Write your name here

| Surname | | Other names | |

Pearson Edexcel
International
Advanced Level

Centre Number

Candidate Number

Chemistry

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

Sample Assessment Materials for first teaching September 2018
Time: 1 hour 30 minutes

Paper Reference
WCH11/01

You 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*.
- **Show all your working in calculations and include units where**
  appropriate.

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*.
- There is a Periodic Table on the back page of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S 5 8 3 0 9 A 0 1 2 4

Pearson

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   An outline of part of the Periodic Table is shown.
    The letters are not the usual symbols of the elements.

R										S			T				
	U										V			W			
		X											Y				
			Z														

(a) Which elements are in the s-block of the Periodic Table?

(1)

☒ **A** R and U

☒ **B** T and Y

☒ **C** V and W

☒ **D** X and Z

(b) Which element has four occupied quantum shells, with six electrons in the outermost shell?

(1)

☒ **A** V

☒ **B** X

☒ **C** Y

☒ **D** Z

(c) In which pair do the ions have the same electronic configuration?

(1)

☒ **A** R^+ and T^{2-}

☒ **B** T^{2-} and Y^{2-}

☒ **C** U^{2+} and T^{2-}

☒ **D** U^{2+} and W^-

(Total for Question 1 = 3 marks)

2 This question is about phosphorus and sulfur.

Which species contains 15 protons, 16 neutrons and 18 electrons?

☒ **A** P^{3-}

☒ **B** P^{3+}

☒ **C** S^{2-}

☒ **D** S^{2+}

(Total for Question 2 = 1 mark)

3 Which is the electronic configuration of nitrogen?

(Total for Question 3 = 1 mark)

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

4 A sample of neon contains the following isotopes.

Isotope	Percentage abundance
^{20}Ne	90.92
^{21}Ne	0.26
^{22}Ne	8.82

What is the relative atomic mass of neon to two decimal places?

☒ **A** 20.00

☒ **B** 20.09

☒ **C** 20.18

☒ **D** 21.00

(Total for Question 4 = 1 mark)

5 Data from the mass spectrum of a sample of pure iron is given in the table.

m / z	Relative peak height
28	0.1
54	6.3
56	100.0
57	2.4
58	0.3

Which species is most likely to cause the peak at $m/z = 28$?

☒ **A** ^{28}Fe$^+$

☒ **B** ^{56}Fe^{2+}

☒ **C** ^{28}Si$^+$

☒ **D** ^{84}Sr^{3+}

(Total for Question 5 = 1 mark)

6 Which of these is not a chemical reaction?

☒ **A** cracking

☒ **B** fractional distillation

☒ **C** polymerisation

☒ **D** reforming

(Total for Question 6 = 1 mark)

7 Which of these fuels is obtained from fermented sugar cane?

☒ **A** ethanol

☒ **B** hydrogen

☒ **C** petrol

☒ **D** propane

(Total for Question 7 = 1 mark)

8 What is the systematic name for this compound?
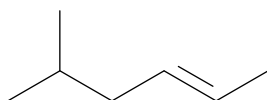
☒ **A** *E*-5-methylhex-2-ene

☒ **B** *Z*-5-methylhex-2-ene

☒ **C** *E*-2-methylpent-4-ene

☒ **D** *Z*-2-methylpent-4-ene

(Total for Question 8 = 1 mark)

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

9 Ethene reacts with bromine to form 1,2-dibromoethane.
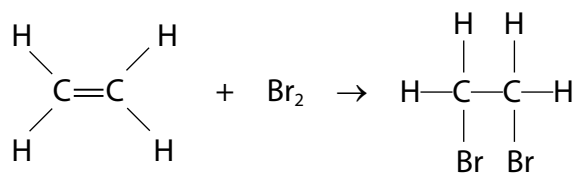
For the ethene molecule, what is the type of bond broken and the type of bond fission occurring in this reaction?

	Bond broken	Bond fission
☒ **A**	π	heterolytic
☒ **B**	π	homolytic
☒ **C**	σ	heterolytic
☒ **D**	σ	homolytic

(Total for Question 9 = 1 mark)

10 There is 0.045 g of solute in 1500 g of a solution.

What is the concentration of the solution in parts per million (ppm)?

☒ **A** 3.00

☒ **B** 6.75

☒ **C** 30.0

☒ **D** 67.5

(Total for Question 10 = 1 mark)

11 What is the concentration, in mol dm^{-3}, of a solution containing 7.84 g of phosphoric(V) acid, H_3PO_4, in 400 cm^3 of solution?

☒ **A** 0.02

☒ **B** 0.08

☒ **C** 0.20

☒ **D** 19.6

(Total for Question 11 = 1 mark)

12 A sample of a hydrocarbon with mass 7.2 g contained 6.0 g of carbon.

What is the empirical formula of the hydrocarbon?

☒ **A** CH_2

☒ **B** C_5H_{12}

☒ **C** C_6H_6

☒ **D** C_7H_6

(Total for Question 12 = 1 mark)

13 Which pair of substances contains the same number of moles at room temperature and pressure (r.t.p.)?

[A_r values Ca = 40, Li = 7, Al = 27, Mg = 24. Molar volume of gas at r.t.p. = 24 dm³ mol⁻¹]

☒ **A** 24 dm³ of chlorine, Cl_2, and 20 g of calcium, Ca

☒ **B** 24 dm³ of oxygen, O_2, and 14 g of lithium, Li

☒ **C** 1.2 dm³ of hydrogen, H_2, and 2.7 g of aluminium, Al

☒ **D** 1.2 dm³ of nitrogen, N_2, and 1.2 g of magnesium, Mg

(Total for Question 13 = 1 mark)

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

14 What are the maximum numbers of electrons in a 2p orbital and in the third quantum shell?

		Maximum number of electrons in a 2p orbital	Maximum number of electrons in the third quantum shell
☒	**A**	2	8
☒	**B**	2	18
☒	**C**	6	8
☒	**D**	6	18

(Total for Question 14 = 1 mark)

15 Water reacts with H^+ ions to form H_3O^+ ions.

Identify the bonding **within** the H_3O^+ ion.

☒ **A** covalent bonding only

☒ **B** covalent and dative covalent bonding only

☒ **C** covalent, dative covalent and ionic bonding

☒ **D** ionic bonding only

(Total for Question 15 = 1 mark)

16 What are the shapes of the $AlCl_3$ and PH_3 molecules?

		Shape of $AlCl_3$ molecule	Shape of PH_3 molecule
☒	**A**	pyramidal	pyramidal
☒	**B**	pyramidal	trigonal planar
☒	**C**	trigonal planar	trigonal planar
☒	**D**	trigonal planar	pyramidal

(Total for Question 16 = 1 mark)

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

17 Which describes the polarity of the C—Cl bond and the polarity of the CCl_4 molecule?

	Polarity of C—Cl bond	Polarity of CCl_4 molecule
☒ **A**	non-polar	non-polar
☒ **B**	non-polar	polar
☒ **C**	polar	polar
☒ **D**	polar	non-polar

(Total for Question 17 = 1 mark)

18 What is the empirical formula of the following molecule?
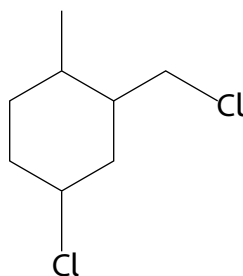
- ☒ **A** C_4H_4Cl
- ☒ **B** C_4H_7Cl
- ☒ **C** $C_8H_{11}Cl_2$
- ☒ **D** $C_8H_{14}Cl_2$

(Total for Question 18 = 1 mark)

TOTAL FOR SECTION A = 20 MARKS

SECTION B

Answer ALL the questions.

Write your answers in the spaces provided.

19 The graph shows the first ionisation energies for the elements with atomic numbers from 3 to 12.

First
ionisation energy
/ kJ mol^{-1}
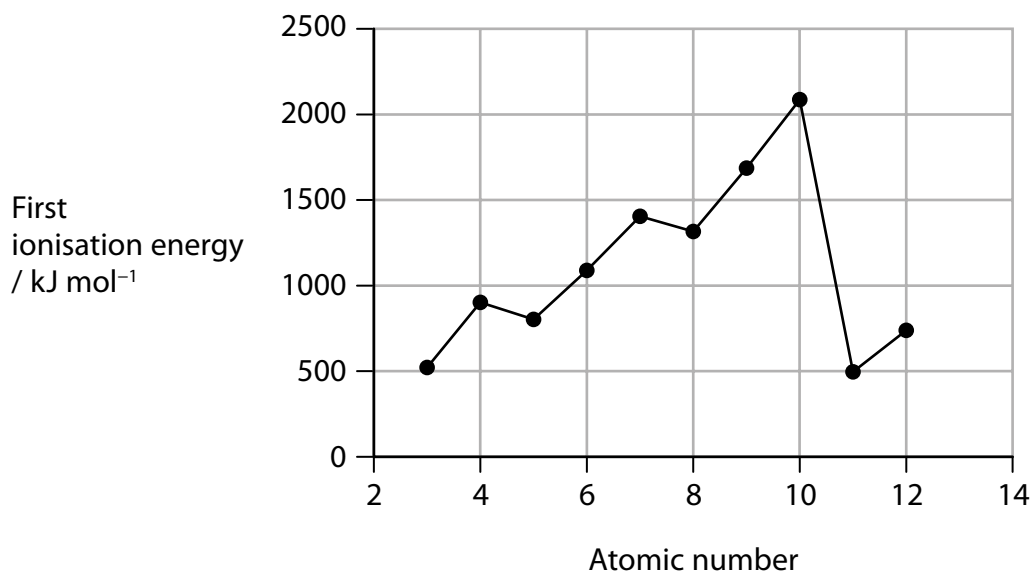
Atomic number

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

(2)

(b) Explain the changes in first ionisation energy for the elements with atomic numbers from 3 to 10.

(4)

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(c) Explain why the first ionisation energy of element 11 is lower than that of element 3.

(2)

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(Total for Question 19 = 8 marks)

20 This question is about bromine.

(a) Complete the electronic configuration for a bromine atom, using the s, p, d notation.

(1)

[Ar]...

(b) Bromine exists as two isotopes with mass numbers 79 and 81.

(i) Complete the table to show the numbers of subatomic particles in a
^{79}Br atom and a $^{81}Br^-$ ion.

(2)

Species	Protons	Neutrons	Electrons
^{79}Br			
$^{81}Br^-$			

(ii) A sample of bromine contained equal amounts of the two isotopes.

Complete the mass spectrum to show the peaks you would expect for Br_2^+
from this sample of bromine gas.

(2)
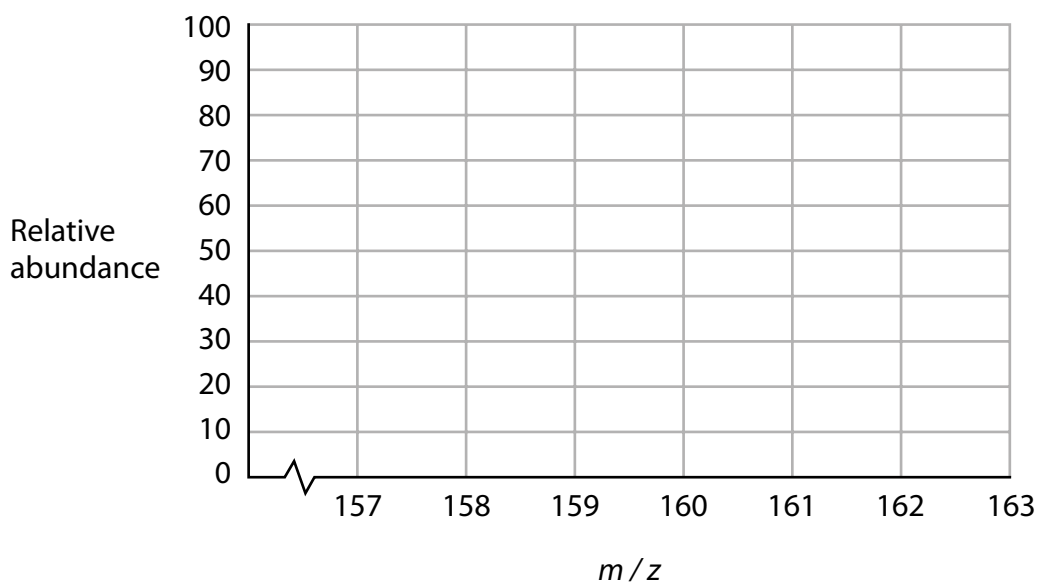
(iii) Calculate the number of bromine molecules in 2.00 g of Br_2.

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

(2)

Number of molecules = ...

(c) A sample of bromine gas occupied 200 cm^3 at a temperature of 77 °C and a pressure of 1.51×10^5 Pa.

Calculate, using the ideal gas equation, the amount in moles of bromine molecules in this sample.

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

(4)

Amount of bromine molecules = ... mol

(Total for Question 20 = 11 marks)

21 Magnesium is a metal in Group 2 of the Periodic Table. It reacts with chlorine to form the salt magnesium chloride, $MgCl_2$.

(a) Draw a dot-and-cross diagram for magnesium chloride.

Show outer shell electrons only.

(1)

(b) Magnesium conducts electricity when it is in the solid state. Magnesium chloride conducts electricity when it is molten or dissolved in water but not when it is in the solid state.

Explain these observations.

(3)

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(c) Magnesium chloride can also be made by reacting magnesium oxide with dilute hydrochloric acid.

$$MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$$
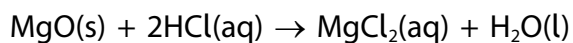
(i) Write the **ionic** equation, including state symbols, for this reaction.

(1)

(ii) Calculate the minimum volume of 2.00 mol dm^{-3} hydrochloric acid needed to completely react with 2.45 g of magnesium oxide.

(3)

Minimum volume of hydrochloric acid = ... cm^3

(d) A further method for making magnesium chloride is by reacting magnesium carbonate with dilute hydrochloric acid.

$$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l) + CO_2(g)$$

Calculate the maximum mass of magnesium chloride that could be formed when 2.25 g of magnesium carbonate is added to excess dilute hydrochloric acid.

(2)

Maximum mass magnesium chloride = ... g

(e) Explain why the reaction to make magnesium chloride from magnesium oxide has a higher atom economy than the reaction using magnesium carbonate. No calculation is required.

(2)

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(Total for Question 21 = 12 marks)

22 The alkanes are a homologous series of saturated hydrocarbons.

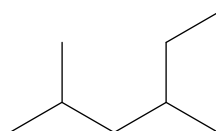(a) Draw the displayed formulae of the three alkanes with molecular formula C_5H_{12}.

(3)

(b) Give the systematic name of compound **P**.

(1)

Compound **P**

Systematic name ....

(c) The table shows the boiling temperatures of the first four straight-chain alkanes.

Molecular formula of alkane	Boiling temperature / °C
CH_4	−164
C_2H_6	−89
C_3H_8	−42
C_4H_{10}	−0.5

Predict the molecular formula and boiling temperature of the straight-chain alkane that has five carbon atoms in its molecules.

(2)

Molecular formula ....

Boiling temperature ....

(d) Alkanes undergo incomplete combustion when they burn in a limited supply of air.

(i) Write the equation for the incomplete combustion of propane, C_3H_8, to form carbon, carbon monoxide, carbon dioxide and water.
State symbols are not required.

(1)

(ii) Explain the toxicity of carbon monoxide.

(2)

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(e) Propane reacts with chlorine in the presence of ultraviolet radiation. The reaction starts when some chlorine molecules are split into free radicals. A mixture of products is formed.

(i) Write the two propagating steps to show how C_3H_7Cl is formed. Curly arrows are not required.

(2)

(ii) Identify the different C_3H_7Cl molecules that are produced in this reaction.

(1)

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(iii) Give a reason why a mixture of C_3H_7Cl molecules is formed.

(1)

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(iv) Give a reason why some hexane is formed in this reaction.

(1)

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(v) A small amount of a product with molar mass $113\,g\,mol^{-1}$ is formed.

Deduce the structure and name of a possible product with this molar mass.

(2)

Structure ....

Name ....

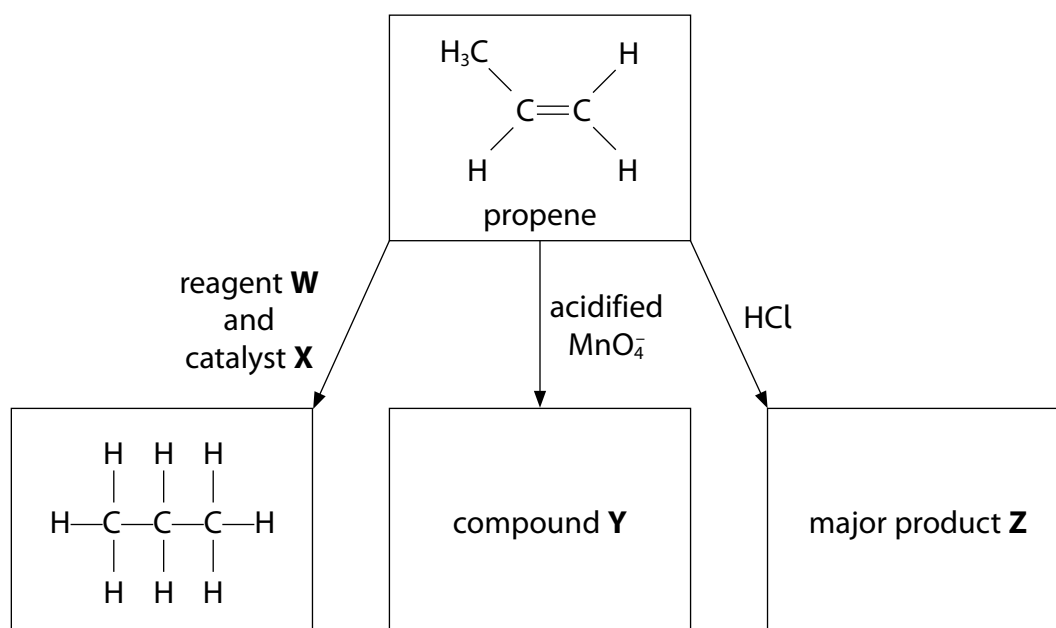**(Total for Question 22 = 16 marks)**

23 Alkenes contain a double bond between two carbon atoms.

(a) Some reactions of propene are shown.

(i) Give the names of reagent **W** and catalyst **X**.

(2)

Reagent **W** ....

Catalyst **X** ....

(ii) Draw the displayed formula of compound **Y**.

(1)

(iii) Draw the skeletal formula of the major product **Z**.
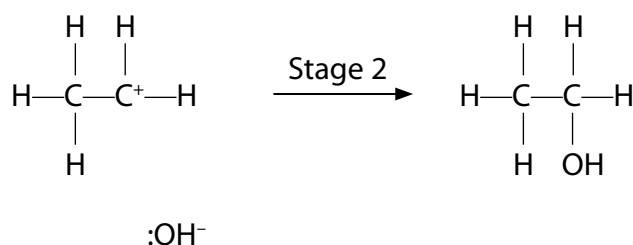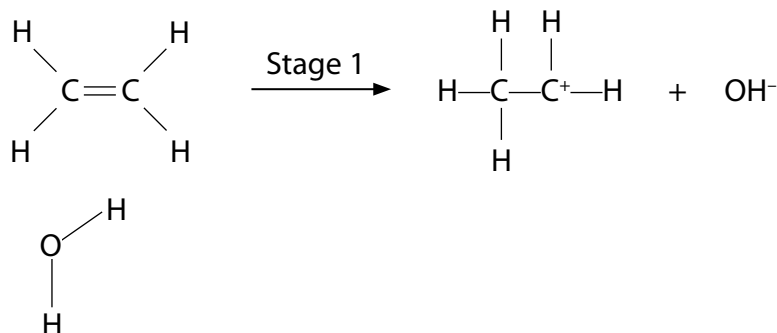
(1)

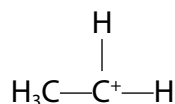(b) Ethene reacts with steam in the presence of a catalyst to form ethanol.

The mechanism takes place in two stages.

(i) Complete the simplified mechanism for the reaction by adding curly arrows and the relevant dipole.

(4)

(ii) Predict the shape of the intermediate ion with reference to the positively-charged carbon. Justify your answer.
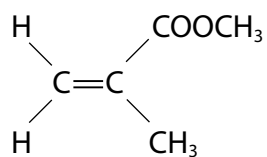

(3)

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(c) Methyl 2-methylpropenoate has the structure:

$$\begin{array}{ccc} H & & COOCH_3 \\ & \diagdown \ \ \diagup & \\ & C{=}C & \\ & \diagup \ \ \diagdown & \\ H & & CH_3 \end{array}$$

Draw a section of the polymer formed from methyl 2-methylpropenoate, showing two repeat units.

(2)

(Total for Question 23 = 13 marks)

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