Cambridge O Level

CANDIDATE NAME								

CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **5129/22**

Paper 2
October/November 2015

2 hours 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 an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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 **20** printed pages.

International Examinations

[Turn over

1 (a) To make proteins, plants require carbon dioxide, water and one particular element.

   (i) Name this element and explain how the plant obtains it.

   element ....

   explanation ....

   .... [3]

   (ii) State a type of protein made by plants.

   .... [1]

(b) Explain why animal life is completely dependent on plants.

   ....

   ....

   ....

   ....

   ....

   .... [3]

2 Lithium is a metal in Group I of the Periodic Table.

(a) State the name given to the Group I elements.

.... [1]

(b) Lithium reacts with water to produce lithium hydroxide and hydrogen.

(i) Balance the equation for the reaction between lithium and water.

.... Li + ... H_2O $\longrightarrow$ .... LiOH + H_2 [1]
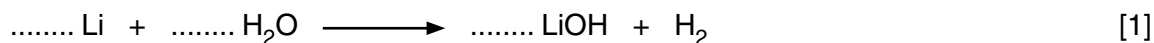
(ii) Universal Indicator is added to the reaction mixture.

State the colour of the solution at the end of the reaction.

.... [1]

(c) Potassium is another Group I metal.

State two **visible** differences between the reaction of potassium with water and the reaction of lithium with water.

1 ....

....

2 ....

....
[2]

3 Use words from the list to complete the sentences below.

density   field   force   length

mass   volume   weight

Each word may be used once, more than once or not at all.

(a) The .... of a body is a measure of the amount of substance in the body.

The .... of an object is less on the Moon than on the Earth because the

gravitational .... strength is less on the Moon. [3]

(b) When a solid is heated, the .... of the solid decreases. [1]

4 (a) State two reasons why solid food is chewed before it is swallowed.

1 ....

....

2 ....

....
[2]

(b) Animals use their teeth to chew food.

(i) Sometimes teeth develop dental decay.

Describe the causes of dental decay.

....

....

....

....

.... [3]

(ii) Table 4.1 lists two methods which people can use to prevent dental decay.

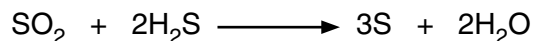Complete Table 4.1 by explaining why each method is effective.

Table 4.1

method of caring for the teeth	explanation of why the method is effective
use a small brush or a twig	
do not eat sweet foods between meals	

[2]

5 Sulfur dioxide reacts with hydrogen sulfide to produce sulfur and water.

The equation for the reaction is

$$SO_2 \ + \ 2H_2S \longrightarrow 3S \ + \ 2H_2O$$

(a) Calculate the relative molecular mass of

(i) sulfur dioxide, ...

(ii) hydrogen sulfide. .... [2]

[A_r: S, 32; H, 1; O, 16]

(b) Use your answers in **(a)** to complete the following sentences.

34 g of hydrogen sulfide produces .... g of sulfur.

1.7 g of hydrogen sulfide produces .... g of sulfur.

[2]

(c) Sulfur dioxide is a pollutant of the atmosphere.

(i) State the source of sulfur dioxide found in the atmosphere.

....

.... [1]

(ii) State and explain the adverse effects of sulfur dioxide on the environment.

....

....

.... [2]

6   (a)   Fig. 6.1 shows light incident on a glass block. The angle of incidence is 75° and the angle of refraction is 37°.

Fig. 6.1
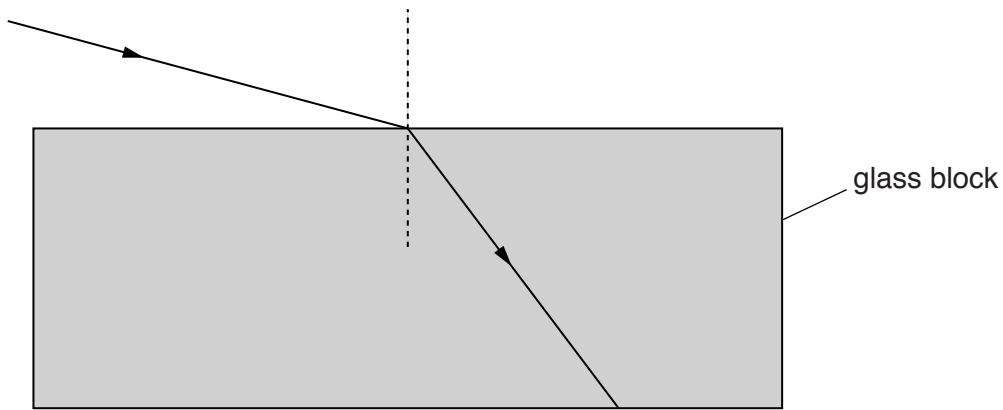
(i)   Calculate the refractive index of the glass.

refractive index = ... [2]

(ii)   The glass block is replaced by a block made from a material with a lower refractive index. The angle of incidence remains the same, at 75°.

State the change, if any, in the value of the angle of refraction.

.... [1]

(b)   Fig. 6.2 shows parallel rays of light incident on a thin converging (convex) lens.
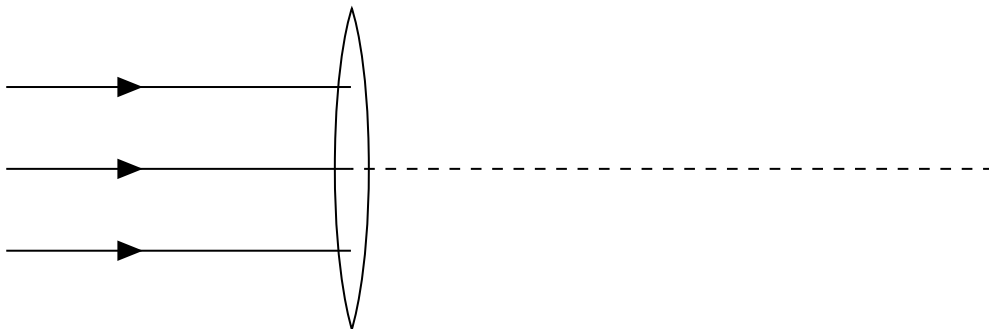

Fig. 6.2

Complete Fig. 6.2 to show the path of the rays after passing through the lens.   [2]

7 Fig. 7.1 shows the male reproductive system.
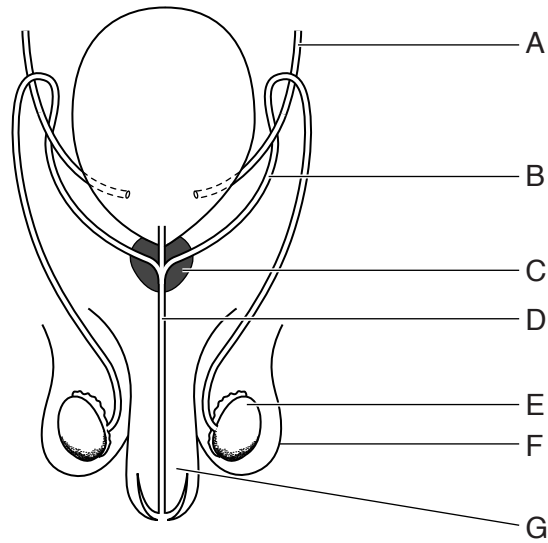
Fig. 7.1

(a) State the letter in Fig. 7.1 which identifies

   (i) a sperm duct, ...

   (ii) a testis, ...

   (iii) the urethra. ....

[3]

(b) State the function of

   (i) the penis, ...

   ....

   (ii) the prostate gland. ....

   ....

[2]

8 **(a)** Use words from the following list to complete the sentences below.

Each word may be used once, more than once or not at all.

electrons	**element**	**gained**	**ions**
isotopes	**lost**	**neutrons**	**protons**

(i) Atoms are made up of a nucleus containing .... and ....

surrounded by .... [1]

(ii) In neutral atoms, there are the same numbers of .... as ....
[1]

(iii) In negative ions, there are more .... than .... [1]

(iv) When an ionic bond is formed between a metal and a non-metal, ... are

.... by the metal. [1]

(b) The element einsteinium was discovered in 1952 and is named after the scientist Albert Einstein.

An atom of einsteinium is represented by $^{254}_{99}Es$.

Calculate the number of protons and the number of neutrons in an atom of einsteinium.

number of protons = ...

number of neutrons = ... [2]

9 Fig. 9.1 shows an incomplete electrical circuit.

1.5 V

A

4.0 Ω
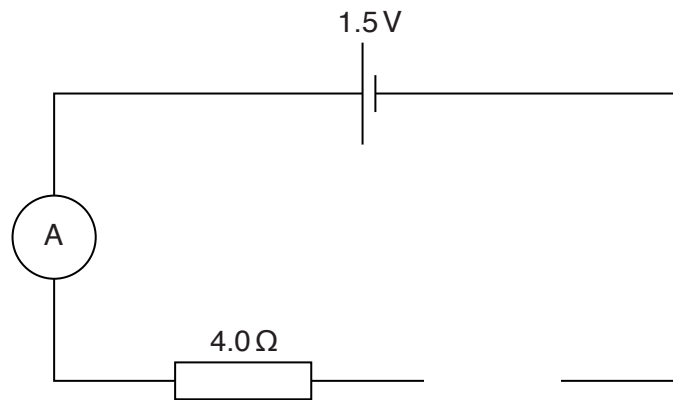
Fig. 9.1

(a) Complete the circuit diagram of Fig. 9.1 by drawing the symbol for a variable resistor. [1]

(b) For the completed circuit of Fig. 9.1, the potential difference (p.d.) across the cell is 1.5 V and the ammeter reads 0.13 A.

(i) Calculate the p.d. across the resistor of resistance 4.0 Ω.

p.d. = ... V [2]

(ii) Calculate the p.d. across the variable resistor when the current in it is 0.13 A.

p.d. = ... V [1]

10 (a) Define *transpiration*.

....

.... [2]

(b) Fig. 10.1 shows a healthy plant and its appearance some time later, after it has wilted.

healthy plant   wilted plant
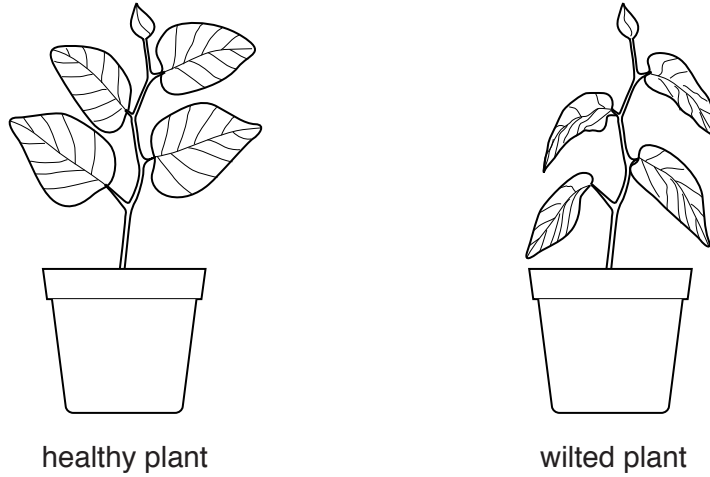
Fig. 10.1

State and explain a change to the environment of the plant that would prevent further wilting.

change ....

explanation ....

.... [2]

11 Three states of matter are solid, liquid and gas.

Fig. 11.1 shows the arrangement of the particles in a solid and a liquid.
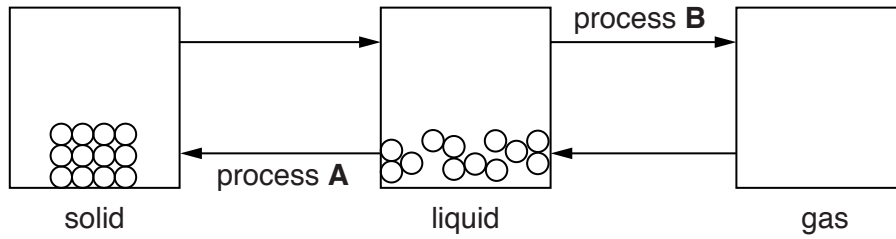
Fig. 11.1

(a) Complete Fig. 11.1 to show the arrangement of the particles in a gas. [1]

(b) Describe, in terms of energy and movement, how particles in a liquid differ from particles in a solid.

....

....

....

.... [2]

(c) Name

(i) process **A**, ...

(ii) process **B**. ....

[2]

12 Fig. 12.1 shows a sound wave transmitted from the bottom of a boat.

The diagram is not to scale.
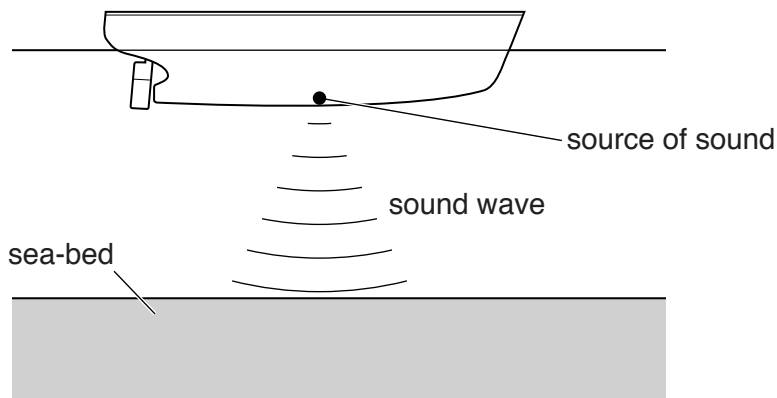
Fig. 12.1

The pulse of sound transmitted from the bottom of the boat is reflected from the sea-bed and detected back at the bottom of the boat 0.040 s later.

The speed of sound in sea-water is 1400 m/s.

(a) Calculate the distance from the bottom of the boat to the sea-bed.

distance = ... m [3]

(b) The frequency of the sound wave used is 20 000 Hz.

(i) State what is meant by the *frequency* of a wave.

....

.... [1]

(ii) Calculate the wavelength of the sound in sea-water.

wavelength = ... unit .... [3]

13 Use words from the list to complete the sentences below.

Each word may be used once, more than once or not at all.

alcohols	**antibodies**	**blood clotting**
carbon dioxide	**chlorophyll**	**haemoglobin**
oxygen	**phagocytosis**	**photosynthesis**

Red blood cells are able to transport .... from lungs to

tissue cells because they contain ....… .

White blood cells protect the body from infection by producing ....

and they carry out the process of ....

Platelets are another blood component. They are responsible for ....

[5]

14 Fig. 14.1 shows the electronic structures of an atom of nitrogen and an atom of hydrogen.
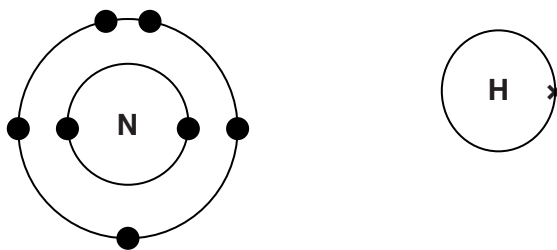
Fig. 14.1

(a) In the space below, construct a 'dot and cross' diagram to show the outer shell electrons in a molecule of ammonia.

[2]

(b) Ammonia dissolves in water to form an alkaline solution which turns Universal Indicator blue.

(i) State the name of the ion which causes the solution to be alkaline.

.... [1]

(ii) Suggest a pH value for ammonium hydroxide solution.

.... [1]

(c) Ammonia reacts with sulfuric acid to form ammonium sulfate.

Ammonium sulfate contains ammonium ions (NH_4^+) and sulfate ions (SO_4^{2-}).

Deduce the formula of ammonium sulfate. .... [1]

15 A liquid-in-glass thermometer measures temperature using the change in volume of the liquid.

(a) State two other physical properties that may be used for the measurement of temperature.

1 ....

2 ....
[2]

(b) State one feature of a liquid-in-glass thermometer that determines its sensitivity.

.... [1]

(c) Fig. 15.1 shows a thermometer used to measure the increase in temperature of cold water in a metal can placed near an infra-red heater.
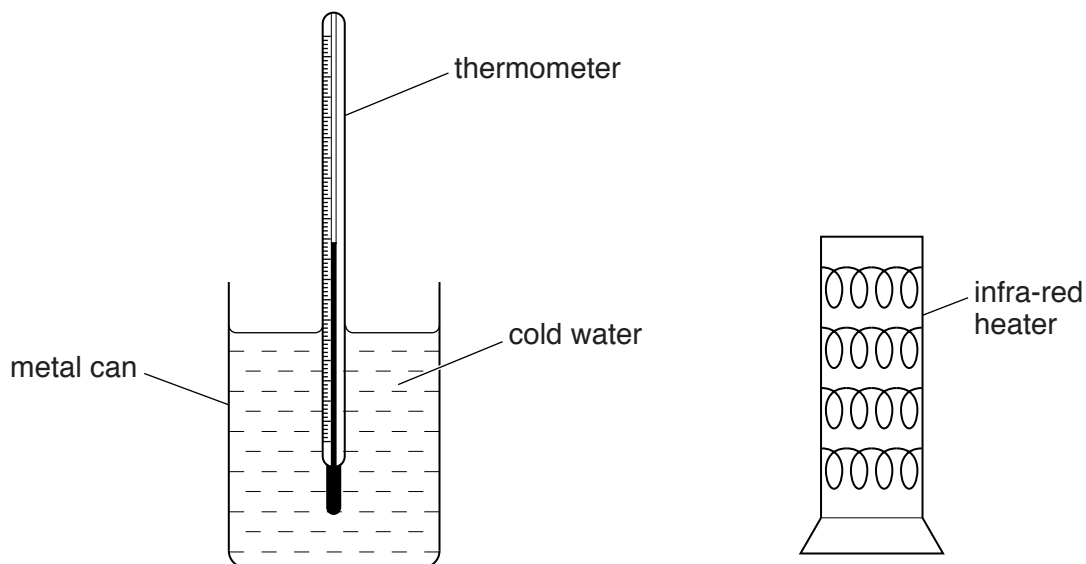
Fig. 15.1

(i) State the main method by which heat energy is transferred through the air to the can.

.... [1]

(ii) State the method by which heat energy is transferred through the metal of the can.

.... [1]

(d) The outside of the metal can is white.

Explain why the temperature of the water rises more quickly when the can is black.

....

.... [1]

(e) Explain, in detail, how air above the heater becomes warmer.

....

....

.... [2]

(f) Both infra-red radiation and sound are waves.

Sound, but not infra-red radiation, can be heard.

State one **other** difference between infra-red radiation and sound.

....

.... [1]

16 Ethene is the simplest molecule in the alkene homologous series.

(a) State how the molecular structure of alkenes differs from the molecular structure of alkanes.

....

.... [1]

(b) Ethene burns in excess oxygen to form carbon dioxide and water.

State the test for carbon dioxide and the result of the test.

test ....

result .... [2]

(c) State the name of the reagent that is used to distinguish between alkenes and alkanes.

.... [1]

(d) Poly(ethene) is made from ethene by polymerisation.

Explain the meaning of the term *polymerisation*.

....

....

.... [2]

17 A nucleus of uranium $^{238}_{92}$U decays by emitting an alpha-particle (α-particle) to form thorium (Th).

Complete the nuclear equation for this decay.

$$^{238}_{92}\text{U} \longrightarrow \quad \underline{}_{\underline{}}\,\alpha \quad + \quad \underline{}_{\underline{}}\,\text{Th}$$
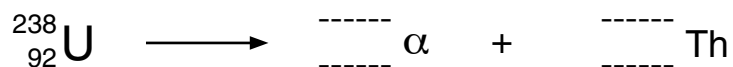
[4]

18 Fig. 18.1 shows a list of processes carried out by certain cells and a list of specialised cells.

Processes	**Cells**

alcohol breakdown

kidney cell

removal of water and urea

liver cell

glycogen production

mesophyll cell

light energy converted to chemical energy

root hair cell

urea formation

Fig. 18.1

On Fig. 18.1, draw **one** line from each process to a cell where the process takes place. [5]

 [Turn over

DATA SHEET
The Periodic Table of the Elements

Group

I	II		III	IV	V	VI	VII	0
								$\begin{array}{c} 4 \\ \textbf{He} \\ \text{Helium} \\ 2 \end{array}$

$\begin{array}{c} 1 \\ \textbf{H} \\ \text{Hydrogen} \\ 1 \end{array}$

I	II	III	IV	V	VI	VII	0
$\begin{array}{c}7\\ \textbf{Li}\\ \text{Lithium}\\3\end{array}$	$\begin{array}{c}9\\ \textbf{Be}\\ \text{Beryllium}\\4\end{array}$	$\begin{array}{c}11\\ \textbf{B}\\ \text{Boron}\\5\end{array}$	$\begin{array}{c}12\\ \textbf{C}\\ \text{Carbon}\\6\end{array}$	$\begin{array}{c}14\\ \textbf{N}\\ \text{Nitrogen}\\7\end{array}$	$\begin{array}{c}16\\ \textbf{O}\\ \text{Oxygen}\\8\end{array}$	$\begin{array}{c}19\\ \textbf{F}\\ \text{Fluorine}\\9\end{array}$	$\begin{array}{c}20\\ \textbf{Ne}\\ \text{Neon}\\10\end{array}$
$\begin{array}{c}23\\ \textbf{Na}\\ \text{Sodium}\\11\end{array}$	$\begin{array}{c}24\\ \textbf{Mg}\\ \text{Magnesium}\\12\end{array}$	$\begin{array}{c}27\\ \textbf{A}l\\ \text{Aluminium}\\13\end{array}$	$\begin{array}{c}28\\ \textbf{Si}\\ \text{Silicon}\\14\end{array}$	$\begin{array}{c}31\\ \textbf{P}\\ \text{Phosphorus}\\15\end{array}$	$\begin{array}{c}32\\ \textbf{S}\\ \text{Sulfur}\\16\end{array}$	$\begin{array}{c}35.5\\ \textbf{C}l\\ \text{Chlorine}\\17\end{array}$	$\begin{array}{c}40\\ \textbf{Ar}\\ \text{Argon}\\18\end{array}$

Transition elements:

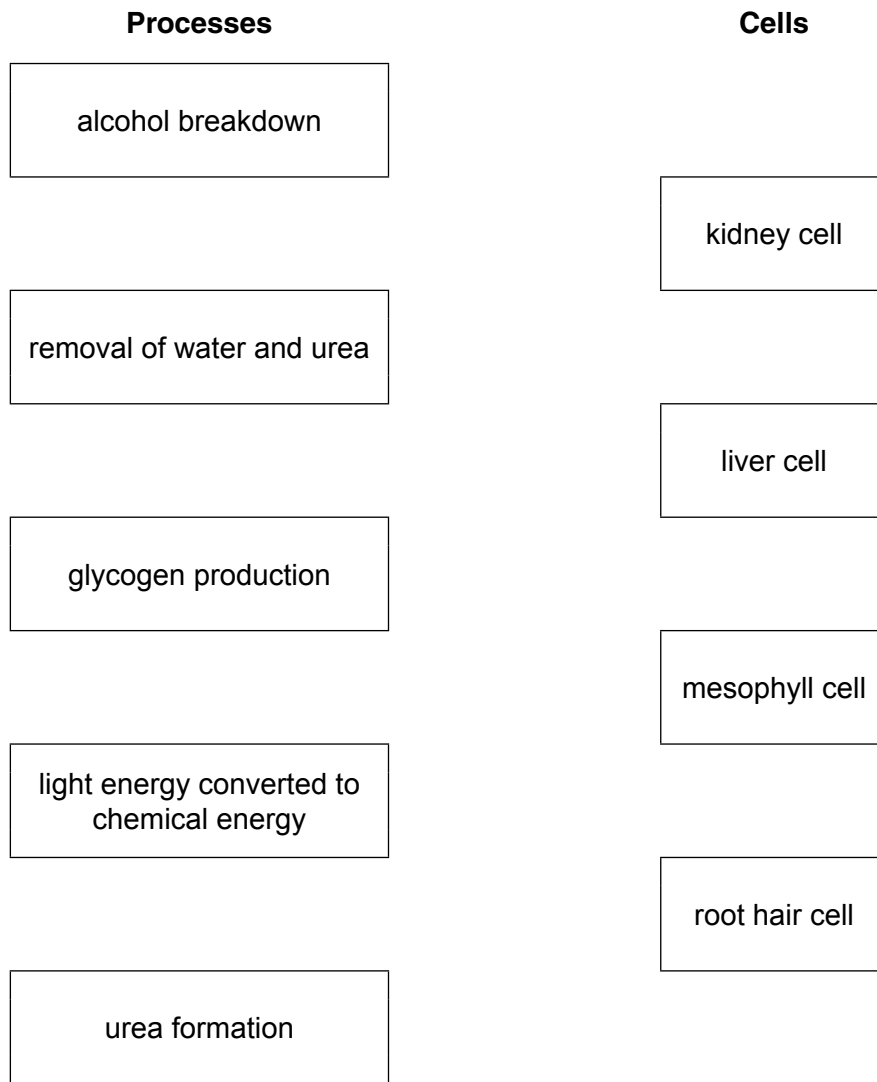|									
$\begin{array}{c}39\\ \textbf{K}\\ \text{Potassium}\\19\end{array}$	$\begin{array}{c}40\\ \textbf{Ca}\\ \text{Calcium}\\20\end{array}$	$\begin{array}{c}45\\ \textbf{Sc}\\ \text{Scandium}\\21\end{array}$	$\begin{array}{c}48\\ \textbf{Ti}\\ \text{Titanium}\\22\end{array}$	$\begin{array}{c}51\\ \textbf{V}\\ \text{Vanadium}\\23\end{array}$	$\begin{array}{c}52\\ \textbf{Cr}\\ \text{Chromium}\\24\end{array}$	$\begin{array}{c}55\\ \textbf{Mn}\\ \text{Manganese}\\25\end{array}$	$\begin{array}{c}56\\ \textbf{Fe}\\ \text{Iron}\\26\end{array}$	$\begin{array}{c}59\\ \textbf{Co}\\ \text{Cobalt}\\27\end{array}$	$\begin{array}{c}59\\ \textbf{Ni}\\ \text{Nickel}\\28\end{array}$

$\begin{array}{c}64\\ \textbf{Cu}\\ \text{Copper}\\29\end{array}$	$\begin{array}{c}65\\ \textbf{Zn}\\ \text{Zinc}\\30\end{array}$	$\begin{array}{c}70\\ \textbf{Ga}\\ \text{Gallium}\\31\end{array}$	$\begin{array}{c}73\\ \textbf{Ge}\\ \text{Germanium}\\32\end{array}$	$\begin{array}{c}75\\ \textbf{As}\\ \text{Arsenic}\\33\end{array}$	$\begin{array}{c}79\\ \textbf{Se}\\ \text{Selenium}\\34\end{array}$	$\begin{array}{c}80\\ \textbf{Br}\\ \text{Bromine}\\35\end{array}$	$\begin{array}{c}84\\ \textbf{Kr}\\ \text{Krypton}\\36\end{array}$

$\begin{array}{c}85\\ \textbf{Rb}\\ \text{Rubidium}\\37\end{array}$	$\begin{array}{c}88\\ \textbf{Sr}\\ \text{Strontium}\\38\end{array}$	$\begin{array}{c}89\\ \textbf{Y}\\ \text{Yttrium}\\39\end{array}$	$\begin{array}{c}91\\ \textbf{Zr}\\ \text{Zirconium}\\40\end{array}$	$\begin{array}{c}93\\ \textbf{Nb}\\ \text{Niobium}\\41\end{array}$	$\begin{array}{c}96\\ \textbf{Mo}\\ \text{Molybdenum}\\42\end{array}$	$\begin{array}{c}\\ \textbf{Tc}\\ \text{Technetium}\\43\end{array}$	$\begin{array}{c}101\\ \textbf{Ru}\\ \text{Ruthenium}\\44\end{array}$	$\begin{array}{c}103\\ \textbf{Rh}\\ \text{Rhodium}\\45\end{array}$	$\begin{array}{c}106\\ \textbf{Pd}\\ \text{Palladium}\\46\end{array}$

$\begin{array}{c}108\\ \textbf{Ag}\\ \text{Silver}\\47\end{array}$	$\begin{array}{c}112\\ \textbf{Cd}\\ \text{Cadmium}\\48\end{array}$	$\begin{array}{c}115\\ \textbf{In}\\ \text{Indium}\\49\end{array}$	$\begin{array}{c}119\\ \textbf{Sn}\\ \text{Tin}\\50\end{array}$	$\begin{array}{c}122\\ \textbf{Sb}\\ \text{Antimony}\\51\end{array}$	$\begin{array}{c}128\\ \textbf{Te}\\ \text{Tellurium}\\52\end{array}$	$\begin{array}{c}127\\ \textbf{I}\\ \text{Iodine}\\53\end{array}$	$\begin{array}{c}131\\ \textbf{Xe}\\ \text{Xenon}\\54\end{array}$

$\begin{array}{c}133\\ \textbf{Cs}\\ \text{Caesium}\\55\end{array}$	$\begin{array}{c}137\\ \textbf{Ba}\\ \text{Barium}\\56\end{array}$	$\begin{array}{c}139\\ \textbf{La}\\ \text{Lanthanum}\\57\end{array}$ *	$\begin{array}{c}178\\ \textbf{Hf}\\ \text{Hafnium}\\72\end{array}$	$\begin{array}{c}181\\ \textbf{Ta}\\ \text{Tantalum}\\73\end{array}$	$\begin{array}{c}184\\ \textbf{W}\\ \text{Tungsten}\\74\end{array}$	$\begin{array}{c}186\\ \textbf{Re}\\ \text{Rhenium}\\75\end{array}$	$\begin{array}{c}190\\ \textbf{Os}\\ \text{Osmium}\\76\end{array}$	$\begin{array}{c}192\\ \textbf{Ir}\\ \text{Iridium}\\77\end{array}$	$\begin{array}{c}195\\ \textbf{Pt}\\ \text{Platinum}\\78\end{array}$

$\begin{array}{c}197\\ \textbf{Au}\\ \text{Gold}\\79\end{array}$	$\begin{array}{c}201\\ \textbf{Hg}\\ \text{Mercury}\\80\end{array}$	$\begin{array}{c}204\\ \textbf{T}l\\ \text{Thallium}\\81\end{array}$	$\begin{array}{c}207\\ \textbf{Pb}\\ \text{Lead}\\82\end{array}$	$\begin{array}{c}209\\ \textbf{Bi}\\ \text{Bismuth}\\83\end{array}$	$\begin{array}{c}209\\ \textbf{Po}\\ \text{Polonium}\\84\end{array}$	$\begin{array}{c}210\\ \textbf{At}\\ \text{Astatine}\\85\end{array}$	$\begin{array}{c}222\\ \textbf{Rn}\\ \text{Radon}\\86\end{array}$

$\begin{array}{c}223\\ \textbf{Fr}\\ \text{Francium}\\87\end{array}$	$\begin{array}{c}226\\ \textbf{Ra}\\ \text{Radium}\\88\end{array}$	$\begin{array}{c}227\\ \textbf{Ac}\\ \text{Actinium}\\89\end{array}$ †

*58–71 Lanthanoid series

$\begin{array}{c}140\\ \textbf{Ce}\\ \text{Cerium}\\58\end{array}$	$\begin{array}{c}141\\ \textbf{Pr}\\ \text{Praseodymium}\\59\end{array}$	$\begin{array}{c}144\\ \textbf{Nd}\\ \text{Neodymium}\\60\end{array}$	$\begin{array}{c}147\\ \textbf{Pm}\\ \text{Promethium}\\61\end{array}$	$\begin{array}{c}150\\ \textbf{Sm}\\ \text{Samarium}\\62\end{array}$	$\begin{array}{c}152\\ \textbf{Eu}\\ \text{Europium}\\63\end{array}$	$\begin{array}{c}157\\ \textbf{Gd}\\ \text{Gadolinium}\\64\end{array}$	$\begin{array}{c}159\\ \textbf{Tb}\\ \text{Terbium}\\65\end{array}$	$\begin{array}{c}162\\ \textbf{Dy}\\ \text{Dysprosium}\\66\end{array}$	$\begin{array}{c}165\\ \textbf{Ho}\\ \text{Holmium}\\67\end{array}$	$\begin{array}{c}167\\ \textbf{Er}\\ \text{Erbium}\\68\end{array}$	$\begin{array}{c}169\\ \textbf{Tm}\\ \text{Thulium}\\69\end{array}$	$\begin{array}{c}173\\ \textbf{Yb}\\ \text{Ytterbium}\\70\end{array}$	$\begin{array}{c}175\\ \textbf{Lu}\\ \text{Lutetium}\\71\end{array}$

†90–103 Actinoid series

$\begin{array}{c}232\\ \textbf{Th}\\ \text{Thorium}\\90\end{array}$	$\begin{array}{c}231\\ \textbf{Pa}\\ \text{Protactinium}\\91\end{array}$	$\begin{array}{c}238\\ \textbf{U}\\ \text{Uranium}\\92\end{array}$	$\begin{array}{c}237\\ \textbf{Np}\\ \text{Neptunium}\\93\end{array}$	$\begin{array}{c}244\\ \textbf{Pu}\\ \text{Plutonium}\\94\end{array}$	$\begin{array}{c}243\\ \textbf{Am}\\ \text{Americium}\\95\end{array}$	$\begin{array}{c}247\\ \textbf{Cm}\\ \text{Curium}\\96\end{array}$	$\begin{array}{c}247\\ \textbf{Bk}\\ \text{Berkelium}\\97\end{array}$	$\begin{array}{c}251\\ \textbf{Cf}\\ \text{Californium}\\98\end{array}$	$\begin{array}{c}252\\ \textbf{Es}\\ \text{Einsteinium}\\99\end{array}$	$\begin{array}{c}257\\ \textbf{Fm}\\ \text{Fermium}\\100\end{array}$	$\begin{array}{c}258\\ \textbf{Md}\\ \text{Mendelevium}\\101\end{array}$	$\begin{array}{c}259\\ \textbf{No}\\ \text{Nobelium}\\102\end{array}$	$\begin{array}{c}260\\ \textbf{Lr}\\ \text{Lawrencium}\\103\end{array}$

Key

a
X
b

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

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