MODEL ANSWERS.

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Wednesday 12 June 2019

Morning (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.
- **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.*
- 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 ☒.

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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P58563A

1/1/1/1/

P 5 8 5 6 3 A 0 1 2 0

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

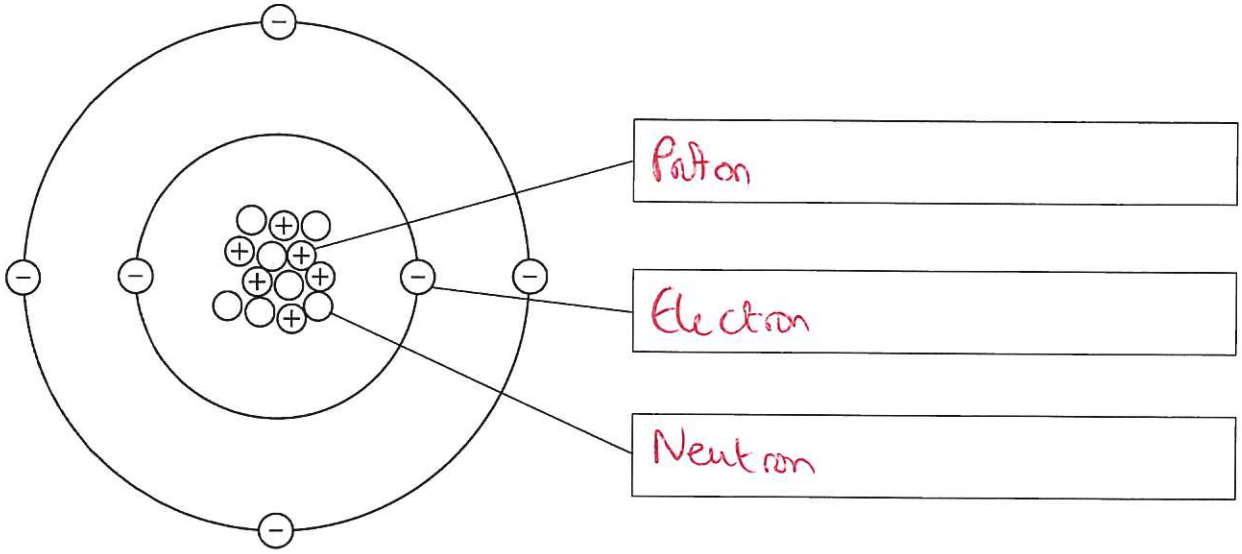
relative atomic mass
atomic symbol
name
atomic (proton) number

** 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.

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

1 The diagram shows the particles in an atom of an element.



(a) The box gives the names of some particles.

electron	ion	molecule	neutron	proton

Use words from the box to label the diagram.

(3)

(b) Give the mass number of this atom.

(1)

13

(c) Complete the sentence about isotopes.

(2)

Isotopes are atoms that have the same number of protons

but have a different number of Neutrons .

(Total for Question 1 = 6 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

2 The table gives some information about the halogens, chlorine, bromine and iodine.

Halogen	Physical state at room temperature	Colour
chlorine	gas	pale green
bromine	liquid	red-brown
iodine	solid	dark grey

(a) Complete the table.

(2)

(b) Chlorine has two isotopes of mass numbers 35 and 37

The relative percentage of each isotope in a sample of chlorine is

chlorine-35 77.78% chlorine-37 22.22%

Calculate the relative atomic mass of this sample of chlorine.

Give your answer to one decimal place.

(3)

$A_r = 0.7778(35) + 0.2222(37)$

$= 35.4444$

relative atomic mass = 35.4 (1 d.p.)

(c) A student is given an aqueous solution of chlorine and an aqueous solution of potassium bromide.

Explain how he can use these two solutions to compare the reactivity of chlorine with the reactivity of bromine.

(4)

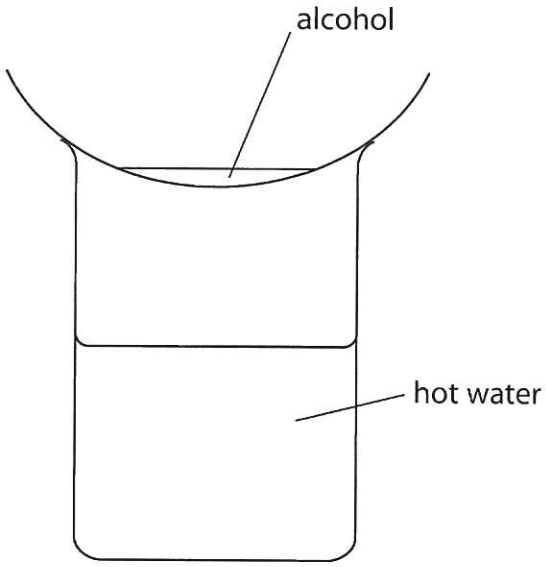
Add Chlorine Solution to potassium bromide Solution. The Solution turns orange as bromine is displaced So Chlorine is more reactive than Bromine.

(Total for Question 2 = 9 marks)

BLANK PAGE

3 Methanol, ethanol, propanol and butanol are alcohols. They are all liquids that evaporate easily when warmed.

A student uses this apparatus to compare the time taken for the four liquids to evaporate.



She uses this method.

- pour some methanol into an evaporating basin
- place the evaporating basin on top of a beaker containing hot water
- measure the time taken for the methanol to evaporate completely
- repeat the experiment with each of the other alcohols, using the same apparatus

(a) State two variables the student should control to make sure her results are valid.

(2)

1 Volume of alcohol

2 Temperature of the water.

(b) State why it is not safe to heat the evaporating basin directly with a Bunsen flame.

(1)

Alcohols are flammable.

(c) The table shows the results of experiments done by four students, A, B, C and D.

Alcohol	Formula of alcohol	Time taken for liquid to evaporate in s				
		Student A	Student B	Student C	Student D	Mean time in s
methanol	CH_3OH	20	24	22	26	23
ethanol	C_2H_5OH	32	34	35	30	33
propanol	C_3H_7OH	45	47	50	48	48
butanol	C_4H_9OH	64	63	90	60	62

(i) Calculate the mean (average) time for butanol to evaporate.

(2)

$\frac{64 + 63 + 60}{3} = 62.333\ s$

mean time = 62 s

(ii) Explain how the results show which alcohol evaporates most easily.

(2)

Methanol evaporates most easily as the time taken is the shortest for methanol.

(iii) State the relationship between the number of carbon atoms in the molecule and how easily the alcohol evaporates.

(2)

As the number of Carbon atoms increases, the ease of evaporation decreases.

(Total for Question 3 = 9 marks)

4 This question is about metals.

(a) Which statement describes metallic bonding?

(1)

☐ **A** electrostatic attraction between oppositely charged ions

☐ **B** electrostatic attraction between the nuclei of two atoms and a pair of electrons shared between them

☒ **C** electrostatic attraction between positively charged particles and delocalised electrons

☐ **D** electrostatic attraction between atoms

(b) Aluminium is malleable and can be easily shaped to make saucepans used for cooking food.

State two other properties of aluminium that make it suitable for saucepans used for cooking food.

(2)

1 Good Conductor of heat.

2 Doesn't react with food.

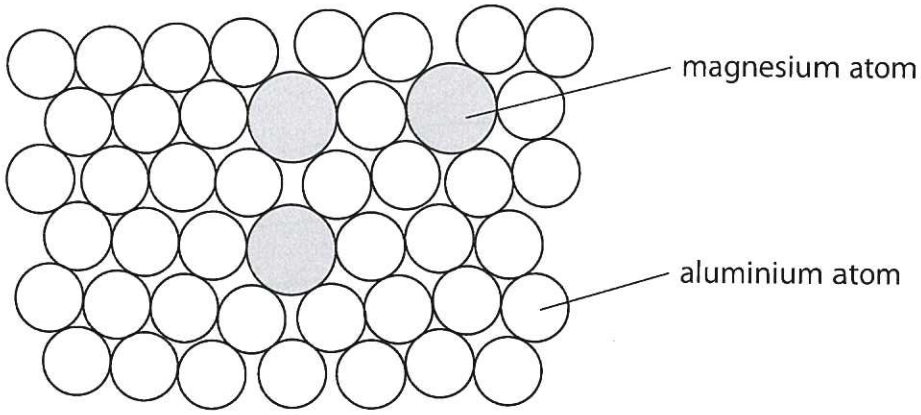
Resistant to Corrosion

High melting point.

Low density (lightweight) Strong.

(c) Magnalium is an alloy of aluminium and magnesium.

The diagram shows how the atoms are arranged in this alloy.



(i) State what is meant by the term **alloy**.

(1)

A mixture of two or more elements, one of which is a metal.

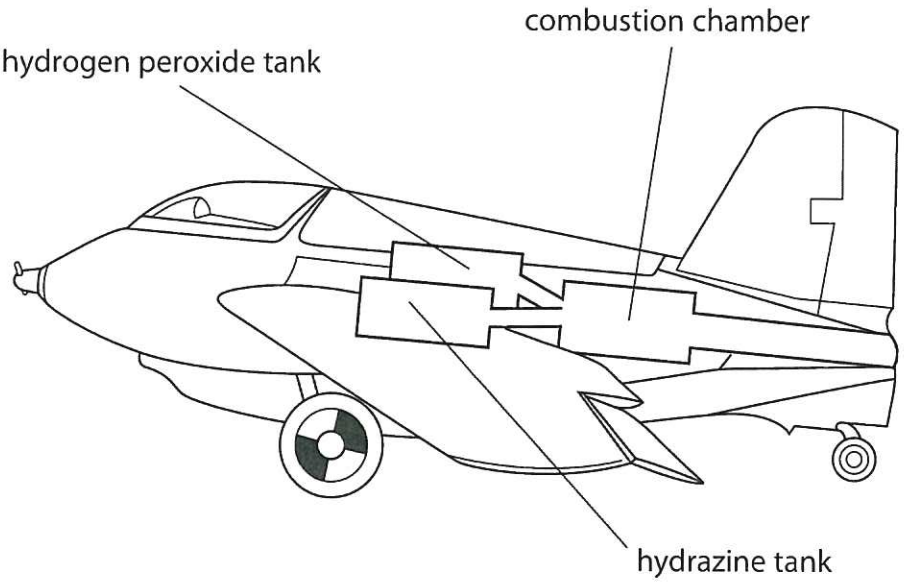
(ii) Explain why magnalium is harder than aluminium.

(3)

In the alloy, the regular arrangement of atoms is distorted because Magnesium atoms are larger than Aluminium atoms and it is therefore more difficult for the layers to slide over one another.

(Total for Question 4 = 7 marks)

5 During the Second World War, engineers developed a rocket-powered aircraft.



The aircraft carried these two liquids

- hydrazine, N_2H_4
- hydrogen peroxide, H_2O_2

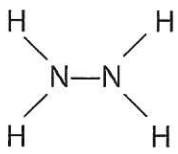
When these two liquids mix in the combustion chamber, they evaporate and then react rapidly to form nitrogen gas, N_2, and steam, H_2O

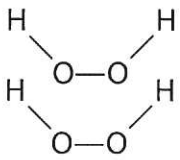
The reaction is exothermic.

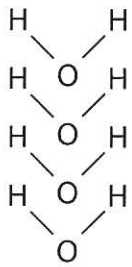
The equation for the reaction is

$$N_2H_4 \quad + \quad 2H_2O_2 \quad \rightarrow \quad N_2 \quad + \quad 4H_2O$$

The displayed formulae for the reactants and products are







(a) The tables give the bond energies for the bonds broken in the reactants and the bonds made in the products.

Bonds broken	
bond	bond energy in kJ/mol
N—N	159
N—H	391
O—O	143
O—H	463

Bonds made	
bond	bond energy in kJ/mol
N≡N	945
O—H	463

(i) Use the data in the tables to calculate the total amount of energy required to break all of the bonds in the reactants.

(1)

$4(391) + 4(463) + 2(143) + 159$

$= 3861$

energy required = 3861 kJ

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

(1)

$945 + 8(463)$

$= 4649$

energy released = 4649 kJ

(iii) Calculate the enthalpy change, ΔH, in kJ/mol, for the reaction. Include a sign in your answer.

(3)

ΔH = Breaking − making

$= 3861 - 4649$

$= -788$ kJ mol^{-1}

ΔH = ... kJ/mol

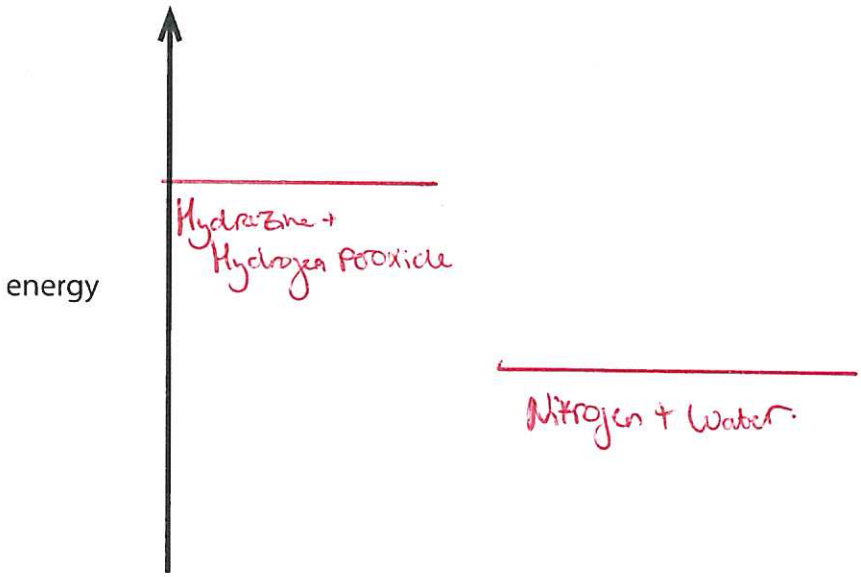
(b) Explain, in terms of bonds broken and bonds made, why this reaction is exothermic.

(2)

More energy is released in making the bonds in the products than is taken in to break the bonds in the reactants.

(c) Draw an energy level diagram for the reaction between N_2H_4 and H_2O_2

(3)



(Total for Question 5 = 10 marks)

BLANK PAGE

6 Some cars in Brazil use ethanol, C_2H_5OH, as a fuel instead of petrol.

The ethanol is made by the fermentation of glucose which is obtained from sugar cane.

The sugar is extracted from the sugar cane and then dissolved in water to make a sugar solution.

(a) (i) Name the substance that is added to the sugar solution that causes glucose to ferment.

(1)

Yeast

(ii) Which temperature is the most suitable for fermentation?

(1)

- ☐ **A** 0°C
- ☐ **B** 10°C
- ☒ **C** 30°C
- ☐ **D** 80°C

(iii) Explain why fermentation is done in the absence of air.

(2)

The fermentation needs to be anaerobic as otherwise ethanol wouldn't be formed but CO_2 and H_2O instead.

(b) (i) State what is meant by the term **fuel**.

(1)

A substance that releases thermal energy when combusted.

(ii) Write a chemical equation for the complete combustion of ethanol in air.

(2)

$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) Ethanol is also manufactured by reacting steam with ethene, C_2H_4

The equation for this reaction is

$$C_2H_4(g) + H_2O(g) \rightarrow C_2H_5OH(g)$$

State the conditions of temperature and pressure used in this process.

(2)

temperature 300°C

pressure 60-70 atm

(d) When ethanol is heated with acidified potassium dichromate(VI), it is oxidised to ethanoic acid.

(i) State the colour change that occurs in the potassium dichromate(VI) during this reaction.

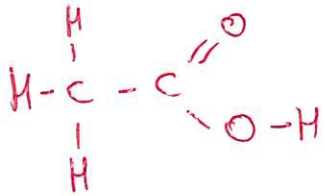
(1)

from Orange to Green

(ii) The structural formula of ethanoic acid is CH_3COOH

Draw the displayed formula of ethanoic acid.

(2)



(iii) Complete the equation for the reaction of ethanoic acid with sodium.

(2)

$CH_3COOH(aq) + Na(s) \rightarrow CH_3COONa(aq) + \frac{1}{2}H_2(g)$

(Total for Question 6 = 14 marks)

7 Dinitrogen tetraoxide, N_2O_4, is a colourless gas.

Nitrogen dioxide, NO_2, is a brown gas.

The two gases can exist together in dynamic equilibrium according to the equation

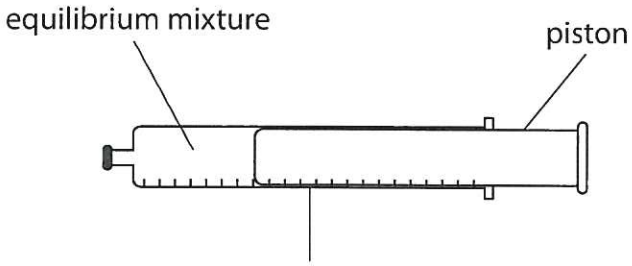
$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

(a) Explain what is meant by the term **dynamic equilibrium**.

(2)

When a reaction is taking place in opposite directions at the same time, with equal rates.

(b) Some N_2O_4 and some NO_2 are put into a sealed gas syringe and allowed to form an equilibrium mixture.



This equilibrium mixture is brown.

(i) The pressure of the gas in the syringe is increased by pushing in the piston. The mixture is then allowed to reach a new equilibrium at the same temperature as before.

Explain why the new equilibrium mixture contains less NO_2 than the original equilibrium mixture.

(2)

The position of equilibrium has moved to the left because there are fewer molecules of gas on the left hand side of the equation.

(ii) A student suggests that the new equilibrium mixture would be lighter in colour than the original equilibrium mixture, as there is now less NO_2 present.

Suggest why the new equilibrium mixture is actually darker than the original.

(1)

The Concentration of NO_2 has increased.

(c) Carbon monoxide, CO, and oxides of nitrogen are produced in a car engine when petrol is burned.

These oxides can be partly removed by using a catalytic converter fitted to the car's exhaust system.

(i) State how oxides of nitrogen are produced in the car engine.

(1)

Nitrogen from the air reacts with oxygen from the air in the engine.

(ii) Give a disadvantage of allowing oxides of nitrogen to escape into the atmosphere.

(1)

Acid rain.

(iii) Write a chemical equation for the reaction between nitrogen monoxide, NO, and carbon monoxide to form carbon dioxide and nitrogen.

(1)

$2NO + 2CO \rightarrow N_2 + 2CO_2$

(Total for Question 7 = 8 marks)

8 The concentration of NaClO(aq) in a solution of bleach is found by reacting it with hydrochloric acid.

The equation for the reaction is

$$NaClO(aq) + 2HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + Cl_2(g)$$

An excess of dilute hydrochloric acid is added to 4.00 cm^3 of bleach solution.

60.0 cm^3 of chlorine gas is produced.

(a) Explain a safety precaution that should be taken when doing this experiment.

(2)

Use a fume Cupboard because Chlorine is toxic.

or

wear goggles / Safety gloves because acid or bleach may be Corrosive.

(b) (i) Calculate the amount, in moles, of chlorine gas produced.
Assume one mole of chlorine gas occupies 24 000 cm^3.

(2)

$n(Cl_2) = \frac{60}{24000} = 2.5 \times 10^{-3}$ mol

amount of chlorine = 2.5×10^{-3} mol

(ii) Determine the amount, in moles, of NaClO in 4.00 cm^3 of bleach.

(1)

$n(NaClO) = n(Cl_2) = 2.5 \times 10^{-3}$ mol

amount of NaClO = 2.5×10^{-3} mol

(iii) Calculate the concentration, in mol/dm^3, of the bleach solution.

(2)

$Conc(NaClO) = \frac{mol}{vol} = \frac{2.5 \times 10^{-3}}{4 \times 10^{-3}} = 0.625$ mol dm^{-3}

concentration = 0.625 mol/dm^3

(Total for Question 8 = 7 marks)

TOTAL FOR PAPER = 70 MARKS

BLANK PAGE

BLANK PAGE