

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International GCSE (9–1)

Centre Number

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Candidate Number

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Wednesday 10 June 2020

Afternoon (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 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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Pearson

The Periodic Table of the Elements

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	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18																																																																																																																																																																																																																																																																																																																
	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36																																																																																																																																																																																																																																																																																																								
	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54																																																																																																																																																																																																																																																																																																								
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	58 Ce cerium 58	59 Pr praseodymium 59	60 Nd neodymium 60	61 Pm promethium [61]	62 Sm samarium 62	63 Eu europium 63	64 Gd gadolinium 64	65 Tb terbium 65	66 Dy dysprosium 66	67 Ho holmium 67	68 Er erbium 68	69 Tm thulium 69	70 Yb ytterbium 70	71 Lu lutetium 71	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86																																																																																																																																																																																																																																																																																										
	87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	90 Th thorium 90	91 Pa protactinium 91	92 U uranium 92	93 Np neptunium [93]	94 Pu plutonium 94	95 Am americium 95	96 Cm curium 96	97 Bk berkelium 97	98 Cf californium 98	99 Es einsteinium 99	100 Fm fermium 100	101 Mendelevium 101	102 Nobelium 102	103 Lr lawrencium 103	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109	110 Ds darmstadtium 110	111 Rg roentgenium 111	112 Cn copernicium 112	113 Nh nihonium 113	114 Fl flerovium 114	115 Mc moscovium 115	116 Lv livermorium 116	117 Ts tennessine 117	118 Og oganesson 118	119 Uue unbinilium [119]	120 Uub ununbium [120]	121 Uut ununtrium [121]	122 Uuq ununquadium [122]	123 Uup ununpentium [123]	124 Uuq ununhexium [124]	125 Uuh ununheptium [125]	126 Uuq ununoctium [126]	127 Uuh ununnonium [127]	128 Uuo ununnilium [128]	129 Uuq ununundecium [129]	130 Uuh ununbium [130]	131 Uuo ununtrium [131]	132 Uuq ununquadium [132]	133 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1	H	1
	hydrogen	

relative atomic mass
atomic symbol
name
atomic (proton) number

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

* 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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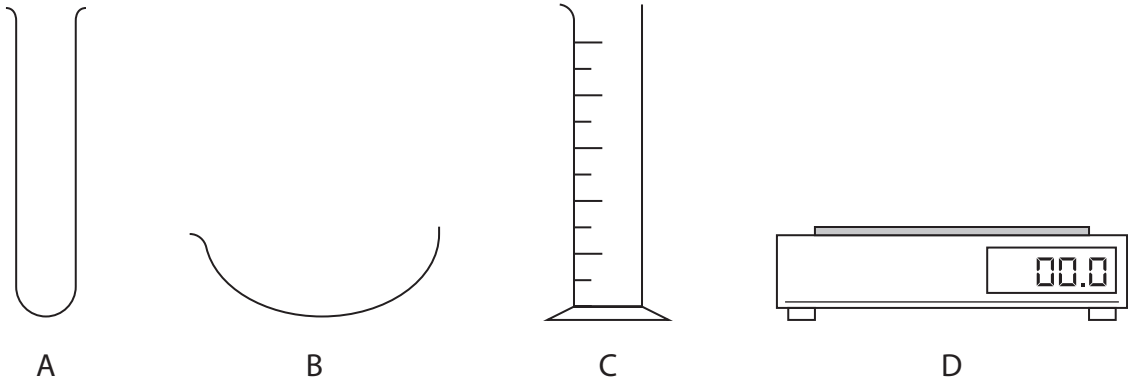
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Answer ALL questions.

1 The diagram shows some pieces of apparatus.



(a) Complete the table by giving the name of each piece of apparatus.

(4)

Letter	Name
A	
B	
C	
D	

(b) Which piece of apparatus can be used to measure the volume of a liquid?

(1)

- A
- B
- C
- D

(Total for Question 1 = 5 marks)



2 Thallium, Tl, is an element in Group 3 and Period 6 of the Periodic Table.

The atomic number of thallium is 81

(a) How many electrons are there in the outer shell of an atom of thallium?

(1)

- A 3
- B 6
- C 13
- D 81

(b) A thallium ion has a charge of 3+

How many electrons are there in this thallium ion?

(1)

- A 3
- B 78
- C 81
- D 84



(c) A sample of thallium contains two isotopes.

The table shows the mass number and percentage abundance of each isotope in the sample.

Isotope	Mass number	Percentage abundance (%)
thallium-203	203	30.80
thallium-205	205	69.20

(i) Give the number of protons and the number of neutrons in one atom of the thallium-205 isotope.

(2)

number of protons

number of neutrons

(ii) Calculate the relative atomic mass of this sample of thallium.

Give your answer to one decimal place.

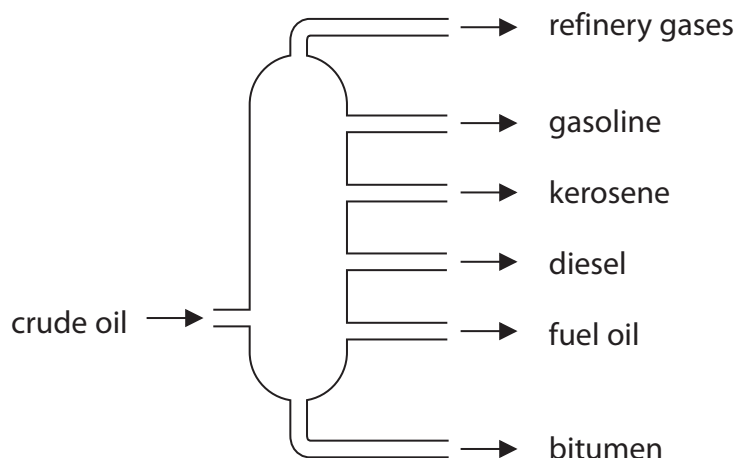
(3)

relative atomic mass =

(Total for Question 2 = 7 marks)



- 3 (a) The diagram shows a fractionating column used to separate crude oil into fractions.



- (i) Give a use for bitumen and a use for gasoline.

(2)

use for bitumen

use for gasoline

- (ii) Explain why bitumen is collected at the bottom of the fractionating column and gasoline is collected near the top of the fractionating column.

(2)

.....

- (b) There is a low demand for some of the fractions obtained from crude oil.

Cracking can be used to convert these fractions into more useful substances.

- (i) State the conditions needed for cracking.

(2)

.....

- (ii) Dodecane ($C_{12}H_{26}$) can be cracked to produce an alkane and two alkenes.

Complete the equation by giving the formulae of the two alkenes.

(2)



(Total for Question 3 = 8 marks)



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4 This question is about some of the alkali metals and their compounds.

(a) When a teacher drops a small piece of sodium into a trough of cold water, she observes bubbles of gas.

Give two other observations that would be made when sodium reacts with cold water.

(2)

1

2

(b) Lithium reacts with fluorine to form the compound lithium fluoride.

(i) Give a chemical equation for this reaction.

(1)

(ii) Give a test to show that lithium fluoride contains lithium ions.

(2)

(iii) Draw diagrams to show the arrangement of the electrons in a lithium ion and in a fluoride ion.

Include the charge on each ion.

(3)

lithium ion	fluoride ion



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(c) The table shows the electronic configurations of sodium and potassium.

Element	Electronic configuration
sodium	2.8.1
potassium	2.8.8.1

Explain, in terms of their electronic configurations, why potassium is more reactive than sodium.

(3)

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(Total for Question 4 = 11 marks)



5 This question is about the metal aluminium.

(a) (i) Draw a labelled diagram to represent the structure and bonding in a metal. (2)

(ii) Explain why a metal conducts electricity. (2)

.....
.....
.....
.....

(b) Aluminium is used to make cans for drinks.



Give two properties of aluminium that make it suitable for this use. (2)

1.....
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2.....
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(c) Aluminium is extracted from aluminium oxide (Al_2O_3) by electrolysis.

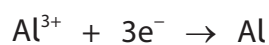
The electrolyte is aluminium oxide dissolved in molten cryolite.

(i) State why aluminium cannot be extracted by heating aluminium oxide with carbon.

(1)

(ii) Aluminium is produced at the negative electrode.

The ionic half-equation for the reaction is



State why this is a reduction reaction.

(1)

(iii) Complete the ionic half-equation for the reaction at the positive electrode.

(2)



(Total for Question 5 = 10 marks)



- 6 A student wants to prepare sodium chloride crystals from sodium hydroxide solution and dilute hydrochloric acid.

He does a titration to find the volume of dilute hydrochloric acid needed to neutralise the sodium hydroxide solution.

This is his method.

- add 25.0 cm^3 of sodium hydroxide solution to a conical flask
- add a few drops of phenolphthalein indicator to the conical flask
- titrate the solution with the hydrochloric acid

- (a) Name a suitable piece of apparatus that the student should use to measure 25.0 cm^3 of sodium hydroxide solution.

(1)

- (b) (i) Give the colour of the phenolphthalein indicator in sodium hydroxide solution and in hydrochloric acid.

(2)

colour in sodium hydroxide solution.....

colour in hydrochloric acid.....

- (ii) Suggest why universal indicator is never used in a titration.

(1)

- (c) The student finds that 21.50 cm^3 of hydrochloric acid is needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

- (i) Describe what the student should do next to prepare a pure solution of sodium chloride.

(2)



(ii) Describe how the student could obtain dry crystals of sodium chloride from the pure sodium chloride solution.

(4)

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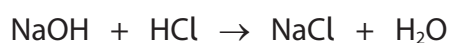
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(d) The student needs 21.50 cm³ of hydrochloric acid to neutralise 25.0 cm³ of sodium hydroxide solution of concentration 0.800 mol/dm³.

The equation for the reaction is



Calculate the concentration, in mol/dm³, of the hydrochloric acid.

(3)

concentration = mol/dm³

(Total for Question 6 = 13 marks)

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7 (a) Ethanol, C_2H_5OH , can be oxidised to produce ethanoic acid, CH_3COOH , by heating it with potassium dichromate(VI).

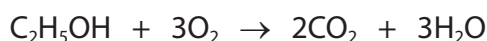
(i) Name one other reactant needed for this reaction to occur. (1)

(ii) Which colour change occurs during this reaction? (1)

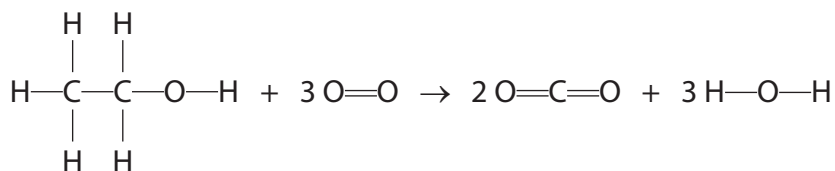
- A colourless to green
- B green to orange
- C orange to colourless
- D orange to green

(b) When ethanol is burned in air, complete combustion can occur.

The equation for this reaction is



This equation can also be written using displayed formulae to show all the covalent bonds in the molecules.



The table gives the bond energies for these bonds.

Bond	C—C	C—H	C—O	O—H	O=O	C=O
Bond energy in kJ/mol	346	412	358	463	496	743



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

(2)

energy needed kJ

(ii) Use values from the table to calculate the energy released when all the bonds in the products are formed.

(2)

energy released kJ

(iii) Calculate the molar enthalpy change (ΔH) in kJ/mol, for the complete combustion of ethanol.

Include a sign in your answer.

(1)

$\Delta H =$ kJ/mol

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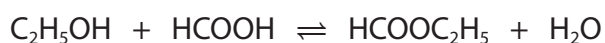
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- (c) Ethanol reacts with methanoic acid, HCOOH, in the presence of an acid catalyst to form an ester.

The equation for the reaction is



- (i) Give the name of the ester that forms. (1)

- (ii) Draw the displayed formula for this ester. (2)

- (iii) When this reaction takes place in a sealed container, the reaction can reach dynamic equilibrium.

Give two characteristics of a reaction at dynamic equilibrium. (2)

1

2



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(d) Methanoic acid reacts with sodium carbonate to form sodium methanoate, carbon dioxide and water.

The equation for the reaction is



Calculate the volume, in cm^3 , of carbon dioxide gas produced when 2.3 g of methanoic acid reacts completely with sodium carbonate.

[M_r of HCOOH = 46]

[molar volume of carbon dioxide at rtp = 24 dm^3]

(4)

volume of carbon dioxide = cm^3

(Total for Question 7 = 16 marks)

TOTAL FOR PAPER = 70 MARKS



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