Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

3515074880

PHYSICAL SCIENCE **0652/31**

Paper 3 Theory (Core) **October/November 2021**

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. Any blank pages are indicated.

1 An aircraft travels a distance of 1000 m along a runway in a time of 25 s. It leaves the ground at 1000 m and lifts into the air.

(a) Calculate the average speed of the aircraft along the runway.

average speed = ... m / s [2]

(b) The speed—time graph for the aircraft is shown in **Fig. 1.1**.

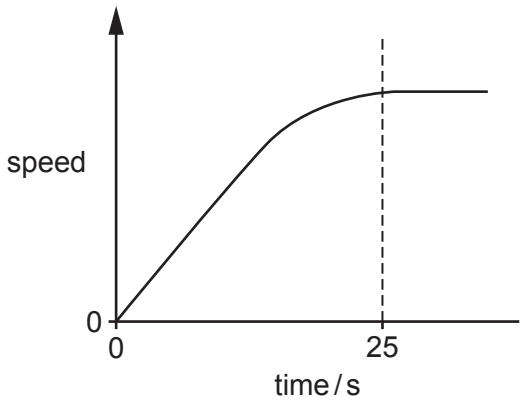

Fig. 1.1

Describe the motion of the aircraft along the runway.

.....

.....

..... [2]

(c) The aircraft must travel at a speed of at least 70 m / s before it can leave the ground. This is a higher speed than the average speed given in the answer to **(a)**.

Explain why the aircraft leaves the ground at 1000 m along the runway and not before.

.....

..... [1]

(d) Choose words or phrases from the box to complete the sentences about the aircraft.

You may use each word or phrase once, more than once or not at all.

chemical	**electrical**	**gravitational potential**
kinetic	**strain**	**thermal**

As the aircraft accelerates along the runway, the engines convert the ..... energy in the fuel to ..... energy and ..... energy.

When the aircraft leaves the ground and gets higher, it gains ..... energy. [4]

[Total: 9]

2 Chlorine is an element in Group VII of the Periodic Table.

(a) State the name of Group VII.

..... [1]

(b) State the number of electrons in the outer shell of a Group VII element.

..... [1]

(c) Name **one** element in Group VII which is a solid at room temperature.

..... [1]

(d) Chlorine reacts with sodium to form a soluble salt.

(i) State the name and write the formula of this soluble salt.

name .....

formula .....
[2]

(ii) State the type of bonding in this salt.

..... [1]

(e) Hydrogen chloride, HC*l*, is a compound of hydrogen and chlorine.

(i) Table 2.1 gives some information about hydrogen and chlorine.

Use the Periodic Table on page 20 to complete Table 2.1.

Table 2.1

element	relative atomic mass	atomic number
chlorine	35.5	.....
hydrogen	.....	1

[2]

(ii) Chlorine-35 and chlorine-37 are isotopes of chlorine.

Explain why their nucleon numbers are different.

.....

..... [1]

(f) Cobalt(II) chloride is used to test for water.

State the colour of cobalt(II) chloride in the presence of water.

..... [1]

[Total: 10]

3 A circuit diagram for the headlamps in a car is shown in Fig. 3.1.

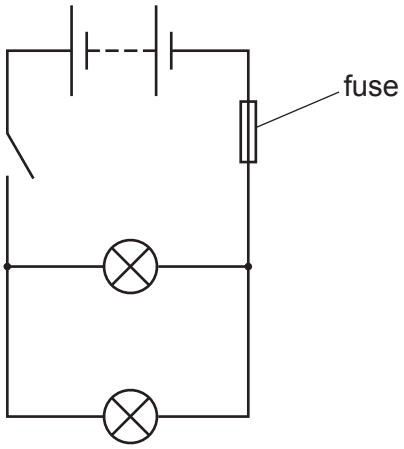

Fig. 3.1

(a) State **one** advantage of connecting the lamps in parallel.

.....

..... [1]

(b) Each lamp contains a wire which gets very hot and glows brightly when the switch is closed.

Name **two** types of electromagnetic radiation emitted by the wire.

1. .....

2. .....

[2]

(c) **(i)** When the potential difference across one of the lamps is 12 V, its resistance is 2.4 Ω.

Calculate the current in the lamp.

current = ... A [2]

(ii) Complete the following sentence using one of these phrases.

more than **the same as** **less than**

The current in the fuse is ..... the current in one of the lamps. [1]

(iii) Draw a (ring) around a suitable fuse rating.

2.6 Ω 10 W 12 V 15 A [1]

(d) A fault in the circuit makes a large current flow.

Describe how the fuse protects the circuit.

.....

.....

..... [2]

[Total: 9]

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4 Iron is a transition metal.

(a) Suggest the colour of an ore containing iron oxide.

..... [1]

(b) Iron is extracted from its ore by reduction in a blast furnace.

Explain what is meant by reduction.

.....

..... [1]

(c) Carbon monoxide is also produced in a blast furnace.

(i) State why carbon monoxide is a dangerous substance.

..... [1]

(ii) Carbon monoxide reacts with another element to produce carbon dioxide.

Write the **word** equation for this reaction and write the formula of the product.

word equation .....

.....

formula of product .....
[2]

(d) State **one** effect of releasing large quantities of carbon dioxide into the Earth's atmosphere.

.....

..... [1]

[Total: 6]

5 A student has some sheets of card.

(a) The total thickness of 50 sheets is 4.8 cm.

Calculate the thickness of one sheet of card.

thickness of one sheet of card = ... cm [2]

(b) The student cuts a sheet of card into the shape of a bird.

The bird hangs upright when he attaches a piece of string to a hole above the centre of mass, as shown in Fig. 5.1.

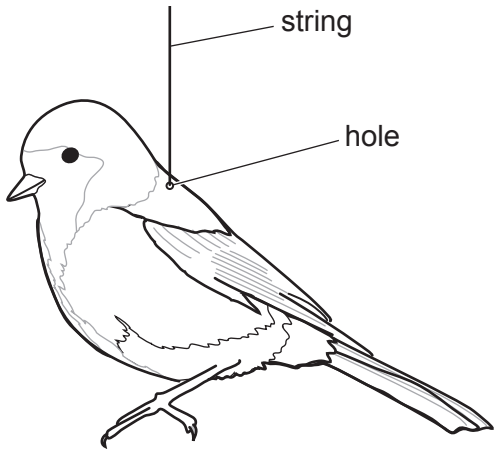

Fig. 5.1

Describe a method for finding the centre of mass.

You may draw on Fig. 5.1 to help with your description.

.....

.....

.....

.....

..... [3]

(c) The student cuts a different bird shape from the card.

The new bird only hangs upright when a weight of 0.15 N is attached 20 cm from the hole, as shown in Fig. 5.2.

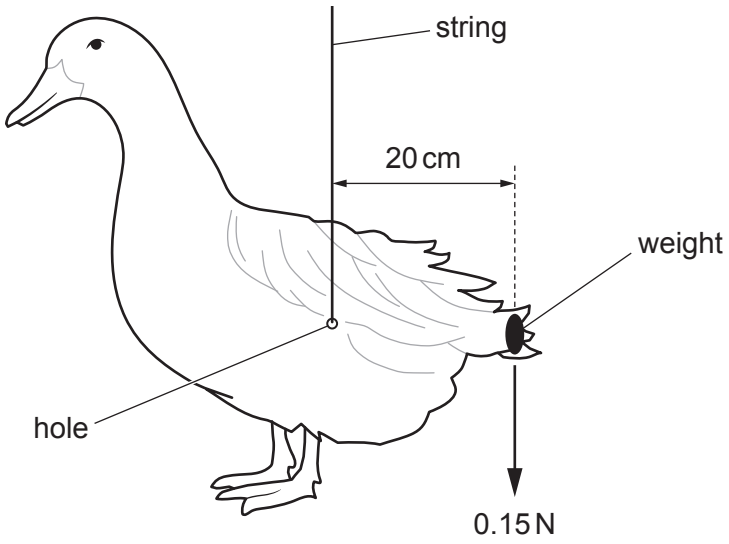

Fig. 5.2

Calculate the moment of the 0.15 N weight. State the unit.

moment = ... unit ..... [3]

(d) Explain what is meant by the moment of a force about a point.

.....

..... [1]

[Total: 9]

6 Table 6.1 describes the particles in a solid.

Table 6.1

	solid	gas
arrangement	regular	.....
separation	close together	.....
movement	vibration	.....

(a) Complete Table 6.1 to describe the particles in a gas. [3]

(b) Water can exist as a solid, a liquid or a gas.

Name the solid state and the gas state of water.

solid state .....

gas state .....

[2]

(c) Complete Fig. 6.1 by drawing a dot and cross diagram to show the outer electrons in a molecule of water.

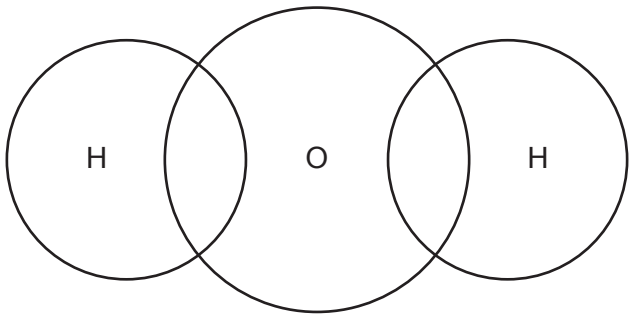

Fig. 6.1

[2]

(d) Water is made safe to drink in two stages:

(i) On Fig. 6.2, name the process in **stage 1**.

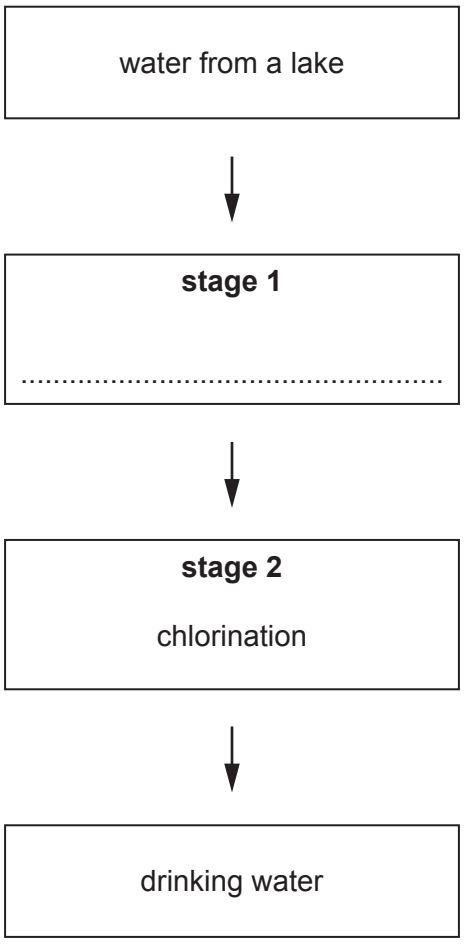

Fig. 6.2

[1]

(ii) State why chlorine is added to water to make it safe to drink.

..... [1]

[Total: 9]

7 A student tests five rods. Each rod is made from a different material.

In the first test he places each rod in an electric circuit and records the brightness of a lamp.

In the second test he places each rod in the core of an electromagnet and records the number of paperclips held by the rod.

In the third test he switches off the electromagnet and records how many paperclips continue to be held by the rod.

The five different rods are made from aluminium, carbon, iron, plastic and steel.

(a) Complete Table 7.1.

Table 7.1

rod material	brightness of lamp	electromagnet **on**: number of paperclips held	electromagnet **off**: number of paperclips held
.....	bright	0	0
.....	bright	8	7
.....	bright	8	0
carbon	bright	.....	.....
.....	off	0	0

[4]

(b) Fig. 7.1 shows a rod that is permanently magnetised.

Part of four magnetic field lines have been drawn.

Complete the diagram to show the shape of the four field lines.

Draw an arrow on each line to show the direction of the field.

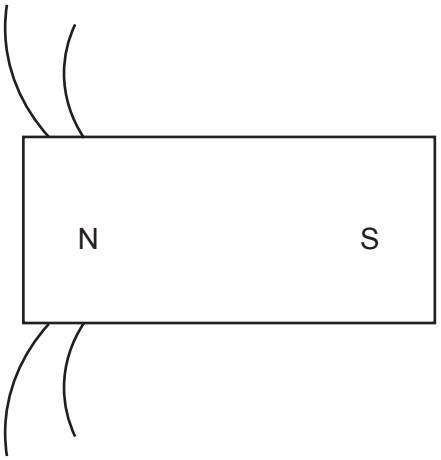

Fig. 7.1

[2]

[Total: 6]

8 Fig. 8.1 shows some of the fractions obtained by the fractional distillation of petroleum.

The different fractions can be separated because they boil at different temperatures.

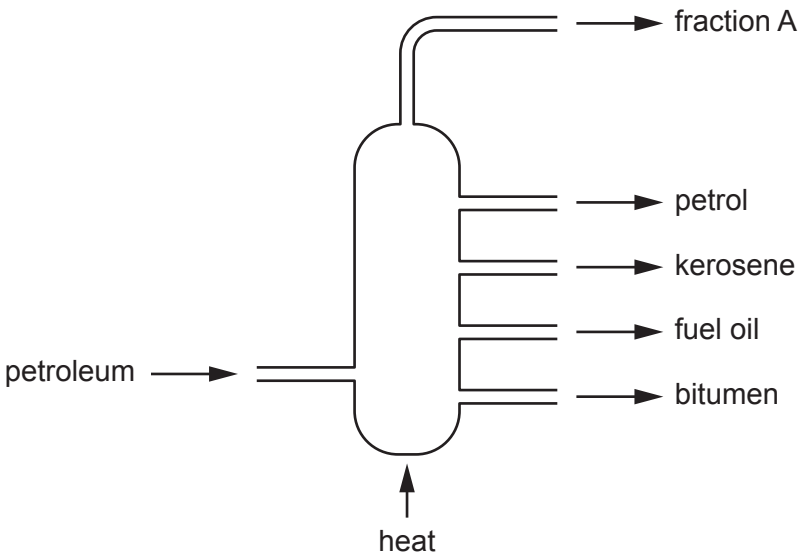

Fig. 8.1

(a) (i) Fraction **A** boils at the lowest temperature.

Name fraction **A**.

..... [1]

(ii) Name the fraction used to make road surfaces.

..... [1]

(b) Explain how the diagram shows that bitumen boils at the highest temperature.

.....

..... [1]

(c) The compounds present in petroleum are hydrocarbons.

Draw (rings) around the symbols of the elements found in **all** hydrocarbons. [2]

C H N O S

(d) Ethene is a compound obtained from fractions of petroleum in a process called cracking.

Ethene is an alkene. It has a double bond between carbon atoms.

(i) State the word used to describe compounds like alkenes which have double bonds between carbon atoms.

..... [1]

(ii) Explain why ethene is important in the manufacture of poly(ethene).

.....

..... [1]

(iii) Fig. 8.2 shows the structure of another compound, methane.

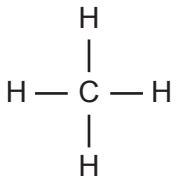

Fig. 8.2

Complete Fig. 8.3 in a similar way to show the structure of ethene.

C C

Fig. 8.3

[2]

[Total: 9]

9 Fig. 9.1 shows a glass block. One side of the block is a mirror.

Part of a ray of light **R** is shown inside the glass block.

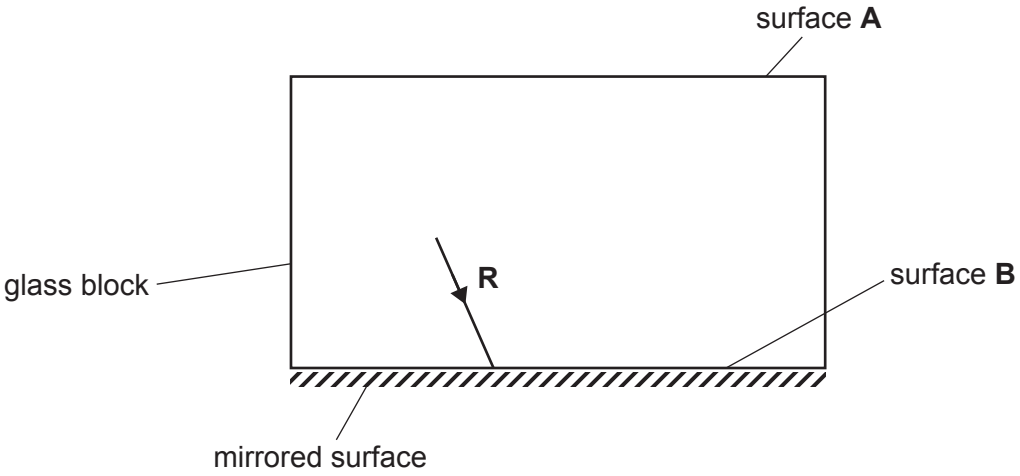

Fig. 9.1

(a) The ray is incident on the side which is a mirror.

(i) Draw the path of the ray **after** it meets the side which is a mirror. [1]

(ii) Draw the ray extended backwards to show its path **before** it enters the glass block. [2]

(b) Name the process

- at surface **A** .....
- at surface **B** .....

[2]

(c) Two objects are placed in front of a plane mirror, as shown in Fig. 9.2.

On Fig. 9.2 draw the images formed by the mirror of each object.

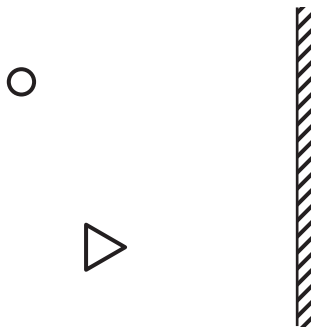

Fig. 9.2

[2]

[Total: 7]

10 Ethanol, C_2H_5OH, is used as a fuel.

(a) Name the element in air which reacts with ethanol when it burns.

..... [1]

(b) State the word used to describe the type of reaction that releases heat (thermal) energy.

..... [1]

(c) Nitrogen is the main component of air.

(i) State the percentage of nitrogen in air.

..... [1]

(ii) Nitrogen is a diatomic gas.

Write the formula of a molecule of nitrogen.

..... [1]

(d) Ethanol can be made from sugar.

The enzymes in yeast act as a catalyst in the breakdown of sugar.

(i) Name the process used to produce ethanol from sugar.

..... [1]

(ii) State the effect of using a catalyst on the rate of ethanol production.

.....

..... [1]

[Total: 6]

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 –		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.).