IGCSE Physics Pastpapers

Year 2021

Summer22,42,62,41,43,61,63
winter22,42,62,41,43,61,63
march22,42,62

Class:_____
Name:_____

Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/22**

Paper 2 Multiple Choice (Extended) **May/June 2021**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

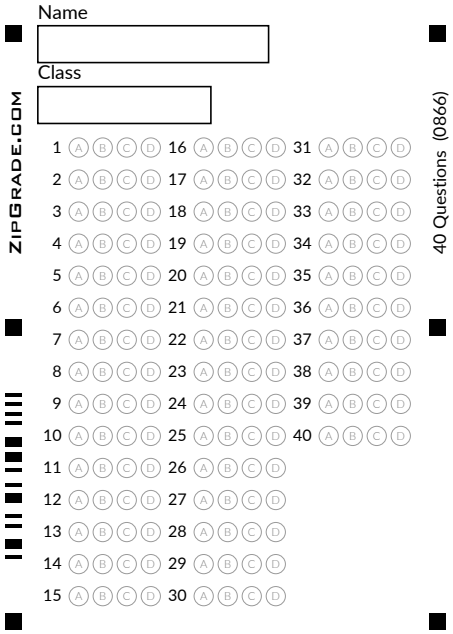
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **16** pages.

[Turn over



1 Which piece of apparatus is the most suitable for measuring the mass of a pencil sharpener?

A digital balance

B measuring cylinder

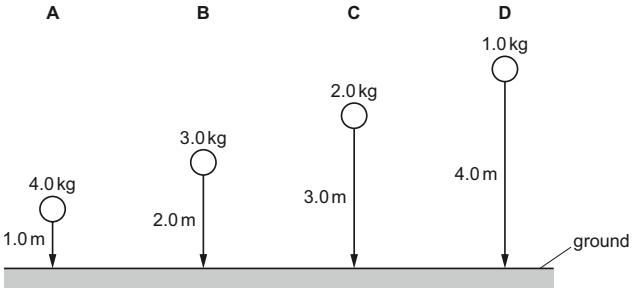
C newton meter

D ruler

2 Four balls with different masses are dropped from the heights shown.

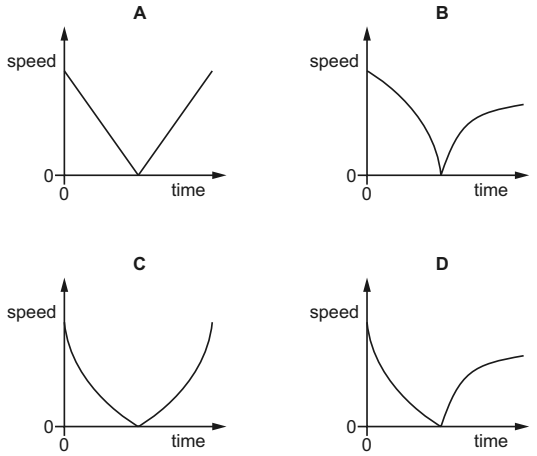
Air resistance may be ignored.

Which ball has the smallest average speed?



3 A ball is thrown vertically upwards through the air. Air resistance acts on the ball.

Which graph shows how its speed varies with time?



4 What is the best description of the meaning of the 'mass' of an object?

A the space occupied by the object

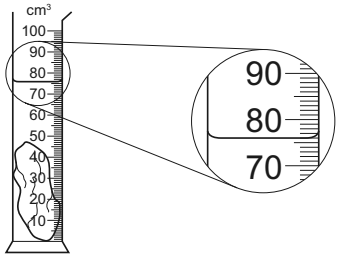
B the force that gravity exerts on the object

C the resistance of the object to changes in motion

D the closeness of packing of the molecules in the object

5 A measuring cylinder contains 40 cm^3 of water.

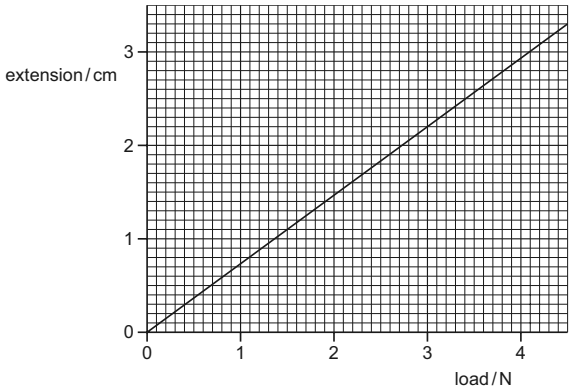
A stone of mass 94 g is lowered into the water so that it is fully submerged as shown.



What is the density of the stone?

A 1.1 g / cm^3 **B** 1.2 g / cm^3 **C** 2.1 g / cm^3 **D** 2.6 g / cm^3

6 The extension–load graph for a spring is shown. The unstretched length of the spring is 17.0 cm.



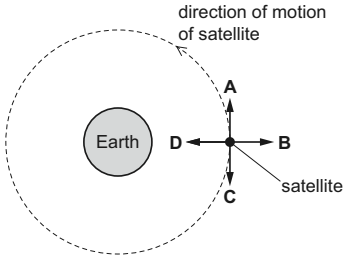
When an object is suspended from the spring, the length of the spring is 19.2 cm.

What is the weight of the object?

A 1.4 N **B** 1.6 N **C** 2.6 N **D** 3.0 N

7 A satellite orbits the Earth in an anticlockwise direction at constant speed, as shown.

When the satellite is in the position shown, in which direction does the resultant force act upon it?



8 A tennis ball has a mass of 57 g.

A tennis player hits the tennis ball with a tennis racket. The tennis ball has a velocity of 25 m / s when it hits the racket.

The velocity of the tennis ball when it leaves the player's racket is 15 m / s in the opposite direction from its approaching direction.

The average force exerted by the tennis racket on the ball is 35 N.

For how long is the tennis ball in contact with the tennis racket?

A 0.015 s **B** 0.016 s **C** 0.065 s **D** 0.65 s

9 This question is about four methods used to produce electrical energy.

Which method has a correct description?

	method	energy source is renewable	emits carbon dioxide
A	a hydroelectric power station	yes	no
B	a coal-fired power station	no	no
C	a wind turbine	no	yes
D	a nuclear power station	yes	yes

10 A stone is released from rest from a high building on Earth. Air resistance is negligible.

What is its velocity when it has fallen 5 m?

A 7.1 m / s **B** 10 m / s **C** 50 m / s **D** 100 m / s

11 The power input to an electric motor is 400 W. The efficiency of the motor is 85%.

How much power is wasted?

A 60 W **B** 85 W **C** 340 W **D** 470 W

12 A book has a mass of 400 g.

The surface of the book in contact with a table has dimensions 0.10 m × 0.20 m.

The gravitational field strength g is 10 N / kg.

What is the pressure exerted on the table due to the book?

A 0.08 N / m^2 **B** 8.0 N / m^2 **C** 20 N / m^2 **D** 200 N / m^2

13 A horizontal metal plate of area 0.50 m^2 lies at the bottom of a lake at a depth of 40 m.

The density of water is 1000 kg / m^3 and the gravitational field strength g is 10 N / kg.

What is the downward force acting on the plate due to the water?

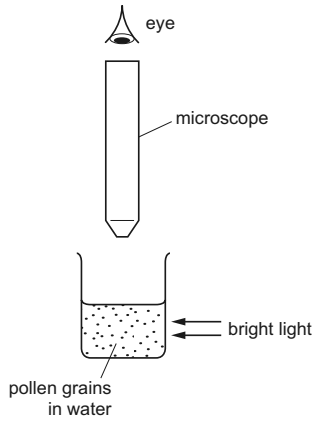
A 20 kN **B** 80 kN **C** 200 kN **D** 800 kN

14 Which row describes the forces between the molecules and the motion of the molecules in a gas?

	forces between molecules	motion of molecules
A	strong	move freely
B	strong	vibrate only
C	weak	move freely
D	weak	vibrate only

15 Very small pollen grains are suspended in water. A bright light shines from the side.

When looked at through a microscope, small specks of light are seen to be moving in a random, jerky manner.



What are the moving specks of light?

A pollen grains being hit by other pollen grains

B pollen grains being hit by water molecules

C water molecules being hit by other water molecules

D water molecules being hit by pollen grains

16 A hole is drilled in a metal plate.

What happens to the length of the plate and to the diameter of the hole when the plate is cooled?

	length of plate	diameter of hole
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

17 Which statement describes a sensitive liquid-in-glass thermometer?

A a thermometer which can be used to measure very high and very low values of temperature

B a thermometer which gives the same increase in length of the liquid column for each degree of temperature rise

C a thermometer which is accurate because it has been calibrated

D a thermometer which gives a large increase in the length of the liquid column for each degree of temperature rise

18 A block of aluminium of mass 2.0 kg has an initial temperature of 20 °C. It absorbs 7300 J of thermal energy.

The specific heat capacity of aluminium is 913 J / (kg °C).

What is the final temperature of the aluminium block?

A 4.0 °C **B** 8.0 °C **C** 24 °C **D** 28 °C

19 A student sets up four cans. Each can contains the same mass of water at 90 °C.

The cans are identical except for the outside surfaces.

Which can will cool down the fastest?

A dull, black surface

B dull, white surface

C shiny, black surface

D shiny, white surface

20 Thermal energy is transferred by conduction in a metal bar.

Which statement is **not** correct?

A Fast vibrating ions leave the surface.

B Free moving electrons carry thermal energy through the bar.

C Ions vibrate and strike neighbouring ions to make them vibrate.

D Ions vibrate but do not change position.

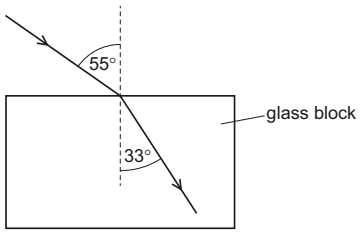
21 A water wave passes into a region where the wave travels more slowly.

As it passes into the slow region, what happens to the frequency and what happens to the wavelength of the wave?

	frequency	wavelength
A	decreases	remains the same
B	increases	remains the same
C	remains the same	decreases
D	remains the same	increases

22 Light travelling at a speed of 3.0×10^8 m / s strikes the surface of a glass block and undergoes refraction as it enters the block.

The diagram shows a ray of this light before and after it enters the block.



What is the speed of light in the glass?

A 1.8×10^8 m / s

B 2.0×10^8 m / s

C 4.5×10^8 m / s

D 5.0×10^8 m / s

23 Which statement about the image of an object formed in a plane mirror is correct?

A It is smaller than the object.

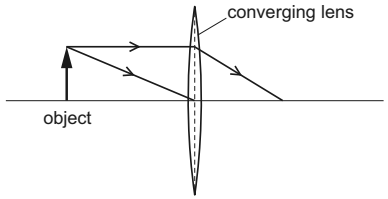
B It is the same size as the object.

C It is larger than the object.

D It is inverted.

24 An object is placed in front of a thin converging lens.

The diagram shows the paths of two rays from the top of the object.



An image of the object is formed on a screen to the right of the lens.

How does this image compare with the object?

A It is larger and inverted.

B It is larger and the same way up.

C It is smaller and inverted.

D It is smaller and the same way up.

25 Here are three statements about the speed of electromagnetic waves.

1 The speed of an electromagnetic wave in a vacuum is 340 m / s.

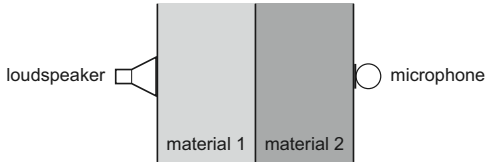
2 The speed of an electromagnetic wave in a vacuum is 3.0×10^8 m / s.

3 The speed of an electromagnetic wave in a vacuum is approximately the same as in air.

Which statements are correct?

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 2 only

26 The sound from a loudspeaker must pass through two materials to reach a microphone.



Which combination of materials gives the shortest time for the sound to reach the microphone?

	material 1	material 2
A	air	hydrogen
B	air	water
C	copper	aluminium
D	water	oil

27 Which method does **not** demagnetise a bar magnet?

A Heat the bar magnet and place it in the east-west direction to cool.

B Place the bar magnet in the east-west direction and hammer it.

C Place the bar magnet in a coil connected to an a.c. supply and slowly withdraw it.

D Place the bar magnet in a coil connected to a d.c. supply and slowly withdraw it.

28 Three piles of small nails, P, Q and R, are placed on a bench below three electromagnets.

One set of nails is made of copper, one of soft iron and one of steel.

Diagram 1 shows the situation when the electromagnets are switched on.

Diagram 2 shows the situation when the electromagnets are then switched off.

diagram 1
the switches are **closed**

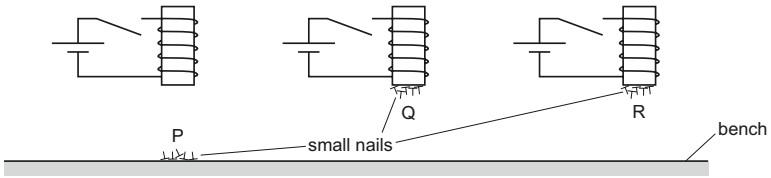
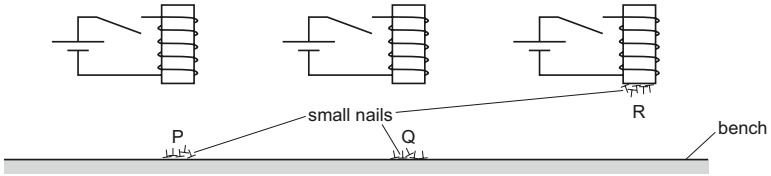


diagram 2
the switches are **open**



Which row correctly identifies the materials from which the nails are made?

	copper	soft iron	steel
A	P	Q	R
B	P	R	Q
C	Q	P	R
D	Q	R	P

29 A magnet is suspended by a cotton thread.

The magnet is displaced then allowed to swing freely until it comes to rest.

Why does the magnet always come to rest pointing in the same direction?

A because of the interaction between the electric field of the magnet and the electric field of the Earth

B because of the interaction between the electric field of the magnet and the magnetic field of the Earth

C because of the interaction between the magnetic field of the magnet and the gravitational field of the Earth

D because of the interaction between the magnetic field of the magnet and the magnetic field of the Earth

30 A student rubs a plastic rod with a cloth.

The rod becomes positively charged.

What has happened to the rod?

A It has gained electrons.

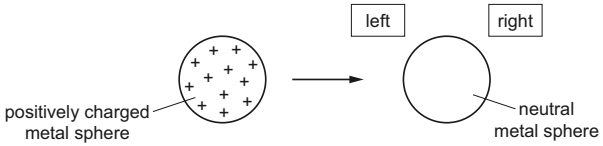
B It has gained protons.

C It has lost electrons.

D It has lost protons.

31 An isolated metal sphere is positively charged.

It is then brought near to another isolated metal sphere that is neutral.



What happens to the charges on the neutral sphere as the positively charged sphere is brought close to it?

A Some positive charges move to the left and some negative charges move to the right.

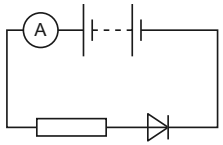
B Some positive charges move to the right and some negative charges move to the left.

C Some positive charges move to the right, but the negative charges do not move.

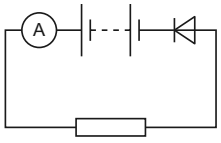
D The positive charges do not move, but some negative charges move to the left.

32 Which circuit has a zero reading on the ammeter?

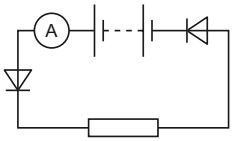
A



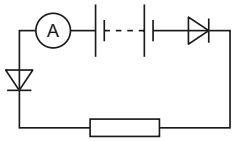
B



C



D

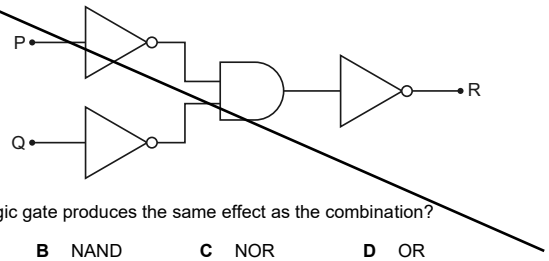


33 Two 10 Ω resistors are connected in series and then in parallel.

What is the combined resistance in each case?

	resistance in series / Ω	resistance in parallel / Ω
A	10	5
B	10	10
C	20	5
D	20	10

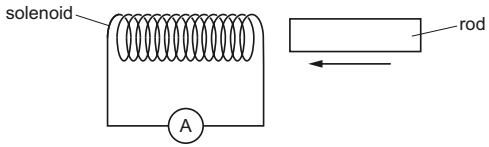
34 The diagram shows a combination of four logic gates that produce an output signal at R that depends on the states of the inputs P and Q.



Which single logic gate produces the same effect as the combination?

A AND **B** NAND **C** NOR **D** OR

35 A solenoid is connected to a very sensitive ammeter. A rod is inserted into one end of the solenoid. The ammeter shows that there is a small electric current in the solenoid while the rod is moving.



Which rod is being inserted?

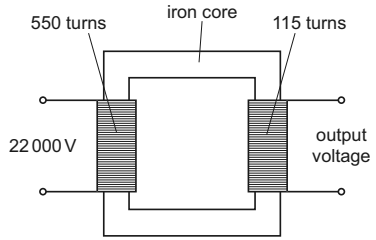
A a heated copper rod

B a magnetised steel rod

C an uncharged nylon rod

D a radioactive uranium rod

36 The diagram shows a transformer.



What is the output voltage?

A 0.35 V **B** 2.9 V **C** 4600 V **D** 105 000 V

37 Which row correctly states how nuclei behave during nuclear fission and during nuclear fusion?

	fission	fusion
A	nuclei join together	nuclei join together
B	nuclei join together	nuclei split apart
C	nuclei split apart	nuclei join together
D	nuclei split apart	nuclei split apart

38 The charge on a proton is *e*.

What is the charge on an electron and what is the charge on a neutron?

	electron	neutron
A	*e*	*e*
B	*e*	0
C	$-e$	$-e$
D	$-e$	0

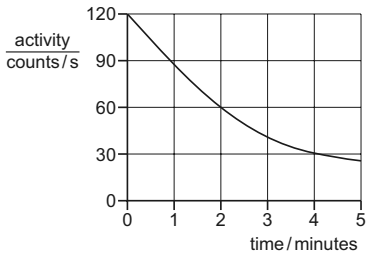
39 Some radioactive nuclei decay to give new nuclei which are also radioactive. Part of a series of decays is shown.

$$^{238}_{92}\text{U} \rightarrow {}^{234}_{90}\text{Th} \rightarrow {}^{234}_{91}\text{Pa} \rightarrow {}^{234}_{92}\text{U} \rightarrow {}^{230}_{90}\text{Th} \rightarrow {}^{226}_{88}\text{Ra}$$

How many decays involve the emission of a β-particle?

A 1 **B** 2 **C** 3 **D** 5

40 The graph shows the activity of a radioactive source over a period of time.



What is the half-life of the source?

A 1.0 minute **B** 2.0 minutes **C** 2.5 minutes **D** 4.0 minutes

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/42**

Paper 4 Theory (Extended) **May/June 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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages.

DC (ST/JG) 198540/2

[Turn over

1 **(a)** Fig. 1.1 shows a sealed weather balloon which is stationary in still air.

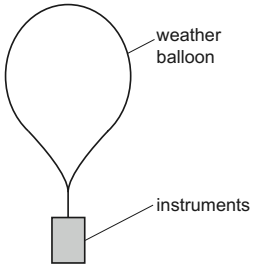


Fig. 1.1

State whether the overall density of the balloon and its instruments is greater than, less than, or the same as the density of the surrounding air.

..... [1]

(b) At night, the gas inside the balloon cools. The pressure of the air outside the balloon remains the same.

(i) State whether the balloon rises, falls or remains stationary.

..... [1]

(ii) Explain your answer.

.....

.....

..... [2]

(c) An object is released from the balloon. It starts at rest and eventually reaches a constant speed.

(i) On the axes of Fig. 1.2, sketch a speed–time graph to show this motion.

Fig. 1.2

[3]

(ii) State the values of the initial acceleration and the final acceleration of the object.

initial acceleration .....

final acceleration .....

[2]

[Total: 9]

2 **(a)** Define the *moment* of a force.

..... [1]

(b) Fig. 2.1 shows an object of negligible weight. The object is in equilibrium.

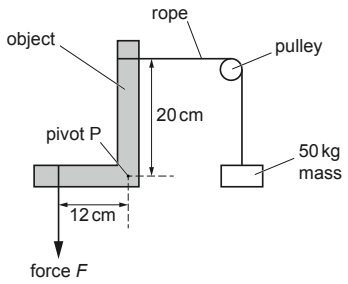


Fig. 2.1

The object is free to rotate about its pivot P.

Calculate the value of force *F*.

F = ... [2]

(c) Describe an experiment involving vertical forces to show that there is no net moment on an object in equilibrium. You may draw a diagram in the space provided.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

3 Fig. 3.1 shows water flowing at very slow speed over a cliff edge.

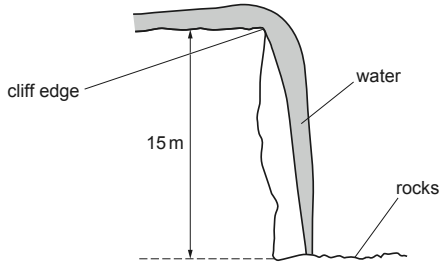


Fig. 3.1

The water falls 15 m onto the rocks below.

(a) Show that the velocity of the water when it strikes the rocks is 17 m / s.

[4]

(b) 30 kg of water flows over the cliff edge every second.

Calculate the force exerted by the rocks on the falling water. Ignore any splashing.

force = ... [3]

[Total: 7]

4 **(a)** Pollen particles are mixed into a liquid. They are seen to move when observed through a microscope.

(i) Describe this movement.

..... [1]

(ii) Explain this movement in terms of the molecules of the liquid and the pollen particles.

.....

.....

..... [3]

(b) **(i)** Medical professionals sometimes rub ethanol over the skin of a patient. Ethanol evaporates readily at room temperature and has a high specific latent heat of vaporisation.

State whether the patient experiences heating, cooling or neither at the site where the ethanol is applied. Explain your answer.

statement .....

explanation .....

.....

..... [3]

(ii) State any effect on the rate of evaporation of ethanol when a fan blows air over the patient's skin.

..... [1]

[Total: 8]

5 **(a)** A machine delivers a hot drink in a plastic cup, which is uncomfortably hot to hold.

Fig. 5.1 shows the cup with the hot drink.

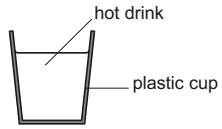


Fig. 5.1

Fig. 5.2a shows the cup with the hot drink and a holder for the sides of the cup.

Fig. 5.2b shows a cross-section through the holder. The holder is made from two strong paper cylinders separated by a wavy piece of strong paper to make air gaps.

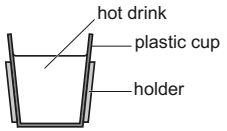


Fig. 5.2a

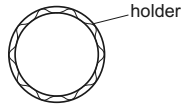


Fig. 5.2b

Explain how using the holder makes it more comfortable to hold the cup.

.....

.....

..... [3]

(b) A student carries out experiments on the cooling of the hot drink described in **(a)**, with and without the holder in place. He finds that the holder only reduces the rate of cooling slightly.

Suggest and explain another action that reduces the rate of cooling more effectively.

suggestion .....

explanation .....

.....

..... [3]

(c) State the method of thermal energy transfer from a star through the vacuum of space.

..... [1]

[Total: 7]

6 **(a)** Fig. 6.1 shows a ray of green light passing through a prism.

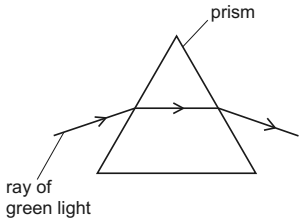


Fig. 6.1

A ray of blue light is directed towards the prism on the same path as the ray of green light.

On Fig. 6.1, draw the path of the blue light through and out of the prism. [3]

(b) The wavelength of the blue light in air is 4.8×10^{-7} m.

Calculate the frequency of the blue light.

frequency = ... [3]

[Total: 6]

7 **(a)** Fig. 7.1 shows two magnets and the gap between the N pole of one magnet and the S pole of the other magnet.

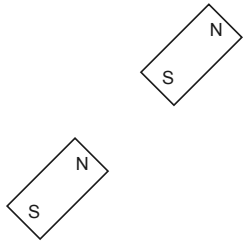


Fig. 7.1

On Fig. 7.1, draw **three** lines to show the pattern and direction of the magnetic field in the gap. [2]

(b) **(i)** Fig. 7.2 is a repeat of Fig. 7.1 showing the two magnets.

On Fig. 7.2, draw the position of a plotting compass needle when it comes to rest in the gap between the N pole and the S pole.

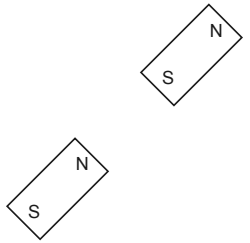


Fig. 7.2 [1]

(ii) Explain why the needle comes to rest in this position.

.....

.....

..... [2]

(c) Describe a method of demagnetising a bar magnet.

.....

.....

..... [2]

[Total: 7]

8 **(a)** Two identical radioactive sources emit α-particles and γ-rays into two vacuum tubes.

(i) Fig. 8.1 shows two electrically charged plates on either side of one of the vacuum tubes.

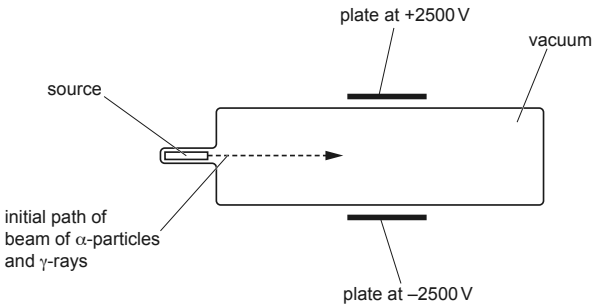


Fig. 8.1

Write the symbol α **once** in Table 8.1 to indicate any deflection of the α-particles.

Write the symbol γ **once** in Table 8.1 to indicate any deflection of the γ-rays.

Table 8.1

into page	out of page	no deflection	towards bottom of page	towards top of page

[2]

(ii) Fig. 8.2 shows the poles of a very strong magnet on either side of the other vacuum tube.

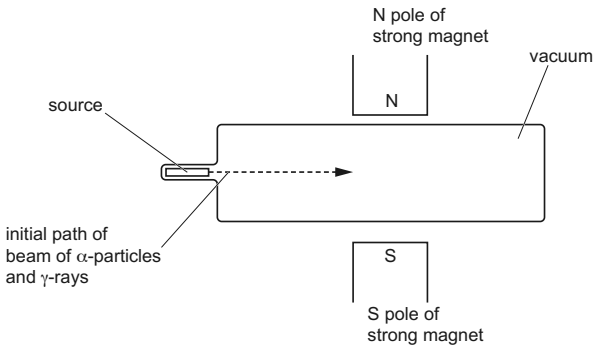


Fig. 8.2

Write the symbol α **once** in Table 8.2 to indicate any deflection of the α-particles.

Write the symbol γ **once** in Table 8.2 to indicate any deflection of the γ-rays.

Table 8.2

into page	out of page	no deflection	towards bottom of page	towards top of page

[2]

(b) Fig. 8.3 shows a simple direct current (d.c.) electric motor with a split-ring commutator.

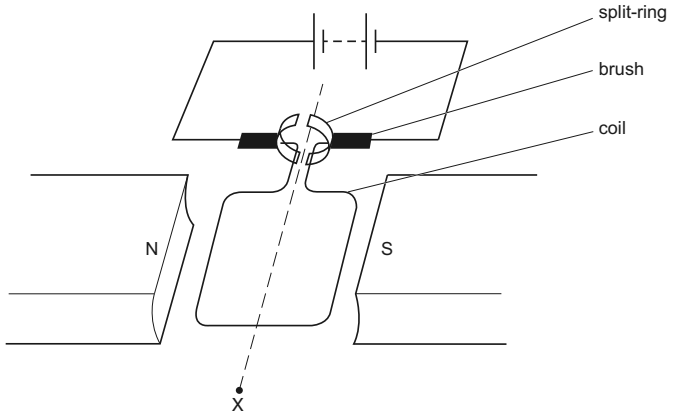


Fig. 8.3

(i) State and explain the direction of rotation of the coil as seen from point X.

statement .....

explanation .....

..... [3]

(ii) The coil rotates through 90° from the position shown.

State what happens to the moment in this position.

..... [1]

(iii) The coil is rotated through 180° from the position shown. By considering the forces on the coil, explain how the split-ring commutator enables the motor to turn continuously.

.....

..... [2]

[Total: 10]

9 **(a)** Fig. 9.1 shows a circuit.

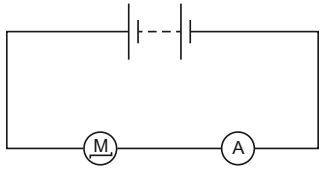


Fig. 9.1

On Fig. 9.1, draw **two** clearly labelled arrows to show the direction of the electron flow and the direction of the conventional current in the circuit. [2]

(b) The current in the motor is 13A. The charge on an electron is 1.6×10^{-19} C.

Calculate the number of electrons that pass through the motor every second.

number of electrons = ... [3]

[Total: 5]

10 (a) Fig. 10.1 shows the potential difference–current graph for a circuit component K.

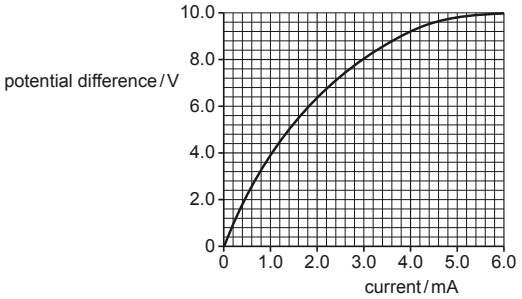


Fig. 10.1

Calculate the resistance of component K when the current in it is 4.0 mA.

resistance = ... [2]

(b) Fig. 10.2 shows a circuit containing component K.

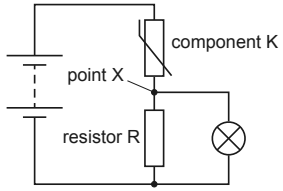


Fig. 10.2

At low temperature, component K has a much greater resistance than resistor R.

At high temperature, component K has a much smaller resistance than resistor R.

State and explain the effect on the lamp when the temperature changes from very low to very high.

Refer to the voltage at point X in your explanation.

statement .....

explanation .....

.....

.....

.....

..... [4]

(c) State the name of component K.

..... [1]

[Total: 7]

11 **(a)** A student investigates a radioactive substance in a laboratory.

Fig. 11.1 is a graph showing the count rate detected as the substance decays for 7.5 minutes.

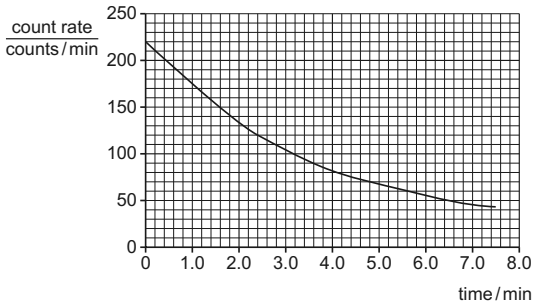


Fig. 11.1

The background radiation is 20 counts / min.

(i) Determine the half-life of the substance.

half-life = ... [3]

(ii) Calculate the count rate detected at time = 9.6 minutes.

count rate = ...counts / min [2]

(b) The substance emits α-particles and γ-rays. The student suggests that it is safe to store the substance in a plastic container of thickness 2 mm.

State and explain whether the student's suggestion is correct.

statement .....

explanation .....

..... [3]

[Total: 8]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/62**

Paper 6 Alternative to Practical **May/June 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

DC (MS/SW) 199686/3

[Turn over

1 A student determines the density of sand.

Fig. 1.1 shows a beaker with a mark at the 250 cm^3 level.

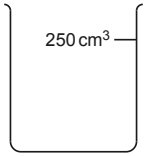


Fig. 1.1

(a) Estimate the volume of water V_W that the beaker would hold when filled to the top.

V_W = ... cm^3 [1]

(b) The student uses string and a metre rule to determine the circumference c of the beaker.

c = 21.3 cm

Explain briefly how to use the string and the metre rule to determine the circumference c as accurately as possible. You may draw a diagram.

.....

.....

.....

..... [2]

(c) The student measures the height h of the beaker.

(i) Show clearly on Fig. 1.1, the height h that he should measure. [1]

His reading is h = 9.0 cm

(ii) Calculate the external volume V_B of the beaker using the equation

$$V_B = \frac{hc^2}{12.6}.$$

V_B = ... cm^3 [2]

(d) The student measures the mass of the beaker on a balance, as shown in Fig. 1.2.

(i) Write down the mass m_B of the beaker, to the nearest gram.

Fig. 1.2

m_B = ... g [1]

The student fills the beaker to the top with dry sand. He measures the mass m of the beaker containing the sand.

m = 724 g

(ii) Calculate the mass m_S of sand in the beaker. Use the equation $m_S = (m - m_B)$.

m_S = ... g [1]

(iii) Calculate the density ρ of the sand using the equation

$$\rho = \frac{m_S}{V_B}.$$

Include the unit.

ρ = ... [2]

(e) The student uses a measuring cylinder to measure the volume of dry sand. Draw a diagram of the measuring cylinder and show the line of sight that the student must use to obtain an accurate volume reading.

[1]

[Total: 11]

2 A student investigates the position of the image in a plane mirror.

Fig. 2.1 shows the ray-trace sheet that the student uses.

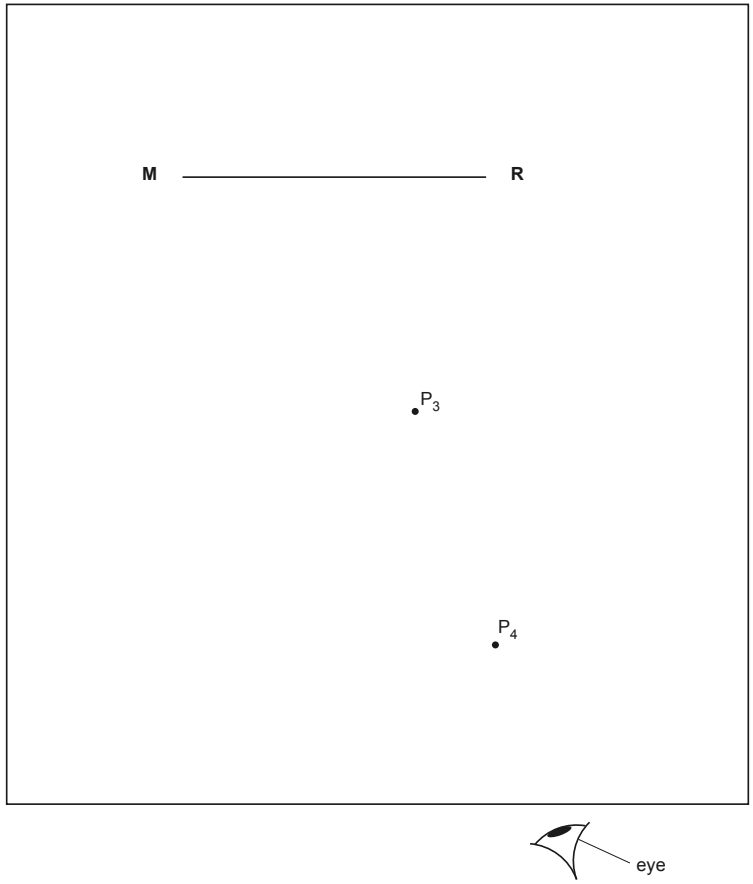


Fig. 2.1

(a)
- The line **MR** shows the position of a plane mirror. Draw a normal to this line that passes through its centre. Continue the normal so that it reaches the bottom of the ray-trace sheet. Label the normal **NL**. Label the point at which **NL** crosses **MR** with the letter **B**.
- Draw a line **CD** 5.0 cm below **MR** and parallel to **MR**.
- Label the point **X** where **CD** crosses **NL**.
- Draw a line **EF** 5.0 cm below **CD** and parallel to **CD**.
- Label the point **Y** where **EF** crosses **NL**.

[2]

(b) Draw a line 7.0 cm long from **B** at an angle of incidence $\theta_1 = 20°$ to the normal below **MR** and to the left of the normal. Label the end of this line **A**. [1]

(c) The student places two pins, P_1 and P_2, on line **AB**. Suggest a suitable distance x between the pins for this type of ray-trace experiment.

x = ... [1]

(d) The student views the images of pins P_1 and P_2 from the direction indicated by the eye in Fig. 2.1. She places pin P_3 on line **CD** so that the images of P_2 and P_1 appear exactly behind pin P_3.

She places pin P_4 on line **EF** so that pin P_3, and the images of P_2 and P_1, all appear exactly behind pin P_4. The positions of P_3 and P_4 are shown on Fig. 2.1.

(i) Measure and record the distance a from **X** to P_3.

a = ... [1]

(ii) Measure and record the distance b from **Y** to P_4.

b = ... [1]

(iii) Calculate $\frac{a}{b}$.

$\frac{a}{b}$ = ... [1]

(e) The student repeats the procedure using an angle of incidence $\theta_2 = 40°$. She records the new values of a and b.

$a =$ 4.2 cm

$b =$ 8.3 cm

Calculate the new value $\frac{a}{b}$.

$\frac{a}{b} =$ ..... [2]

(f) State and explain whether the two values of $\frac{a}{b}$ can be considered to be equal in this experiment.

.....

..... [1]

(g) A student carries out this experiment with care. Suggest a practical reason why the results may **not** be accurate.

.....

..... [1]

[Total: 11]

3 A student investigates resistance.

Fig. 3.1 shows the circuit used.

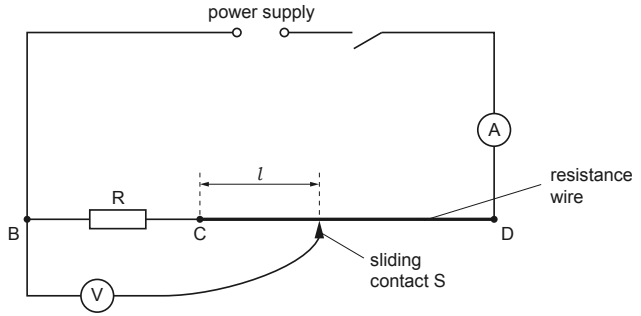


Fig. 3.1

(a) The student measures the current I in the circuit.

He places the sliding contact S at C and measures the potential difference (p.d.) V_1 across the resistor R.

The voltmeter and ammeter are shown in Fig. 3.2 and Fig. 3.3.

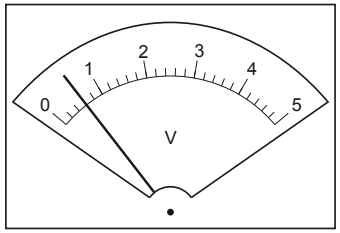


Fig. 3.2

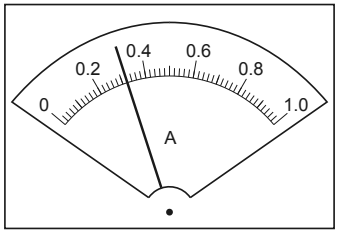


Fig. 3.3

(i) Write down the readings.
Include the units for potential difference, current or resistance where appropriate in all parts of the question.

$V_1 =$ .....

$I_1 =$ .....

[2]

(ii) Calculate the resistance R_1 of the resistor using the equation $R_1 = \frac{V_1}{I_1}$.

$R_1 =$ .....

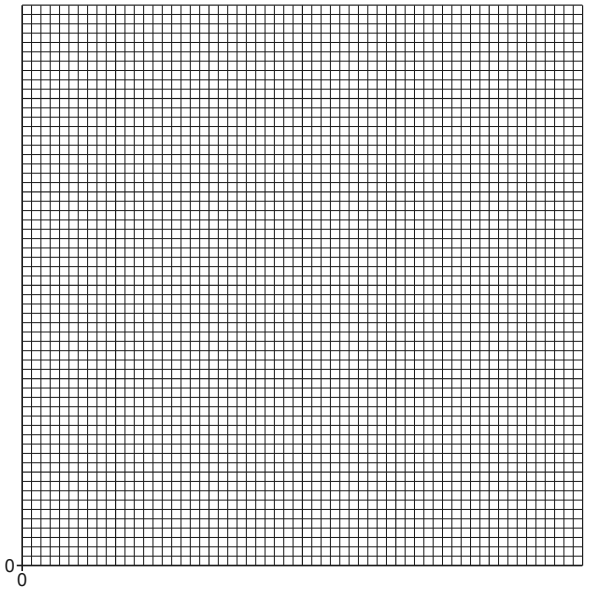
[2]

(b) The student disconnects the voltmeter from terminal B and connects the voltmeter to terminal C.
He places the sliding contact S at a distance l = 20.0 cm from C. He records, in Table 3.1, the reading on the voltmeter.
He repeats the procedure using l = 40.0 cm, 60.0 cm, 80.0 cm and 100.0 cm. His readings are shown in Table 3.1.

Table 3.1

l / cm	V / V
20.0	0.4
40.0	0.8
60.0	1.1
80.0	1.5
100.0	1.9

Plot a graph of V / V (y-axis) against l / cm (x-axis). Start both axes at the origin (0,0).



[4]

(c) Use your value of V_1 from **(a)(i)** to find the length l_R of resistance wire that has the same resistance as resistor R. Show clearly on the graph how you obtained the necessary information.

l_R = ... cm [2]

(d) The resistance of the resistance wire is proportional to its length. Estimate the resistance of 100 cm of the resistance wire.

estimate ..... [1]

[Total: 11]

4 A student investigates springs made from different metals.

Plan an experiment to investigate the extension of springs made from different metals.

The following apparatus is available:

boss, clamp and stand
metre rule
springs made from different metals
selection of loads with hangers.

You can also use other apparatus and materials that are usually available in a school laboratory.

In your plan, you should:

- write a list of suitable metals for the springs
- draw a diagram of the set up you would use
- explain briefly how to carry out the investigation
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the readings to reach a conclusion.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [7]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4291326166

PHYSICS **0625/41**

Paper 4 Theory (Extended) **May/June 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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 A skydiver of mass 76 kg is falling vertically in still air. At time $t = 0$, the skydiver opens his parachute.

Fig. 1.1 is the speed–time graph for the skydiver from $t = 0$.

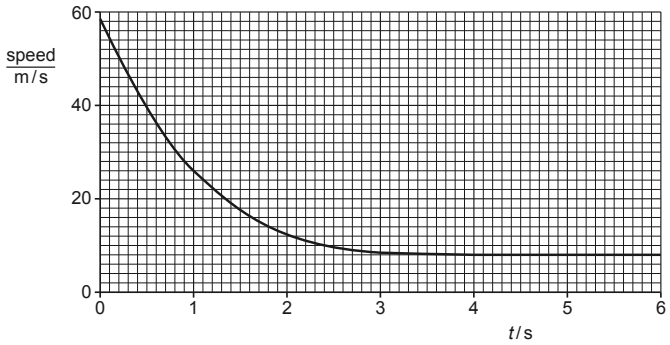


Fig. 1.1

(a) Using Fig. 1.1, determine:

(i) the deceleration of the skydiver immediately after the parachute opens

deceleration = ... [2]

(ii) the force due to air resistance acting on the skydiver immediately after the parachute opens.

force = ... [3]

(b) Explain, in terms of the forces acting on the skydiver, his motion between $t = 0$ and $t = 6.0$ s.

.....

.....

.....

..... [3]

(c) Explain why opening the parachute cannot reduce the speed of the skydiver to zero.

.....

.....

..... [2]

[Total: 10]

2 Fig. 2.1 shows a wooden trolley of mass 1.2 kg at rest on the rough surface of a bench.

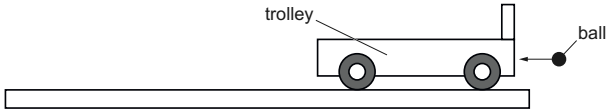


Fig. 2.1

A ball of mass 0.52 g travels horizontally towards the trolley. The ball embeds itself in the wood of the trolley. The trolley moves with an initial speed of 0.065 m/s.

(a) Calculate:

(i) the impulse exerted on the trolley

impulse = ... [2]

(ii) the speed of the ball as it hits the trolley.

speed = ... [2]

(b) As the trolley moves across the rough surface, it slows down and stops.

Explain, in terms of the work done, the energy change that takes place as the trolley slows down.

.....

.....

.....

..... [3]

[Total: 7]

3 **(a)** Explain, in terms of molecules, why liquids are very difficult to compress.

.....

.....

..... [2]

(b) Fig. 3.1 shows a device that uses liquid pressure to lift heavy boxes.

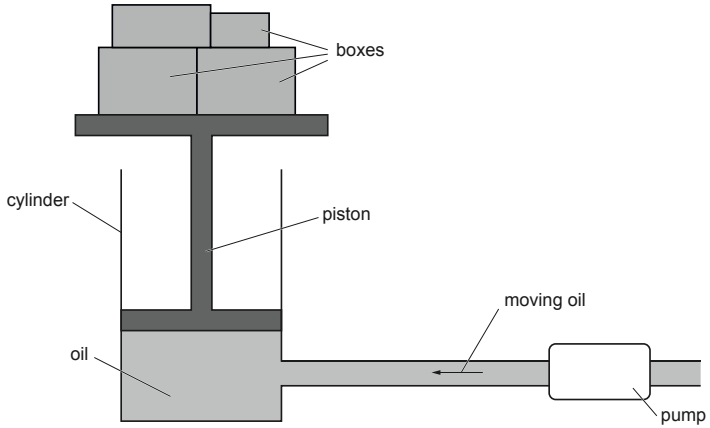


Fig. 3.1

The boxes are lifted by pumping oil into the cylinder.

The force upwards on the piston due to the oil, and the force downwards on the piston due to the air above the piston, combine to produce a constant force of 8800 N.

The pressure of the air is 1.0×10^5 Pa and the cross-sectional area of the bottom surface of the piston is 0.016 m^2.

(i) Calculate the pressure of the oil at the bottom surface of the piston.

pressure = ... [3]

(ii) As the boxes are lifted, the depth of the oil increases.

Explain why the pump must exert an increasing pressure on the oil as the depth of the oil increases.

.....

.....

..... [2]

(iii) Suggest **one** reason why the force of 8800 N in **(b)** cannot lift boxes of weight 8800 N.

.....

..... [1]

[Total: 8]

4 An aluminium saucepan with a plastic handle contains cold water.

Fig. 4.1 shows the saucepan on a hotplate.

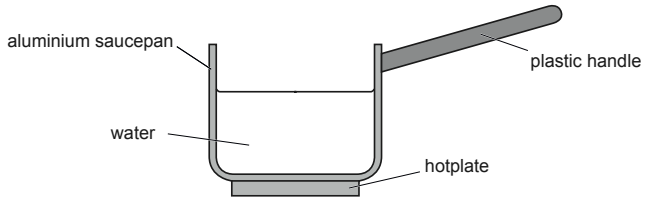


Fig. 4.1

(a) State why the pan is made from aluminium but the handle is made from plastic.

.....

..... [1]

(b) The hotplate is switched on and, as the temperature of the water increases, the internal energy of the water increases.

(i) State, in terms of molecules, what is meant by *an increase in internal energy*.

.....

..... [1]

(ii) Explain, in terms of the atomic lattice and electrons, how thermal energy is transferred through the aluminium.

.....

.....

.....

..... [3]

(iii) Eventually, the water reaches boiling point. Thermal energy from the hotplate is still being transferred to the water.

Explain, in terms of molecules, the effect of this thermal energy on the water.

.....

.....

.....

..... [3]

(iv) The mass of the water decreases by 0.11 kg in 300 s. The specific latent heat of vaporisation of water is 2.3×10^6 J / kg.

Calculate the rate at which the water gains thermal energy.

rate of gain of energy = ... [3]

[Total: 11]

5 Fig. 5.1 shows the structure of a liquid-in-glass thermometer.

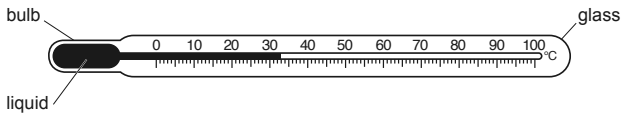


Fig. 5.1

The bulb of the thermometer is placed into a beaker of warm water. As the liquid expands, it moves along the tube.

(a) Explain, in terms of molecules, why a liquid expands when heated.

.....

.....

..... [2]

(b) Explain, in terms of molecules, why a liquid expands more than a solid when heated.

.....

.....

..... [2]

(c) A second thermometer has a larger bulb that contains more of the same liquid than the thermometer shown in Fig. 5.1. It has a different scale. In every other way, it is identical.

(i) Explain how the sensitivity of the second thermometer compares with the sensitivity of the thermometer in Fig. 5.1.

.....

.....

..... [2]

(ii) Explain how the range of the second thermometer compares with the range of the thermometer in Fig. 5.1.

.....

..... [1]

(d) (i) State **one** everyday problem that is a result of thermal expansion.

.....

..... [1]

(ii) Suggest and explain **one** way of solving this problem.

.....

.....

..... [2]

[Total: 10]

6 Fig. 6.1 is a full-scale diagram that represents a sound wave travelling in air.

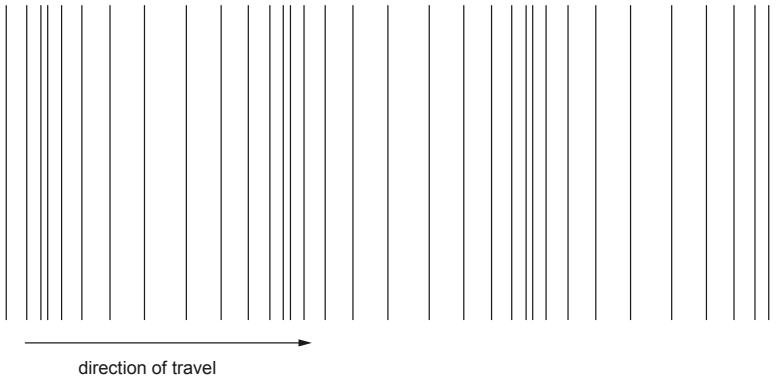


Fig. 6.1

(a) On Fig. 6.1, mark **two** points, each at the centre of a different compression. Label both of the points C. [1]

(b) The speed of sound in air is 330 m / s.

Measure the diagram and determine the frequency of the sound.

frequency = ... [3]

(c) The wave reaches a barrier. Fig. 6.2 shows the wave passing through a gap in the barrier.

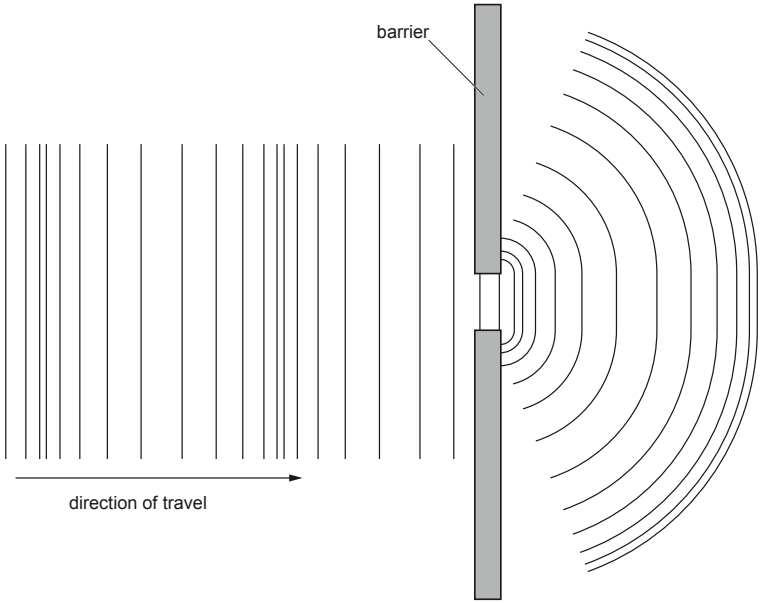


Fig. 6.2

The frequency of the wave is increased to a value many times greater than the value obtained in **(b)**.

Describe and explain **two** ways in which a diagram representing the wave with the greater frequency differs from Fig. 6.2.

1. .....

.....

2. .....

.....

[3]

[Total: 7]

7 Fig. 7.1 represents an alternating current (a.c.) generator.

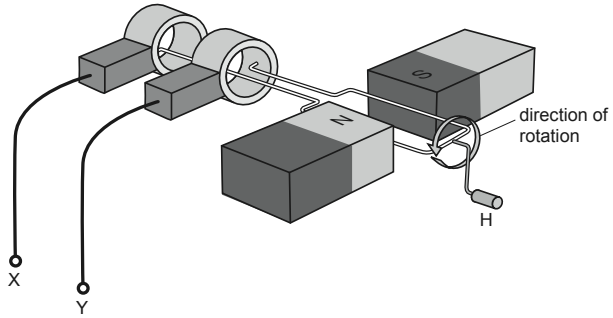


Fig. 7.1

(a) A student rotates the handle H, as shown in Fig. 7.1.

(i) On Fig. 7.2, sketch a graph to show how the electromotive force (e.m.f.) between terminals X and Y varies with time during **two** complete revolutions of the coil.

Fig. 7.2

[3]

(ii) On Fig. 7.2, mark and label a point P, for the e.m.f. when the coil is horizontal, as shown in Fig. 7.1. [1]

(iii) The student turns the handle more quickly.

State **two** ways in which the e.m.f. between terminals X and Y changes.

1. .....

2. .....

[2]

(b) Terminals X and Y are connected to the primary coil of a transformer.

State and explain what happens in the transformer as the student turns the handle of the a.c. generator.

.....

.....

.....

..... [3]

(c) Explain why the power losses in transmission cables are lower when electrical energy is transmitted at higher voltages.

.....

.....

..... [2]

[Total: 11]

8 A student sets up a circuit that includes a 12 V battery, an 800 Ω resistor, a voltmeter and a thermistor. Fig. 8.1 is an incomplete circuit diagram because the symbol for the thermistor is missing.

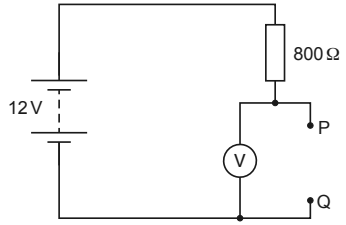


Fig. 8.1

The thermistor is connected between terminals P and Q.

(a) Complete Fig. 8.1 by drawing the symbol for a thermistor between terminals P and Q. [1]

(b) The 12 V battery consists of eight identical cells connected in series.

Calculate the electromotive force (e.m.f.) of each cell.

e.m.f. = ... [1]

(c) The reading on the voltmeter is 8.0 V.

(i) Determine the resistance of the thermistor.

resistance = ... [3]

(ii) A few hours later, the student notices that the reading on the voltmeter is greater.

Explain what can be deduced from this observation.

.....

.....

.....

..... [3]

[Total: 8]

9 There are three naturally occurring isotopes of hydrogen: hydrogen-1, hydrogen-2 and hydrogen-3. The nuclide notation for hydrogen-1 is ${}^{1}_{1}\mathrm{H}$.

(a) Write down the symbol, using nuclide notation, for:

hydrogen-2 .....

hydrogen-3. .....

[1]

(b) In a fusion reactor, a nucleus of hydrogen-2 and a nucleus of hydrogen-3 undergo fusion.

(i) State what is meant by *nuclear fusion*.

.....

.....

..... [2]

(ii) The fusion reaction produces a free neutron and **one** other particle.

Write down, using nuclide notation, the equation that represents this reaction.

[3]

(c) Nuclear fusion in the Sun is the source of most but not all of the resources that are used to generate electrical energy on Earth.

State **two** resources for which nuclear fusion in the Sun is **not** the source.

1. .....

2. .....

[2]

[Total: 8]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/43**

Paper 4 Theory (Extended) **May/June 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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m/s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (ST/JG) 198539/3

[Turn over

1 Fig. 1.1 shows a load suspended from a spring.

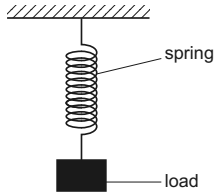


Fig. 1.1

The value of the spring constant k of the spring is 0.20 N / cm. The spring reaches its limit of proportionality when the load is 15 N.

(a) Calculate the extension of the spring when the load is 3.0 N.

extension = ... [2]

(b) Explain what is meant by the term *limit of proportionality* of the spring.

.....

.....

..... [2]

(c) On Fig. 1.2, sketch an extension–load graph for a spring. Label the limit of proportionality with the letter L on your graph.

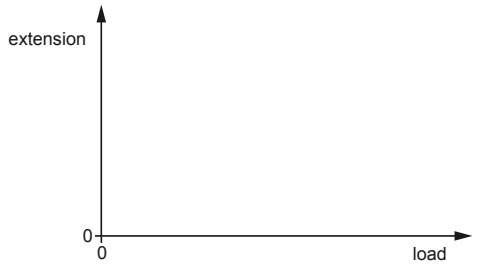


Fig. 1.2

[2]

(d) The load is pulled down a small distance below its equilibrium position to position A, as shown in Fig. 1.3. The load then moves up and down between position A and position B in Fig. 1.3.

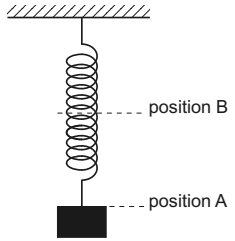


Fig. 1.3

Describe the energy transfers which occur as the load moves:

from position A to the equilibrium position

.....

.....

from the equilibrium position to position B.

.....

.....

[3]

[Total: 9]

2 **(a)** Fig. 2.1 shows a bookshelf with two groups of books A and B on it. There are six books in each group of books. All the books are identical. The mass of each book is 0.52 kg.

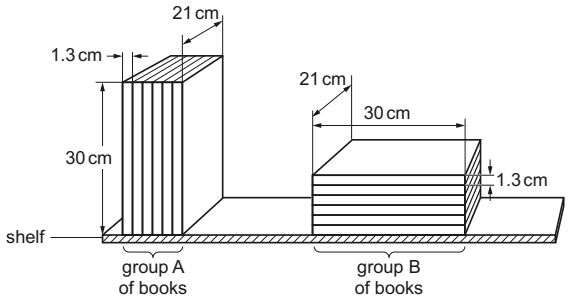


Fig. 2.1

(i) Explain why the pressure exerted on the shelf by the books in group B is less than the pressure exerted on the shelf by the books in group A.

.....

.....

..... [3]

(ii) Calculate the pressure exerted on the shelf by the books in group A.

pressure = ... [3]

(b) A diver dives to a depth below the surface of the sea where the total pressure is 3.0×10^5 Pa. The atmospheric pressure is 1.0×10^5 Pa. The density of the sea water is 1030 kg / m^3.

Calculate the depth of the diver below the surface of the sea.

depth = ... [3]

[Total: 9]

3 A car travels at constant speed v on a horizontal, straight road. The driver sees an obstacle on the road ahead.

(a) The distance travelled in the time between the driver seeing the obstruction and applying the brakes is the thinking distance.

Explain why the thinking distance is directly proportional to v.

.....

..... [1]

(b) When the brakes are applied, the car decelerates uniformly to rest. The frictional force applied by the brakes is constant. The distance travelled between first applying the brakes and the car stopping is the braking distance.

Explain why the braking distance is proportional to v^2.

.....

.....

.....

..... [3]

(c) The car is travelling at 22 m / s.

(i) The thinking distance is 15 m.

Calculate the time taken to travel the thinking distance.

time = ... [2]

(ii) The car has a mass of 1400 kg. The time taken for the car to stop after the brakes are applied is 2.1 s.

Calculate the force required to stop the car in this time.

force = ... [2]

[Total: 8]

4 **(a)** **(i)** Define *specific latent heat of fusion*.

.....

..... [2]

(ii) A cup of water contains 250 cm^3 of water at a temperature of 0 °C. An identical cup contains 250 cm^3 of a mixture of ice and water at a temperature of 0 °C.

The temperature of the surrounding air is 20 °C.

State and explain which cup contains the liquid with the lower temperature after 10 minutes.

statement .....

explanation .....

..... [2]

(b) **(i)** On a hot day, sweat forms on a person's skin and then evaporates.

Explain, in terms of molecules, how the evaporation of sweat cools the person.

.....

.....

.....

.....

..... [3]

(ii) Explain why this process is more effective when a wind is blowing.

.....

..... [1]

[Total: 8]

5 **(a)** Fig. 5.1 shows a wave on the sea approaching a harbour.

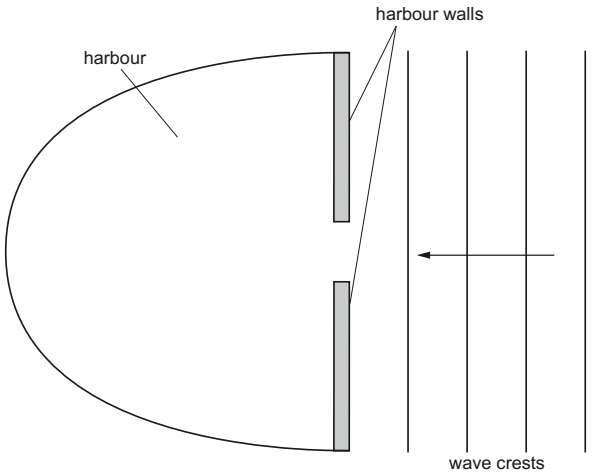


Fig. 5.1

(i) On Fig. 5.1, draw **three** wave crests in the harbour. [2]

(ii) Another harbour has a much wider gap between its walls.

Describe and explain how the pattern of wave crests in this harbour is different from the pattern you have drawn in **(i)**.

description.....

.....

explanation.....

..... [2]

(b) A sound wave of frequency 850 Hz travels through sea water. The speed of sound in sea water is 1500 m / s.

Calculate the wavelength of this sound wave in sea water.

wavelength = ... [2]

[Total: 6]

6 Fig. 6.1 is a full-scale diagram of a lens and an object O.

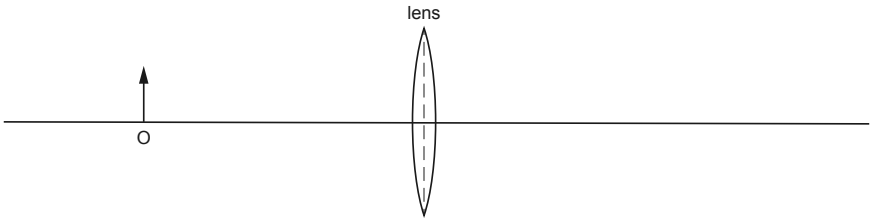


Fig. 6.1

(a) The focal length of the lens is 3.5 cm.

On Fig. 6.1, mark and label with the letter F the positions of the **two** principal focuses. [1]

(b) On Fig. 6.1, draw **three** rays to locate the image. Draw an arrow to represent the image and label the image I. [3]

(c) State **three** properties of the image I.

..... [2]

(d) A student incorrectly states that this lens is being used as a magnifying glass.

(i) State how the image produced by a magnifying glass is different from the image I.

..... [1]

(ii) The student moves the object O to a position P so that the lens shown in Fig. 6.1 acts as a magnifying glass.

On Fig. 6.1, mark a possible position for P. [1]

[Total: 8]

7 **(a)** Define *electromotive force* (*e.m.f.*).

.....

.....

..... [2]

(b) Fig. 7.1 shows a circuit.

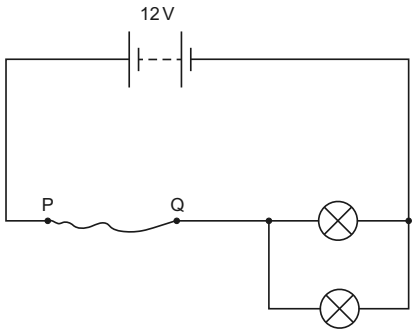


Fig. 7.1

The two lamps shown are identical. Each lamp has a potential difference (p.d.) of 3.0 V across it and a current of 2.0 A in it. PQ is a length of uniform metal wire. The resistance of PQ is *R*.

(i) Calculate the value of *R*.

R = ... [3]

(ii) Another piece of wire is made of the same metal as PQ. The length of the new piece of wire is twice the length of PQ. The diameter of the new piece of wire is twice the diameter of PQ.

Calculate the resistance of the new piece of wire.

resistance = ... [3]

[Total: 8]

8 **(a)** State the difference between an analogue signal and a digital signal. You may draw a diagram to help explain your answer.

.....

..... [2]

(b) Draw the symbol for a NOR gate.

[1]

(c) Fig. 8.1 shows a combination of logic gates X, Y and Z. The gates are not represented by the standard symbols.

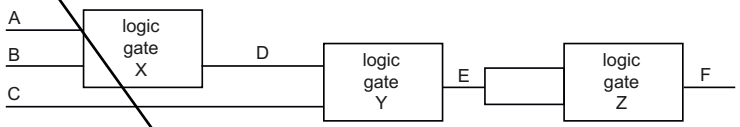


Fig. 8.1

Table 8.1 shows a partly completed truth table for this combination of logic gates.

Table 8.1

inputs			intermediate points		output
A	B	C	D	E	F
0	0	0	0	0	
0	1	0	0	0	
1	0	1	0	1	
1	1	1	1	1	
0	0	0	0	0	
0	1	0	0	0	
1	0	1	0	1	
1	1	1	1	1	

(i) From Table 8.1, deduce:

1. the name of logic gate X

..... [1]

2. the name of logic gate Y.

..... [1]

(ii) Logic gate Z is a NAND gate.

Complete column F of Table 8.1. [2]

[Total: 7]

9 **(a)** An X-ray machine requires a supply of 110 kV. The mains electricity supply is 230 V. A transformer is used to supply the correct voltage to the X-ray machine. There are 50 turns on the primary coil of the transformer.

Calculate the number of turns on the secondary coil.

number of turns = ... [2]

(b) Draw a labelled diagram of a step-down transformer. On the labels, state a suitable material for each of the components.

[3]

(c) Explain how a transformer operates.

.....

.....

.....

..... [3]

[Total: 8]

10 **(a)** Fig. 10.1 shows a beam of radiation in a vacuum. The beam contains α-particles, β-particles and γ-rays.

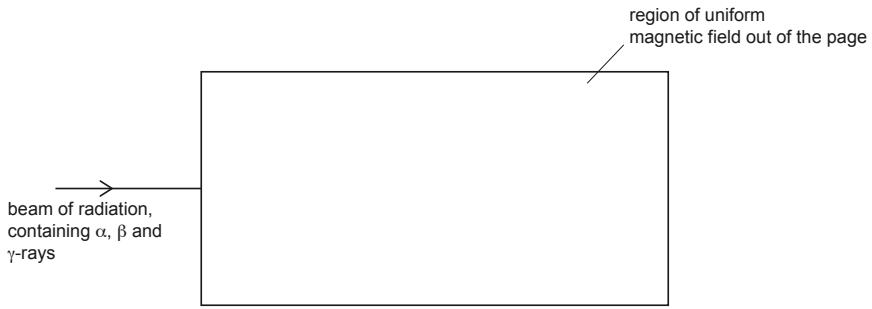


Fig. 10.1

The beam enters a region where there is a strong, uniform magnetic field. The direction of the magnetic field is out of the page.

On Fig. 10.1, mark and label the paths through the magnetic field of:

(i) α-particles (label this path α) [1]

(ii) β-particles (label this path β) [2]

(iii) γ-rays (label this path γ). [1]

(b) Radioactive sources have many uses in medicine.

State **two** safety precautions which hospital staff take when working with γ-ray sources.

1. .....

2. ..... [2]

(c) The radioactive isotope iodine-131 is used as a tracer in medical diagnosis. A nucleus of iodine-131 contains 53 protons and 78 neutrons. The symbol for iodine is I.

(i) Use nuclide notation to show this isotope of iodine.

[1]

(ii) Iodine-131 emits γ-radiation. It has a half-life of 8 hours.

Explain why this emission and this half-life make iodine-131 a suitable material for a tracer in medical diagnosis.

.....

.....

.....

..... [2]

[Total: 9]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6222074801

PHYSICS **0625/61**

Paper 6 Alternative to Practical **May/June 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

[Turn over

1 A student investigates the period of a pendulum. Fig. 1.1 and Fig. 1.2 show the arrangement.

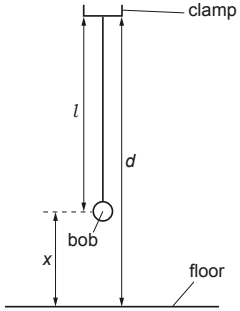


Fig. 1.1

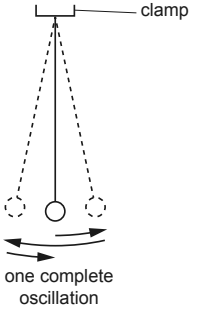


Fig. 1.2

(a) The student measures the distance *d* between the bottom of the clamp and the floor.

d = ... 120.0 cm .....

This distance *d* remains constant throughout the experiment.

He adjusts the length l of the pendulum to 70.0 cm.

Calculate the distance *x* between the centre of the pendulum bob and the floor. Record the value of *x* in the first row of Table 1.1. [1]

(b) The student displaces the bob slightly and releases it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

He measures, and records in the first row of Table 1.1, the time *t* for 10 complete oscillations.

(i) Calculate, and record in the first row of Table 1.1, the period *T* of the pendulum. The period is the time for one complete oscillation. [1]

(ii) Calculate, and record in the first row of Table 1.1, T^2. [2]

(iii) Complete the column headings in Table 1.1. [1]

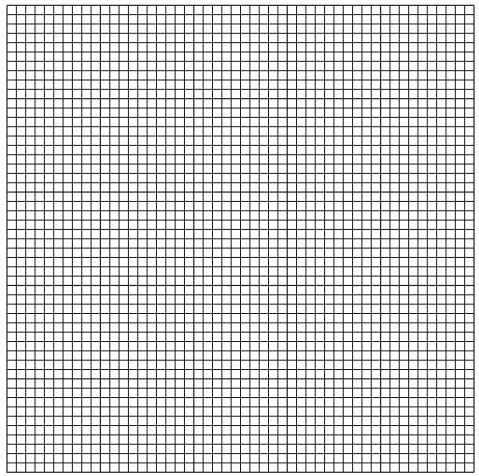
Table 1.1

x/	t/	T/	T^2/
	16.7		
45.0	17.3	1.73	2.99
40.0	17.9	1.79	3.20
35.0	18.4	1.84	3.39
30.0	19.0	1.90	3.61

(c) He repeats the procedure using x = 45.0 cm, 40.0 cm, 35.0 cm and 30.0 cm.

He records the readings in Table 1.1.

Plot a graph of T^2 (y-axis) against x (x-axis). You do **not** need to start your axes at the origin (0,0).



[4]

(d) State whether the graph line shows that T^2 is proportional to x. Give a reason for your answer.

statement .....

reason .....

[1]

(e) Explain why timing 10 oscillations gives a more accurate result for the period T than timing one oscillation.

.....

..... [1]

[Total: 11]

2 A student investigates resistance.

Fig. 2.1 shows the circuit she uses.

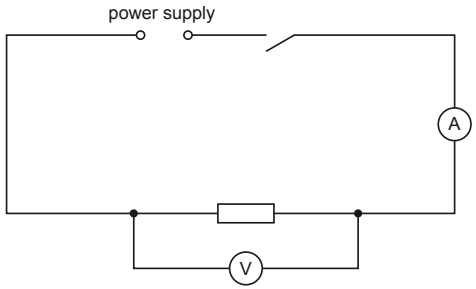


Fig. 2.1

(a) She records the potential difference (p.d.) V_1 across the resistor and the current I_1 in the circuit.

The meters are shown in Fig. 2.2 and Fig. 2.3.

(i) Write down the readings. Include the units for potential difference, current or resistance where appropriate in all parts of the question.

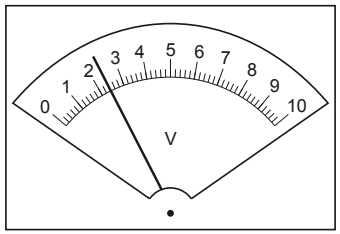


Fig. 2.2

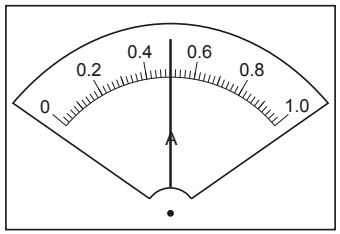


Fig. 2.3

V_1 = ...

I_1 = ...

[3]

(ii) Calculate the resistance R_1 of the resistor using the equation $R_1 = \frac{V_1}{I_1}$.

R_1 = ... [1]

(b) She connects a second resistor in series with the first resistor. She connects the voltmeter across both resistors and records the potential difference V_2 across both resistors and the current I_2 in the circuit.

V_2 = 2.6

I_2 = 0.28

Calculate the resistance R_S of the resistors in series using the equation $R_S = \frac{V_2}{I_2}$.

R_S = ... [1]

(c) She connects the second resistor in parallel with the first resistor. She connects the voltmeter across both resistors. She records the potential difference V_3 across the resistors and the current I_3 in the circuit.

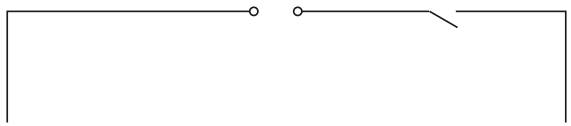
V_3 = 2.4

I_3 = 0.99

Calculate the resistance R_P of the resistors in parallel using the equation $R_P = \frac{V_3}{I_3}$. Give your answer to a suitable number of significant figures for this experiment.

R_P = ... [1]

(d) Complete the circuit diagram to show the circuit she uses in part **(c)**.



[2]

(e) Describe how to extend part **(c)** of this experiment to investigate the relationship between the combined resistance of identical resistors connected in parallel and the number of resistors.

.....

.....

.....

..... [2]

(f) In this type of electrical experiment, a variable resistor can be used to vary the current.

Draw the circuit symbol for a variable resistor.

[1]

[Total: 11]

3 A student investigates the refraction of light through a transparent block.

Fig. 3.1 shows the transparent block **ABCD** on the student's ray-trace sheet.

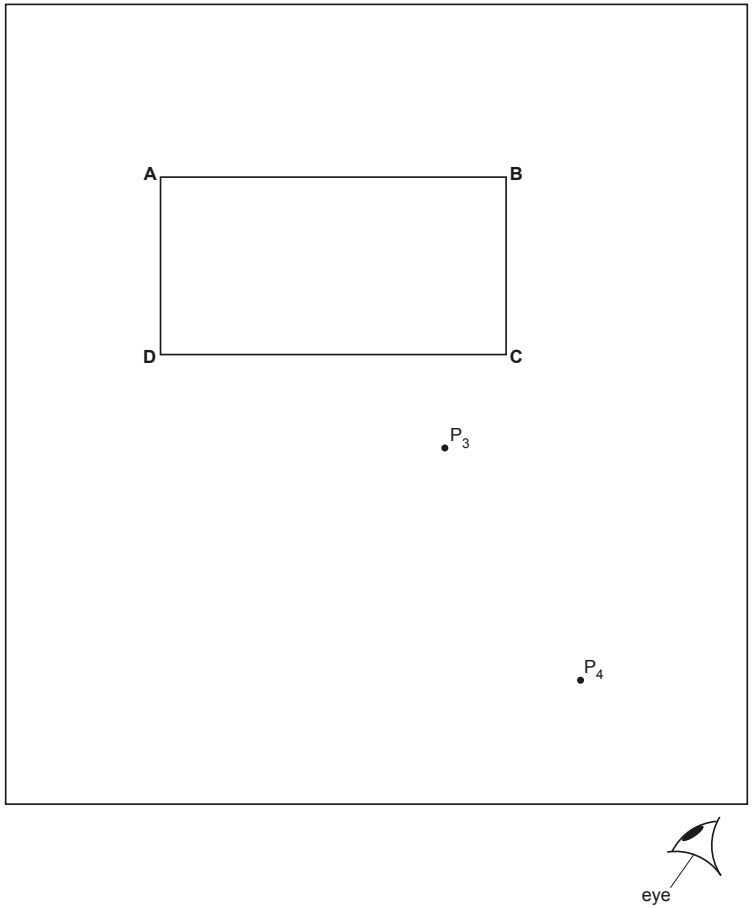


Fig. 3.1

(a) • Draw a normal at the centre of side **AB**. Continue the normal so that it reaches the bottom of the ray-trace sheet. Label the normal **NL**.

• Label the point **Q** where **NL** crosses **AB**.

[1]

(b)
- Draw a line **EF** parallel to **CD** and 2.0 cm below **CD**.
- Label the point **J** where **NL** crosses **EF**.
- Draw a line **GH** parallel to **CD** and 7.0 cm below **CD**.
- Label the point **K** where **NL** crosses **GH**.

[1]

(c) (i) Draw a line **PQ** at an angle $i = 30°$ to the normal and on the left-hand side of the normal above the block. [1]

(ii) The student places two pins P_1 and P_2 on line **PQ**. Fig. 3.1 is not drawn full size. Suggest a suitable distance apart for pins P_1 and P_2 in this type of experiment.

distance apart ..... [1]

(d) The student observes the images of P_1 and P_2 through side **CD** of the block. She adjusts her line of sight until the images of P_1 and P_2 appear one behind the other.
She places a pin P_3 on line **EF** and a pin P_4 on line **GH** so that P_3, and the images of P_1 and P_2 seen through the block, appear behind pin P_4.

(i) On Fig. 3.1, measure the length a of the line from **J** to P_3.

$a =$ ..... [1]

(ii) On Fig. 3.1, measure the length b of the line from **K** to P_4.

$b =$ ..... [1]

(iii) Calculate $\frac{b}{a}$.

$\frac{b}{a} =$ ..... [2]

(e) State **one** precaution that you would take in this type of experiment in order to produce an accurate ray trace.

.....

..... [1]

(f) A student plans to test the suggestion that, in this experiment, $\frac{b}{a}$ is a constant for all possible values of i. List suitable values of i that the student could use.

..... [2]

[Total: 11]

4 A student investigates the rate of cooling, in air, of heated blocks made of different metals. The temperature of each block is increased by placing it in hot water.

Plan an experiment to investigate how the rate of cooling depends on the metal from which each block is made.

The following apparatus is available to the student:

cylindrical blocks of different metals, each with a hole for a thermometer, as shown in Fig. 4.1
a thermometer.

Other apparatus normally available in a school laboratory can also be used.

In your plan, you should:

- list any additional apparatus required
- explain briefly how you would carry out the investigation, including the measurements you would take
- state the key variables to be kept constant
- draw a suitable table, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the results to reach a conclusion.

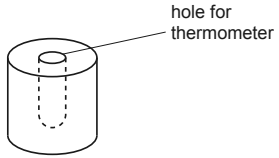


Fig. 4.1

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [7]

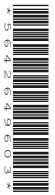
Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER



PHYSICS **0625/63**

Paper 6 Alternative to Practical **May/June 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (MS/CT) 199687/3

[Turn over

1 A student investigates the behaviour of a spring, and then uses the spring to determine the density of modelling clay.

The apparatus is shown in Fig. 1.1.

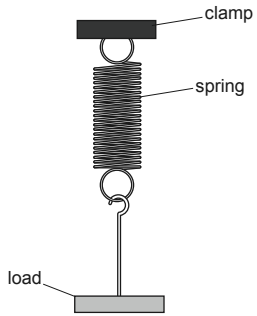


Fig. 1.1

(a) Describe **two** precautions that the student should take when measuring the length of the spring, to ensure an accurate reading. You may draw a diagram.

1. .....

.....

2. .....

.....

[2]

(b) The student measures the length l_0 of the spring without any load.

l_0 = 2.3 cm

A load of weight W = 2.0 N is suspended from the spring, as shown in Fig. 1.2.

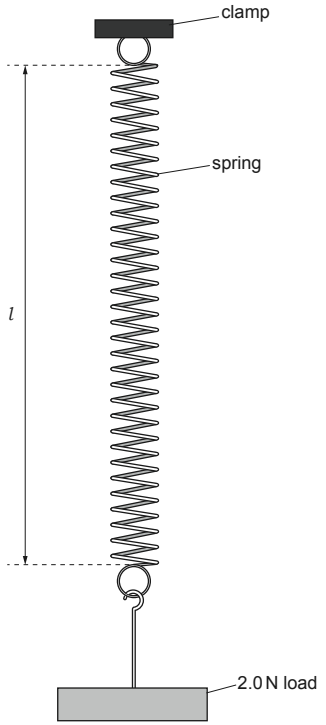


Fig. 1.2

(i) On Fig. 1.2, measure the stretched length l of the spring.

l = ... cm [1]

(ii) Calculate the extension e of the spring for a load of weight W = 2.0 N.
Use the equation $e = (l - l_0)$.

e = ... cm [1]

(c) The 2.0 N load is removed from the spring.

A load U is made of modelling clay wrapped on a wire hanger. Load U is suspended from the spring.

The student measures the stretched length l_U of the spring.

l_U = 7.4 ..... cm

Calculate the extension e_U of the spring with load U.

e_U = ... cm

The extension of a spring is directly proportional to the weight of the load.

Use your values of W and e from **(b)(ii)** and your value of e_U to determine the weight W_U of load U.
Show your working.

W_U = ...
[2]

(d) Load U is fully immersed in a beaker of water, as shown in Fig. 1.3.

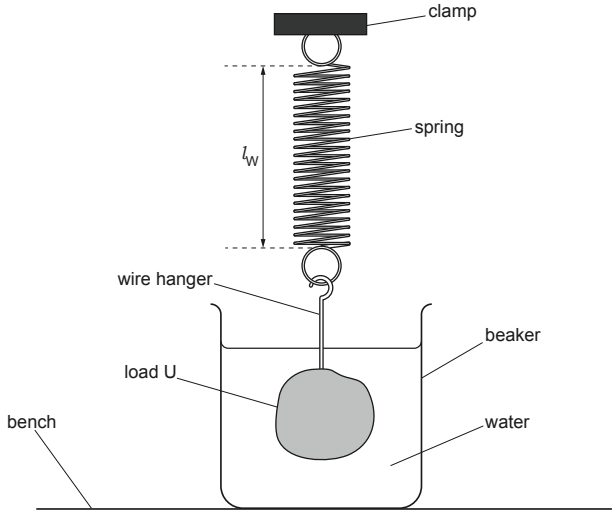


Fig. 1.3

On Fig. 1.3, measure the stretched length l_W of the spring.

l_W = ... cm

Calculate the extension e_W of the spring with load U in the water.

e_W = ... cm

Calculate the density ρ of the modelling clay.
Use your values of e_U from **(c)**, your value of e_W and the equation

$$\rho = \frac{e_U}{(e_U - e_W)} \times k \text{ , where } k = 1.0\,\text{g/cm}^3.$$

ρ = ... g/cm^3
[2]

(e) Suggest a possible source of inaccuracy in the determination of ρ in this experiment.

.....

.....

..... [1]

(f) The student plots a graph of load against extension for the spring, to show that the two quantities are directly proportional.

State how his graph line shows that load and extension are directly proportional.

.....

.....

..... [2]

[Total: 11]

2 A student determines the electromotive force (e.m.f.) and resistance of a cell by using a resistance wire.

She uses the circuit shown in Fig. 2.1.

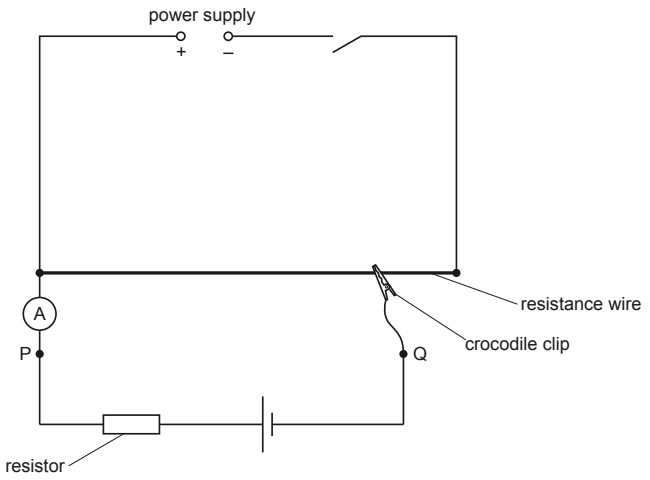


Fig. 2.1

(a) On Fig. 2.1, draw a voltmeter connected to measure the potential difference (p.d.) across terminals P and Q. [1]

(b) The switch is closed. The student moves the crocodile clip on the resistance wire so that the potential difference V across terminals P and Q is 5.0 V.

She measures the current I for the cell and resistor in series.

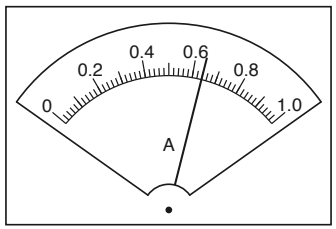


Fig. 2.2

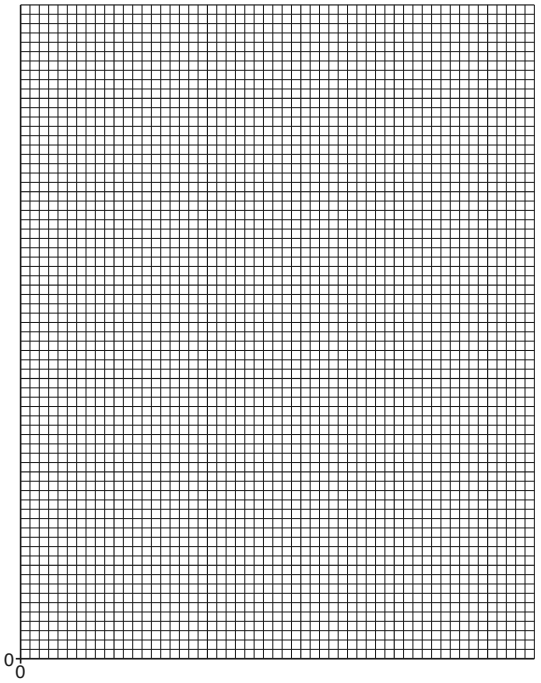
Read, and record in Table 2.1, the value of I shown on the meter in Fig. 2.2. [1]

(c) The student repeats the procedure in **(b)** for values of V = 4.5 V, 4.0 V, 3.5 V and 3.0 V. Her readings are shown in Table 2.1.

Table 2.1

V/V	I/A
5.0	
4.5	0.56
4.0	0.44
3.5	0.35
3.0	0.28

Plot a graph of I/A (y-axis) against V/V (x-axis). Start both axes at the origin (0,0).



[4]

(d) The e.m.f. E of the cell is equal to the value of V when I = 0.0 A.

Determine the value of E from the graph.

E = ... [1]

(e) (i) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [1]

(ii) The value of $\frac{1}{G}$ is numerically equal to the resistance $(r + R)$ where r is the resistance of the cell and $R = 4.0\,\Omega$.

Calculate the resistance r of the cell.

r = ... Ω [1]

(f) Suggest how the experiment and graph could be improved to obtain a more accurate value for e.m.f. E.

.....

.....

..... [2]

[Total: 11]

3 A student investigates the refraction of light by a transparent block.
He uses his results to determine a quantity known as the refractive index of the material of the block.

The student's ray-trace sheet is shown full size in Fig. 3.1.

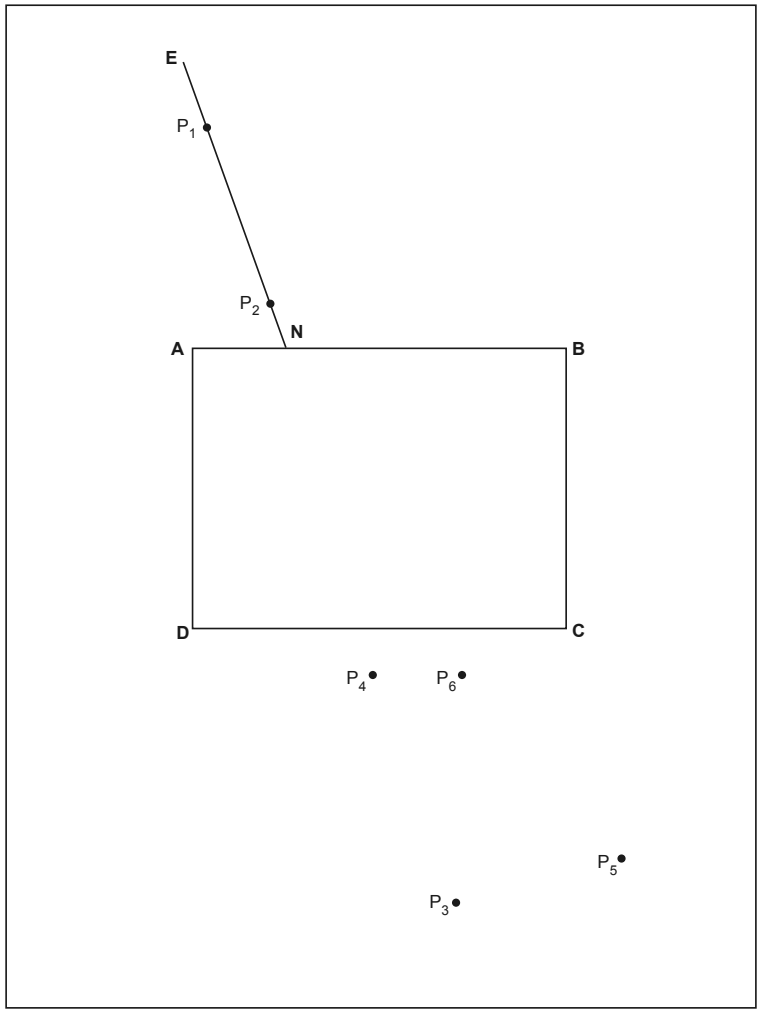


Fig. 3.1

(a) The student places a transparent block **ABCD** near the centre of the ray-trace sheet, as indicated in Fig. 3.1.

(i) Draw a normal at point **N**, extending above **AB**. Label the upper end of the normal with the letter **L**.
Extend the normal downwards until it crosses line **CD**. Label the point at which it crosses **CD** with the letter **F**. [1]

(ii) The student draws line **EN** as shown in Fig. 3.1.

On Fig. 3.1, measure the angle θ_1 between the lines **LN** and **EN**.

θ_1 = ... [1]

(b) The student places two pins, P_1 and P_2, on line **EN**, as shown in Fig. 3.1.

Suggest whether the two pins are a suitable distance apart for accurate ray tracing.
Explain your answer.

statement .....

explanation .....

.....
[1]

(c) The student views the images of P_1 and P_2 through the block.

He places two pins, P_3 and P_4, so that pins P_3 and P_4, and the images of P_1 and P_2, all appear exactly one behind the other.

- Draw a line through P_3 and P_4, extending the line until it meets **NF**.
- Label the point at which this line meets **NF** with the letter **G**.
- Label the point at which this line crosses **CD** with the letter **H**.
- Draw a line joining points **N** and **H**.

[1]

(d) **(i)** Measure the length *a* of line **NH**.

a = ... cm

Measure the length *b* of line **GH**.

b = ... cm
[1]

(ii) Calculate a value *n* for the refractive index, using the equation $n = \frac{a}{b}$.

n = ... [2]

(e) The student repeats the above procedure for an angle $\theta_2 = 40°$.

He places two pins, P_5 and P_6, so that pins P_5 and P_6, and the images of P_1 and P_2, all appear exactly one behind the other.

- Draw a line through pins P_5 and P_6. Extend the line until it meets **GH**.
- Label the point at which this line meets **GH** with the letter **K**.
- Label the point at which this line crosses **CD** with the letter **R**.

(i) Measure the angle α, where α is the smaller angle between lines **RK** and **GH**.

α = ... [1]

(ii) A student suggests that the angle α should be equal to the difference between the angle θ_2 from **(e)** and the angle θ_1 from **(a)(ii)**.

State whether your results support this suggestion. Justify your answer by reference to your results.

statement .....

justification .....

.....
[1]

(f) Suggest a precaution which should be taken to ensure accurate results in this type of experiment.

.....

..... [1]

(g) Suggest why different students, all carrying out this experiment carefully, may **not** obtain identical results.

.....

..... [1]

[Total: 11]

4 A student investigates the factors affecting the deflection of a wooden strip clamped at one end.

Plan an experiment which enables him to investigate how **one** factor affects the distance *D* that the free end of the wooden strip moves downwards when loads are placed on it.

The apparatus available includes:

a variety of wooden strips which can be clamped as shown in Fig. 4.1
a set of masses with a hanger.

In your plan, you should:

- list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including how *D* is to be measured and any precautions that must be taken to ensure reliable results
- draw a table, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

You may add to Fig. 4.1 or draw another diagram if it helps to explain your plan.

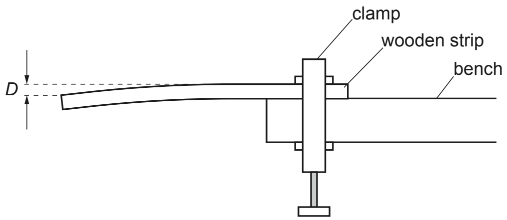


Fig. 4.1

[7]

Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/22**

Paper 2 Multiple Choice (Extended) **October/November 2021**

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

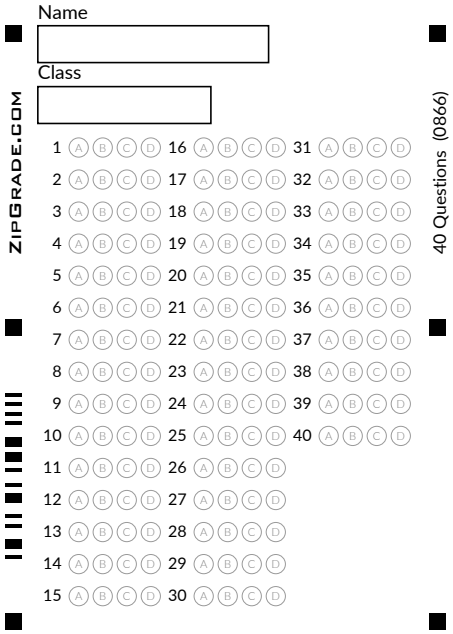
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **20** pages. Any blank pages are indicated.

[Turn over

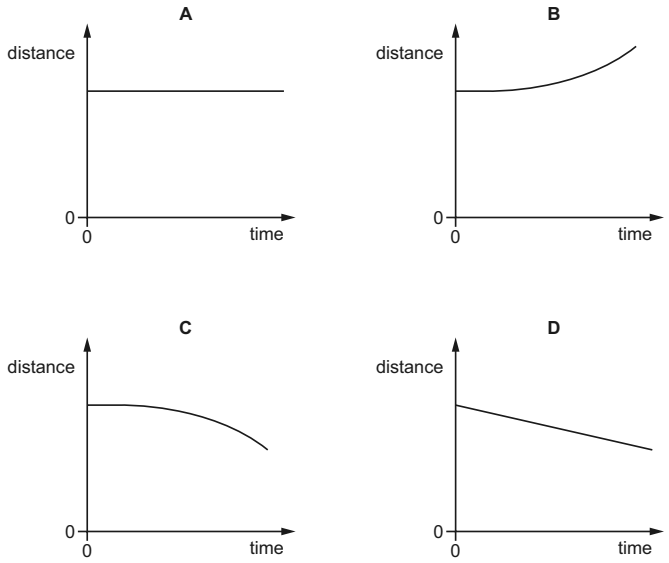


1 A student is taking some measurements.

Which measurement is taken directly using a micrometer screw gauge?

A 0.52 g / mm^2 **B** 0.52 g / mm^3 **C** 0.52 mm **D** 0.52 mm^2

2 Which graph represents an object that is moving at constant speed?



3 In which situation does object X have a greater mass than object Y?

A Object X is in a larger gravitational field than object Y and both have the same weight.

B Object X shows a greater resistance to change in motion than object Y and both experience the same resultant force.

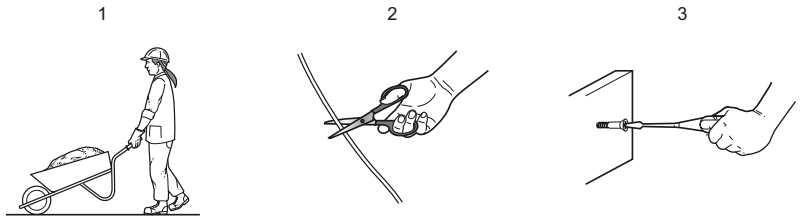
C Object X has a lower density than object Y and both occupy the same volume.

D Object X moves at a greater speed than object Y and both possess the same kinetic energy.

4 Which substance in the table has the lowest density?

	substance	mass / g	volume / cm^3
A	nylon	1.2	1.0
B	cotton	1.5	1.0
C	olive oil	1.8	2.0
D	water	2.0	2.0

5 Three simple machines are shown.



moving soil with a wheelbarrow

cutting string with scissors

screwing a screw with a screwdriver

Which machines are an application of the moment of a force?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

6 A spring, which obeys Hooke's law, has an unstretched length of 10 cm.

A load of 20 N is suspended from the spring.

The new length of the spring is 36 cm.

What is the spring constant k of the spring?

A 0.56 N / cm **B** 0.77 N / cm **C** 1.3 N / cm **D** 1.8 N / cm

7 A rocket is launched upwards from the surface of the Moon.

Hot gases are ejected downwards over a very short period of time.

Which statement is **not** correct?

A The rocket experiences a downward force.

B The rocket experiences an upward force.

C The total momentum of the hot gases is equal to the momentum of the rocket.

D The total momentum of the hot gases and rocket when the hot gases have been ejected is zero.

8 Electrical energy may be obtained from nuclear fission.

In which order is the energy transferred in this process?

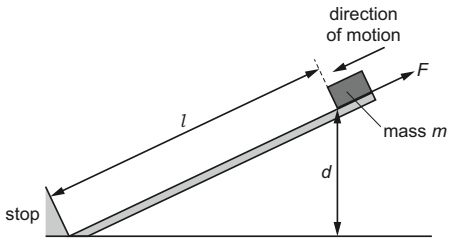
A nuclear fuel → generator → reactor and boiler → turbines

B nuclear fuel → generator → turbines → reactor and boiler

C nuclear fuel → reactor and boiler → generator → turbines

D nuclear fuel → reactor and boiler → turbines → generator

9 A box of mass m slides down a slope of length l against a frictional force F. It descends a vertical height d.



As the box slides down the slope, it loses gravitational potential energy and it does work against the friction.

Which row gives the loss in gravitational potential energy and the work done against friction?

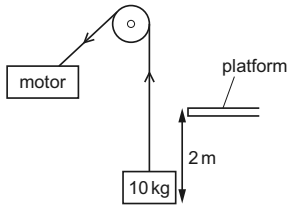
	loss in gravitational potential energy	work done against friction
A	mgd	Fl
B	mgd	Fd
C	mgl	Fl
D	mgl	Fd

[Turn over

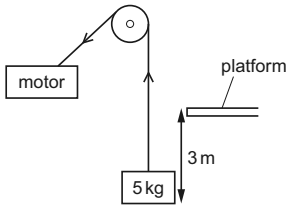
10 A rope, connected to a pulley system and motor, is used to lift different objects through different distances. The time taken to lift each object is the same. The diagrams are not to scale.

Which motor requires the greatest power?

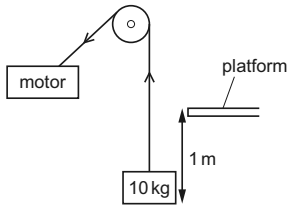
A



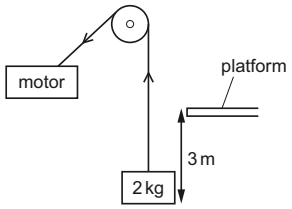
B



C



D



11 Which equation can be used to calculate the pressure at a depth h beneath the surface of a liquid?

A $p = \frac{h}{\rho g}$ **B** $p = \frac{h\rho}{g}$ **C** $p = h\rho g$ **D** $p = \frac{1}{h\rho g}$

12 A liquid is evaporating. The liquid is not boiling.

Which statement about the liquid is correct at an instant in time?

A Any molecule can escape, and from any part of the liquid.

B Any molecule can escape, but only from the liquid's surface.

C Only molecules with enough energy can escape, and only from the liquid's surface.

D Only molecules with enough energy can escape, but from any part of the liquid.

13 A gas is contained in a sealed container in a laboratory. The temperature of the gas increases.

What happens to the average speed and what happens to the total kinetic energy of the gas molecules?

	average speed	total kinetic energy
A	does not change	does not change
B	does not change	increases
C	increases	does not change
D	increases	increases

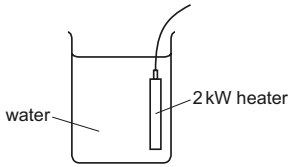
14 An aluminium block has a mass of 200 g.

The specific heat capacity of aluminium is 900 J / (kg °C).

How much energy is needed to increase the temperature of the block from 20 °C to 110 °C?

A 2.0 J **B** 2000 J **C** 16 200 J **D** 16 200 000 J

15 The diagram shows the apparatus used to measure the specific latent heat of vaporisation of water.

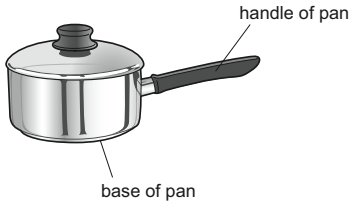


After the water begins to boil, 110 g of water is converted to steam in 120 s.

Using these results, what is the value of the specific latent heat of vaporisation of water?

A 1.8 J / kg **B** 1800 J / kg **C** 2200 J / kg **D** 2 200 000 J / kg

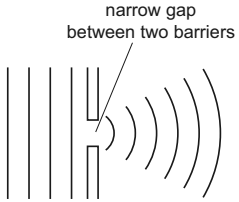
16 The diagram shows a pan used for cooking food.



Which row is correct for the materials used to make the base and the handle of the pan?

	base of pan	handle of pan
A	good thermal conductor	good thermal conductor
B	good thermal conductor	poor thermal conductor
C	poor thermal conductor	good thermal conductor
D	poor thermal conductor	poor thermal conductor

17 The diagram shows the pattern of water waves as they pass through a narrow gap.



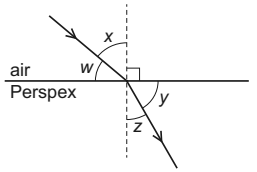
Which row names the process shown and describes the effect of using a wider gap?

	name of process	wider gap
A	refraction	waves spread out less
B	refraction	waves spread out more
C	diffraction	waves spread out less
D	diffraction	waves spread out more

18 Which row is **not** correct for a wave on the surface of water?

	quantity	usual unit
A	amplitude	m
B	frequency	Hz
C	wavelength	λ
D	speed	m / s

19 The diagram shows how a ray of light refracts when going from air to Perspex.



The critical angle of Perspex is *c*.

Which expression is correct?

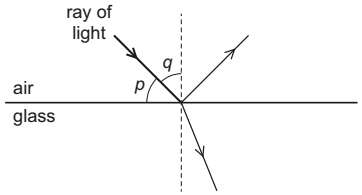
A $\frac{\sin x}{\sin z} = \sin c$

B $\frac{\sin z}{\sin x} = \sin c$

C $\frac{\sin w}{\sin y} = \sin c$

D $\frac{\sin y}{\sin w} = \sin c$

20 The diagram shows a ray of light in air incident on a glass block. Some of the light is refracted and some of the light is reflected. Two angles, *p* and *q*, are marked on the diagram.



Which row gives the angle of incidence and states whether total internal reflection occurs?

	angle of incidence	total internal reflection
A	*p*	no
B	*p*	yes
C	*q*	no
D	*q*	yes

21 The letter F is reflected in a mirror.

What does the optical image look like?

A **B** **C** **D**

22 The Sun emits infrared radiation and light.

Light from the Sun reaches the Earth in 8 minutes.

Which row gives correct information about the infrared radiation?

	wavelength of infrared radiation	time taken for infrared radiation to reach the Earth
A	longer than wavelength of light	8 minutes
B	longer than wavelength of light	much less than 8 minutes
C	shorter than wavelength of light	8 minutes
D	shorter than wavelength of light	much more than 8 minutes

23 Which statement about electromagnetic waves is **not** correct?

A They travel at 3×10^8 m/s in a vacuum.

B They transfer energy.

C They travel at 340 m/s in air.

D They are transverse waves.

24 What is ultrasound?

A sound waves that are so loud that they damage human hearing

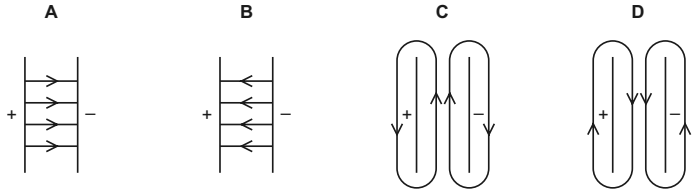
B sound waves that are too high-pitched for humans to hear

C sound waves that are too low-pitched for humans to hear

D sound waves that are too quiet for humans to hear

25 Which diagram shows the electric field pattern between two oppositely charged parallel metal plates?

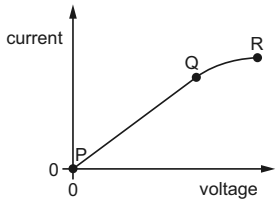
A **B** **C** **D**



26 Which circuit symbol represents a component used to measure electric current?

A **B** **C** **D**

27 The graph shows the current–voltage characteristic for a conductor.



Where on the graph can Ohm's law be applied to the conductor?

A at Q only

B between P and Q

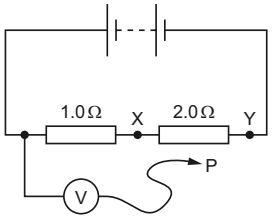
C between P and R

D between Q and R

28 The diagram shows a circuit containing two resistors of resistance 1.0 Ω and 2.0 Ω.

A voltmeter is connected across the 1.0 Ω resistor by connecting P to X.

The reading on the voltmeter is 6.0 V.



P is moved to point Y in the circuit.

What is the new reading on the voltmeter?

A 3.0 V **B** 6.0 V **C** 12 V **D** 18 V

29 There is a current I in a resistor. The potential difference (p.d.) across the resistor is V.

Which other physical quantity is needed to be able to determine the energy transferred W by the resistor?

A the electromotive force (e.m.f.) E of the source

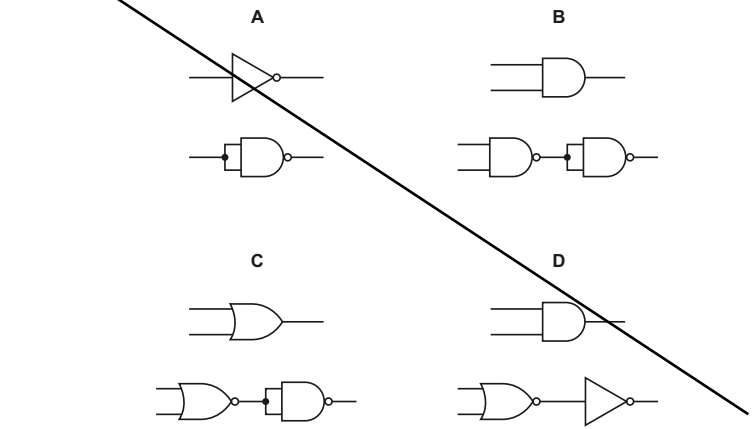
B the power P dissipated

C the resistance R of the resistor

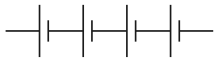
D the time t for which there is a current in the resistor

30 The diagrams show pairs of circuits containing logic gates.

In which diagram does the lower circuit of the pair behave differently from the upper circuit?



31 Several cells are connected in series, as shown.



What is the combined electromotive force (e.m.f.) of the cells?

A the average of the e.m.f.s of the separate cells

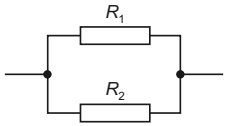
B the e.m.f. of one of the cells

C the product of the e.m.f.s of the cells

D the sum of the e.m.f.s of the cells

32 Two resistors, with resistances R_1 and R_2, are connected in parallel.

The resistance R_1 is greater than the resistance R_2.



What is the resistance of the parallel combination?

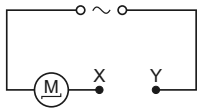
A less than either R_1 or R_2

B equal to R_1

C equal to R_2

D the average of R_1 and R_2

33 The diagram shows a motor connected to an a.c. supply. The circuit is incomplete.



Which device needs to be connected between point X and point Y to prevent the wires from overheating if a fault in the motor causes the current to get too high?

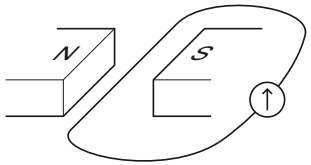
A an ammeter

B a fuse

C a transformer

D a length of thick copper wire

34 The diagram shows a wire between two magnets. An electromotive force (e.m.f.) is induced in the wire when it is moved up between the two magnets.



Four tests are done.

1 The direction of movement of the wire is reversed.

2 The direction of the magnetic field is reversed.

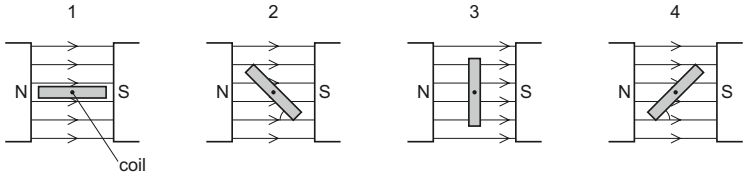
3 The wire is moved more quickly.

4 The magnetic field strength is decreased.

Which tests will induce a smaller e.m.f. in the wire?

A 1 and 2 **B** 1 and 3 **C** 3 and 4 **D** 4 only

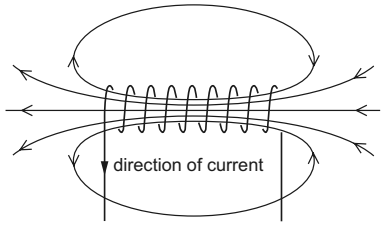
35 Four positions of a current-carrying coil in a magnetic field, as in a d.c. motor, are shown. In diagrams 2 and 4, the coil is at an angle of 45° to the field lines.



Which row is correct?

	turning effect of the forces in positions 1 and 3	turning effect of the forces in positions 2 and 4
A	different	different
B	different	same
C	same	different
D	same	same

36 The diagram shows the magnetic field due to a current in a solenoid.



The direction of the current is reversed.

Which row describes the effect that this has on the magnitude and on the direction of the magnetic field?

	magnitude of magnetic field	direction of magnetic field
A	increases	changes
B	increases	unchanged
C	unchanged	changes
D	unchanged	unchanged

37 The nucleus of an americium atom contains 146 neutrons and 95 protons. It decays by emitting an α-particle.

How many neutrons and how many protons remain in the nucleus when this form of americium decays?

	number of neutrons remaining	number of protons remaining
A	142	93
B	142	95
C	144	93
D	144	95

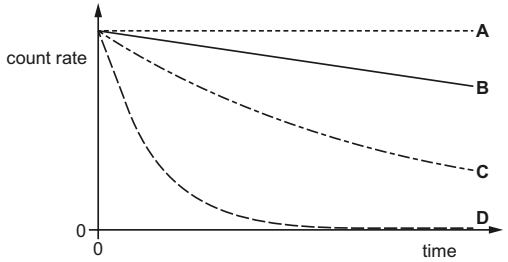
38 A sample of americium decays and changes into neptunium. The half-life of americium is 432 years.

Which fraction of the americium will remain after 1728 years?

A 0 **B** $\frac{1}{16}$ **C** $\frac{1}{8}$ **D** $\frac{1}{4}$

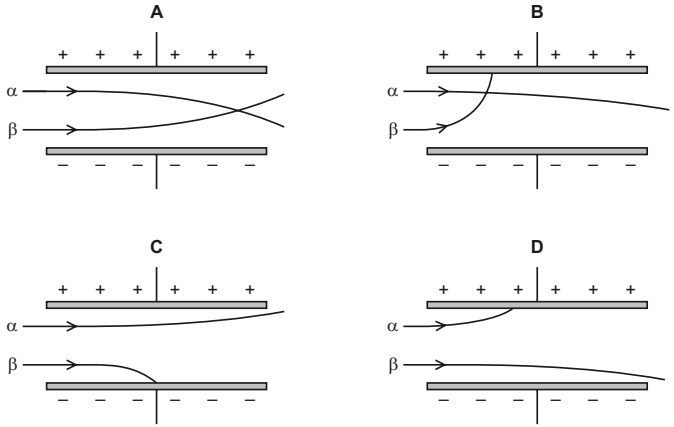
39 The graph shows the decay curves of four different radioactive isotopes.

Which isotope has the largest half-life?



40 The diagrams show α-particles and β-particles passing through an electric field.

Which diagram shows the correct paths of the α-particles and β-particles?



Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/42**

Paper 4 Theory (Extended) **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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 Fig. 1.1 shows a space rocket accelerating away from a launch pad.

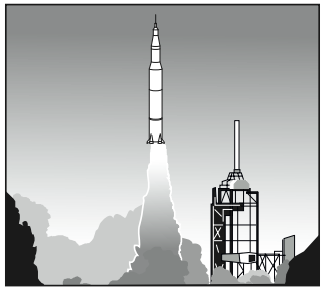


Fig. 1.1

Fig. 1.2 is a speed–time graph for the first 30 s of the rocket's flight.

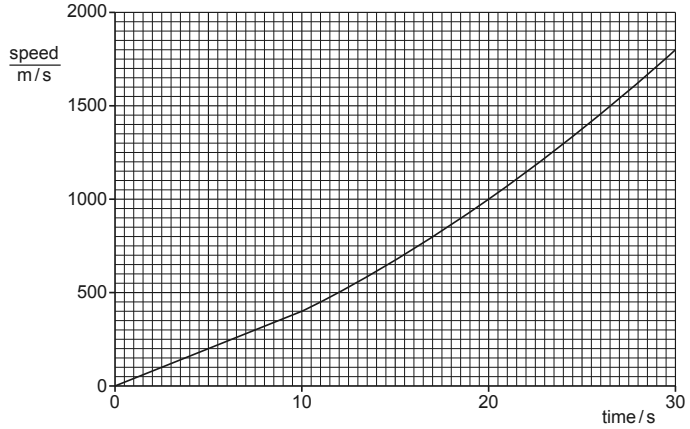


Fig. 1.2

(a) Describe how the acceleration of the rocket changes between time = 10 s and time = 30 s.

..... [1]

(b) By drawing a tangent to the graph, determine the acceleration of the rocket at time = 25 s.

acceleration = ... [2]

(c) Determine the distance travelled by the rocket between time = 0 and time = 10 s.

distance = ... [2]

[Total: 5]

2 **(a)** State Hooke's law.

.....

..... [1]

(b) Fig. 2.1 shows the extension–load graph for a spring.

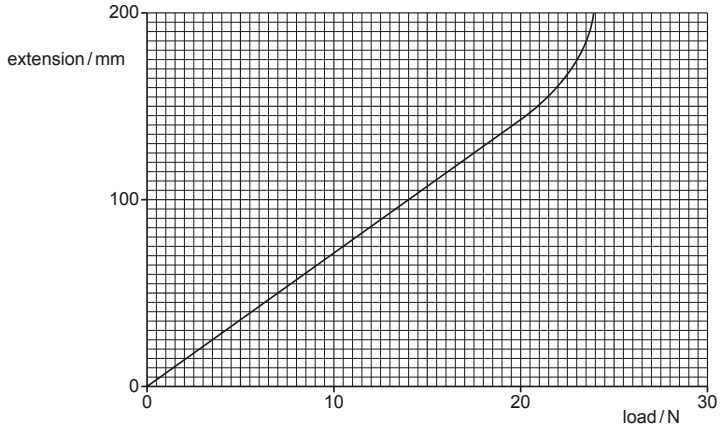


Fig. 2.1

(i) On Fig. 2.1, mark and label the region where the spring obeys Hooke's law. [1]

(ii) Calculate the spring constant *k*.

k = ... [2]

(iii) The original length of the spring is 120 mm.

Calculate the length of the spring when a load of 8.5 N is applied to the spring.

length = ... [2]

(c) The weight of an object is 4.0 N on a planet where the acceleration of free fall is 8.7 m / s^2.

Calculate the mass of the object.

mass = ... [2]

[Total: 8]

3 Fig. 3.1 shows a collision at very slow speed between two cars travelling along a straight road.

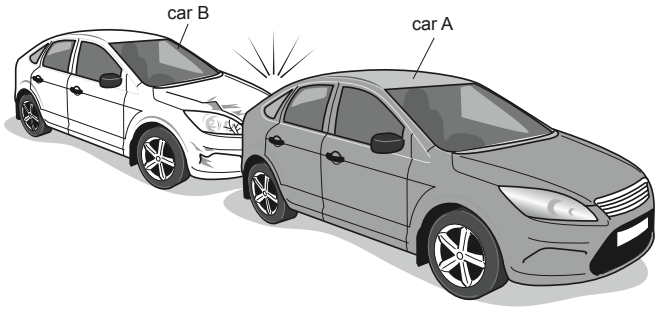


Fig. 3.1

Car B, of mass 800 kg, is moving at 2.0 m / s and collides with car A, of mass 1000 kg, which is stationary. After the collision, both cars travel in the same direction as the initial direction of car B.

(a) After the collision, car A moves at 1.3 m / s.

Show that the speed of car B after the collision is approximately 0.4 m / s.

[3]

(b) (i) Calculate the impulse exerted by car A on car B.

impulse = ... [2]

(ii) State the impulse exerted by car B on car A.

impulse = ... [1]

[Total: 6]

4 **(a)** A power station uses wind energy to generate electricity.

State and explain whether this method of generating electricity is renewable.

statement .....

explanation .....

.....

..... [2]

(b) State **two** energy resources that do **not** have the Sun as their source.

1 .....

2 ..... [2]

(c) For each energy resource, state the form of energy stored in:

fossil fuels .....

water behind hydroelectric dams. ..... [2]

[Total: 6]

5 **(a)** A thermocouple thermometer is used to determine the temperature difference between a mixture of ice and water and liquid mercury at approximately 600 °C.

Complete Fig. 5.1 with a labelled diagram to show how the thermocouple thermometer can be used in this way.

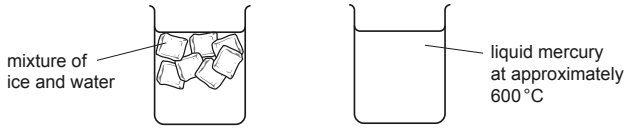


Fig. 5.1

[3]

(b) State **two** other physical properties that can be used to measure temperature.

1 .....

2 ..... [2]

(c) State **two** benefits of using a thermocouple thermometer instead of a liquid-in-glass thermometer.

1 .....

2 ..... [2]

[Total: 7]

6 Fig. 6.1 shows particles of a material in which a sound wave is travelling.

Fig. 6.1 (not to scale)

(a) On Fig. 6.1, mark:

(i) the centre of a compression with the letter C [1]

(ii) the centre of a rarefaction with the letter R [1]

(iii) one wavelength with a double-ended arrow. [1]

(b) Circle **one** value from the list which is the speed of sound in water.

15 m/s **150 m/s** **1500 m/s** **15 000 m/s** **150 000 m/s** **1 500 000 m/s** [1]

(c) The wavelength of a sound wave in water is 12 cm.

Calculate the frequency of this sound wave using your value from **(b)**.

frequency = ... [3]

(d) State and explain whether the sound in **(c)** is ultrasound.

statement .....

explanation .....

.....

..... [2]

[Total: 9]

7 Fig. 7.1 shows a ray of light approaching face AB of a glass prism of refractive index 1.5.

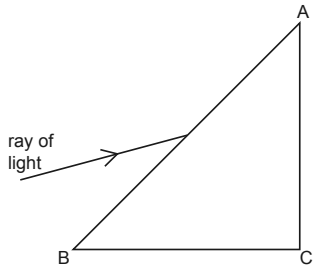


Fig. 7.1

(a) **(i)** On Fig. 7.1, accurately draw the path of the ray within the prism from face AB to face AC. You will need to make a measurement from Fig. 7.1 and carry out a calculation.

[4]

(ii) Determine the angle of incidence of this ray when it strikes face AC.

angle = ... [1]

(b) Without further measurement or calculation, sketch on Fig. 7.1 the approximate path of the ray after passing through the face AC. [1]

(c) Fig. 7.2 shows a ray of light travelling within an optical fibre.

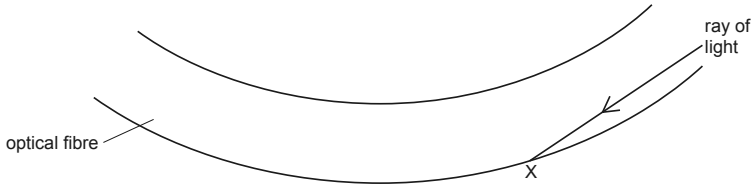


Fig. 7.2

(i) Complete the path of the ray of light to the left-hand end of the fibre. [2]

(ii) Name the process taking place at X. ..... [1]

[Total: 9]

8 **(a)** Fig. 8.1 shows a conducting object A, initially uncharged, held on an insulating stand. The positively charged rod B is brought close to object A.

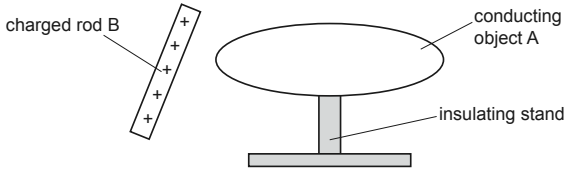


Fig. 8.1

(i) On Fig. 8.1, draw the distribution of charges on object A. [2]

(ii) A wire is connected from object A to earth.

State and explain any movement of charge.

statement .....

explanation .....

.....

..... [2]

(b) There is a current in a wire of 0.65 mA for 2.2 minutes.

Calculate the charge that flows.

charge = ... [3]

[Total: 7]

9 **(a)** Fig. 9.1 shows a cell of electromotive force (e.m.f.) 1.5 V and a battery of e.m.f. 6.0 V connected in series.

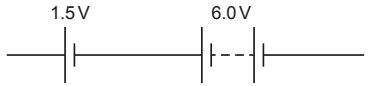


Fig. 9.1

Calculate the combined e.m.f. of the cell and the battery.

e.m.f. = ... [1]

(b) The combined resistance of the three resistors shown in Fig. 9.2 is 4.4 Ω.

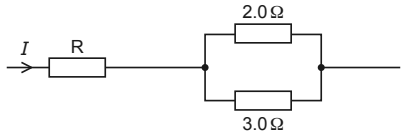


Fig. 9.2

(i) Calculate the resistance of resistor R.

resistance = ... [3]

(ii) The current I in Fig. 9.2 is 0.94 A.

Calculate the potential difference (p.d.) across the combination of resistors.

p.d. = ... [2]

[Total: 6]

10 **(a)** Name the logic gate shown in Fig. 10.1. .....

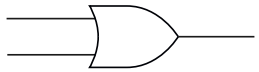


Fig. 10.1

[1]

(b) Fig. 10.2 shows a combination of logic gates.

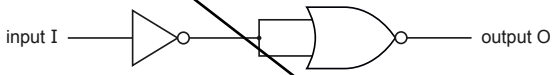


Fig. 10.2

Complete the right-hand column of Table 10.1, the truth table for the combination of logic gates. You may use the blank column for your working.

Table 10.1

input I		output O
0		
1		

[2]

(c) An electrical device has a metal case.

Explain the benefit of earthing the metal case.

.....

.....

..... [2]

(d) **(i)** Explain how a fuse protects a circuit.

.....

.....

..... [2]

(ii) The current in an electric kettle connected to the mains through a fuse is 10A.

Fuses with the following ratings are available.

3A **9A** **10A** **13A** **30A**

Circle the correct fuse rating for this appliance and explain your answer.

.....

.....

..... [2]

[Total: 9]

11 (a) Describe the composition and structure of a neutral atom of beryllium-8, which has a proton number of 4 and a nucleon number of 8.

.....

.....

.....

..... [4]

(b) A radioactive isotope decays by β-emission to form an isotope of barium with nucleon number 135.

Table 11.1

element	symbol	proton number
iodine	I	53
xenon	Xe	54
caesium	Cs	55
barium	Ba	56
lanthanum	La	57
cerium	Ce	58
praseodymium	Pr	59

Use data from Table 11.1 to write down the nuclide equation for this decay.

[4]

[Total: 8]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/62**

Paper 6 Alternative to Practical **October/November 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

DC (CJ/CT) 204872/2

[Turn over

1 A student determines the density of a block of wood.

(a) Fig. 1.1 shows one face of the block of wood that the student uses.

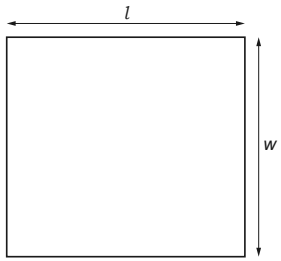


Fig. 1.1

(i) Measure the length l and width w of the block of wood. Fig. 1.1 is drawn actual size.

l = ... cm

w = ... cm
[1]

(ii) The student measures the height h of the block of wood.

h = 4.0 ..... cm

Calculate the volume V of the block of wood using the equation $V = l \times w \times h$.

V = ... cm^3 [1]

(iii) The student measures the mass m of the block of wood on a balance.

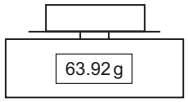


Fig. 1.2

Write down the mass m of the block as shown in Fig. 1.2. Give your answer to the nearest gram.

m = ... g [1]

(iv) Calculate the density ρ of the wood using the equation $\rho = \frac{m}{V}$. Give your answer to a suitable number of significant figures for this experiment and include the unit.

ρ = ... [2]

(b) The student places the block of wood carefully in water in a glass dish. The wood floats as shown in Fig. 1.3.

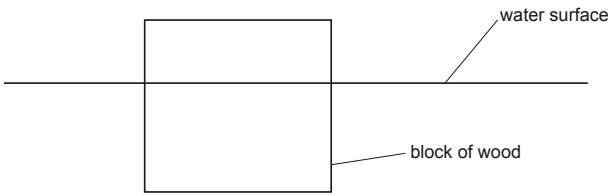


Fig. 1.3

(i) Using Fig. 1.3, estimate, without taking a measurement, the volume V_1 of wood that is below the water surface.

V_1 = ... cm^3 [1]

(ii) Calculate m_W, the mass of water with volume V_1, using the equation $m_W = \rho_W \times V_1$, where $\rho_W = 1.00$ in the same units as ρ in part **(a)(iv)**.

m_W = ... [1]

(c) A student suggests that the mass m of the block of wood should be equal to the mass m_W of the water with volume V_1.

(i) Calculate the difference d between your values of m and m_W.

d = ... [1]

(ii) Discuss whether the difference d is small enough to conclude that $m = m_W$.

.....

.....

..... [1]

(d) Another student wants to obtain a more accurate value for V_1. He uses the method of floating the block of wood in water as described in **(b)**.

Suggest how the student could obtain a more accurate value by taking a measurement.

.....

.....

..... [2]

[Total: 11]

2 A student investigates the resistances of a resistor and a lamp.

Fig. 2.1 shows the first circuit arrangement.

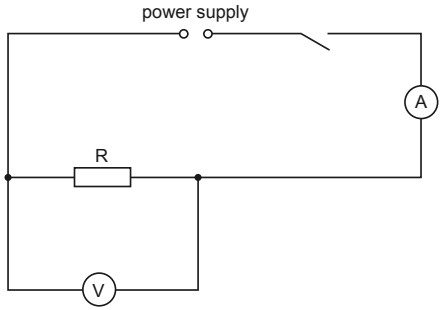


Fig. 2.1

(a) She records V_S, the potential difference (p.d.) across the resistor R, and the current I_S in the circuit. The meters are shown in Fig. 2.2 and Fig. 2.3.

(i) Write down the readings. Include the units for potential difference, current or resistance where appropriate in all parts of the question.

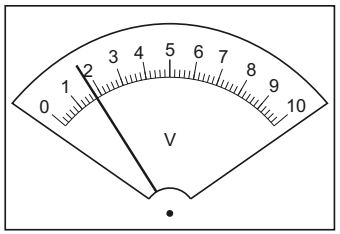


Fig. 2.2

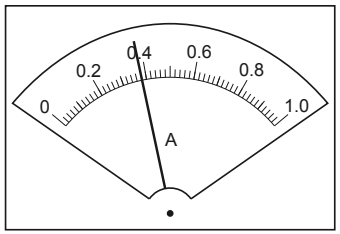


Fig. 2.3

V_S = ...

I_S = ...
[2]

(ii) Calculate R_S, the resistance of resistor R, using the equation $R_S = \frac{V_S}{I_S}$.

R_S = ... [2]

(b) The student replaces the resistor with the lamp. She records V_L the potential difference across the lamp and the current I_L in the circuit.

V_L = 1.7

I_L = 0.35

Calculate R_L, the resistance of the lamp, using the equation $R_L = \frac{V_L}{I_L}$.

R_L = ... [2]

(c) The student connects the resistor R in series with the lamp. She connects the voltmeter to record V_C, the potential difference across the series combination of the resistor and the lamp. Draw the circuit diagram for this arrangement.

[2]

(d) The student records V_C the potential difference across the resistor and the lamp in series and the current I_C in the circuit.

V_C = 1.7

I_C = 0.21

Calculate R_C, the combined resistance of the resistor and the lamp connected in series, using the equation $R_C = \frac{V_C}{I_C}$.

R_C = ... [1]

(e) State and explain briefly whether the results show that $R_S + R_L = R_C$ within the limits of experimental accuracy.

statement .....

explanation .....

.....

[2]

[Total: 11]

[Turn over

3 A student investigates the image produced by a lens.

Fig. 3.1 shows the apparatus.

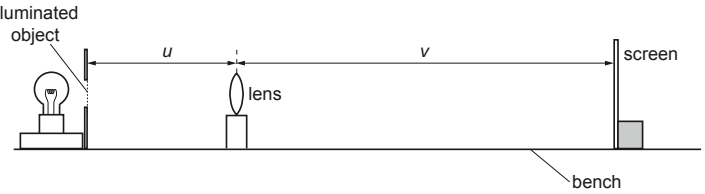


Fig. 3.1

(a)
- The student places the lens a distance u = 20.0 cm from the illuminated object.
- He moves the screen until a clearly focused image is formed on the screen.
- He measures the distance v between the centre of the lens and the screen.
- Calculate, and record in the first row of Table 3.1, $\frac{u}{v}$.
- He repeats the procedure for u = 25.0 cm, u = 30.0 cm, u = 35.0 cm and u = 40.0 cm. The readings and results are shown in Table 3.1.

Table 3.1

u / cm	v / cm	$\frac{u}{v}$
20.0	79.5	
25.0	44.5	0.56
30.0	35.0	0.86
35.0	30.0	1.17
40.0	27.0	1.48

[1]

(b) Plot a graph of u / cm (y-axis) against $\frac{u}{v}$ (x-axis). Start the y-axis at u = 15.0 cm.

[4]

(c) Use your graph to find u_1, the value of u when $\frac{u}{v}$ = 1.0. Show clearly on the graph how you obtained the necessary information.

u_1 = ... [2]

(d) Calculate the focal length f of the lens using the equation $f = \frac{u_1}{2}$. Give your answer to a suitable number of significant figures for this experiment.

f = ... cm [2]

(e) Suggest **one** practical difficulty with this experiment. Explain briefly how you would try to overcome this difficulty in order to obtain accurate results.

suggestion .....

.....

explanation .....

.....

.....

[2]

[Total: 11]

4 A student investigates the strengths of wires made from different metals by measuring the force required to break the wires.

The apparatus is shown in Fig. 4.1. A wire is held by a clamp at one end and a load is suspended from the other end. The load is increased until the wire breaks. The student takes all the necessary safety precautions.

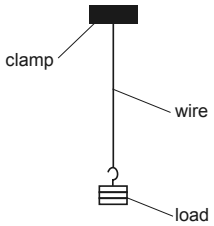


Fig. 4.1

Plan an experiment to investigate the force required to break wires made from different metals.

The following apparatus is available:

clamps and stands
a selection of masses with a suitable hanger
metre rule
a selection of wires made from different metals.

You can also use other apparatus and materials that are usually available in a school laboratory.

In your plan, you should:

- write a list of suitable metals for the wires you would investigate
- explain briefly how you would do the investigation
- state the key variables that you would keep constant
- draw a table, or tables, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the results to reach a conclusion.

You may add to the diagram if it helps your explanation.

You are **not** required to write about the safety precautions that the student should take.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [7]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/41**

Paper 4 Theory (Extended) **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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

[Turn over

1 Some physical quantities are scalars and other physical quantities are vectors.

(a) State how a vector quantity differs from a scalar quantity.

.....

..... [1]

(b) Circle the vector quantities in the list.

acceleration energy mass momentum temperature time speed velocity

[2]

(c) A microphone in a recording studio has a mass of 0.55 kg and a weight *W*.

(i) Calculate *W*.

W = ... [1]

(ii) The microphone is suspended from the ceiling by a cord attached to a small ring. Fig. 1.1 shows the microphone pulled to one side and kept stationary by a horizontal thread.

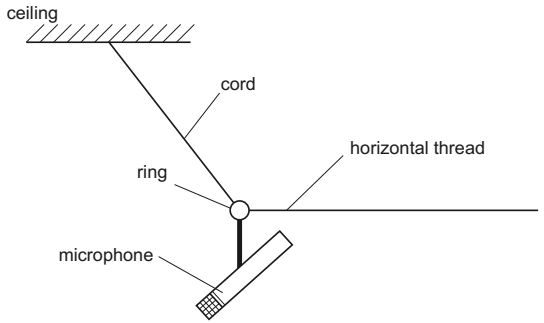


Fig. 1.1 (not to scale)

The tension T in the horizontal thread is 8.1 N.

Determine graphically the magnitude and the direction, relative to the vertical, of the resultant of W and T. Use a scale of 1.0 cm to 1.0 N or greater.

magnitude of resultant = ...

direction of resultant = ... relative to vertical
[3]

(iii) State and explain how the magnitude and direction of the resultant in **(c)(ii)** compares with the force on the ring due to the tension in the cord.

.....

.....

..... [2]

[Total: 9]

2 A student carries out an experiment using a plastic beaker that contains 0.24 kg of water at 17 °C. The thermal capacity (heat capacity) of the beaker is negligible.

(a) Define *thermal capacity*.

.....

.....

..... [2]

(b) Several ice cubes are at a temperature of 0 °C. The ice cubes are dropped into the water and the internal energy of the water decreases.

(i) Give a simple molecular account of this decrease in internal energy.

.....

.....

..... [2]

(ii) The specific heat capacity of water is 4200 J / (kg °C).

Calculate the decrease in the internal energy of the water as its temperature decreases from 17 °C to 0 °C.

decrease in internal energy = ... [2]

(c) As the temperature of the water decreases, some of the ice melts.

(i) Explain why this ice melts.

.....

.....

..... [2]

(ii) Describe how to determine the specific latent heat of fusion of ice using this experiment. State any other measurements that the student needs to make.

.....

.....

.....

.....

..... [3]

[Total: 11]

3 Fig. 3.1 shows a balloon inflated with air.

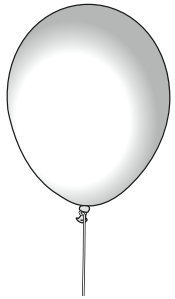


Fig. 3.1

The pressure of the air at the inner surface of the balloon keeps the rubber stretched.

(a) Explain, in terms of the momentum of the molecules, why there is a pressure at the inner surface of the balloon.

.....

.....

.....

..... [3]

(b) The volume of the air in the balloon is 630 cm^3 and the pressure of the air in the balloon is 1.0×10^5 Pa.

The balloon is tied to a heavy stone and dropped into a lake. The balloon is pulled down quickly and the temperature of the air inside does **not** change.

(i) Calculate the volume of the air when the pressure of the air is 1.4×10^5 Pa.

volume = ... [2]

(ii) The balloon and stone stop moving when the stone hits the bottom of the lake. The temperature of the air now begins to decrease.

Explain why the volume of the air in the balloon decreases as the temperature decreases.

.....

.....

.....

..... [2]

[Total: 7]

4 A train of mass 1.8×10^5 kg is at rest in a station. At time $t = 0$, the train begins to accelerate along a straight, horizontal track and reaches a speed of 20 m/s at $t = 15$ s. The train continues at a speed of 20 m/s for 10 s.

At $t = 25$ s, the driver applies the brakes and the resistive force on the train causes it to decelerate uniformly to rest in a further 24 s.

Fig. 4.1 is an incomplete distance–time graph for this journey.

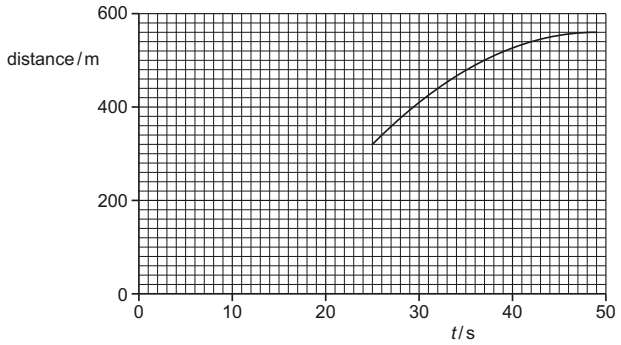


Fig. 4.1

(a) Complete Fig. 4.1 by drawing:

(i) a line to represent the motion of the train between $t = 15$ s and $t = 25$ s [1]

(ii) a curve to represent the motion of the train between $t = 0$ and $t = 15$ s. [1]

(b) Calculate the kinetic energy of the train between $t = 15$ s and $t = 25$ s.

kinetic energy = ... [3]

(c) While the train decelerates to rest, it does work against the resistive force and its kinetic energy decreases.

(i) Define *work done*.

.....

..... [2]

(ii) Using Fig. 4.1, determine the distance moved by the train while it decelerates.

distance moved = ... [1]

(iii) Calculate the resultant force acting on the train while it decelerates.

resultant force = ... [2]

[Total: 10]

5 **(a)** Explain, in terms of the behaviour of light rays, what is meant by *principal focus* for a thin converging lens.

.....

.....

..... [2]

(b) State what is meant by *focal length*.

.....

..... [1]

(c) A lens is used to produce a focused image of an object on a translucent screen. Fig. 5.1 shows the object O and its image I.

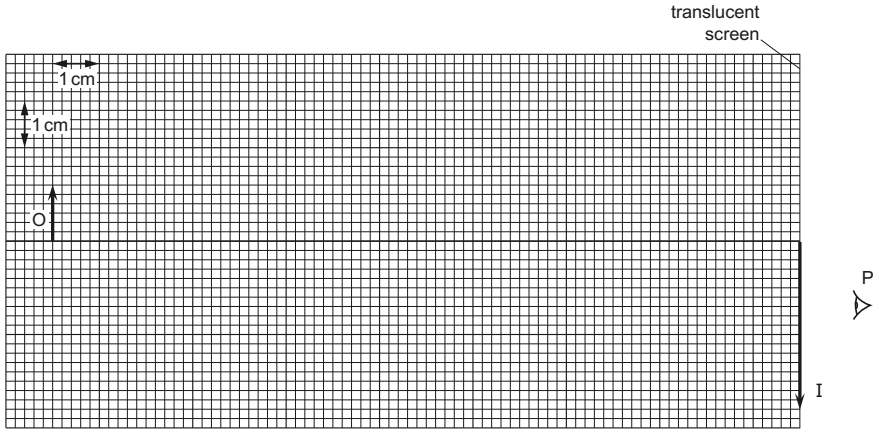


Fig. 5.1

(i) Consider the straight ray that passes from the tip of O to the tip of I and find the position of the lens. Mark the position of the lens by drawing a vertical line labelled L from the top of the grid to the bottom. [1]

(ii) On Fig. 5.1, draw a ray that passes through one of the principal focuses and determine the focal length of the lens.

focal length = ... [2]

(iii) Object O is a printed document that includes a large letter R on the side facing the lens. The top edge of the document corresponds to the tip of O. Fig. 5.2 shows the printed document.

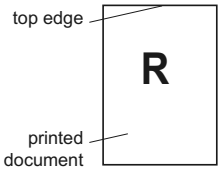


Fig. 5.2

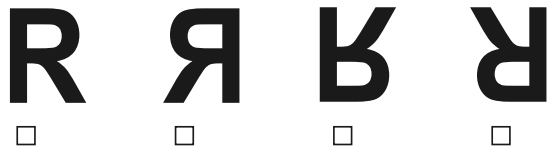


Fig. 5.3

On Fig. 5.3, mark a tick in **one** of the boxes (☑) to indicate how the image on the translucent screen appears to someone who is looking at the screen from point P. Explain why the image has this appearance.

.....

.....

..... [2]

[Total: 8]

6 X-rays are electromagnetic waves. Fig. 6.1 shows the position of X-rays in the electromagnetic spectrum arranged according to increasing wavelength.

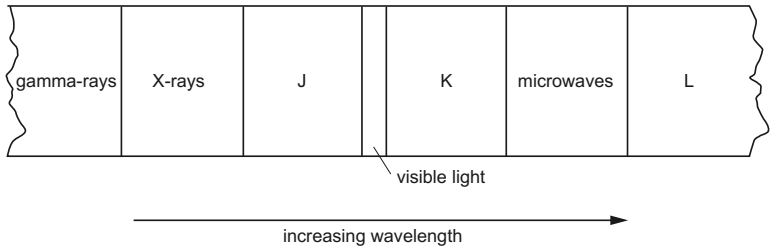


Fig. 6.1

(a) Three components of the spectrum are unnamed but labelled J, K and L.

(i) State the names of these three components.

J .....

K .....

L .....
[2]

(ii) State which of these three components has the lowest frequency.

..... [1]

(b) Calculate the frequency of X-rays that have a wavelength of 1.2×10^{-9} m in a vacuum.

frequency = ... [3]

(c) **(i)** Describe **one** medical use of X-rays.

.....

.....

.....

.....

..... [3]

(ii) State **one** reason why it is necessary to take safety precautions when X-rays are used.

.....

..... [1]

[Total: 10]

7 A plastic rod becomes negatively charged when it is rubbed with a woollen cloth.

(a) Describe, in terms of particles, how the rod becomes negatively charged when rubbed with the cloth.

.....

.....

..... [2]

(b) A light, conducting ball is at rest on a metal table. When the rod is brought close to the ball, as shown in Fig. 7.1, the ball jumps up towards the rod.

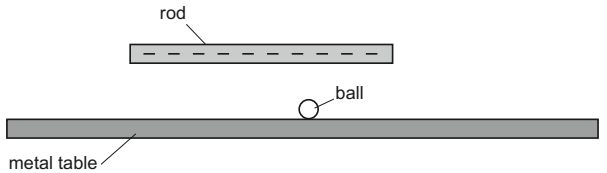


Fig. 7.1

(i) Explain why the ball jumps up.

.....

.....

.....

..... [3]

(ii) The ball touches the rod and falls back down to the table.

Explain why this happens.

.....

.....

..... [2]

[Total: 7]

8 A circuit contains two fixed resistors and a light-dependent resistor (LDR). Fig. 8.1 shows that the power supply is a 9.0 V battery.

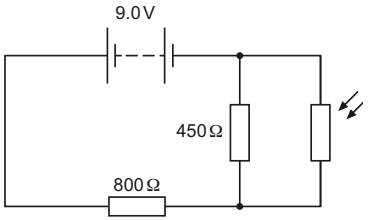


Fig. 8.1

The current in the 450 Ω resistor is 0.012 A.

(a) State what is meant by electric current.

.....

..... [1]

(b) The current in the LDR is I_1 and the current in the 800 Ω resistor is I_2.

Complete the equation that relates the current in the 450 Ω resistor to I_1 and I_2.

current in the 450 Ω resistor = ... [1]

(c) Calculate the power dissipated in the 800 Ω resistor.

power = ... [4]

(d) The brightness of the light that is incident on the LDR increases.

Explain what happens to the potential difference (p.d.) across the 450 Ω resistor.

.....

.....

.....

..... [3]

[Total: 9]

9 Uranium-235 ($^{235}_{92}U$) is a radioactive isotope of uranium that occurs naturally on Earth.

(a) Describe the composition and structure of a neutral atom of uranium-235.

.....

.....

.....

.....

..... [4]

(b) Another isotope of uranium is uranium-238.

Describe how an atom of uranium-238 differs from an atom of uranium-235.

.....

..... [1]

(c) In the reactor in a nuclear power station, a nucleus of uranium-235 absorbs a slow-moving neutron and then undergoes nuclear fission.

Two neutrons, a nucleus of xenon-140 ($^{140}_{54}Xe$) and a nucleus of an element represented by E are produced.

Complete the equation for this fission reaction.

$$n + {}^{235}_{92}U \rightarrow {}^{140}_{54}Xe + {}^{\cdots\cdots}_{\cdots\cdots}E + 2n$$

[2]

(d) Xenon-140 ($^{140}_{54}Xe$) is radioactive. It decays by β-emission to isotope Q.

Determine:

(i) the proton number of Q ..... [1]

(ii) the nucleon number of Q. ..... [1]

[Total: 9]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

PHYSICS **0625/43**

Paper 4 Theory (Extended) **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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m/s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

DC (PQ/FC) 214506/2

[Turn over

1 A ship sails in a straight line between two ports.
Fig. 1.1 shows the speed–time graph of the ship for the first 100 minutes of its journey between the two ports.

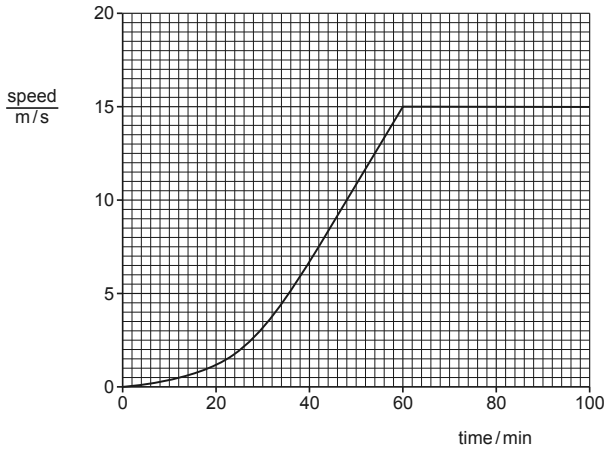


Fig. 1.1

(a) Calculate the maximum acceleration during the first 100 minutes of the ship's journey.

maximum acceleration = ... [2]

(b) Calculate the total distance travelled by the ship between time = 42 min and time = 100 min.

distance travelled = ... [3]

(c) At a time not shown on the graph, the acceleration of the ship is $0.0087\,m/s^2$. The total mass of the ship and its passengers is 2.3×10^7 kg.

(i) Calculate the resultant force on the ship.

force = ... [2]

(ii) Explain why the force on the ship due to the ship's engine is greater than the value you calculated in **(c)(i)**.

.....

..... [1]

[Total: 8]

2 Fig. 2.1 shows a simplified version of a 'gravity lamp'. This apparatus is used to light a light-emitting diode (LED) without mains electricity.

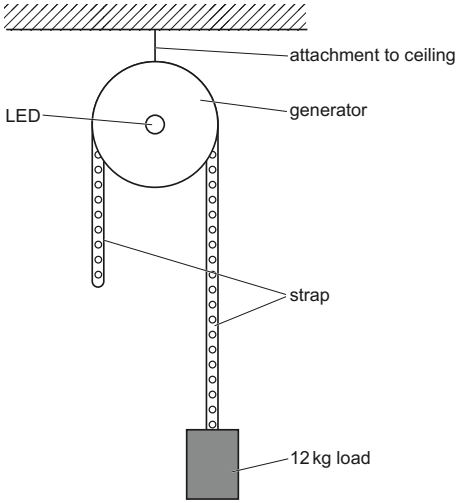


Fig. 2.1

The load of 12 kg is raised to a height of 1.7 m above the ground. The load is connected to a pulley system. The time taken for the load to fall to the ground is 1200 seconds. The load falls at constant speed. The generator is connected to an LED.

(a) Calculate the rate of transfer of gravitational potential energy as the load falls to the ground.

rate of transfer of gravitational potential energy = ... [4]

(b) The light output of the LED is 0.10 W.
Calculate the efficiency of the 'gravity lamp'.

efficiency = ... [2]

(c) Suggest a social or environmental advantage of using a 'gravity lamp'.

.....

..... [1]

[Total: 7]

3 **(a)** A gas bubble is released at the bottom of a lake.

Atmospheric pressure is 1.0×10^5 Pa. The density of water is 1000 kg / m^3. The temperature of the water in the lake is constant.

(i) The gas bubble rises to the surface. The volume of the gas bubble increases as it rises higher in the water.

Explain why the volume of the bubble increases.

.....

.....

..... [2]

(ii) The volume of the gas bubble is 0.40 cm^3 when it is 3.0 m below the surface of the lake.

Calculate the volume of the gas bubble when it is 0.50 m below the surface of the lake.

volume = ... [4]

(b) Fig. 3.1 shows a diagram of a hydraulic press used to compress paper for recycling.

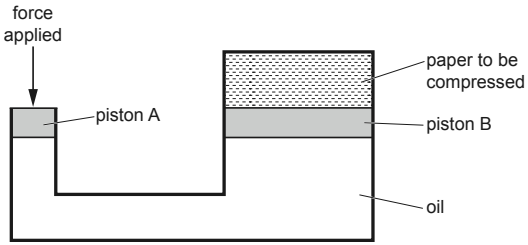


Fig. 3.1

When a force is applied to piston A, it causes a pressure in the oil. This pressure produces an upwards force on piston B. As piston B moves, it compresses the paper.

A small quantity of air leaks into the oil.

Suggest and explain the effect the air has on the operation of the hydraulic press.

.....

.....

.....

..... [2]

[Total: 8]

4 Explain what happens to the pressure of a constant volume of air when the temperature of the air increases. Use ideas of momentum of molecules in your explanation.

.....

.....

.....

.....

.....

.....

..... [4]

5 **(a)** An aluminium saucepan and a steel saucepan have the same dimensions. Table 5.1 shows the values of the specific heat capacity and the density of aluminium and of steel.

Table 5.1

metal	specific heat capacity / J/(kg °C)	density / kg/m^3
aluminium	0.91	2600
steel	0.50	7600

The mass of the aluminium saucepan is 0.41 kg.

(i) Calculate the mass of the steel saucepan.

mass = ... [2]

(ii) Calculate the thermal capacity of the aluminium saucepan.

thermal capacity = ... [2]

(iii) Water is heated in the steel saucepan. The initial temperature of the water and the saucepan is 20 °C.

Calculate the energy transfer needed to raise the temperature of the steel saucepan to 100 °C.

energy = ... [2]

(b) Explain why metals are better thermal conductors than non-metals.

..... [2]

[Total: 8]

6 **(a)** Describe an experiment to determine the speed of sound in air. State the apparatus you need, details of how to take measurements and how to calculate the speed of sound in air.

You may use the space below to draw a **labelled** diagram as part of your answer.

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) Sound waves from a television are diffracted through doorways. Light waves from a television are **not** diffracted through doorways.

Suggest why light waves and sound waves behave differently in this situation.

.....

.....

..... [2]

[Total: 7]

7 **(a)** Fig. 7.1 shows a ray of green light emerging from one face of a glass prism.

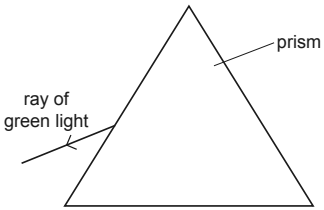


Fig. 7.1

(i) On Fig. 7.1, draw the path of the green light entering and passing through the prism. [2]

(ii) The green light is monochromatic. State, in terms of a **wave property**, what is meant by monochromatic light.

..... [1]

(b) (i) State the speed of light in air.

..... [1]

(ii) The wavelength of green light in air is 5.2×10^{-7} m.

Calculate the frequency of green light.

frequency = ... [2]

(iii) The refractive index of glass for green light is 1.52.

Calculate the speed of green light in glass.

speed = ... [2]

[Total: 8]

8 **(a)** Fig. 8.1 shows two charged metal plates with a gap between them. The plates are parallel to each other. The top plate is negatively charged and the bottom plate is positively charged.

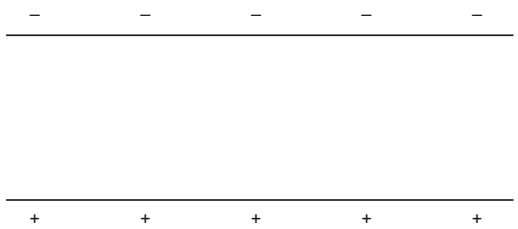


Fig. 8.1

On Fig. 8.1, draw **five** electric field lines between the two plates. [2]

(b) An electric iron has a power of 2400 W. The potential difference (p.d.) of the mains supply is 220 V.

(i) Calculate the electric current in the iron.

current = ... [2]

(ii) Calculate the electric charge which flows through the iron in 15 minutes.

charge = ... [2]

(iii) Fuse ratings of 3A, 5A, 10A, 13A and 30A are available.

State which of these fuse ratings is suitable for use in the iron.

fuse rating ..... [1]

[Total: 7]

9 Fig. 9.1 shows current–potential difference (p.d.) graphs for a resistor, a thermistor and a filament lamp.

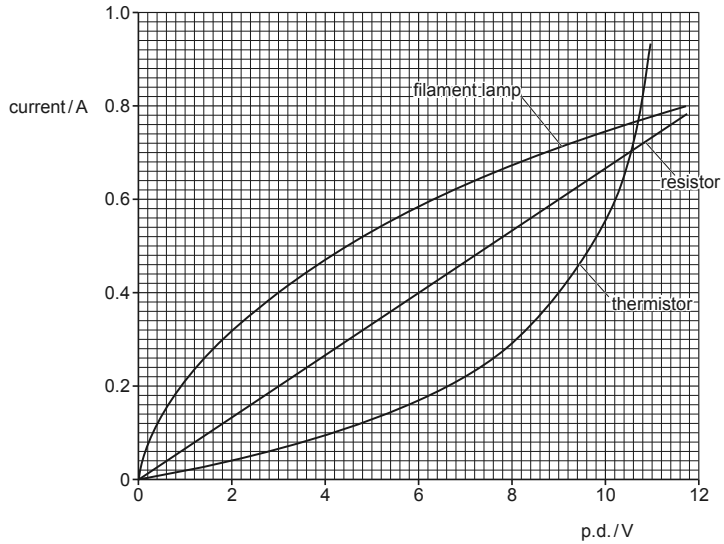


Fig. 9.1

The resistor, the thermistor and the filament lamp are connected in series with a power supply.

(a) **(i)** Draw a circuit diagram for this circuit.

[2]

(ii) Add a voltmeter to your circuit diagram in **(a)(i)** in a correct position to measure the p.d. across the resistor. [1]

(iii) Using the graph in Fig. 9.1, determine the p.d. across the terminals of the power supply when the p.d. across the resistor is 6.0 V.

p.d. across terminals of power supply = ... [4]

(b) Describe a practical use for a thermistor.

.....

..... [1]

[Total: 8]

10 **(a)** A transformer has 500 turns on the primary coil and 25 turns on the secondary coil. The input voltage is 120 V.

(i) Calculate the output voltage.

output voltage = ... [2]

(ii) The current in the primary coil is 125 mA. The transformer is 100% efficient.

Calculate the output current.

output current = ... [2]

(b) Fig. 10.1 shows a loose wire connected in a circuit with a d.c. (direct current) power supply and a switch. The length of the wire between the two supports is in the magnetic field of a horseshoe magnet.

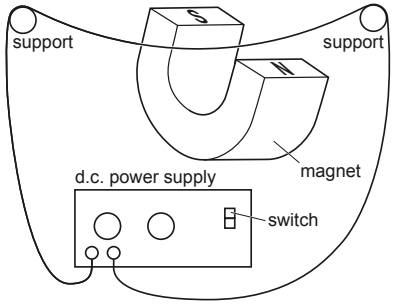


Fig. 10.1

The power supply is switched on and the wire moves down.

(i) On Fig. 10.1, draw an arrow on the wire to show the direction of the current. [1]

(ii) The power supply is switched off and the wire returns to its original position. The power supply is then switched on so that the current is in the opposite direction.

State and explain what happens to the wire.

.....

..... [2]

(c) A split-ring commutator is an important feature of a d.c. motor.

Suggest **one** reason why the d.c. motor cannot operate without a split-ring commutator.

..... [1]

[Total: 8]

11 **(a)** A detector of radioactivity is placed in a laboratory where there are no radioactive samples. A student notices that the detector shows a count rate that varies between 20 counts / min and 24 counts / min.

(i) Suggest a source of these readings.

..... [1]

(ii) Explain why these readings are **not** constant.

..... [1]

(b) A nucleus of uranium (U) contains 92 protons and 146 neutrons. It decays by emitting an α-particle to become a nucleus of thorium (Th).

Complete the nuclide equation for this radioactive decay.

$$\,^{\cdots}_{\cdots}\mathrm{U} \longrightarrow \,^{\cdots}_{\cdots}\mathrm{Th} + \,^{\cdots}_{\cdots}\alpha$$

[3]

(c) An isotope of radon has a half-life of 3.8 days. It decays by emitting α-radiation.

Calculate the time taken for 16 mg of this isotope to decay to 2 mg of this isotope.

time = ... days [2]

[Total: 7]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **0625/61**

Paper 6 Alternative to Practical **October/November 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

[Turn over

1 A student investigates the stretching of a spring.

Fig. 1.1 shows the apparatus.

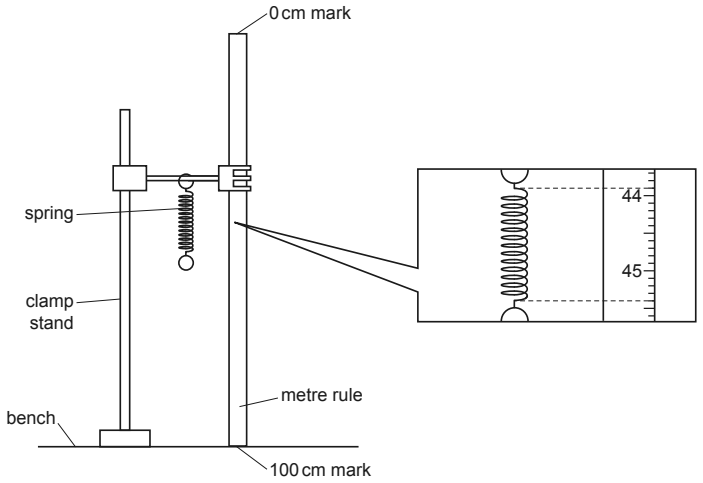


Fig. 1.1

(a) The metre rule is clamped in position near to the spring.

(i) Write down the scale readings in mm from the metre rule at the top and bottom of the spring, as shown in Fig. 1.1.

top reading = ... mm

bottom reading = ... mm
[2]

(ii) Using the two readings, calculate the length l_0 of the spring in mm. Record l_0 in Table 1.1. The value l_0 is the length of the spring when the load L = 0.00 N. [1]

(b) The student suspends a load L = 0.20 N from the spring. He records the new length l of the spring in Table 1.1.

(i) Use the equation $e = (l - l_0)$ to calculate the extension e of the spring. Record the value of e in Table 1.1. [1]

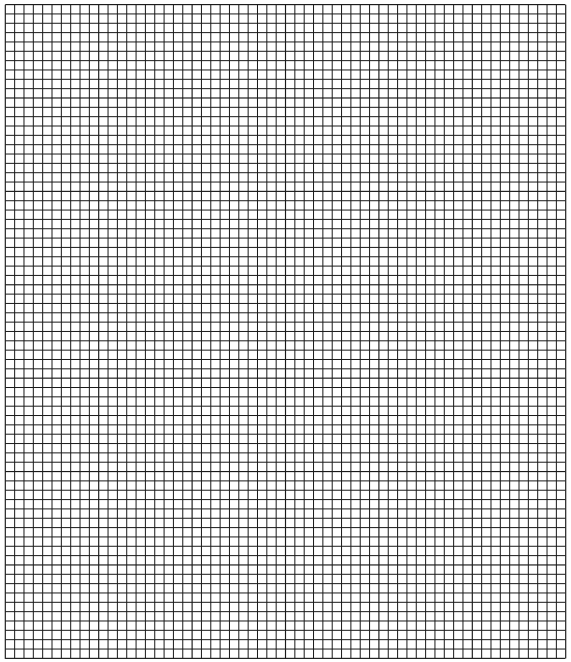
(ii) Complete the extension column heading in Table 1.1. [1]

(c) The student repeats the procedure using loads L = 0.40 N, L = 0.60 N, L = 0.80 N and L = 1.00 N. He records the readings and results in Table 1.1.

Table 1.1

L / N	l / mm	e /
0.00		0
0.20	17	
0.40	20	5
0.60	23	8
0.80	25	10
1.00	28	13

Plot a graph of e / mm (y-axis) against L / N (x-axis).



[4]

(d) Fig. 1.2 shows the unstretched spring and the spring with a load. On Fig. 1.2, show clearly the distances l_0, l and e.

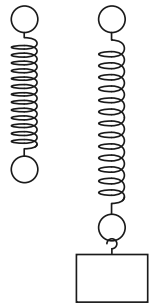


Fig. 1.2

[2]

[Total: 11]

2 A student investigates the resistance of resistors in different circuit arrangements.

Fig. 2.1 shows the first circuit arrangement.

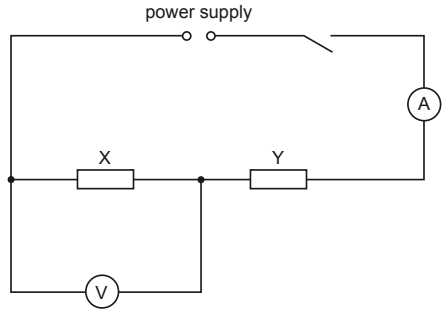


Fig. 2.1

(a) She measures the potential difference (p.d.) V_X across the resistor X and the current I_X in the circuit. The meters are shown in Fig. 2.2 and Fig. 2.3.

(i) Write down the readings. Include the units for potential difference, current or resistance where appropriate in all parts of the question.

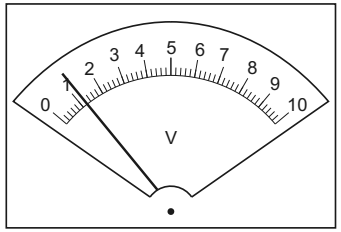


Fig. 2.2

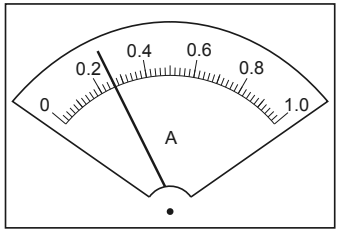


Fig. 2.3

V_X = ...

I_X = ...
[2]

(ii) Calculate R_X, the resistance of resistor X, using the equation $R_X = \frac{V_X}{I_X}$.

R_X = ... [2]

(b) The student connects the voltmeter to record V_{XY}, the potential difference across the two resistors X and Y in series. She calculates R_{XY}, the combined resistance of resistors X and Y connected in series.

R_{XY} = 10.4

She calculates the resistance R_Y of resistor Y.

R_Y = 5.78

State and explain whether R_X and R_Y can be considered to be equal within the limits of experimental accuracy.

.....

.....

..... [1]

(c) The student connects a resistor Z in **parallel** with resistor X. She connects the voltmeter to record V_{XZ}, the potential difference across the parallel combination of resistor X and resistor Z.

Draw the circuit diagram for this arrangement. Label the resistors X, Y and Z.

[3]

(d) The student records V_{XZ}, the potential difference across the two resistors X and Z in parallel, and I_{XZ}, the current in the circuit.

V_{XZ} = 0.8

I_{XZ} = 0.36

Calculate R_{XZ}, the combined resistance of resistors X and Z connected in parallel, using the equation $R_{XZ} = \frac{V_{XZ}}{I_{XZ}}$. Give your answer to 2 significant figures.

R_{XZ} = ... [1]

(e) Another student does this experiment using a set of three identical resistors. His results show that, within the limits of experimental accuracy, the combined resistance of two identical resistors connected in series is four times the combined resistance of the same two resistors connected in parallel. To test whether his results are true for other values of resistance, he does the same procedure with other sets of three identical resistors.

Suggest the values of resistance he could use to reach a conclusion during a 1 hour practical lesson.

.....

.....

..... [2]

[Total: 11]

3 A student investigates the position of the image in a plane mirror.

Fig. 3.1 shows the ray-trace sheet.

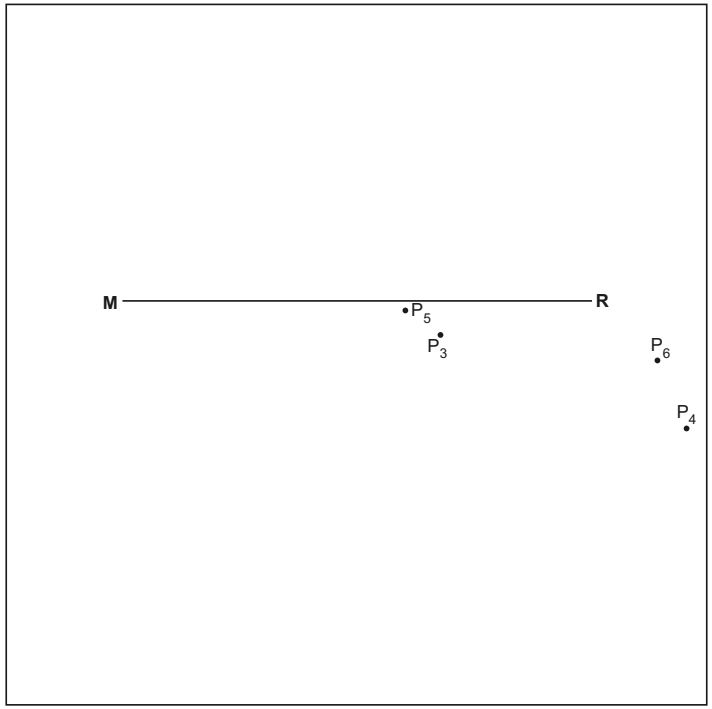


Fig. 3.1

(a)
- On Fig. 3.1, draw a normal to the line **MR** that passes through its centre. Label the normal **NL**. Label the point at which **NL** crosses **MR** with the letter **B**.
- Draw a line 7.0 cm long from **B** at an angle of incidence $i = 70°$ to the normal below **MR** and to the left of the normal. Label the end of this line **A**.
- Draw another line 7.0 cm long from **B** at an angle $\theta = 40°$ to the normal below **MR** and to the left of the normal. Label the end of this line **C**.

[3]

(b) Mark, with two neat crosses, positions for two pins, P_1 and P_2, on line **AB** at a suitable distance apart for this type of ray-trace experiment. [1]

(c) The student places a plane mirror on line **MR** and views the images of pins P_1 and P_2 in the mirror. He places two pins, P_3 and P_4, so that pins P_3 and P_4 and the images of P_2 and P_1 all appear exactly one behind the other. The positions of P_3 and P_4 are marked on Fig. 3.1.

Draw a line through the positions of P_3 and P_4. Continue the line until it meets **MR**.

Measure the angle α between the line and the normal **NL** below **MR**. Include the unit.

α = ... [1]

(d) The student places the reflecting face of the mirror vertically on the line **AB** with the centre of the mirror at **B**.

He places pins P_1 and P_2 on line **CB**. He places pins P_5 and P_6 so that pins P_5 and P_6 and the images of P_2 and P_1 all appear exactly one behind the other.

Draw a line through the positions of P_5 and P_6. Continue the line until it meets **NL**.

Measure the angle β between the line and **NL** below **MR**. Include the unit.

β = ... [1]

(e) A student investigates a possible relationship between angles α and β. The angle θ remains constant at $\theta = 40°$. Suggest values of the angle of incidence i that he could use.

.....

..... [2]

(f) A student does this experiment with care. Suggest **one** practical reason why the results may **not** be exactly those that the theory of reflection predicts.

.....

..... [1]

(g) Tick the boxes that indicate relevant precautions that the student should take with this type of ray-trace experiment.

- ☐ carry out the experiment in a darkened room
- ☐ draw thin lines
- ☐ keep one eye closed
- ☐ keep room temperature constant
- ☐ view the bases of the pins
- ☐ view the tops of the pins

[2]

[Total: 11]

4 A student investigates the time taken to heat water in different uninsulated containers. The containers all have the same volume and shape. The water is heated with an electric immersion heater.

The following apparatus is available:

a selection of containers
measuring cylinder
thermometer
supply of cold water
immersion heater with power supply.

Plan an experiment to investigate the time taken to heat water in different uninsulated containers.

You should:

- list any additional apparatus that is required
- explain briefly how you would carry out the investigation
- state the key variables that you would keep constant
- draw a table, or tables, with column headings to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain briefly how you would use your readings to reach a conclusion.

....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
....
.... [7]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

PHYSICS **0625/63**

Paper 6 Alternative to Practical **October/November 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

DC (NF/SG) 214840/2

[Turn over

1 A student investigates the effect of insulation on the cooling of water.

She uses the apparatus shown in Fig. 1.1.

The sides of beaker A are covered with material that is a thermal insulator.

Beaker B has no covering on its sides.

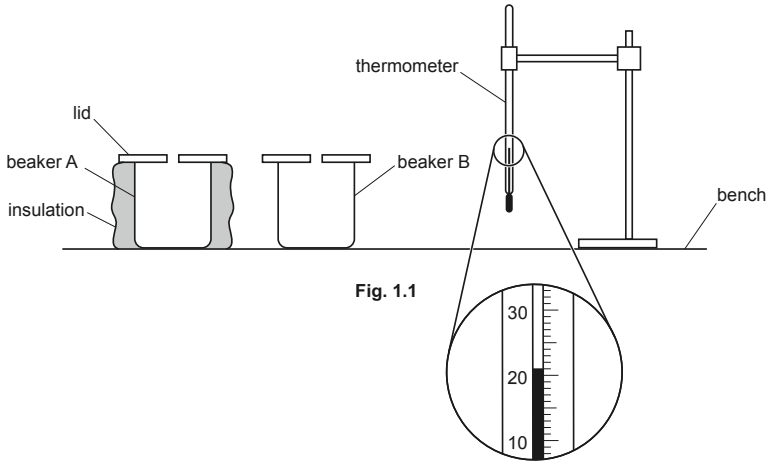


Fig. 1.1

(a) Record room temperature θ_R shown on the thermometer in Fig. 1.1.

θ_R = ... [1]

(b) The student pours 150 cm^3 of hot water into beaker A and records the temperature θ at time t = 0.

She records, in Table 1.1, the temperature of the water in the beaker every 30 s. The student repeats the process for beaker B.

Add units to the column headings in Table 1.1. [1]

Table 1.1

	beaker A with insulation	beaker B without insulation
t/	θ/	θ/
0	88.0	87.5
30	86.0	83.5
60	84.5	81.5
90	83.5	80.0
120	82.5	79.0
150	82.0	78.5
180	81.5	78.0

(c) Describe **two** precautions that can be taken to ensure that temperature readings in the experiment are as accurate as possible.

1. .....

.....

2. .....

..... [2]

(d) Write a conclusion stating whether the insulation affects the rate of cooling of the water. Justify your answer by reference to values from the results.

.....

.....

.....

..... [2]

(e) (i) Calculate the average cooling rate x_1 during the first half of the experiment for the water in beaker B. Use the readings for beaker B from Table 1.1 and the equation

$$x_1 = \frac{\theta_0 - \theta_{90}}{T},$$

where T = 90 s and θ_0 and θ_{90} are the temperatures of the water in beaker B at t = 0 and t = 90 s.

Include the unit.

x_1 = ... [1]

(ii) Calculate the average cooling rate x_2 during the second half of the experiment for the water in beaker B. Use the readings for beaker B from Table 1.1 and the equation

$$x_2 = \frac{\theta_{90} - \theta_{180}}{T},$$

where T = 90 s and θ_{90} and θ_{180} are the temperatures of the water in beaker B at t = 90 s and t = 180 s.

Include the unit.

x_2 = ... [1]

(f) (i) Suggest an additional experiment to test whether the lid affects the cooling rate of the water in beaker B. State how the readings are used to show the effect.

.....

.....

..... [1]

(ii) A student suggests that the temperature of the water in beaker B at t = 0 for this additional experiment must be the same as in **(b)** for the comparison to be fair.

State whether your results support this suggestion.

Use your results from **(e)** to explain whether this precaution is necessary.

statement .....

explanation .....

.....

.....

[2]

[Total: 11]

2 A student compares the resistances of two wires.

She uses the circuit, part of which is shown in Fig. 2.1.

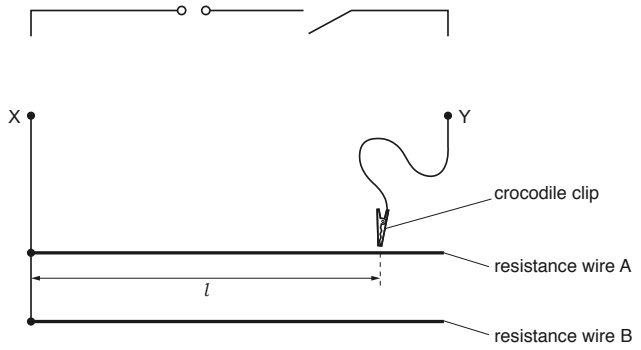


Fig. 2.1

(a) On Fig. 2.1, complete the circuit diagram to show a voltmeter connected to measure the potential difference (p.d.) across terminals X and Y, and an ammeter connected to measure the current in the circuit. [2]

(b) The student connects the crocodile clip to a length l = 90.0 cm of resistance wire A and measures the potential difference V and the current I for the length l of the wire.

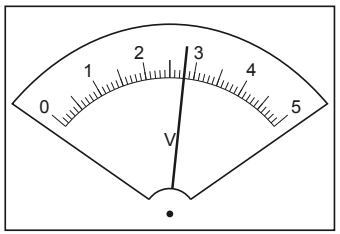


Fig. 2.2

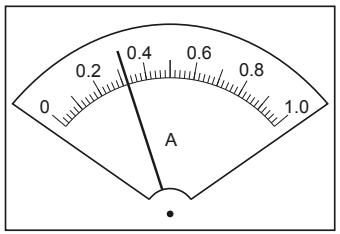


Fig. 2.3

(i) Read, and record in Table 2.1, the values of V and I shown on the meters in Fig. 2.2 and Fig. 2.3. [2]

Table 2.1

wire	l / cm	V /	I /	R /
A	90.0			
B	90.0	2.6	0.45	
A	50.0	2.7	0.54	
B	50.0	2.3	0.72	

(ii) The student then connects the crocodile clip to lengths l = 90.0 cm of wire B, l = 50.0 cm of wire A and l = 50.0 cm of wire B.

Her readings are shown in Table 2.1.

Calculate, and record in Table 2.1, the resistance R of each length of wire A and wire B.

Use the values of V and I and the equation

$$R = \frac{V}{I}.$$

[2]

(iii) Complete the headings in Table 2.1. [1]

(c) (i) Calculate a value P using your results from Table 2.1 and the equation

$$P = \frac{R \text{ for 90.0 cm of wire A}}{R \text{ for 90.0 cm of wire B}}.$$

P = ...

Calculate a value Q using your results from Table 2.1 and the equation

$$Q = \frac{R \text{ for 50.0 cm of wire A}}{R \text{ for 50.0 cm of wire B}}.$$

Q = ...
[1]

(ii) A student suggests that the values of P and Q should be equal.

State whether your results support this suggestion. Justify your answer by reference to values from your results.

statement .....

justification .....

.....

.....
[2]

(d) Suggest **one** reason why students all doing this experiment carefully with the same apparatus may not obtain the same results.

.....

..... [1]

[Total: 11]

3 A student investigates the image produced by a converging lens.

He uses the apparatus shown in Fig. 3.1.

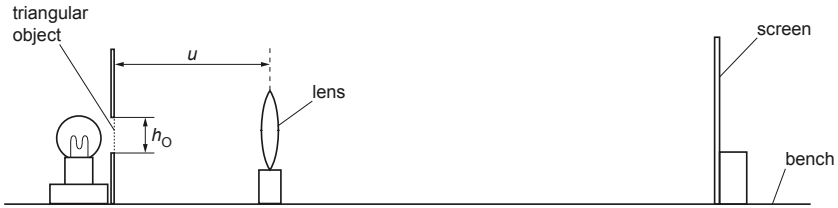


Fig. 3.1

(a) The triangular object is shown full size in Fig. 3.2.

Measure and record the height h_O of the triangular object in Fig. 3.2.

h_O = ... cm [1]

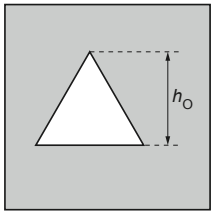


Fig. 3.2

(b) The student sets the distance u between the triangular object and the lens to 20.0 cm. He moves the screen until a sharp image of the triangular object is seen on the screen. The student measures, and records in Table 3.1, the height h_I of the image on the screen.

Briefly describe a technique to obtain an image on the screen that is as sharp as possible in this experiment.

.....

..... [1]

(c) The student repeats the process for u = 25.0 cm, u = 30.0 cm, u = 35.0 cm and u = 40.0 cm. His readings are shown in Table 3.1.

For distance u = 20.0 cm, calculate, and record in Table 3.1, the value of $\frac{1}{h_I}$. [1]

Table 3.1

u/cm	h_I/cm	$\frac{1}{h_I} \Big/ \frac{1}{\text{cm}}$
20.0	5.6	
25.0	3.2	0.31
30.0	1.9	0.53
35.0	1.5	0.67
40.0	1.2	0.83

(d) Plot a graph of u/cm (y-axis) against $\frac{1}{h_I} \Big/ \frac{1}{\text{cm}}$ (x-axis).

[4]

(e) **(i)** Determine the gradient of the graph.

Show clearly on the graph how you obtained the necessary information.

gradient = ... [1]

(ii) Calculate the focal length f of the lens. Use your value of h_O from **(a)** and the equation

$$f = \frac{G}{h_O},$$

where G is numerically equal to the gradient from **(e)(i)**.

f = ... [1]

(f) Describe **one** difficulty that can be experienced when measuring the height of the image.

Suggest an improvement to overcome this difficulty.

difficulty .....

.....

improvement .....

..... [2]

[Total: 11]

4 A student investigates the strength of an electromagnet.

The electromagnet is made from a coil of insulated wire wrapped around an iron rod. When there is an electric current in the coil, the iron rod becomes magnetised. The electromagnet can then attract magnetic materials (e.g. iron and steel).

Plan an experiment to investigate how **one** factor affects the number of steel paper clips the electromagnet can support.

The apparatus available includes:
- an electromagnet, shown in Fig. 4.1
- a power supply
- a selection of steel paper clips.

In your plan, you should:

- state a factor which can be measured and list any additional apparatus needed
- state the key variables to be kept constant
- explain briefly how to do the experiment, including any precautions to ensure reliable results (you may draw a diagram or add to Fig. 4.1 to help your explanation)
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

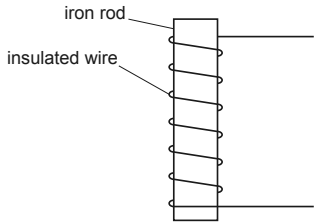


Fig. 4.1

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [7]

Cambridge Assessment International Education

Cambridge IGCSE™

PHYSICS **0625/22**

Paper 2 Multiple Choice (Extended) **February/March 2021**

45 minutes

You must answer on the multiple choice answer sheet.

3645684800

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = $10\,m/s^2$).

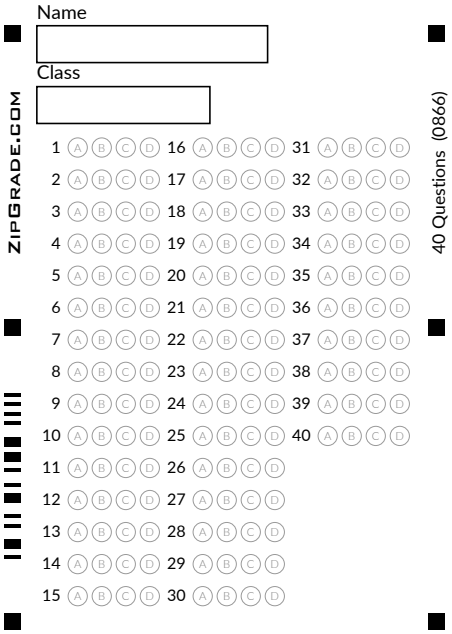
INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **16** pages.

IB21 03_0625_22/3RP

[Turn over



1 A student has a measuring cylinder containing water and also has a balance.

Which of these could she use to find the volume of a small metal sphere?

She has no other apparatus.

A either the measuring cylinder containing water or the balance

B the measuring cylinder containing water only

C the balance only

D neither the measuring cylinder nor the balance

2 A ball hits a bat with a velocity of 30 m/s, and leaves the bat travelling with a velocity of 20 m/s in the opposite direction. The ball is in contact with the bat for 0.10 s.

What is the magnitude of the acceleration of the ball whilst it is in contact with the bat?

A $1.0\,m/s^2$ **B** $5.0\,m/s^2$ **C** $100\,m/s^2$ **D** $500\,m/s^2$

3 A train begins a journey from a station and travels 60 km in a time of 20 minutes.

What is the average speed of the train?

A 3.0 m/s **B** 5.0 m/s **C** 50 m/s **D** 60 m/s

4 Which statement about mass is correct?

A A mass of 10 kg weighs 1 N near the Earth's surface.

B Mass is a gravitational force.

C Mass increases when the gravitational field strength increases.

D The greater the mass of a body, the more it resists a change in its motion.

5 A small bottle has a mass of 20 g when empty. The volume of the bottle is $10\,cm^3$.

When full of liquid, the total mass is 150 g.

What is the density of the liquid?

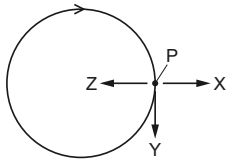
A $0.50\,g/cm^3$ **B** $2.0\,g/cm^3$ **C** $13\,g/cm^3$ **D** $15\,g/cm^3$

6 An object of mass 0.80 kg is moving in a straight line at a velocity of 2.0 m/s. A force is exerted on the object, in the direction of motion, for a period of 1.0 minute and the velocity of the object increases to 6.0 m/s.

What force is exerted on the object?

A 0.053 N **B** 0.080 N **C** 3.2 N **D** 4.8 N

7 An object moves at constant speed in the circular path shown.



Which statement about the acceleration of the object when it is at point P is correct?

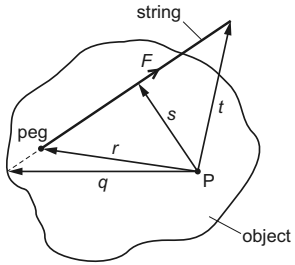
A The acceleration is in the direction of arrow X.

B The acceleration is in the direction of arrow Y.

C The acceleration is in the direction of arrow Z.

D The object is not accelerating.

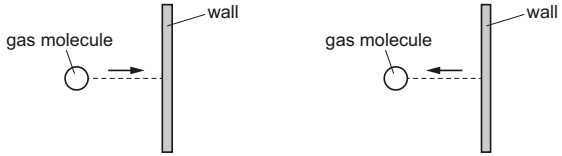
8 An object is pivoted at point P. A student ties a length of string to a peg on the object. He pulls the string with a force *F*.



What is the moment of the force *F* about the point P?

A $F \times q$ **B** $F \times r$ **C** $F \times s$ **D** $F \times t$

9 A gas molecule strikes the wall of a container. The molecule rebounds with the same speed.



before hitting the wall after hitting the wall

What happens to the kinetic energy and what happens to the momentum of the molecule?

	kinetic energy	momentum
A	changes	changes
B	changes	stays the same
C	stays the same	changes
D	stays the same	stays the same

10 A horizontal force pulls a box along a horizontal surface.

The box gains 30 J of kinetic energy and 10 J of thermal energy is produced by the friction between the box and the surface.

How much work is done by the force?

A 10 J **B** 20 J **C** 30 J **D** 40 J

11 A crane is used to lift loads vertically.

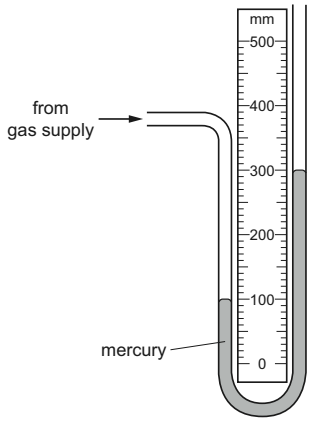
The output power of the crane to lift a car is *P*.

The crane then lifts a lorry, which has 3.0 times the weight of the car, through 0.25 of the distance in 0.50 of the time.

What is the output power of the crane now?

A $\frac{3P}{8}$ **B** $\frac{3P}{2}$ **C** $\frac{8P}{3}$ **D** $6P$

12 The diagram shows a manometer connected to a gas supply.



What is the pressure of the gas supply?

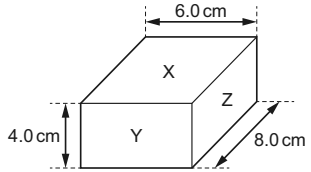
A 100 mm Hg above atmospheric pressure

B 100 mm Hg below atmospheric pressure

C 200 mm Hg above atmospheric pressure

D 200 mm Hg below atmospheric pressure

13 The diagram shows a box of dimensions 6.0 cm × 8.0 cm × 4.0 cm.



The box rests on a flat horizontal surface.

On which face must the box rest in order to exert the least pressure?

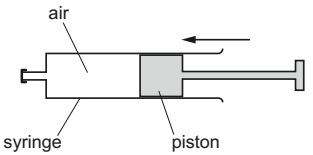
A face X

B face Y

C face Z

D The pressure is the same for all the faces.

14 Air in a sealed syringe is slowly compressed by moving the piston. The temperature of the air stays the same.



Which statement about the air is correct?

A The pressure of the air decreases because its molecules now travel more slowly.

B The pressure of the air decreases because the area of the syringe walls is now smaller.

C The pressure of the air increases because its molecules now hit the syringe walls more frequently.

D The pressure of the air increases because its molecules now travel more quickly.

15 In an experiment, smoke particles are suspended in air and viewed through a microscope.

The smoke particles move about with short random movements.

Which of the following statements is correct?

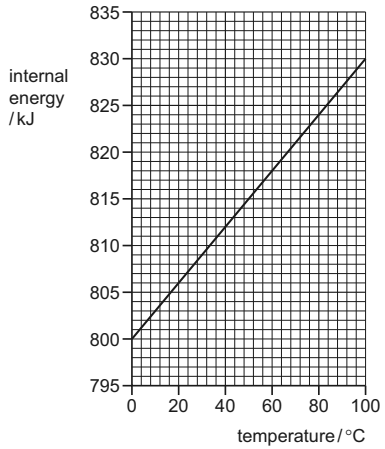
A Air particles have large masses compared to smoke particles and they move in one direction only.

B Air particles have large masses compared to smoke particles and they move in random directions.

C Air particles move at high speeds compared to smoke particles and they move in one direction only.

D Air particles move at high speeds compared to smoke particles and they move in random directions.

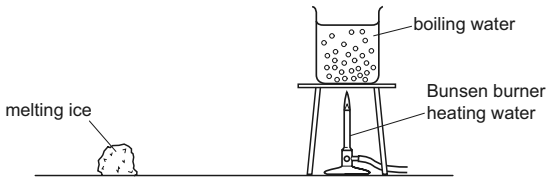
16 The graph shows how the internal energy of 1.0 kg of a metal changes with temperature.



What is the increase in the internal energy of a block of the same metal of mass 0.25 kg when its temperature rises from 40 °C to 50 °C?

A 30 J **B** 300 J **C** 750 J **D** 1200 J

17 A piece of melting ice at 0 °C and a beaker of boiling water are both in a laboratory. The laboratory is at 20 °C.



What is happening to the temperature of the melting ice and what is happening to the temperature of the boiling water?

	temperature of melting ice	temperature of boiling water
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

18 One end of a copper rod is heated.

What is one method by which thermal energy is transferred in the copper rod?

A Free electrons transfer energy from the cooler end to the hotter end.

B Free electrons transfer energy from the hotter end to the cooler end.

C Molecules of copper move from the cooler end to the hotter end.

D Molecules of copper move from the hotter end to the cooler end.

19 Which change will cause a decrease in the rate of radiation emitted by an object?

A changing the surface colour from white to black

B changing the surface texture from dull to shiny

C increasing the surface temperature

D increasing the surface area

20 What is the approximate wavelength in air of the highest frequency sound that can be heard by a normal healthy person?

A 0.02 m **B** 60 m **C** 20 000 m **D** 7 000 000 m

21 What causes the change in direction when light travels from air into glass?

A The amplitude of the light changes.

B The colour of the light changes.

C The frequency of the light changes.

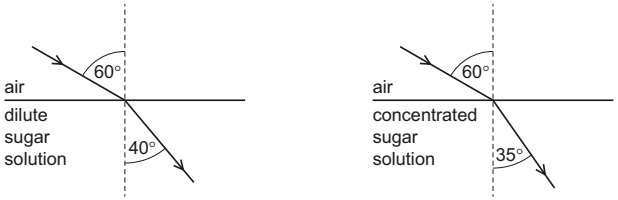
D The speed of the light changes.

22 Light from a torch is incident on a plane mirror. The angle of incidence is 38°.

What is the angle of reflection?

A 38° **B** 52° **C** 76° **D** 142°

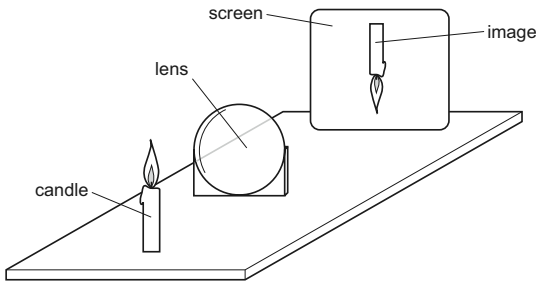
23 Two rays with an angle of incidence of 60° pass into dilute and concentrated sugar-water solutions. The refractions are shown.



Which row is correct?

	refractive index as concentration increases	speed through solution as concentration increases
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

24 A thin converging lens is used to produce a sharp image of a candle.



Various sharp images are produced on the screen by moving the lens and the screen backwards and forwards.

Which statement is **always** correct?

A The image is at the principal focus (focal point) of the lens.

B The image is bigger than the object.

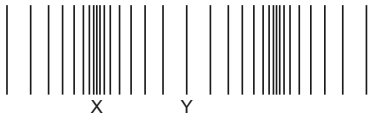
C The image is closer to the lens than the object.

D The image is inverted.

25 Which row gives the approximate speeds at which ultraviolet waves travel in air and in a vacuum?

	speed in air / m/s	speed in a vacuum / m/s
A	340	3.0×10^8
B	340	340
C	3.0×10^8	340
D	3.0×10^8	3.0×10^8

26 The diagram represents a sound wave.



What are the names of the parts of the sound wave labelled X and Y?

	X	Y
A	amplitude	wavelength
B	compression	rarefaction
C	rarefaction	amplitude
D	wavelength	compression

27 The speed of sound is different in different states of matter.

The speed of sound in liquid water is 1500 m/s.

Which row correctly compares the speed of sound in ice and the speed of sound in water vapour with the speed of sound in water?

	speed of sound in ice / m/s	speed of sound in steam / m/s
A	less than 1500	less than 1500
B	less than 1500	more than 1500
C	more than 1500	less than 1500
D	more than 1500	more than 1500

28 Three methods to demagnetise a magnet are suggested. The magnet is in an east-west direction.

1 hitting the magnet repeatedly with a hammer

2 heating the magnet until red hot

3 withdrawing the magnet from a coil which has a direct current (d.c.) in it

Which methods demagnetise the magnet?

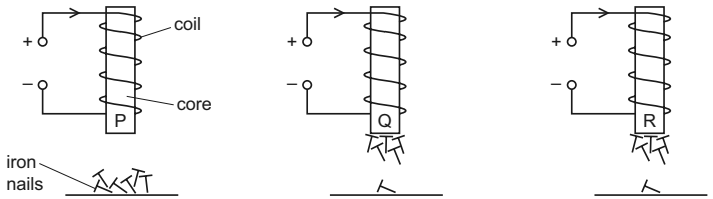
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

29 Three cores of different metals P, Q and R are placed inside identical coils of wire.

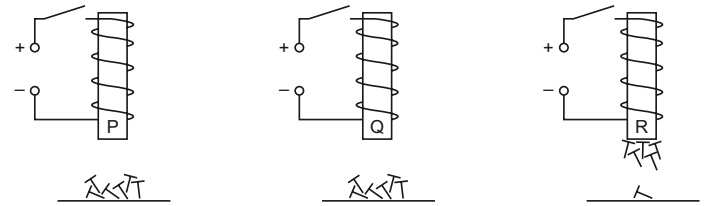
At least one of the metals is non-magnetic.

The cores are held above some iron nails.

The three diagrams show what happens when there is a current in the coils.



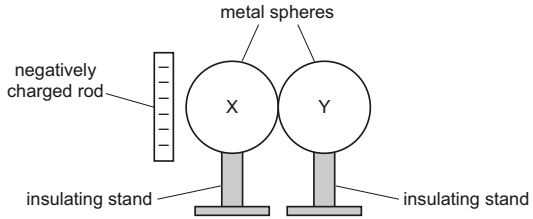
The three diagrams below show what happens when the current is then switched off.



Which core metals are magnetic?

A P only **B** R only **C** P and Q **D** Q and R

30 Two uncharged metal spheres X and Y rest on insulating stands and touch each other. A negatively charged plastic rod is brought near to sphere X.



Using the insulating stand, sphere Y is moved away from sphere X.

What are the signs and the relative magnitudes of the charges induced on X and Y?

	charge on X	charge on Y	relative magnitudes of charges
A	negative	negative	equal
B	negative	positive	different
C	positive	negative	equal
D	positive	positive	different

31 Which two changes to a metal wire both decrease its resistance?

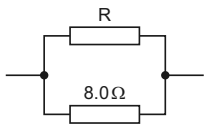
	length of wire	cross-sectional area of wire
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

32 There is a current I in a resistor of resistance R for a time t. The potential difference across the resistor is V.

Which equation gives the energy E transferred by the resistor?

A $E = IR$ **B** $E = IV$ **C** $E = IRt$ **D** $E = IVt$

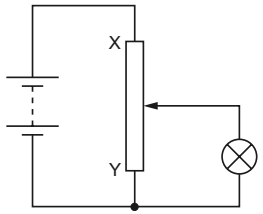
33 A resistor R is connected in parallel with an 8.0Ω resistor. The resistance of this combination is 4.0Ω.



What is the resistance of resistor R?

A 0.50Ω **B** 2.0Ω **C** 4.0Ω **D** 8.0Ω

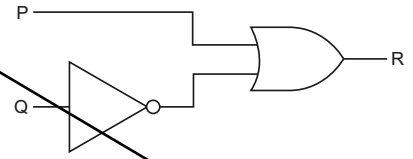
34 A student designs a circuit to use as a dimmer switch for a lamp.



What happens to the brightness of the lamp and the potential difference (p.d.) across the lamp, when the slider is moved from X to Y?

	brightness of lamp	p.d. across the lamp
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

35 The circuit shown contains two gates.



Which truth table describes the operation of the circuit?

A

P	Q	R
0	0	0
0	1	1
1	0	1
1	1	1

B

P	Q	R
0	0	0
0	1	0
1	0	1
1	1	1

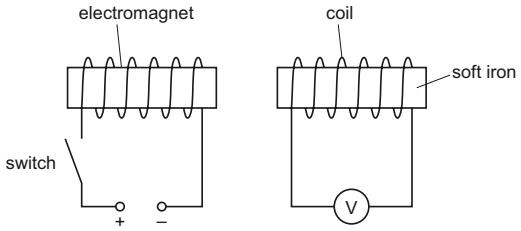
C

P	Q	R
0	0	1
0	1	0
1	0	0
1	1	0

D

P	Q	R
0	0	1
0	1	0
1	0	1
1	1	1

36 The diagram shows an electromagnet near a coil of wire connected to a voltmeter. The reading on the voltmeter is zero.



The switch is closed. The electromagnet magnetises quickly.

What happens to the reading on the voltmeter?

A It keeps increasing.

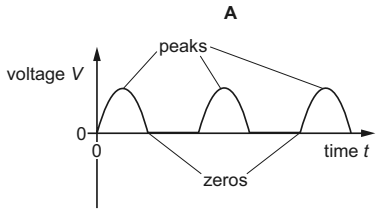
B It quickly increases and stays at maximum.

C It quickly increases and then decreases.

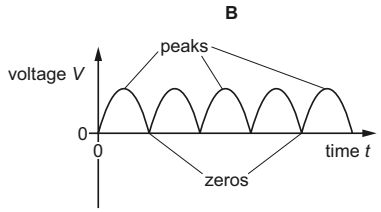
D It stays on zero.

37 Which graph shows the voltage output of an a.c. generator with the peaks and zeros correctly labelled?

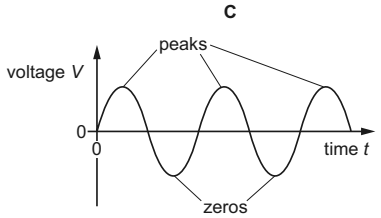
A



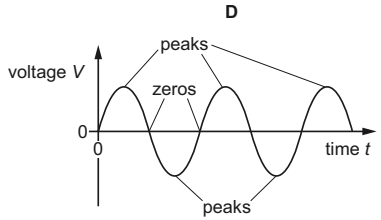
B



C



D



38 Three students are describing the structure of an atom.

student 1 All the positively charged particles are in the nucleus.

student 2 Positive electrons are in the nucleus.

student 3 Negative electrons orbit around the nucleus.

Which students are making a correct statement?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

39 When alpha particles are incident on a thin metal foil, most of them pass through undeviated.

What does this observation reveal about the nature of the atom?

A The atom has a dense nucleus.

B The atom is mostly empty space.

C The atom is very small.

D The nucleus of the atom is positively charged.

40 A laboratory worker measures the count rate from a radioactive source. He records his results in a table.

time / minutes	count rate / counts / s
0	100
1.0	73
2.0	54
3.0	41
4.0	31

The average background radiation in the laboratory is 8 counts per second.

What is the half-life of the source?

A 1.5 minutes

B 2.0 minutes

C 3.0 minutes

D 4.0 minutes

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8324509767

PHYSICS **0625/42**

Paper 4 Theory (Extended) **February/March 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.
- Take the weight of 1.0 kg to be 10 N (acceleration of free fall = 10 m / s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 **(a)** Fig. 1.1 shows a piece of glass of thickness 2.0 cm and area 0.15 m^2.

The density of the glass is 2.6×10^3 kg / m^3.

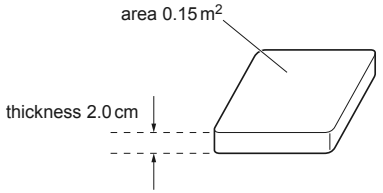


Fig. 1.1 (not to scale)

Calculate the weight of the piece of glass.

weight = ... [3]

(b) The piece of glass shown in Fig. 1.1 is used as the vertical viewing window of an aquarium. The atmospheric pressure outside the aquarium is 1.0×10^5 Pa. The average pressure on the inside of the aquarium window is 1.3×10^5 Pa.

Calculate the resultant force acting on the window due to these pressures and state the direction in which it acts.

force = ...

direction of force .....
[4]

(c) Fig. 1.2 shows a vacuum pump connected to the top of a vertical tube with its lower end immersed in a tank of liquid. The pump reduces the pressure above the column to zero and the pressure at point X is 9.6×10^4 Pa.

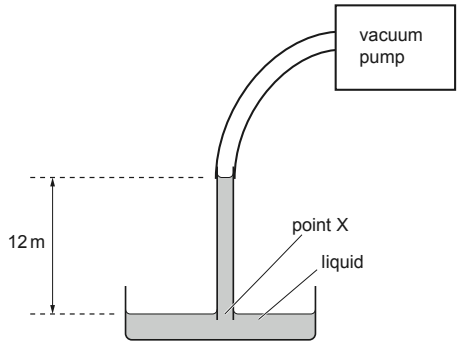


Fig. 1.2 (not to scale)

Calculate the density of the liquid.

density = ... [3]

[Total: 10]

2 (a) (i) State what is meant by the *moment* of a force about a point.

..... [1]

(ii) Fig. 2.1 shows a large crane on a construction site lifting a block of mass 14 000 kg.

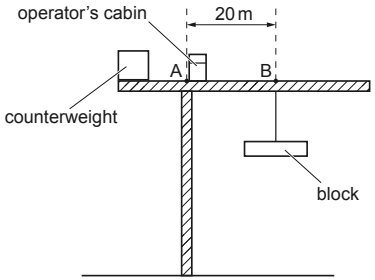


Fig. 2.1

Calculate the moment about A due to the 14 000 kg block suspended from B.

moment = ... [2]

(b) (i) Speed is a scalar quantity and velocity is a vector quantity. State the difference between a scalar quantity and a vector quantity.

.....

..... [2]

(ii) Write down **one** other scalar quantity and **one** other vector quantity.

scalar quantity .....

vector quantity .....

[2]

(c) Fig. 2.2 shows two forces acting on an object.

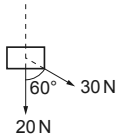


Fig. 2.2 (not to scale)

Draw a scale diagram to determine the resultant force acting on the object. State the scale you use.

scale .....

magnitude of resultant force = ...

direction of resultant relative to the direction of the 20 N force = ...
[4]

[Total: 11]

3 A power station burns waste materials from farm crops to generate electricity.

(a) State and explain whether this process is renewable.

statement .....

explanation .....

.....
[2]

(b) The power station uses some of its waste thermal energy to heat water for houses in a nearby town.

State **one** problem of using waste energy in this way if the power station is far from the town.

.....

Suggest a way of reducing this problem.

.....

.....
[2]

(c) State **two** environmental consequences of burning coal to generate electricity.

consequence 1. .....

consequence 2. .....
[2]

[Total: 6]

4 **(a)** In terms of the momentum of molecules, explain how a gas exerts pressure on the walls of its container.

.....

.....

.....

.....

.....

.....

..... [4]

(b) A fixed mass of gas of volume V_1 is at a pressure p_1. It is compressed to a volume V_2.

(i) Complete the equation for the final pressure p_2 of the gas when the gas is compressed at constant temperature.

p_2 =

[2]

(ii) State and explain how the final pressure compares with p_2 when the temperature of the gas increases during compression.

statement .....

explanation .....

.....

.....

.....

[3]

[Total: 9]

5 **(a)** State the name of the reflection of a sound wave or ultrasound wave.

..... [1]

(b) Fig. 5.1 shows an ultrasound wave being used to scan an internal organ of a human body.

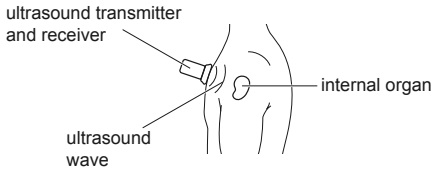


Fig. 5.1

The ultrasound wave has a frequency of 2.0 MHz and passes through human tissue at a speed of 1500 m / s.
Calculate the wavelength of the ultrasound wave in human tissue.

wavelength = ... [3]

(c) Fig. 5.2 shows crests of a wave from a point source S approaching a straight barrier.

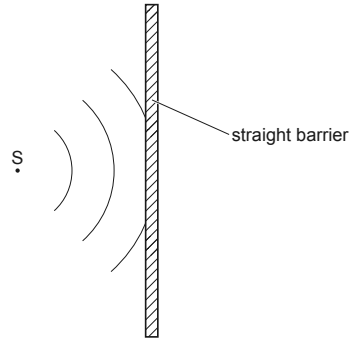


Fig. 5.2

(i) On Fig. 5.2, indicate and label **one** wavelength.

(ii) On Fig. 5.2, draw **three** crests of the wave reflected from the barrier.

[3]

[Total: 7]

6 **(a)** Fig. 6.1 is a full scale diagram showing a converging lens, the two principal focuses F_1 and F_2 and an object PO.

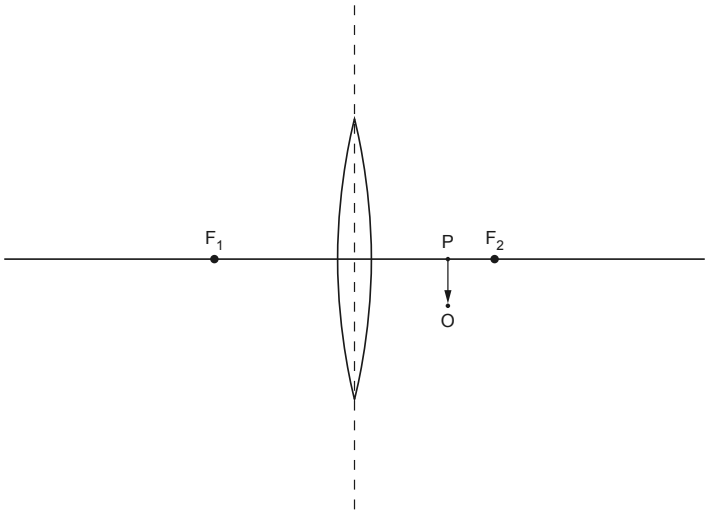


Fig. 6.1

On Fig. 6.1, draw two rays from point O of the object to determine the position of the image. Label the image IJ. Measure the length of the image.

image length = ...
[3]

(b) Ring **three** descriptions of the image.

diminished **magnified** **real** **same size**

same way up as object **upside down compared to object** **virtual** [3]

(c) Fig. 6.2 shows three rays of green light passing through glass blocks.

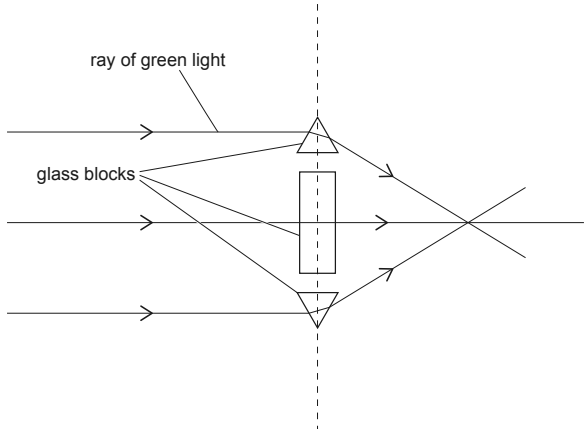


Fig. 6.2

Three rays of red light approach the glass blocks on the same paths as the rays of green light.

On Fig. 6.2, draw the paths of these rays of red light to the right of the glass blocks. [2]

[Total: 8]

7 Fig. 7.1 shows a horizontal conducting wire XY between two opposite magnetic poles. Wire XY forms a circuit with an ammeter.

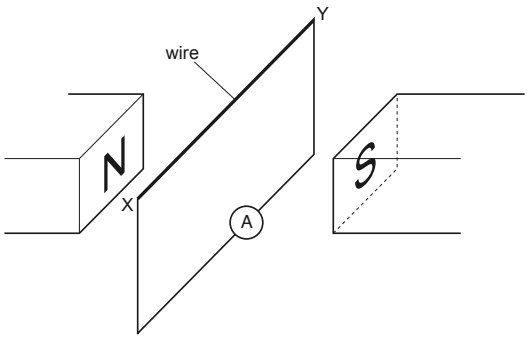


Fig. 7.1

(a) Explain why the reading on the ammeter is zero when the wire XY is not moving.

.....

..... [1]

(b) The wire XY is moved and there is a deflection on the ammeter that indicates there is a current in the wire from X to Y.

On Table 7.1, tick **one** box to indicate the direction of the movement of the wire XY and explain your answer.

Table 7.1

into page	out of page	to the left	to the right	to the bottom of the page	to the top of the page

explanation .....

.....

.....

[3]

(c) State what is observed on the ammeter when the wire XY is moved

(i) in the opposite direction to part **(b)** ..... [1]

(ii) in the same direction as part **(b)** but at a greater speed ..... [1]

[Total: 6]

8 **(a)** Define electromotive force (e.m.f.).

.....

..... [1]

(b) Fig. 8.1 shows a source E of e.m.f. 60 V in a circuit.

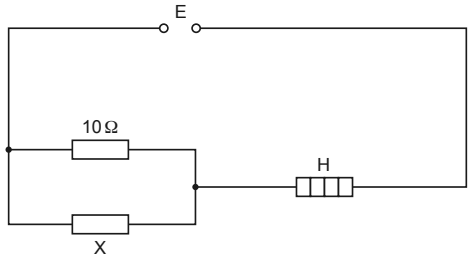


Fig. 8.1

The heater H has a resistance of 22.5 Ω and the potential difference (p.d.) across it is 45 V.

Calculate:

(i) the power of the heater

power = ... [3]

(ii) the p.d. across resistor X

p.d. = ... [2]

(iii) the current in the 10 Ω resistor.

current = ... [2]

[Total: 8]

9 **(a)** Write down the truth table for an OR gate.

[2]

(b) Draw the symbol for a NOR gate.

[1]

(c) Fig. 9.1 shows a digital circuit designed to produce the values shown in Table 9.1 for the output S from the two inputs P and Q.

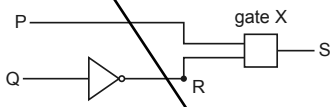


Fig. 9.1

(i) Table 9.1 is the truth table for the circuit shown in Fig. 9.1.

Table 9.1

P	Q	R	S
0	0		0
0	1		0
1	0		1
1	1		0

Complete the column for point R in Table 9.1. [1]

(ii) State which type of gate is used for gate X. Explain your answer.

statement .....

explanation .....

.....

.....

[3]

[Total: 7]

10 **(a)** State the proton number, nucleon number and the value of the charge on an α-particle.

proton number .....

nucleon number .....

charge .....

[3]

(b) A nucleus of strontium-90 consists of 38 protons and 52 neutrons. Strontium-90 is radioactive and decays by β-emission to an isotope of yttrium. The symbol for strontium is Sr and the symbol for yttrium is Y. Write down the nuclide equation of this decay.

[3]

(c) The half-life of radon-220 is 56 s. A sample of radon-220 is in a container. After 112 s the mass of radon-220 is 9.2 mg.

Calculate the mass of the original sample.

mass = ... [2]

[Total: 8]

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2736667153

PHYSICS **0625/62**

Paper 6 Alternative to Practical **February/March 2021**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

[Turn over

1 A student investigates the motion of an oscillating metre rule.

He uses the apparatus shown in Fig. 1.1.

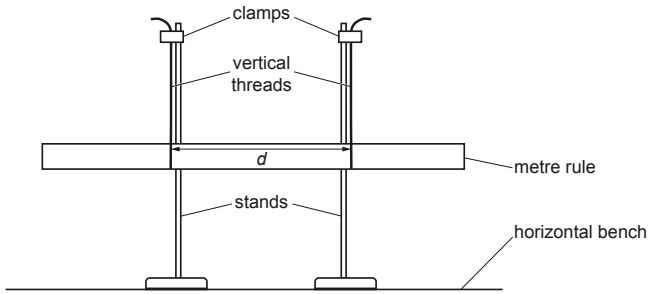


Fig. 1.1

(a) The student ensures that the metre rule is horizontal.

Briefly describe how to check that the metre rule is horizontal. You may draw a diagram or draw on Fig. 1.1 if it helps to explain your answer.

.....

.....

..... [1]

(b) The student moves the stands so that the vertical threads are at the marks on the metre rule shown in Fig. 1.2.

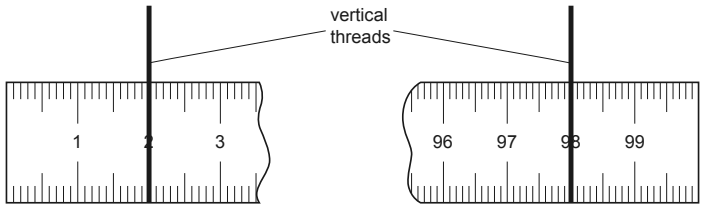


Fig. 1.2

Calculate the distance *d* between the threads.

d =..... cm [1]

(c) He twists the metre rule a small amount, as shown in Fig. 1.3, and then lets it go so that it oscillates in a rotating motion.

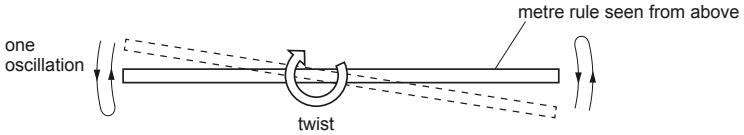


Fig. 1.3

He measures the time *t* for 5 complete oscillations of the metre rule.

t = 3.63 s

Suggest why it is useful to take a trial reading for this experiment.

.....

..... [1]

(d) The student carries out the same procedure for *d* values of 20.0 cm, 30.0 cm, 40.0 cm, 50.0 cm and 60.0 cm. His readings are shown in Table 1.1.

Table 1.1

d / cm	*t* / s	$\frac{1}{T}\Big/\frac{1}{\text{s}}$
20.0	17.85	
30.0	11.36	0.44
40.0	8.77	0.57
50.0	6.93	0.72
60.0	5.68	0.88

For distance *d* = 20.0 cm, calculate and record in Table 1.1, the value of $\frac{1}{T}$ where *T* is the time for 1 oscillation of the metre rule.
Use the value of time *t* from Table 1.1 and the equation $\frac{1}{T} = \frac{5}{t}$. [1]

(e) Plot a graph of distance *d* / cm (*y*-axis) against $\frac{1}{T}\Big/\frac{1}{\text{s}}$ (*x*-axis).

[4]

(f) Determine the gradient *G* of the graph. Show clearly on the graph how you obtained the necessary information.

G =..... [1]

(g) (i) Explain why it is more accurate to measure the time for 5 oscillations rather than for 1 oscillation.

.....

.....

..... [1]

(ii) Describe how the experiment could be improved to make the readings more reliable.

.....

.....

..... [1]

[Total: 11]

2 Students investigate the cooling of hot water in two different cups.

They use the apparatus shown in Fig. 2.1.

Cup A is made from thin plastic. The top of cup A has an inside diameter of 7 cm. Cup B is made from expanded polystyrene. The top of cup B has an inside diameter of 8 cm.

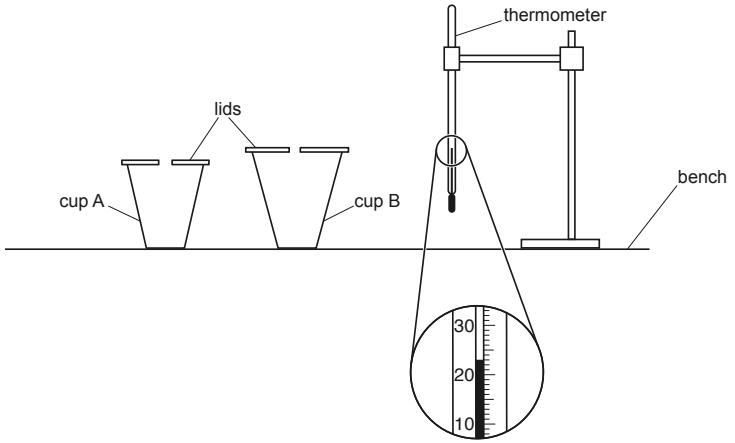


Fig. 2.1

(a) (i) Record the room temperature θ_R shown on the thermometer in Fig. 2.1.

θ_R =..... [1]

(ii) Describe **one** precaution that you would take to ensure that temperature readings in the experiment are as accurate as possible.

.....

..... [1]

(b) A volume of 100 cm^3 of hot water is poured into each cup and the initial temperature θ is recorded in Table 2.1.
The temperature of the water in each cup is recorded every 30 s. The values are shown in Table 2.1.

Table 2.1

	cup A	cup B
t/	θ/	θ/
0	87.5	88.0
30	84.5	86.0
60	82.0	84.5
90	80.5	83.0
120	79.0	82.0
150	78.0	81.0
180	77.0	80.5

Complete the headings in Table 2.1. [1]

(c) Write a conclusion stating which cup, A or B, is the more effective in reducing the cooling rate of the hot water in this experiment.

Justify your answer by reference to the results.

.....

.....

.....

..... [2]

(d) **(i)** Calculate x_A, the average cooling rate for cup A over the whole experiment. Use the readings for cup A from Table 2.1 and the equation

$$x_A = \frac{\theta_0 - \theta_{180}}{T}$$

where T = 180 s and θ_0 and θ_{180} are the temperatures at time t = 0 and at time t = 180 s.
Include the unit for the cooling rate.

x_A =..... [2]

(ii) Suggest an additional experiment to show how the lid affects the cooling rate of cup A.

Explain how to use the additional results to show the effect.

additional experiment .....

.....

explanation .....

.....

.....
[2]

(e) A student wishes to compare the effect of the materials of the cups on cooling rates. Suggest **two** variables that she should control to make this test fair.

1. .....

.....

2. .....

.....
[2]

[Total: 11]

3 A student investigates a resistor and a lamp connected in series.
She uses the circuit shown in Fig. 3.1.

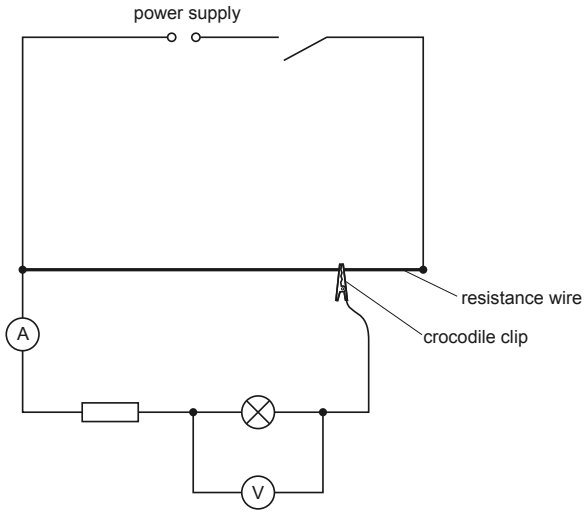


Fig. 3.1

(a) The student moves the crocodile clip on the resistance wire so that the value of the potential difference V_L across the lamp is 2.0 V.

She measures the current I for the lamp and resistor in series.

She then connects the voltmeter to measure the potential difference V_R across the resistor.

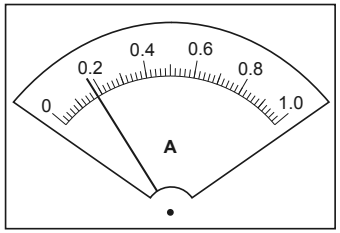


Fig. 3.2

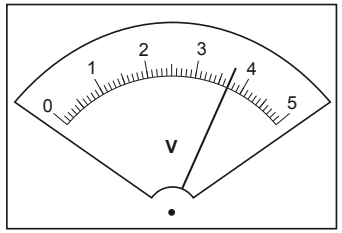


Fig. 3.3

Read, and record in Table 3.1, the values of I and V_R shown on the meters in Fig. 3.2 and Fig. 3.3.

[2]

(b) The student repeats the steps in **(a)** for values of V_L = 1.0 V and V_L = 0.5 V.
Her readings are shown in Table 3.1.

Table 3.1

V_L/V	I/A	V_R/V	R_L/Ω	R_R/Ω
2.0				
1.0	0.15	3.0		
0.5	0.12	2.4		

Calculate, and record in Table 3.1, the resistance of the lamp R_L for each value of V_L.

Use the values of V_L and I from Table 3.1 and the equation $R_L = \frac{V_L}{I}$.

Calculate, and record in Table 3.1, the resistance of the resistor R_R for each value of V_L.

Use the values of V_R and I from Table 3.1 and the equation $R_R = \frac{V_R}{I}$.

[2]

(c) **(i)** Describe the pattern of any change in the value of R_L as V_L decreases.

.....

..... [1]

(ii) A student suggests that R_R should be constant.

State whether your results support this suggestion.
Justify your statement by reference to values from Table 3.1.

statement .....

.....

justification .....

.....

.....

[2]

(d) A student wishes to determine the resistance of the lamp R_L when the potential difference across the lamp $V_L = 0.0\,V$.

Describe how the experiment can be extended to do this with the help of a suitable graph.

.....

.....

.....

..... [2]

(e) It is possible to use a variable resistor instead of a resistance wire to change the potential difference across the lamp.

Complete the circuit in Fig. 3.4 to show:

- a variable resistor used for this purpose
- the voltmeter connected to measure the potential difference across the resistor

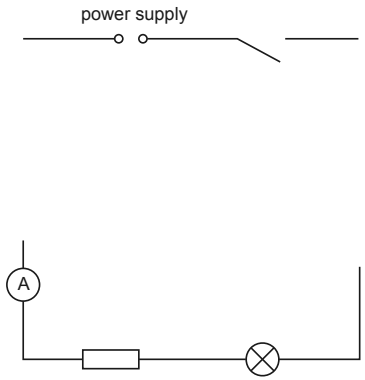


Fig. 3.4 [2]

[Total: 11]

4 A student investigates the motion of a ball rolling down a slope.

Plan an experiment which enables him to investigate how **one** factor affects the average speed of the ball.

Average speed can be calculated using the equation:

$$\text{average speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

The apparatus available includes:

balls of various sizes and materials
a board which can act as a slope
blocks to support one end of the board.

In your plan, you should:

- state a factor which can be measured
- list any additional apparatus needed
- explain briefly how to carry out the experiment including exactly which measurements are to be taken
- state the key variables to be kept constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

You may draw a diagram if it helps to explain your plan.

[7]

[Total: 7]