UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTER NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

5519021346

CO-ORDINATED SCIENCES (DOUBLE)(US) **0442/33**

Paper 3 (Extended) **October/November 2013**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Center number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a 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 32.

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 **30** printed pages and **2** blank pages.

1 Fig. 1.1 shows a root hair cell.

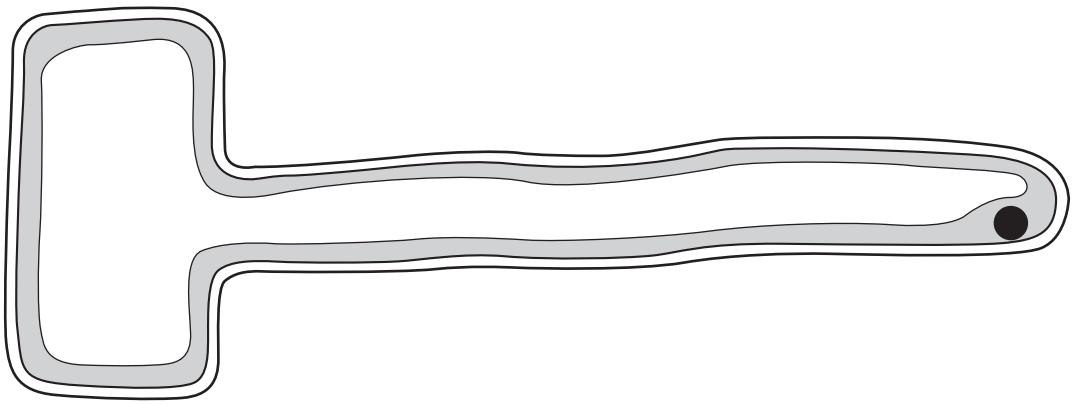

Fig. 1.1

(a) Use the letters **A**, **B** and **C** to label these parts of the root hair cell in Fig. 1.1.

A a partially permeable membrane

B the part that contains DNA

C a structure that is **not** present in animal cells [3]

(b) Describe how the structure of the root hair cell helps it to carry out its functions.

.....

.....

.....

.....

.....

..... [3]

(c) Fig. 1.2 shows part of a plant stem from which the outer layer has been removed.

For iner's

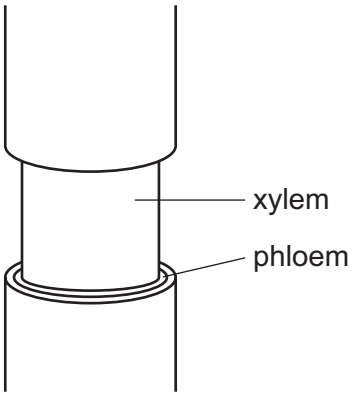

Fig. 1.2

Explain why this treatment would cause the roots of the plant to die.

.....

.....

.....

.....

..... [3]

2 **(a)** Table 2.1 shows information about some chemical elements and their positions in the Periodic Table.

Table 2.1

element	group number in the Periodic Table
oxygen	6
calcium	2
lithium	1
sulfur	6
fluorine	7

Select **two** elements from Table 2.1 whose atoms form covalent bonds with each other and explain your answer.

..... and .....

explanation .....

.....

..... [2]

(b) Fig. 2.1 shows the electron arrangement in an atom of phosphorus.

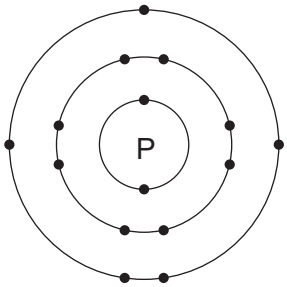

Fig. 2.1

Phosphorus and hydrogen bond together to form the compound phosphine. One molecule of phosphine contains one atom of phosphorus.

Predict and explain the chemical formula of one molecule of phosphine. You may wish to draw a diagram to help you to answer this question.

predicted formula .....

explanation .....

.....

..... [3]

(c) A student added **excess** acidified barium chloride solution to a solution of magnesium sulfate.

Fig. 2.2 shows the procedure followed.

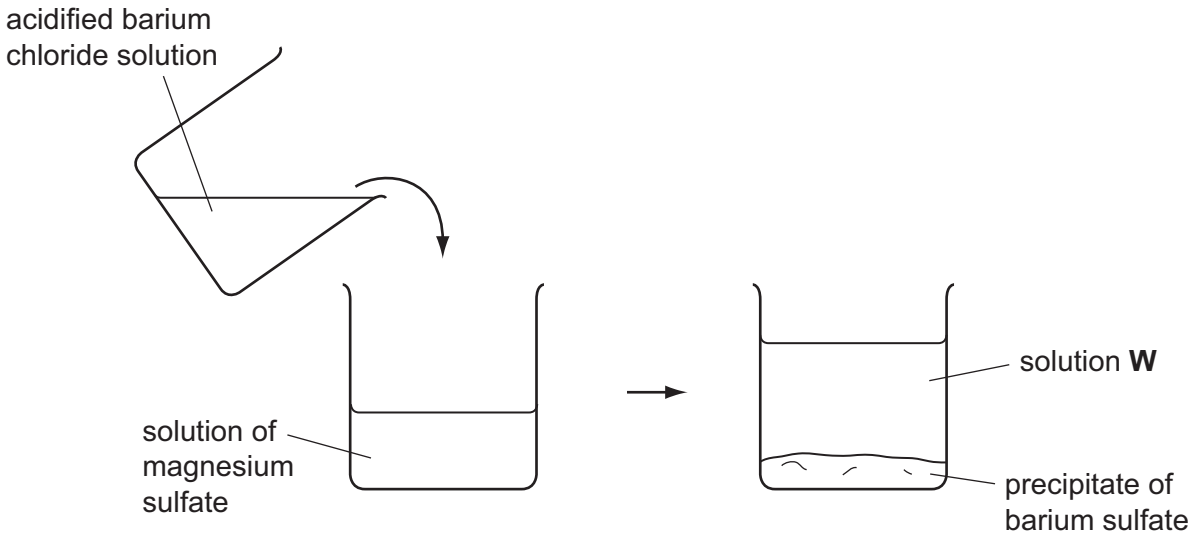

Fig. 2.2

A white precipitate of barium sulfate was produced.

The chemical equation for the reaction is

$$BaCl_2(aq) + MgSO_4(aq) \longrightarrow BaSO_4(s) + MgCl_2(aq)$$

(i) State **three** ions that are dissolved in solution **W** in Fig. 2.2.

1 .....

2 .....

3 ..... [1]

(ii) He used 50.0 cm^3 of magnesium sulfate solution of concentration 0.75 mol/dm^3.

Calculate the number of moles of magnesium sulfate used by the student.

Show your working.

..... moles [2]

(iii) State the number of moles of barium sulfate precipitate that were produced reaction.

.....moles [1]

(iv) Use the Periodic Table on page 32 to calculate the mass of barium sulfate that formed in the reaction.

Show your working.

.....g [2]

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3 **(a)** Fig. 3.1 shows a circuit used to measure the current passing through a resistor when the voltage across it is changed.

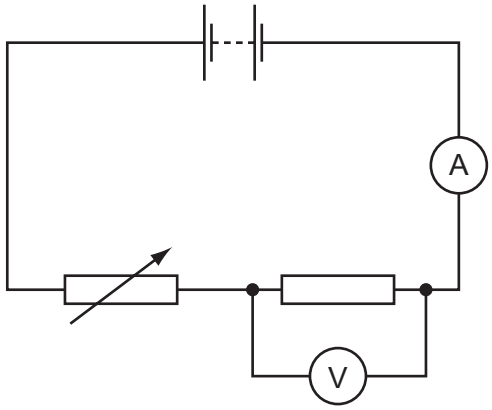


Fig. 3.1

Complete the sentences below using suitable words.

When the voltage across the resistor is reduced, the current through the resistor

..... .

When the voltage of the supply is reduced, the voltage across the resistor

..... .

[1]

(b) The resistance of a piece of wire depends on a number of variables such as the temperature of the wire and the material from which it is made.

State **two other** factors which affect the resistance of a piece of wire.

1 .....

2 ..... [2]

(c) Fig. 3.2 shows a circuit used to power a small motor.

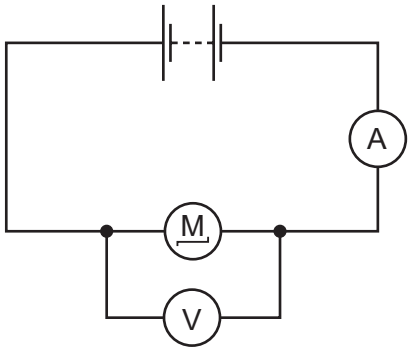


Fig. 3.2

The voltage across the motor is 3 V. The current through the motor is 0.6 A.

(i) Calculate the power input to the motor.

State the formula that you use, show your working and state the unit of your answer.

formula

working

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

(ii) The motor is able to lift a load of 40 N through 1.2 m in 36 seconds.

Calculate the power output of the motor.

State the formula that you use, show your working and state the unit of your answer.

formula

working

..... unit ..... [3]

(iii) Explain why there is a difference between your answers to **(i)** and **(ii)**.

.....

.....

..... [1]

(iv) Calculate the efficiency of the motor.

Show your working.

..... [2]

(d) An electric current in a wire is a flow of electrons. β(beta)-radiation also consists of electrons.

(i) State the name of the sign of the charge on an electron.

..... [1]

(ii) α(alpha)–radiation moves in the opposite direction to β–radiation in an electrical field.

γ(gamma)–radiation passes through an electrical field without deviation.

Explain these two statements.

.....

.....

.....

..... [2]

4 Soya beans are an important crop in Brazil. Soya beans can be used to make soya which can be made into yogurt.

(a) To make yogurt, microorganisms are added to soya milk. The milk is then kept warm for several hours.

(i) State the type of microorganism that is added to milk to make yogurt.

.....[1]

(ii) Explain why the milk is kept warm for several hours.

.....

.....

.....[2]

(b) Researchers in Brazil investigated whether adding sugar to the soya milk affected the yogurt that was produced.

They added sugar to one batch of soya milk, but not to another. They measured the percentage of lactic acid in each batch of yogurt at the start, and after 4, 5, 6 and 7 hours.

Fig. 4.1 shows their results.

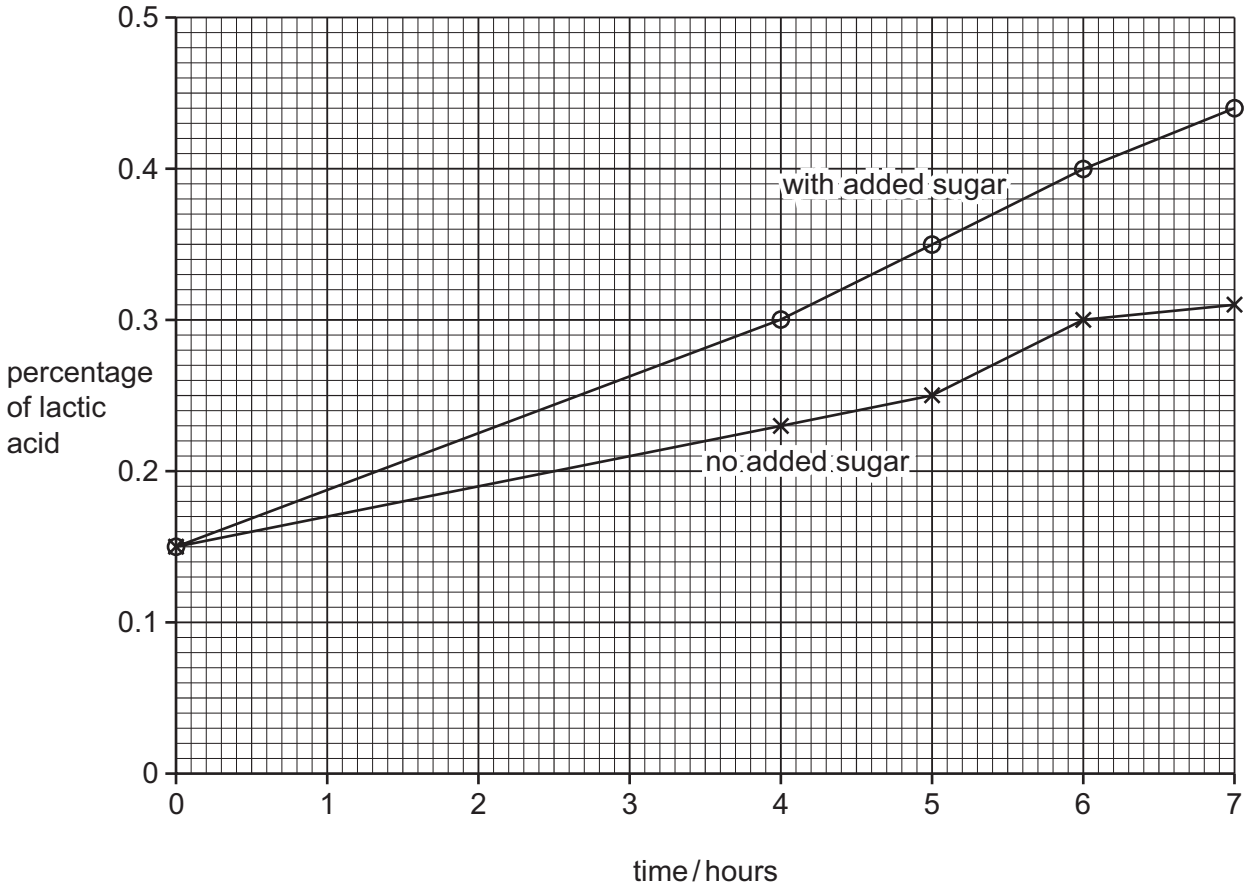


Fig. 4.1

(i) Describe the change in lactic acid concentration during the fermentation yogurt with no added sugar.

.....

.....

..... [2]

(ii) Compare the concentration of lactic acid when sugar is added with the concentration of lactic acid when no sugar is added.

State the difference and explain it.

.....

.....

..... [2]

(c) Large areas of rainforest have been cleared in Brazil, to provide more land for growing soya beans.

Explain how cutting down the rainforest can harm the environment.

.....

.....

.....

.....

.....

..... [4]

5 A student carried out experiments to investigate the differences in reactivity of elements.

(a) Fig. 5.1 shows what the student observed when he removed an iron nail that had been placed into a solution of copper sulfate for a short time.

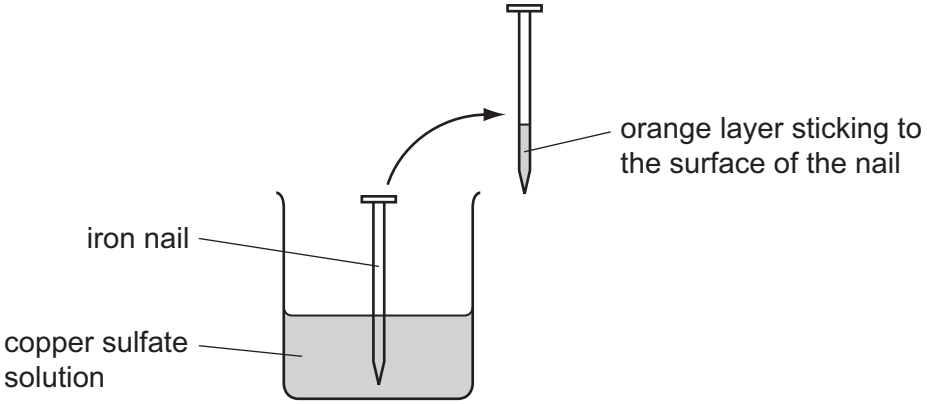


Fig. 5.1

The student correctly concluded that a layer of copper had formed on the surface of the nail.

Explain, in terms of electron transfer, how the reaction is an example of redox (reduction and oxidation).

.....

.....

..... [2]

(b) Fig. 5.2 shows apparatus used by the student to investigate the reaction between different metals and steam, $H_2O(g)$.

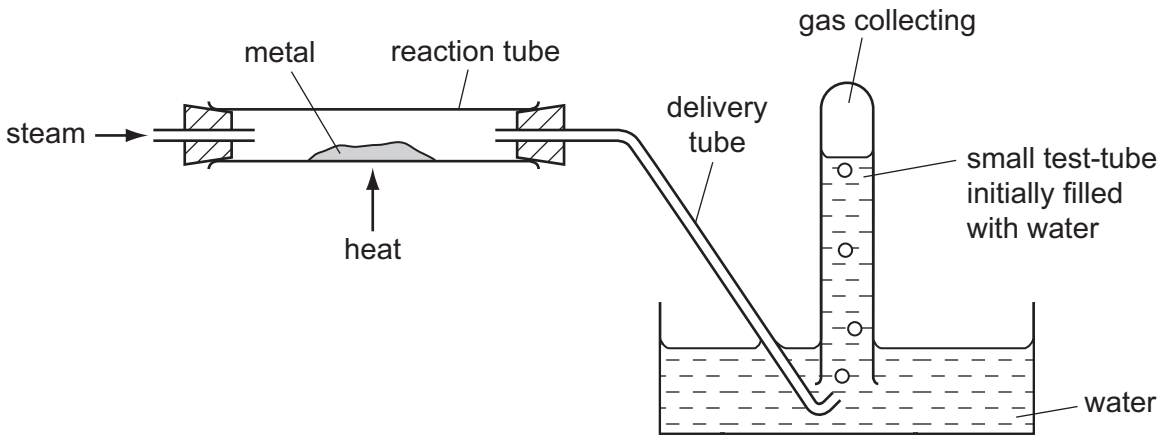


Fig. 5.2

The student carried out experiments using two metals, **P** and **Q**. His observations are shown in Table 5.1.

Table 5.1

metal	observation in reaction tube	observation in small test-tube
P	no reaction	no gas produced
Q	• rapid exothermic reaction • white powdery solid produced	gas **G** collects

(i) State the element which combined with metal **Q** to form the white powdery solid.

..... [1]

(ii) Name the gas **G**. ..... [1]

(iii) Use the observations to compare the reactivities of the three elements, **P**, **Q** and gas **G**.

Explain your answer.

most reactive .....

.....

least reactive .....

explanation .....

.....

.....

..... [3]

(c) Mild steel is an alloy that contains mainly iron. Mild steel will rust unless it is protected.

State and explain how a covering of metallic zinc provides sacrificial protection of steel from rusting.

.....

.....

.....

.....

..... [4]

6 **(a)** **(i)** Fig. 6.1 gives information about the uses of different types of electromagnetic waves and their effects on living tissue.

Draw lines to link each electromagnetic wave with its effect on living tissue and its use.

One has been completed as an example.

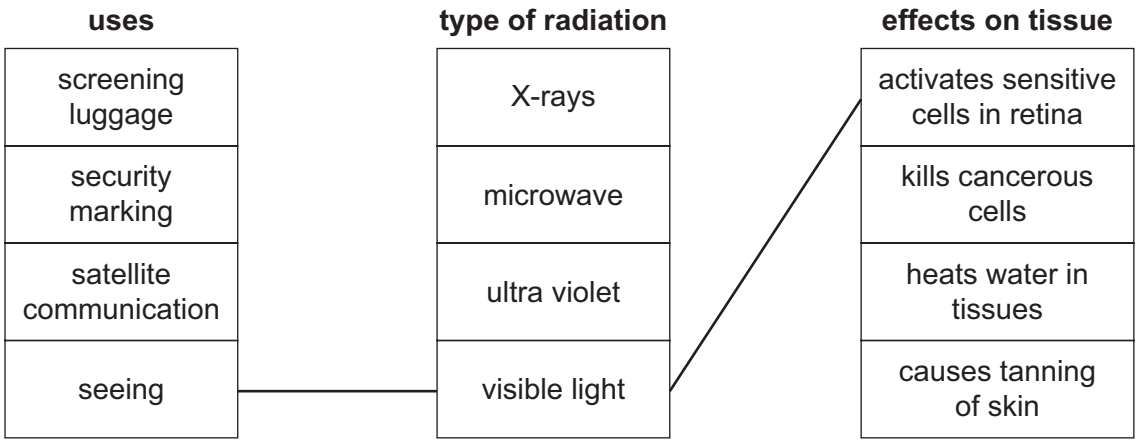


Fig. 6.1

[4]

(ii) State **one** property that is the same for all electromagnetic waves.

.....

[1]

(b) Infra-red radiation is the part of the electromagnetic spectrum often involved in heat transfer by radiation.

A student carried out an experiment to find out the type of surface that was the best emitter of radiation.

She set up the apparatus shown in Fig. 6.2 and measured the temperature of the water in the flasks every minute for 20 minutes.

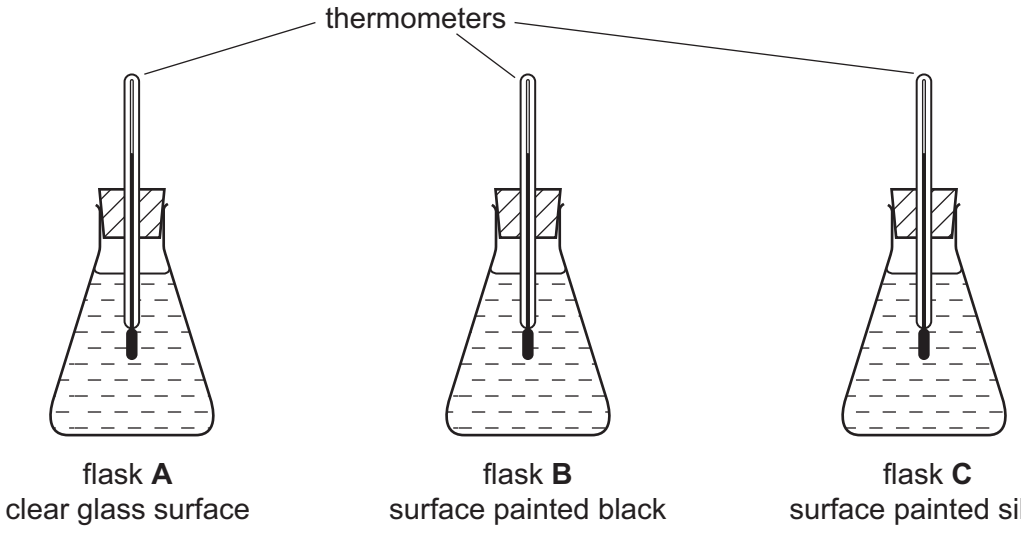


Fig. 6.2

Her results are shown in Fig. 6.3.

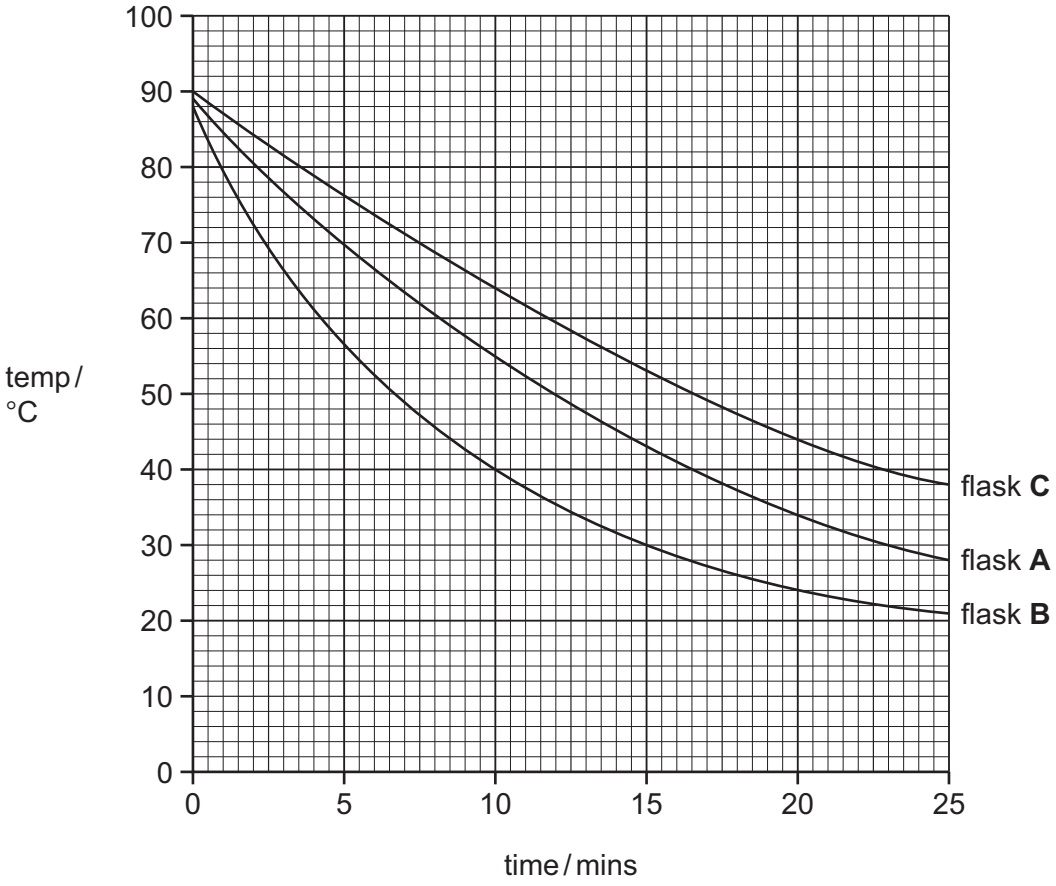


Fig. 6.3

(i) From the graphs identify, with a reason, the flask that cools most rapidly.

.....

..... [1]

(ii) Suggest why the flask you identified in **(i)** cooled more rapidly than the others

.....

..... [1]

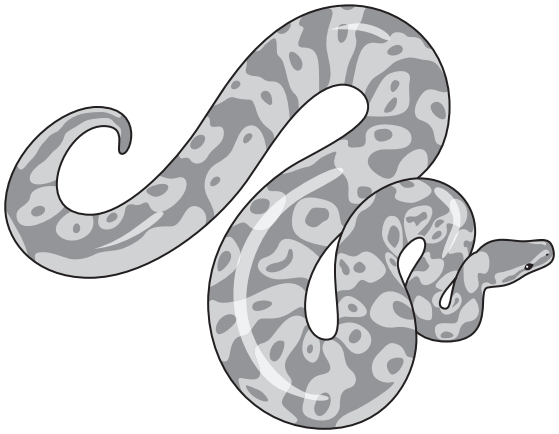
(iii) State **two** variables which the student needed to keep constant during her experiment.

1 .....

2 .....

[1]

7 Ball pythons (royal pythons) are snakes that are kept as pets in many parts of the wo



The color of a ball python is determined by its genes.

Gene **A** has two alleles, $\mathbf{A^N}$ and $\mathbf{A^B}$. Neither allele is dominant or recessive.

Table 7.1 shows the three possible genotypes and colors arising from this gene.

Table 7.1

genotype	color
$\mathbf{A^N\ A^N}$	normal
$\mathbf{A^N\ A^B}$	cinnamon
$\mathbf{A^B\ A^B}$	black

(a) Suggest why the alleles of this gene are **not** shown using a single capital letter and its small letter, e.g. **A** and **a**.

.....

..... [1]

(b) State the correct biological term for the visible appearance produced by the genotype, in this case the color of the snake.

..... [1]

(c) People try to breed pythons with unusual colors, because they are worth more m

Use information from Table 7.1 to construct a genetic diagram to explain how a breede can produce cinnamon offspring from a normal snake and a cinnamon snake.

[4]

(d) A breeder has several normal snakes, no cinnamon snakes and one black snake.

Suggest how she can breed more black snakes.

.....

.....

.....

..... [2]

8 Dilute nitric acid reacts with calcium carbonate according to the equation.

nitric acid	+	calcium carbonate	→	calcium nitrate	+	carbon dioxide	+	water

(a) Calcium nitrate contains calcium ions and nitrate ions.

Calcium is an element in Group 2 of the Periodic Table and nitrate ions have the formula NO_3^-.

Deduce the chemical formula of calcium nitrate.

Show how you obtained your answer.

formula of calcium nitrate ..... [3]

(b) A student carried out an investigation into the way that the rate of the reaction between calcium carbonate and nitric acid changed when he varied the concentration of the nitric acid.

Fig. 8.1 shows the apparatus the student used to measure the rate of reaction.

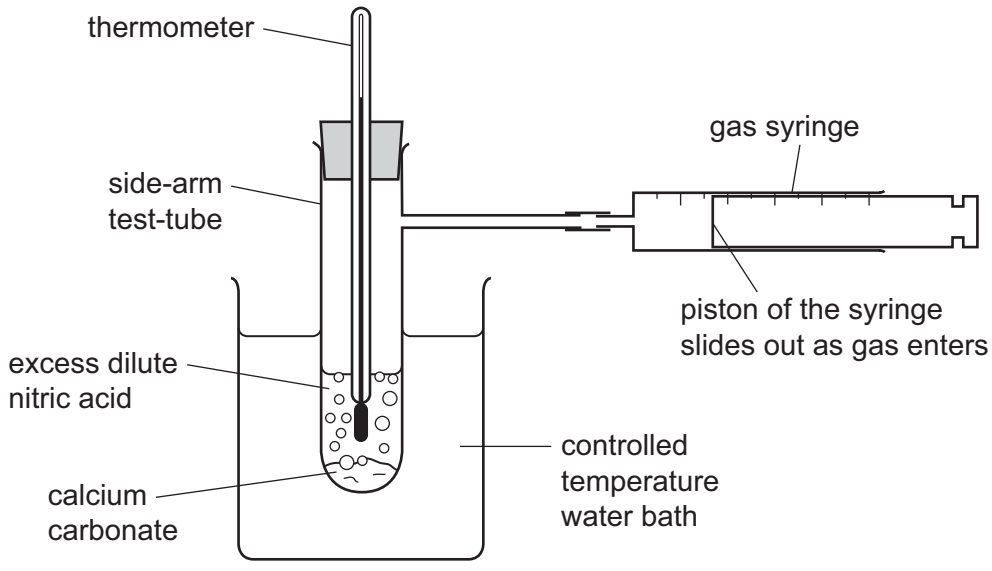


Fig. 8.1

The student measured the rate of reaction by finding the time it took for the gas to fill with gas.

The student measured the rate of reaction using five different concentrations of nitric acid.

Fig. 8.2 shows the student's results as a graph of rate of reaction against acid concentration.

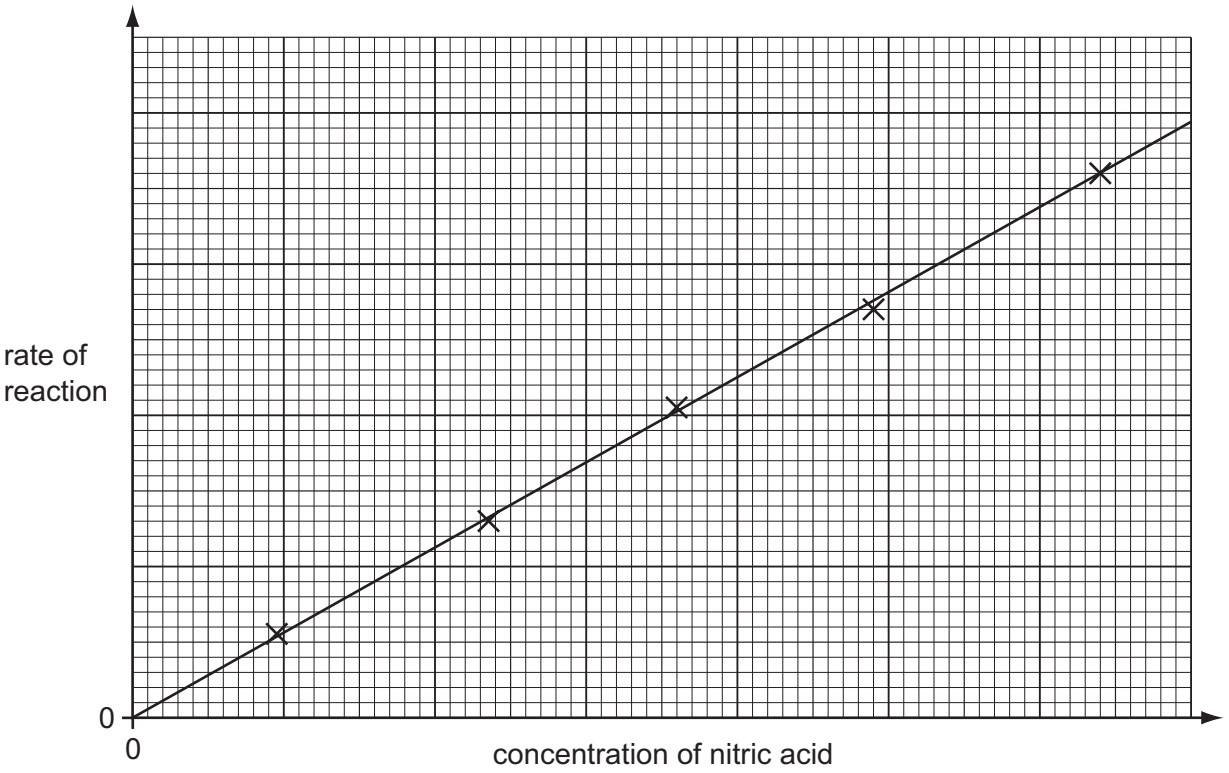


Fig. 8.2

(i) Describe the relationship shown by the graph.

.....

.....

..... [2]

(ii) Explain these results in terms of particle collisions.

.....

.....

..... [2]

(iii) Explain why the temperature of the reacting mixture needs to be kept constant.

.....

.....

..... [2]

9 Fig. 9.1 shows a solar-powered golf cart used to carry golfers around a golf course.

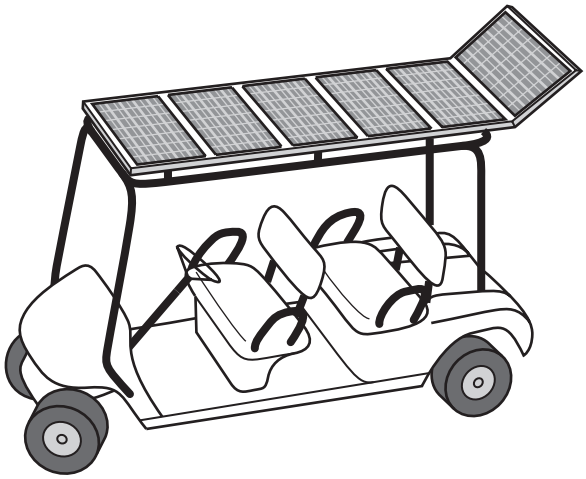


Fig. 9.1

(a) As the cart moves around the course, the motion of the cart is measured.

Fig. 9.2 shows a distance / time graph for a small part of the journey lasting 60 seconds.

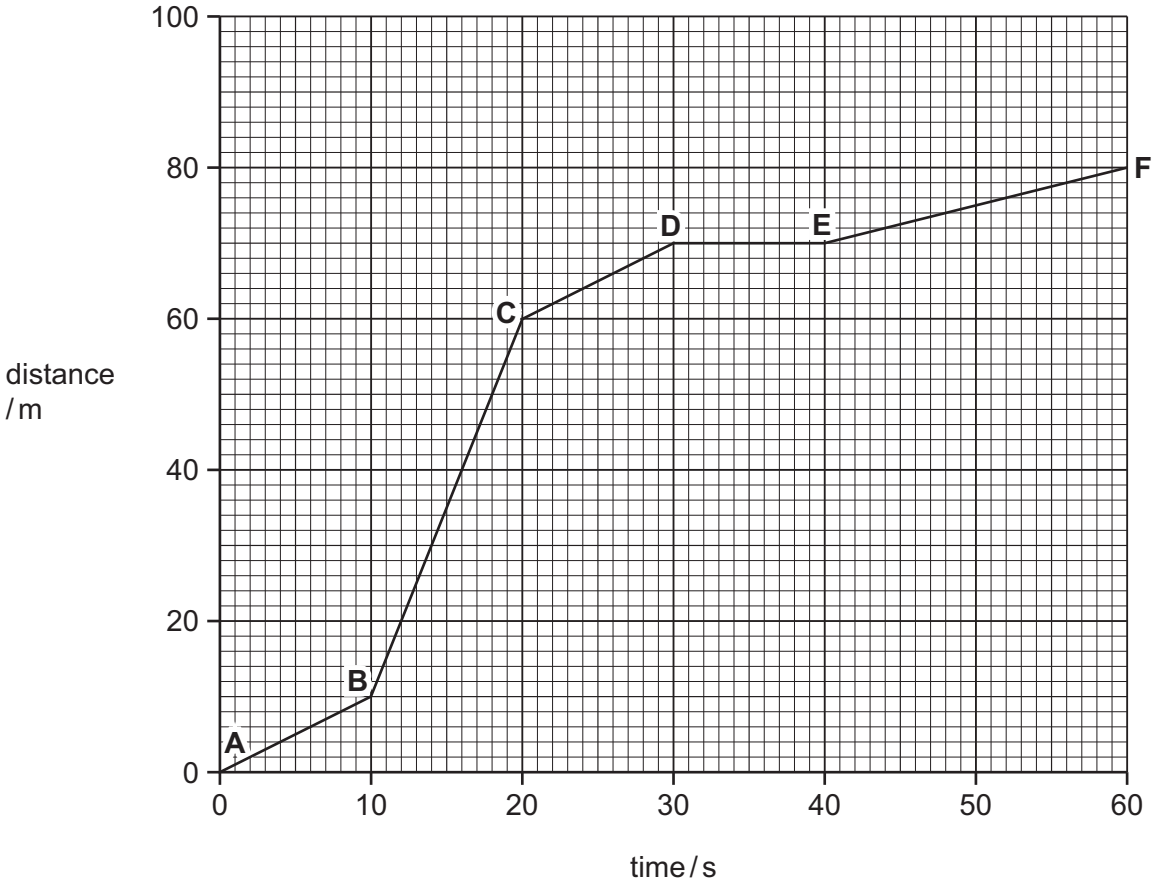


Fig. 9.2

(i) Show that the speed of the cart between **B** and **C** is 5 m / s.

Show your working in the space.

[1]

(ii) The mass of the cart is 400 kg.

Calculate the kinetic energy of the cart between **B** and **C**.

State the formula that you use, show your working and state the unit of your answer.

formula

working

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

(iii) Describe the motion of the cart between **D** and **E**.

..... [1]

(iv) Later in the journey, the cart accelerates from 1 m / s to 3 m / s in 5 seconds.

Calculate the acceleration of the cart.

State the formula that you use, show your working and state the unit of your answer.

formula

working

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

(b) (i) During the cart's journey, the temperature of the air in the tires increases by

The volume of the air in the tire remains the same.

Explain in terms of particles why the **pressure** of the air in the tire increases when this happens.

.....

.....

..... [1]

(ii) Sometimes the golfer's hands begin to sweat.

Explain in terms of particles how sweating cools his hands by evaporation.

.....

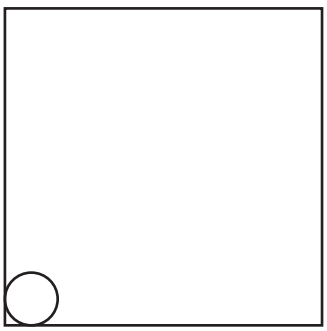
.....

.....

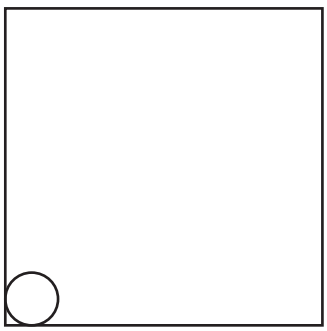
..... [2]

(iii) During evaporation, water changes state from liquid to gas.

Complete the diagrams to show the arrangement of particles in a liquid and in a gas.



liquid



gas

[2]

Please turn over for Question 10.

10 Fig. 10.1 shows a section through an eye.

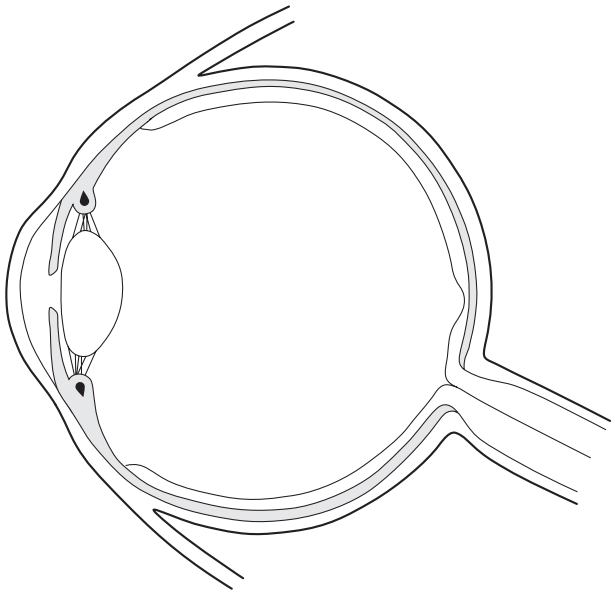


Fig. 10.1

(a) Complete the sentences to describe how the eye focuses on a nearby object, after it has been looking at a distant object.

Light from a nearby object is diverging ..... than light from a distant object. To focus on a nearby object, the ..... muscles ..... . This ..... the tension on the suspensory ligament, which ..... the focal length of the lens. [5]

(b) On Fig. 10.1, write the letter **F** to show where the rays of light focused by the lens form an image. [1]

(c) When bright light shines onto the eye, the size of the pupil quickly decreases. T
reflex action.

(i) Explain what is meant by the term *reflex action*.

.....

..... [1]

(ii) Outline the role of each of the following structures in this reflex action.

sensory neurone .....

.....

motor neurone .....

..... [3]

(d) Most parts of the body are supplied with nutrients and oxygen by blood flowing through capillaries. The cornea and lens of the eye do not contain blood capillaries. They obtain nutrients and oxygen from the aqueous humour and vitreous humour.

(i) Suggest why these parts of the eye do not contain blood capillaries.

.....

..... [1]

(ii) Explain why all the living cells in the eye require oxygen.

.....

.....

.....

..... [2]

11 Gasoline and diesel are liquid mixtures of hydrocarbons used as fuels.

Fig. 11.1 shows the structure of a typical molecule in gasoline.

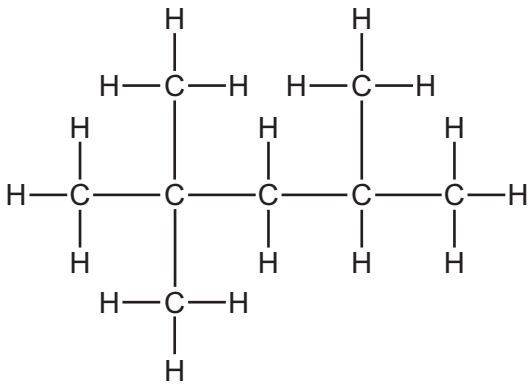


Fig. 11.1

(a) (i) State the chemical formula of the molecule in Fig. 11.1.

..... [1]

(ii) Explain briefly why a molecule like the one in Fig. 11.1 is classified as an *alkane* molecule.

.....

..... [1]

(b) Table 11.1 shows some properties of gasoline and diesel.

Table 11.1

fuel	temperature range over which the fuel boils / °C	viscosity (how easily the liquid flows)
gasoline	40 to 205	runny (flows easily)
diesel	250 to 350	less runny

(i) Explain, in terms of molecules and forces, why the properties of these fuels are different.

.....

.....

.....

..... [2]

(ii) Decane, $C_{10}H_{22}$, boils at a temperature of 174 °C.

Suggest why gasoline boils over a range of temperatures whereas decane boils a a single temperature.

.....

..... [1]

(c) Ethene, C_2H_4, is an unsaturated hydrocarbon.

(i) Describe a chemical test and its result which would show that ethene is unsaturated.

test .....

.....

result ..... [2]

(ii) Ethene can be made to undergo **complete** combustion in an exothermic reaction with oxygen, O_2.

Deduce the balanced symbol equation for this reaction.

..... [2]

12 (a) Fig. 12.1 shows a light ray entering an optical fiber.

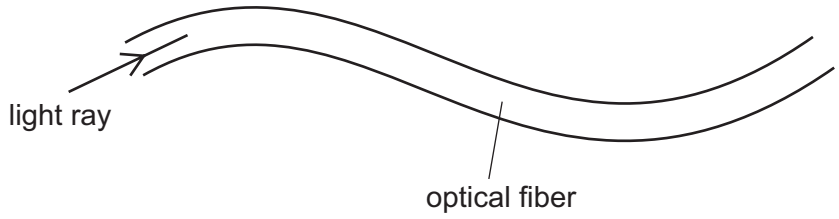


Fig. 12.1

The light ray travels all the way through the optical fiber.

Explain why the light ray is able to stay inside the optical fiber.

You may draw on the diagram if it helps your answer.

.....

.....

.....

..... [3]

(b) Fig. 12.2 shows an observer's eye looking at an object in a mirror.

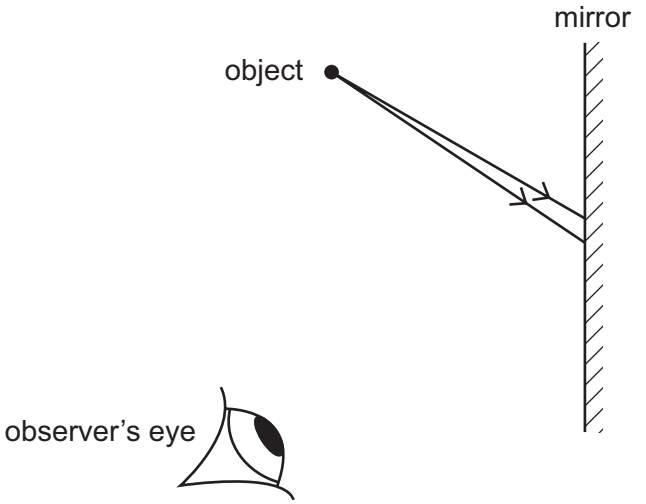


Fig. 12.2

(i) On Fig. 12.2 complete the ray diagram to show how the two rays of light from the object enter the eye of the observer. [1]

(ii) On Fig. 12.2 show how the observer sees rays of light which appear to come from the image behind the mirror.

Label the position of the image with an **X**. [2]

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DATA SHEET
The Periodic Table of the Elements

	Group																	
	I	II									III	IV	V	VI	VII	0
																4 He Helium 2
					1 H Hydrogen 1											
	7 Li Lithium 3	9 Be Beryllium 4									11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
	23 Na Sodium 11	24 Mg Magnesium 12									27 Al Aluminum 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
	85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
	Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

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

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