Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2879741868

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.

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[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.

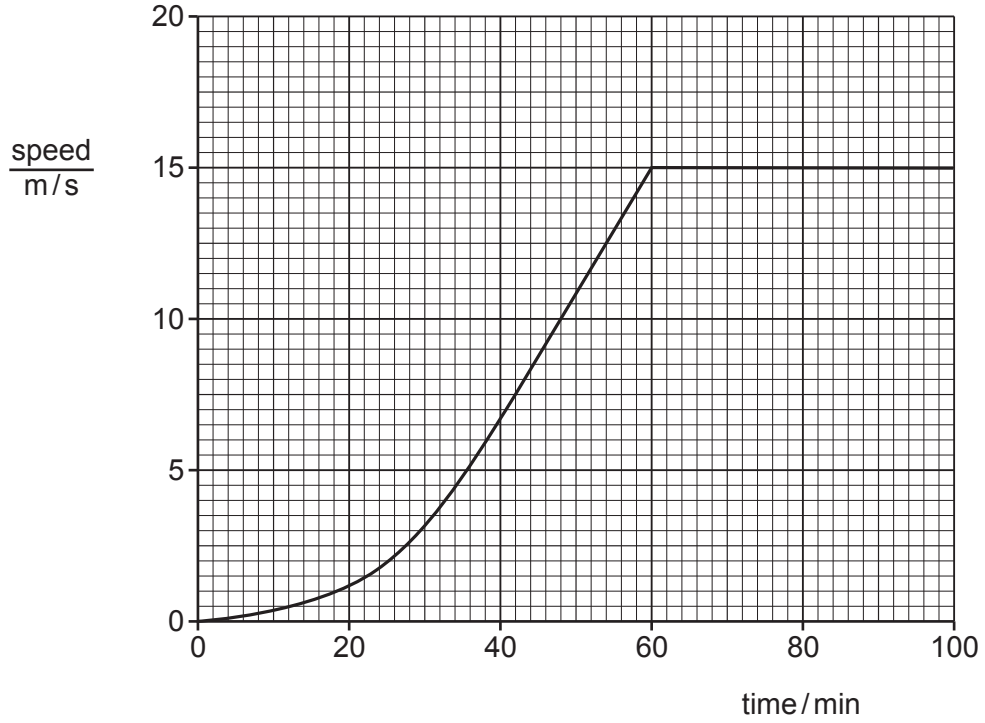


Fig. 1.1

(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]

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(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.

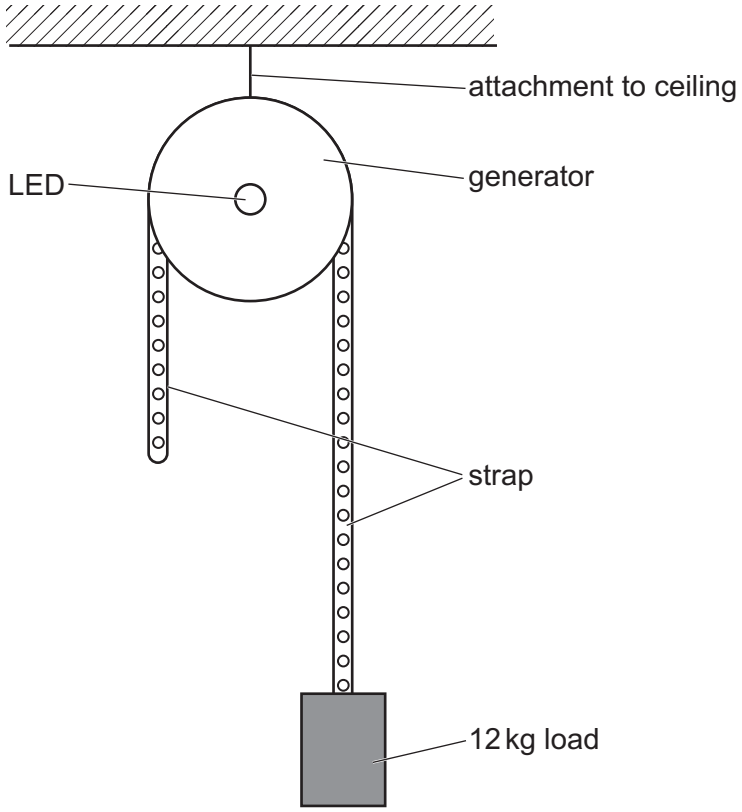


Fig. 2.1

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]

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(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.

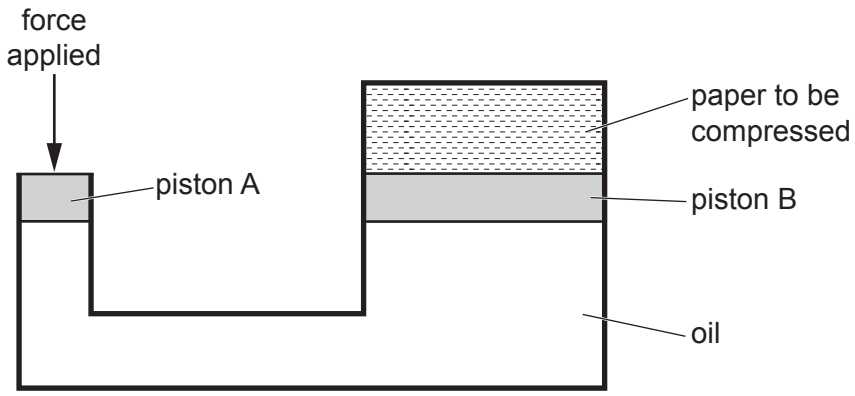


Fig. 3.1

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]

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

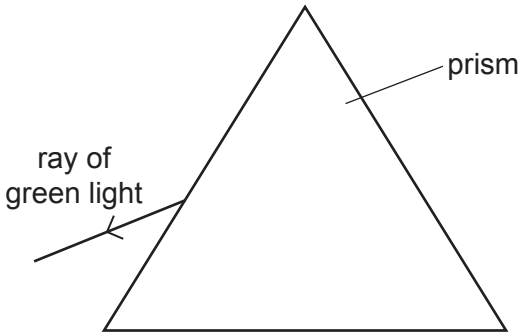


Fig. 7.1

(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.

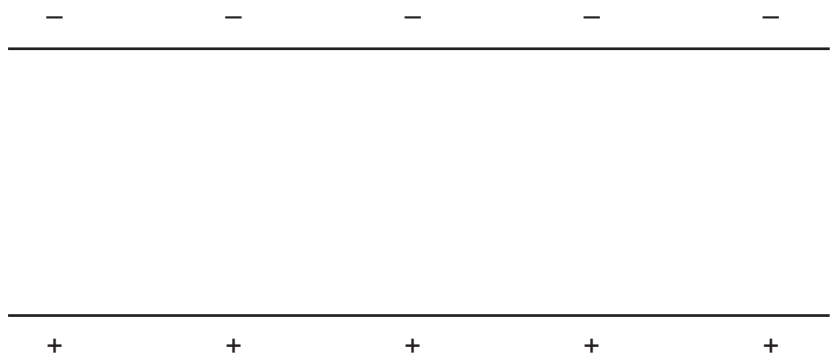


Fig. 8.1

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]

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

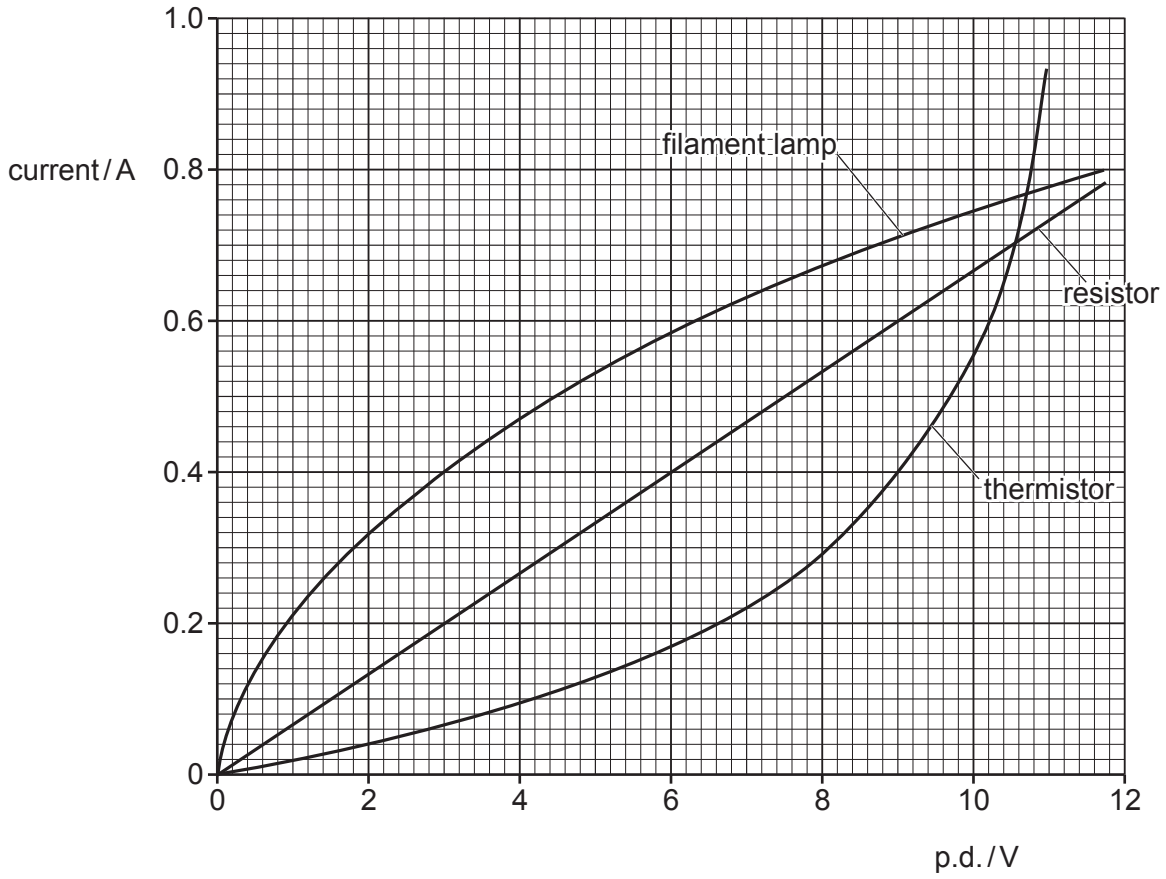


Fig. 9.1

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.

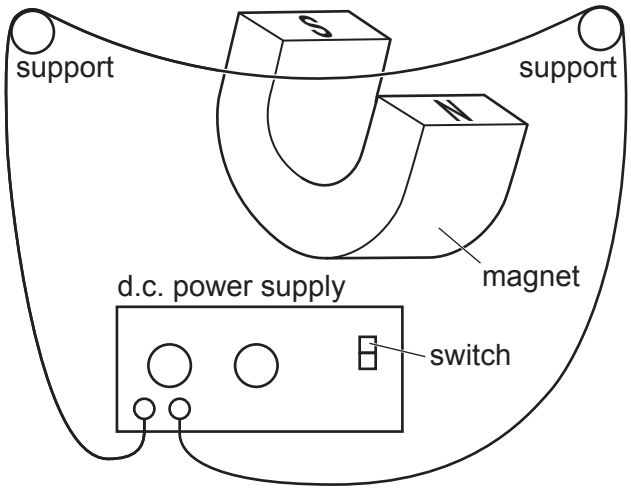


Fig. 10.1

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]

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(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.

$$^{\cdots\cdots}_{\cdots\cdots}\mathrm{U} \longrightarrow {}^{\cdots\cdots}_{\cdots\cdots}\mathrm{Th} + {}^{\cdots\cdots}_{\cdots\cdots}\alpha$$

[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]

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