Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **October/November 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Blank pages are indicated.

1 Fig. 1.1 shows some pasta noodles and some vegetable noodles.

pasta noodles vegetable noodles

Fig. 1.1

Table 1.1 compares the nutrients and energy listed on a packet of each type of noodles.

Table 1.1

nutrient	typical value in 100 g of pasta noodles	typical value in 100 g of vegetable noodles
carbohydrate (fibre)	31 g (1.3 g)	6.2 g (2 g)
protein	5.8 g	2.4 g
fat	0.9 g	0.6 g
calcium	7 mg	32 mg
vitamin C	0 mg	36 mg
iron	1.3 mg	0.7 mg
energy content	664 kJ	143 kJ

(a) Use the information in Table 1.1 to suggest why the vegetable noodles may be better than the pasta noodles at preventing scurvy.

.....

..... [1]

(b) A doctor advises an obese person to eat vegetable noodles rather than pasta noodles.

Use the information in Table 1.1 to explain why the doctor gives this advice.

.....

.....

.....

..... [2]

(c) State **one** nutrient shown in Table 1.1 that must be broken down by chemical digestion before it can be used in the body.

..... [1]

(d) Describe the importance of fibre in the diet.

.....

..... [1]

(e) The word equation for aerobic respiration is shown.

glucose + oxygen ⟶ carbon dioxide + water

(i) Describe how oxygen is transported by the blood.

.....

.....

..... [2]

(ii) Explain the effect of exercise on the pattern of breathing.

Refer to concentration of carbon dioxide in the blood in your answer.

.....

.....

.....

.....

..... [3]

[Total: 10]

2 **(a)** Cracking breaks down large saturated hydrocarbon molecules into smaller hydrocarbon molecules.

(i) State what is meant when a hydrocarbon is described as *saturated*.

.....

..... [1]

(ii) The equation for a cracking reaction is shown.

$$C_{20}H_{42} \rightarrow C_{10}H_{22} + 3C_2H_4 + C_xH_y$$

Determine the values of *x* and *y*.

x = ... *y* = ... [2]

(b) One of the products of cracking hydrocarbons is ethene, C_2H_4.

(i) Draw a dot-and-cross diagram to show the bonding in a molecule of ethene.

Show only the outer shell electrons.

[2]

(ii) State the colour change seen when ethene is added to aqueous bromine.

from ..... to ..... [1]

(c) The complete combustion of ethene is an exothermic reaction.

(i) Identify the **two** compounds that are produced in this reaction.

1 .....

2 .....
[2]

(ii) State whether bond breaking and bond forming are endothermic or exothermic processes.

Use your answer to explain why the combustion of ethene is an exothermic reaction.

bond breaking is .....

bond forming is .....

explanation .....

..... [2]

[Total: 10]

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3 **(a)** Fig. 3.1 shows the forces acting on a truck full of sand as it is pulled along level ground at constant speed.

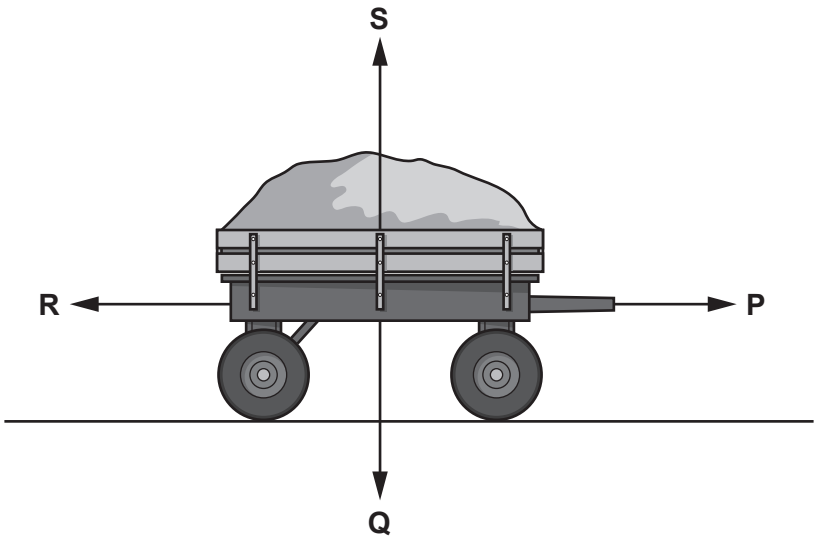

Fig. 3.1

(i) State the letter of the force, **P**, **Q**, **R** or **S**, due to the effect of the Earth's gravitational field.

..... [1]

(ii) Force **S** is called the reaction force.

Describe the relationship between force **S** and force **Q**.

.....

..... [1]

(b) Fig. 3.2 shows a man pulling the truck full of sand along the ground, up a slope and onto a platform.

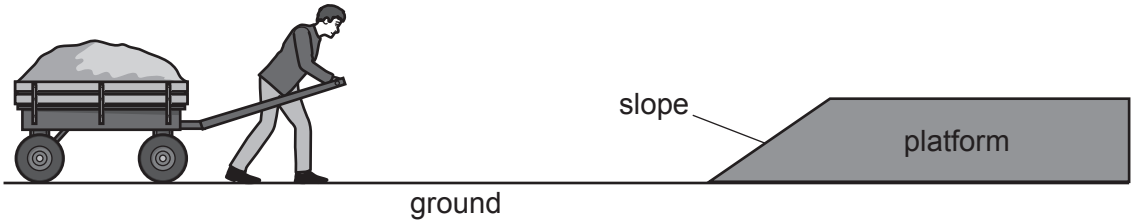

Fig. 3.2

Fig. 3.3 shows a speed–time graph of the motion of the man and truck.

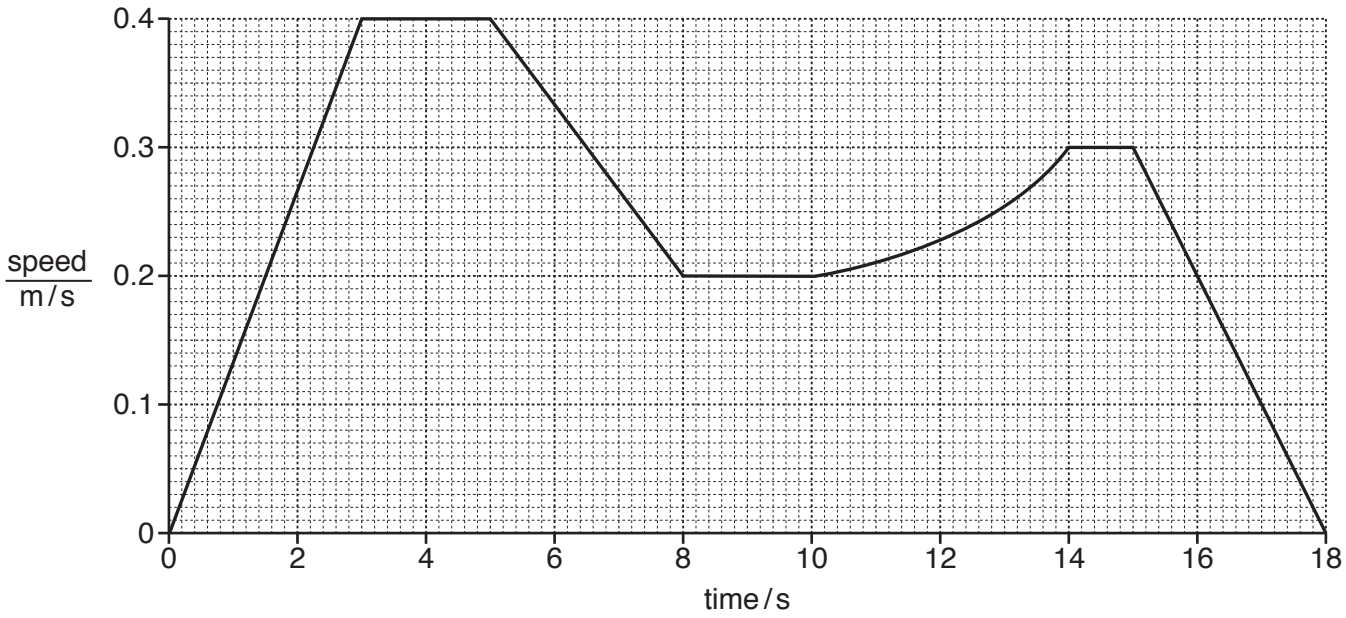

Fig. 3.3

(i) On Fig. 3.3, draw an **X** on the graph to show when the man and truck have the greatest acceleration. [1]

(ii) On Fig. 3.3, draw a **Y** on the graph to show when the man and truck are moving with non-constant acceleration. [1]

(iii) Use Fig. 3.3 to calculate the acceleration of the truck between 5.0 s and 8.0 s.

Give the units of your answer.

acceleration = ... units ..... [3]

(c) (i) The height of the platform in Fig. 3.2 is 1.2 m.

The mass of the truck full of sand is 200 kg.

The gravitational field strength g is 10 N / kg.

Show that the increase in gravitational potential energy of the truck full of sand due to moving from the ground to the platform is 2.4 kJ.

[2]

(ii) The man does 5.0 kJ of work to pull the truck full of sand up the slope and onto the platform.

This work done is much greater than the increase in gravitational potential energy from **(c)(i)**.

Suggest reasons for this difference.

.....

.....

.....

..... [2]

[Total: 11]

4 Fig. 4.1 is a cross-sectional diagram of a leaf.

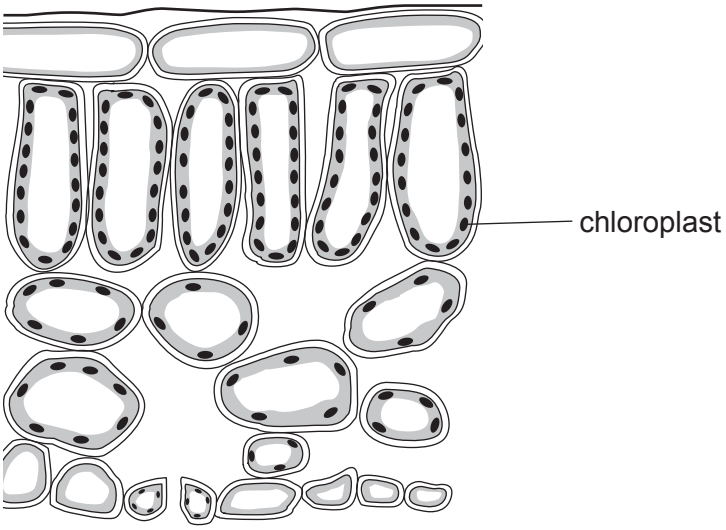

Fig. 4.1

(a) (i) On Fig. 4.1, use a label line and the letter **P** to show a cell **in the lower epidermis** where photosynthesis takes place. [1]

(ii) Explain your answer to **(i)**.

.....

..... [1]

(b) Explain why the rate of transpiration increases when the temperature of the environment increases.

.....

.....

.....

.....

..... [3]

(c) In a garden, snails feed on the leaves of trees. Thrushes feed on the snails, and hawks eat the thrushes.

(i) Construct the food chain for these organisms.

[2]

(ii) Identify the primary consumer in this food chain.

Give a reason for your answer.

name of primary consumer .....

reason .....

.....

[2]

(iii) State **two** ways that energy is lost between the trophic levels in the food chain.

1 .....

2 .....

[2]

[Total: 11]

5 **(a)** Iron is extracted from iron oxide in a blast furnace.

One of the reactions occurring in the blast furnace is shown.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

Name the oxidising agent in this reaction.

..... [1]

(b) Iron is a transition element. Aluminium is **not** a transition element.

Describe **one** property of iron that is **not** a property of aluminium.

.....

..... [1]

(c) Aluminium is obtained by the electrolysis of molten aluminium oxide.

(i) Explain why aluminium oxide must be molten during electrolysis.

.....

..... [1]

(ii) Aluminium oxide contains aluminium ions, Al^{3+}, and oxide ions, O^{2-}.

Deduce the formula of aluminium oxide.

formula ..... [1]

(iii) The melting point of aluminium oxide is 2072 °C. The melting point of methane is –182 °C.

Explain the difference in these melting points.

Use ideas about types of bonds and attractive forces in your answer.

.....

.....

.....

.....

.....

..... [3]

(d) Aluminium is an element in Period 3 of the Periodic Table.

Describe the relationship between the number of outer shell electrons and the metallic character of the elements across a period.

.....

..... [1]

[Total: 8]

6 Fig. 6.1 shows a device called a 'solar still'. A solar still is used to produce fresh water from sea water.

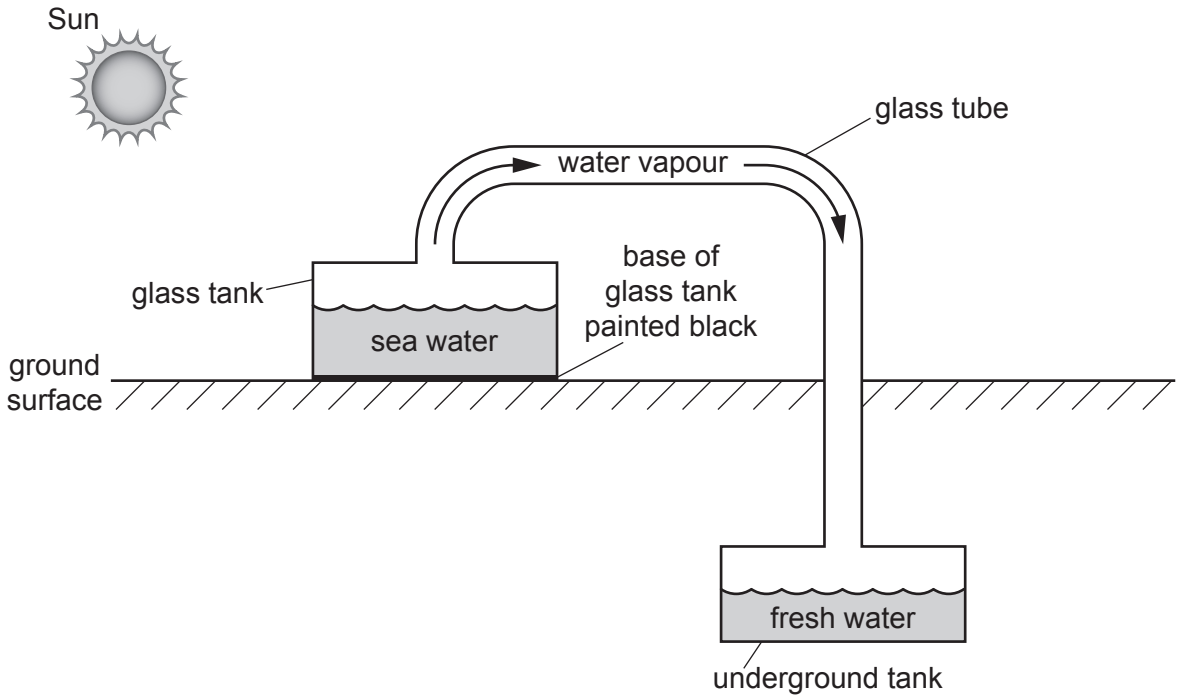

Fig. 6.1

Sea water is added to a glass tank. The glass tank is in full sunlight.

Water evaporates in the glass tank. The water vapour travels through a glass tube to an underground tank where it cools.

Fresh water condenses and collects in the underground tank.

(a) (i) Describe how the following change as liquid water evaporates into water vapour.

- the forces between the water molecules
- the distances between the water molecules
- the motion of the water molecules

.....

.....

.....

.....

.....

..... [3]

(ii) The bottom of the glass tank is painted black.

Describe how this helps to increase the rate of evaporation of the water in the glass tank.

.....

.....

.....

..... [2]

(iii) Explain why the temperature of the sea water remaining in the glass tank decreases as a result of the evaporation.

.....

.....

.....

..... [2]

(b) Energy from the Sun is used to heat the sea water.

State the method of energy transfer from the Sun to the Earth.

..... [1]

[Total: 8]

7 **(a)** Fig. 7.1 is a diagram of a cross-section through an artery.

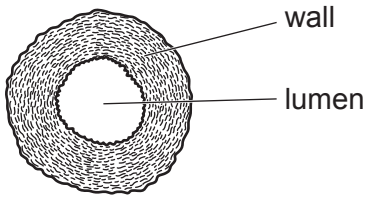

Fig. 7.1

Explain **two** ways the structure of the artery is adapted for its function.

1 .....

.....

2 .....

.....

[2]

(b) Describe how the structure of capillaries allows efficient exchange of materials.

.....

..... [1]

(c) Fig. 7.2 shows a diagram of the internal structure of the heart.

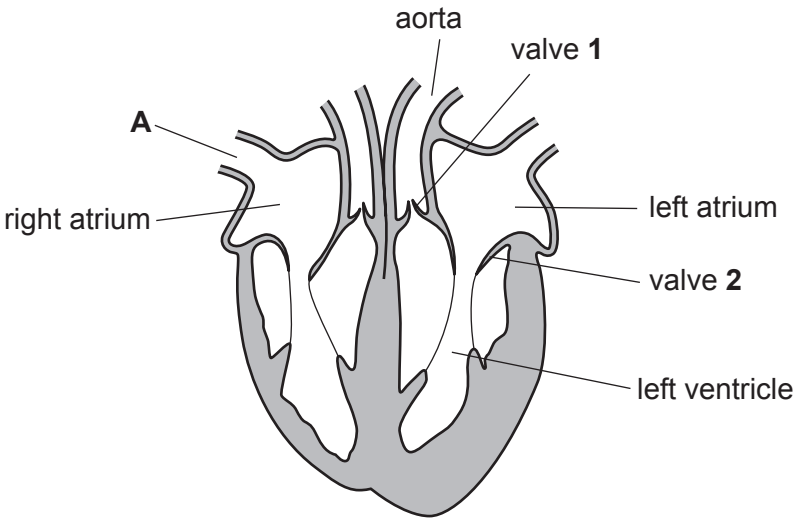

Fig. 7.2

(i) Blood from the body enters the right atrium through blood vessel **A**.

State the name of blood vessel **A**.

..... [1]

(ii) Blood is forced through the aorta by contraction of the muscle in the wall of the left ventricle.

Describe the action of valves **1** and **2** in Fig. 7.2 during this contraction.

valve **1** .....

valve **2** .....
[1]

(d) Describe the function of valves in veins.

.....

..... [1]

[Total: 6]

8 When 1 g of copper carbonate **powder** is added to excess dilute hydrochloric acid, aqueous copper chloride and carbon dioxide gas are produced.

Fig. 8.1 shows a graph of the mass of the reaction mixture against time.

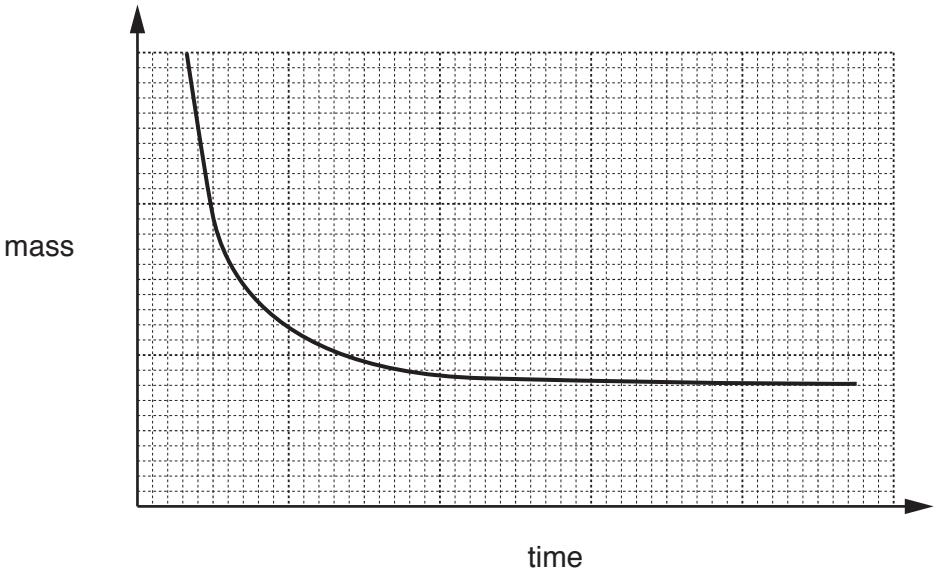

Fig. 8.1

(a) The experiment is repeated using a 1 g **lump** of copper carbonate instead of powder.

On Fig. 8.1, sketch a line to show the graph of the mass of the reaction mixture against time for this experiment. [2]

(b) The carbon dioxide produced is released into the atmosphere.

State why scientists are concerned about an increase in the concentration of carbon dioxide in the atmosphere.

.....

..... [1]

(c) Copper(II) ions, Cu^{2+}, in the aqueous copper chloride can be identified by chromatography.

The R_f value for copper(II) ions is 0.4.

Describe how a chromatogram can be used to show that a solution contains copper(II) ions.

.....

.....

.....

.....

..... [3]

(d) During the electrolysis of aqueous copper(II) chloride, copper forms at the cathode.

Describe how copper forms at the cathode. Use ideas about ions and electrons in your answer.

.....

.....

..... [2]

[Total: 8]

9 Fig. 9.1 shows a circuit containing a 6.0 V battery, an electric bell, two identical switches **S1** and **S2**, and two identical lamps **L1** and **L2**. Both switches are open.

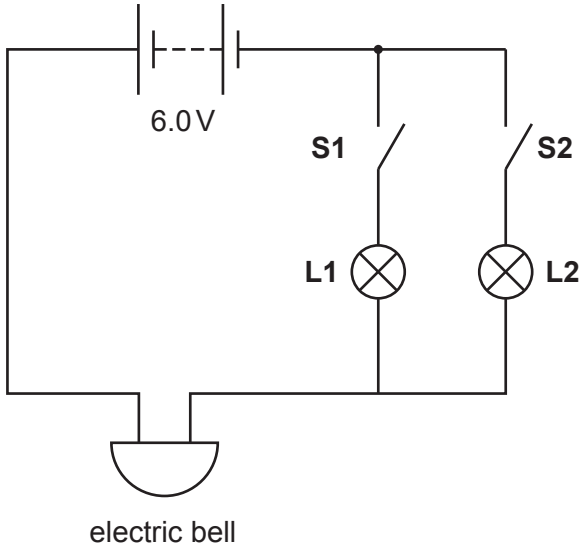

Fig. 9.1

(a) The resistance of each lamp is 4.0 Ω.

(i) When switch **S1** is closed, lamp **L1** lights, and the bell rings.

The current in the bell is 0.9 A.

Show that the resistance of the bell is 2.7 Ω.

[3]

(ii) When both switches **S1** and **S2** are closed at the same time, both lamps **L1** and **L2** light, and the bell rings.

Calculate the current in the bell when both switches are closed.

current = ... A [3]

(b) The lamps in Fig. 9.1 are connected in parallel.

State **two** advantages of connecting lamps in parallel in a circuit.

1 .....

2 .....
[2]

[Total: 8]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	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 64	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	43 Tc technetium –	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
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	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	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).