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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5067639773

CO-ORDINATED SCIENCES **0654/32**

Paper 3 Theory (Core) **May/June 2026**

2 hours

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. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / s^2).

INFORMATION

- The total mark for this paper is 120.
- 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 **28** pages. Any blank pages are indicated.

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1 Figure 1.1 shows a magnified image of a specialised plant cell.

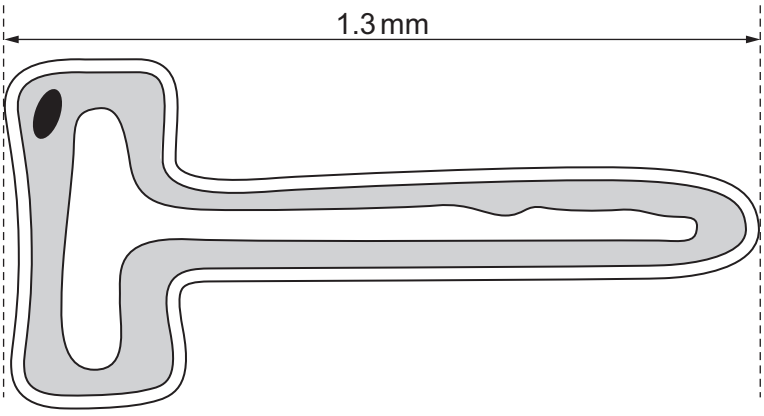

Figure 1.1

(a) Identify the type of plant cell shown in Figure 1.1.

..... [1]

(b) **(i)** The plant cell in Figure 1.1 grows rapidly to a length of 1.3 mm.

The image size of the plant cell in Figure 1.1 is 100 mm long.

Calculate the magnification of the plant cell in Figure 1.1.

magnification = ... [2]

(ii) Plants also grow by producing new cells.

State how new cells are produced in plants.

..... [1]

(c) The plant cell in Figure 1.1 is specialised for the uptake of water.

Complete the sentence about the movement of water into the cell.

Water diffuses into the cell by ..... through the partially ..... cell membrane.

[2]

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(d) Describe how the cell shown in Figure 1.1 is adapted to its function.

.....

.....

..... [2]

(e) Cells in the leaf of a plant are also adapted to their function.

Some of them contain a green pigment.

Name the green pigment and the plant cell structure that contains the green pigment.

green pigment .....

plant cell structure .....

[2]

(f) Figure 1.2 is a diagram of a leaf.

Part of the leaf has no green pigment.

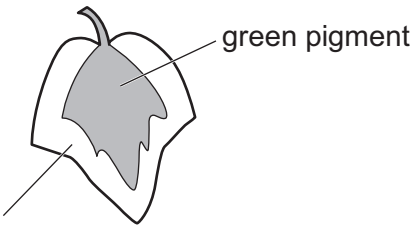

Figure 1.2

The glucose produced by photosynthesis is converted to starch in the leaf.

A student tests the different parts of the leaf for starch using iodine solution.

Complete Table 1.1 by predicting the results of the starch tests on the two different parts of the leaf shown in Figure 1.2.

Table 1.1

part of leaf	colour of iodine solution on leaf	starch present
no green pigment		
green pigment		

[2]

[Total: 12]

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2 Figure 2.1 shows a method used to reduce the risk of an infection passing from one person to another by direct contact.

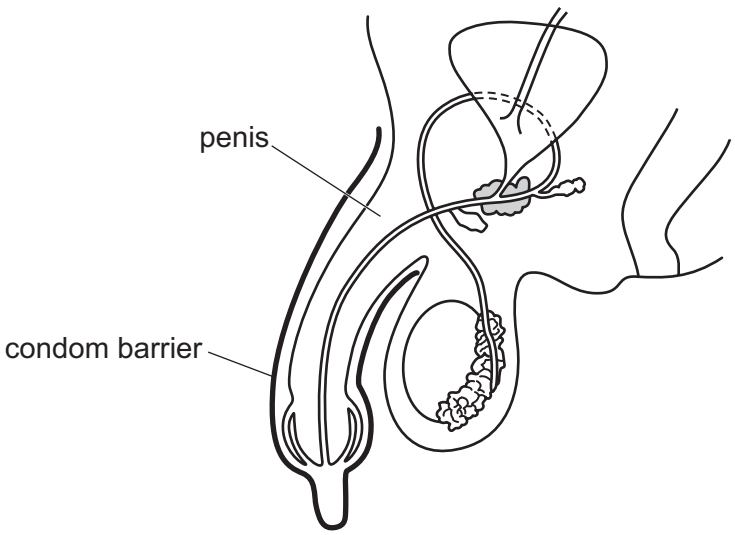

Figure 2.1

(a) Complete the sentence about Figure 2.1.

The method shown in Figure 2.1 is used as protection from

..... transmitted infections. [1]

(b) (i) HIV is an example of an infection that can be prevented by the method shown in Figure 2.1.

Circle the group that HIV belongs to.

animal **bacteria** **plant** **virus**

[1]

(ii) Place ticks (✓) to identify **two** other methods of transmission of HIV.

bitten by infected mosquito	☐
from droplets sneezed out by infected host	☐
from infected mother to baby during pregnancy	☐
infected blood transfusion	☐
preparing food with dirty hands	☐
touching a contaminated surface	☐

[2]

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(c) Testes produce the male gamete needed for fertilisation.

Describe the process of fertilisation in humans.

.....

.....

..... [2]

(d) Describe the changes that happen in the female ovaries and uterus after menstruation and before fertilisation.

.....

.....

.....

..... [2]

[Total: 8]

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3 Figure 3.1 shows a food web from an ecosystem.

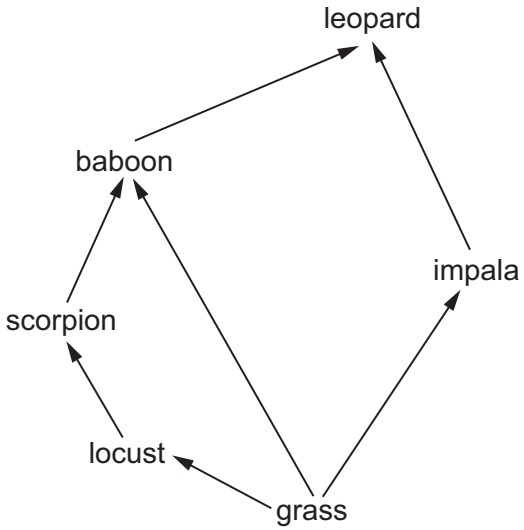

Figure 3.1

(a) Complete the sentence to describe an ecosystem.

Use words from the list. Each word may be used once, more than once or not at all.

community **environment** **genes** **reflexes** **tissues**

An ecosystem is a unit containing the ..... of

organisms and their ....., interacting together.

[2]

(b) Using the organisms shown in Figure 3.1, identify:

a carnivore .....

a tertiary consumer. .....

[2]

(c) Identify the process from the carbon cycle that is shown by the arrow between the locust and scorpion in Figure 3.1.

Circle the correct answer.

decomposition **feeding** **photosynthesis** **respiration**

[1]

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(d) Describe the flow of energy through the food chain that includes the **impala** in Figure 3.1.

Include ideas about:

- the source of energy
- the different energy stores
- where energy is transferred.

.....

.....

.....

.....

.....

..... [3]

(e) Humans burn the grass.

This removes the grass from the ecosystem.

Suggest the impacts on the ecosystem of burning the grass.

.....

.....

.....

..... [2]

[Total: 10]

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4 **(a)** Draw **one** straight line to connect each word to its correct definition.

word	definition
allele	alternative form of a gene
genotype	observable features of an organism
phenotype	genetic make-up of an organism

[2]

(b) Sex is an inherited characteristic.

(i) Describe what is meant by the term inheritance.

.....

..... [2]

(ii) Complete Table 4.1 to show how sex is inherited in humans.

Table 4.1

cell	sex chromosomes present
female gamete	..... or .....
male gamete	..... or .....
female zygote	..... and .....
male zygote	..... and .....

[2]

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(c) Beta thalassaemia is an inherited condition.

The pedigree diagram in Figure 4.1 shows the inheritance of the condition in one family.

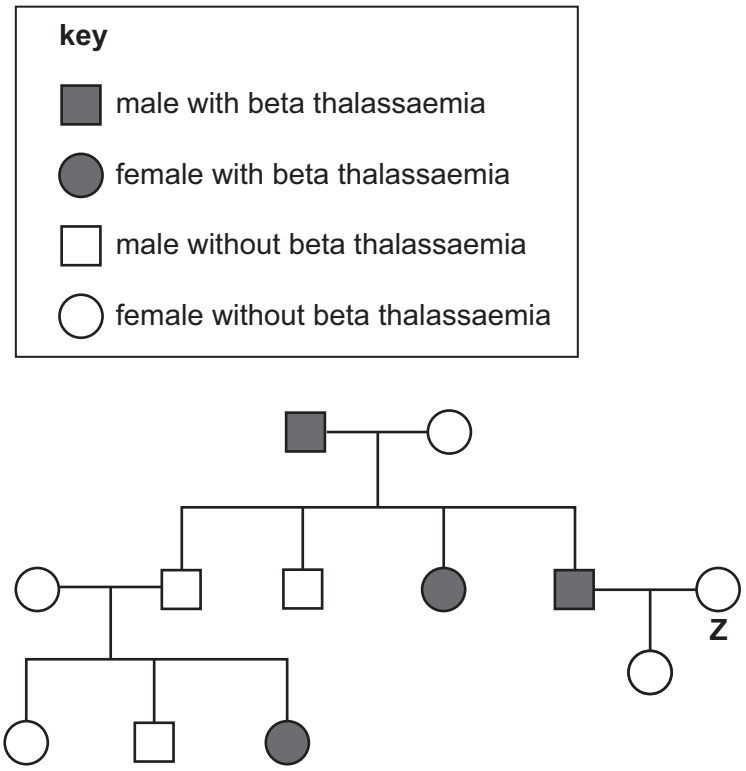

Figure 4.1

(i) Determine how many males in the family have beta thalassaemia.

..... [1]

(ii) Person **Z** in Figure 4.1 is homozygous.

Describe what is meant by homozygous.

.....

..... [1]

(iii) People with beta thalassaemia do **not** produce enough haemoglobin.

Explain how this causes people with beta thalassaemia to feel tired and lack energy.

.....

.....

..... [2]

[Total: 10]

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5 **(a)** Part of the reactivity series of metals is shown.

potassium

sodium

calcium

magnesium

aluminium

zinc

iron

copper

silver

gold

Answer the following questions by using metals from this reactivity series.

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

(i) State the **two** metals that are used to make brass.

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

(ii) State **two** metals that are in Group II of the Periodic Table.

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

(iii) State **one** metal that is extracted from its ore by electrolysis.

..... [1]

(iv) State **two** metals that are alkali metals.

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

(v) Name **one** metal that increases the rate of some reactions and remains unchanged at the end of the reaction.

..... [1]

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(b) The word equation for the reaction between calcium and oxygen is shown.

calcium + oxygen → calcium oxide

5.0 g of calcium reacts completely with 2.0 g of oxygen.

Calculate the mass of oxygen that reacts completely with 40.0 g of calcium.

mass of oxygen = ... g [1]

(c) Calcium oxide dissolves in water to make aqueous calcium hydroxide, which is called limewater.

State the gas that turns limewater milky.

..... [1]

(d) Aqueous calcium hydroxide contains calcium ions, Ca^{2+}.

Describe how a calcium ion is formed from a calcium atom.

Use ideas about electron gain and loss in your answer.

.....

..... [2]

[Total: 9]

6 **(a)** Complete the sentences about the air.

Use words from the list.

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

argon **compound** **element** **methane**

mixture **nitrogen** **oxygen**

Air is a ..... of gases.

78% of clean, dry air is ..... .

A noble gas found in the air in small quantities is ..... .

A gas that pollutes air is ..... .

[4]

(b) An oxygen atom has a proton number of 8 and a mass number of 16.

(i) Determine the number of neutrons in this oxygen atom.

number of neutrons = ... [1]

(ii) Determine the number of electrons in this oxygen atom.

number of electrons = ... [1]

(iii) Determine the electronic configuration of this oxygen atom.

electronic configuration = ... [1]

(c) Magnesium reacts with copper oxide in a redox reaction to produce magnesium oxide and copper.

(i) Write the word equation for this reaction.

..... + ... → ..... + ...

[1]

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(ii) Explain why this reaction is a redox reaction.

.....

..... [1]

(d) Magnesium oxide is an ionic compound.

Ionic compounds are generally soluble in water.

State **two** other properties of ionic compounds.

1 .....

.....

2 .....

.....

[2]

[Total: 11]

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7 **(a)** Ethene, C_2H_4, is an example of an alkene.

All alkenes are unsaturated hydrocarbons.

(i) Determine the total number of atoms in a molecule of ethene, C_2H_4.

number of atoms = ... [1]

(ii) Calculate the relative molecular mass, M_r, of ethene.

[A_r: C, 12; H, 1]

relative molecular mass M_r = ... [2]

(iii) Describe what is meant by unsaturated and hydrocarbon.

unsaturated

.....

.....

hydrocarbon

.....

.....

[3]

(iv) Describe the test to identify an unsaturated hydrocarbon and give the observation for a positive result.

test .....

observation .....

[2]

(b) Ethene is used to make a polymer.

(i) Name the polymer that is made from ethene.

..... [1]

(ii) State the type of polymerisation used to make this polymer from ethene.

..... [1]

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(c) Ethene is a gas at room temperature and pressure.

Describe the motion and separation of particles in gases.

motion

.....

.....

separation

.....

.....

[2]

[Total: 12]

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8 **(a)** Sulfur dioxide is produced when some fossil fuels are burned.

(i) State the name of **one** solid fossil fuel.

..... [1]

(ii) State why sulfur dioxide is produced when some fossil fuels are burned.

.....

..... [1]

(b) When sulfur dioxide dissolves in rain water, acid rain is formed.

(i) Suggest the pH of acid rain.

pH = ... [1]

(ii) The pH of a sample of acid rain is determined using a pH meter.

Describe another method for determining the pH of a sample of acid rain.

.....

..... [2]

(c) Hydrogen reacts with oxygen to produce water.

Balance the equation for this reaction.

$$\text{.....}H_2 + O_2 \rightarrow \text{.....}H_2O$$

[2]

(d) A sample of water is tested for purity.

The sample has a boiling point range of 101–102 °C at room temperature and pressure.

State how this shows that the sample of water is impure.

.....

..... [1]

[Total: 8]

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Turn over

9 **(a)** An astronaut travels in a spacecraft.

When the spacecraft takes off from the Earth's surface, it is pushed upwards by a force of 30 000 000 N.

The weight of the spacecraft is 24 000 000 N.

Calculate the resultant upward force on the spacecraft.

resultant force = ... N [1]

(b) The astronaut is exposed to ionising radiation.

The ionising radiation is cosmic rays from outer space.

Cosmic rays are one significant source of background radiation on the Earth.

(i) State **one** other significant source of background radiation on the Earth.

..... [1]

(ii) State **one** effect of ionising radiation on the human body.

..... [1]

(iii) Cosmic rays contain α-particles and protons.

Complete the sentence.

A proton is the nucleus of a hydrogen atom but an α-particle is the nucleus of a ..... atom.

[1]

(c) The Sun is a small mass star.

Describe the next stages in the life cycle of the Sun.

.....

.....

..... [2]

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(d) The Sun produces visible light waves and sound waves.

The visible light waves travel from the Sun to the Earth but the sound waves do not.

(i) Explain why sound waves are unable to travel from the Sun to the Earth.

.....

..... [1]

(ii) It takes 500 s for visible light waves to travel at a speed of 3.0×10^5 km / s from the Sun to the Earth.

Calculate the distance from the Sun to the Earth.

distance = ... km [2]

(iii) Figure 9.1 shows an incomplete electromagnetic spectrum.

Place visible light in the correct position.

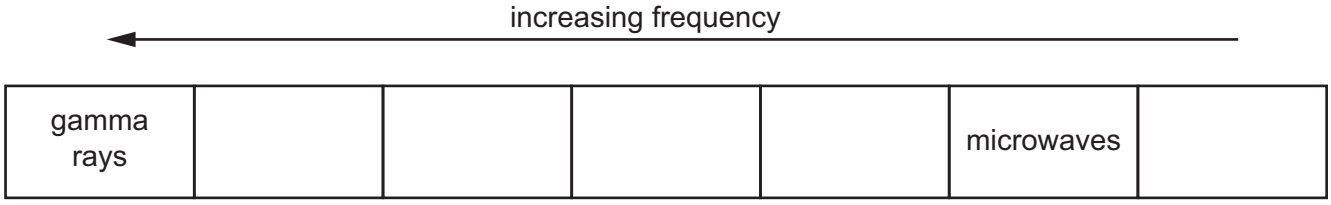

Figure 9.1

[1]

[Total: 10]

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10 (a) Figure 10.1 shows the horizontal forces acting on a motorcycle moving along a horizontal road at constant speed.

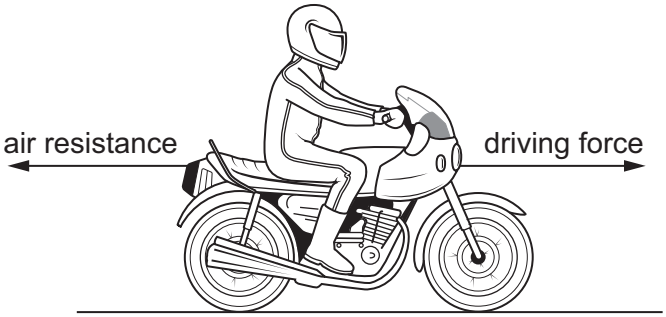

Figure 10.1

Explain, in terms of forces, why the speed is constant.

.....

.....

..... [1]

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(b) The motorcycle has a front lamp and a rear lamp.

The lamps are connected in parallel across a 12 V battery.

Each lamp has its own switch.

The lamps are protected by a single fuse.

(i) Complete the circuit diagram in Figure 10.2 to show the **two** lamps and **two** switches connected in parallel across the 12 V battery.

Include a fuse to protect the circuit.

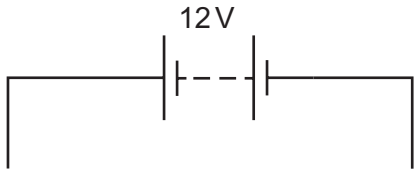

Figure 10.2

[4]

(ii) Describe how a fuse works.

.....

..... [1]

(c) **(i)** As the motorcycle moves along the road, it gains an electrostatic charge by friction.

State which charged particles are transferred between the motorcycle and the road.

..... [1]

(ii) As the motorcycle moves along the road, the air in the tyres warms up.

Describe how the motion of the air particles in the tyres changes as the air warms up.

.....

..... [1]

[Total: 8]

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11 A drone is a small machine that flies.

Figure 11.1 shows a battery-powered drone.



Figure 11.1

(a) The battery voltage is 14.8 V.

The battery supplies a current of 12 mA for 1 hour.

Calculate the energy transferred from the battery.

energy = ... J [3]

(b) (i) The mass of the drone is 4.0 kg.

The drone rises from the ground to a height of 15 m.

Show that the useful work done on the drone in lifting it to a height of 15 m is about 590 J.

[2]

(ii) It takes 3.0 s for the drone to rise 15 m.

Calculate the useful power of the drone.

power = ... W [2]

(iii) State the energy store that increases as the drone rises.

..... [1]

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(c) The drone then moves horizontally at a constant height of 15 m for 200 s.

Figure 11.2 shows a speed–time graph for the drone.

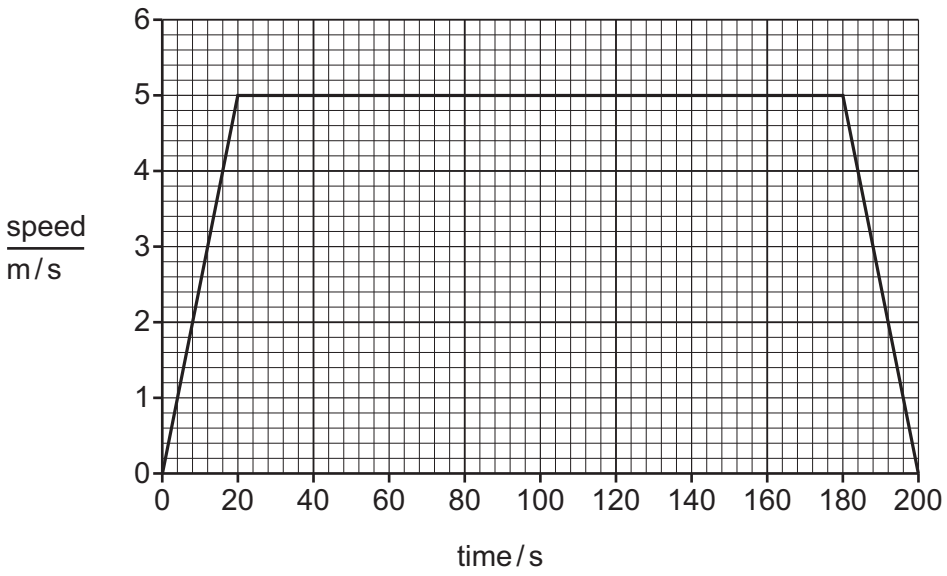

Figure 11.2

(i) State the maximum speed of the drone.

maximum speed = ... m / s [1]

(ii) Show that the drone travels a distance of 50 m between time = 0 and time = 20 s.

[2]

[Total: 11]

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12 **(a)** Bats communicate using ultrasound waves.

(i) State what is meant by ultrasound.

.....

..... [1]

(ii) State what is meant by the frequency of a wave.

.....

..... [1]

(iii) Elephants communicate using infrasound.

Infrasound waves are sound waves with a frequency below the lower limit of frequencies audible to humans.

Suggest a frequency for infrasound waves.

Explain your answer.

infrasound frequency = ... Hz

explanation .....

.....

[2]

(b) An elephant stands with all four feet in contact with the ground.

Each foot has an area of 0.13 m^2.

The weight of the elephant is 35 000 N.

Calculate the pressure exerted by the elephant on the ground.

pressure = ... N/m^2 [3]

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(c) An elephant stands by a water hole and sprays water over its back.

The water evaporates in the warmth of the Sun.

(i) Complete the sentences to describe this use of evaporation.

Evaporation is a change of state from liquid to ..... .

The more ..... particles escape from the ..... of the liquid. [3]

(ii) Suggest **one** reason why elephants spray themselves with water and leave the water to evaporate.

.....

..... [1]

[Total: 11]

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).

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