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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

9575902634

PHYSICS **0625/42**

Paper 4 Theory (Extended) **February/March 2023**

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 9.8 N (acceleration of free fall = 9.8 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.

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1 **(a)** A boat crosses a river. The boat points at right angles to the river bank and it travels at a speed of 3.5 m / s relative to the water.

A river current acts at right angles to the direction the boat points. The river current has a speed of 2.5 m / s.

By drawing a scale diagram or by calculation, determine the speed and direction of the boat relative to the river bank.

speed = ...

direction relative to the river bank = ...
[4]

(b) Speed is a scalar quantity and velocity is a vector quantity.

State the names of **one** other scalar quantity and **one** other vector quantity.

scalar quantity .....

vector quantity .....
[2]

[Total: 6]

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2 Fig. 2.1 shows a ship loaded with containers.

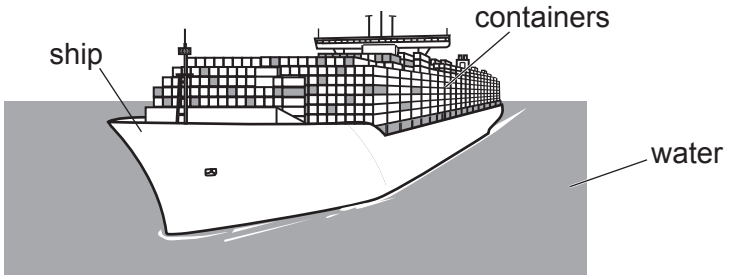

Fig. 2.1

(a) The ship is made of steel.

The density of steel is 7800 kg / m^3 and the density of water is 1000 kg / m^3.

Explain why the ship floats in the water.

.....

.....

..... [2]

(b) The containers with the greatest mass are loaded near the bottom of the ship.

State and explain the effect on the stability of the ship of loading the containers in this way.

.....

.....

..... [2]

(c) A crane lifts a container 48 m vertically upwards. The mass of the container is 30 000 kg.

Calculate the energy transferred to the gravitational potential energy stored in the container.

energy = ... [2]

[Total: 6]

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3 **(a)** State the principle of conservation of energy.

.....

.....

..... [2]

(b) A wind turbine has a maximum output power of 1.8 MW. The turbine operates at maximum power for 4.0 h.

(i) Define the unit kW h.

.....

.....

..... [1]

(ii) Calculate the energy produced by the wind turbine operating at maximum power for 4.0 h. Give your answer in kW h.

energy = ... kW h [2]

(c) Radiation from the Sun is the main source of energy for most of our energy resources.

State **two** energy resources that are **not** due to radiation from the Sun.

.....

..... [2]

[Total: 7]

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4 Fig. 4.1 shows a metal pan on an electric hotplate. The pan contains 200 cm^3 of water.

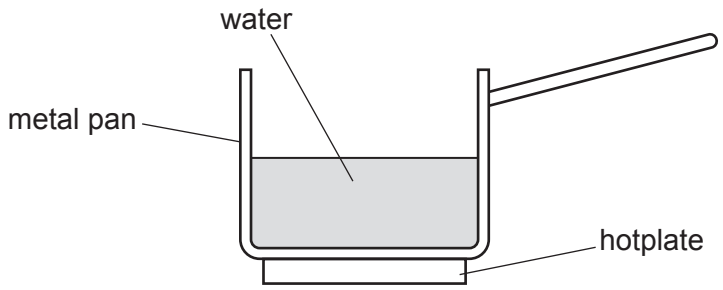

Fig. 4.1

The pan is heated. The temperature of the water in the pan increases.

(a) Thermal energy is transferred through the metal pan by conduction.

State and explain the **two** ways that thermal energy is conducted in a metal.

.....

.....

.....

.....

..... [3]

(b) **(i)** The water boils and leaves the liquid as a gas.

Explain, in terms of forces and distances between particles, why the gas occupies a much greater volume than it does as a liquid.

.....

.....

.....

..... [2]

(ii) State **two** ways in which boiling differs from evaporation.

1 .....

2 .....
[2]

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(c) The water is replaced with 200 cm^3 of milk.

The initial temperature of the milk is 20.0 °C. The boiling point of milk is 95.0 °C.

The milk starts to boil when 60 700 J of thermal energy has been transferred to it. The density of milk is 1.03 g/cm^3.

Calculate the value of the specific heat capacity of milk. Give your answer to 3 significant figures.

specific heat capacity = ... [4]

[Total: 11]

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5 **(a)** Fig. 5.1 shows a semicircular transparent plastic block.

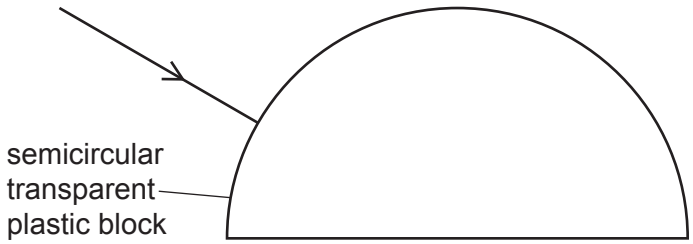

Fig. 5.1

A ray of light is incident normally on the curved surface of the block. The refractive index of the plastic is 1.5.

(i) Calculate the critical angle for the plastic.

critical angle = ... [2]

(ii) On Fig. 5.1, draw the path of the ray in the block and after the ray emerges from the block. [2]

(b) Fig. 5.2 is a full-scale diagram of a lens and an object O.

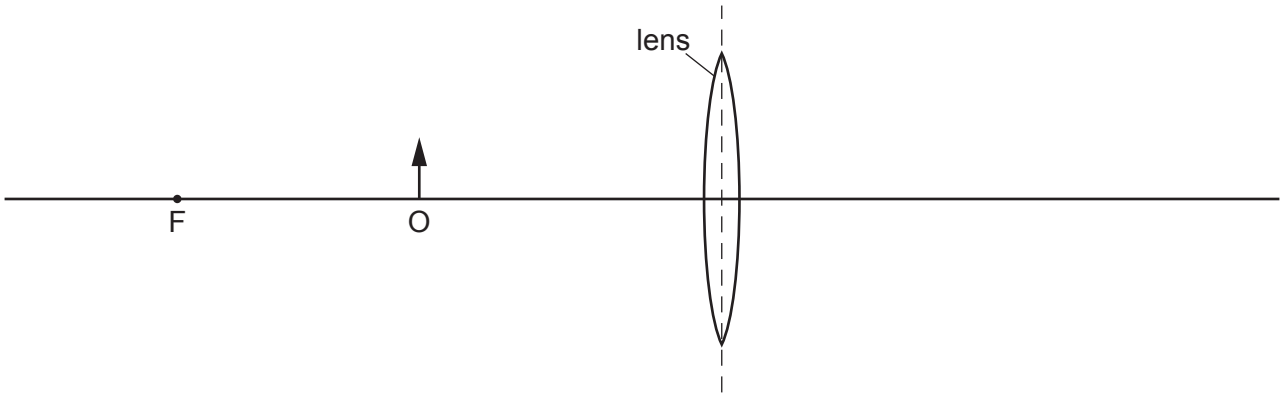

Fig. 5.2

The point marked F shows the position of a principal focus of the lens.

(i) Determine the focal length of the lens.

focal length = ... [1]

(ii) On Fig. 5.2, draw **two** rays from the object to locate the image. Label the image I. [3]

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(c) Fig. 5.3 shows a simplified diagram of an eye with rays from a distant object and the path of the rays inside the eye of a person with short sight.

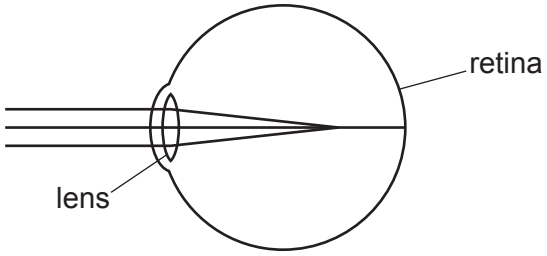

Fig. 5.3

On Fig. 5.4, draw an additional lens outside the eye to correct short-sightedness and show the path of the rays inside the eye.

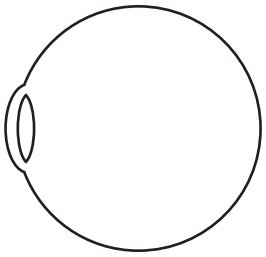

Fig. 5.4

[2]

[Total: 10]

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6 **(a)** Sound waves have compressions and rarefactions.

Explain what is meant by compression and rarefaction.

compression .....

.....

rarefaction .....

.....
[2]

(b) We can see light from the Sun but we cannot hear any sound from it.

State the reason for this.

.....

..... [1]

(c) During a thunderstorm, an observer sees the lightning almost immediately but hears the sound of the thunder several seconds later. The thunder and lightning are produced at the same time.

The sound of the thunder is heard 9.0 s after the lightning is seen. The speed of sound in air is 340 m / s.

Calculate the distance from the thunderstorm to the observer.

distance = ... [2]

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(d) In a lightning strike, there is a current of 3.0×10^4 A for 48 ms.

Calculate the charge that flows.

charge = ... [3]

[Total: 8]

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7 **(a)** Define potential difference (p.d.).

.....

..... [2]

(b) **(i)** State the equation which defines electromotive force (e.m.f.) *E*.

[1]

(ii) The e.m.f. of a battery is 9.0 V. The battery is in a circuit.

Calculate the work done by the battery when it moves a charge of 30 C around a complete circuit.

work done = ... [2]

(c) A circuit consists of a d.c. power supply, a lamp and a thermistor.

(i) Draw a circuit diagram of these components connected in series.

[2]

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(ii) Explain what happens in the circuit you have drawn in **(c)(i)** when the temperature of the thermistor is increased.

.....

.....

..... [2]

[Total: 9]

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8 Fig. 8.1 shows a horizontal, flat coil in a magnetic field

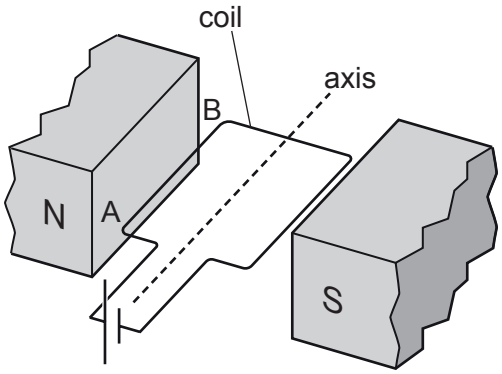

Fig. 8.1

The coil is connected to a cell. The coil rotates.

(a) Determine the direction of movement of the side AB relative to the plane of the coil.

direction of movement = ... [1]

(b) Explain how you determined the direction in **(a)**.

.....

.....

..... [2]

(c) State and explain what happens to the coil as it reaches the vertical position.

.....

.....

.....

..... [2]

(d) To operate as a motor, a split-ring commutator and brushes are added to the parts shown in Fig. 8.1.

Explain the effects of the split-ring commutator and the brushes on the action of the motor.

.....

.....

..... [3]

[Total: 8]

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9 **(a)** A nuclear power station has a reactor where controlled nuclear fission of uranium-235 takes place.

(i) Explain what is meant by nuclear fission.

.....

.....

.....

.....

..... [3]

(ii) State **one** advantage and **one** disadvantage of generating electrical power in nuclear power stations compared with electrical power generated using wind turbines.

advantage .....

disadvantage .....

[2]

(b) Deuterium is an isotope of hydrogen (H) with 1 proton and 1 neutron. Nuclear fusion occurs when two nuclei of deuterium combine. An isotope of helium (He) and a neutron are formed.

Use nuclide notation to write down the nuclide equation for this reaction.

[3]

[Total: 8]

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10 **(a)** The time taken for Mars to orbit the Sun is 690 Earth days. The average orbital radius of Mars is 2.28×10^8 km. An Earth day is 24 h.

Calculate the average orbital speed of Mars in km / s.

average speed = ... [3]

(b) State the shape of the orbits of the planets.

..... [1]

(c) Light from a distant galaxy is redshifted.

(i) Explain what is meant by redshift.

.....

..... [2]

(ii) State the quantity that the redshift of a galaxy is used to calculate.

..... [1]

[Total: 7]

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