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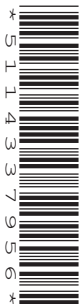
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CENTRE
NUMBER

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COMBINED SCIENCE

5129/21

Paper 2

October/November 2017

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 24.

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 **22** printed pages and **2** blank pages.

- 1 A student lifts a sack of mass 50 kg through a vertical distance of 2.4 m in 0.80 s.

The gravitational field strength g is 10 N/kg.

Calculate

- (a) the useful work done to lift the sack,

work done = J [2]

- (b) the average useful power output of the student.

power output = W [2]

- 2 Use words from the list to complete the sentences about functions of the liver.

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

amino acids

antibodies

fats

glycogen

hormones

kidneys

lungs

starch

The liver forms urea from excess

Urea is then taken by the blood to the where it is excreted.

The liver converts excess glucose into and stores it.

Amino acids and are destroyed by the liver.

[4]

3 Ethene burns in an excess of oxygen to form carbon dioxide and water.

The equation for the reaction is



The relative molecular mass of ethene is 28 and the relative molecular mass of water is 18.

[A_r: O, 16; C, 12]

(a) (i) Calculate the relative molecular mass of carbon dioxide.

.....[1]

(ii) Complete the following sentences.

28 g of ethene produces g of carbon dioxide and g of water.

0.7 g of ethene produces g of carbon dioxide. [3]

(b) Complete the diagram to show the bonds in a molecule of ethene.



[1]

4 A beam rests on a pivot.

The weight of the beam is negligible.

Masses **W**, **X** and **Y** are placed on the beam, as shown in Fig. 4.1.

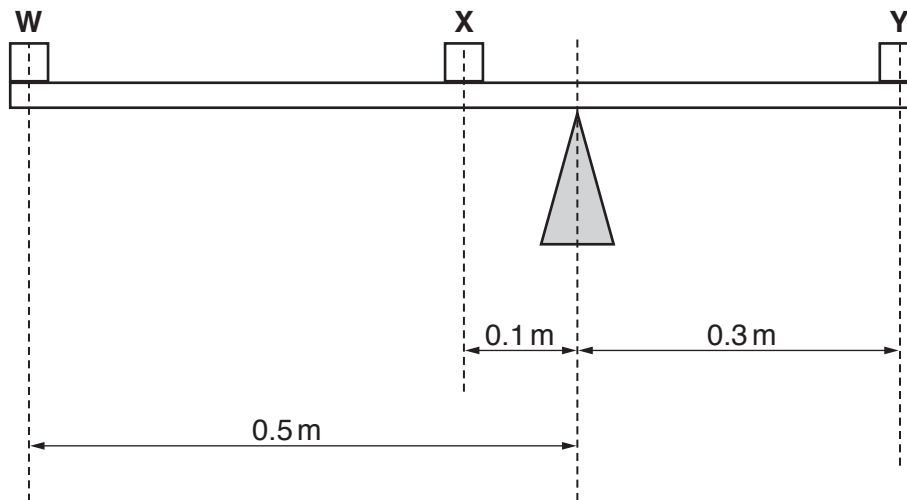


Fig. 4.1

The weight of mass **Y** is 12 N and the weight of mass **W** is 4 N.

Calculate the weight of mass **X** that balances the beam.

weight = N [3]

- 5 Muscle cells respire aerobically during mild exercise. During strenuous exercise muscle cells also respire anaerobically.

Complete Table 5.1 to show the comparison between aerobic and anaerobic respiration.

Write a tick (✓) where a statement is correct and a cross (✗) where it is not correct.

One row has been done for you.

Table 5.1

statement	aerobic respiration	anaerobic respiration
oxygen is used		
glucose is used		
large amount of energy released	✓	✗
carbon dioxide is produced		
lactic acid is produced		

[4]

6 Ammonia is manufactured using the Haber process.

In the Haber process, nitrogen and hydrogen are heated together in the presence of a catalyst.

(a) (i) Draw circles around the values of temperature and pressure used in the Haber process.

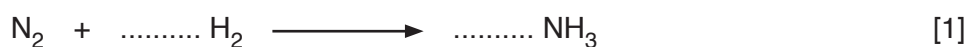
temperature / °C	150	250	350	450
pressure / atm	100	200	300	400

[2]

(ii) Name the catalyst used in the reaction.

.....[1]

(iii) Balance the equation for the reaction.



(b) Complete Fig. 6.1 to show the outer electrons in a molecule of ammonia.

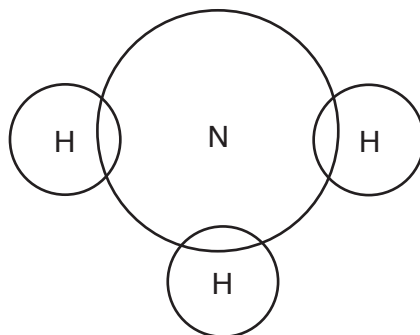


Fig. 6.1

[2]

(c) State **one** use of ammonia.

.....[1]

7 Microwaves are part of the electromagnetic spectrum.

(a) (i) Name an electromagnetic wave with a **higher** frequency than microwaves.

.....[1]

(ii) State the speed of microwaves in a vacuum.

speed = m/s [1]

(b) The frequency of the microwaves is 2.4×10^9 Hz.

Use your answer to (a)(ii) to calculate the wavelength of the microwaves.

wavelength =m [2]

(c) Microwave radiation is incident on a metal surface, as shown in Fig. 7.1.

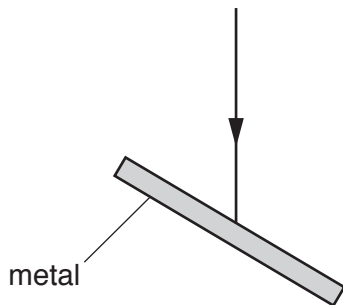


Fig. 7.1

On Fig. 7.1, draw

1. the normal to the surface at the point where the microwave radiation is incident on the metal,
2. a ray to show the direction of the microwave radiation after reflection from the metal surface.

[2]

8 Fig. 8.1 shows a white blood cell, as seen using a microscope.

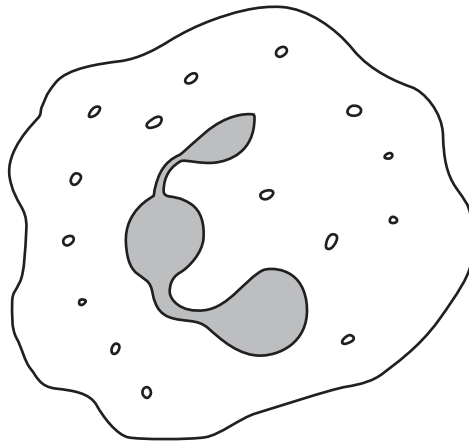


Fig. 8.1

(a) On Fig. 8.1, label the nucleus with the letter N. [1]

(b) (i) State and explain why the cytoplasm of a red blood cell is different to the cytoplasm of a white blood cell.

difference

explanation

.....

.....

[2]

(ii) State **two** differences in structure between a white blood cell and a mesophyll cell of a leaf.

1

.....

2

.....

[2]

- 9 (a) In Fig. 9.1, the boxes on the left show the names of some metals.

The boxes on the right show the reaction of elements with water and with dilute hydrochloric acid.

Draw **one** line from each metal to its reaction.

metal	reaction
calcium	no reaction with cold water but reacts vigorously with steam
copper	reacts vigorously with cold water
sodium	no reaction with hydrochloric acid or steam
zinc	reacts slowly with cold water

Fig. 9.1

[4]

- (b) When a metal reacts with water, hydrogen gas is released.

Describe the test and the result of the test for hydrogen gas.

test

result

[2]

10 The volume of blood pumped out of the heart per minute is called the *cardiac output*.

Fig. 10.1 shows how the cardiac output for two students, **F** and **G**, changes as the rate of exercise increases.

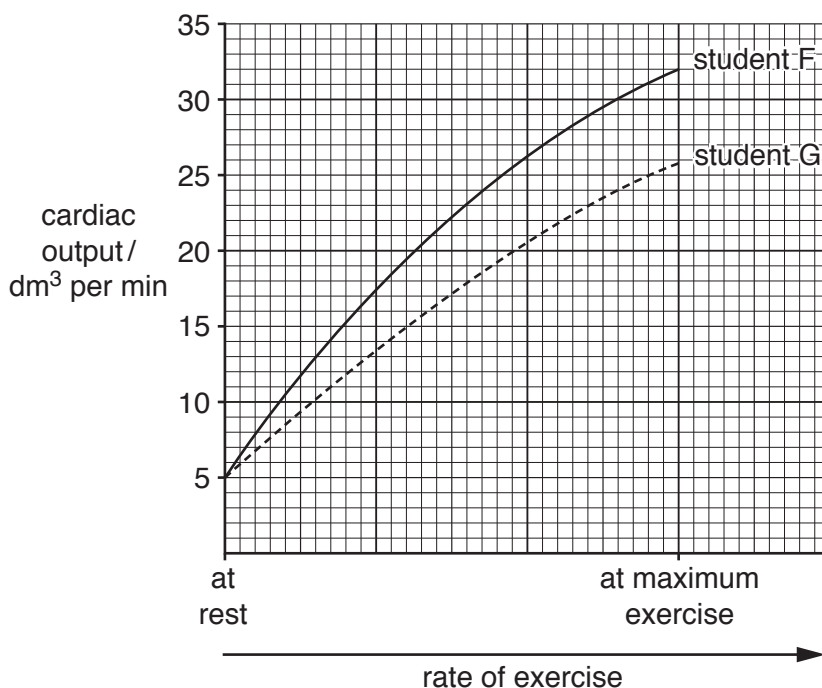


Fig. 10.1

(a) (i) State the cardiac output for student **F** when at rest and at maximum rate of exercise.

cardiac output at rest = dm³ per min

cardiac output at maximum rate of exercise = dm³ per min [1]

(ii) Use your answers to (a)(i) to calculate the increase in cardiac output for student **F** from rest to maximum rate of exercise.

increase = dm³ per min [1]

(iii) Calculate the percentage increase in cardiac output for student **F** between being at rest and at maximum rate of exercise.

percentage increase = [1]

(b) Suggest **two** ways in which the action of the heart changes during exercise to produce an increase in cardiac output.

1

.....

2

.....

[2]

(c) Suggest **one** reason for the difference in the cardiac output of students **F** and **G** when exercising.

.....

.....[1]

- 11 A girl rubs a balloon on her hair.

The balloon gains electric charge.

She holds the balloon against a window.

When she removes her hand, the balloon stays on the glass and does not fall, as shown in Fig. 11.1.

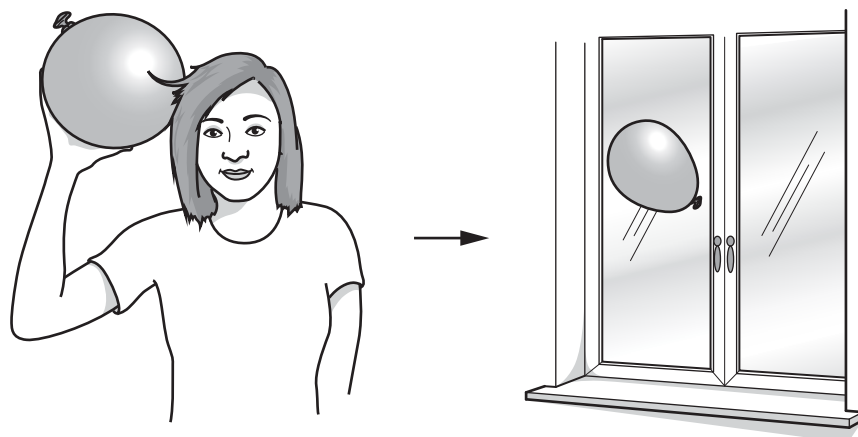


Fig. 11.1

Explain why the balloon stays on the glass.

.....

.....

.....

..... [3]

- 12 Complete the following sentences about the structure of an isotope of silicon, which is represented by the symbol, ${}_{14}^{30}\text{Si}$.

The of an element determines the position of the element in the Periodic Table.

This isotope of silicon contains protons and neutrons.

Isotopes of the same element have different numbers of

The electronic structure of the silicon atom is [4]

13 Fig. 13.1 shows different objects. These are reflectors **A** and **B**, lens **C** and glass block **D**.

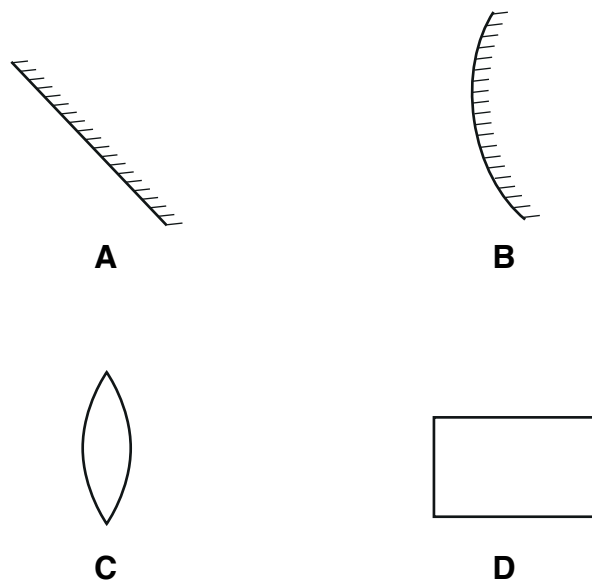


Fig. 13.1

Some of the objects shown in Fig. 13.1 are hidden behind some screens.

Parallel rays of light are aimed at the objects behind the screens. The light rays behave as shown in Fig. 13.2.

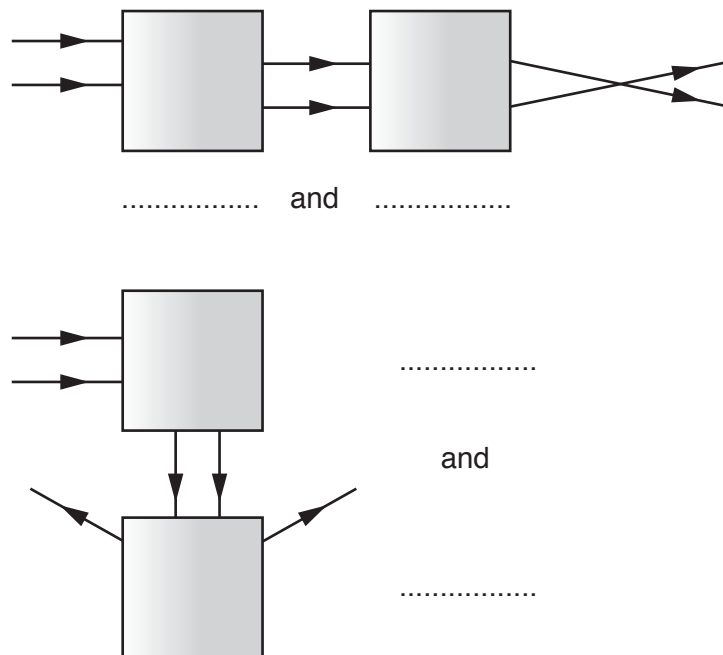


Fig. 13.2

On the dotted lines in Fig. 13.2, write the letters of the objects from Fig. 13.1 that must be placed behind each of the screens.

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

[4]

14 Fig. 14.1 shows a section through a germinating seed.

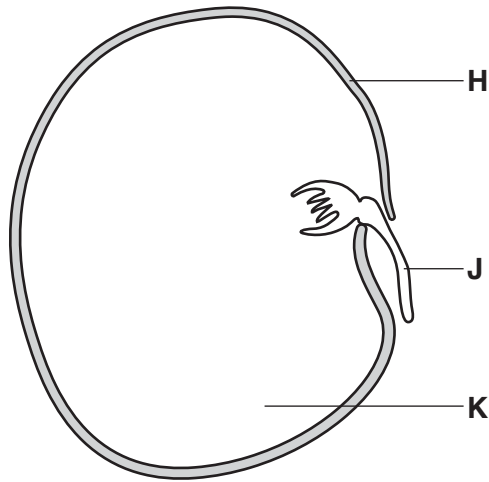


Fig. 14.1

(a) Identify structures H, J and K.

H

J

K

[3]

(b) Fig. 14.2 shows a fertile seed that has been planted in soil.

The soil temperature is 25 °C.

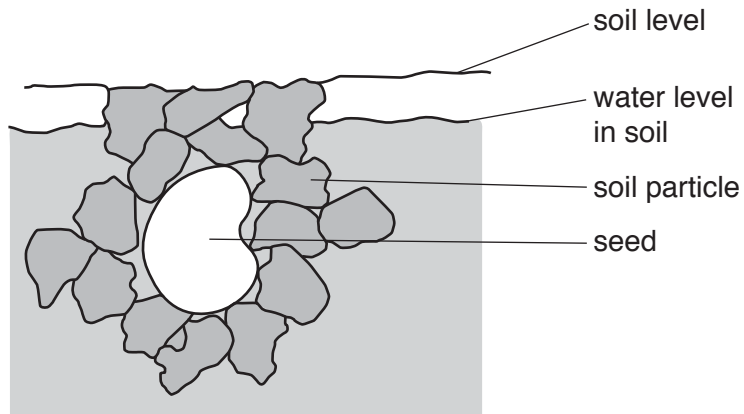


Fig. 14.2

After several weeks, the seed has not germinated.

Explain why germination has not taken place.

.....

.....

.....

.....

[2]

15 A list of apparatus is shown.

balance beaker burette condenser
filter funnel measuring cylinder pipette thermometer

From the list, name **one** piece of apparatus which **must** be used for each of the experiments.

Each piece of apparatus may be used once, more than once, or not at all.

- (a) distilling sea water [1]
- (b) accurately measuring 24.5 cm³ of a liquid [1]
- (c) separating coloured dyes [1]
- (d) titrating an acid with an alkali [1]

16 Two coils, X and Y are placed close to one another, as shown in Fig. 16.1.

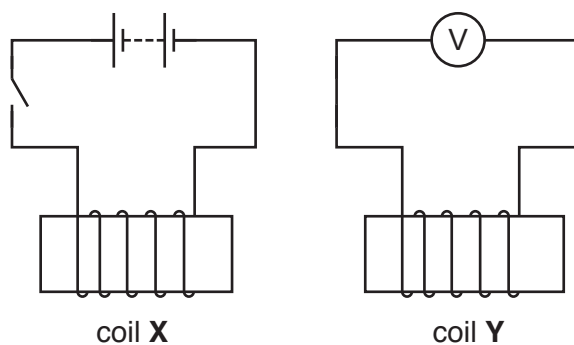


Fig. 16.1

Coil X is connected to a battery and a switch.

A voltmeter is connected across coil Y.

(a) Explain why there is a reading on the voltmeter for a short time as the switch is closed.

.....

.....

.....

..... [3]

(b) Coil X and coil Y are now moved further apart.

Predict how the deflection of the voltmeter will change when the switch is closed.

Explain your answer.

prediction

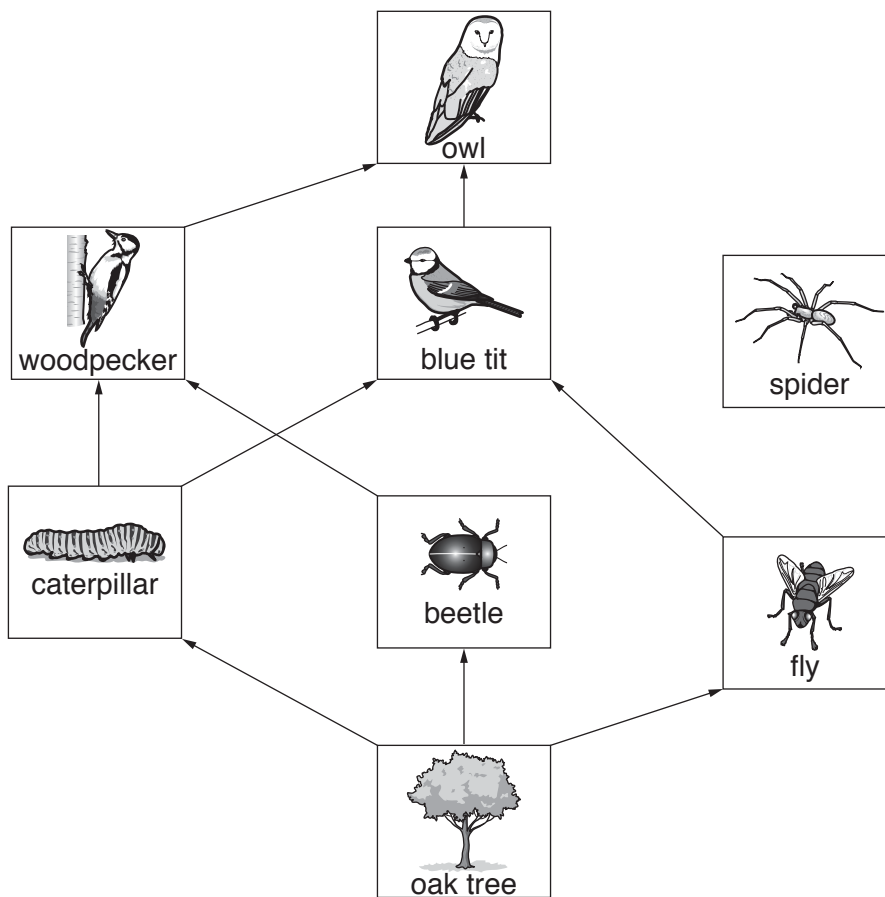
.....

explanation

.....

[2]

17 Part of a food web is shown in Fig. 17.1.



not drawn to scale

Fig. 17.1

(a) Some spiders move into the oak tree.

Spiders eat flies. Blue tits eat spiders.

Complete Fig. 17.1 to show this information. [2]

(b) Name the organism that is the source of energy for all other organisms shown in Fig. 17.1.

.....[1]

(c) The woodpeckers in this food web die out.

Suggest and explain what happens to the number of blue tits in the food web.

.....

[2]

18 Sulfur is an element. Water is a compound.

Describe the difference between an element and a compound using sulfur and water as examples.

.....

.....

.....

.....[3]

19 The nuclide notation of an atom is



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

atom electron element
neutron nucleon nuclide proton

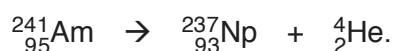
Each word may be used once, more than once, or not at all.

X is the symbol for the

A is the number.

Z is the number. [2]

(b) The radioactive decay of americium-241 (Am) is represented by the equation



(i) Describe the radioactive decay process shown in the equation.

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

(ii) The emission from americium-241 may be used to produce charged air molecules.

State the name of the process that produces charged air molecules.

.....[1]

(iii) The charged air molecules move in part of a circuit that produces a current of 1.0×10^{-11} A.

The current is through a resistor of resistance $4.5 \times 10^7 \Omega$.

Calculate the potential difference across the resistor.

State the unit.

potential difference = unit [3]

20 Fig. 20.1 shows part of the alimentary canal and some associated organs.

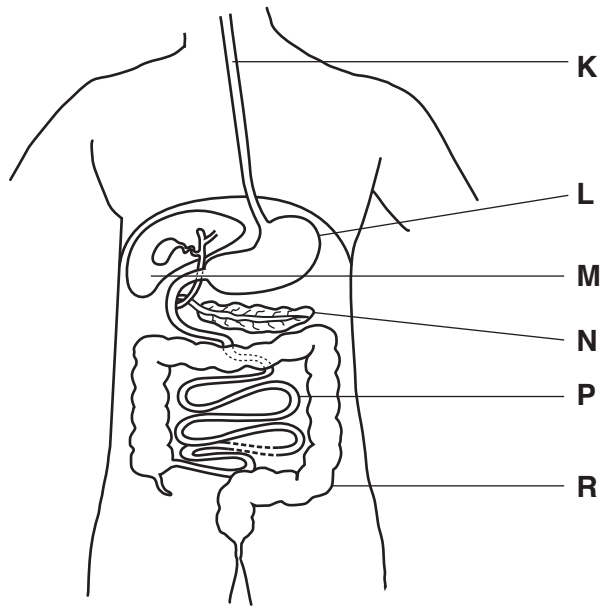


Fig. 20.1

(a) Use letters from Fig. 20.1 to identify the stomach and the colon.

stomach

colon

[2]

(b) Explain how food is moved along the ileum.

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

21 Natural gas and petroleum are sources of fuels.

(a) Name the main constituent of natural gas.

.....[1]

(b) Name the process used to separate petroleum.

.....[1]

(c) When a fuel burns, energy is released.

State the name given to reactions that release energy.

.....[1]

(d) Petroleum is a mixture of hydrocarbons.

Explain what is meant by the term *hydrocarbon*.

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

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The Periodic Table of Elements

Group																																																																																											
I	II	Key										III	IV	V	VI	VII	VIII																																																																										
		atomic number atomic symbol name relative atomic mass																																																																																									
3 Li lithium 7	4 Be beryllium 9	1 H hydrogen 1	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	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	87 Fr francium —	88 Ra radium —	89–103 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 —	86 Rn radon —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —
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 dm³ at room temperature and pressure (r.t.p.).