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Surname

Other names

Pearson
Edexcel GCSE

Centre Number

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Candidate Number

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Chemistry/Additional Science

Unit C2: Discovering Chemistry

Higher Tier

Wednesday 15 June 2016 – Afternoon

Time: 1 hour

Paper Reference

5CH2H/01

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.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

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 ►

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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0											
	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 23	12 C carbon 6	13 Al aluminium 27	14 N nitrogen 7	15 P phosphorus 31	16 O oxygen 8	17 Cl chlorine 35.5	18 Ar argon 40									
	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 63.5	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	
	37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	[98] Tc technetium 43	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	[223] Fr francium 87
	55 Cs caesium 133	56 Ba barium 137	57 La* lanthanum 139	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86	[223] Fr francium 87
	Elements with atomic numbers 112-116 have been reported but not fully authenticated																		

1	H	1
	hydrogen	

relative atomic mass
atomic symbol
name
atomic (proton) number

Key

* 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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Questions begin on next page.



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 ☒.

The periodic table

1 The positions of ten elements are shown in the outline periodic table.

The letters are not the symbols of the elements.

	1	2											3	4	5	6	7	0
			☐															
	E													G		J		
	L													M				
											Q						R	
	T													X				Z

(a) Use the letters given in the table to identify

(i) the element that is a noble gas.

(1)

.....

(ii) three elements that are in the same period.

(1)

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(b) Which element reacts with hydrogen to form a compound that dissolves in water to give an acidic solution?

Put a cross (☒) in the box to show your answer.

(1)

- A** element **G**
- B** element **J**
- C** element **R**
- D** element **Z**



(c) Which elements, when combined, form an ionic compound?

Put a cross (☒) in the box to show your answer.

(1)

- A E and R
- B G and J
- C G and R
- D R and Z

(d) Element Q is a metal and a good conductor of electricity.

Explain how metals conduct electricity.

(2)

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(e) Reactivity increases down group 1 of the periodic table.

Elements E and T are in group 1 of the periodic table.

Explain why element T is more reactive than element E.

(2)

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(Total for Question 1 = 8 marks)



Sodium sulfate

2 Sodium sulfate is an ionic solid which is soluble in water.

(a) Which row of the table shows the likely properties of sodium sulfate?

Put a cross (☒) in the box to show your answer.

(1)

	melting point / °C	conducts electricity when dissolved in water
<input type="checkbox"/> A	22	yes
<input type="checkbox"/> B	22	no
<input type="checkbox"/> C	884	yes
<input type="checkbox"/> D	884	no

(b) Sodium sulfate contains sodium ions, Na^+ , and sulfate ions, SO_4^{2-} .

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The formula for sodium sulfate is

- A** NaSO_4
- B** $\text{Na}(\text{SO}_4)_2$
- C** Na_2SO_4
- D** $\text{Na}_2(\text{SO}_4)_2$

(ii) Sodium ions can be identified using a flame test.

Which colour in the flame shows the presence of sodium ions?

Put a cross (☒) in the box to show your answer.

(1)

- A** lilac
- B** red
- C** orange-red
- D** yellow



(iii) Explain how a sodium atom, Na, becomes a sodium ion, Na⁺.

(2)

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(c) When sodium sulfate solution reacts with barium hydroxide solution, a white precipitate of barium sulfate forms in the mixture.

The barium sulphate precipitate can be separated from the mixture and purified.

(i) Describe how pure, dry barium sulfate can be obtained from the mixture.

(2)

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(ii) Before certain X-rays, patients are given a suspension of barium sulfate to drink.

Explain why this causes no harm to the patient, even though barium salts are toxic.

(2)

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(Total for Question 2 = 9 marks)

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Chemical reactions

- 3 (a) When ammonium nitrate dissolves in water, the change is endothermic.

In an experiment, a thermometer is placed in some water in a beaker and ammonium nitrate crystals are added.

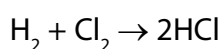
State what you would **see** to show that the reaction is endothermic.

(1)

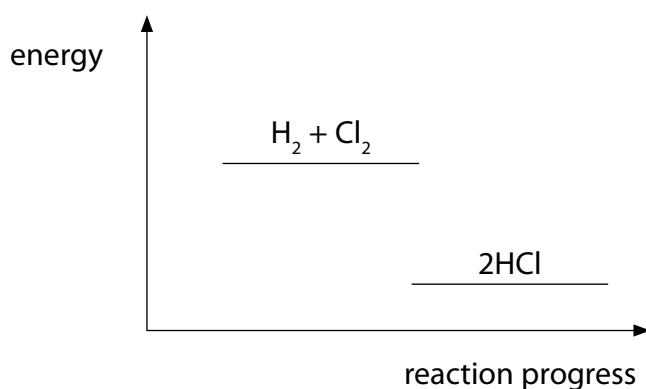
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- (b) The reaction between hydrogen and chlorine to form hydrogen chloride is exothermic.



The energy change taking place when the reactants, hydrogen and chlorine, form the product, hydrogen chloride, is shown in the diagram.



Explain, in terms of the breaking of bonds and the making of bonds, why this reaction is exothermic.

(2)

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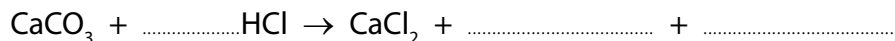


(c) Marble chips react with dilute hydrochloric acid.

Marble is a form of calcium carbonate.

(i) Complete the balanced equation for this reaction.

(2)



(ii) Explain how using smaller sized marble chips affects the rate of this reaction, when all the other conditions remain the same.

(2)

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(iii) Explain, in terms of collisions between particles, how increasing the concentration of the hydrochloric acid affects the rate of this reaction, when all the other conditions remain the same.

(2)

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(Total for Question 3 = 9 marks)



Atomic structure and isotopes

4 (a) An atom of potassium has an atomic number of 19 and a mass number of 39.

(i) Complete the table to show the number of protons, neutrons and electrons in this potassium atom.

(2)

number of		
protons	neutrons	electrons

(ii) Describe the positions of these particles in the potassium atom.

(2)

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(iii) State the electronic configuration of this potassium atom.

(1)

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(iv) Give the relative mass of an electron.

(1)

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(b) A sample of gallium, Ga, contains the isotopes gallium-69 and gallium-71.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

Isotopes are different atoms of the same element that contain

- A different numbers of electrons
- B different numbers of protons but same number of electrons
- C same number of protons but different numbers of neutrons
- D same number of neutrons

(ii) The sample of gallium contains

60.2% of gallium-69

39.8% of gallium-71

Calculate the relative atomic mass of gallium.

(3)

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(Total for Question 4 = 10 marks)



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Chlorine

5 Chlorine is an element in group 7 of the periodic table.

(a) Chlorine, Cl_2 , is a simple molecular, covalent substance.

The atoms in a molecule of chlorine are held together by a covalent bond.

(i) Explain what is meant by the term **covalent bond**.

(2)

(ii) Phosphorus reacts with chlorine to form phosphorus trichloride, PCl_3 .

A phosphorus atom has five electrons in its outer shell.

A chlorine atom has seven electrons in its outer shell.

Draw the dot and cross diagram to show the bonding in a molecule of phosphorus trichloride, PCl_3 .

Show outer electrons only.

(2)

(iii) Aluminium reacts with chlorine to form aluminium chloride, AlCl_3 .

Write the balanced equation for this reaction.

(2)

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Handwriting practice area with 20 horizontal dotted lines.

(Total for Question 5 = 12 marks)



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Composition, yield and empirical formulae

- 6 (a) Calculate the percentage by mass of nitrogen in ammonium nitrate, NH_4NO_3 .
(relative atomic masses: H = 1.0, N = 14, O = 16)

(3)

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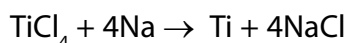
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percentage by mass of nitrogen = %

- (b) In the extraction of titanium from its ore, the final stage involves the reaction between titanium(IV) chloride, TiCl_4 , and sodium.



Calculate the maximum mass of titanium that can be obtained from 500 tonnes of titanium(IV) chloride in this reaction.

(relative atomic mass: Ti = 48
relative formula mass of TiCl_4 = 190)

(2)

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mass of titanium = tonnes

- (c) Reactions used in the chemical industry often produce unwanted products together with the required product.

State a problem this may cause for the manufacturer.

(1)

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(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS



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