Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2164880390

PHYSICS **5054/22**

Paper 2 Theory **October/November 2017**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **19** printed pages and **1** blank page.

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Section A

Answer **all** the questions in this section. Answer in the spaces provided.

1 Two small tugboats are pulling a large ship in a harbour. Fig. 1.1 represents the view from above and shows the directions of the forces on the ship.

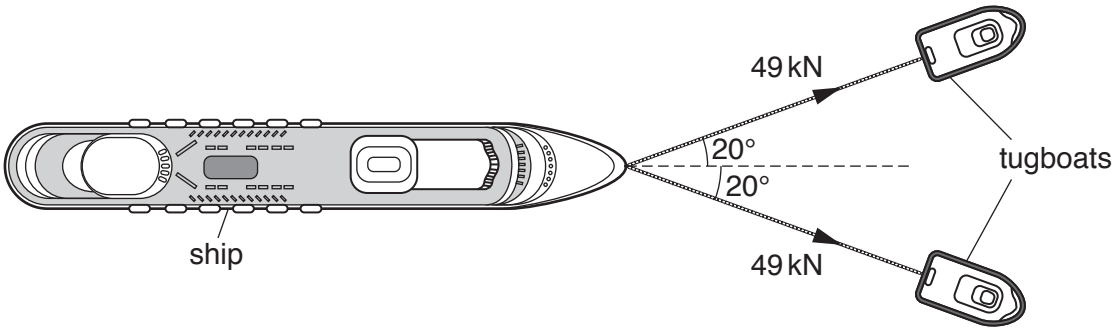


Fig. 1.1 (not to scale)

Each of the tugboats is exerting a force of 49 kN on the ship.

(a) Determine by a graphical method the resultant of these two forces and state the scale used.

scale .....

resultant = ...

[3]

(b) The engines of the ship are not operating and the water in the harbour is stationary. The ship is moving in a straight line in the direction of the total force exerted by the tugboats. It is travelling at a constant speed.

Explain, in terms of the forces acting, why the ship is moving in a straight line at constant speed.

.....

.....

.....

.....[2]

2 A force applied to a solid object may cause it to accelerate so that its velocity changes.

(a) State two other properties of the object which may change when a force is applied.

1. .....

2. .....
[2]

(b) A spring has a mass of 0.012 kg.

(i) The gravitational field strength g is 10 N / kg.

Calculate the weight of the spring.

weight = ...[1]

(ii) The spring is suspended vertically and a load is attached to its lower end. The spring extends by 2.7 cm and does not pass the limit of proportionality.

Fig. 2.1 shows the spring and load attached to the lower end of a second identical spring.

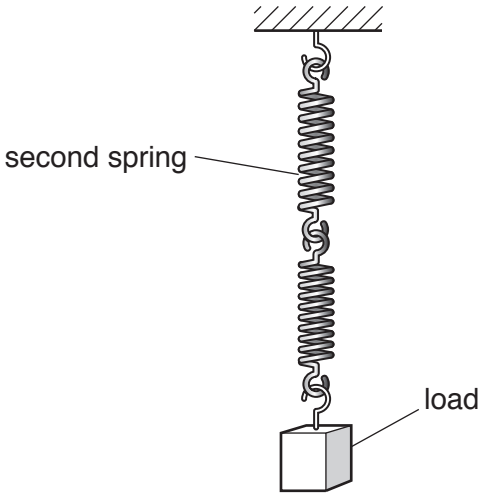


Fig. 2.1

Suggest one reason why the extension of the second spring differs from 2.7 cm.

.....

.....

.....[1]

(iii) Explain what is meant by *limit of proportionality*.

.....

.....

.....[1]

(c) The load in Fig. 2.1 is pulled down below its equilibrium position.

(i) State the form of energy stored in the stretched springs.

.....[1]

(ii) The load is released and it moves upwards and downwards. The distance travelled in each movement decreases until the load stops moving.

Explain why the load stops moving.

.....

.....

.....[1]

3 A solid, rectangular concrete block is lying horizontally on flat ground with one of its largest sides in contact with the ground. Fig. 3.1 shows the dimensions of the block.

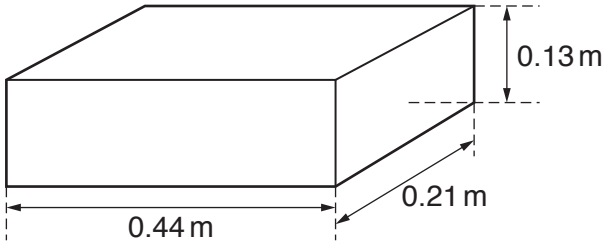


Fig. 3.1

The weight of the block is 240 N.

(a) Calculate the pressure on the ground caused by the block.

pressure = ...[2]

(b) State why the total pressure on the ground underneath the block is larger than the value obtained in **(a)**.

.....

.....[1]

(c) The block is of uniform density.

(i) State the height of the centre of mass of the block above the ground.

height = ...[1]

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(ii) The block is rotated about its lower, left-hand edge so that it comes to rest on one of its smallest sides.

This is shown in Fig. 3.2.

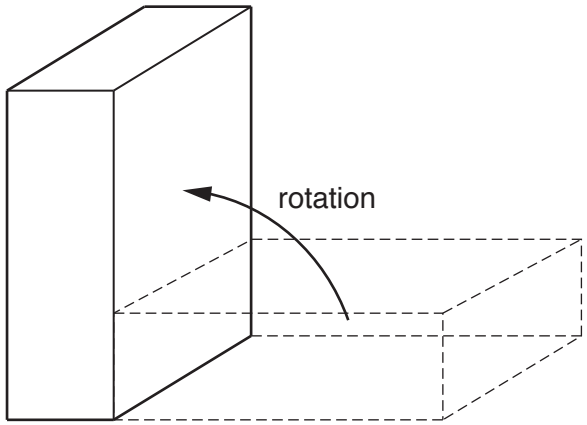


Fig. 3.2

Explain why work is done as the block is rotated.

.....

.....

.....

.....[2]

4 A 75 W filament lamp in an office is accidentally left switched on for 63 hours when the office is closed.

(a) (i) Calculate the electrical energy that is supplied to this lamp in this time.

electrical energy = ...[3]

(ii) The efficiency of the lamp is 0.12 (12%).

Calculate the energy released by the lamp in the form of light.

light energy = ...[1]

(b) The power station that generates the electricity supplied to the office uses oil as its fuel.

(i) State and explain whether oil is a renewable or a non-renewable source of energy.

.....

.....

.....[1]

(ii) Discuss one environmental consequence of using oil as a source of energy.

.....

.....

.....[2]

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5 A process called *nuclear fusion* takes place in the Sun.

(a) Discuss the process of nuclear fusion taking place in the Sun.

.....

.....

.....

.....

.....

.....

.....[3]

(b) On Earth, solar panels and solar cells are powered by energy from the Sun.

Describe how this energy from the Sun travels to Earth.

.....

.....

.....

.....[2]

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[Turn over

6 Fig. 6.1 shows a girl standing a few hundred metres in front of a large building.



Fig. 6.1 (not to scale)

The girl uses a signal generator and a loudspeaker to send a short pulse of sound towards the building. The sound has a frequency of 3700 Hz.

A short time later, the girl hears an echo.

(a) State what is meant by the term *echo*.

.....

.....[1]

(b) The pitch of the echo is the same as that of the original sound but the echo is not as loud.

State what has happened to

(i) the amplitude of the sound wave,

.....[1]

(ii) the frequency of the sound wave.

.....[1]

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

Calculate the wavelength of this sound.

wavelength = ...[2]

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7 A 4.5 V battery is connected in a circuit with an ammeter, a light-dependent resistor (LDR) and a 1800 Ω fixed resistor. Fig. 7.1 is the circuit diagram.

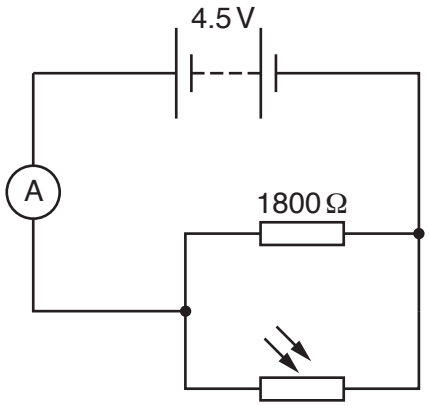


Fig. 7.1

(a) The resistance of the LDR is 9000 Ω.

Calculate

(i) the total resistance of the circuit,

resistance = ...[2]

(ii) the reading on the ammeter.

reading = ...[2]

(b) A very bright lamp is switched on and the light intensity on the LDR increases.

State and explain what happens to

(i) the current in the LDR,

.....

.....[1]

(ii) the current in the 1800 Ω resistor.

.....

.....[1]

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[Turn over

8 In the engine compartment of a car, the battery supplies a current of 120 A to the starter motor.

(a) The starter motor is switched on for 3.5 s.

Calculate the charge that passes through the starter motor in this time.

charge = ...[2]

(b) The starter motor circuit is switched on and off using a relay.

The relay is controlled using a second circuit. A switch in the second circuit is used by the driver to operate the relay and turn the starter motor on and off.

Explain how the current in the second circuit controls the relay.

.....

.....

.....

.....

.....[2]

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Section B

Answer **two** questions from this section. Answer in the spaces provided.

9 Fig. 9.1 shows an astronaut in space near to a space station in orbit above the Earth.

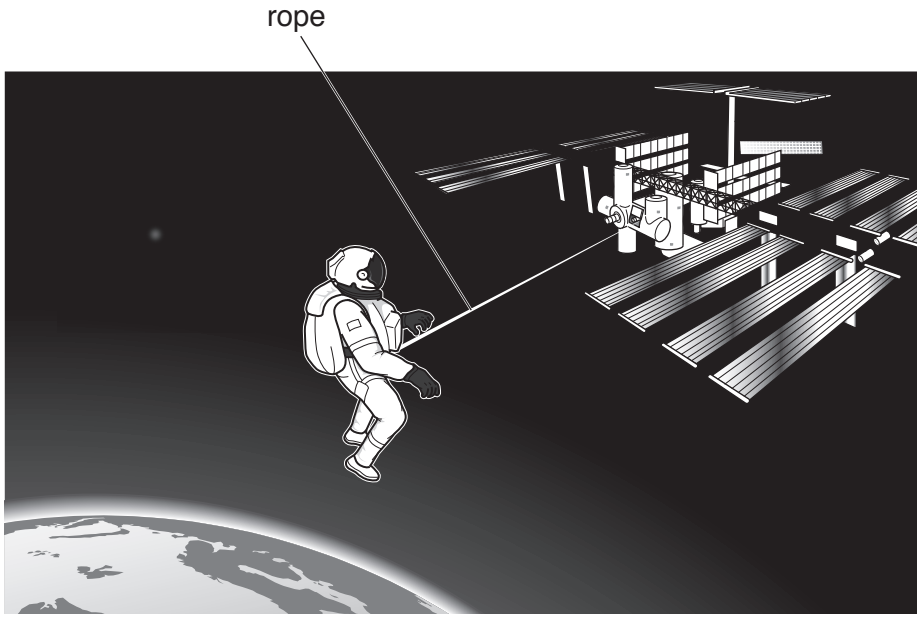


Fig. 9.1

The total mass of the astronaut and all his equipment is 160 kg.

The astronaut is initially at rest relative to the space station but he is then pulled towards the space station by the rope. His acceleration towards the space station is 0.35 m / s^2 for 1.2 s.

(a) Calculate

(i) the resultant force that causes a mass of 160 kg to accelerate at 0.35 m / s^2,

resultant force = ...[2]

(ii) the speed at which the astronaut is travelling after 1.2 s.

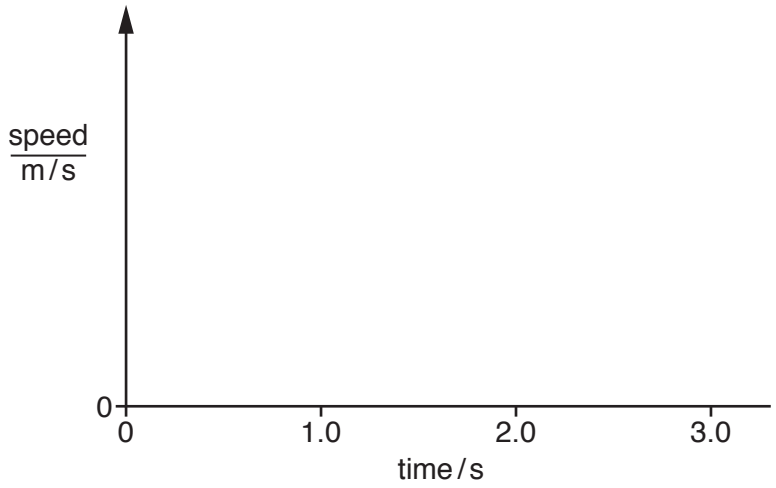
speed = ...[2]

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[Turn over

(b) The resultant force on the astronaut is constant for 1.2 s, but then it decreases to zero instantly as the rope becomes slack.

(i) On Fig. 9.2, sketch the speed-time graph for the astronaut for the first 3.0 s of his motion.



[2]

Fig. 9.2

(ii) Describe how the distance moved by the astronaut during the first 3.0 s may be found using the speed-time graph.

.....

.....

.....[2]

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(c) The space station is travelling at a constant speed in a circular orbit around the Earth as shown in Fig. 9.3.

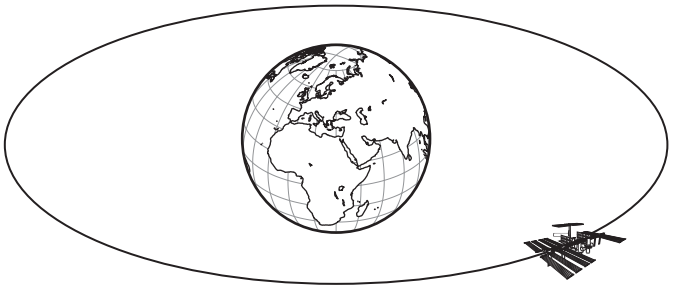


Fig. 9.3

(i) A force acts on the space station to keep it in this orbit.

1. On Fig. 9.3, draw an arrow to show the direction of this force. [1]

2. Explain what causes this force.

.....

.....

.....[2]

(ii) State what is meant by the *velocity* of an object.

.....

.....

.....[2]

(iii) State and explain what happens during the orbit to

1. the velocity of the space station,

.....

.....

.....[1]

2. the kinetic energy of the space station.

.....

.....

.....[1]

10 A boiler containing water is plugged into a 230 V mains supply. The heater in the boiler is operating at full power.

(a) The power used by the heater is 2.8 kW.

(i) Calculate the current in the heater.

current = ...[3]

(ii) The wiring in the cable from the socket and in the boiler remains safe and does not overheat provided that the current is less than 20 A.

Suggest a suitable fuse rating for the circuit.

.....[1]

(b) The specific heat capacity of water is 4200 J/(kg °C). The heater is used to increase the temperature of 6.3 kg of water.

(i) In a certain time, the temperature of the water increases from 23 °C to 49 °C.

Calculate the change in the internal energy of the water.

change in internal energy = ...[2]

(ii) The heater supplies thermal energy to the water at a constant rate. It takes more time for the temperature of the water to increase from 49 °C to 75 °C than from 23 °C to 49 °C. In both cases, the increase in temperature is the same.

Suggest why it takes more time for the temperature to increase from 49 °C to 75 °C.

.....

.....

.....[1]

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(c) Fig. 10.1 shows the heater at the bottom of the water in the boiler.

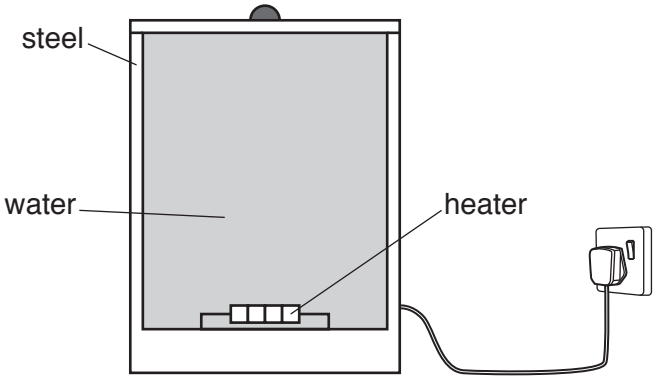


Fig. 10.1

(i) Explain how thermal energy is transferred from the heater throughout the water.

.....

.....

.....

.....

.....[3]

(ii) The part of the boiler that holds the water is made from steel.

Describe, in terms of particles, how thermal energy passes through the steel.

.....

.....

.....

.....

.....[3]

(iii) State and explain, in terms of particles, what happens to the density of the steel as its temperature increases.

.....

.....

.....

.....[2]

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[Turn over

11 The metals in the list below have many different uses.

aluminium **copper** **iron** **silver** **steel**

(a) State which metal from the list is used for

(i) a compass needle,

.....

(ii) magnetic screening,

.....

(iii) the core of a transformer.

.....
[2]

(b) **(i)** Describe one use for a transformer.

.....

.....

.....[2]

(ii) An a.c. generator supplies an input voltage of 220 V to a transformer.

1. In the space below, sketch a graph of the output voltage against time for the a.c. generator. [2]

2. The transformer has 1700 turns on the primary coil and 85 turns on the secondary coil.

Calculate the output voltage of the transformer.

output voltage = ...[2]

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(c) Fig. 11.1 shows a magnet next to one end of a solenoid.

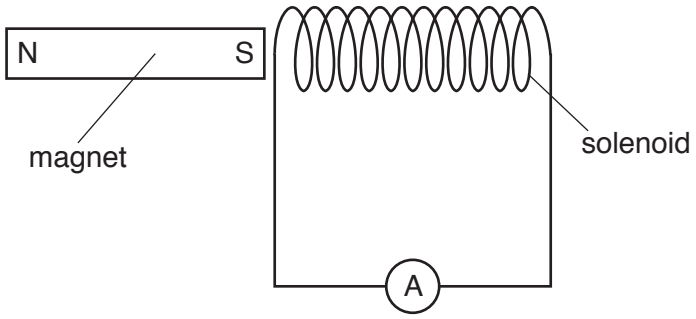


Fig. 11.1

The terminals of the solenoid are connected to a very sensitive ammeter.

(i) The magnet is moved to the right at a constant speed and a reading is observed on the ammeter.

1. Explain why there is a current in the ammeter.

.....

.....

.....

.....

.....[3]

2. Explain how the current in the ammeter opposes the change producing it.

.....

.....

.....

.....[2]

(ii) The magnet stops when the S-pole reaches the middle of the solenoid.

The reading on the ammeter is observed when the magnet is moved to the left at a constant speed that is less than its speed in **(c)(i)**.

State two ways in which the reading on the ammeter differs from the reading observed in **(c)(i)** as the magnet moves to the left.

1. .....

2. .....
[2]

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