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COMBINED SCIENCE

0653/33

Paper 3 Theory (Core)

May/June 2021

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. Any blank pages are indicated.



- 1 (a) Nutrition is one of the characteristics of living organisms.

Identify the characteristics of living organisms defined as

the chemical reactions in cells that break down nutrient molecules and release energy

.....

the ability to detect and respond to changes in the environment.

.....

[2]

- (b) Fig. 1.1 shows part of the alimentary canal and associated organs.

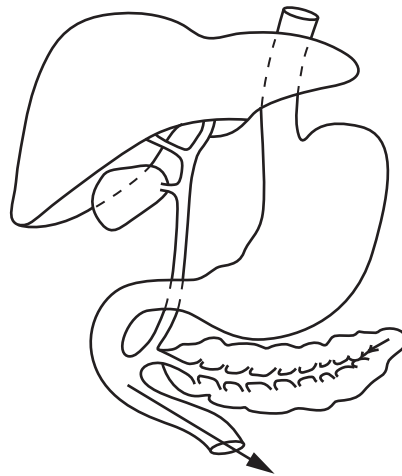


Fig. 1.1

- (i) Draw the letter **X** on Fig. 1.1 to identify the position of the liver. [1]
- (ii) The arrow shows the direction the food moves as it passes into the small intestine.

Complete these sentences about what happens in the small intestine.

Large insoluble molecules are broken down by the process of

Small food molecules are then moved into the blood by the process of

[2]

- (c) A student investigates nutrition in plants. Sugar is stored as starch in a leaf.

The student puts black paper around a green leaf still attached to the plant. After two days she takes the leaf from the plant and removes the black paper. She then tests the leaf for starch using iodine solution.

Fig. 1.2 shows the results.

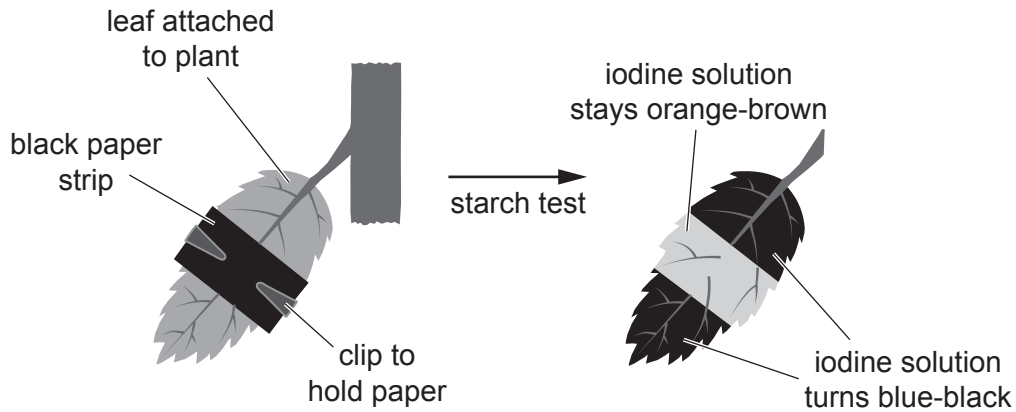


Fig. 1.2

Explain the results seen in Fig. 1.2 for the area that was covered by black paper.

.....

.....

..... [2]

- (d) Different plant tissues in the stem have different functions.

Name the tissue that transports sugars in the stem.

..... [1]

- (e) Starch and sugar are carbohydrates.

Table 1.1 shows the mass of carbohydrates in some different food types.

Table 1.1

food type	mass of carbohydrate in 100 g of food /g
bread	40
cake	59
cheese	2
lentils	18
rice	25
tomato	3

- (i) Identify the food type that contains the most carbohydrate.

..... [1]

- (ii) A man eats 200g of bread and 50g of cheese.

Calculate the mass of carbohydrate he eats.

mass of carbohydrate =g [2]

[Total: 11]

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- 2 (a) Fig. 2.1 shows a process used to separate substances in a fossil fuel.

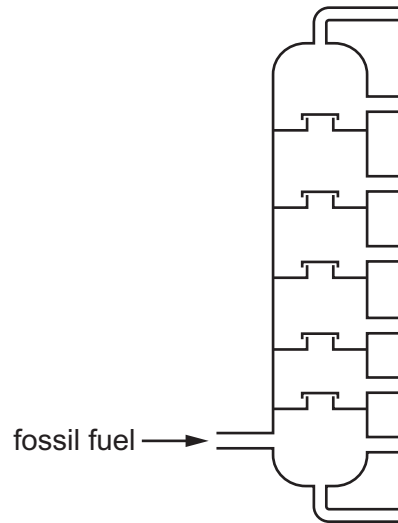


Fig. 2.1

- (i) Name this process.

..... [1]

- (ii) Name the fossil fuel that is separated by this process.

..... [1]

- (b) Methane is the main constituent of another fossil fuel.

- (i) Name this fossil fuel.

..... [1]

- (ii) Complete Fig. 2.2 to show the dot-and-cross diagram of one molecule of methane, CH₄.

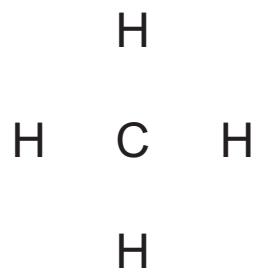


Fig. 2.2

[2]

(iii) Identify a greenhouse gas that is formed by the complete combustion of methane.

..... [1]

- (c) Carbon has atomic number 6 and mass number 12.
Hydrogen has atomic number 1 and mass number 1.

Complete Table 2.1 to show the number of protons and the number of neutrons in one atom of carbon and in one atom of hydrogen.

Table 2.1

atom	number of protons	number of neutrons
carbon		
hydrogen		

[2]

[Total: 8]

- 3 (a) Fig. 3.1 shows a man lying down on a sandy beach on a sunny day.

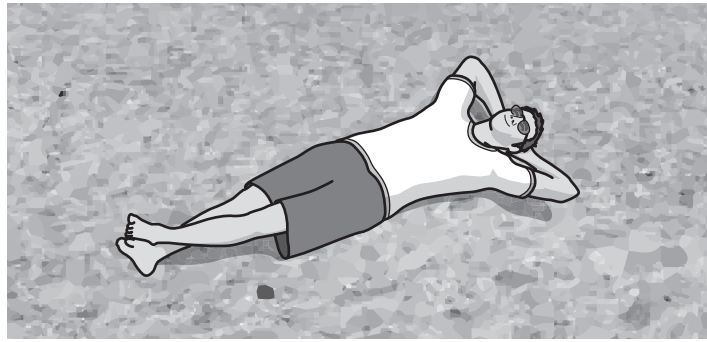


Fig. 3.1

Visible light is one type of electromagnetic radiation emitted by the Sun. The man is also affected by ultraviolet and infrared radiation from the Sun.

Fig. 3.2 shows the electromagnetic spectrum.

	X-rays	X	visible light		micro-waves	
--	--------	----------	---------------	--	-------------	--

Fig. 3.2

Identify **X** in Fig. 3.2 and state **one** effect it will have on the man.

X is

effect

.....

[2]

- (b) The man stands up. There is a mark in the sand to show where he was lying. When he stands up, his feet make deeper marks in the sand.

Explain why the marks are deeper in the sand when he is standing.

.....

.....

.....

..... [2]

(c) Fig. 3.3 shows the man holding a beach ball.



Fig. 3.3

- (i) The ball has a mass of 0.25 kg.
The ball exerts a downward force on the man's hand of 2.45 N.
Calculate the gravitational field strength, g .

$$g = \dots\dots\dots \text{ N/kg [2]}$$

- (ii) The man throws the ball vertically upwards in the air. He catches it as it falls down.
Complete the sentences about energy below.

The ball gains energy as it moves upwards.

The ball gains energy as it falls down.

[2]

- (d) The man throws the ball to a friend.
The friend catches the ball 4.2 s later.
The distance travelled by the ball is 15 m.
Show that the average speed of the ball is 3.6 m/s.

[1]

[Total: 9]

- 4 (a) (i) The boxes on the left show different components of blood.
The boxes on the right show functions of the components.

Draw one straight line from each component of the blood to its function.

component of blood	function
plasma	transport oxygen
platelets	transport hormones
red blood cells	clotting the blood

[2]

- (ii) Fig. 4.1 shows both red and white blood cells as seen using a light microscope.

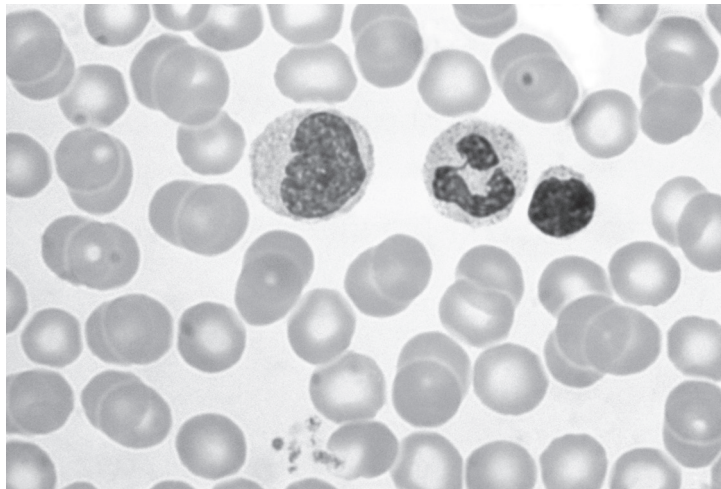


Fig. 4.1

Identify **one** structure found in white blood cells that is **not** found in red blood cells.
Use Fig. 4.1 to help you.

..... [1]

- (b) Cancer can affect the components of the blood.
There are different types of cancer that affect the blood.

Fig. 4.2 shows the percentage of people that survived four different blood cancers, **A**, **B**, **C** and **D** in 1992 and 2008.

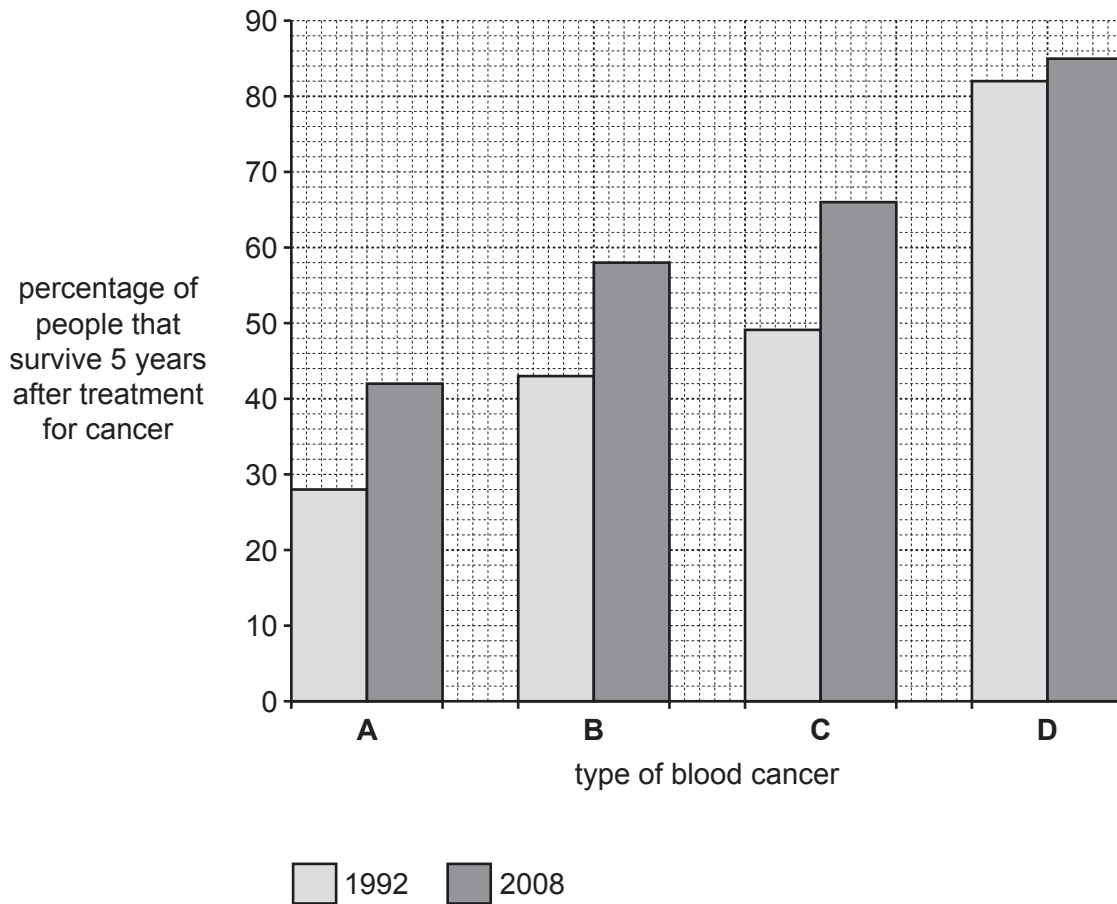


Fig. 4.2

- (i) Identify the blood cancer with the best survival rate in both 1992 and 2008. [1]
 (ii) Blood cancer **B** can stop white blood cells functioning correctly.

Explain why someone with blood cancer **B** finds it more difficult to fight infections.

.....

 [2]

(c) Hepatitis is a sexually transmitted infection that can be passed on through body fluids and infected blood.

(i) One way to prevent the spread of hepatitis is using sterilised needles.
State **two other** ways to prevent the spread of hepatitis.

1

2

[2]

(ii) Name **one other** sexually transmitted infection.

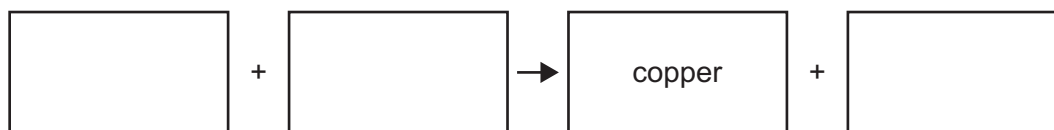
..... [1]

[Total: 9]

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5 (a) Copper is extracted from copper(II) oxide by heating with carbon.

(i) Complete the word equation for this reaction.



[2]

(ii) Copper(II) oxide is reduced to copper in this reaction.
Explain what is meant by the term reduced.

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

(b) Brass is a mixture of copper and zinc.

(i) State the name of this type of mixture.

..... [1]

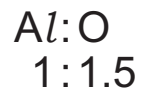
(ii) Door keys are sometimes made from brass.

Suggest why brass, rather than pure copper, is used to make door keys.

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

(c) Aluminium is extracted from aluminium oxide.

(i) The ratio of aluminium atoms to oxygen atoms in aluminium oxide is shown.



Deduce the formula of aluminium oxide.

..... [1]

(ii) State the method used to extract aluminium from aluminium oxide.

..... [1]

(iii) Suggest why carbon **cannot** be used to extract aluminium from aluminium oxide.
Use ideas about reactivity in your answer.

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

(d) Copper is a transition element.
Aluminium is not a transition element.

(i) Suggest **one** property of copper that is **not** shown by aluminium.

..... [1]

(ii) Suggest one **physical** property that is shown by **both** copper and aluminium.

..... [1]

[Total: 10]

- 6 (a) Table 6.1 shows the melting points and boiling points of six substances.

Table 6.1

substance	melting point /°C	boiling point /°C
ammonia	-78	-33
benzene	6	80
bromine	-7	59
lactic acid	17	122
mercury	-39	357
sulfur	115	445

- (i) Identify **two** substances that are liquid at 65°C.

..... and [1]

- (ii) Identify **two** substances whose molecules are far apart at 60°C.

..... and [1]

- (b) A student has a liquid-in-glass thermometer without a scale. The student wants to mark a scale on the thermometer.

The student puts the thermometer into melting ice, waits for the level of the liquid in the thermometer to stop changing, and marks this liquid level as 0°C.

- (i) Suggest what the student does in order to decide where to put a mark for 100°C.

.....
 [1]

- (ii) Measuring temperature uses a property of the liquid in the thermometer that changes with temperature.

State the property that is used.

..... [1]

(c) Fig. 6.1 shows the student using a mirror to observe a digital thermometer.

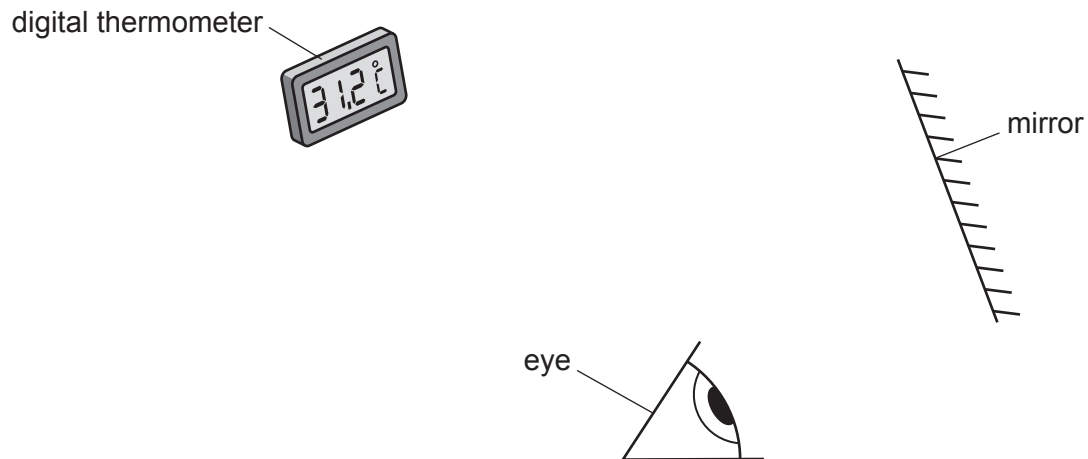


Fig. 6.1

(i) On Fig. 6.1 draw a ray to show how the student is able to use the mirror to read the scale on the thermometer.

Include in your drawing:

- the normal
- the angles of incidence (i) and reflection (r).

[3]

(ii) Fig. 6.2 shows the image seen by the student in the mirror.



Fig. 6.2

Describe the characteristic of an image in a plane mirror, as shown in Fig. 6.2.

..... [1]

[Total: 8]

7 (a) Fig. 7.1 shows a food web.

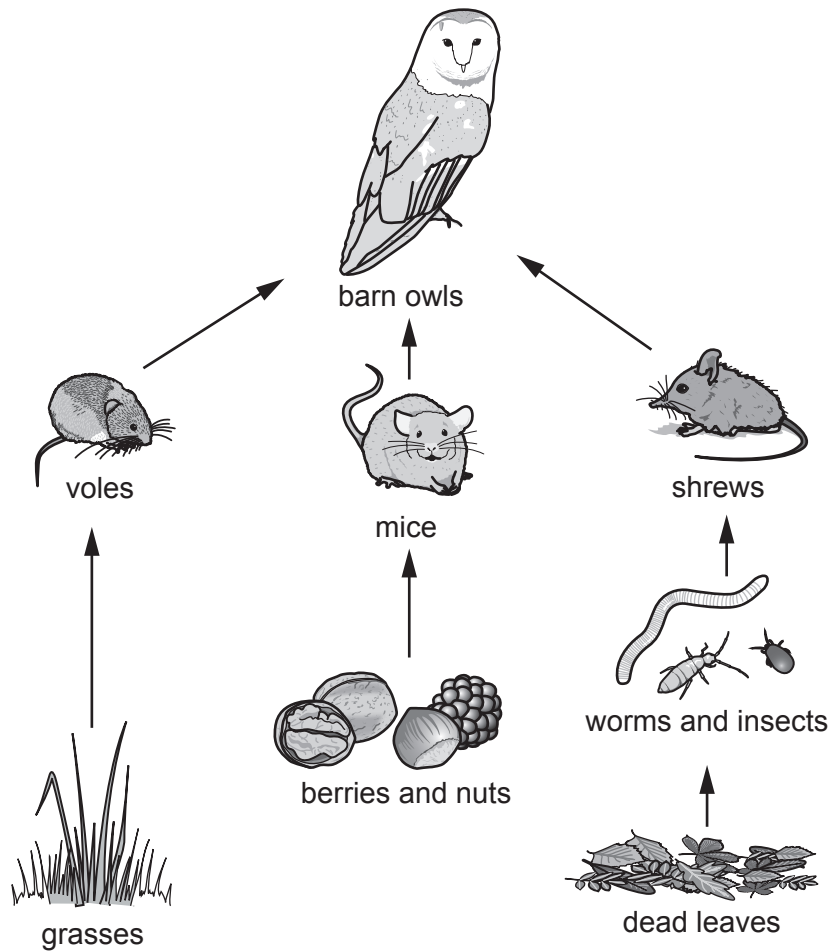


Fig. 7.1

(i) State the principal source of energy for a food web.

..... [1]

(ii) The owl is the top carnivore in this food web.

Define the term carnivore.

.....
 [1]

(iii) Complete the sentence to explain why shrews are classed as secondary consumers in this food web.

Shrews are secondary consumers because they eat,
 which are consumers.

[2]

(b) Grass roots take in mineral ions from the soil to make amino acids.

(i) State the name of the mineral ions needed to make amino acids.

..... [1]

(ii) Grasses take in water from the soil through the root hair cells.

Describe how water moves into root hair cells.

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

[Total: 7]

- 8 (a) Chlorine and bromine are diatomic non-metals in Group VII of the Periodic Table. Chlorine is above bromine in Group VII.

(i) Explain what is meant by diatomic.

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

(ii) State the trend in the colour and the boiling point of the elements going down Group VII.

colour

boiling point [1]

(iii) State why chlorine is used in the treatment of the water supply.

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

(iv) Describe a chemical test for chlorine and give the observation for a positive result.

test

observation [2]

- (b) Chlorine reacts with sodium in an exothermic reaction. Argon, a Group VIII element, is next to chlorine in the Periodic Table. Argon does **not** react with sodium.

(i) State what is meant by exothermic.

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

(ii) Explain why argon does **not** react with sodium. Use ideas about electrons in your answer.

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

[Total: 8]

- 9 Fig. 9.1 shows three ammeters, **L**, **M** and **N**, measuring the current in different parts of a circuit containing two cells and three identical lamps, **X**, **Y** and **Z**.

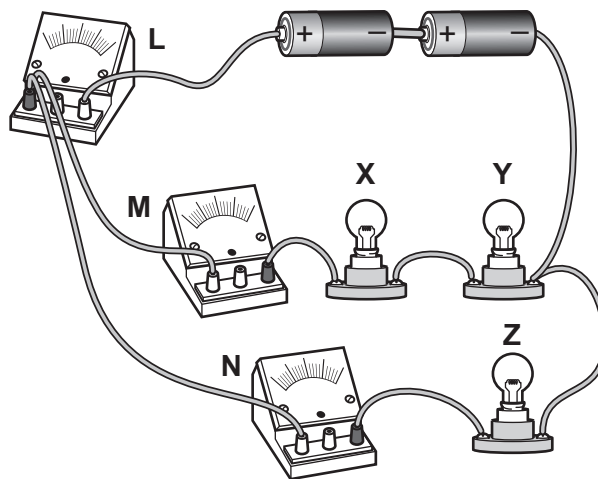


Fig. 9.1

- (a) On Fig. 9.2 complete the circuit diagram for the circuit in Fig. 9.1.



Fig. 9.2

[3]

- (b) (i) The resistance of each lamp when lit is $11\ \Omega$.
Calculate the combined resistance of lamps **X** and **Y**.

resistance = Ω [1]

- (ii) State which ammeters will show the largest current and the smallest current.
Give reasons for your answers.

largest current

reason

.....

smallest current

reason

.....

[3]

- (c) Ammeter **N** shows a current of 0.31 A.
The resistance of lamp **Z** when lit is 11Ω .
Calculate the potential difference across lamp **Z**.

Give the unit of your answer.

p.d. = unit [3]

[Total: 10]

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The Periodic Table of Elements

Group																							
I	II		III										IV	V	VI	VII	VIII						
3 Li lithium 7	4 Be beryllium 9	<p style="text-align: center;">Key</p> <p>atomic number atomic symbol name relative atomic mass</p>																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																	1 H hydrogen 1	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5
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 –	–	–	–	–	–					

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 mendeleevium –	102 No nobelium –	103 Lr lawrencium –

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