



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER



**COMBINED SCIENCE**

**0653/22**

Paper 2 (Core)

**October/November 2014**

**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.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

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

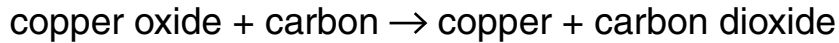
At the end of the examination, fasten all your work securely together.

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

This document consists of **19** printed pages and **1** blank page.

- 1 (a) Copper metal can be extracted from copper oxide by heating it with carbon.

The word equation for this reaction is shown below.



Explain why this reaction could be described as a redox reaction.

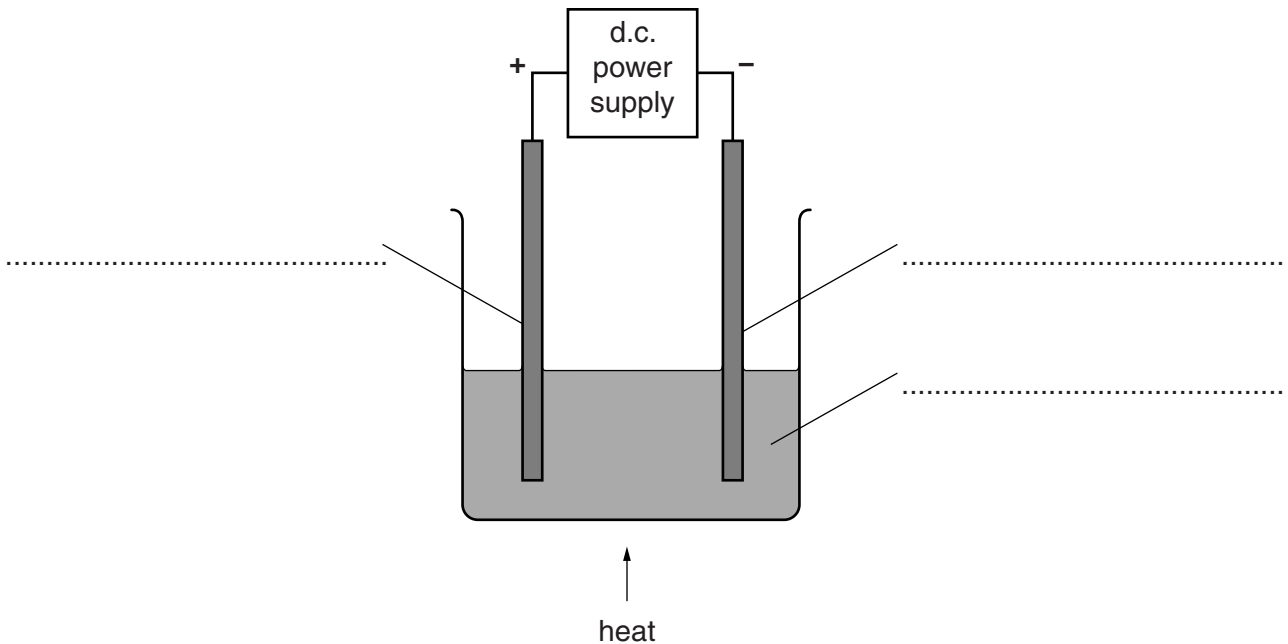
.....  
 .....[2]

- (b) Lead can be extracted from lead bromide by electrolysis.

Stage 1. Lead bromide crystals are melted.

Stage 2. The molten lead bromide is electrolysed.

Fig. 1.1 shows the apparatus that could be used for the electrolysis of molten lead bromide.



**Fig. 1.1**

- (i) Use the following terms to complete the labelling of the diagram in Fig. 1.1.

**anode          cathode          electrolyte** [2]

- (ii) Name and describe the appearance of the products that appear at or near

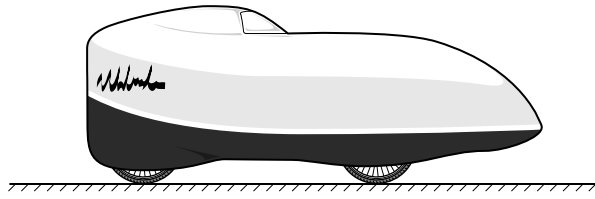
the **positive** electrode, .....

.....

the **negative** electrode. ....

.....[3]

- 2 Fig. 2.1 shows a special bicycle used to break the world speed record for a human-powered bicycle.



**Fig. 2.1**

On one run along a measured distance of 200 m, the rider's speed is 40 m/s.

- (a) (i) Calculate the time taken by the rider over the measured distance of 200 m.

State the formula you use and show your working.

formula

working

time = ..... s [2]

- (ii) Calculate the rider's speed in kilometres per hour (km/h).

Show your working.

speed = ..... km/h [2]

- (b) After pedalling at constant speed for 200 m, the rider uses the brakes to stop the bicycle over the next 300 m.

On the axes below, sketch the shape of the speed/time graph for this motion.



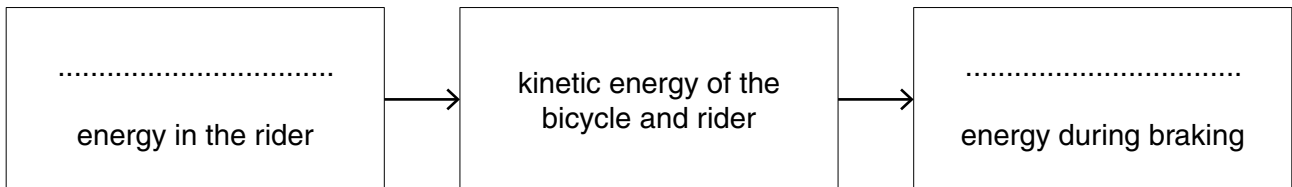
[2]

- (c) While moving at a constant speed of 40 m/s, the bicycle is moved forward by a constant force of 400 N against the opposing forces.

- (i) State the magnitude of the opposing forces. Give a reason for your answer.

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

- (ii) Complete the sequence of energy transfers that occurs during the run.



[2]

3 (a) Fig. 3.1 shows the human gas exchange system.

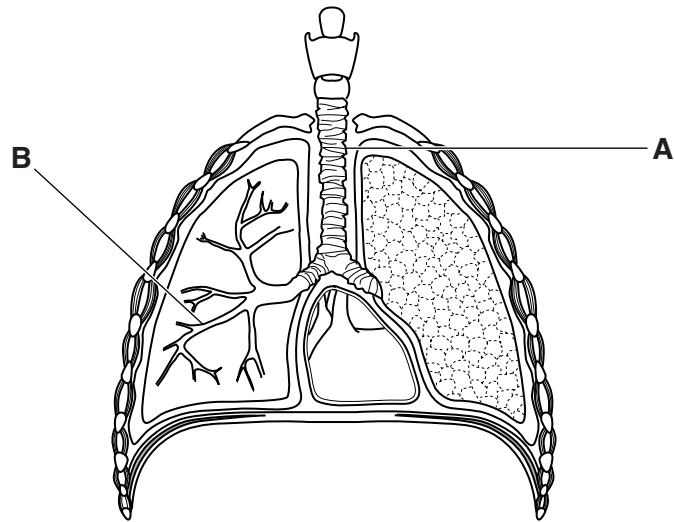


Fig. 3.1

Name structures **A** and **B**.

**A** .....

**B** .....

[2]

(b) A student investigates his breathing before and after exercise. He measures the number of breaths taken during one minute. He also measures the average volume of one breath during this minute.

His results are shown in Table 3.1.

Table 3.1

	number of breaths per minute	average volume of one breath/dm <sup>3</sup>
at rest	20	0.5
immediately after exercise	35	1.6

Describe **two** ways in which the breathing of the athlete changes with exercise.

1.....

.....

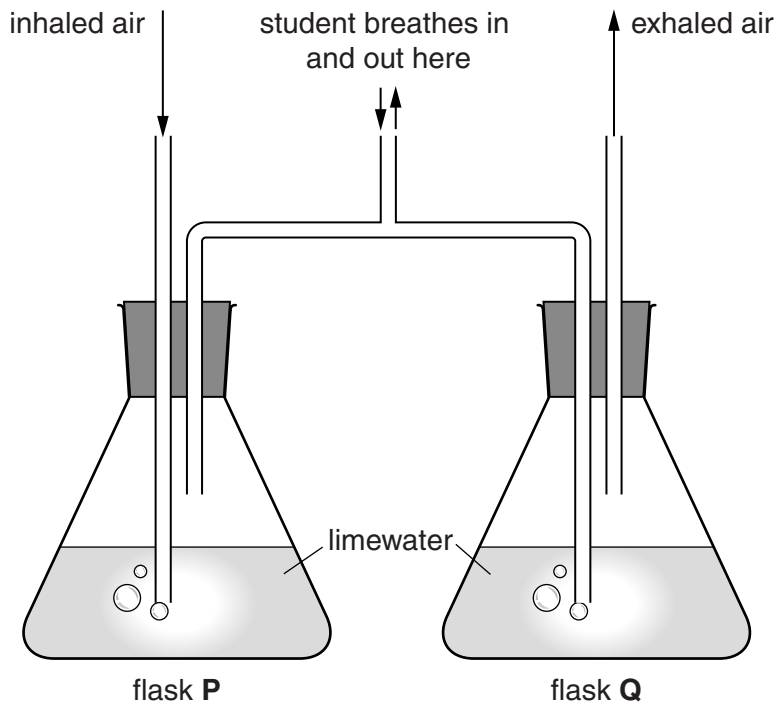
2 .....

.....[2]

- (c) The student uses the apparatus in Fig. 3.2 to compare inhaled and exhaled air. The inhaled air passes through the limewater in flask **P**. The exhaled air passes through the limewater in flask **Q**. The limewater changes to a milky colour when enough carbon dioxide passes through it.

The student breathes in and out of the apparatus until the limewater goes milky in one of the flasks. He times how long this takes.

The experiment is done twice, once before exercise and once after exercise.



**Fig. 3.2**

Table 3.2 shows the results obtained.

**Table 3.2**

	observation of limewater in flask <b>P</b>	time taken for limewater to change in flask <b>Q</b> /s
before exercise	no change	20
immediately after exercise	no change	4

- (i) Use the information in Table 3.2 to compare the carbon dioxide content of inhaled and exhaled air.

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

(ii) Study the times taken for the limewater to turn milky in Table 3.2 before and after exercise.

Draw a conclusion from these results.

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

(iii) Suggest why there is no change observed in flask P.

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

4 Fig. 4.1 shows the circuit symbols for an electric bell and a push-switch.



Fig. 4.1

(a) (i) Complete the circuit diagram in Fig. 4.2 for a circuit for a door-bell with a push-switch, powered by a battery with four cells, for the front door of a house.

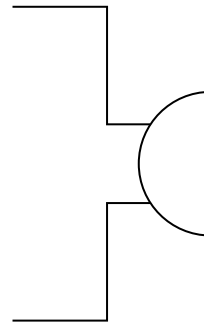


Fig. 4.2

[2]

(ii) Add a voltmeter to the completed circuit diagram in Fig. 4.2 to measure the voltage across the battery. [1]

(b) The ringing bell emits a sound of frequency 400 Hz.

(i) State the meaning of the term *frequency*.

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

(ii) The house owner makes the sound of the bell louder by adding another cell to the battery, but the pitch of the sound from the bell remains unchanged.

State the effect this change has on the amplitude and frequency of the sound emitted.

effect on the amplitude .....

effect on the frequency .....

[2]



- (c) (i) The voltage provided by the battery is 6V. When the bell is rung, a current of 2A flows through the bell.

Use the formula

$$R = \frac{V}{I}$$

to calculate the resistance of the bell.

Show your working and state the unit of your answer.

working

resistance = ..... unit ..... [2]

- (ii) The house owner adds a second identical bell in the circuit in parallel to the first bell. When the switch is pushed, both bells ring.

Suggest the effect the second bell will have on the current taken from the battery when the bells are rung. Give a reason for your answer.

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

5 (a) An atom of carbon has a proton (atomic) number 6 and nucleon (mass) number 12.

(i) Complete Table 5.1 to show the structure of this carbon atom.

Table 5.1

	in nucleus	outside nucleus
number of protons		
number of neutrons		
number of electrons		

[2]

(ii) Explain why a carbon atom is electrically neutral.

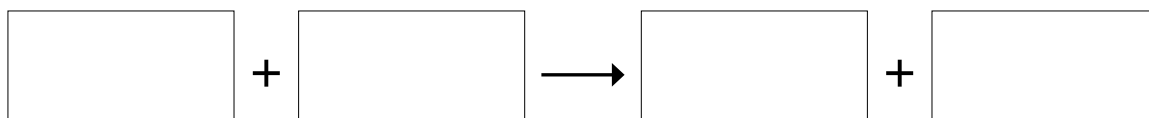
.....  
 .....  
 ..... [2]

(b) Methane is a carbon compound which is used as a fuel.

(i) Suggest a source of methane.

..... [1]

(ii) Write a **word** equation for the complete combustion of methane.



[2]

(c) Fig. 5.1 shows the structure of a molecule of methane.

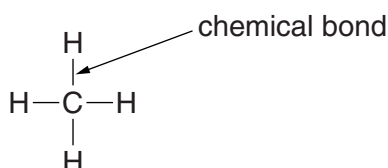


Fig. 5.1

(i) State the chemical formula of methane.

..... [1]

(ii) Name the type of chemical bond present in a methane molecule.

..... [1]

(iii) State the number of electrons found in the chemical bond shown in Fig. 5.1.

..... [1]

- 6 Fig. 6.1 shows a method that uses solar energy to purify drinking water. The method is used in hot desert countries.

The impure water is heated by the sun and distilled. The pure water is collected separately, while the impurities are left behind.

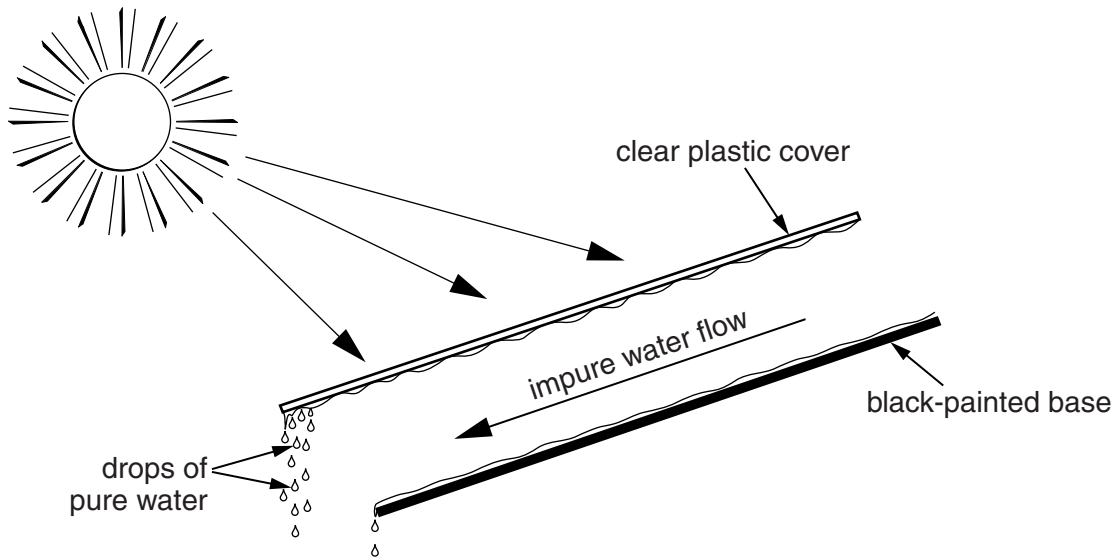


Fig. 6.1

- (a) State the part of the Sun's electromagnetic spectrum that heats the water.

.....[1]

- (b) Solar energy produces water vapour from the impure water.

Explain why water molecules are able to escape more easily from warm water than from cold water.

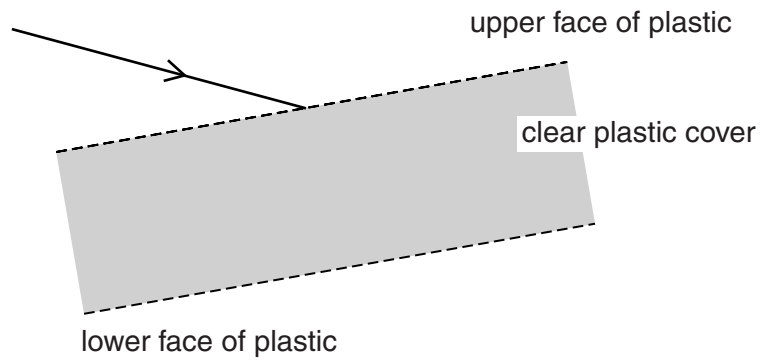
.....  
 .....  
 .....[2]

- (c) Explain why thermal energy transfer from the Sun only occurs by radiation and not by conduction or convection.

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

(d) Fig. 6.2 shows a ray of sunlight about to pass through the plastic cover.

Draw the path of the ray from the point where it enters the plastic to show what happens at the lower face of the plastic. Indicate the angles of incidence and refraction at the upper face.



**Fig. 6.2**

[3]

- 7 (a) Fig. 7.1 shows what happens when a plant is placed near a window where bright light is coming from one side.

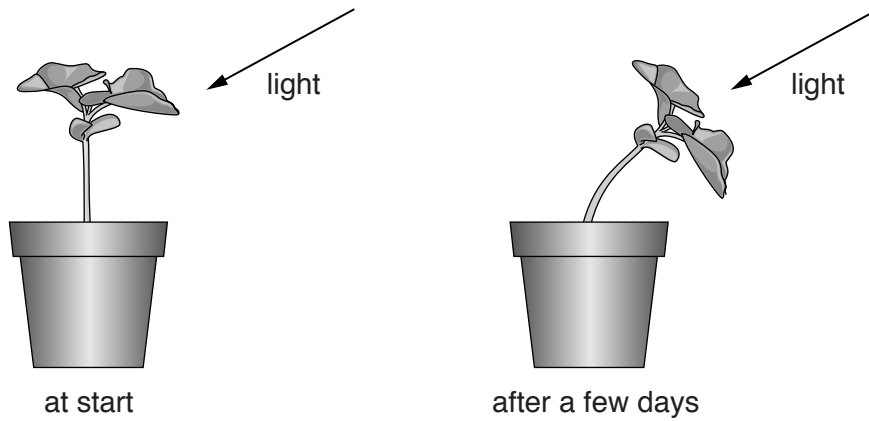


Fig. 7.1

- (i) Name the response shown by the plant.

.....[1]

- (ii) Explain why the response shown in Fig. 7.1 is an advantage to the plant.

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

- (iii) Using the information in Fig. 7.1 name **two** characteristics of living things shown by this plant.

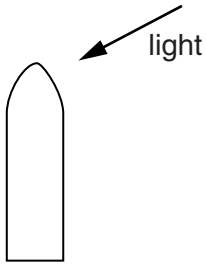
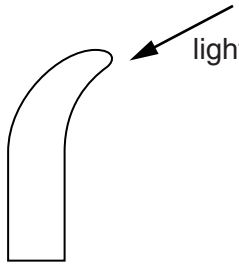
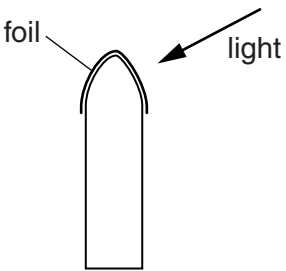
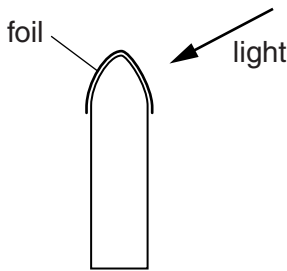
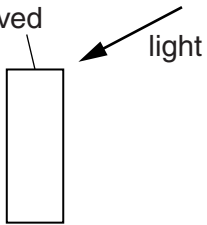
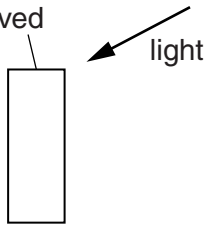
1 .....

2 .....[2]

- (b) A student carries out an experiment to find out more about plant responses. He uses simple shoots and light coming from one side.

The results are shown in Table 7.2.

**Table 7.2**

at the start	after a few days
 <p style="text-align: center;">shoot X</p>	 <p style="text-align: center;">shoot X</p>
 <p style="text-align: center;">shoot Y</p>	 <p style="text-align: center;">shoot Y</p>
 <p style="text-align: center;">shoot Z</p>	 <p style="text-align: center;">shoot Z</p>

- (i) Describe the results shown in Table 7.2.

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

- (ii) Suggest a possible conclusion about the control of plant responses in the shoots.

Explain your answer.

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

(c) Animals are able to respond to situations by secreting the hormone adrenaline.

Adrenaline is secreted into the blood when an athlete starts to run a race.

Suggest how this helps the athlete to run fast.

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





- (b) Aluminium sulfide is a *compound* made by heating a *mixture* of aluminium and sulfur. Aluminium sulfide is a compound of the *elements* aluminium and sulfur.

The left hand column in Fig. 8.2 gives four descriptions of materials.

The right hand column shows three different types of materials.

Draw a line from each description on the left hand side to the correct material on the right.

cannot be broken down into simpler substances	compound
contains different atoms chemically bonded together	element
contains more than one type of atom which are not bonded together	mixture
contains one type of atom	

**Fig. 8.2**

[4]

- (c) (i) When aluminium and sulfur atoms react together, positive aluminium ions and negative sulfide ions are formed.

Describe, in terms of electrons, how these ions are formed from atoms.

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

- (ii) Aluminium sulfide consists of two aluminium ions to every three sulfide ions.

State the chemical formula of aluminium sulfide.

..... [1]

9 Fig. 9.1 shows the reproductive system of a female.

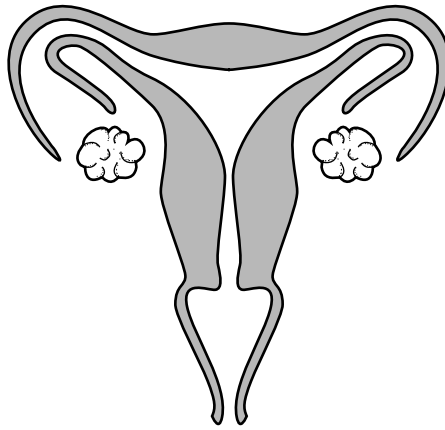


Fig. 9.1

(a) (i) On Fig. 9.1 use label lines to label the cervix and the vagina. [2]

(ii) On Fig. 9.1 use a label line and the letter **H** to show where haploid cells are found. [1]

(b) (i) State the area where fertilisation occurs.

.....[1]

(ii) The fertilised egg cell (the zygote) divides to form a ball of cells.

Describe where this ball of cells settles (implants) to continue development into a baby.

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

(c) One way in which the human immunodeficiency virus (HIV) can be transmitted is through sexual intercourse.

State one other way in which HIV can be transmitted.

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



**DATA SHEET**  
**The Periodic Table of the Elements**

		Group									
		I	II	III	IV	V	VI	VII	0		
		1 <b>H</b> Hydrogen 1									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4										
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	57 <b>Co</b> Cobalt 27	58 <b>Ni</b> Nickel 28	59 <b>Cu</b> Copper 29	60 <b>Zn</b> Zinc 30	61 <b>Ga</b> Gallium 31	62 <b>Ge</b> Germanium 32	63 <b>As</b> Arsenic 33	64 <b>Se</b> Selenium 34
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	45 <b>Sc</b> Scandium 21	46 <b>Ti</b> Titanium 22	47 <b>V</b> Vanadium 23	48 <b>Cr</b> Chromium 24	49 <b>Mn</b> Manganese 25	50 <b>Fe</b> Iron 26	51 <b>Co</b> Cobalt 27	52 <b>Ni</b> Nickel 28	53 <b>Cu</b> Copper 29	54 <b>Zn</b> Zinc 30
223 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	89 <b>Y</b> Yttrium 39	90 <b>Zr</b> Zirconium 40	91 <b>Nb</b> Niobium 41	92 <b>Mo</b> Molybdenum 42	93 <b>Tc</b> Technetium 43	94 <b>Ru</b> Ruthenium 44	95 <b>Rh</b> Rhodium 45	96 <b>Pd</b> Palladium 46	97 <b>Ag</b> Silver 47	98 <b>Cd</b> Cadmium 48
		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67
		232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	244 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	247 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	252 <b>Es</b> Einsteinium 99
		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	142 <b>Nd</b> Neodymium 60	143 <b>Pm</b> Promethium 61	144 <b>Sm</b> Samarium 62	145 <b>Eu</b> Europium 63	146 <b>Gd</b> Gadolinium 64	147 <b>Tb</b> Terbium 65	148 <b>Dy</b> Dysprosium 66	149 <b>Ho</b> Holmium 67
		232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	244 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	247 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	252 <b>Es</b> Einsteinium 99
		167 <b>Er</b> Erbium 68	168 <b>Tm</b> Thulium 69	169 <b>Yb</b> Ytterbium 70	170 <b>Lu</b> Lutetium 71	175 <b>Lu</b> Lutetium 71	173 <b>Yb</b> Ytterbium 70	257 <b>Fm</b> Fermium 100	257 <b>Es</b> Einsteinium 99	258 <b>Md</b> Mendelevium 101	259 <b>No</b> Nobelium 102
		222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86	222 <b>Rn</b> Radon 86

\* 58–71 Lanthanoid series  
† 90–103 Actinoid series

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

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

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