Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 1 hour 15 minutes

Paper reference **4CH1/2C**

Chemistry

UNIT: 4CH1
PAPER: 2C

You must have:
Calculator, ruler

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.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 7 1 8 9 4 A 0 1 2 8

Pearson

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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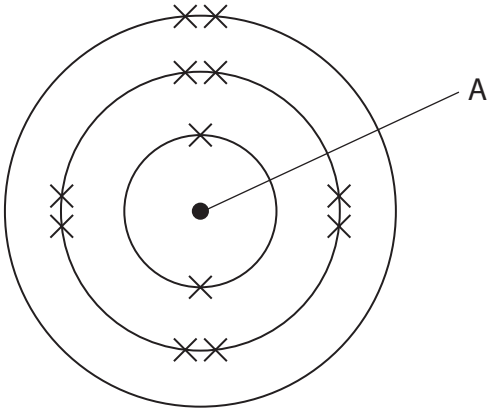
Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) The diagram shows the electronic configuration of an atom of an element.



Complete the table by giving the missing information.

(3)

Name of the part of this atom labelled A	
Number of the group that contains this element	
Number of the period that contains this element	

(b) The table gives information about four different species, W, X, Y and Z.

Species	Number of protons	Number of neutrons	Number of electrons
W	2	2	2
X	13	14	10
Y	17	18	17
Z	17	20	17

(i) Give the mass number of W.

(1)

.....

(ii) Give a reason why X has a 3+ charge.

(1)

.....

.....

(iii) Explain why Y and Z are isotopes of the same element.

(2)

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

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2 The table shows properties of four substances, A, B, C and D.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when solid	Conducts electricity when molten
A	800	1465	no	yes
B	327	1749	yes	yes
C	232	573	no	no
D	3550	4830	no	no

(a) Use information from the table to identify these substances.

(i) Which substance could be a metal?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which substance could be diamond?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(iii) Which substance is a gas at 600 °C?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

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(b) One of the substances in the table is a compound with the formula $C_{10}H_{16}N_2O_3S$

(i) Give the number of different elements in $C_{10}H_{16}N_2O_3S$

(1)

.....

(ii) Determine the number of atoms in a molecule of $C_{10}H_{16}N_2O_3S$

(1)

.....

(Total for Question 2 = 5 marks)

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3 This question is about soluble salts and insoluble salts.

(a) Which pair of solutions produces an insoluble salt when mixed?

(1)

- ☒ **A** sodium sulfate and potassium nitrate
- ☒ **B** potassium carbonate and calcium nitrate
- ☒ **C** sodium chloride and ammonium nitrate
- ☒ **D** sodium hydroxide and potassium sulfate

(b) When solutions of lead nitrate and sodium sulfate are mixed, one product is solid lead sulfate.

This is the equation for the reaction.

$$Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + 2NaNO_3(aq)$$

Describe how a pure, dry sample of solid lead sulfate can be obtained from the mixture.

(3)

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(c) The table gives the solubility of a salt in water at six different temperatures.

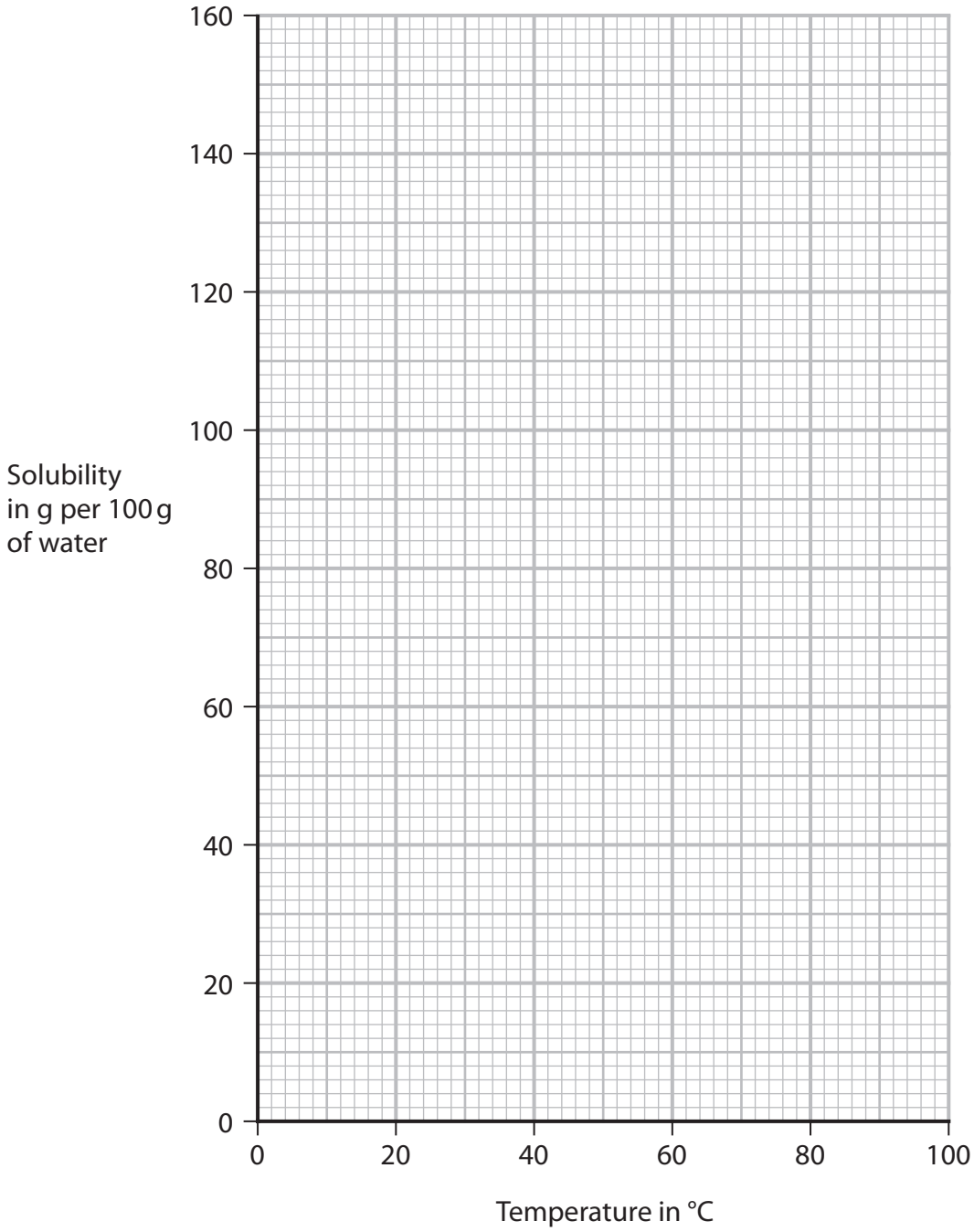
Temperature in °C	0	20	40	60	80	100
Solubility in g per 100 g of water	18	34	54	77	104	142

(i) Plot the points on the grid.

(1)

(ii) Draw a curve of best fit.

(1)



(iii) A saturated solution of the salt in 100 g of water is cooled from 90 °C to 30 °C.

Use your graph to determine the mass of salt that will crystallise.

Show your working on the graph.

(2)

mass of salt = ... g

(Total for Question 3 = 8 marks)

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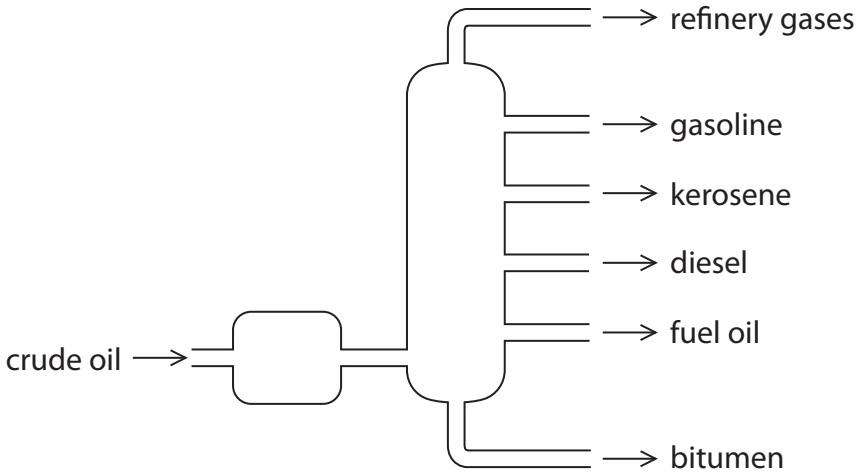
4 Fractional distillation is used to separate crude oil into fractions.

The diagram shows a fractionating column and the fractions obtained from crude oil.



(a) (i) Describe how crude oil is separated into fractions in the fractionating column.

(4)

(ii) Give a use for kerosene and a use for bitumen.

(2)

kerosene

bitumen

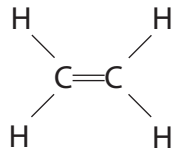
(b) Some fractions obtained from crude oil are cracked to form alkenes.

(i) Describe what is meant by cracking.

(2)

(ii) Ethene is obtained by cracking.

This is the displayed formula of ethene.



Explain why ethene is described as an unsaturated hydrocarbon.

(3)

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(iii) Describe a test to show that ethene is unsaturated.

(2)

.....

.....

.....

.....

(Total for Question 4 = 13 marks)

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5 This question is about metals.

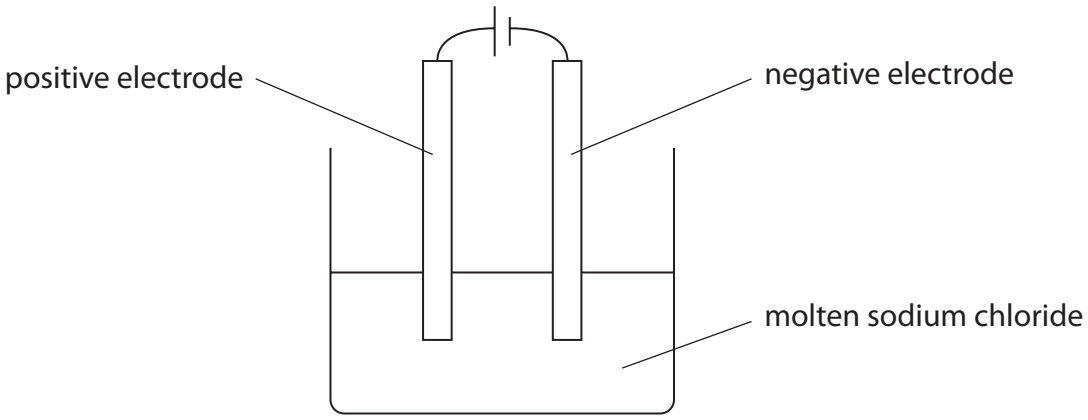
(a) Explain why metals are malleable.

(2)

(b) Sodium metal is extracted by the electrolysis of molten sodium chloride.

Sodium metal forms at the negative electrode and chlorine gas forms at the positive electrode.

The diagram represents this electrolysis.



(i) Explain why molten sodium chloride conducts electricity.

(2)

(ii) Explain how sodium metal forms at the negative electrode.

(2)

(iii) Write an ionic half-equation for the formation of chlorine gas at the positive electrode.

(1)

.....

(iv) Give a reason why sodium metal does not form in the electrolysis of an aqueous solution of sodium chloride.

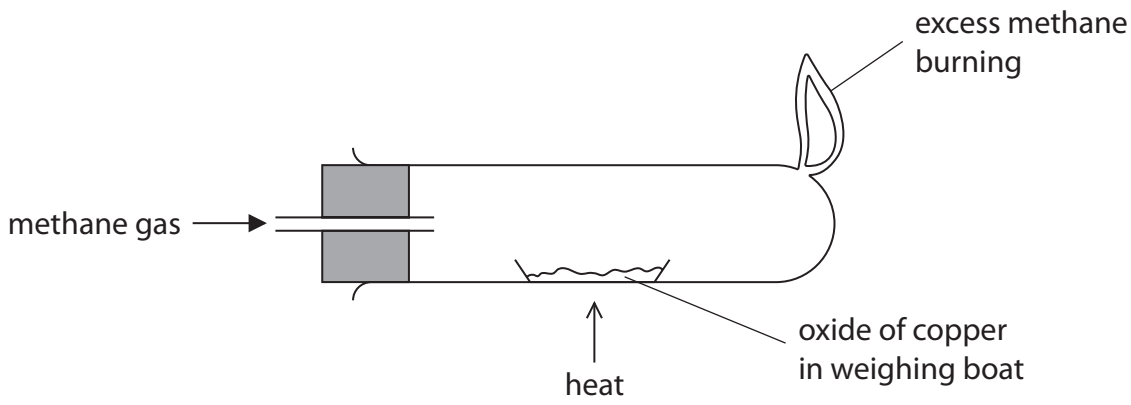
(1)

.....

.....

(c) Copper can be produced by reacting an oxide of copper with methane.

The diagram shows the apparatus used.



The oxide of copper is heated until the reaction is complete.

The table shows the results.

	Mass in g
empty weighing boat	17.25
weighing boat + oxide of copper	22.02
weighing boat + copper	21.06

Use the results to show that this oxide has the empirical formula CuO

[for Cu, $A_r = 63.5$ for O, $A_r = 16$]

(3)

(Total for Question 5 = 11 marks)

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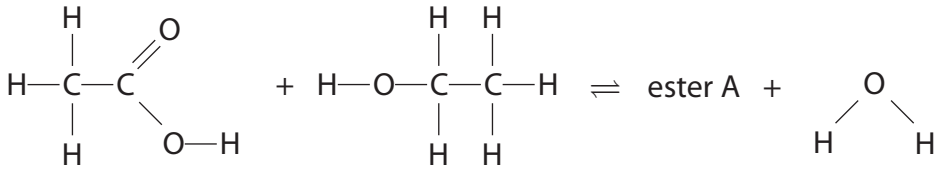
6 When ethanoic acid reacts with ethanol in the presence of concentrated sulfuric acid, one of the products is ester A.

This is the equation for the reaction.



ethanoic acid ethanol water

(a) (i) Draw a circle around the functional group in ethanoic acid.

(1)

(ii) Give the displayed formula of ester A.

(2)

(iii) Name ester A.

(1)

(b) The reaction mixture is kept in a sealed container until dynamic equilibrium is reached.

State what is meant by the term **dynamic equilibrium**.

(2)

(c) During the reaction, the number of moles of ethanoic acid in the reaction mixture decreases, but the number of moles of concentrated sulfuric acid does not change.

(i) Give a reason why the number of moles of concentrated sulfuric acid does not change.

(1)

(ii) A student does a titration to find the accurate volume of sodium hydroxide solution needed for complete neutralisation.

The student starts by using a pipette to transfer 25.0 cm^3 of the reaction mixture to a conical flask.

Describe how the student should complete the titration.

(6)

(Total for Question 6 = 13 marks)

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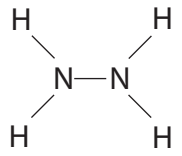
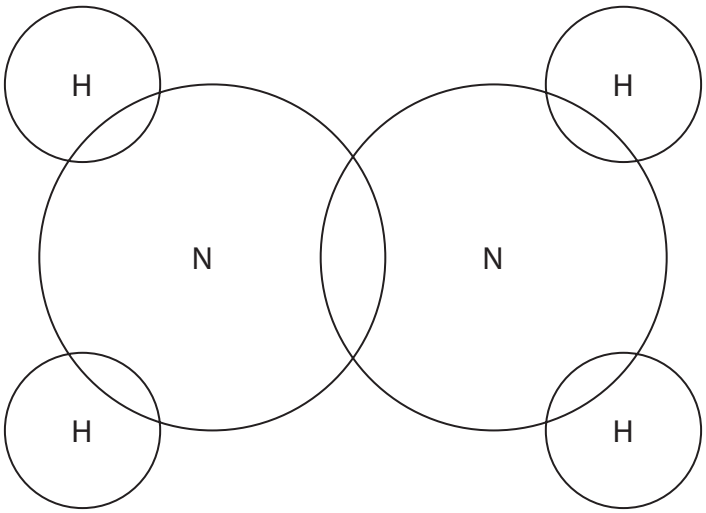
7 This question is about hydrazine, N_2H_4

(a) This is the displayed formula for a molecule of hydrazine.



Complete the dot-and-cross diagram for hydrazine.

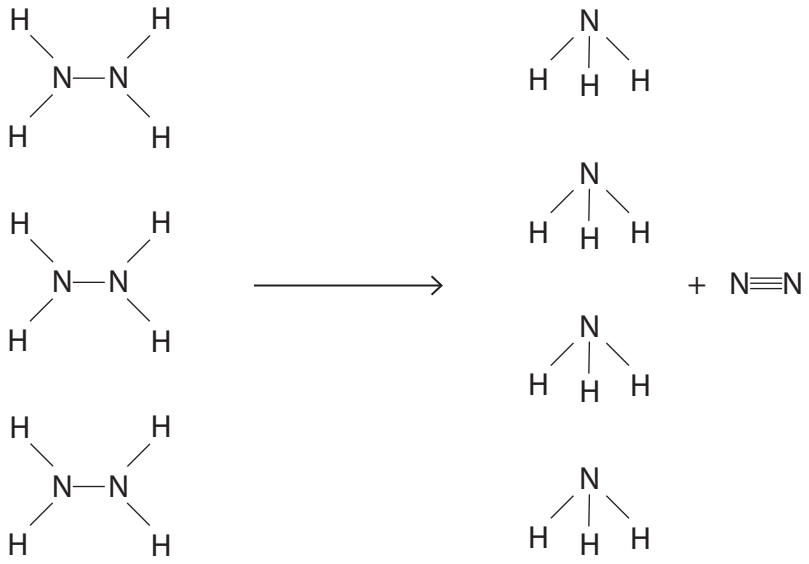
(2)



(b) This is the equation for the decomposition of hydrazine.

$$3N_2H_4(g) \rightarrow 4NH_3(g) + N_2(g)$$

The equation can be shown using displayed formulae.



The table gives the relevant bond energies.

Bond	Bond energy in kJ/mol
N—N	158
N—H	391
N≡N	945

(i) Use the data in the table to calculate the total energy needed to break all the bonds in the reactants.

(2)

energy needed = ... kJ

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(ii) Use the data in the table to calculate the total energy released when all the bonds in the products are made.

(2)

energy released = ... kJ

(iii) Calculate the enthalpy change, ΔH, in kJ/mol, for the reaction.

(1)

ΔH = ... kJ/mol

(iv) Explain, in terms of bonds broken and bonds made, why this reaction is exothermic.

(2)

.....

.....

.....

.....

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(c) A sample of hydrazine is completely decomposed.

This is the equation for the decomposition of hydrazine.

$$3N_2H_4(g) \rightarrow 4NH_3(g) + N_2(g)$$

The products of the decomposition are bubbled through 1100 cm^3 of water.

The ammonia completely dissolves in the water, but nitrogen is insoluble in water.

The nitrogen has a volume of 1570 cm^3 at room temperature and pressure (rtp).

Calculate the concentration, in mol/dm^3, of the ammonia solution.

Give your answer to 3 significant figures.

[for a gas at rtp, molar volume = 24 000 cm^3]

(4)

concentration = ... mol/dm^3

(Total for Question 7 = 13 marks)

TOTAL FOR PAPER = 70 MARKS

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