

Answer all questions

*Leave
blank*

1. (a) State the meaning of the terms

(i) relative atomic mass

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(2)

(ii) mass number

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(1)

(iii) isotopes

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(2)

(b) The isotopic composition of a sample of sulphur is found using a mass spectrometer.

(i) Explain how the atoms of the sample of sulphur are ionised.

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(2)

(ii) State the type of charge on the sulphur ions formed in the mass spectrometer.

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(1)

(iii) State how the resulting sulphur ions are then accelerated.

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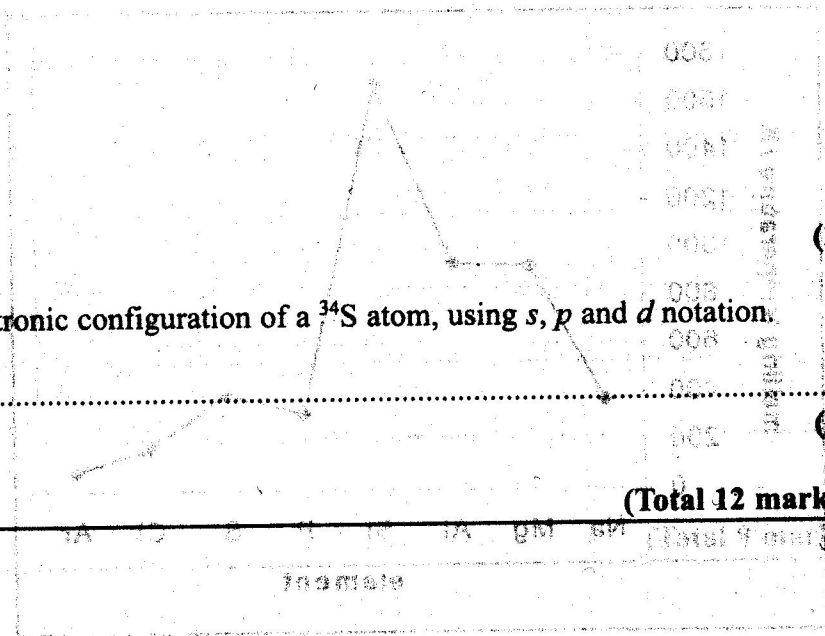
(1)

(c) For a particular sample of sulphur atoms the following isotopic composition was recorded.

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Isotope	Percentage composition
^{32}S	95.00
^{33}S	0.76
^{34}S	4.24

Calculate the relative atomic mass of this sample of sulphur. Give your answer to two decimal places.



(d) Predict the electronic configuration of a ^{34}S atom, using *s*, *p* and *d* notation.

$1s^2$

(2)

(1)

(Total 12 marks)

Q1

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2. (a) State and explain the trend in the boiling temperatures of the noble gases.

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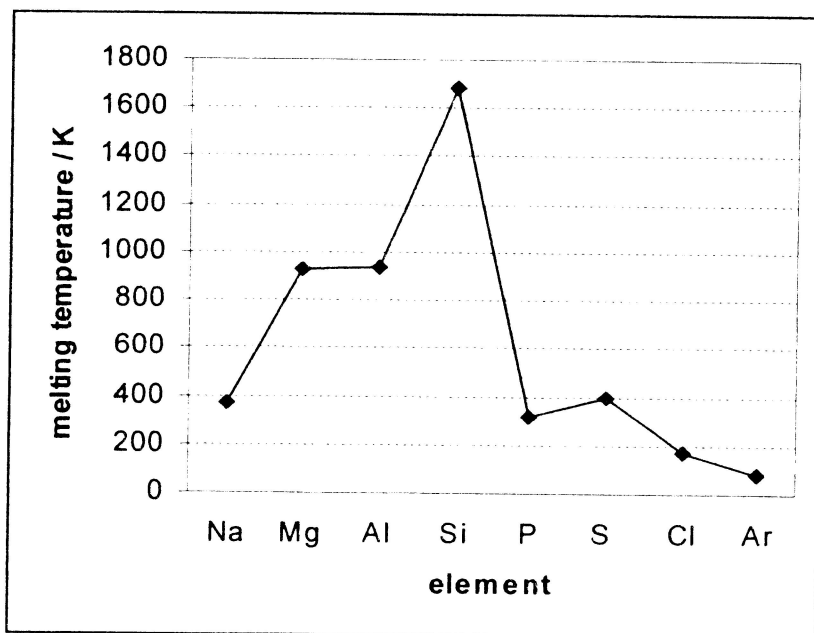
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(3)

(b) The graph below shows the melting temperatures of the elements of Period 3 of the Periodic Table, sodium to argon, plotted against atomic number.



(i) Identify one of the elements above that is composed of simple molecules at room temperature.

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(1)

(ii) Silicon has a giant atomic structure. Explain how this structure results in the high melting temperature shown on the graph.

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(2)

(iii) Explain why the melting temperature of magnesium is higher than that of sodium.

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(3)

(Total 9 marks)

Q2

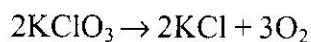
3. A compound **A** is formed when chlorine is bubbled through hot concentrated potassium hydroxide solution.

- (a) Analysis of **A** shows that it contains 31.84% potassium, 28.98% chlorine and the remainder is oxygen.

Show that the empirical formula of **A** is KClO_3

(3)

- (b) On being heated strongly solid **A** decomposes completely to give oxygen gas and solid potassium chloride.



If 1.00 g of solid **A** is decomposed completely in this way, calculate the volume of oxygen gas produced at room temperature and pressure.

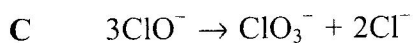
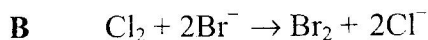
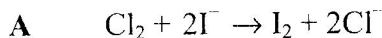
(One mole of a gas at room temperature and pressure occupies 24 dm^3)

(3)

Q3

(Total 6 marks)

4. Consider the following equations



(a) From these equations identify

(i) the equation which represents a useful extraction from sea water;

..... (1)

(ii) a species acting as a reducing agent in equation **B**.

..... (1)

(b) Describe what you would see when the reaction in **A** occurs.

.....
 (2)

(c) (i) Define **disproportionation**.

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 (1)

(ii) Select one of the equations above as an example of disproportionation and show, by the use of oxidation numbers, how this reaction fits the definition.

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 (3)

(Total 8 marks)

Q4

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5. (a) State the shape of a water molecule and explain why it has this shape.

Shape

Explanation

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.....
.....

(3)

(b) Predict the shape of the H_3O^+ ion and draw a diagram to illustrate its shape.

Shape

Diagram

(2)

(c) (i) Use water as an example to explain what is meant by the term **hydrogen bond**.

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(3)

(ii) State the difference in density between solid ice and liquid water and describe how the presence of hydrogen bonds accounts for this.

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(3)

Q5

(Total 11 marks)

6. (a) Calcium and magnesium react vigorously with dilute hydrochloric acid but with dilute sulphuric acid the calcium stops reacting even though the magnesium continues.

(i) Write a balanced equation for the reaction between magnesium metal and dilute hydrochloric acid. Include all state symbols.

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(2)

? (ii) Calcium reacts slightly more vigorously than magnesium with dilute hydrochloric acid. Suggest, in terms of atomic structure, why this is so.

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(2)

(iii) Suggest why calcium stops reacting with dilute sulphuric acid after a few seconds even though it did react initially.

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(2)

(b) (i) Write balanced chemical equations for the thermal decomposition of potassium nitrate and calcium nitrate. Do not include state symbols.

Potassium nitrate

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(1)

Calcium nitrate

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(2)

(ii) State the relative thermal stability of potassium nitrate and calcium nitrate and explain how it is related to the sizes and charges of the ions involved.

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(5)

Q6

(Total 14 marks)

TOTAL FOR PAPER: 60 MARKS

END

THE PERIODIC TABLE

1 2 3 4 5 6 7 0

Group

Period

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	1 H Hydrogen 1																		4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4																	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12																	32 Ar Argon 18
4	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	65.4 Zn Zinc 30	73 Ga Gallium 31	75 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	
5	85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	
6	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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86	
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																

Key

Molar mass g mol ⁻¹	
Symbol	
Name	
Atomic number	

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	(147) Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	163 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	(231) Pa Protactinium 91	238 U Uranium 92	(237) Np Neptunium 93	(242) Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(251) Cf Californium 98	(254) Es Einsteinium 99	(253) Fm Fermium 100	(256) Md Mendelevium 101	(254) No Nobelium 102	(257) Lr Lawrencium 103