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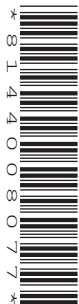
CANDIDATE
NAME

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COMBINED SCIENCE

0653/31

Paper 3 Theory (Core)

October/November 2023

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 **20** pages.

1 (a) Fig. 1.1 shows the female reproductive system in humans.

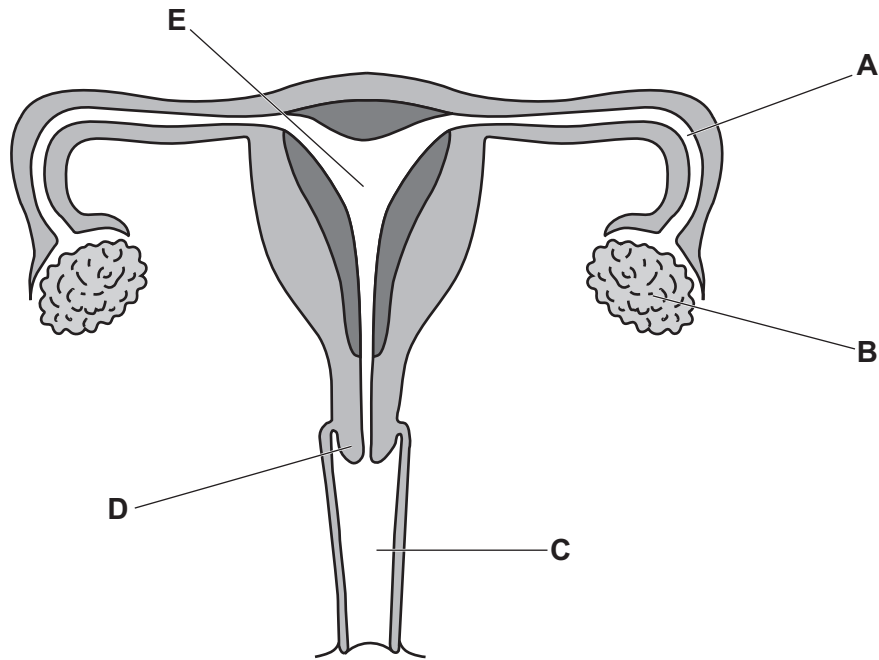


Fig. 1.1

State the letter in Fig. 1.1 that identifies:

- the cervix
- where eggs are released from
- where fertilisation takes place.

[3]

(b) (i) Complete the definition of fertilisation in humans.

Fertilisation is the fusion of the from a male gamete and a female gamete to form a zygote. [1]

(ii) Describe the early development of a zygote.

.....

 [2]

- (c) A study records the number of new human immunodeficiency virus (HIV) infections each year in people from one region of a country.

Fig. 1.2 shows a chart of the results.

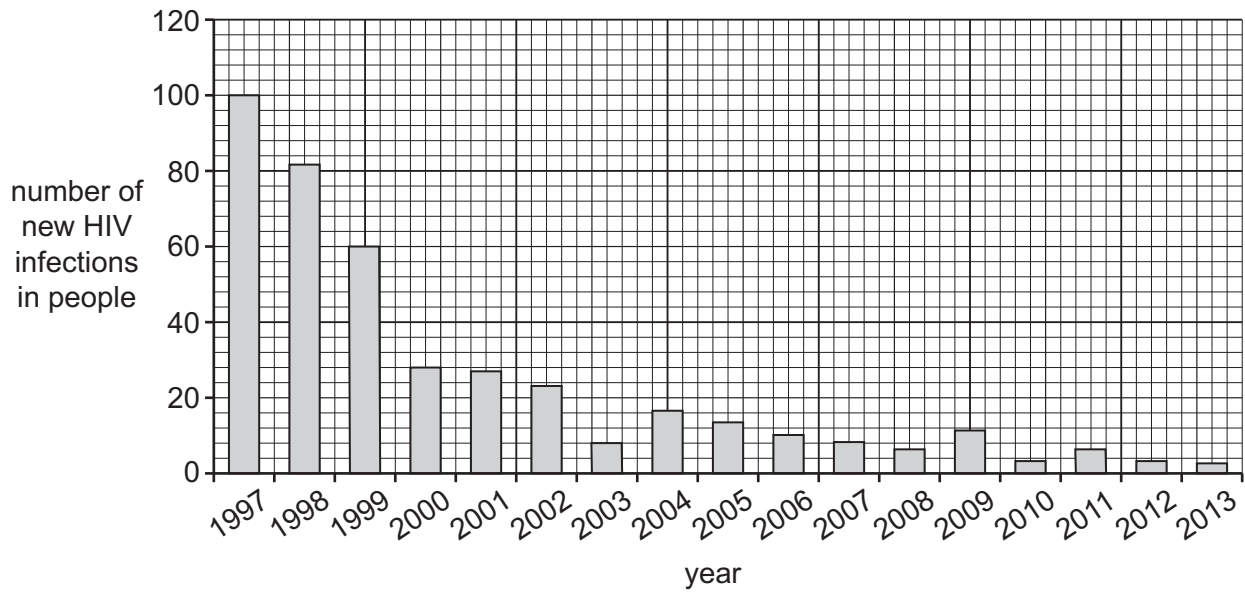


Fig. 1.2

- (i) Identify the year in Fig. 1.2 with a total of 60 new HIV infections in people.

..... [1]

- (ii) Describe the trend shown in Fig. 1.2 between 1997 and 2013.

.....
 [1]

- (iii) Describe **two** ways that HIV is transmitted from person to person.

1

2

[2]

[Total: 10]

2 A student dissolves sodium carbonate, Na_2CO_3 , in water to form aqueous sodium carbonate.

(a) (i) State a chemical test for water and the observation for a positive result.

test

observation

[2]

(ii) Complete Fig. 2.1 to show the dot-and-cross diagram of a molecule of water.

Show all of the outer shell electrons.

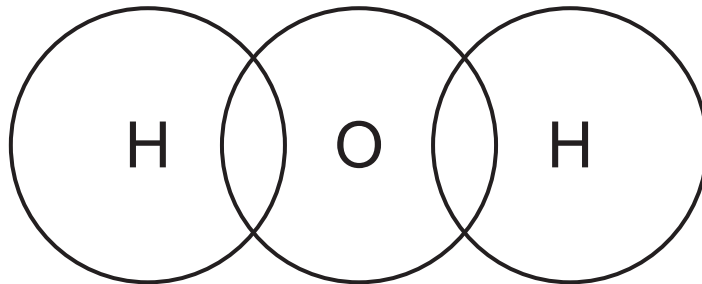


Fig. 2.1

[2]

(b) The student measures the boiling point of the aqueous sodium carbonate.

(i) State the piece of apparatus used to measure the temperature of the boiling point of the aqueous sodium carbonate.

..... [1]

(ii) State whether boiling is a chemical or a physical change.

Give a reason for your answer.

change

reason

.....

[1]

(iii) During boiling, thermal energy (heat) is taken in.

State the name for the type of process that takes in thermal energy.

..... [1]

(c) The student adds dilute hydrochloric acid to a sample of aqueous sodium carbonate.

Complete the word equation for the reaction.



[2]

[Total: 9]

3 Fig. 3.1 shows the forces acting on an aircraft in flight.

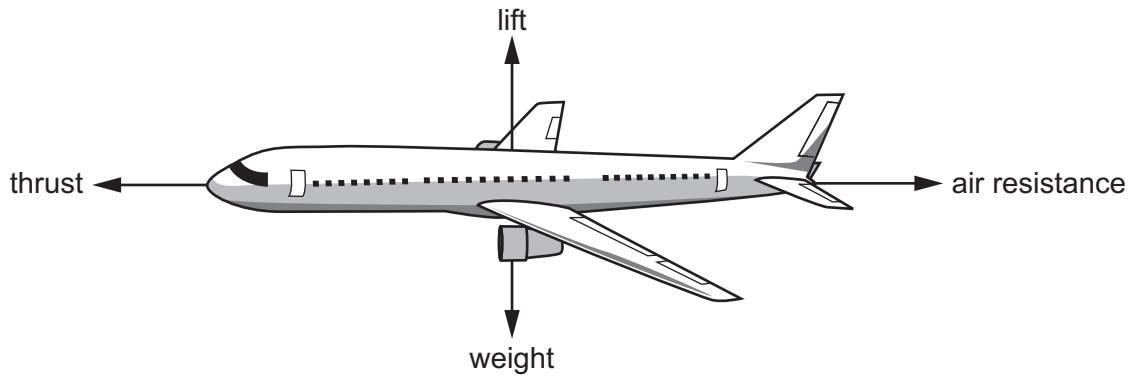


Fig. 3.1

(a) The aircraft has a mass of 190 000 kg.

(i) Calculate the weight of the aircraft.

The gravitational force on unit mass g is 10 N/kg.

weight = N [2]

(ii) Complete the sentences about air resistance.

Air resistance is a force that acts on an object moving through air. Air resistance is a form of [1]

(iii) The body of the aircraft is made of an aluminium alloy with a density of 2800 kg/m³.

The mass of the aluminium alloy is 120 000 kg.

Calculate the volume of the aluminium alloy.

volume = m³ [2]

(b) Complete the sentences about energy transfers.

The aircraft uses fuel for combustion. When the aircraft climbs higher at a constant speed, energy is transferred from energy to energy.

[2]

(c) The aircraft travels a distance of 1950 km in a time of 4 h 15 min.

Calculate the average speed for this journey in km/h.

speed = km/h [3]

[Total: 10]

4 (a) Transpiration is loss of water vapour from plant leaves.

(i) Describe the effect of temperature on transpiration.

.....
 [1]

(ii) Plants take in more water than is lost from the leaves.

State **one** use of water in plants.

..... [1]

(b) Fig. 4.1 is a photomicrograph of some of the cells in a plant root.

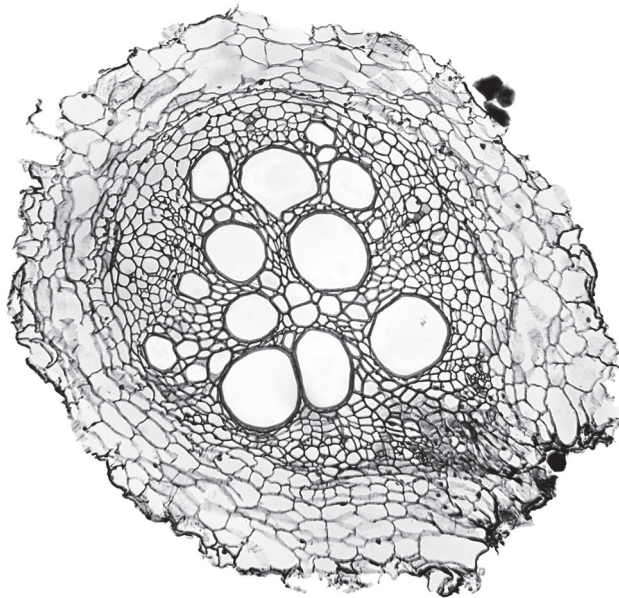


Fig. 4.1

(i) Draw a label line and the letter **X** on Fig. 4.1 to identify a xylem vessel. [1]

(ii) Water is transported from the soil to the xylem vessels through two types of cell.

State the names of the **two** types of cell.

1

2

[2]

(c) Plants and animals are both sources of food for humans.

A balanced diet needs to contain fibre and starch.

(i) State the dietary importance of fibre.

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

(ii) Circle the food that is a principal source of fibre.

chicken **eggs** **milk** **potatoes** [1]

(iii) State the name of the smaller molecules that starch is made from.

..... [1]

[Total: 8]

5 Copper is a transition element.

Aluminium is a metal in Group III of the Periodic Table.

(a) State **one** general physical property of metals.

..... [1]

(b) Copper is extracted from copper oxide in a process that uses carbon.

Aluminium is extracted from its ore by a different process.

(i) Describe **one** condition required for the extraction of copper from copper oxide using carbon.

..... [1]

(ii) Suggest why aluminium **cannot** be extracted from its ore using carbon.

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

(iii) State the name of an ore of aluminium.

..... [1]

(iv) Recycling metals uses less energy and costs less than extracting metals from their ores.

Suggest **one** other reason why metals are recycled.

..... [1]

(c) Aluminium alloys are used to make aircraft bodies.

(i) State what is meant by the term alloy.

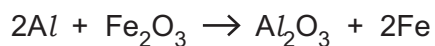
.....
..... [1]

(ii) Suggest **one** reason why aluminium alloys, rather than pure aluminium, are used to make aircraft bodies.

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

(d) Aluminium reacts with iron(III) oxide, Fe_2O_3 , at high temperatures.

The equation for this reaction is shown.



Identify **one** substance that is oxidised and **one** substance that is reduced during this reaction.

oxidised

reduced

[1]

[Total: 8]

- 6 A student determines the resistance of resistor **R**.

Fig. 6.1 shows resistor **R** connected in series with a battery and an ammeter.

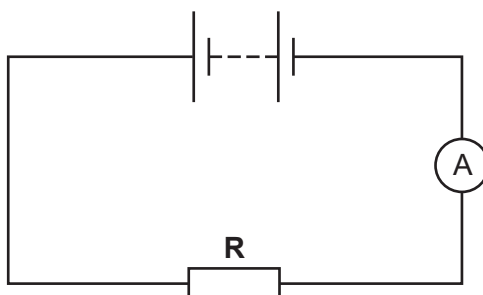


Fig. 6.1

- (a) The reading on the ammeter is 0.24A.

- (i) State the name of the **quantity** measured by the ammeter.

..... [1]

- (ii) The student connects a voltmeter to measure the potential difference (p.d.) across resistor **R**.

On Fig. 6.1, draw a voltmeter symbol and show how the student connects the voltmeter to take this measurement. [2]

- (iii) The potential difference across resistor **R** is 3.6V.

Calculate the resistance of resistor **R**.

Give the unit of your answer.

resistance = unit [3]

(b) Resistor **S** has the same resistance as resistor **R**.

(i) The student connects resistor **S** in series with resistor **R**.

Fig. 6.2 shows the circuit.

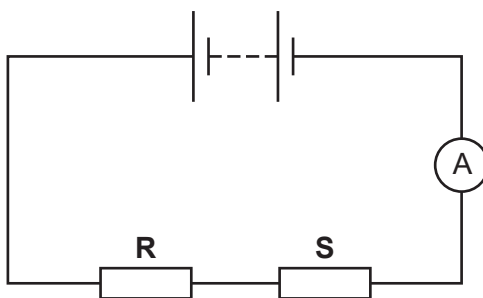


Fig. 6.2

State the reading on the ammeter.

reading =A [1]

(ii) The student connects resistor **S** in parallel with resistor **R**.

Fig. 6.3 shows the circuit.

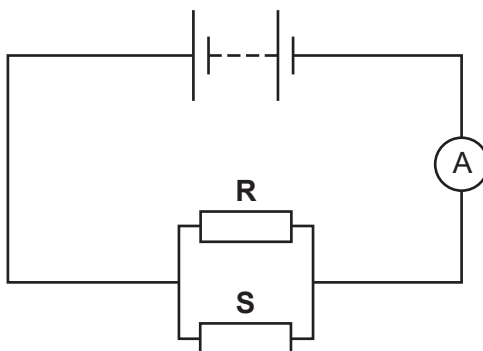


Fig. 6.3

Describe how the reading on the ammeter compares to the reading in (a).

Give a reason for your answer.

description

reason

.....

.....

[2]

[Total: 9]

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

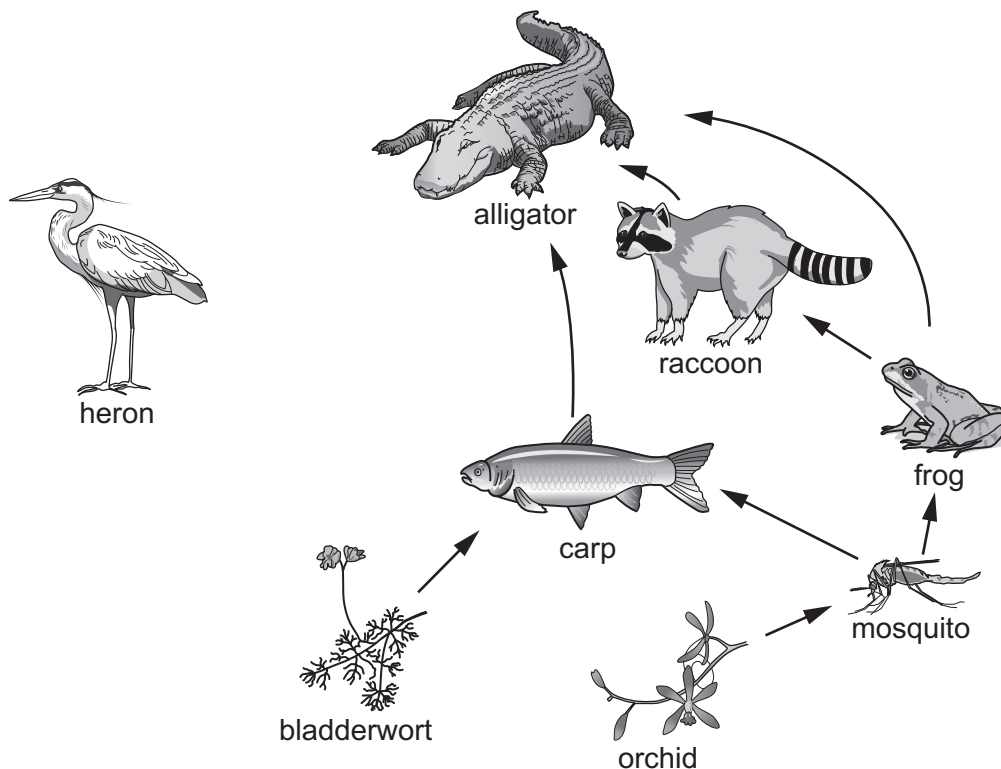


Fig. 7.1

(i) The food web is **not** complete.

The heron eats the carp. The alligator eats the heron.

Draw **two** arrows on Fig. 7.1 to show these feeding relationships. [1]

(ii) State the name of **one** producer shown in Fig. 7.1.

..... [1]

(iii) Complete the sentences about the food web in Fig. 7.1.

The mosquito eats the orchid. The mosquito is a consumer.

The frog eats the mosquito. The frog is a secondary consumer.

The raccoon eats the frog. The raccoon is a consumer. [2]

(b) All living organisms respire.

State the **word** equation for aerobic respiration.

..... [2]

(c) (i) Fig. 7.2 shows some of the pathway taken by food in the human alimentary canal.

Complete Fig. 7.2.

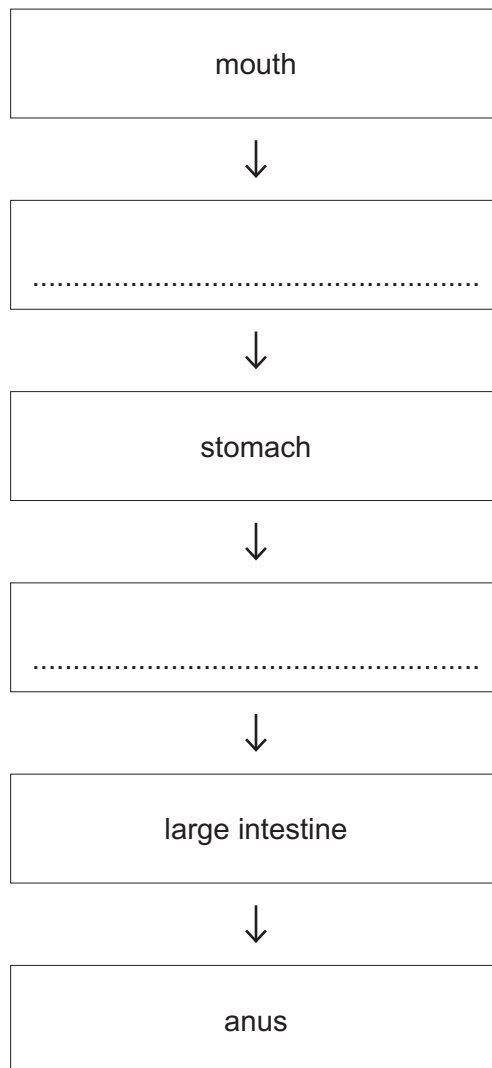


Fig. 7.2

[2]

(ii) Circle the function of the anus.

absorption

digestion

egestion

ingestion

[1]

[Total: 9]

8 Chlorine is in Group VII of the Periodic Table.

(a) A chlorine atom has 17 electrons and nucleon number 35.

(i) Complete Fig. 8.1 to show the electrons in this chlorine atom.

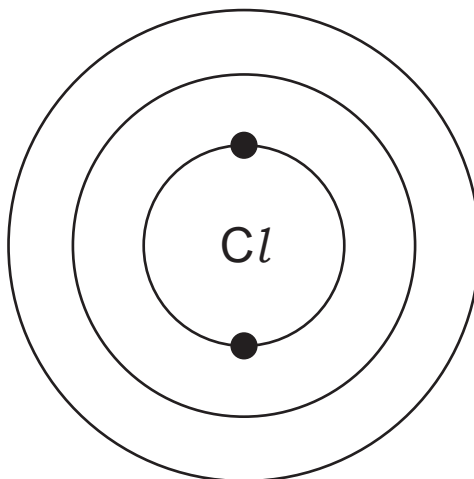


Fig. 8.1

[1]

(ii) Deduce the number of neutrons in this chlorine atom.

..... [1]

(b) Chlorine gas and aqueous sodium hydroxide are made when an electric current is passed through solution X.

(i) State the name of the process that breaks down compounds by passing an electric current through them.

..... [1]

(ii) Identify solution X.

..... [1]

(c) The elements in Group VII exist as diatomic molecules.

(i) State what is meant by the term diatomic.

.....

..... [1]

(ii) Describe **two** trends in the properties of elements in Group VII, going down the group.

1

2

[2]

(d) Complete the sentences about the treatment of the water supply.

Use **one** word in each gap.

The process of is used to remove insoluble particles from the water.

The process of chlorination is used to kill in the water.

[2]

[Total: 9]

9 Many security measures are used in airports, including security scans of baggage, intruder alarms and video cameras.

(a) There are seven regions of the electromagnetic spectrum.

Fig. 9.1 shows an incomplete electromagnetic spectrum.

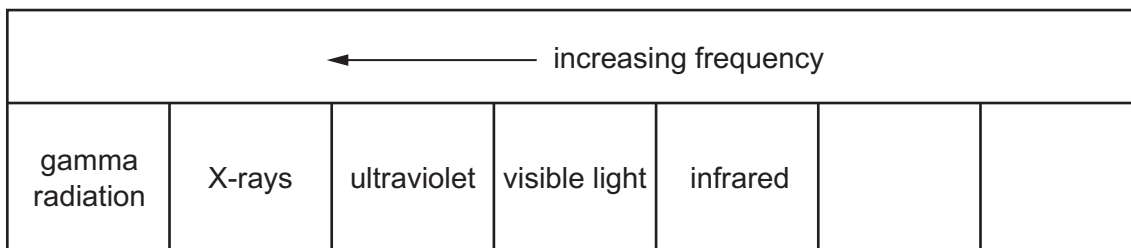


Fig. 9.1

(i) Complete Fig. 9.1. [2]

(ii) State which region of the electromagnetic spectrum is used for:

security scans of baggage

intruder alarms.

[2]

(b) An intruder alarm emits sound waves.

Fig. 9.2 represents two sound waves, **A** and **B**, shown to the same scale.

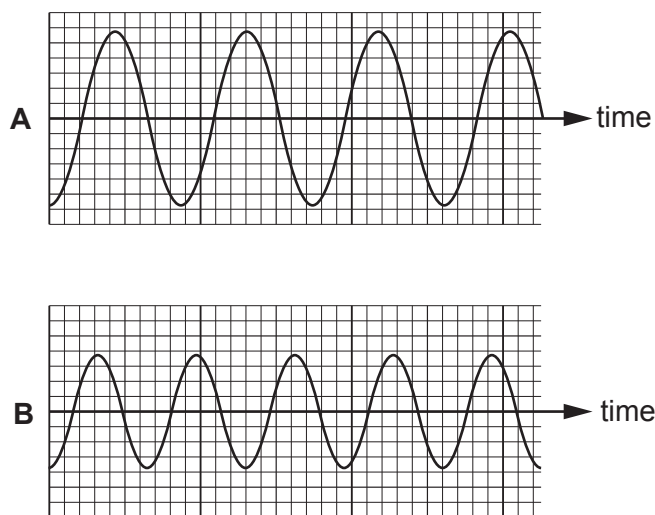


Fig. 9.2

State which sound wave is:

• lower pitch

• louder.

[1]

(c) Video cameras use thin converging lenses.

Fig. 9.3 shows a thin converging lens forming the real image of an object on a screen.

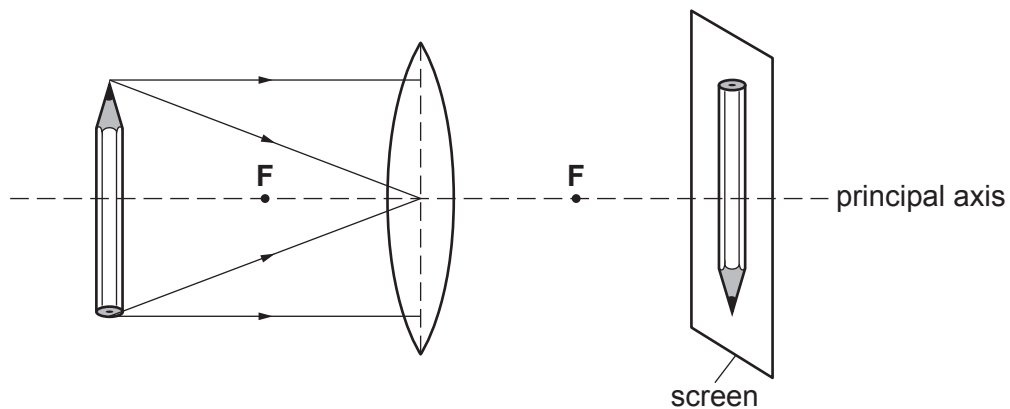


Fig. 9.3

- (i) On Fig. 9.3, use a double-headed arrow (\leftrightarrow or \updownarrow) to show the focal length of the lens. [1]
- (ii) On Fig. 9.3, complete the ray diagram to show the formation of the image on the screen. [2]

[Total: 8]

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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	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px;"> 1 H hydrogen 1 </div> <div style="border: 1px solid black; padding: 5px;"> Key atomic number atomic symbol name relative atomic mass </div> </div>																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 —	—	—

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.).