Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **5054/22**

Paper 2 Theory **May/June 2016**

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 **15** 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 Fig. 1.1 shows the speed-time graph for a car travelling along a horizontal road.

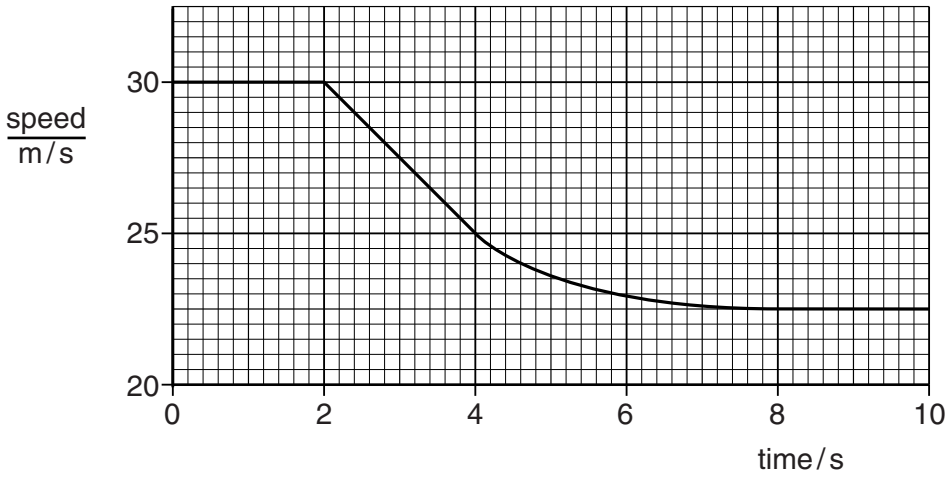

Fig. 1.1

(a) On Fig. 1.1, mark and label a point where the car has a non-uniform deceleration. [1]

(b) Calculate the deceleration of the car at $t = 3.0\,s$.

deceleration = ...[2]

(c) Explain, in terms of the horizontal forces that act on the car, why its speed is constant at $t = 1.0\,s$.

.....

.....

.....

.....[2]

2 Fig. 2.1 shows an electric motor lifting a load.

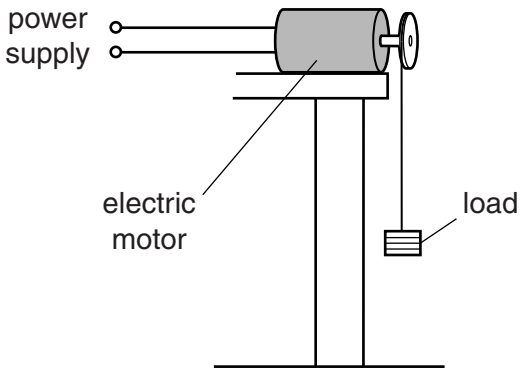

Fig. 2.1

The load, of weight 5.0 N, is raised through a vertical height of 3.5 m at a constant speed. The efficiency of the electric motor is 0.65 (65%).

(a) Calculate the increase in gravitational potential energy of the load.

gravitational potential energy = ...[2]

(b) (i) State the formula that relates efficiency, energy input and useful energy output.

.....

.....[1]

(ii) Calculate the energy input to the motor.

energy input = ...[2]

(c) Suggest one reason why the efficiency of the motor is less than 1.0 (100%).

.....

.....[1]

[Turn over

3 A student has three springs A, B and C. He measures the length of each spring, in turn, when different weights are placed on the end of each spring.

His table of results is shown in Fig. 3.1.

weight/N	length of spring A/cm	length of spring B/cm	length of spring C/cm
1.0	6.1	8.6	9.7
1.5	6.9	9.5	10.5
2.0	7.7	10.4	11.3
2.5	8.5	11.2	13.1
3.0	9.3	12.1	16.9

Fig. 3.1

(a) (i) State which spring has been stretched past the limit of proportionality.

.....

(ii) Using data from Fig. 3.1, explain how you obtained your answer to **(a)(i)**.

.....

.....

.....

.....

[2]

(iii) Calculate the unstretched length of spring A.

unstretched length = ...[1]

(b) Describe how the student can use spring A to determine the mass of a small rock.

.....

.....

.....

.....

.....[2]

4 A beaker is filled with water and placed on a hot-plate to boil, as shown in Fig. 4.1. The hot-plate is on top of a balance, which measures the mass of water in the beaker.

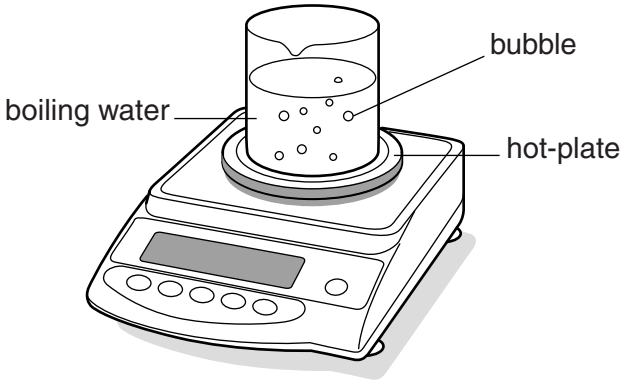

Fig. 4.1

The liquid boils for a long time. There are bubbles within the boiling water.

(a) State what is inside each bubble.

.....[1]

(b) The mass of water is measured at two different times, while the water is boiling steadily.

During this time

- the mass of water in the beaker decreases by 20 g
- the energy supplied to the hot-plate is 52 000 J
- the energy lost from the hot-plate and beaker to the atmosphere is 6000 J

Calculate the specific latent heat of vaporisation of water.

specific latent heat = ...[3]

(c) The beaker of water is taken off the hot-plate. The boiling stops but evaporation still continues and the water cools.

Explain, using ideas about molecules, how evaporation causes cooling.

.....

.....

.....[2]

[Turn over

5 A person can focus clearly on objects that are far away, but near objects appear blurred.

Fig. 5.1 shows three rays from a point on a near object as they pass through the person's eye. The refraction of the light as it enters the eye is ignored.

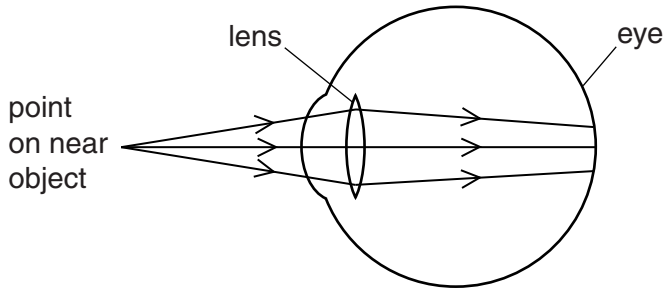

Fig. 5.1

(a) (i) State the name of the eye defect shown in Fig. 5.1.

.....[1]

(ii) Explain what causes the image of the near object to appear blurred.

.....

.....

.....[2]

(b) A lens is used to correct the defect.

(i) On Fig. 5.2, draw a suitable lens placed in front of the eye and continue the path of the three rays to the back of the eye.

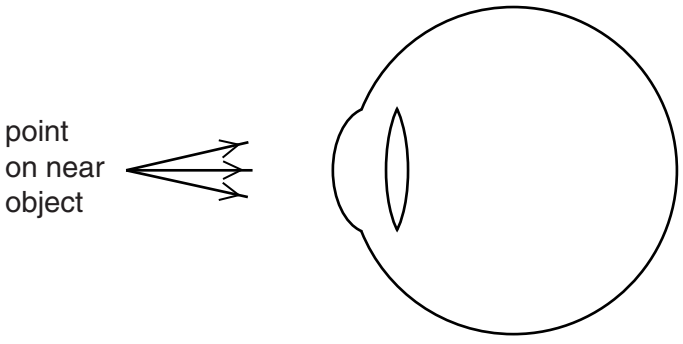

Fig. 5.2 [2]

(ii) State what type of lens is used.

.....[1]

6 Fig. 6.1 shows some of the colours in the visible part of the electromagnetic spectrum.

red	orange	yellow	green	blue

Fig. 6.1

(a) State which colour in Fig. 6.1 has

(i) the largest wavelength, ... [1]

(ii) the highest frequency. ..... [1]

(b) Visible light, infra-red, ultra-violet and radio waves are four components of the electromagnetic spectrum.

State two other components of the electromagnetic spectrum and describe a different use that is made of each component.

1. component .....

description of use .....

.....

.....

2. component .....

description of use .....

.....

.....

[4]

[Turn over

7 An uncharged piece of metal P rests on an insulator. A positively charged rod is placed close to P, as shown in Fig. 7.1.

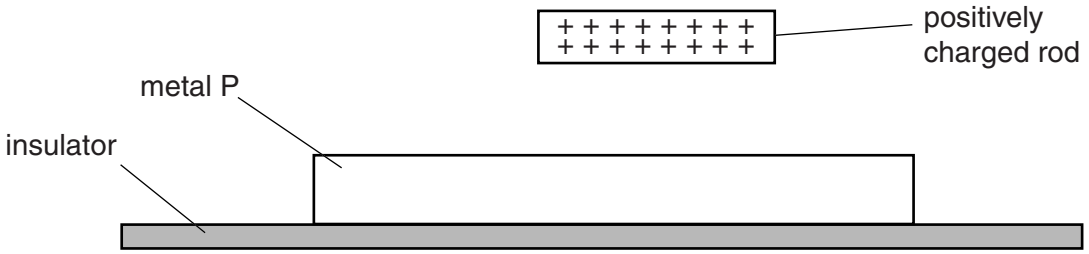

Fig. 7.1

(a) State a material that is an electrical insulator.

.....[1]

(b) On Fig. 7.1, draw the distribution of charges on P. [2]

(c) P is then connected to earth by a wire, as shown in Fig. 7.2.

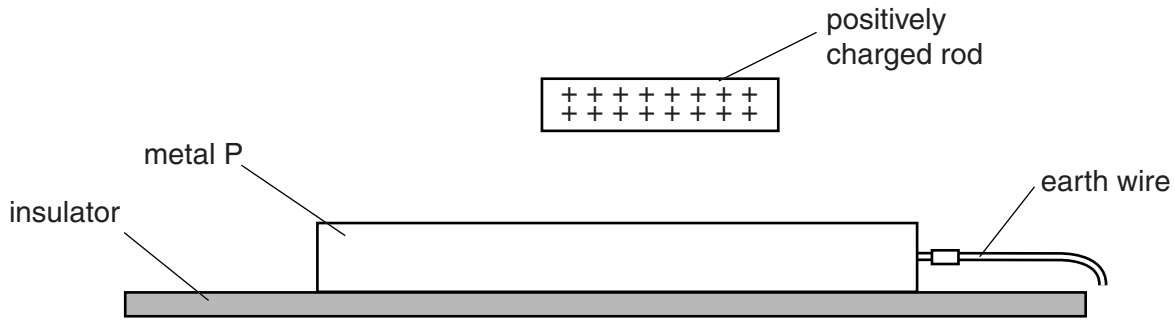

Fig. 7.2

(i) On Fig. 7.2, show the distribution of charges on P with the earth wire connected. [1]

(ii) State what happens to the charges on P if the positively charged rod is removed

1. with the earth wire still connected to P,

.....

.....[1]

2. after the earth wire is disconnected from P.

.....

.....[1]

8 A transformer and a diode are used to charge a battery.

Fig. 8.1 shows the transformer, which contains a soft-iron core and two coils.

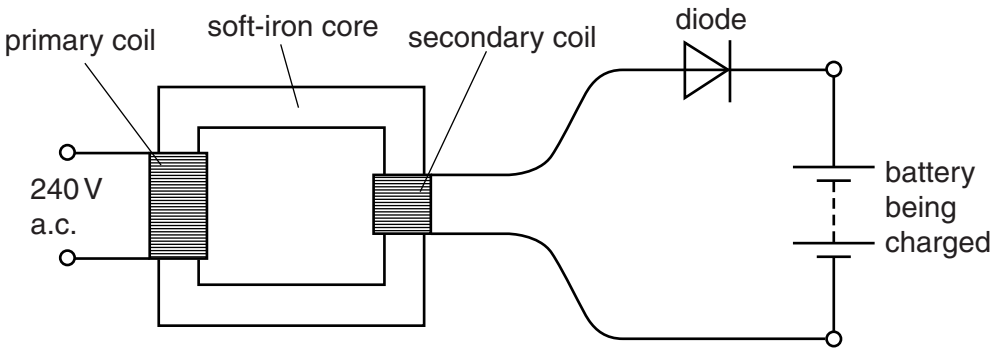

Fig. 8.1

The primary coil is connected to the 240 V a.c. mains supply. The secondary coil is connected in series with the diode and the battery.

(a) Explain why an electromotive force (e.m.f.) is induced in the secondary coil.

.....

.....

.....

.....

.....[2]

(b) The e.m.f. induced in the secondary coil is less than 240 V.

Suggest why.

.....

.....[1]

(c) Suggest why steel is not used as the core of a transformer.

.....

.....[1]

(d) Describe the action of the diode.

.....

.....[1]

[Turn over

Section B

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

9 Fig. 9.1 is a circuit diagram.

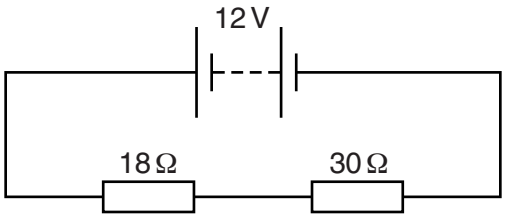

Fig. 9.1

The electromotive force (e.m.f.) of the battery is 12 V.

(a) Explain what is meant by *electromotive force*.

.....

.....[2]

(b) An 18 Ω resistor and a 30 Ω resistor are connected in series with the battery.

(i) **1.** State the relationship between the current I_B in the battery, the current I_1 in the 18 Ω resistor and the current I_2 in the 30 Ω resistor.

.....[1]

2. State an equation that relates the e.m.f. E of the battery, the potential difference V_1 across the 18 Ω resistor and the potential difference V_2 across the 30 Ω resistor.

.....[1]

(ii) Calculate the current in the battery.

current = ...[2]

(iii) Calculate the potential difference (p.d.) across the 18 Ω resistor.

p.d. = ...[1]

(iv) Calculate the power produced in the 18 Ω resistor.

power = ...[2]

(c) The resistors obey Ohm's law.

State Ohm's law and describe one limitation on this law.

.....

.....

.....[2]

(d) The resistors are made from the same material, but have different cross-sectional areas and different lengths.

State the relationship between

(i) the resistance R and the length l of a wire of constant cross-sectional area,

.....

(ii) the resistance R and the cross-sectional area A of a wire of constant length.

.....
[2]

(e) A resistor is shown in Fig. 9.2 and part of the resistor colour code is shown in Fig. 9.3.

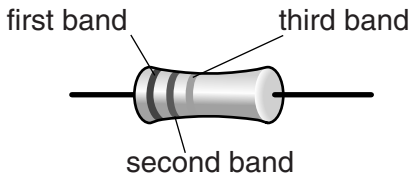

Fig. 9.2

digit or multiplier	colour
0	black
1	brown
2	red
3	orange

Fig. 9.3

State the colour of the bands on the 30 Ω resistor.

first band = ...

second band = ...

third band = ...
[2]

10 (a) Fig. 10.1 shows the basic structure of a cathode-ray oscilloscope (c.r.o.).

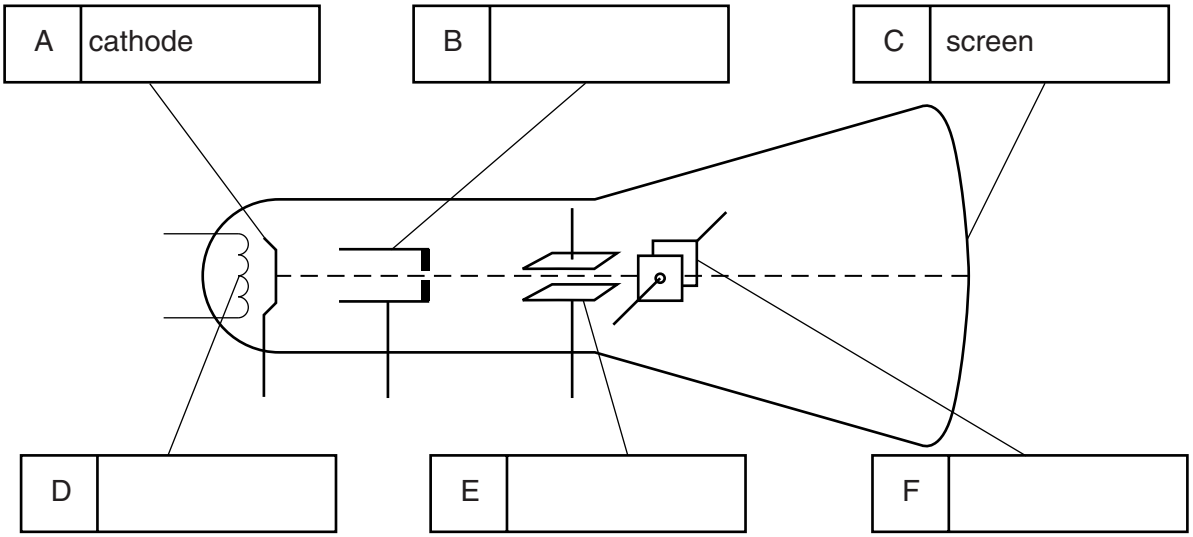

Fig. 10.1

Electrons strike the middle of the screen and a bright spot is produced.

(i) On Fig. 10.1, write the names of parts B, D, E and F in the spaces provided. [3]

(ii) State the purpose of

1. part B,

.....

.....[1]

2. part D.

.....

.....[1]

(iii) State the useful energy change that occurs as electrons hit the screen of the c.r.o.

.....

.....[1]

(iv) Describe what happens inside the c.r.o. to turn the spot into a horizontal line.

.....

.....

.....

.....[2]

(b) A microphone is connected to a c.r.o. to display a sound wave.

Fig. 10.2 shows the trace on the c.r.o.

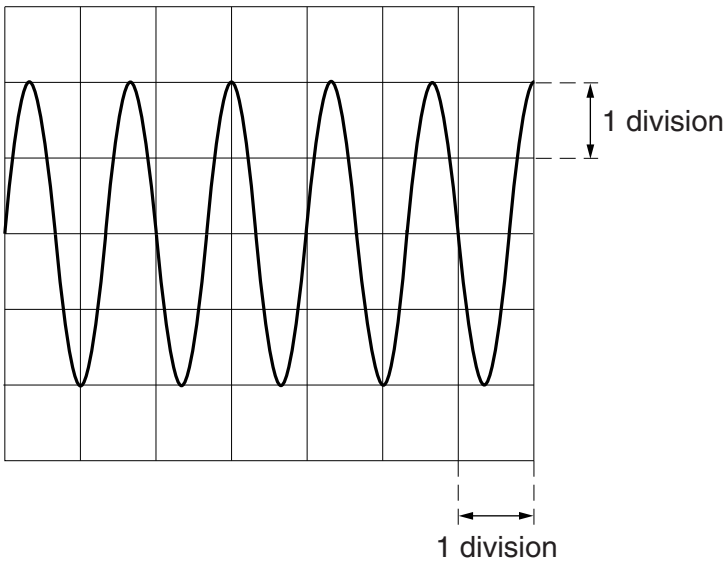

Fig. 10.2

The settings on the c.r.o. are: Y-gain 0.5 V / division; time base 2.0 ms / division.

(i) Determine

1. the maximum voltage,

voltage = ...[1]

2. the time for one oscillation,

time = ...[2]

3. the frequency of the sound wave.

frequency = ...[2]

(ii) The settings of the c.r.o. remain the same. On Fig. 10.2, sketch the trace of a sound wave with a smaller amplitude and a lower frequency. [2]

[Turn over

11 Fig. 11.1 represents a nuclear fusion reaction.

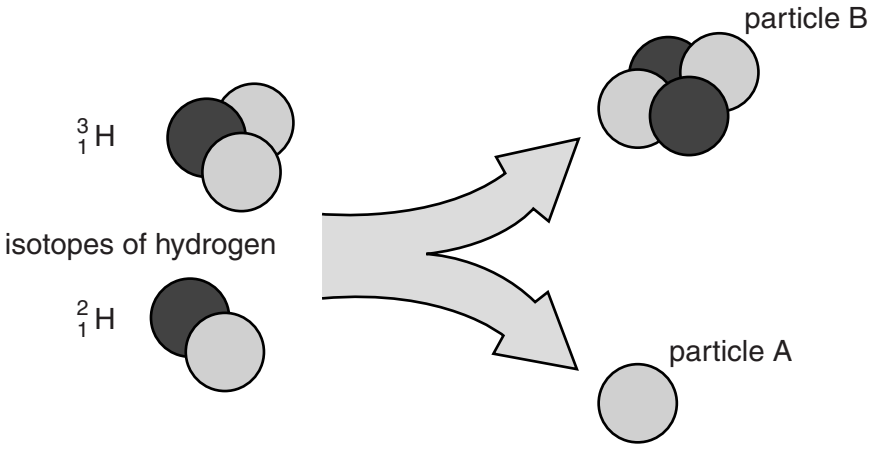

Fig. 11.1

At very high temperatures, nuclei of the two isotopes $^{2}_{1}H$ and $^{3}_{1}H$ fuse together. Energy is produced and two new particles are formed, particle A and particle B.

(a) Explain what is meant by *isotopes* of hydrogen.

.....

.....

.....[2]

(b) Using Fig. 11.1, state

(i) the number of neutrons in a nucleus of the isotope $^{3}_{1}H$, ...

(ii) the name of particle A, ...

(iii) the proton number of particle B, ...

(iv) the nucleon number (mass number) of particle B. .....

[4]

(c) A very high temperature is needed to force nuclei together.

Explain why.

.....

.....

.....[2]

(d) A star forms from a large cloud of gas and dust in space.

Describe what happens as the star forms.

.....

.....

.....

.....

.....[3]

(e) The isotope of hydrogen $^{3}_{1}H$ has a half-life of 12 years.

(i) State what is meant by *half-life*.

.....

.....[2]

(ii) A sample contains 16 000 atoms of $^{3}_{1}H$.

Calculate the number of atoms of $^{3}_{1}H$ present in the sample after 48 years.

number = ...[2]

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