Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **5054/21**

Paper 2 Theory **May/June 2018**

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.

DC (NH/SG) 148119/3

CAMBRIDGE International Examinations

Section A

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

1 A cyclist travels along a straight, horizontal road, as shown in Fig. 1.1.

Fig. 1.1

(a) Describe how the average speed of the cyclist can be measured.

In your account, suggest what equipment is used, the measurements that are made and how the average speed is calculated.

.....

.....

.....

.....

.....

.....[3]

(b) For part of the journey, the cyclist has a constant, negative acceleration.

(i) State what is meant by a *negative acceleration*.

.....

.....[1]

(ii) The size of the acceleration is $1.8\,m/s^2$.

Calculate the change in speed of the cyclist in a time of 2.5 s.

change in speed = ...[2]

2 Fig. 2.1 shows a man pushing a heavy box with a force *P*. A frictional force *F* acts in a horizontal direction.

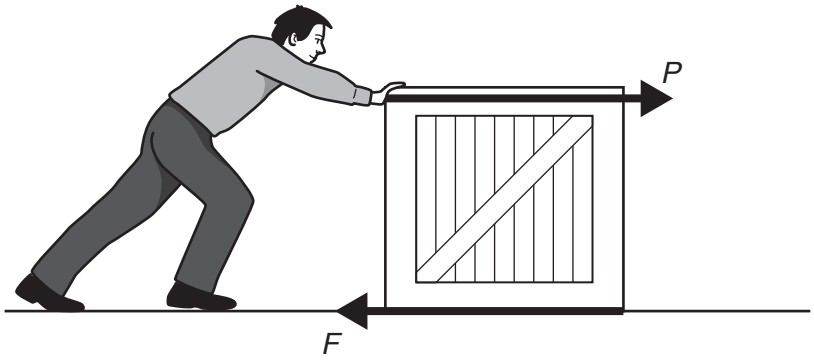

Fig. 2.1

(a) The forces on the box are *balanced* and the box is stationary.

(i) State what is meant by *balanced forces*.

.....

.....[1]

(ii) The frictional force in Fig. 2.1 does not produce any heating effect.

State what must happen for the frictional force to produce heating.

.....

.....[1]

(iii) Apart from being stationary, describe one other possible state of motion of the box when the forces are balanced.

.....

.....[1]

(b) When $P = 100\,\text{N}$ and $F = 85\,\text{N}$, the box accelerates. The mass of the box is 25 kg.

Calculate the acceleration of the box.

acceleration = ...[3]

[Turn over

3 A passenger in an aircraft closes a plastic bag with some air inside, as shown in Fig. 3.1.

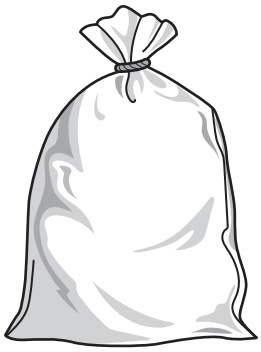

Fig. 3.1

(a) Explain how the molecules of air in the bag exert a pressure on the inside of the bag.

.....

.....

.....

.....

.....[2]

(b) When the bag is closed, the pressure of the air inside the aircraft is 80 kPa and the bag contains 500 cm^3 of air.

(i) When the aircraft is on the ground, the pressure of the air inside the aircraft is 100 kPa.

Calculate the volume of air inside the bag when the aircraft is on the ground.

volume = ...[2]

(ii) State two assumptions that you made in your calculation in **(b)(i)**.

1. .....

.....

2. .....

.....
[2]

4 A woman does work as she raises a flag by pulling downwards on a rope. This is shown in Fig. 4.1.

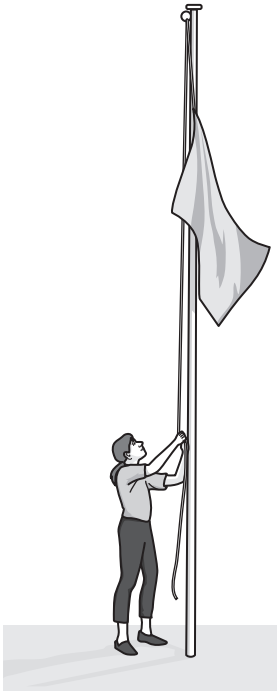

Fig. 4.1

(a) Define what is meant by *work done*.

.....

.....[2]

(b) The mass of the flag is 0.35 kg and the flag is raised through a height of 6.0 m.

The gravitational field strength g is 10 N / kg.

Calculate the increase in gravitational potential energy of the flag.

gravitational potential energy = ...[2]

(c) Suggest and explain a reason why the work done on the rope is larger than the value calculated in **(b)**.

.....

.....

.....

.....[2]

[Turn over

5 A student has three resistors; each resistor is labelled 3.9 Ω, 3 W.

She checks the value of the resistance of **one** of the resistors.

(a) In the space below, draw a circuit diagram of a circuit that she can use to find this resistance. Include a battery, a variable resistor, a voltmeter and an ammeter in the circuit.

[2]

(b) When the circuit is turned on, the potential difference (p.d.) across the resistor is 4.2 V and the current in the resistor is 1.2 A.

(i) Calculate the resistance of the resistor.

resistance = ...[2]

(ii) Shortly after the circuit is turned on, the resistor overheats and gives off smoke.

Explain why it overheats. Include a calculation in your answer.

.....

.....

.....

.....

.....[2]

(iii) The other two resistors are also labelled 3.9 Ω, 3 W. The first resistor is now removed and the student connects these other two resistors in series to the p.d. of 4.2 V.

State and explain whether these resistors overheat.

.....

.....

.....

.....[1]

6 A steel rod is magnetised using an electrical method.

(a) Describe how this is done.

You may draw a diagram if you wish.

.....

.....

.....[2]

(b) Describe how you can check that the steel rod is magnetised.

.....

.....

.....

.....[2]

[Turn over

7 Electrostatics can be a nuisance but is also useful.

(a) A person walks across a carpet. As he touches a door handle he receives an electric shock.

Suggest why this happens.

.....

.....

.....[2]

(b) In spray painting, small drops of paint with a positive charge emerge from a nozzle. The drops are used to paint the leg of a metal chair, which has a negative charge, as shown in Fig. 7. 1.

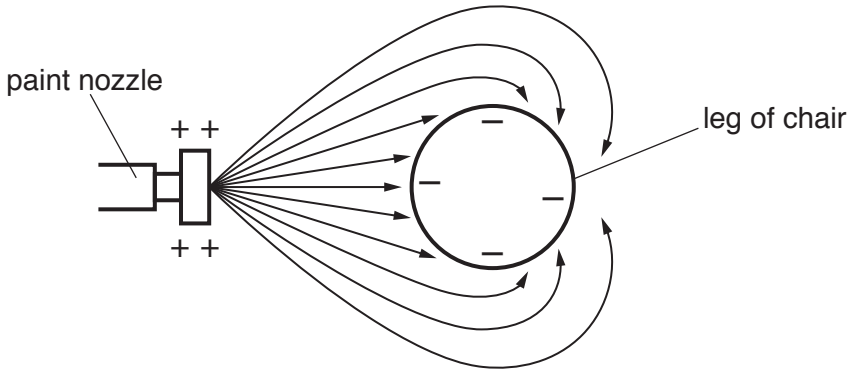

Fig. 7.1 (not to scale)

Fig. 7.2 shows what happens when there is no charge on the nozzle, or on the drops or on the leg of the chair.

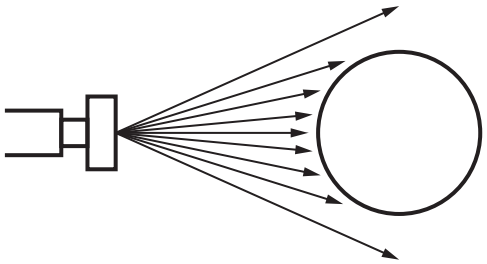

Fig. 7.2 (not to scale)

(i) The drops in Fig. 7.1 spread out more as they leave the nozzle than those in Fig. 7.2.

Explain why.

.....

.....[2]

(ii) Explain why the paint reaches the back of the leg in Fig. 7.1.

.....

.....[1]

8 Fig. 8.1 shows a transformer connecting an overhead 25 000 V electrical power line to a house.

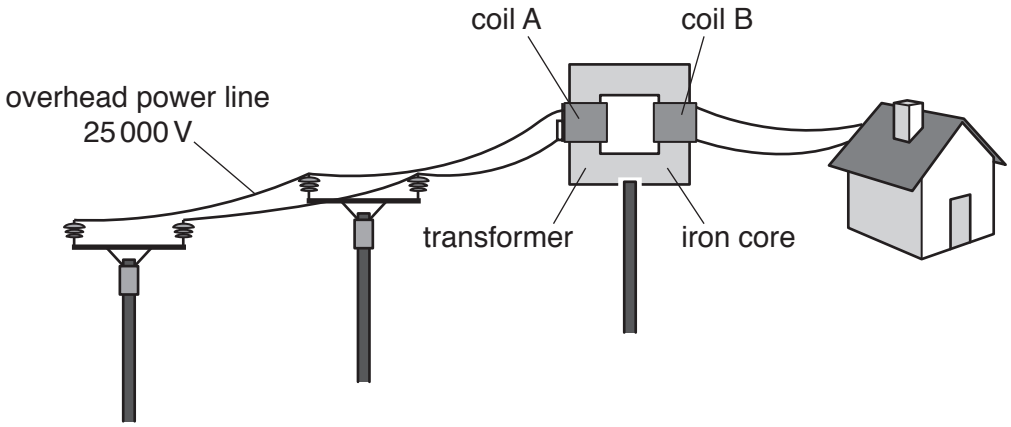

Fig. 8.1 (not to scale)

(a) State whether coil A or coil B in the transformer has the larger number of turns.

Give a reason for your answer.

.....

.....[1]

(b) One purpose of using an iron core in the transformer is to increase the magnetic field inside coil A.

State one other purpose of using the iron core.

.....

.....[1]

(c) Describe briefly how an output voltage is induced in coil B.

.....

.....

.....[1]

(d) Suggest one advantage and one disadvantage of burying a power line underground rather than having an overhead power line.

advantage .....

.....

disadvantage .....

.....

[2]

[Turn over

Section B

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

9 Electromagnetic radiation is produced by the Sun and travels from the Sun to the Earth.

(a) Some of the statements below are true and some of them are false.

Put a tick (✓) in the box after each statement to show whether it is true or false.

	true	false
Gamma rays are used to kill cancerous cells but can also cause cancer.	☐	☐
Infra-red is used in sun-beds.	☐	☐
Radio waves have the highest frequency in the electromagnetic spectrum.	☐	☐
The higher the frequency of the radiation the smaller is the wavelength in air.	☐	☐

[2]

(b) The glass prism in Fig. 9.1 is used to split white light from the Sun into different colours.

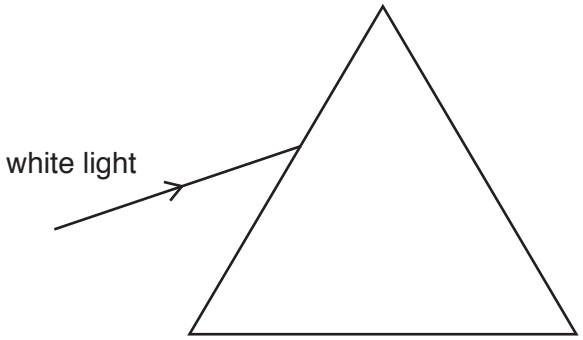

Fig. 9.1

(i) Draw, on Fig. 9.1, to show the action of the prism on the light as it passes through the prism. [3]

(ii) Explain why the prism splits white light into different colours.

.....

.....

.....

.....[2]

(c) The Earth is 1.5×10^8 km from the Sun.

(i) State the speed of light in a vacuum.

.....[1]

(ii) Calculate the time taken for light to travel from the Sun to the Earth.

time = ...[2]

(d) The Sun also produces a solar wind, which is a stream of charged particles.

In one part of space, the solar wind is due to the movement of protons and alpha-particles away from the Sun. A charge of 180 C passes through a small volume of space in 2.0 minutes.

(i) Calculate the electric current in this volume of space.

current = ...[2]

(ii) Complete the table in Fig. 9.2 for an alpha-particle, a proton and a gamma ray.

	nature	charge	stopped by
alpha-particle			
proton	a proton	positive	thin metal
gamma ray	electromagnetic radiation		

Fig. 9.2

[3]

[Turn over

10 (a) (i) Describe two differences between boiling and evaporation.

1. .....

.....

.....

2. .....

.....

.....

[4]

(ii) Explain, using ideas about molecules, why thermal energy is needed to boil a liquid.

.....

.....

.....

.....[2]

(b) In one type of bathroom shower, cold water passes through a metal pipe which contains an electric heater.

The cold water is heated and emerges from the shower head.

The temperature of the cold water before heating is measured and the hot water emerging from the shower in 1.0 minute is collected in a container.

Measurements and other data are:

temperature of water before heating = 16 °C
temperature of water after heating = 37 °C
volume of water collected in 1.0 minute = $4.6 \times 10^{-3}\,m^3$
specific heat capacity of water = 4200 J / (kg °C)
density of water = 1000 kg / m^3

(i) Calculate the mass of water leaving the shower in 1.0 s.

mass = ...[2]

(ii) Calculate the thermal energy (heat) gained by the water in 1.0 s.

energy = ...[3]

(iii) To calculate the efficiency of the shower, the value in **(b)(ii)** and the value of one other quantity are needed.

1. State what other quantity is needed.

.....

.....

2. Describe how these two values are used to calculate the efficiency of the shower.

.....

.....

.....

[2]

(iv) The metal pipe that contains the electric heater is earthed.

Explain why this is necessary.

.....

.....

.....

.....[2]

[Turn over

11 A water wave is produced in a ripple tank.

(a) (i) Draw a diagram of a ripple tank and describe how it is used to produce and observe the wave.

.....

.....

.....

.....

.....

.....

.....[4]

(ii) The water wave in the ripple tank transfers energy.

Describe how to show that there is a transfer of energy.

.....

.....

.....

.....[2]

(iii) State what is meant by a *wavefront*.

.....

.....

.....[2]

(b) Fig. 11.1 shows the variation with time *t* of the height of water at the same place in the tank for two waves P and Q. The height is sometimes above and sometimes below the mean level which is marked as 0.

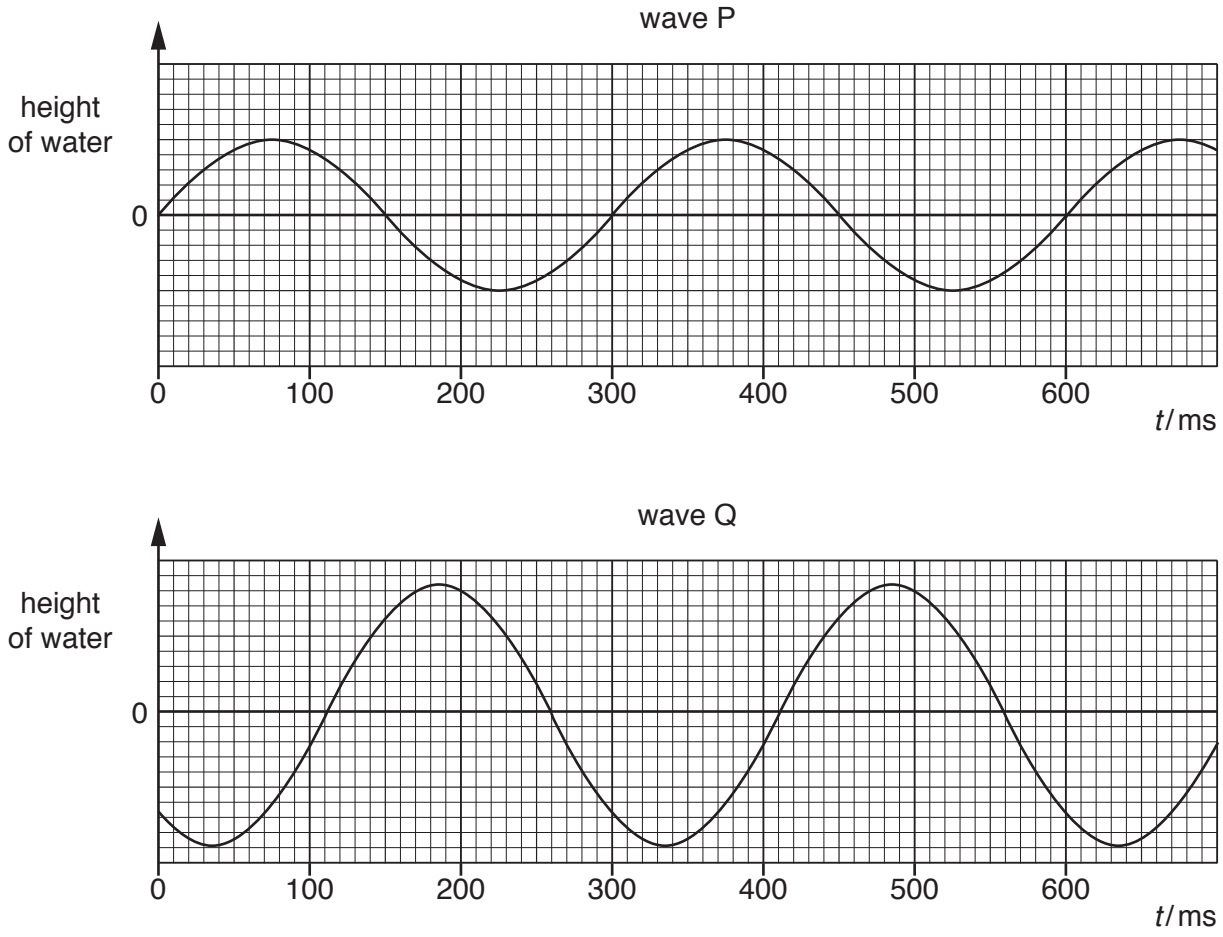

Fig. 11.1

(i) State one difference and one similarity of the two waves.

difference .....

.....

similarity .....

.....

[2]

(ii) The speed of the water wave is 0.20 m / s.

Determine

1. the frequency of wave P,

frequency = ...[3]

2. the wavelength of wave P.

wavelength = ...[2]