Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3646122811

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.

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.

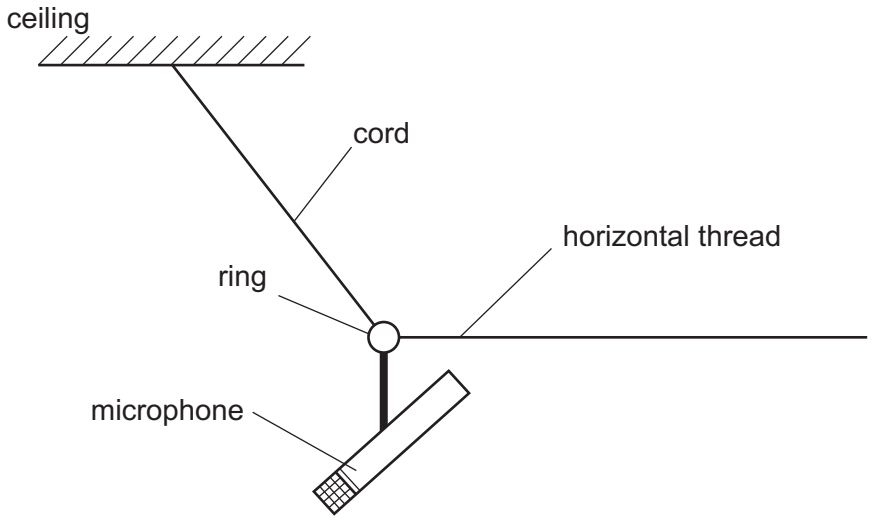

Fig. 1.1 (not to scale)

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.

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..... [3]

[Total: 11]

3 Fig. 3.1 shows a balloon inflated with air.

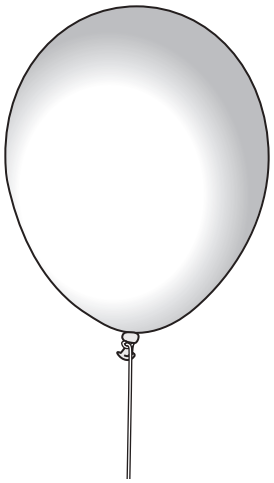

Fig. 3.1

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.

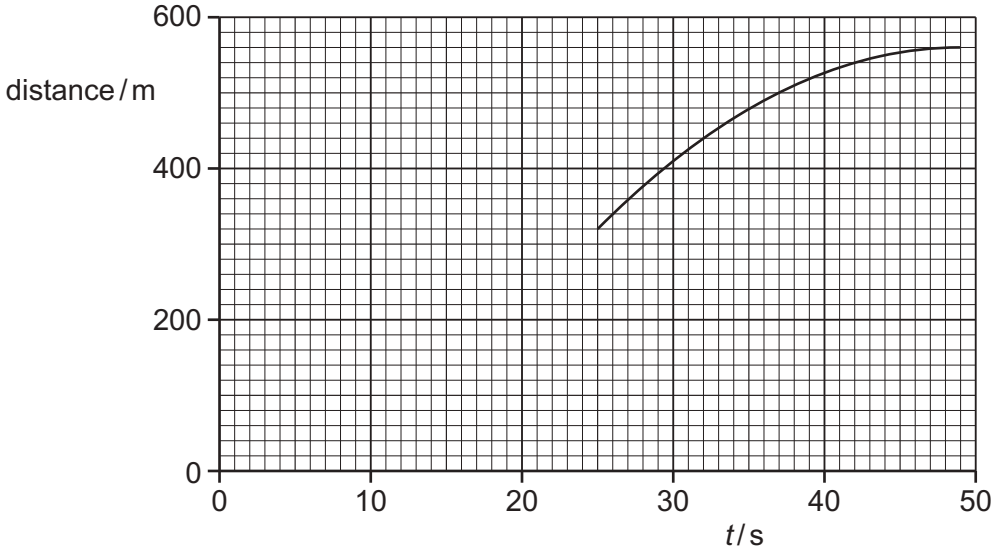

Fig. 4.1

(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.

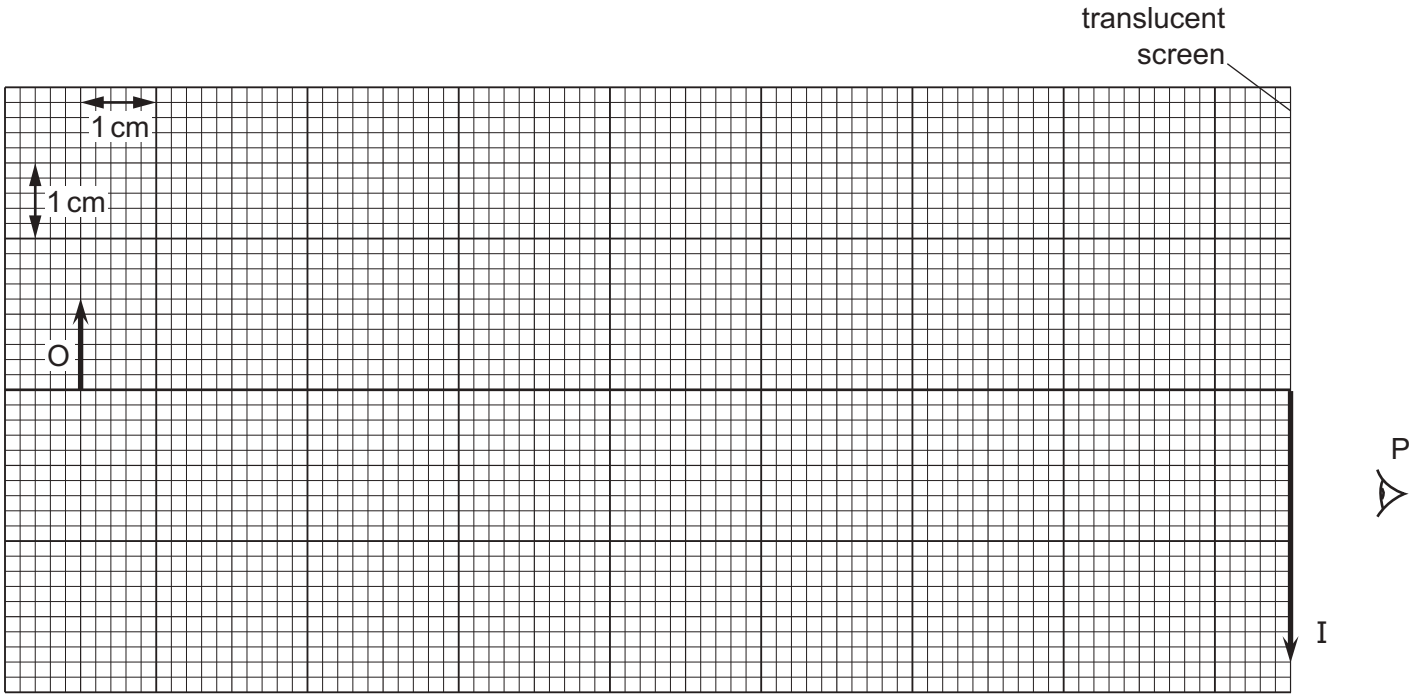

Fig. 5.1

(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.

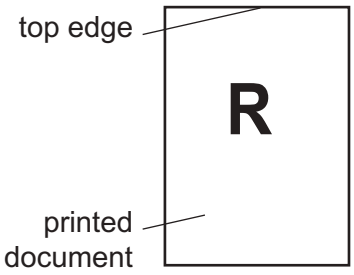

Fig. 5.2

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.

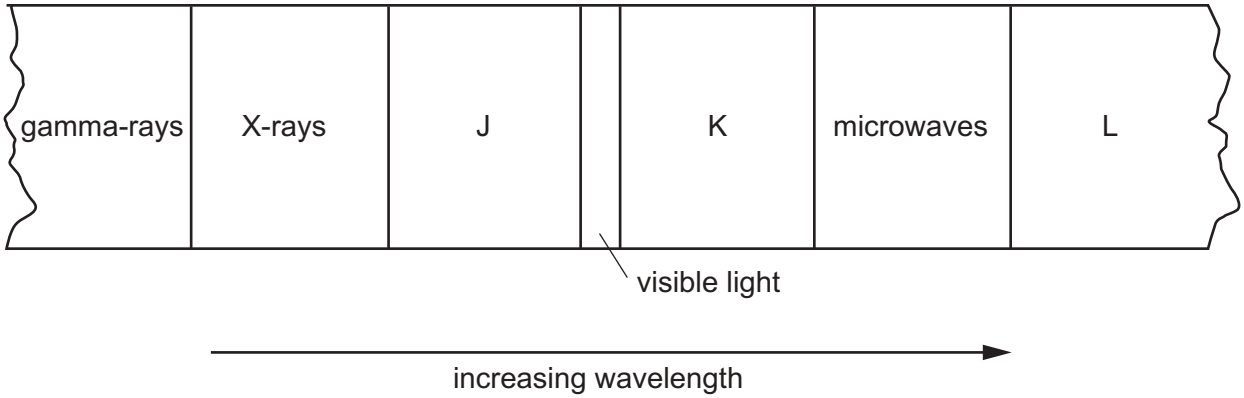

Fig. 6.1

(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]

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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.

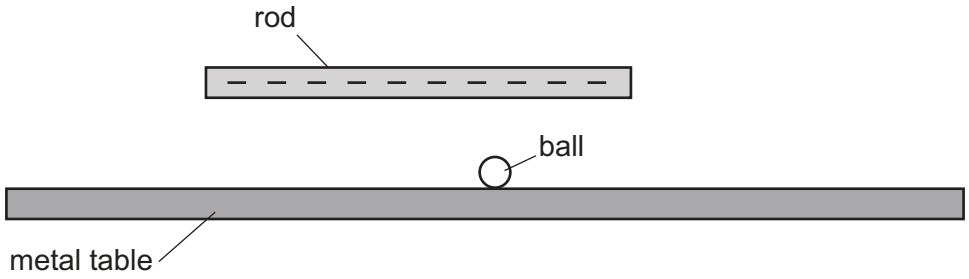

Fig. 7.1

(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.

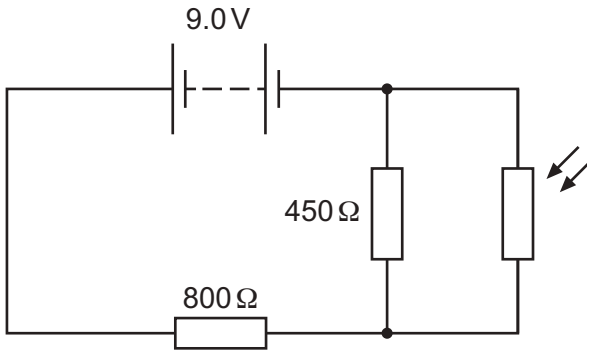

Fig. 8.1

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]

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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.

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

[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]

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