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 **4CH1/2CR**

Chemistry

Unit: 4CH1

Paper: 2CR

You must have:
Calculator

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.*
- Show all the steps in any calculations and state the units.
- 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.
- 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 6 0 1 8 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.

1 This question is about gases in the atmosphere.

(a) The box gives the names of some gases in the atmosphere.

argon	carbon dioxide	helium
nitrogen	oxygen	

Use gases from the box to answer the questions.

Each gas may be used once, more than once or not at all.

(i) Identify the two noble gases.

(1)

Argon , Helium

(ii) Identify the gas that is a compound.

(1)

Carbon dioxide

(iii) Identify the most abundant gas in the atmosphere.

(1)

Nitrogen

(iv) Identify the greenhouse gas.

(1)

Carbon dioxide

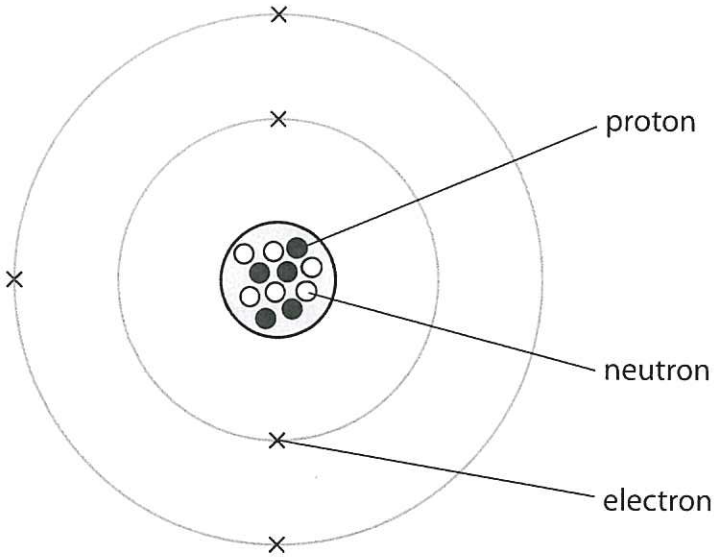
(b) Describe the test for oxygen.

(1)

Oxygen will relight a glowing splint.

(Total for Question 1 = 5 marks)

2 The diagram represents an atom of boron.



(a) Use information from the diagram to complete the table.

The first row has been done for you.

(5)

atomic number	5
mass number	11
number of neutrons	6
group in the Periodic Table that contains boron	3
period in the Periodic Table that contains boron	2
electronic configuration of an atom of boron	2,3

(b) Boron has two isotopes, boron-10 and boron-11.

A sample of boron contains 18.7% of boron-10 and 81.3% of boron-11.

Calculate the relative atomic mass of this sample of boron.

(2)

$A_r = 0.187(10) + 0.813(11)$

$= 10.813$

relative atomic mass = 10.81

(Total for Question 2 = 7 marks)

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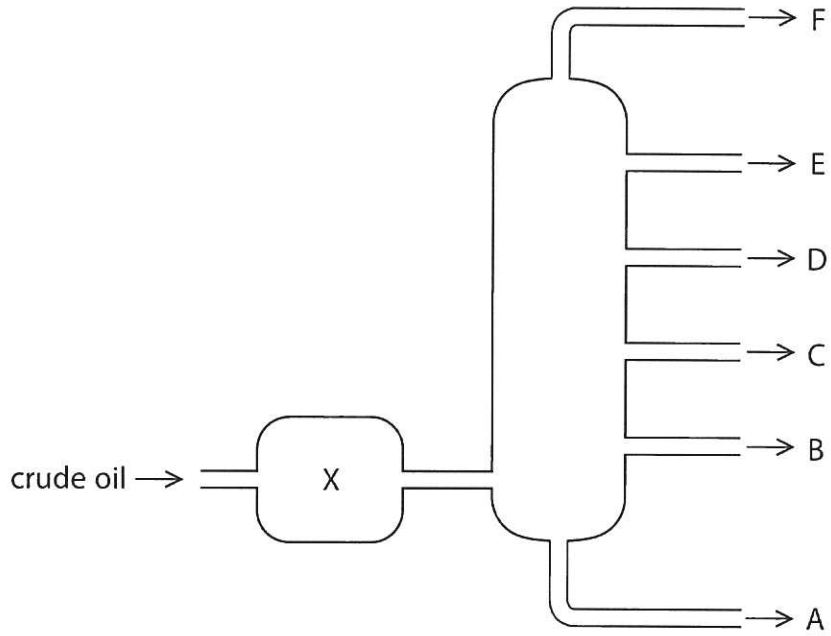
3 Crude oil is an important source of organic compounds.

(a) The diagram shows crude oil being separated into different fractions.



(i) Name the process used to separate crude oil into different fractions.

(1)

Fractional Distillation.

(ii) State what happens to the crude oil at X.

(1)

It is Vapourised.

(iii) Describe the differences between fraction B and fraction E.

In your answer, refer to

- size of the molecules
- boiling point
- colour
- viscosity

(4)

B Contains Long molecules with a higher boiling point. B is darker and more viscous than E.

(b) Crude oil often contains sulfur as an impurity.

Explain why this is a problem when using crude oil fractions as fuels.

(2)

When Sulphur is burnt, SO_2 is formed which Contributes to acid rain.

(Total for Question 3 = 8 marks)

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4 This question is about the halogens and their compounds.

(a) The table gives the colour and physical state at room temperature of the halogens.

Complete the table by predicting the colour of astatine and the physical state of fluorine at room temperature.

(2)

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

(b) Chlorine gas is bubbled into a colourless solution of potassium bromide.

Explain why the solution turns orange.

(2)

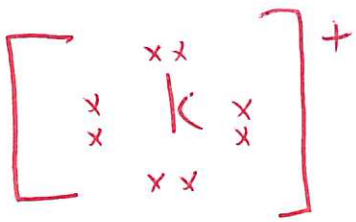
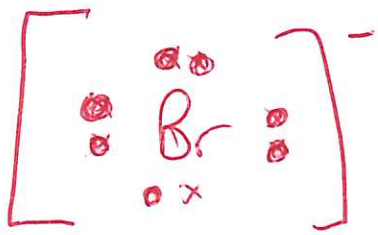
As Chlorine is more reactive than bromine, Chlorine displaces bromine; producing Br_2.

(c) Potassium bromide is an ionic compound.

Draw diagrams to show the outer electrons in a potassium ion and in a bromide ion.

Include the charges on the ions.

(3)

potassium ion	bromide ion
	

(d) A student sets up a circuit to test the electrical conductivity of water, solid sodium chloride and aqueous sodium chloride.

The table shows the student's results.

Substance	Conducts electricity?
water	no
solid sodium chloride	no
aqueous sodium chloride	yes

Explain these results, with reference to the structure and bonding of the substances.

(5)

Water has a Simple Molecular Structure. There are no charged particles free to move So it doesn't Conduct electricity.

Sodium Chloride has a giant ionic Structure - the ions are fixed in position in the lattice so can't move. Hence, it can't conduct electricity when Solid.

Sodium Chloride Conducts electricity when in aqueous Solution as the ions are free to move.

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(e) A concentrated aqueous solution of sodium chloride is electrolysed using graphite electrodes.

Chlorine is formed at the positive electrode (anode).

(i) Give an ionic half-equation for the formation of chlorine at the positive electrode.

(1)

$2Cl^- \rightarrow Cl_2 + 2e^-$

(ii) State why this ionic half-equation represents an oxidation reaction.

(1)

The Chloride ions Lose electrons.

(iii) Which substance is formed at the negative electrode (cathode)?

(1)

- [x] **A** hydrogen
- [ ] **B** oxygen
- [ ] **C** sodium
- [ ] **D** water

(Total for Question 4 = 15 marks)

5 This question is about the reactions of carboxylic acids.

(a) Carboxylic acids react with solutions of metal carbonates.

(i) Complete the chemical equation for the reaction of ethanoic acid, CH_3COOH, with potassium carbonate solution.

(2)

$2CH_3COOH + K_2CO_3 \rightarrow$ $2CH_3COOK$ + CO_2 + H_2O

(ii) State what you would see in this reaction.

(1)

fizzing

(b) The ester, ethyl ethanoate, can be prepared by reacting ethanol with ethanoic acid.

This is the method for the preparation.

- mix equal amounts of ethanoic acid and ethanol in a boiling tube
- add a few drops of concentrated sulfuric acid
- place the boiling tube in a hot water bath for several minutes

(i) State the role of concentrated sulfuric acid in this reaction.

(1)

Catalyst.

(ii) Suggest why the mixture is heated in a water bath rather than directly with a Bunsen burner flame.

(1)

Ethanol is flammable.

(iii) State how you would know that ethyl ethanoate has formed.

(1)

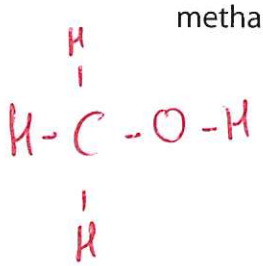
The ester has a distinctive smell.

(c) Another ester, methyl propanoate, can be prepared by reacting methanol with propanoic acid.

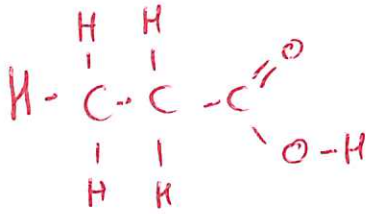
(i) Draw the displayed formulae of methanol, propanoic acid and the ester, methyl propanoate.

(3)

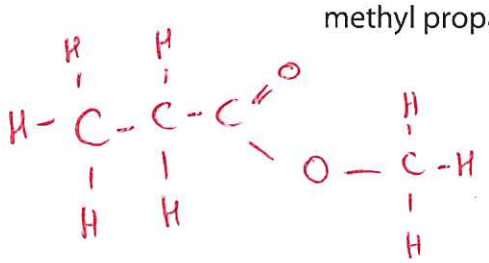
methanol



propanoic acid



methyl propanoate



(ii) Give the name of the other product of this reaction.

(1)

Water

.....

(d) Give one use of esters.

(1)

food flavourings or perfumes.

.....

(Total for Question 5 = 11 marks)

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6 When a bottle of wine is left open for several days, some of the ethanol in the wine turns to ethanoic acid, CH_3COOH

(a) A scientist uses a titration method to investigate how much ethanoic acid is formed if a bottle of white wine is left open for one week.

She uses this method.

- fill a burette with the white wine and record the reading
- add 25.0 cm^3 of sodium hydroxide solution to a conical flask
- add a few drops of phenolphthalein indicator to the flask
- swirl the flask continuously while adding wine from the burette
- add the wine drop by drop near the end point
- record the reading at the end point

(i) Name the piece of apparatus that would be most suitable for measuring the 25.0 cm^3 of sodium hydroxide solution.

(1)

Pipette

(ii) Suggest why red wine would not be suitable to use for this investigation.

(1)

Red wine would mask the colour of the indicator, making it difficult to see the colour change at the end point.

(iii) State why she swirls the flask continuously.

(1)

To mix the contents.

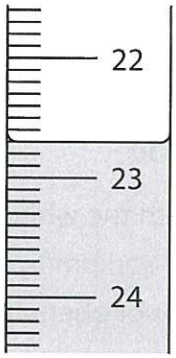
(iv) State why she adds the wine drop by drop near the end point.

(1)

This ensures she doesn't overshoot the end point.

(b) The diagram shows the burette readings at the start and end of one of the titrations.

start



end

Use the readings to complete the table.

Give your values to the nearest 0.05 cm^3.

(3)

burette reading at end	22.70
burette reading at start	2.15
volume of wine added in cm^3	20.55

(c) The scientist repeats the titration four more times.

The table shows her results for these four titrations.

titration number	1	2	3	4
volume of wine added in cm^3	20.40	20.10	20.35	20.45
concordant results	✓		✓	✓

Concordant results are those within 0.20 cm^3 of each other.

(i) Add ticks (✓) to the table to show the concordant results.

(1)

(ii) Use your ticked results to calculate the mean (average) volume of wine added.

(2)

$$\text{Mean} = \frac{20.4 + 20.35 + 20.45}{3}$$

mean volume of wine added = 20.40 cm^3

(d) Another scientist repeats the titration with a different bottle of white wine that has been left open for a week.

The equation for the reaction that occurs in this titration is

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

The mean volume of wine added is 19.50 cm^3.

(i) The concentration of the sodium hydroxide solution is 0.0500 mol/dm^3.

Calculate the amount, in moles, of NaOH in 25.0 cm^3 of sodium hydroxide solution. (2)

$n(NaOH) = Conc \times vol$

$= 0.05 \times 25 \times 10^{-3}$

$= 0.00125$ mol

amount of NaOH = 0.00125 mol

(ii) Deduce the amount, in moles, of CH_3COOH in 19.50 cm^3 of the wine. (1)

Ratio $CH_3COOH : NaOH = 1:1$

amount of CH_3COOH = 0.0125 mol

(iii) Calculate the concentration, in mol/dm^3, of CH_3COOH in the wine. (2)

$Conc(CH_3COOH) = \frac{mol}{vol} = \frac{0.0125}{19.50 \times 10^{-3}}$

$= 0.0641$

concentration of CH_3COOH = 0.0641 mol/dm^3

(Total for Question 6 = 15 marks)

7 Hydrogen gas can be produced by reacting a mixture of methane and steam in the presence of a nickel catalyst.

The reaction conditions are a temperature of 700 °C and a pressure of 5 atmospheres.

The equation for the reaction is

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +206\,kJ/mol$$

(a) What does the symbol $\rightleftharpoons$ represent?

(1)

Reversible reaction

(b) (i) The mixture of methane and steam is heated to a temperature greater than 700 °C but the pressure is kept at 5 atmospheres.

Predict the effect of this change on the yield of hydrogen at equilibrium, giving a reason for your answer.

(2)

As the forward reaction is endothermic, increasing the temperature causes the yield of hydrogen at equilibrium to increase.

(ii) The mixture of methane and steam is kept at the same temperature of 700 °C but the pressure is increased to more than 5 atmospheres.

Predict the effect of this change on the yield of hydrogen at equilibrium, giving a reason for your answer.

(2)

As there are fewer moles of gas on the left hand side of the equation than on the right, the yield of hydrogen at equilibrium decreases.

(c) Calculate the volume, in dm^3, of hydrogen gas at rtp that is produced when 10 tonnes of methane gas completely react with steam.

[molar volume of hydrogen at rtp is $24\,dm^3$]

Give your answer in standard form.

(4)

$n(CH_4) = \frac{mass}{Mr} = \frac{10\,000\,000}{12+4} = 625000\,mol$

$n(H_2) = 3 \times 625000 = 1875\,000\,mol$

$v(H_2) = 1875\,000 \times 24 = 4.5 \times 10^7\,dm^3$

volume of hydrogen = 4.5×10^7 dm^3

(Total for Question 7 = 9 marks)

TOTAL FOR PAPER = 70 MARKS

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