SAMPLE 1

ENTRANCE EXAM IN CHEMISTRY, PHYSICS & BIOLOGY
III YEAR

Chemistry

1 The diagram shows the result of dropping a purple crystal into water.

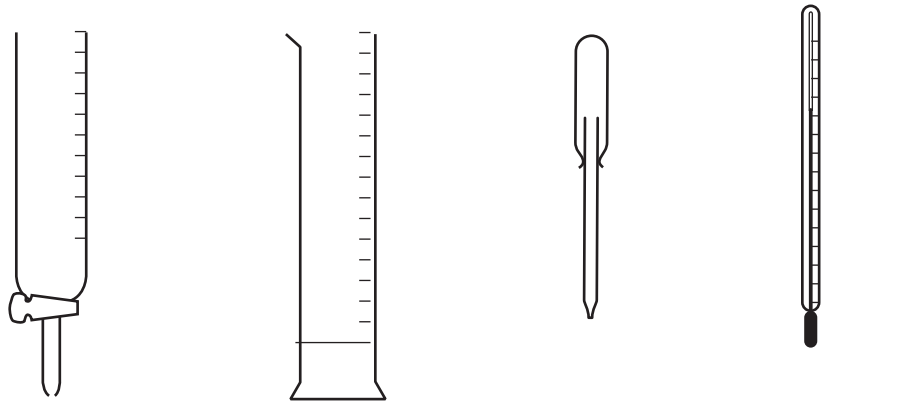


Which processes take place in this experiment?

	chemical reaction	diffusing	dissolving
A	✓	✓	✓
B	✓	✗	✓
C	✗	✗	✓
D	✗	✓	✓

[1]

2 The four pieces of apparatus shown below are used in chemical experiments.



burette | measuring cylinder | pipette | thermometer

Which statement about the apparatus is correct?

A The burette measures the volume of liquid added in a titration.

B The measuring cylinder measures the mass of a substance used in an experiment.

C The pipette measures the volume of gas given off in a reaction.

D The thermometer measures the density of a solution.

[1]

3 Alcohol and water are completely miscible. This means when mixed together they form only one liquid layer.

Which method is used to separate alcohol from water?

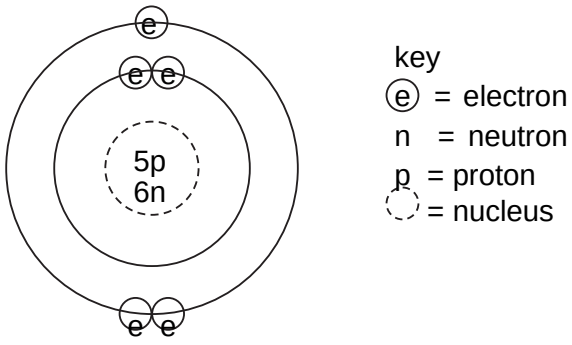
A crystallisation

B filtration

C fractional distillation

D precipitation **[1]**

4 The diagram shows the structure of an atom of element X.



What is X?

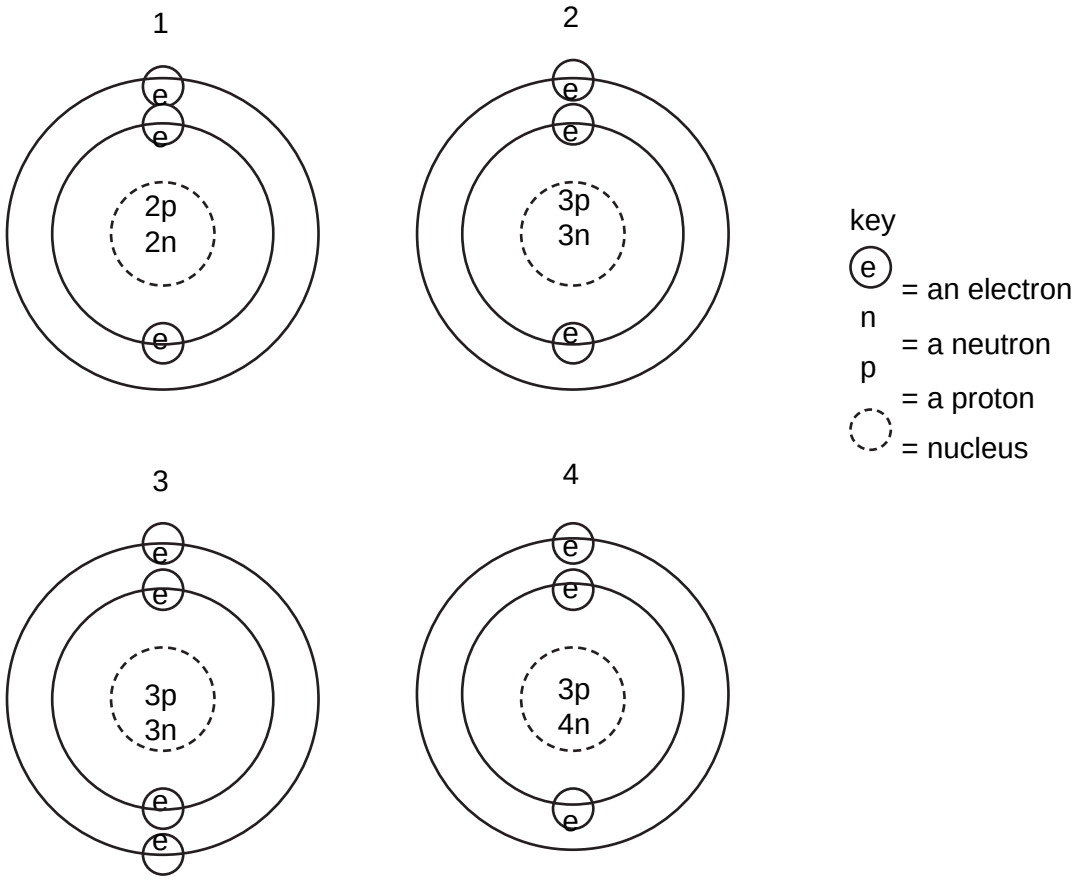
A boron

B carbon

C sodium

D sulfur **[1]**

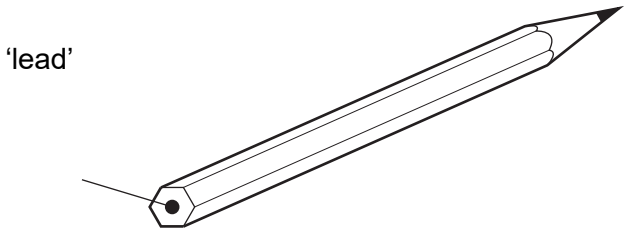
5 The diagrams show four particles.



Which two diagrams show atoms that are isotopes of each other? **[1]**

A 1 and 2 B 1 and 3 C 2 and 3 D 2 and 4

6 The 'lead' in a pencil is made of a mixture of graphite and clay.



When the percentage of graphite is increased, the pencil slides across the paper more easily.

Which statement explains this observation?

A Graphite has a high melting point.

B Graphite is a form of carbon.

C Graphite is a lubricant.

D Graphite is a non-metal. **[1]**

7 Element X is in Group I of the Periodic Table. X reacts with element Y to form an ionic compound.

Which equation shows the process that takes place when X forms ions?

A $X + e^- \rightarrow X^+$

B $X - e^- \rightarrow X^-$

C $X + e^- \rightarrow X^-$

D $X - e^- \rightarrow X^+$

[1]

8 Solid F is an element.
Solid G is a compound.
Neither solid conducts electricity but G conducts electricity when dissolved in water.

These properties suggest that F is ……1…… and that G is ……2…… with ……3…… bonds.

Which words correctly complete gaps 1, 2 and 3?

	1	2	3
A	diamond	AgCl	covalent
B	diamond	NaCl	ionic
C	graphite	AgCl	ionic
D	graphite	NaCl	covalent

[1]

9 A compound contains one atom of calcium, two atoms of hydrogen and two atoms of oxygen.

What is the correct chemical formula of the compound?

A CaO_2H_2 B HOCaOH C H_2CaO_2 D $Ca(OH)_2$ **[1]**

10 In athletics, banned drugs such as nandrolone have been taken illegally to improve performance.
Nandrolone has the molecular formula $C_{18}H_{26}O_2$.

What is the relative molecular mass, M_r, of nandrolone?

(Relative atomic mass: H = 1; C = 12; O = 16)

A 46 B 150 C 274 D 306

[1]

1**1** (a) Choose from the list of substances below to answer the following questions.

calcium oxide
carbon dioxide
carbon monoxide
copper
hydrogen
magnesium
methane
oxygen
water

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

Which substance:

(i) releases hydrogen when it reacts with steam,

..... [1]

(ii) is produced at the cathode when concentrated aqueous sodium chloride is electrolysed,

..... [1]

(iii) is a product of the incomplete combustion of carbon,

..... [1]

(iv) is used in electrical wiring,

..... [1]

(v) is manufactured by heating limestone?

..... [1]

(b) Complete the following sentences about the Periodic Table of elements using words from the list below.

argon	colour	density	sodium
one	similarity	trend	seven

Chlorine, bromine and iodine are elements in Group ..... of the Periodic Table.

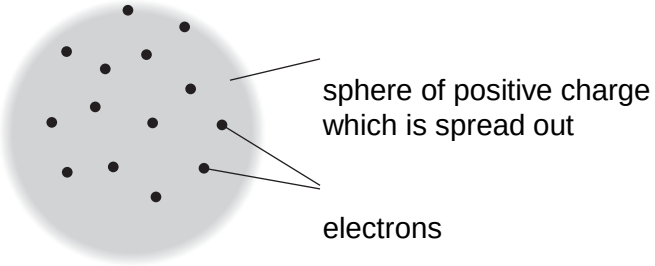
These elements show a ..... in ..... down the group.

They all react rapidly with ..... to form ionic compounds. [4]

[Total: 9]

12 In 1904, J. J. Thomson suggested a model of the atom. He called this the 'plum pudding' model.

This model of an atom, containing 14 electrons, is shown below.



(a) Describe how Thomson's model of the atom differs from our present ideas of the structure of an atom.

.....

.....

.....

..... [3]

(b) Lithium has two naturally-occurring isotopes. These can be written as:

$^{7}_{3}Li$ and $^{6}_{3}Li$

(i) Describe the difference between these isotopes.

..... [1]

(ii) Isotopes can be radioactive or non-radioactive.
State one industrial use of radioactive isotopes.

..... [1]

(c) Lithium is in Group I of the Periodic Table.
The table shows some properties of the Group I elements.

metal	melting point / °C	atomic radius / nm
lithium		0.157
sodium	98	0.191
potassium	63	
rubidium	39	0.250
caesium	29	0.272

Deduce:

the atomic radius of potassium ..... nm [2]

the melting point of lithium, ... °C

(d) Lithium reacts with water. An alkaline solution and a colourless gas are formed.

(i) Complete the word equation for this reaction.

lithium + water □ .... + ...

[2]

(ii) What is the most likely pH of the alkaline solution?
Put a ring around the correct answer.

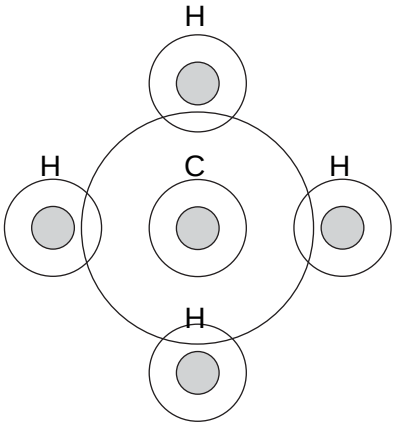
pH 2 pH 5 pH 7 pH 13

[1]

(e) Draw the electronic structure of a potassium atom.

(f) Complete the dot and cross diagram of methane to show all the electrons.

[2]



[2]

[Total: 14]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										4 He Helium 2
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 Aluminium 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

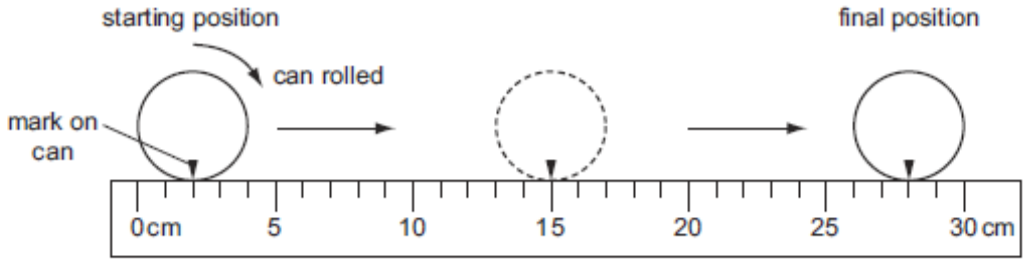
Key

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

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

Physics

1 A cylindrical can is rolled along the ruler shown in the diagram.



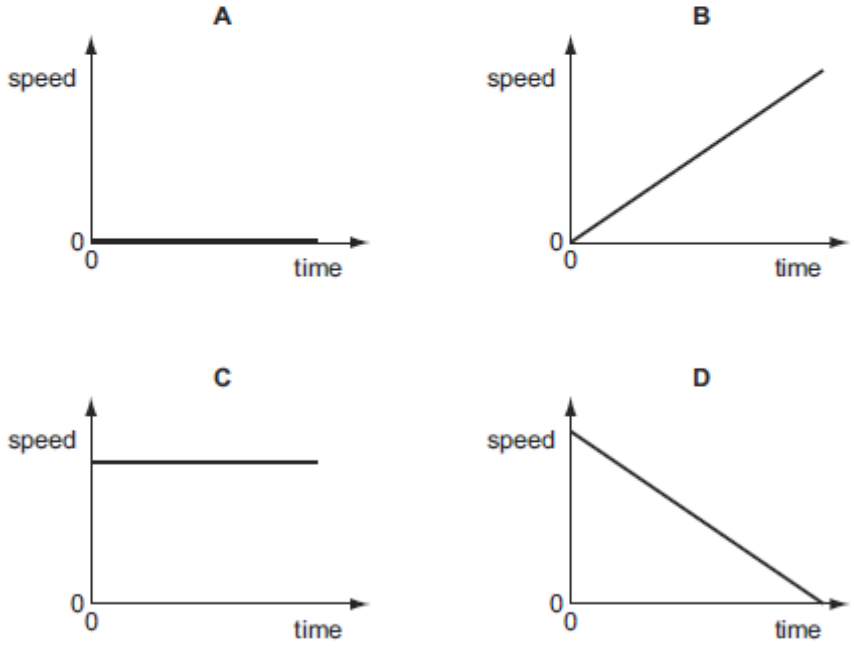
The can rolls over twice.

What is the circumference (distance all round) of the can? **[1]**

A 13 cm **B** 14 cm **C** 26 cm **D** 28 cm

2 A car is moving downhill along a road at a constant speed.

Which graph is the speed / time graph for the car?



[1]

3 In a race, a car travels 60 times around a 3.6 km track. This takes 2.4 hours.

What is the average speed of the car? **[1]**

A 1.5 km / h **B** 90 km / h **C** 144 km / h **D** 216 km / h

4 Which statement about mass and weight is correct?

A Mass and weight are both forces.

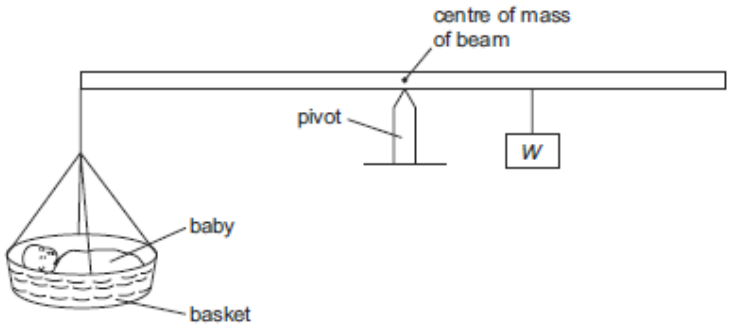
B Neither mass nor weight is a force.

C Only mass is a force.

D Only weight is a force. **[1]**

5 The diagram shows a balance being used to find the weight of a baby. The weight of the basket can be ignored.

At equilibrium, the pivot is nearer to the weight *W* than to the baby.



What is the weight of the baby?

A less than *W*

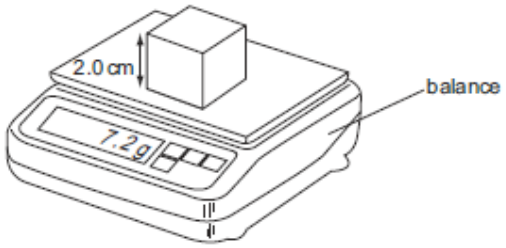
B more than *W*

C *W*

D impossible to tell

[1]

6 A cube of side 2.0 cm is placed on a balance.

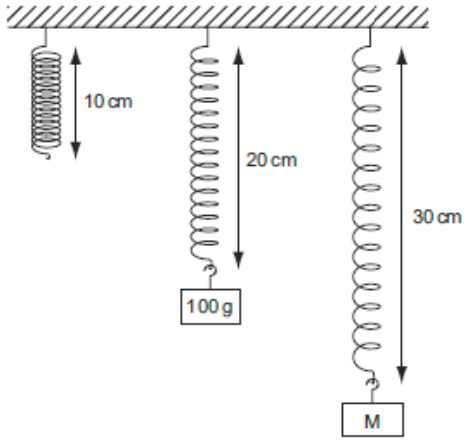


What is the density of the cube?

A 0.90 g/cm^3 **B** 1.2 g/cm^3 **C** 1.8 g/cm^3 **D** 3.6 g/cm^3

[1]

7 Objects with different masses are hung on a spring. The diagram shows how much the spring stretches.



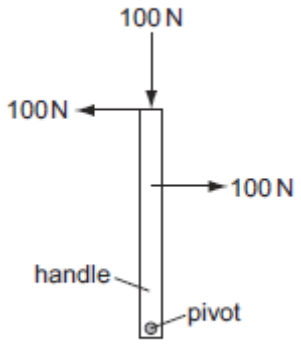
The extension of the spring is directly proportional to the mass hung on it.

What is the mass of object M?

A 110 g **B** 150 g **C** 200 g **D** 300 g

[1]

8 The diagram shows a handle with three forces, each 100 N, applied to it. The handle is free to move.



What is the effect of the forces on the handle?

A The handle will move downwards.

B The handle will not move.

C The handle will turn anticlockwise (to the left). **[1]**

D The handle will turn clockwise (to the right).

9 In which pair of energy sources are both sources renewable?

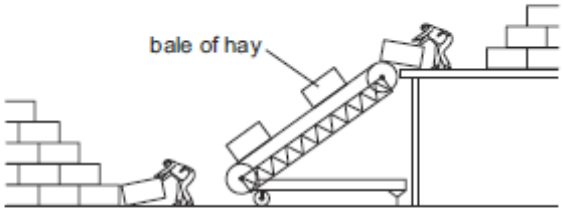
A oil and coal

B oil and tidal

C tidal and geothermal

D tidal and nuclear fission **[1]**

10 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.



As sunset approaches, they increase the speed of the motor so that more bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the motor?

	work done in lifting each bale	useful output power of the motor
A	increases	decreases
B	increases	increases
C	no change	decreases
D	no change	increases

[1]

11 A man lifts 20 bricks, each of weight 6 N.

What other information is needed to calculate the useful work done in lifting the bricks?

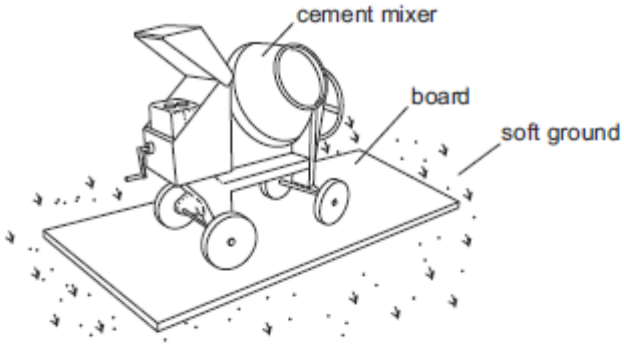
A the distance he lifts the bricks

B the mass of the bricks

C the time taken to lift the bricks **[1]**

D the volume of the bricks

12 To prevent a cement mixer sinking into soft ground, the mixer is placed on a large flat board.



Why does this prevent the mixer sinking?

A The large area decreases the pressure on the ground.

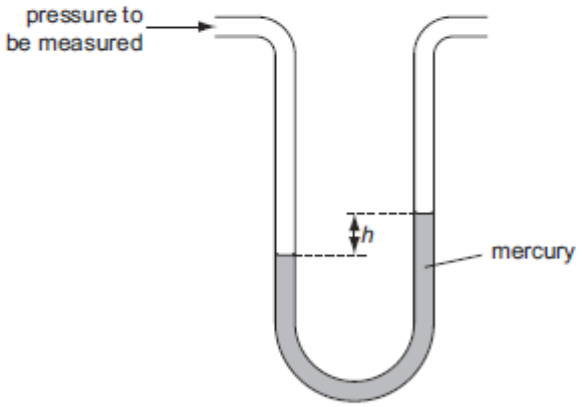
B The large area increases the pressure on the ground.

C The large area decreases the weight on the ground.

D The large area increases the weight on the ground.

[1]

13 The pressure of a gas is measured using a manometer as shown in the diagram.



The mercury in the manometer is replaced with a liquid which is less dense.

How does the value of *h* change?

A It becomes zero.

B It decreases, but not to zero.

C It stays the same.

D It increases.

[1]

14.

The circuit of Fig. 4.1 is set up to run a small immersion heater from a 6.0V battery.

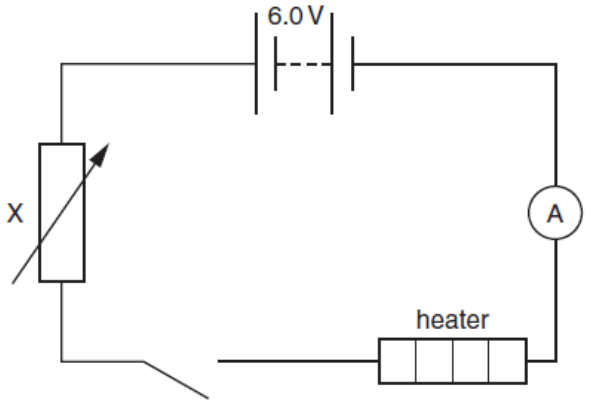


Fig. 4.1

(a) State the name and purpose of component X.

name .....

purpose .....[1]

(b) The heater is designed to work from a 3.6V supply. It has a power rating of 4.5W at this voltage.

(i) Calculate the current in the heater when it has the correct potential difference across it.

current = ...[2]

(ii) Calculate the resistance of component X if there is to be the correct potential difference across the heater. The battery and the ammeter both have zero resistance.

resistance = ...[3]

(c) Some time after the heater is switched on, the ammeter reading is seen to have decreased.

Suggest why this happens.

.....

.....[1]

(d) As an alternative to running the heater from a battery, it is decided to construct a circuit to enable it to be operated from the a.c. mains supply.

Name the electrical component needed to

(i) reduce the potential difference from that of the mains supply down to a potential difference suitable for the heater,

.....[1]

(ii) change the current from a.c. to a current which has only one direction.

.....[1]

15

Fig. 6.1 shows a glass flask full of water at 10 °C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

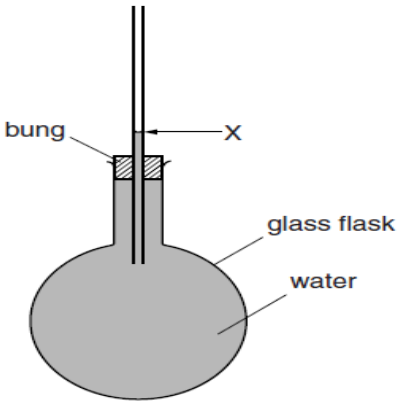


Fig. 6.1

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

(a) Suggest why

(i) the water level initially falls,

.....

..... [2]

(ii) the water level then rises,

.....

..... [2]

(iii) the rise is greater than the fall.

.....

..... [1]

(b) Suggest a change to the apparatus that would make the fall and rise of the water level greater.

.....

..... [1]

16 The circuit shown in Fig. 10.1 uses a 12V battery.

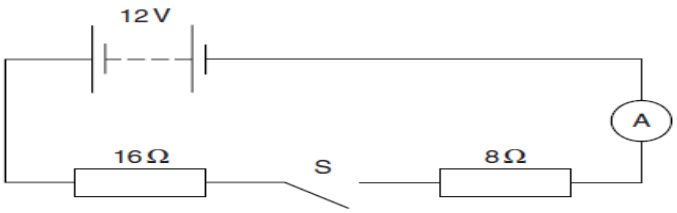


Fig. 10.1

(a) Switch S is open, as shown in Fig. 10.1.

State the value of

(i) the reading on the ammeter,

reading = ... [1]

(ii) the potential difference (p.d.) across S.

p.d. = ... [1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ... [2]

(ii) Calculate the p.d. across the 8 Ω resistor.

p.d. = ... [2]

Biology

1 A living organism, X, can make its own food, get rid of toxic materials and detect and respond to stimuli.

What other four processes must organism X carry out to stay alive?

A excretion, growth, movement, sensitivity

B excretion, growth, nutrition, respiration

C growth, movement, reproduction, respiration

D movement, reproduction, respiration, sensitivity

[1]

2 Which group of organisms has the following features?

- three pairs of jointed legs
- three-part segmented body
- one pair of antennae

A arachnids

B crustaceans

C insects

D myriapods

[1]

3 The table shows some characteristics of four different vertebrates.

Which vertebrate is a reptile?

	fins	legs	scales	hair
A				
B				
C				
D				

key

= feature present

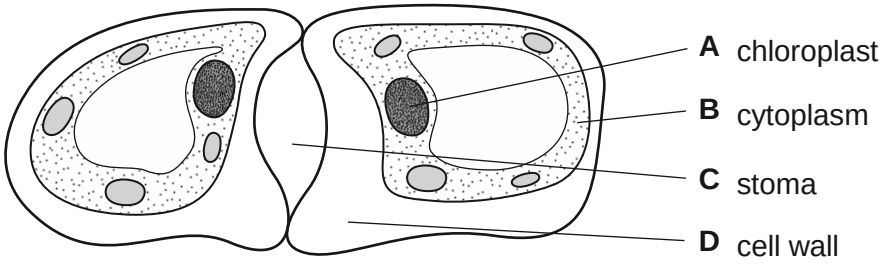
= feature absent

[1]

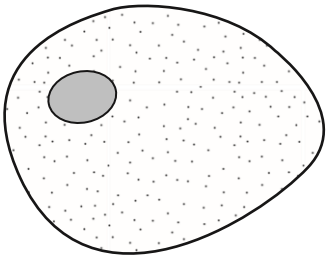
4 The diagram shows a student's drawing of guard cells.

Which label is not correct?

[1]



5 The diagram shows a liver cell.



Which structure is found in a palisade cell that is not present in this liver cell?

A cell membrane

B chloroplast

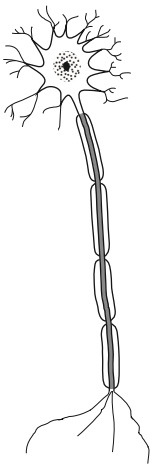
C cytoplasm

D nucleus

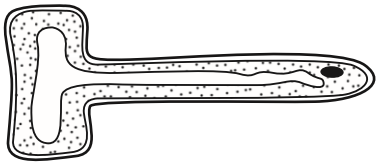
[1]

6 Which diagram shows a plant cell?

A



B



C



D



[1]

7 Which statement about cells or tissues, is correct?

A Cells in the respiratory tract are long and thin.

B Muscle cells are biconcave.

C Red blood cells have no nucleus.

D Xylem vessels have ciliated cells.

[1]

8 Why do some root cells have root hairs?

A for the maintenance of the temperature of the cell sap

B to increase the surface area of the cells

C to increase the volume of the cell sap

D to provide a place for cell nuclei

[1]

9 Which structures must be present in a cell for osmosis to take place?

A cell (sap) vacuole and cell wall

B cell wall and cell membrane

C chloroplast and cytoplasm

D cytoplasm and cell membrane

[1]

10 Which chemical reaction takes place in the stomach?

A Proteins are digested by protease.

B Proteins are digested into fatty acids.

C Starch is digested into amino acids.

D Starch is digested by lipase.

[1]

11. (a) Fig. 1.1 is a diagram of the human digestive system.

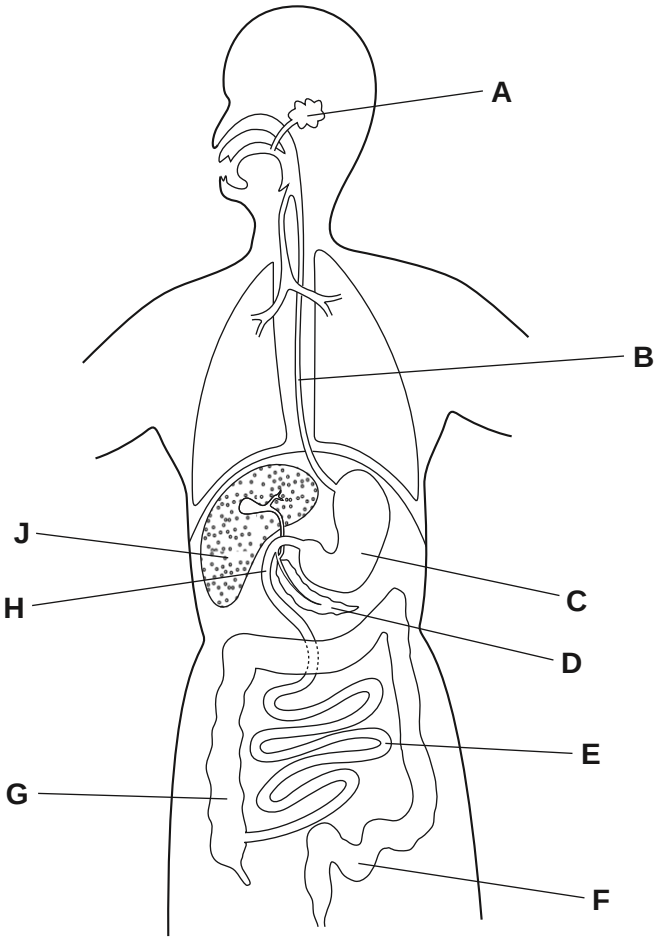


Fig. 1.1

Use the letters from Fig. 1.1 to complete Table 1.1 to give the part of the human digestive system that is identified by each function.

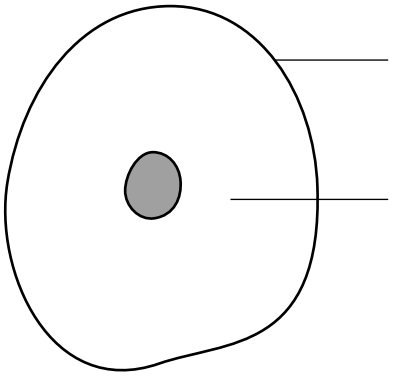
Write one letter only in each box. You may use the same letter more than once. There are some letters that you will not use. The first one has been done for you.

Table 1.1

function	letter
peristalsis	B
protein digestion	
insulin production	
deamination	
partially digested food is mixed with bile	

(4)

12. Fig. 1.1 shows an animal cell.



A.....

B.....

Fig. 1.1

(a) **(i)** Name the features labelled **A** and **B**.

Write your answers on Fig. 1.1. [2]

(ii) The nucleus of living cells contains genetic material.

Name the **chemical** that this genetic material is made from.

..... [1]

(b) The cell in Fig. 1.1 carries out aerobic respiration.

Name **one** chemical that diffuses into an animal cell **and** one chemical that diffuses out of a cell during aerobic respiration.

chemical that diffuses in .....

chemical that diffuses out .....

[2]

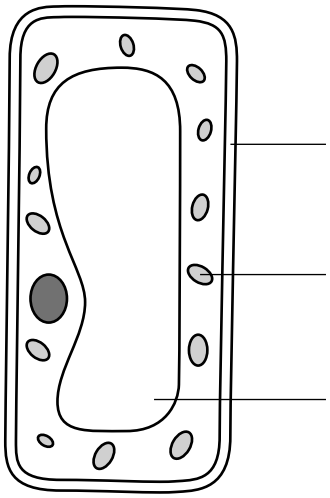
(c) The process of active transport occurs in some cells.

Outline **one** way in which diffusion is different to active transport.

.....

..... [1]

Fig. 1.2 shows a cell from the palisade mesophyll layer of a leaf.



C.....

chloroplast

D.....

Fig. 1.2

(d) (i) Name the features labelled **C** and **D**.

Write your answers on Fig. 1.2. [2]

(ii) Name the process carried out by the chloroplasts **and** explain why all animal life depends on this process.

name of process .....

explanation .....
.....
.....
.....
.....
.....
.....
.....
.....

[5]

13. Fig. 3.1 shows a section through the skin.

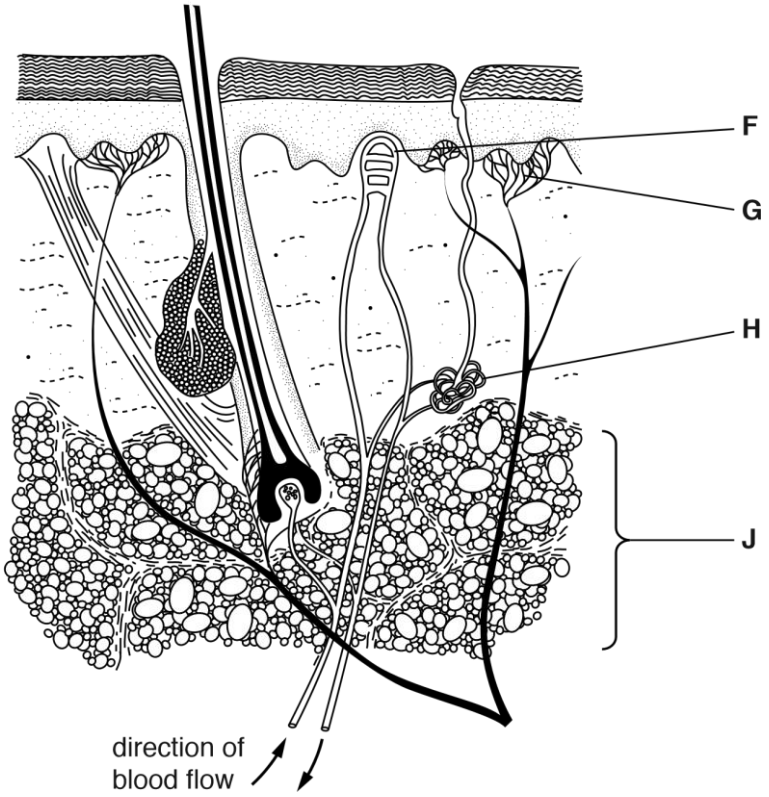


Fig. 3.1

(a) Name the structures labelled in Fig. 3.1 and outline a function in the skin for each one.

Write your answers in Table 3.1.

An example has been done for you.

Table 3.1

structure	name of structure	function in the skin
F		
G		
H	sweat gland	produces sweat for cooling the body
J		

[1]

14. Choose words from the list to complete the sentences about hormones.

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

adrenaline	**blood**	**decrease**	**glands**
increase	**insulin**	**nerves**	**main**
saliva	**system**	**target**	**urine**

Hormones are chemicals produced by ..... .

Hormones are carried round the body by the ..... .

A hormone affects the activity of one part of the body called the ..... organ.

After a person has eaten a meal the pancreas releases the hormone ..... .

One of the effects of this hormone is to lower the glucose level in the ..... . [5]