Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3127719504

CO-ORDINATED SCIENCES **0654/33**

Paper 3 Theory (Core) **May/June 2022**

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 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 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 **32** pages. Any blank pages are indicated.

1 **(a)** Fig. 1.1 shows three different types of neurones.

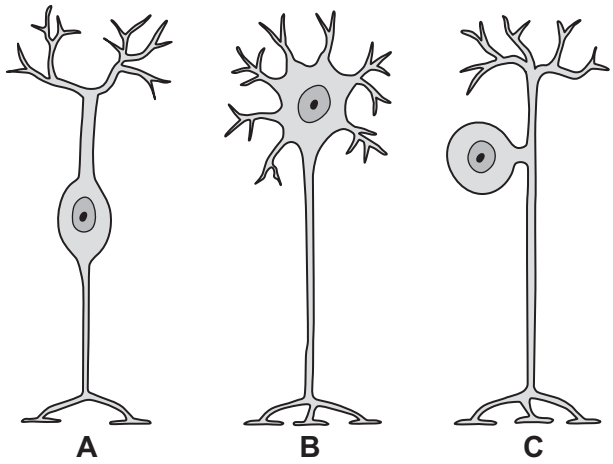

Fig. 1.1

(i) Identify which drawing in Fig. 1.1, **A**, **B** or **C**, represents the motor neurone.

..... [1]

(ii) Describe how nerve impulses are passed along neurones.

.....

..... [1]

(iii) Motor neurones are part of a reflex arc.

Name the two other neurones found in a reflex arc.

1 .....

2 .....

[2]

(iv) Circle **two** words that can be used to describe a reflex action.

automatic **conscious** **rapid** **slow**

stimulus **voluntary**

[2]

(b) Two students investigate reaction time.

The students press a button as quickly as possible after the button lights up.

Table 1.1 shows the results.

Table 1.1

student	reaction time / seconds					
	test 1	test 2	test 3	test 4	test 5	average
A	0.14	0.13	0.14	0.13	0.18	0.14
B	0.15	0.15	0.16	0.16	0.15	

(i) Calculate the average reaction time for student **B**.

Give your value to **two** significant figures.

..... s [2]

(ii) This reaction is a voluntary reaction. This is similar to a reflex arc but involves the brain.

In this reaction, suggest the name of the:

effector .....

coordinator. .....
[2]

[Total: 10]

2 **(a)** Table 2.1 shows a list of six elements.

Table 2.1

name of element
copper
helium
magnesium
nitrogen
oxygen
sodium

(i) State the names of **two** metallic elements from Table 2.1.

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

(ii) State the name of an element from Table 2.1 which is 78% of clean air.

..... [1]

(iii) State the name of a noble gas from Table 2.1.

..... [1]

(iv) State the name of a transition element from Table 2.1.

..... [1]

(b) Excess magnesium powder reacts with dilute hydrochloric acid.

During this reaction, a gas and an aqueous solution of a salt are made.

(i) State the chemical **formula** of the gas made.

..... [1]

(ii) State the name of the salt made.

..... [1]

(iii) Some solid magnesium remains unreacted.

State the method used to remove the unreacted solid magnesium from the reaction mixture.

..... [1]

(iv) The rate of reaction is decreased by decreasing the concentration of the hydrochloric acid.

State two other ways of **decreasing** the rate of this reaction.

1 .....

2 .....
[2]

(c) Table 2.2 shows the composition of an alloy of magnesium.

Table 2.2

element	percentage by mass
aluminium	4%
cerium	3%
lanthanum	1%
magnesium	92%

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

.....

..... [1]

(ii) Calculate the mass of magnesium in 2000 kg of this alloy.

mass = ... kg [1]

[Total: 11]

3 **(a)** X-rays and γ-radiation are used in hospitals.

(i) State **one** use of X-rays in a hospital.

.....

..... [1]

(ii) Write X-rays in the correct place in the incomplete electromagnetic spectrum shown in Fig. 3.1.

← increasing frequency						
γ-radiation			visible light			radio waves

Fig. 3.1

[1]

(iii) X-rays and γ-radiation are forms of ionising radiation.

State **one** harmful effect of ionising radiation on humans.

.....

..... [1]

(b) **(i)** Fig. 3.2 represents a sound wave.

Fig. 3.2

Draw one line from each wave property to its description.

wave property	**description**
amplitude	the distance between the tops of two consecutive waves
frequency	the distance between the top and the middle of a wave
wavelength	the number of waves passing every second

[2]

(ii) State the approximate range of audible frequencies for a healthy human ear.

from ..... Hz to ..... Hz

[2]

(iii) A student determines the speed of sound in air.

State the two measurements that she makes.

Describe how she uses these measurements to calculate the speed of sound.

measurements

.....

.....

description of calculation

.....

.....

.....

[3]

[Total: 10]

4 **(a)** Different digestive enzymes work best at different pH values.

The best pH for enzyme activity is called its optimum pH.

Fig. 4.1 shows the optimum pH of five different digestive enzymes.

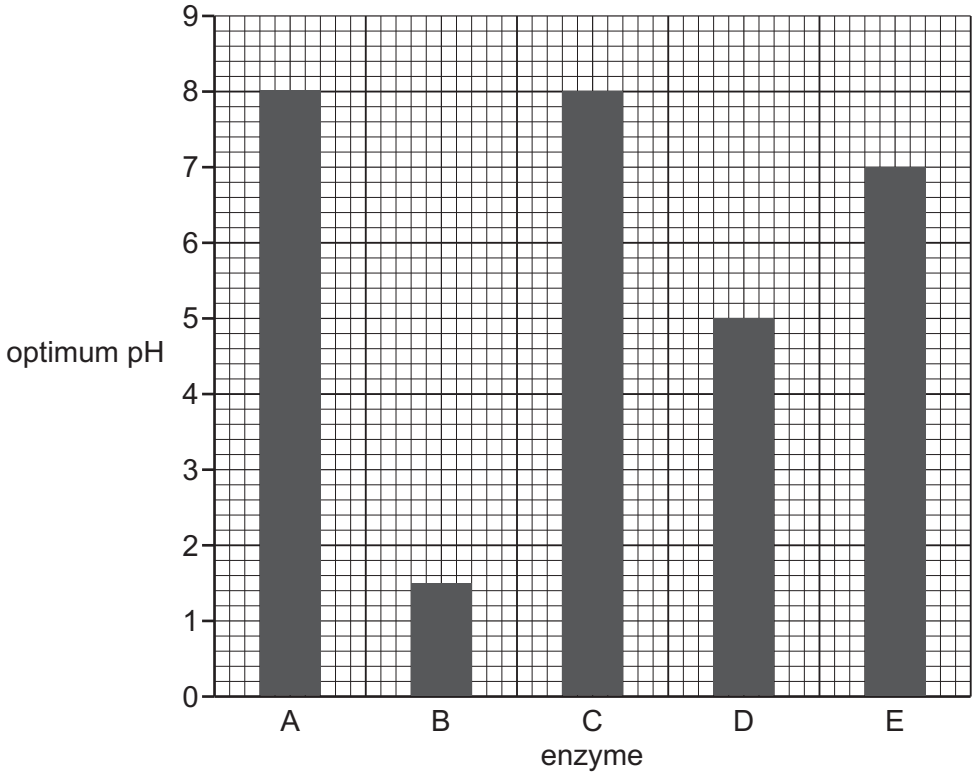

Fig. 4.1

Use Fig. 4.1 to complete these sentences.

The enzyme with the lowest optimum pH is enzyme ..... .

The two enzymes with the same optimum pH are enzymes

..... and ..... .

The enzyme that works best in neutral conditions is enzyme ..... .

[3]

(b) Name **one** factor, other than pH, that affects enzyme activity.

..... [1]

(c) Complete this definition of an enzyme.

Enzymes are proteins that function as ..... catalysts. [1]

(d) Carbohydrate, protein and fat are made from chemical elements.

Place ticks (✓) in the boxes in Table 4.1 to show **all** the correct elements each substance is made from.

Table 4.1

	element			
substance	carbon	hydrogen	oxygen	nitrogen
carbohydrate				
protein				
fat				

[3]

(e) Starch is a carbohydrate.

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

..... [1]

(ii) Circle the name of **one** other carbohydrate.

amino acid **fatty acid** **glycogen** **oil** [1]

[Total: 10]

5 **(a)** A student adds calcium and copper to separate test-tubes of cold water.

Describe the reaction, if any, for each metal.

calcium .....

copper .....

[2]

(b) The student reacts copper carbonate with dilute sulfuric acid.

Copper(II) sulfate, carbon dioxide and water are made.

(i) Complete the word equation for this reaction.

[ ] + [ ] → [ ] + [ ] + [ ]

[1]

(ii) Carbon dioxide gas is a greenhouse gas.

State the name of **one** other greenhouse gas.

..... [1]

(iii) The formula of copper(II) sulfate is $CuSO_4$.

State the number of different elements and the total number of atoms shown in this formula.

number of elements .....

number of atoms .....

[2]

(c) Copper oxide, CuO, is reduced to copper, Cu, by heating with carbon.

The equation for the reaction is shown.

$$2CuO + C \rightarrow 2Cu + CO_2$$

(i) Explain how the equation shows that copper oxide, CuO, is reduced.

.....

..... [1]

(ii) The reaction between copper oxide and carbon is exothermic.

State what is meant by exothermic.

.....

..... [1]

(iii) Name a metal, other than copper, that can be extracted from its ore by heating with carbon.

..... [1]

[Total: 9]

6 **(a)** A farmer uses solar panels to generate the electricity needed for his farm.

Suggest why the farmer should have an alternative method of generating electricity rather than relying on just solar energy.

.....

..... [1]

(b) Fig. 6.1 shows the farmer driving his tractor.

Four forces, **A**, **B**, **C** and **D**, are acting on the tractor.

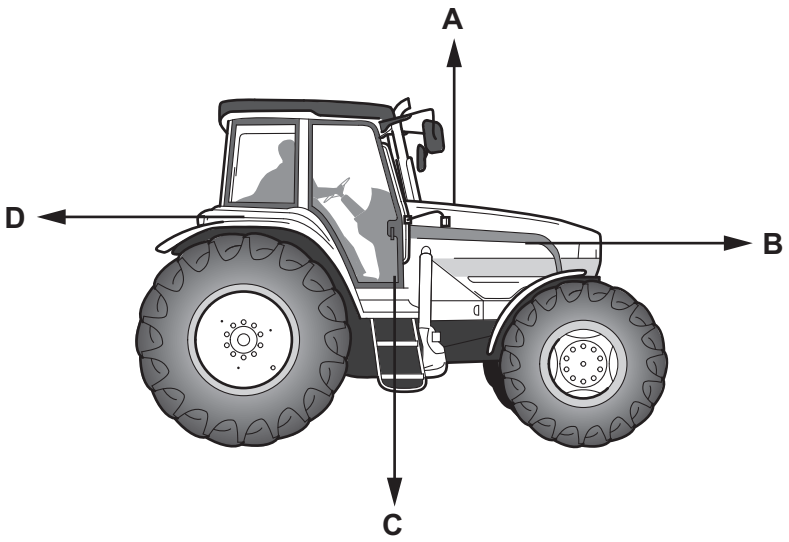

Fig. 6.1

The tractor is moving at constant speed.

The weight of the tractor is 40 000 N.

(i) State which force, **A**, **B**, **C** or **D**, is the weight of the tractor.

force ..... [1]

(ii) Calculate the mass of the tractor.

The gravitational field strength, g, is 10 N / kg.

mass = ... kg [2]

(iii) Force **B** is 2000 N.

State the value of force **D**.

Explain your answer.

force **D** = ... N

explanation

.....

.....
[2]

(c) The tractor uses diesel fuel.

State the form of energy stored in the diesel fuel.

..... [1]

(d) The farmer drives his tractor across a field.

Fig. 6.2 shows the speed-time graph for the tractor.

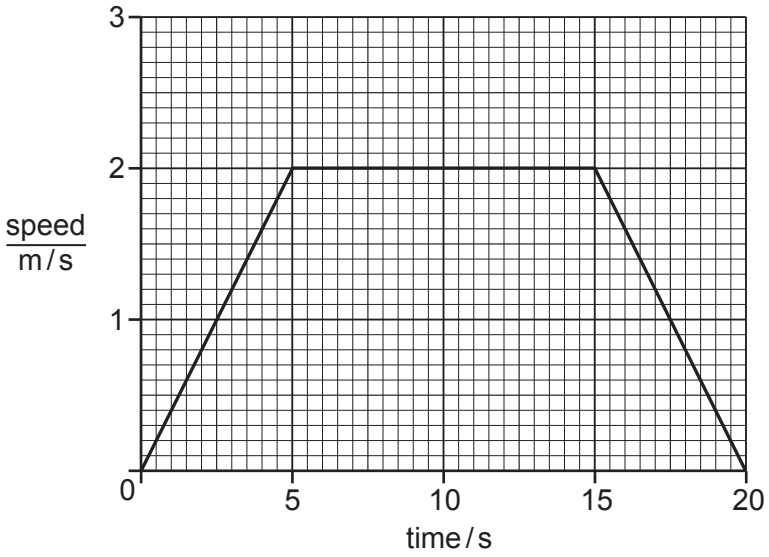

Fig. 6.2

(i) State the maximum speed of the tractor.

speed = ... m/s [1]

(ii) On Fig. 6.2, mark with an **X** a time when the tractor is moving with changing speed. [1]

(iii) Calculate the distance travelled by the tractor between time = 15 s and time = 20 s.

distance = ... m [2]

[Total: 11]

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7 **(a)** Fig. 7.1 is a diagram of the gas exchange system in humans.

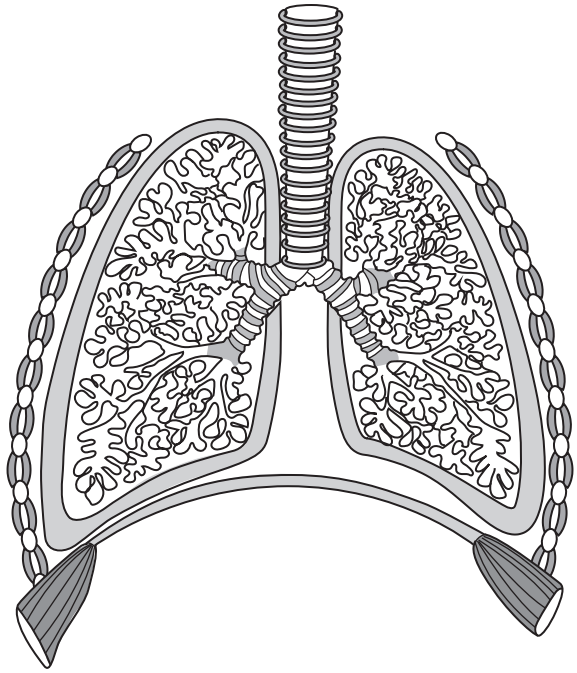

Fig. 7.1

(i) Draw a label line and the name to identify a rib on Fig. 7.1. [1]

(ii) Draw a label line and the name to identify the diaphragm on Fig. 7.1. [1]

(b) Describe how inspired air is different from expired air.

.....

.....

.....

.....

..... [3]

(c) Name **one** of the main blood vessels that connects the lungs with the heart.

..... [1]

(d) Blood transports substances around the body.

(i) State the name of the part of the blood that transports oxygen.

..... [1]

(ii) State the name of the part of the blood that transports hormones.

..... [1]

(e) State the name of the hormone secreted in a 'fight or flight' situation.

..... [1]

[Total: 9]

8 **(a)** Table 8.1 shows information about some of the halogens in the Periodic Table.

Table 8.1

halogen	symbol	proton number	physical state at 20 °C
chlorine	C*l*	17	.....
bromine	Br	35	liquid
iodine	I	53	.....

(i) Complete Table 8.1. [2]

(ii) Halogen molecules are diatomic.

State the formula of a molecule of bromine.

..... [1]

(iii) State the group number of the halogens in the Periodic Table.

..... [1]

(iv) State the number of electrons in an iodine atom.

..... [1]

(b) State the type of bond made when chlorine reacts with hydrogen to make the gas hydrogen chloride, HC*l*.

Explain your answer.

type of bond .....

explanation .....

.....
[2]

(c) Fig. 8.1 shows the apparatus used in the electrolysis of molten lead(II) bromide.

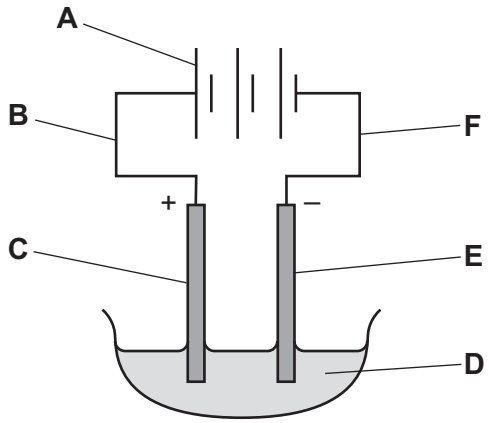

Fig. 8.1

(i) State which letter, **A–F**, in Fig. 8.1 identifies the:

- anode .....
- cathode .....
- electrolyte. .....

[2]

(ii) State the two products of this electrolysis.

1 .....

2 .....

[2]

[Total: 11]

9 **(a)** Table 9.1 contains descriptions of a solid, a liquid and a gas.

Complete Table 9.1 using the words in the list.

solid **liquid** **gas**

Use each word once only.

Table 9.1

description	solid, liquid or gas
the particles have a random arrangement and are close together	.....
the particles have a regular arrangement and are close together	.....
the particles have a random arrangement and are widely separated from each other	.....

[2]

(b) Some water is heated in a copper saucepan on the hot-plate of an electric cooker.

This is shown in Fig. 9.1.

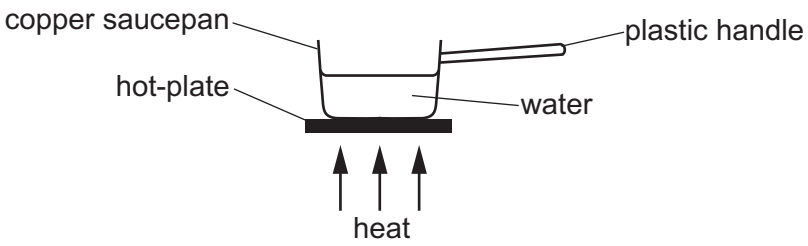

Fig. 9.1

(i) State the main method of thermal energy transfer through:

the copper saucepan .....

the water. .....

[2]

(ii) Suggest why the handle of the saucepan is made from plastic and not copper.

.....

..... [1]

(c) An electric circuit contains a copper wire.

The current in the copper wire is 0.5A.

The potential difference (p.d.) across the copper wire is 4.0V.

Calculate the resistance of the wire.

State the unit of your answer.

resistance = ... unit..... [3]

(d) Fig. 9.2 shows a copper wire placed between the poles of a magnet.

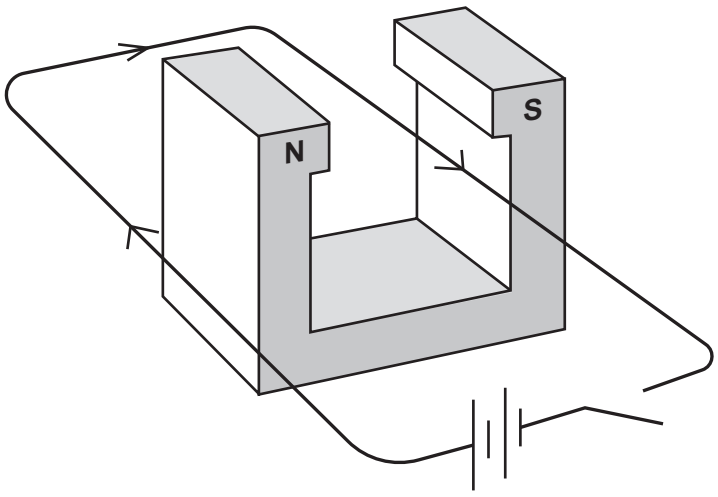

Fig. 9.2

When the switch is closed, the wire moves upwards.

State how this observation would change if the current is reversed.

.....

..... [1]

[Total: 9]

10 (a) Fig. 10.1 is a diagram of a cross-section through a leaf.

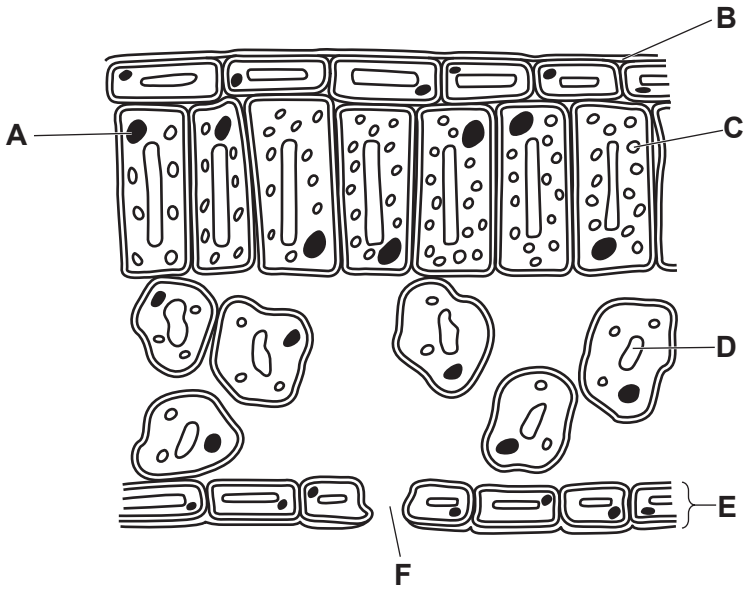

Fig. 10.1

(i) Identify the letter in Fig. 10.1 that represents:

where photosynthesis occurs .....

the part which controls the cell's activities .....

where water vapour is lost from the leaf. .....

[3]

(ii) State the name of the part labelled **E** in Fig. 10.1.

..... [1]

(b) A student investigates which substances are needed for photosynthesis.

The student **removes** different substances from the environment the plant is in.

They then record if the plant photosynthesises.

Table 10.1 shows a summary of their results.

Table 10.1

	substances **removed**				
	carbon dioxide, oxygen and water	carbon dioxide only	oxygen and water	oxygen only	none
did the plant photosynthesise?	no	no	no	yes	yes

(i) Use the information in Table 10.1 to identify which substance is **not** required for photosynthesis.

..... [1]

(ii) During the investigation, the student uses a lamp to provide a source of light.

Predict the effect on photosynthesis if the investigation is repeated with **no light**.

Give a reason for your answer.

prediction .....

reason .....

.....

[2]

(c) Mineral ions are also required for plant health.

(i) State the main mineral ion required for making chlorophyll.

..... [1]

(ii) State the name of the cell where mineral ions enter a plant.

..... [1]

(d) Describe the function of phloem in a plant.

.....

..... [2]

[Total: 11]

11 Fig. 11.1 shows the structures of four molecules, **P**, **Q**, **R** and **S**.

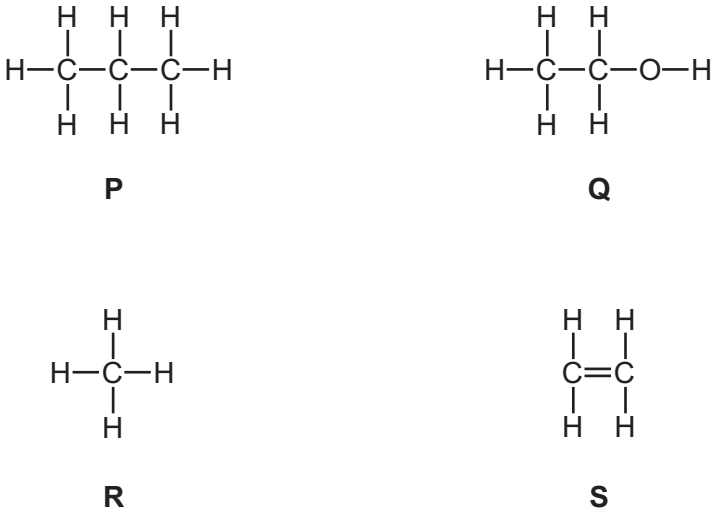

Fig. 11.1

(a) (i) State which of the molecules **P**, **Q**, **R** or **S** is an alkene.

..... [1]

(ii) State which of the molecules **P**, **Q**, **R** or **S** is ethanol.

..... [1]

(iii) State which of the molecules **P**, **Q**, **R** or **S** is the main constituent of natural gas.

..... [1]

(iv) State which **two** of the molecules **P**, **Q**, **R** and **S** are saturated hydrocarbons.

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

(b) Carbon dioxide is made during the complete combustion of substance **R**.

State the name of the other product made in this reaction.

..... [1]

(c) Molecule **S** is a compound made from the two elements carbon and hydrogen.

State what is meant by a compound.

.....

..... [1]

(d) Deduce the formula of molecule **P**.

..... [1]

(e) Fig. 11.2 shows an incomplete dot-and-cross diagram for molecule **R**.

Complete Fig. 11.2.

Show the outer-shell electrons only.

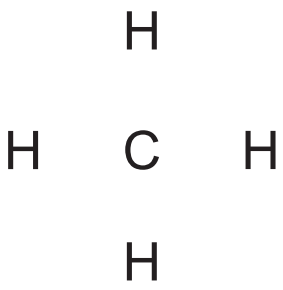

Fig. 11.2

[2]

[Total: 9]

12 **(a)** During a journey, a car becomes positively charged with static electricity.

State the name of the charged particles that have been removed from the car.

..... [1]

(b) The car has two headlamps powered by the car battery.

The lamps are connected in parallel.

Complete the circuit diagram in Fig. 12.1 to show two lamps connected in parallel both controlled by one switch.

The battery has been drawn for you.

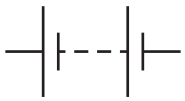

Fig. 12.1

[2]

(c) The driver of the car changes a wheel.

Fig. 12.2 shows a wheel nut being loosened by a spanner.

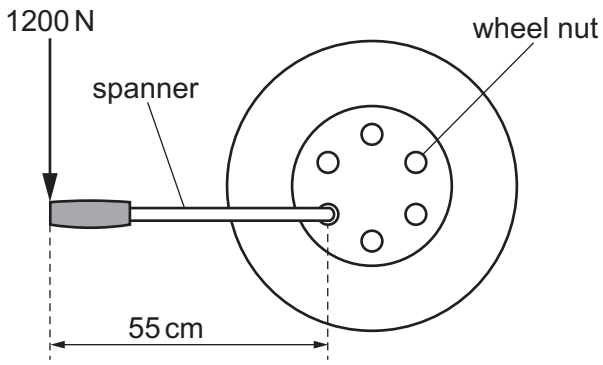

Fig. 12.2

The driver uses a force of 1200 N on the spanner.

Calculate the moment of this force on the wheel nut in Nm.

moment = ... Nm [3]

(d) The car driver uses a mirror to see behind the car.

Fig. 12.3 shows the driver looking into a plane mirror.

He can see the reflection of a street lamp.

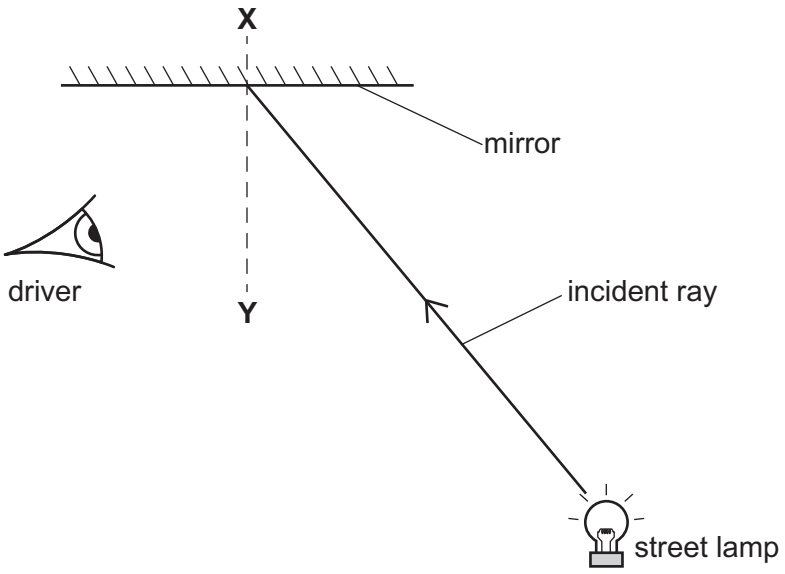

Fig. 12.3

(i) State the name of the line labelled **XY**.

..... [1]

(ii) On Fig. 12.3, label the angle of incidence with the letter ***i***. [1]

(iii) Circle **two** words or phrases that correctly describe the image of the street lamp seen in the mirror.

larger **laterally inverted** **same size**

smaller **upside down**

[2]

[Total: 10]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).