

Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45.

1. The table below shows various gases which can be found in the air. [4]

sulphur dioxide	nitrogen dioxide	nitrogen
ozone	oxygen	carbon dioxide
argon	carbon monoxide	nitrogen monoxide
hydrogen	helium	chlorine

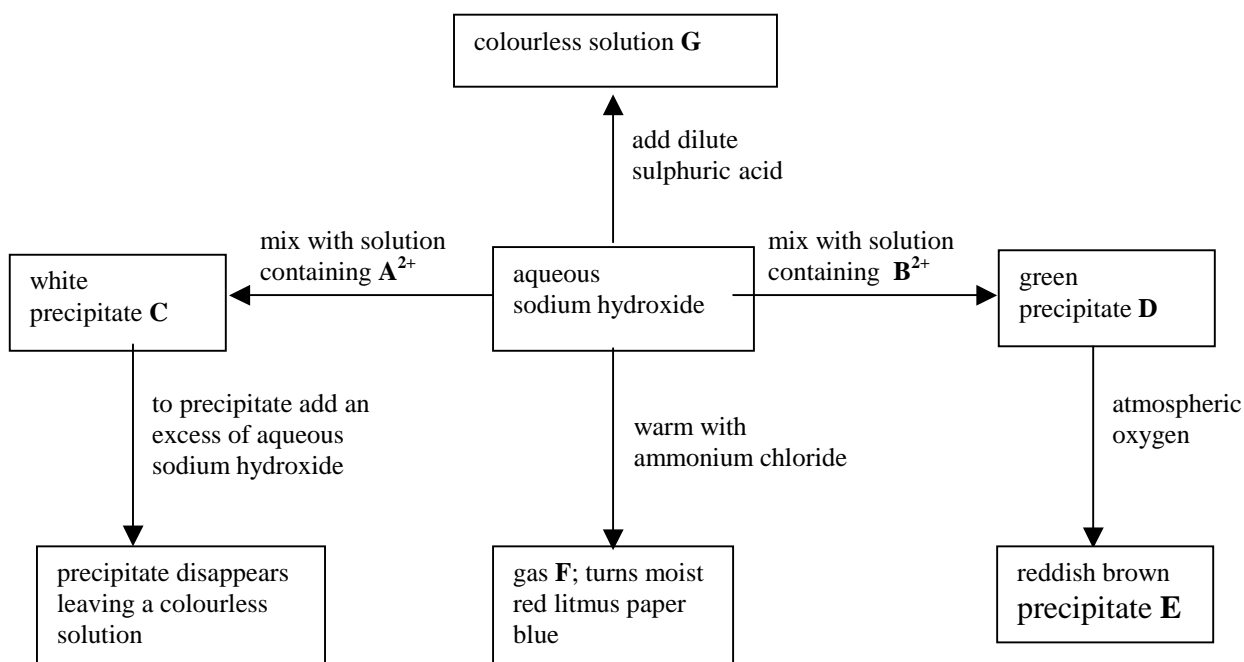
Answer the following questions using only the above list of gases. You may use each item once, more than once, or not at all.

- (a) _____ and _____ cause acid rain.
- (b) _____ make up about 80% of air.
- (c) _____ and _____ are both reducing agents.
- (d) _____ is used to kill bacteria in our drinking water.
2. Complete the table. [3]

Ion	Formula	Number of protons	Number of neutrons	Number of electrons
calcium	${}^{40}_{20}\text{Ca}^{2+}$		20	
fluoride	${}^{19}_9\text{F}^{-}$		10	
hydrogen	${}^1_1\text{H}^{+}$	1		

3. Americium is a highly radioactive element that is prepared by heating barium vapour with americium fluoride, AmF_3 . The relative molecular mass of americium fluoride is 300.
- (a) Define relative atomic mass. [1]
- _____
- _____
- (b) Calculate the relative atomic mass of americium. [1]
- (c) Calculate the percentage, by mass, of fluorine in americium fluoride. [1]

4. The diagram shows some of the properties and reactions of the ions A^{2+} and B^{2+} , and substances **C**, **D**, **E**, **F** and **G**.



- (a) Suggest identities for the ions A^{2+} and B^{2+} , and substances **C**, **D**, **E**, **F** and **G**. [7]

A^{2+} _____ B^{2+} _____
C _____ **D** _____
E _____ **F** _____
G _____

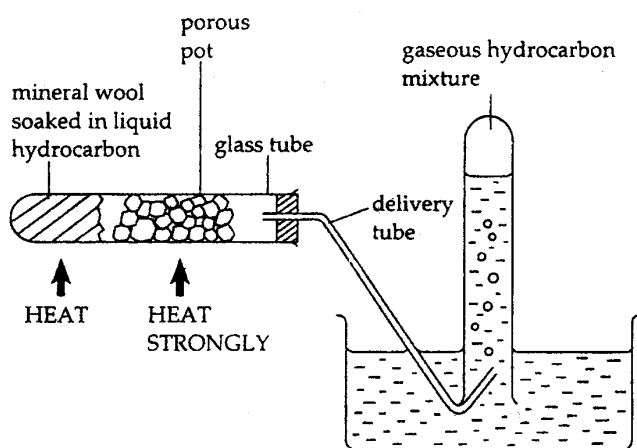
- (b) Write a chemical equation for any **one** of the reactions shown in the diagram. [1]

5. (a) Briefly describe **three** chemical reactions of an acid. [3]

- (b) When sodium hydroxide solution reacts with a solution of the nitrate of a particular metal, a dirty green precipitate forms. What is chemical name for the precipitate? [1]

- (c) Write a chemical equation for the reaction in (b) above. *State symbols are required.* [1]

6. The diagram shows how a liquid hydrocarbon can be made to undergo cracking in the laboratory, and how the gaseous hydrocarbon products can be collected.



- a) What is the purpose of the porous pot? [1]

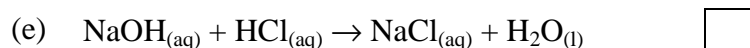
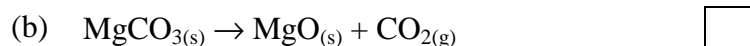
- b) Why is it important to remove the delivery tube from the water as soon as the heating is stopped? [1]

- c) The gas formed during the cracking is found to decolourise aqueous bromine.
i) What does this tell you about the gas? [1]

- ii) From the result of this test, write the chemical name and formula of one compound that could be present in the gas. [1]

- d) What experimental evidence shows that the cracking has split large molecules into small molecules? [2]

7. Three of the reactions below involve both oxidation and reduction. Tick (✓) these in the appropriate box. [3]



8. (a) Metals and non-metals have different physical and chemical properties. State any **two** differences between metals and non-metals, illustrating your answer using the properties of **iron** and **carbon**. [2]

- (b) Explain why, in industry, molten iron is mixed with other metals. [2]

- (c) (i) Zinc metal can be extracted by reducing the oxide with carbon. Explain why it is impossible to extract sodium in this way. [1]

- (ii) Suggest a method to extract sodium from its compounds. [1]

9. Explain the following observations.

- (a) A solid has more mass than the same volume of gas. [2]

- (b) It is easier to compress a gas than a solid. [2]

10. (a) **Explain** the term endothermic reaction. [2]

- (b) Give an **example** of a process which is endothermic. [1]

Section B

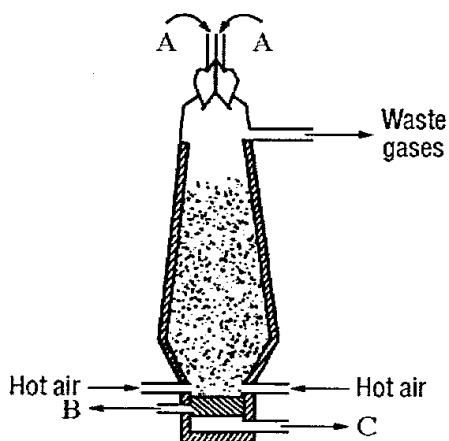
Answer **two** questions

The total mark for this section is 20.

11. (a) A list of metals is shown in the box below.

iron	copper	magnesium	sodium
-------------	---------------	------------------	---------------

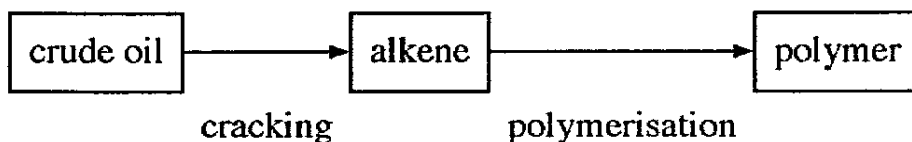
- (i) Arrange the metals in order of decreasing reactivity (from most reactive to least reactive). [1]
- (ii) Using your knowledge of the reactions of these metals with dilute hydrochloric acid, explain why you have arranged the metals as given in your answer to (i). [4]
- (b) Iron metal can be extracted in the Blast Furnace by a reduction process. The figure shows a simplified sectional diagram of a blast furnace for the extraction of iron.



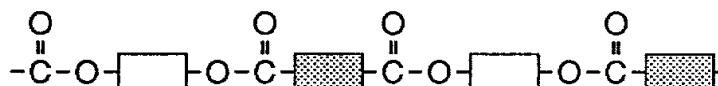
- (i) Name the substances fed into the furnace at A. [1]
- (ii) Name the substance(s) coming out of the furnace at B and at C. [1]
- (iii) The waste gases contain carbon dioxide, carbon monoxide and nitrogen. Explain the presence of each of these gases. [3]
12. Nitrogen dioxide is an air pollutant that is formed when nitrogen combines with oxygen in a motor car engine.
- (a) Name **two other** chemicals that are common air pollutants. [2]
- (b) For **each** of the chemicals named in (a),
- (i) describe how each of them is formed
- (ii) state the effect of each on the environment
- (iii) give measures that can be taken to reduce their effect on the environment. [6]
- (c) At room temperature and pressure, 24 dm^3 of polluted air contains 1.5% by volume of nitrogen dioxide (NO_2). What is the mass of nitrogen dioxide in this sample? [2]

13. (a) Methanoic acid, with the molecular formula HCOOH , is a member of a homologous series. The general formula for this series is $\text{C}_n\text{H}_{2n+1}\text{COOH}$. Another *acid* in the series has **three carbon atoms** in each of its molecules.
- (i) For this acid, write its name and molecular formula and draw its full structural formula. [3]
- (ii) This acid will react with ethanol in the presence of concentrated sulphuric acid. Predict the products of the reaction. [1]

- (b) This diagram shows two industrial processes, cracking and polymerisation.



- (i) What is meant by
- (1) cracking,
 - (2) polymerisation? [2]
- (ii) Terylene is a polyester.
- (1) Name something useful which is made from Terylene. [1]
 - (2) The structure of Terylene is represented by the diagram.



- Draw* a repeating unit in this structure. [1]
- (3) Explain why Terylene can cause pollution. [1]
- (iii) Give an example of a polymer with amide linkage. [1]

~ *The End* ~

The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0
		1 H Hydrogen							4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4							19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12							35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20							80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38							127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56							209 Bi Bismuth 83	226 Ra Radium 88
227 Fr Francium 87	226 Ra Radium 88							227 Ac Actinium 89	227 Ac Actinium 89

11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 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 43	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 Md Mendelevium 101	102 No 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
-----------------------	------------------------	-----------------------------	---------------------------	-----------------------------	--------------------------	----------------------------	-------------------------	----------------------------	---------------------------	----------------------------	----------------------------	---------------------------	----------------------------	-----------------------------	------------------------	--------------------------	--------------------------	--------------------------	------------------------	---------------------------	-----------------------------	---------------------------	----------------------------	---------------------------	---------------------------	----------------------------	-----------------------------	--------------------------	-----------------------------	---------------------------	------------------------------	------------------------------	-----------------------------	---------------------------	-----------------------------	--------------------------	---------------------------	--------------------------	-----------------------	----------------------------	-----------------------------	-------------------------	-------------------------	---------------------------	--------------------------	-----------------------------	--------------------------	--------------------------------	-----------------------------	------------------------------	----------------------------	----------------------------	------------------------------	---------------------------	------------------------------	---------------------------	--------------------------	---------------------------	-----------------------------	----------------------------	---------------------------	----------------------------	---------------------------	---------------------------	--------------------------	---------------------------	----------------------------	------------------------	---------------------------	----------------------------	------------------------	---------------------------	----------------------------	----------------------------	-------------------------	----------------------------	--------------------------	----------------------------	---------------------------	--------------------------------	--------------------------	-----------------------------	-----------------------------	-----------------------------	--------------------------	-----------------------------	-------------------------------	-------------------------------	-----------------------------	---------------------------------	------------------------------	--------------------------------	-----------------------------------	-----------------------------	--------------------------------	-----------------------------	-----------------------------	--------------------------------	----------------------------------	---------------------------------	---------------------------------	------------------------------	-------------------------------	-------------------------------	---------------------------------	--------------------------------	-------------------------------

* 58 – 71 Lanthanoid series
+ 90 – 103 Actinoid series

Key

a	X
b	
+	

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)