Cambridge
O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3034405442

COMBINED SCIENCE **5129/21**

Paper 2 **May/June 2019**

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.
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 28.

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 **26** printed pages and **2** blank pages.

Cambridge Assessment International Education

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1 Some information about a food chain is listed.

Caterpillars are herbivores.

Blackbirds eat caterpillars.

Hawks are carnivores.

Cabbages carry out photosynthesis.

(a) Complete the food chain in Fig. 1.1, using the information in the sentences.

Do not draw pictures of the organisms.

Fig. 1.1

[3]

(b) The hawk in this food chain dies.

State the name of the type of organism that obtains its energy from the body of the dead hawk.

..... [1]

(c) State the source of energy for the food chain.

..... [1]

[Total: 5]

2 A ball rests on a track, as shown in Fig. 2.1.

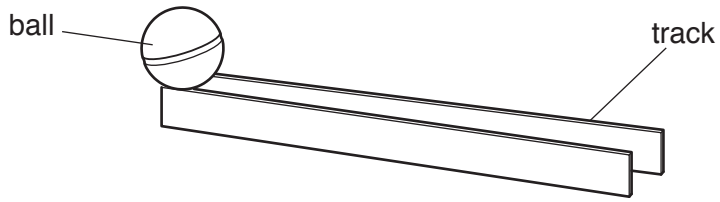

Fig. 2.1

The track is tilted and the ball accelerates as it rolls down the track.

(a) State what is meant by *acceleration*.

.....

.....

..... [2]

(b) Fig. 2.2 shows how the speed of the ball varies as it rolls down the track.

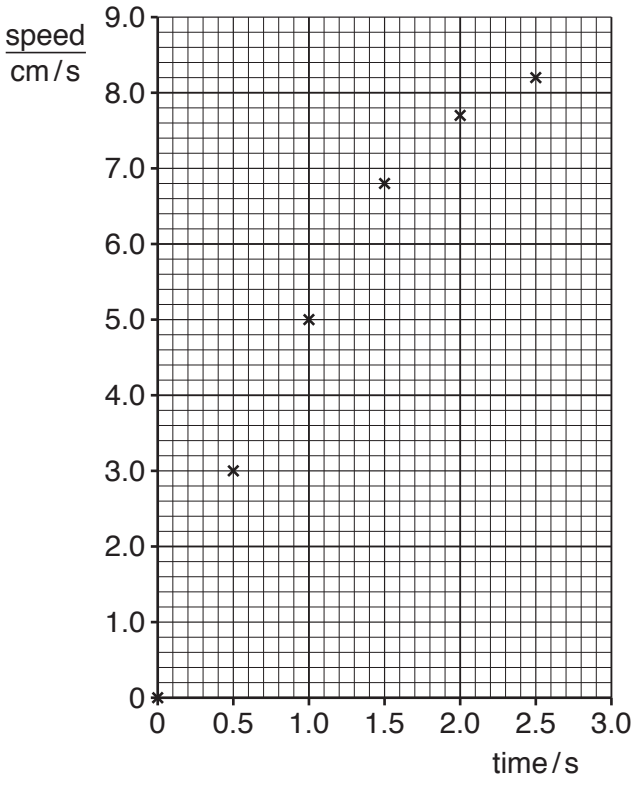

Fig. 2.2

(i) On Fig. 2.2, draw the curved line of best fit. [1]

(ii) Use Fig. 2.2 to complete Table 2.1. [1]

Table 2.1

time / s	0	0.5	1.0	1.5	2.0	2.5
speed / cm / s	0	3.0	5.0	6.8	.....	8.2

(iii) Describe how the acceleration of the ball changes as it rolls down the track.

.....

..... [1]

[Total: 5]

[Turn over

3 Nitrogen dioxide and carbon monoxide are produced in car engines. They cause pollution of the atmosphere.

When universal indicator is added to an aqueous solution of nitrogen dioxide, the indicator turns red.

(a) (i) Suggest the pH of the nitrogen dioxide solution. ..... [1]

(ii) State **one** effect that nitrogen dioxide has on the environment.

.....

..... [1]

(b) Nitrogen dioxide and carbon monoxide are removed from the exhaust gases of modern cars using a catalytic converter. This changes nitrogen dioxide and carbon monoxide into nitrogen and carbon dioxide.

The equation for the reaction is

$$2NO_2 + 4CO \longrightarrow N_2 + 4CO_2 .$$

[A_r: O, 16; N, 14; C, 12]

The relative molecular mass of nitrogen dioxide is 46.

(i) Calculate the relative molecular mass of carbon monoxide.

..... [1]

(ii) Complete the following sentences.

92g of nitrogen dioxide reacts with ..... g of carbon monoxide and

produces ..... g of nitrogen.

0.46g of nitrogen dioxide reacts with ..... g of carbon monoxide.

[3]

[Total: 6]

4 Use words or phrases from the list to complete the sentences about hormones.

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

gland	**kidney**	**liver**	**main**
muscle	**plasma**	**red blood cells**	**target**

A hormone is a chemical produced by a ..... .

It is transported around the body by the ..... .

The part of the body responding to the hormone is called the ..... organ.

Hormones are destroyed by the ..... .

[4]

5 A student invents a machine to measure the force of the wind.

A large piece of light-weight material is used as a wind-catcher and is attached to the top of a mast.

A newton-meter is used to measure the turning force and is attached to the bottom of the mast.

The mast is free to rotate about a pivot as shown in Fig. 5.1.

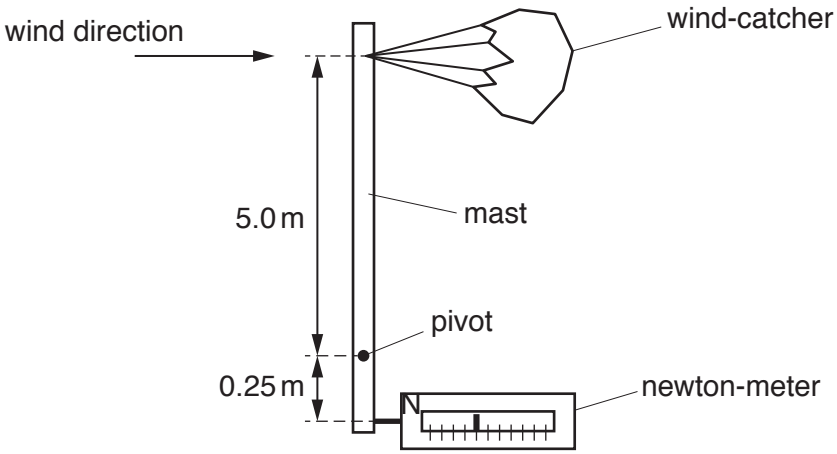

Fig. 5.1 (not to scale)

(a) The newton-meter is attached 0.25 m from the pivot.

On a windy day the reading on the newton-meter is 52.0 N when the mast is vertical.

(i) Calculate the moment of the force applied by the newton-meter about the pivot.

State the unit.

moment = ... unit ..... [2]

(ii) The wind-catcher is attached 5.0 m from the pivot.

Calculate the force from the wind when the mast is vertical.

force = ... N [1]

(b) The newton-meter contains a spring which deforms with elastic deformation.

Describe what happens to the spring in the newton-meter as the force acting on it increases from 0 N and then decreases back to 0 N.

.....

..... [2]

[Total: 5]

6 Equal volumes of dilute nitric acid are placed into three separate test-tubes. Small pieces of three metals **A**, **B** and **C** are placed in the test-tubes.

The results are shown in Fig. 6.1.

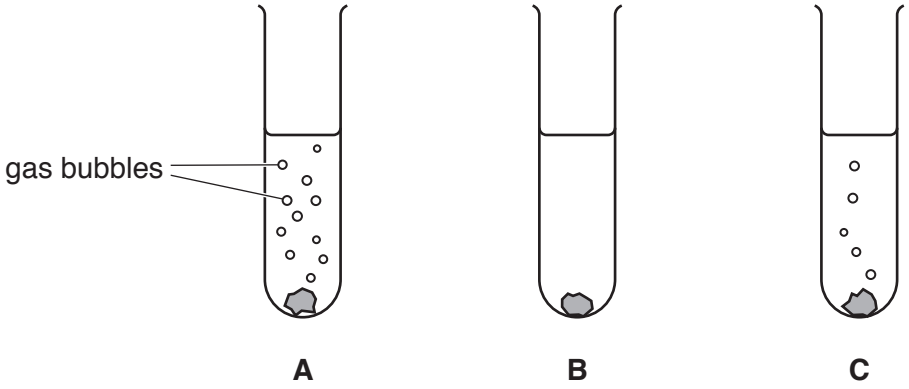

Fig. 6.1

(a) State the test and the result of the test that shows hydrogen is produced when a metal reacts with dilute nitric acid.

test .....

result .....

..... [2]

(b) Determine the order of reactivity of the metals **A**, **B** and **C**.

most reactive .....

.....

least reactive ..... [2]

(c) Nitric acid reacts with copper(II) carbonate to produce copper(II) nitrate, water and carbon dioxide.

(i) Complete and balance the equation for the reaction.

$CuCO_3$ + ... HNO_3 ⟶ $Cu(NO_3)_2$ + H_2O + ... [1]

(ii) State the names of two other substances that react with dilute nitric acid to produce copper(II) nitrate.

1 .....

2 .....

[2]

[Total: 7]

7 Fig. 7.1 shows how the breathing rates of two students **A** and **B** change during and after exercise.

Both students are the same age, sex and body mass.

They are both resting before the exercise.

They both do the same vigorous exercise **for one minute**.

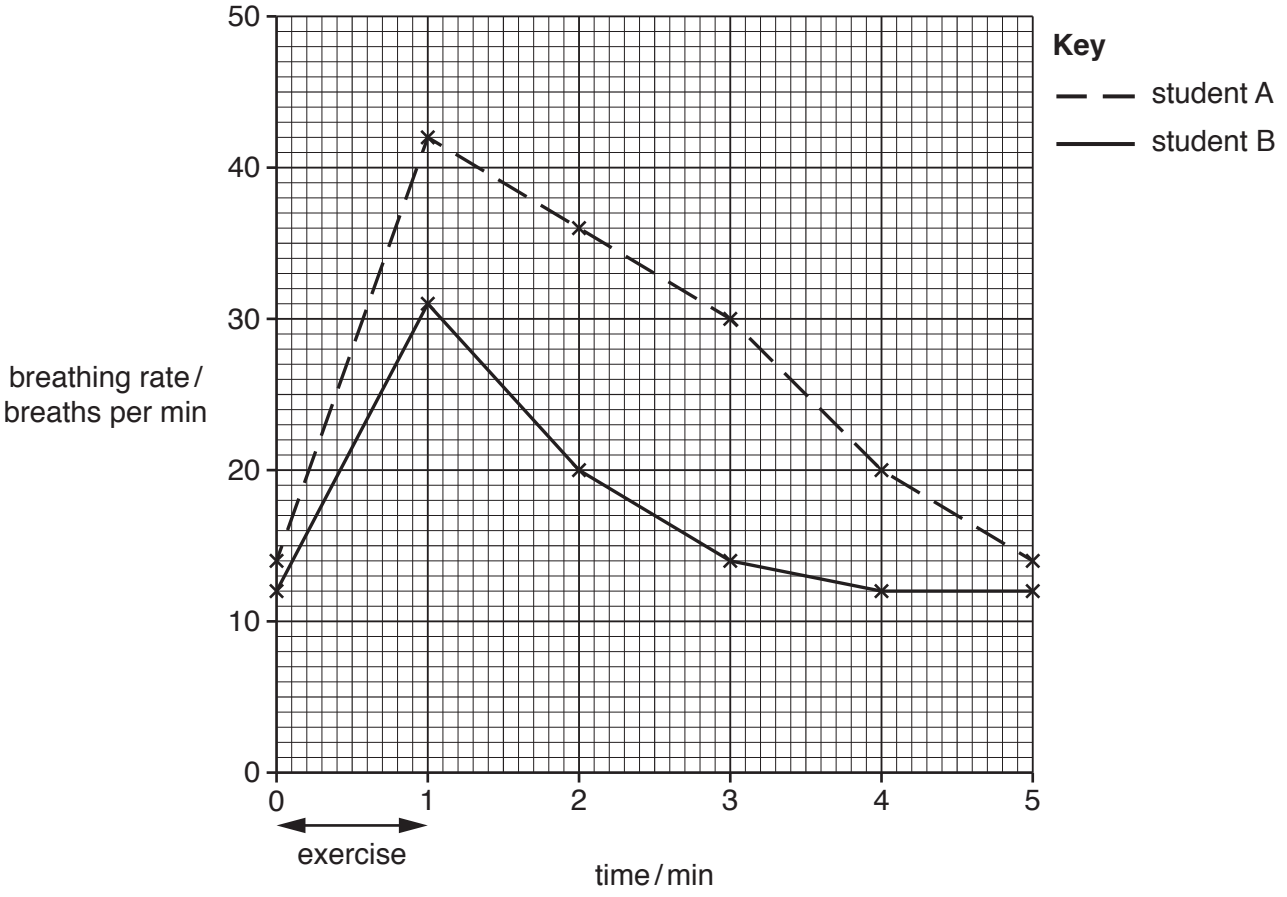

Fig. 7.1

(a) (i) Use the information in Fig. 7.1 to calculate the increase in breathing rate for student **A** as a result of the one minute of exercise.

..... breaths per min [1]

(ii) Explain why breathing rate increases during exercise.

.....

.....

.....

..... [2]

(b) (i) Describe **two** differences shown in the graph in Fig. 7.1 between the changes to the breathing rates of student **A** and student **B**.

1 .....

.....

2 .....

.....
[2]

(ii) Suggest a reason why the breathing rates of student **A** and student **B** are different.

.....

..... [1]

(c) Suggest one body function other than breathing rate which increases during exercise.

.....

..... [1]

[Total: 7]

8 A student compares the thermal properties of materials **A**, **B** and **C**.

The apparatus he uses is shown in Fig. 8.1.

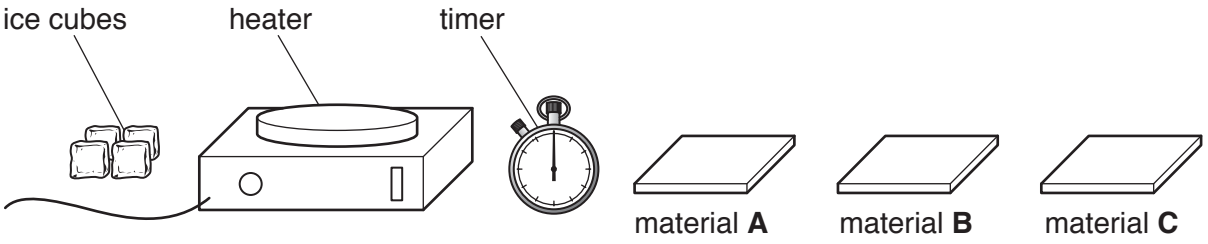

Fig. 8.1

(a) Describe an experiment using the apparatus in Fig. 8.1, that shows material **C** is the best thermal conductor.

.....

.....

.....

..... [3]

(b) The student performs another experiment using different thicknesses of material **A**.

The results of this experiment show that the thickness of the material is *inversely proportional* to the rate at which thermal energy transfers through it.

On Fig. 8.2 label the *y-axis* and draw a line graph to show this *inversely proportional* relationship.

.....

.....

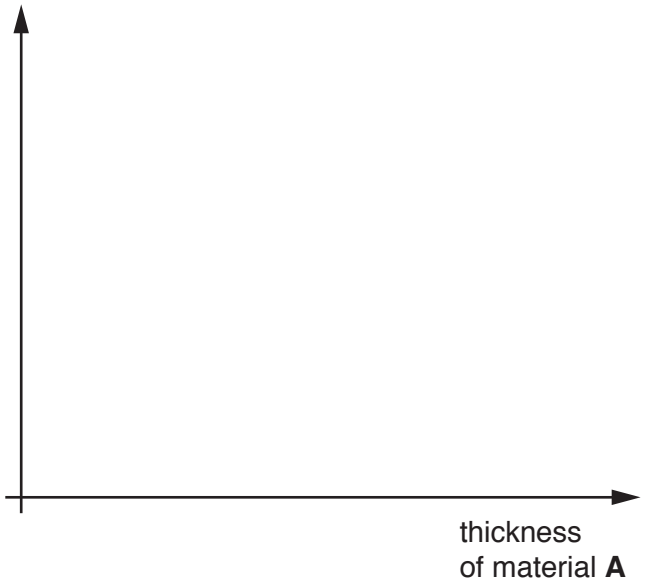

Fig. 8.2

[2]

[Total: 5]

9 Some information about three different atoms **X**, **Y** and **Z** is shown in Table 9.1.

Table 9.1

atom	number of protons	number of neutrons	number of electrons
X	8	8	8
Y	8	9	8
Z	8	10	8

(a) These atoms are isotopes of the same element.

Explain how the data in the table shows this.

.....

.....

..... [2]

(b) Complete Fig. 9.1 to show the electronic structure of atom **Y**.

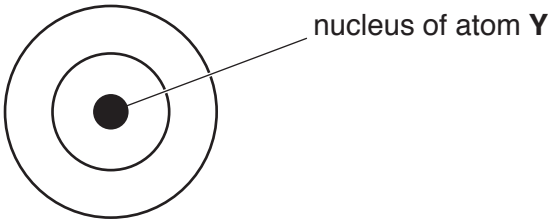

Fig. 9.1

[1]

(c) Use the Periodic Table to identify the element of atom **Y**.

..... [1]

[Total: 4]

10 (a) The boxes on the left in Fig. 10.1 contain the names of plant structures.

The boxes on the right contain descriptions of the functions of these structures in photosynthesis.

Draw one straight line to link each structure to its function.

plant structure	**function in photosynthesis**
chloroplast	absorbs water
root hair cell	gaseous exchange
stomata	transports water to leaf cells
xylem	traps light energy

Fig. 10.1

[4]

(b) Animal life depends on plants carrying out photosynthesis.

State **two** reasons why.

1 .....

.....

2 .....

.....

[2]

[Total: 6]

11 Pentane is a member of a *homologous series*.

(a) Explain what is meant by the term *homologous series*.

.....

.....

..... [2]

(b) When pentane is heated in the presence of a catalyst, the pentane breaks down to form ethene C_2H_4 and one other product.

(i) Complete the equation for the breakdown of pentane.

$$C_5H_{12} \longrightarrow C_2H_4 + \text{.....}$$ [1]

(ii) State the name of this process.

..... [1]

(c) State the test and the result of the test that shows ethene is an unsaturated hydrocarbon.

test .....

result .....

.....

[2]

[Total: 6]

12 The apparatus shown in Fig. 12.1 is used to find the speed of sound.

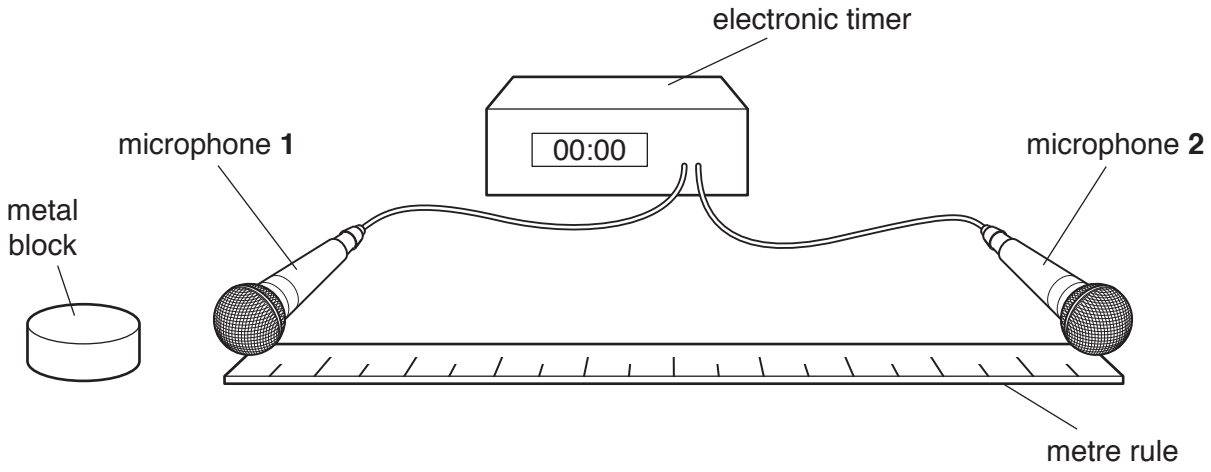

Fig. 12.1

Two microphones are connected to an electronic timer.

The metal block is hit with a hammer to produce a short 'pulse' of sound.

Microphone **1** detects the pulse of sound and starts the electronic timer.

Microphone **2** then detects the pulse of sound and stops the timer.

The microphones are 1.0 m apart.

Sound travels at a speed of 340 m / s.

(a) Calculate the time taken for the sound to travel 1.0 m.

Use the equation: $\text{speed} = \frac{\text{distance}}{\text{time}}$

time = ... s [1]

(b) The pulse of sound produced by the hammer hitting the metal block contains waves with different frequencies and wavelengths.

(i) One of these waves has a frequency of 485 Hz.

Calculate the wavelength of this wave.

wavelength = ... m [1]

(ii) All of the waves within this pulse of sound reach microphone **2** in the same amount of time.

Explain why.

.....

..... [1]

(c) In each microphone there is a coil of wire that is free to move, and a magnet.

Explain how the pulse of sound causes an e.m.f. to be induced in these coils of wire.

.....

.....

..... [2]

[Total: 5]

13 Fig. 13.1 shows the human alimentary canal and associated organs.

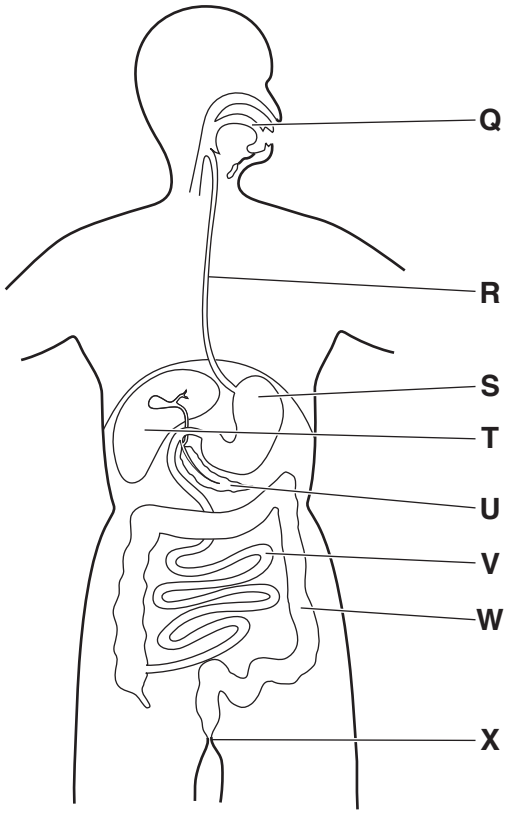

Fig. 13.1

(a) Complete Table 13.1 using the letters from Fig. 13.1.

One has been done for you.

Table 13.1

name of structure	letter
anus	
colon	
liver	
oesophagus	
pancreas	**U**

[4]

(b) Amylase is present in saliva.

The stomach contains an acid.

Describe and explain the effect of stomach acid on the action of amylase.

.....

.....

.....

..... [2]

[Total: 6]

14 A student makes a circuit containing two identical lamps and three ammeters, as shown in Fig. 14.1.

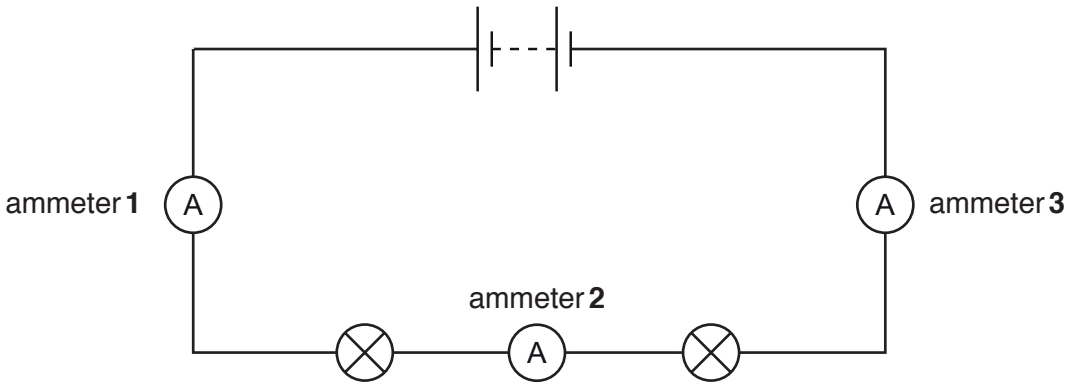

Fig. 14.1

(a) The ammeters measure the current in the circuit.

Explain what is meant by *current*.

.....

.....

..... [2]

(b) Table 14.1 shows four different sets of ammeter readings.

Put **one** tick in the last column to indicate which set of readings is correct for the circuit shown in Fig. 14.1.

Table 14.1

ammeter **1**/A	ammeter **2**/A	ammeter **3**/A	correct readings
0.4	0.4	0.8	
0.4	0.6	0.8	
0.8	0.6	0.4	
0.8	0.8	0.8	

[1]

(c) The student uses a scientific instrument to measure potential difference.

(i) State the name of the instrument.

..... [1]

(ii) The student uses this instrument to measure the potential difference across **one** of the lamps.

The instrument has a digital display and the reading on it is shown in Fig. 14.2.

Fig. 14.2

Determine the potential difference of the battery. State the unit.

potential difference = ... unit ..... [2]

[Total: 6]

15 Fig. 15.1 shows the chromatogram obtained from four different mixtures of dyes, using water as the solvent.

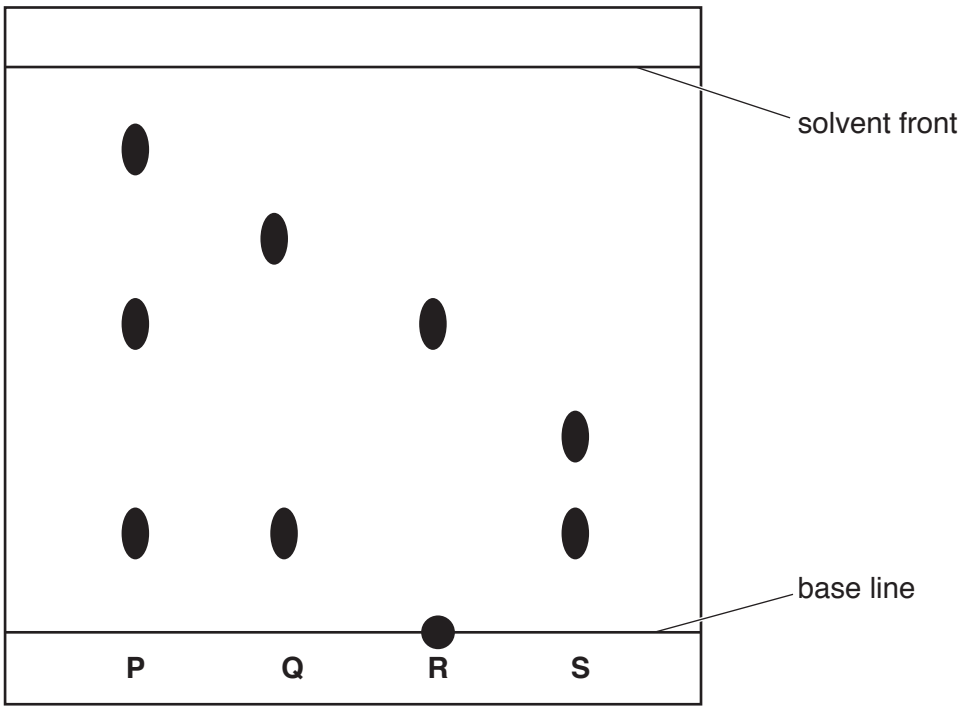

Fig. 15.1

(a) Explain why the base line is drawn using a pencil rather than an ink pen.

.....

..... [1]

(b) Identify the mixture that contains a dye that is insoluble in water and give a reason for your choice.

mixture .....

reason .....

..... [2]

(c) **(i)** State the number of mixtures that contain two different dyes.

..... [1]

(ii) Use Fig. 15.1 to determine the total number of different dyes that are present in all four mixtures.

..... [1]

[Total: 5]

16 Iron is extracted from its ore by reduction with carbon in a blast furnace.

(a) **(i)** Name an ore of iron. ..... [1]

(ii) State what is meant by *reduction*.

.....

..... [1]

(b) Iron rusts when it is exposed to air.

Name the substances present in air that cause iron to rust.

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

(c) Iron is prevented from rusting by coating it with a metal.

State the name of this process and name the metal used.

process .....

metal ..... [2]

[Total: 6]

17 A student investigates the germination of pea seeds.

The apparatus used is shown in Fig. 17.1.

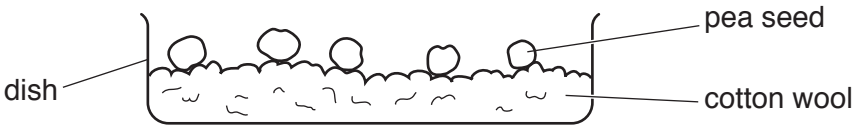

Fig. 17.1

Three dishes, **X**, **Y** and **Z** are used.

Each dish contains five pea seeds.

All the dishes are placed in the light.

The other conditions vary as shown in Table 17.1.

The results of the investigation are shown in Table 17.1.

Table 17.1

conditions and results	dish		
	X	**Y**	**Z**
cotton wool	damp	dry	damp
temperature / °C	20	20	5
results after three days	all germinate	none germinate	none germinate

(a) (i) Explain why the seeds in dishes **Y** and **Z** do not germinate.

dish **Y** .....

.....

dish **Z** .....

..... [2]

(ii) The student uses five pea seeds in each dish.

Suggest why using 30 seeds in each dish is preferable.

.....

..... [1]

(b) In another investigation, five pea seeds are put on damp cotton wool and left at 20 °C in a dark room for three days.

Predict and explain the results.

prediction .....

explanation .....

..... [2]

[Total: 5]

18 Use words or numbers from the list to complete the sentences about electromagnetic waves.

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

3×10^8 **3×10^6** **gamma** **longitudinal** **radio** **transverse**

All electromagnetic waves are ..... .

The electromagnetic wave with the longest wavelength is ..... .

They travel through a vacuum at a speed of ..... m/s

[2]

19 An experiment to investigate magnetism is shown in Fig. 19.1.

A first magnet is placed on an electronic balance and the reading is zeroed.

A second magnet is moved close to it, as shown.

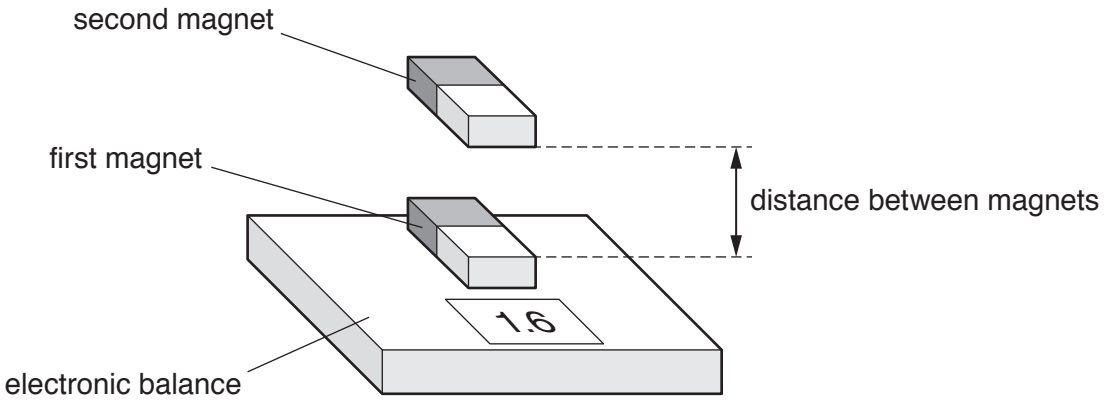

Fig. 19.1

The reading on the balance is displayed in newtons (N).

Table 19.1 shows how the reading on the balance changes as the second magnet moves closer.

Table 19.1

distance between magnets / mm	20	15	10	5.0
electronic balance reading / N	1.0	1.6	2.8	.....

(a) Complete Table 19.1 to suggest the reading on the balance when the distance between the magnets is 5.0 mm. [1]

(b) Explain why the reading on the balance increases.

.....

..... [2]

(c) The average force applied to move the second magnet 5.0×10^{-3} m closer to the first magnet is 2.2 N.

Calculate the work done by this force.

work done = ... J [2]

[Total: 5]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	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.).