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| Centre Number | Candidate Number | Name |
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CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE

0653/03

Paper 3

May/June 2003

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 20.

| For Examiner's Use | |
|--------------------|--|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| Total | |

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

This document consists of **18** printed pages and **2** blank pages.

- 1 (a) Sodium chloride is an ionic compound.

Fig. 1.1 shows how the electrons are arranged in a sodium ion and a chloride ion.

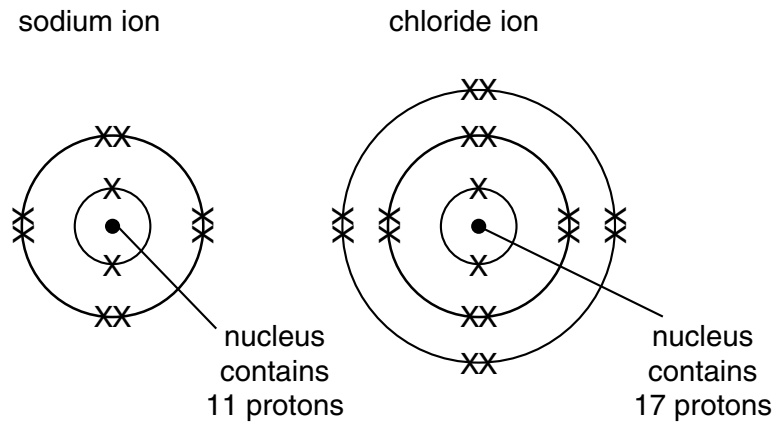


Fig. 1.1

- (i) Use the information in Fig. 1.1 to explain why a sodium ion has an electrical charge of +1.

.....

 [2]

- (ii) Explain why there is no significant difference in mass between a chloride ion and a chlorine atom.

.....

 [2]

(b) Large amounts of sodium chloride solution are electrolysed in the chemical industry. Chlorine is one of the important products from this process.

(i) Explain why chloride ions move towards the anode during electrolysis.

.....
.....
..... [2]

(ii) Describe briefly how chloride ions are changed into chlorine atoms at the anode.

.....
..... [1]

(c) Name the **two** other products that are made in addition to chlorine in the electrolysis of sodium chloride solution.

.....
..... [2]

- 2 (a) Liquids expand on heating, but the change in volume is not large for a temperature change of 50 °C.

Describe an experiment to show how a liquid such as water expands when it is heated by 50 °C.

Your description must include

- the apparatus you would use
- an explanation as to how you would know that the liquid had expanded.

.....

.....

.....

..... [3]

- (b) When heated by 50 °C, will a sample of a liquid expand more or less than the same volume of

a solid, a gas? [1]

- (c) When light from an object passes from water into air, it is refracted as shown in Fig. 2.1.

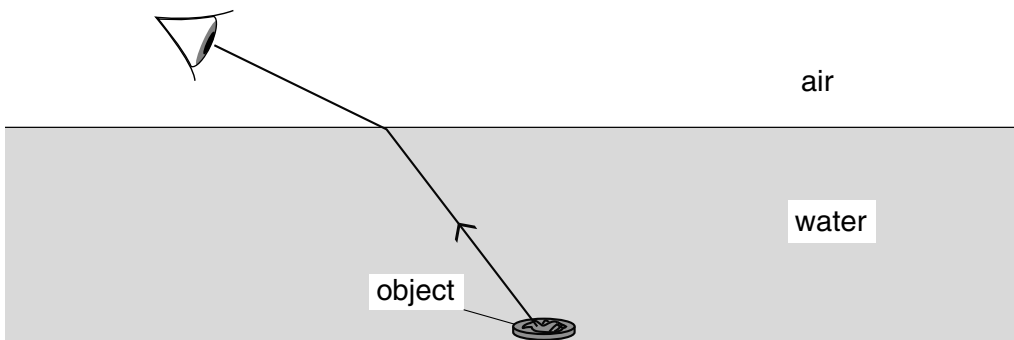


Fig. 2.1

- (i) On Fig.2.1, draw a normal to the surface where the ray emerges and label the angle of refraction. [2]
- (ii) By drawing a suitable line on Fig. 2.1, show where the object appears to be to the observer. [1]

3 (a) Explain what is meant by the term *enzyme*.

.....

.....

.....

..... [2]

(b) Lactose is a sugar which is present in milk. It is broken down to glucose and galactose by the enzyme lactase.

A student carried out an investigation into the effect of temperature on the rate of activity of lactase. He put 5 cm³ of milk into each of three test-tubes, **A**, **B** and **C**. He kept each test-tube at a different temperature, as shown in Fig. 3.1, for 10 minutes. Then he added 5 cm³ of lactase solution to each tube.

After the lactase was added, he tested each tube for glucose every thirty seconds, using paper test strips which change colour when in contact with glucose solution. He recorded the time at which glucose was first detected. One of his results is shown in Fig. 3.1.

| tube | temperature / °C | time at which glucose was first detected / s |
|----------|------------------|--|
| A | 5 | 300 |
| B | 30 | |
| C | 90 | |

Fig. 3.1

(i) Suggest why the Benedict's test for glucose is not suitable to use in this investigation.

.....

..... [1]

(ii) Complete the table by suggesting times for glucose to be first detected in tubes **B** and **C**. (You are not expected to know exact times.) [2]

(iii) Explain your suggested result for tube **C**.

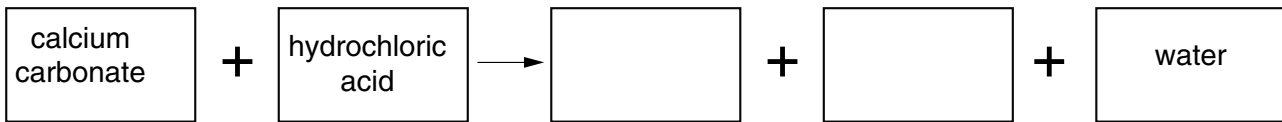
.....

..... [1]

- 4 (a) (i) Describe **one** observation that is made when hydrochloric acid reacts with calcium carbonate.

.....
 [1]

- (ii) Complete the word equation for the reaction.



[2]

Fig. 4.1 shows the apparatus that a student used to study the rate of reaction between dilute hydrochloric acid and calcium carbonate. The student studied the rate of reaction at three different temperatures.

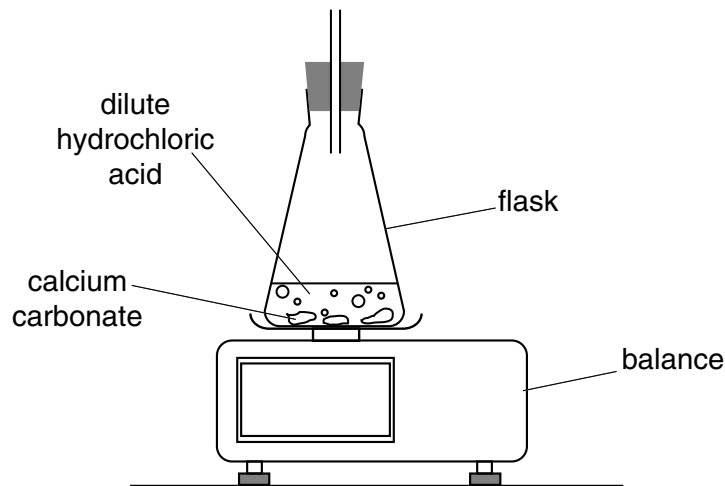


Fig. 4.1

- (b) The table and graph in Fig. 4.2 show some data for the three experiments carried out by the student.

| experiment | initial mass of calcium carbonate / g | temperature of hydrochloric acid / °C |
|------------|---------------------------------------|---------------------------------------|
| A | 10.0 | 15 |
| B | 10.0 | 25 |
| C | 10.0 | 35 |

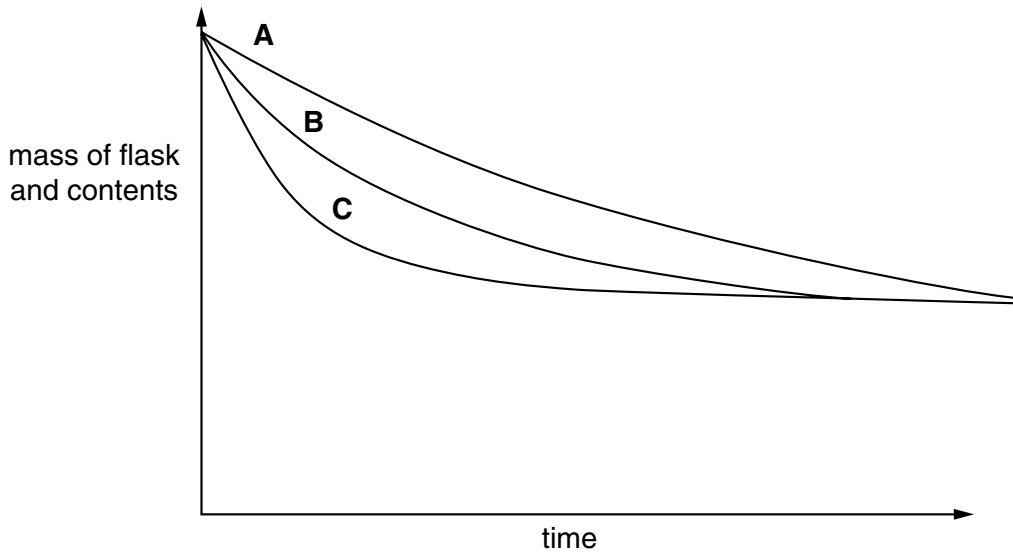


Fig. 4.2

- (i) Explain why the balance reading decreases during the reaction.

.....

 [2]

- (ii) The student used 10.0 g of calcium carbonate in each experiment.

State two other conditions that should be kept the same for each experiment.

1.

 2.
 [2]

- (iii) Describe and explain, in terms of the collisions between particles, the difference in rate between reactions **A** and **C**.

.....

 [2]

5 A skydiver jumps from an aircraft.

- (a) (i) On Fig. 5.1, draw arrows to show the **two** main forces acting on her. Label the arrows with the names of the forces.



Fig. 5.1

[2]

- (ii) Which of the forces you have labelled will be the larger just after she jumps? Explain your answer.

.....
..... [1]

- (b) (i) On Fig. 5.2, draw arrows to show the **two** main forces acting on her when the parachute has opened. Label the arrows with the names of the forces.

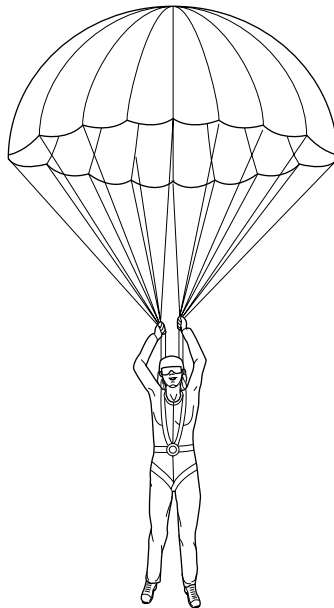


Fig. 5.2

[1]

(ii) How do the forces in Fig. 5.2 compare with the forces in Fig. 5.1?

Explain your answer.

.....

.....

.....

..... [2]

(c) The speed-time graph in Fig. 5.3 shows her descent.

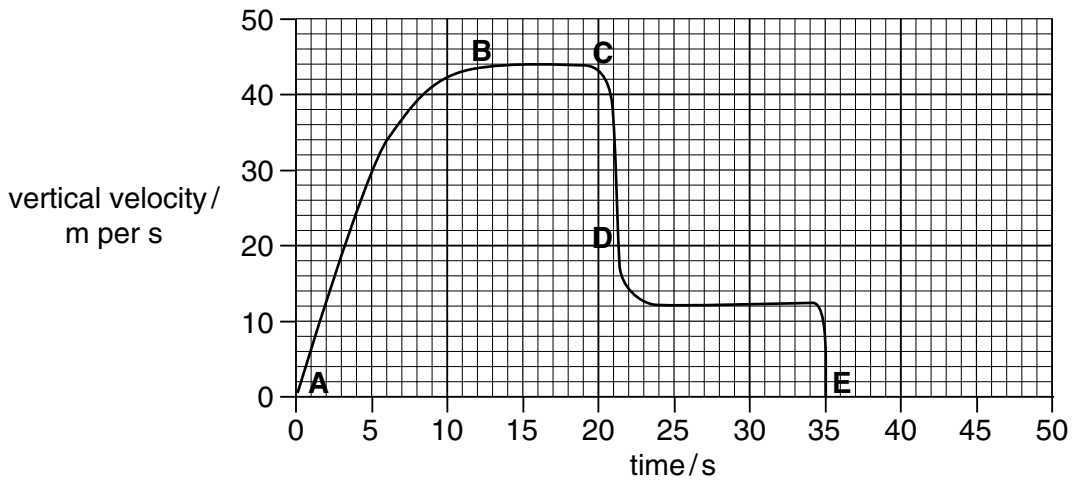


Fig. 5.3

(i) Which section of the graph shows the skydiver travelling with an acceleration which is not uniform?

Explain your answer.

.....

..... [2]

(ii) At which point does she open her parachute?

Explain your answer.

.....

..... [2]

(iii) How long after opening her parachute does she reach the ground?

Explain your answer.

.....

..... [2]

6 Fig. 6.1 is a diagram of a transverse section through a leaf.

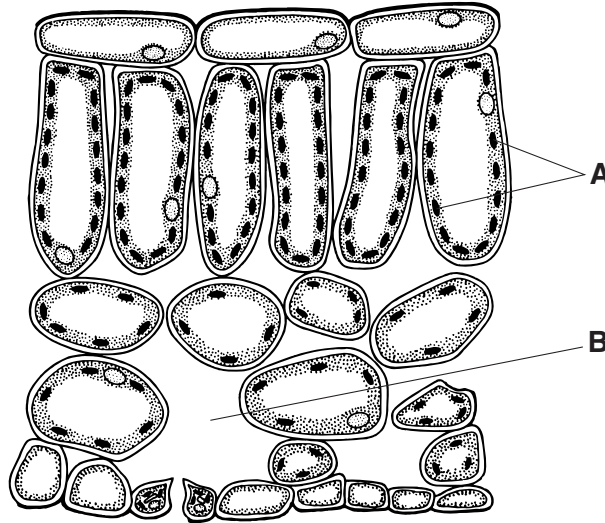


Fig. 6.1

(a) Explain how parts **A** and **B** help photosynthesis to take place in the leaf.

A

.....

.....

B

.....

..... [4]

(b) When photosynthesis takes place in a leaf, glucose is produced. The plant converts some of the glucose to other substances.

(i) Name **one** carbohydrate, other than starch, which the plant makes from glucose and which is used to make cell walls.

..... [1]

(ii) Carbohydrates contain carbon, hydrogen and oxygen. Name **one** other element which is contained in a chlorophyll molecule.

..... [1]

(iii) Describe how a plant obtains the element you have named in (ii).

.....

.....

..... [2]

- (c) Deer often eat the bark from young trees. Fig. 6.2 shows a tree where a whole ring of bark has been removed by deer.

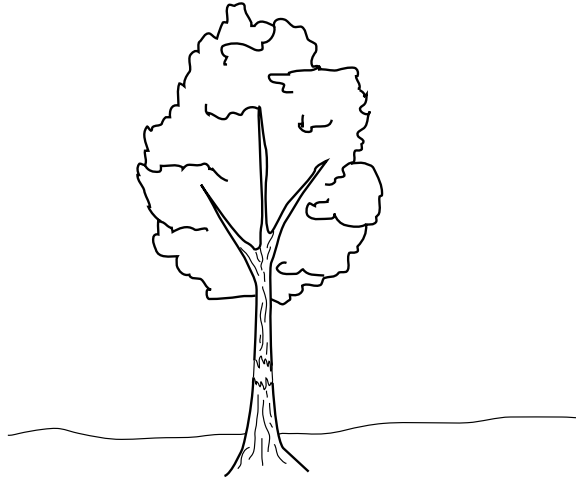


Fig. 6.2

Explain why this tree is likely to die.

.....

.....

..... [2]

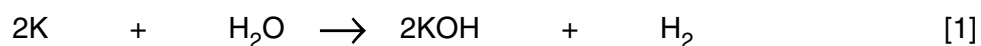
7 Potassium reacts vigorously with water.

- (a) (i) Predict and explain how the temperature of the mixture changes during the reaction.

.....
.....
..... [2]

- (ii) A symbolic equation for the reaction is shown below. This equation is not balanced.

Balance the equation.



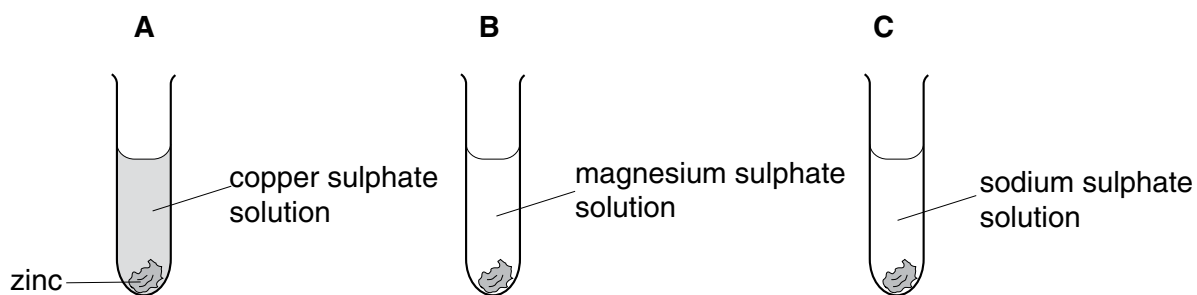
- (iii) Write the formula and charge of an ion whose concentration increases during the reaction.

..... [2]

- (iv) Draw a dot and cross diagram to show how the outer electrons are arranged in a water molecule.

[2]

(b) A student added pieces of zinc to three test-tubes, **A**, **B** and **C**.



She observed a reaction in tube **A**, but not in tubes **B** and **C**.

Explain the results in these experiments.

.....

.....

..... [2]

8 Ordinary light bulbs contain a small tungsten filament which glows when an electric current passes through it. They give off more energy as heat than they give off as light.

(a) These bulbs are not efficient. Explain what this means.

.....
 [1]

(b) How much energy does a 100 W light bulb use per second?

..... [1]

(c) Two light bulbs have a resistance of $3\text{ k}\Omega$ each and are connected in series in the circuit shown in Fig. 8.1.

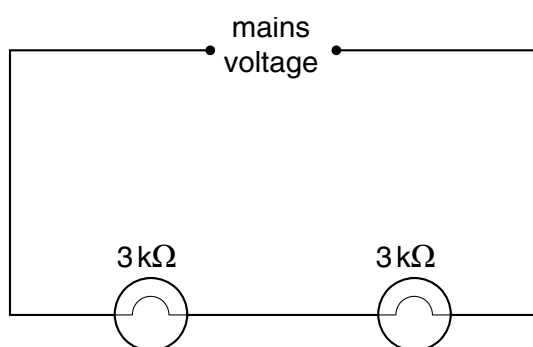


Fig. 8.1

(i) State the combined resistance of these light bulbs.

..... [1]

(ii) If the mains voltage is 240 V, state the voltage across **one** of the light bulbs.

..... [1]

- (d) The light bulbs are now connected in parallel as shown in Fig. 8.2.

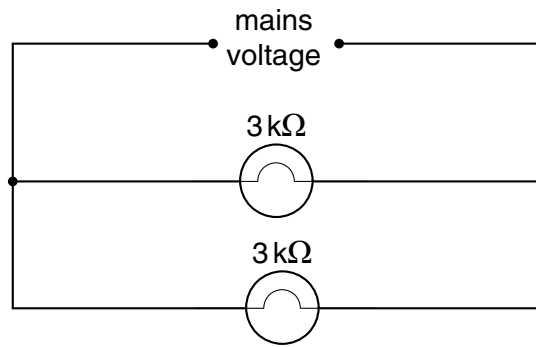


Fig. 8.2

- (i) Calculate the combined resistance of the light bulbs now. Show your working.

..... [2]

- (ii) If the mains voltage is 240 V, state the voltage across **one** of the light bulbs.

..... [1]

9 When the heart muscle contracts, it pushes blood into the arteries at a high pressure. As the blood flows around the circulatory system, the pressure gradually drops.

(a) Using the information above, and your own knowledge of the circulatory system, explain why

(i) you can feel a pulse in an artery but not in a vein,

.....
.....
..... [2]

(ii) arteries have thicker and more elastic walls than veins.

.....
.....
..... [2]

(b) White blood cells can destroy pathogens, such as bacteria or viruses. Some white cells do this by ingesting and digesting the pathogens. Other white cells produce antibodies, which kill the pathogens.

Chicken pox is a disease caused by a virus. Fig. 9.1 shows the level of antibodies to the chicken pox virus in the blood of a girl before, during and after the time when she suffered from chicken pox.

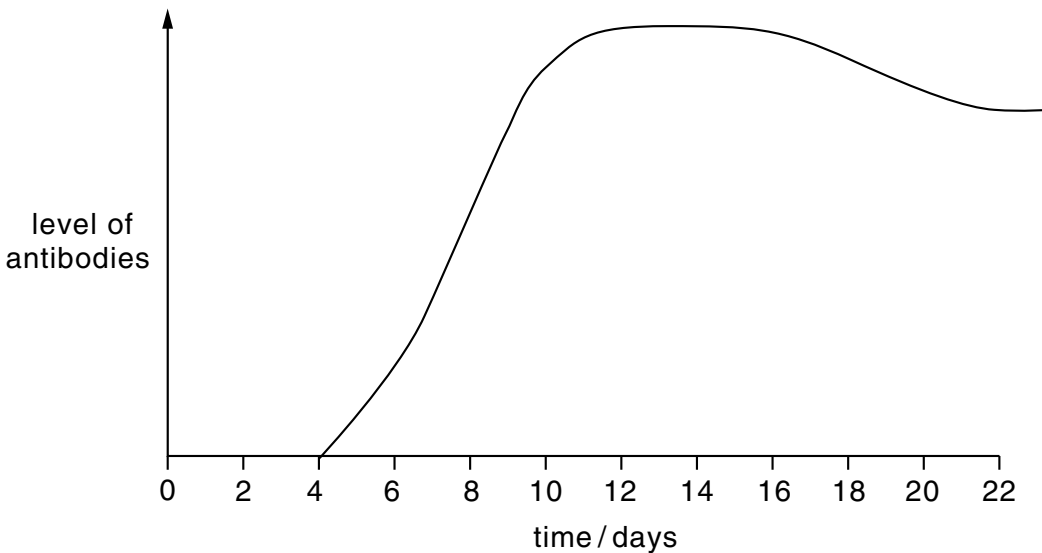


Fig. 9.1

(i) Name the type of white blood cell which produces antibodies.

..... [1]

(ii) On Fig. 9.1, draw an arrow at a point on the graph when the virus could have first entered the girl's body. [1]

(iii) Using the information in Fig. 9.1, explain why it is unlikely that the girl will suffer from chicken pox again.

.....
.....
..... [2]

(iv) Explain why having chicken pox does not affect the girl's chances of suffering from other diseases caused by viruses, such as influenza.

.....
.....
..... [1]

(v) A man was given a kidney transplant. He was told that he could now have a greater risk of suffering from diseases such as chicken pox or influenza.

Explain the reason for this.

.....
.....
..... [2]

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DATA SHEET

The Periodic Table of the Elements

| | | Group | | | | | | | | | | |
|---|------------------------------------|---|--|-------------------------------------|--------------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--|--|-------------------------------|
| I | II | III | IV | V | VI | VII | O | | | | | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">1 H Hydrogen 1</div> </div> | | | | | | | | | | 4 He Helium 2 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | 11 B Boron 5 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulphur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 | | | | | |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 | | | | | |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 65 Zn Zinc 30 | 64 Cu Copper 29 | 59 Ni Nickel 28 | 108 Ag Silver 47 | 127 I Iodine 53 | 131 Xe Xenon 54 | | | | | |
| 226 Ra Radium 88 | 227 Ac Actinium 89 | 112 Cd Cadmium 48 | 106 Pd Palladium 46 | 103 Rh Rhodium 45 | 197 Au Gold 79 | 209 Po Polonium 84 | 210 At Astatine 85 | | | | | |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">a X b</div> </div> | | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 210 Bi Bismuth 83 | 210 Rn Radon 86 | | | | |
| | | 159 Tb Terbium 65 | 157 Gd Gadolinium 64 | 152 Eu Europium 63 | 195 Pt Platinum 78 | 192 Ir Iridium 77 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 201 Hg Mercury 80 | | | |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">a = relative atomic mass X = atomic symbol b = proton (atomic) number</div> </div> | | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 201 Hg Mercury 80 | 209 Po Polonium 84 | 210 Rn Radon 86 | | | | | |
| | | 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 150 Sm Samarium 62 | 101 Ru Ruthenium 44 | 101 Ru Ruthenium 44 | 101 Ru Ruthenium 44 | 101 Ru Ruthenium 44 | 101 Ru Ruthenium 44 | | | |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">*58-71 Lanthanoid series †90-103 Actinoid series</div> </div> | | 144 Nd Neodymium 60 | 144 Nd Neodymium 60 | 150 Sm Samarium 62 | 157 Gd Gadolinium 64 | 162 Dy Dysprosium 66 | 167 Er Erbium 68 | | | | | |
| | | 232 Th Thorium 90 | 232 Th Thorium 90 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | | | |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">Key</div> </div> | | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 167 Er Erbium 68 | 167 Er Erbium 68 | 167 Er Erbium 68 | | | | | |
| | | 175 Lu Lutetium 71 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | | | |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px;">The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).</div> </div> | | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 167 Er Erbium 68 | 167 Er Erbium 68 | 167 Er Erbium 68 | | | | | |
| | | 175 Lu Lutetium 71 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | 173 Yb Ytterbium 70 | | | |