mark)

13 Which is the equation for the **second** ionisation energy of an element, A?

☒ **A** $A(g) \rightarrow A^{2+}(g) + 2e^-$

☒ **B** $A^+(g) \rightarrow A^{2+}(g) + e^-$

☒ **C** $A^{2+}(g) \rightarrow A^{3+}(g) + e^-$

☒ **D** $A^{2+}(g) \rightarrow A^{4+}(g) + 2e^-$

(Total for Question 13 = 1 mark)

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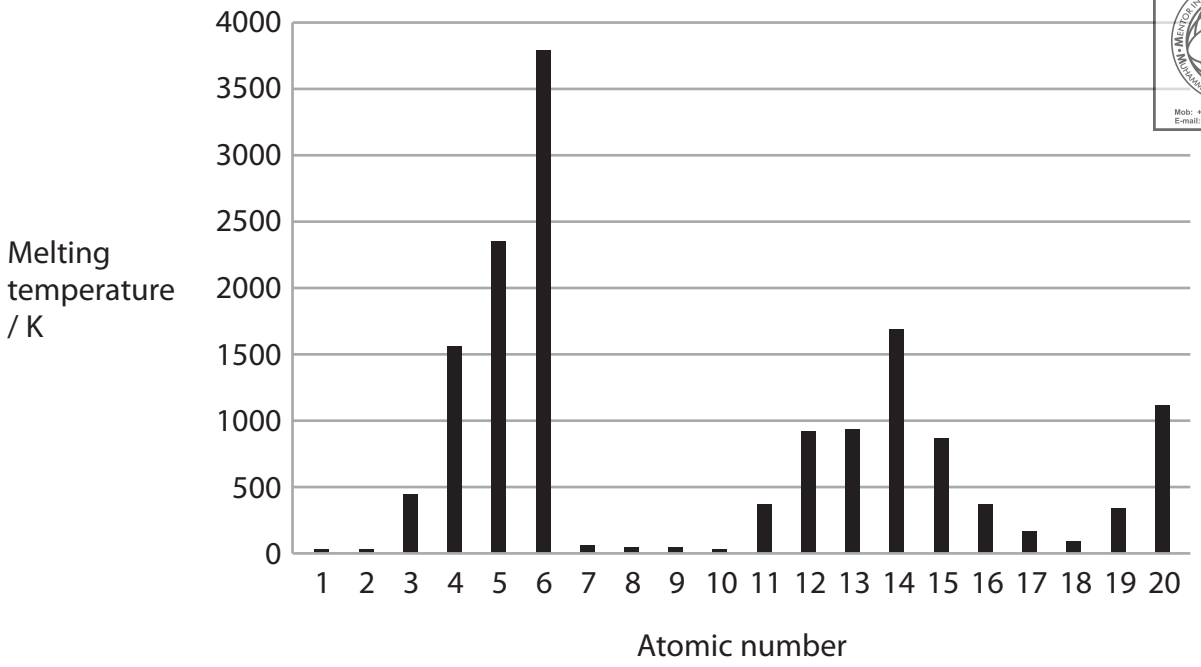
14 The bar chart shows the melting temperatures of the first twenty elements.



The bar chart shows that melting temperatures

☒ **A** of giant covalent structures are the highest in Period 2 and in Period 3

☒ **B** of metals are always higher than non-metals

☒ **C** increase going down each group

☒ **D** increase across Period 2 and Period 3

(Total for Question 14 = 1 mark)

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15 Which is the electronic configuration of the Sc^{3+} ion?

☒ **A** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

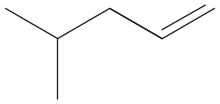
☒ **B** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5\ 3d^1$

☒ **C** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

☒ **D** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$

(Total for Question 15 = 1 mark)

16 What is the name of the product when this molecule reacts with chlorine gas?



☒ **A** 5,5-dichloro-2-methylpentane

☒ **B** 4,5-dichloro-2-methylpentane

☒ **C** 2,3-dichloro-4-methylpentane

☒ **D** 1,2-dichloro-4-methylpentane

(Total for Question 16 = 1 mark)

17 What type of bond breaking occurs in this process?

$$H_2O \rightarrow H^+ + OH^-$$

☒ **A** electrophilic

☒ **B** heterolytic

☒ **C** homolytic

☒ **D** ionic

(Total for Question 17 = 1 mark)

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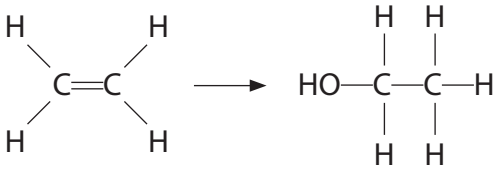
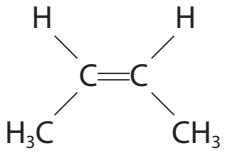
18 What reagent and conditions are used for this conversion?



- ☒ **A** potassium manganate(VII) in aqueous acid
- ☒ **B** sodium hydroxide in dilute aqueous solution
- ☒ **C** steam and acid catalyst
- ☒ **D** steam and nickel catalyst

(Total for Question 18 = 1 mark)

19 But-2-ene shows geometric isomerism.



What are the prefixes that could be used in naming this isomer?

	cis / trans	*E / Z*
☒ **A**	*cis*	*E*
☒ **B**	*cis*	*Z*
☒ **C**	*trans*	*E*
☒ **D**	*trans*	*Z*

(Total for Question 19 = 1 mark)

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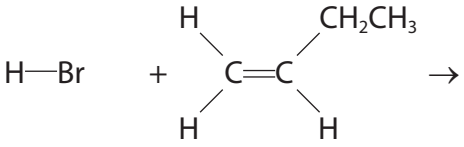
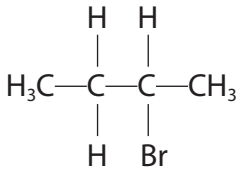
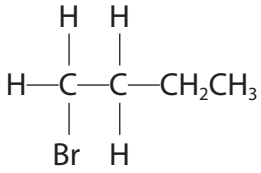
20 Which is the major product of this reaction?



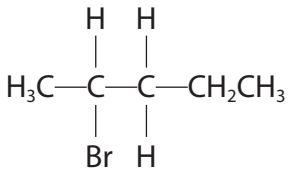
☒ **A**



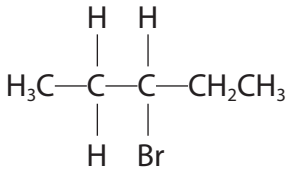
☒ **B**



☒ **C**



☒ **D**



(Total for Question 20 = 1 mark)

TOTAL FOR SECTION A = 20 MARKS

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SECTION B

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

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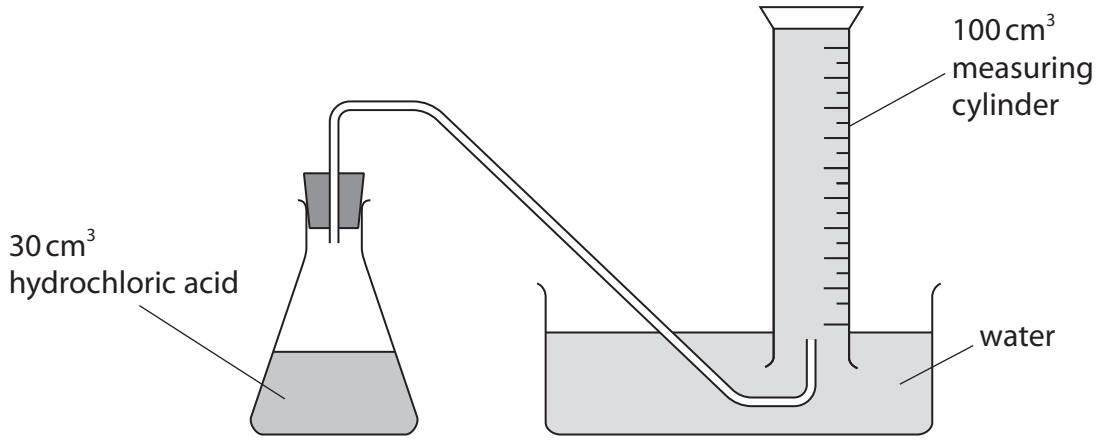
21 Magnesium carbonate powder reacts with hydrochloric acid.

(a) Complete the equation for this reaction by adding state symbols.

(1)

$MgCO_3$(.....) + 2HCl(.....) → $MgCl_2$(.....) + H_2O(.....) + CO_2(.....)

(b) A student carried out an investigation to determine the molar volume of carbon dioxide using this apparatus.



The student carried out five experiments, adding a different mass of magnesium carbonate each time.

The results are shown in the table.

Mass of magnesium carbonate / g	Volume of gas collected / cm^3
0.05	11
0.10	27
0.15	38
0.20	54
0.25	63

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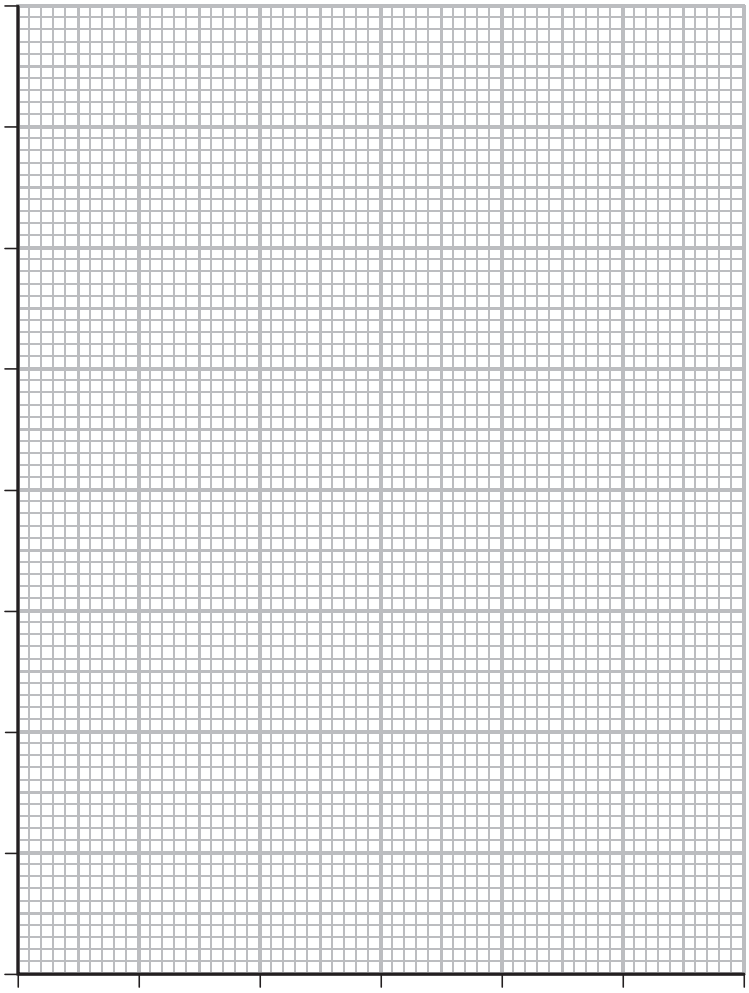
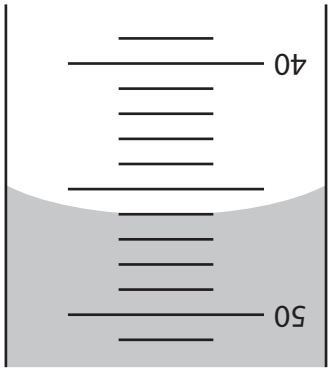
(i) Plot a graph of these results.

(3)



(ii) A student carried out a further experiment using a different mass of magnesium carbonate.



Give the volume of gas collected using the **inverted** measuring cylinder.

(1)

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(iii) Determine the mass of magnesium carbonate added in the experiment in (b)(ii), using your graph.

(1)

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(iv) Calculate the molar volume of carbon dioxide using your answers to parts (b)(ii) and (b)(iii). Give your value to an appropriate number of significant figures and include units.

[A_r values: Mg = 24.3 C = 12.0 O = 16.0]

(4)

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(v) The acid must be in excess for each experiment.

Calculate the **minimum** concentration of hydrochloric acid needed for 30 cm^3 of acid to completely react with 0.25 g of magnesium carbonate.

$$MgCO_3 + 2HCl + MgCl_2 + H_2O + CO_2$$

(2)

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(c) The value of molar volume calculated in (b)(iv) was lower than the student expected.

Give **two** reasons for the value being lower than expected.

Assume that the correct amounts of hydrochloric acid and magnesium carbonate were used.

(2)

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(Total for Question 21 = 14 marks)

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22 This question is about fuels and polymers.

Used coffee grounds have been suggested as a carbon-neutral fuel to replace some fossil fuels.

(a) (i) Explain why coffee grounds might be considered a carbon-neutral fuel.

(2)

(ii) Explain how the use of fossil fuels causes climate change.

(2)

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(b) Long chain alkanes are not normally used as fuels as they produce soot.

(i) Name another pollutant formed by **incomplete** combustion of alkanes.

(1)

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(ii) Write the equation for the **complete** combustion of octane.
State symbols are not required.

(2)

(c) Long chain alkanes are converted into smaller, more useful molecules including alkenes.

(i) Name this process.

(1)

(ii) Give a test for alkenes, including the positive result.

(2)

(d) Alkenes, such as ethene, can be used to make polymers.

(i) Write a balanced equation for the polymerisation of ethene using displayed formulae.

(1)

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(ii) Bananas produce ethene as they ripen.

Suggest one advantage and one disadvantage of using ripening bananas as a source of ethene for polymer production.

(2)

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(e) Burning poly(chloroethene) in an incinerator results in the formation of hydrogen chloride.

(i) State a **hazard** associated with hydrogen chloride.

(1)

(ii) Suggest how the hydrogen chloride could be removed from the waste gases produced in an incinerator.

(1)

(Total for Question 22 = 15 marks)

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23 This question is about bonding.

(a) Draw an electron density map for a molecule of oxygen.

(1)

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(b) Draw a diagram to show the shape of a water molecule.
Give the bond angle.

(2)

Bond angle .....

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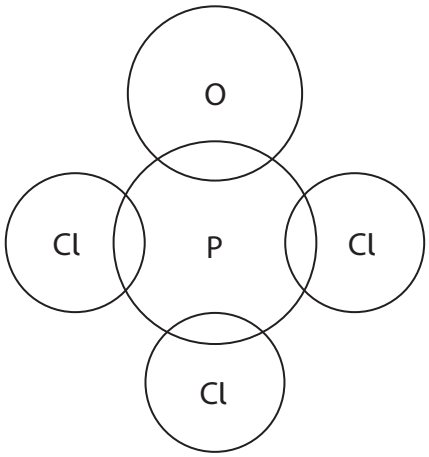
(c) The compound $POCl_3$ has a simple molecular structure.

(i) Complete the dot-and-cross diagram for the $POCl_3$ molecule.

Use crosses (×) for the phosphorus electrons, dots (●) for the chlorine electrons and circles (○) for the oxygen electrons.

(2)



(ii) Explain the shape of this molecule using the electron-pair repulsion theory.

(3)

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(d) The properties of metals depend on their structure and bonding.

(i) Draw a labelled diagram to show the metallic bonding in calcium.

(2)

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(ii) Explain how the electrical conductivity, high melting temperature and malleability of metals depend on their structure and bonding.

(3)

Electrical conductivity .....

.....

.....

High melting temperature .....

.....

.....

Malleability .....

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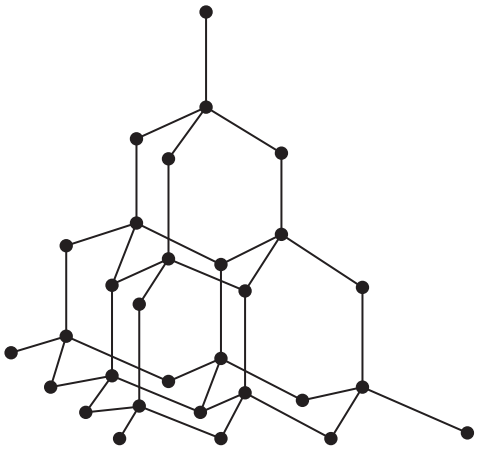
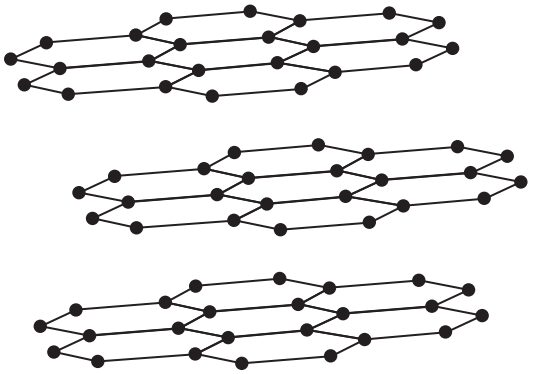
(e) Diamond, graphite and graphene are all forms of carbon.

(i) Explain **two** ways in which the physical properties of diamond and graphite differ. Refer to their structure and bonding in your answer.

(4)



diamond



graphite

(ii) State how the structure of graphene is related to the structure of graphite.

(1)

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(iii) State a use for graphene, identifying the property that makes it suitable for that use.

(2)

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(Total for Question 23 = 20 marks)

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24 Airbags protect occupants by inflating when a car crashes.

Airbags rely on chemical reactions to produce large volumes of gases quickly. In some airbags, solid sodium azide (NaN_3) decomposes forming nitrogen gas and sodium as the only products.

(a) Write an equation for the decomposition of sodium azide.
State symbols are not required.

(1)

(b) A passenger airbag requires 120 dm^3 of gas to fill it.

Calculate, using the ideal gas equation, the mass of sodium azide required to fill a passenger airbag in this reaction under standard conditions (101 000 Pa, 25°C).

Give your answer to an appropriate number of significant figures.

[$pV = nRT$ $R = 8.31\ J\ K^{-1}\ mol^{-1}$]

(6)

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(c) Two further reactions take place in the airbag.

Reaction **A** $10Na + 2KNO_3 \rightarrow K_2O + 5Na_2O + N_2$

Reaction **B** $K_2O + Na_2O + SiO_2 \rightarrow Na_2K_2SiO_4$

(i) Reaction **A** produces more nitrogen to inflate the airbag.

Calculate the atom economy, by mass, for the production of nitrogen in reaction **A**.

Give your answer to an appropriate number of significant figures.

(3)

(ii) State the type of reaction taking place in reaction **B**.

(1)

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(Total for Question 24 = 11 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)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											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							

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

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
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

* Lanthanide series

* Actinide series

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