Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

1651937739

PHYSICS **5054/31**

Paper 3 Practical Test **October/November 2015**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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.

Answer **all** questions.
For each of the questions in Section A, you will be allowed to work with the apparatus for a maximum of 20 minutes. For the question in Section B, you will be allowed to work with the apparatus for a maximum of 1 hour.

You are expected to record all your observations as soon as these observations are made.
An account of the method of carrying out the experiments is **not** required.

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.

For Examiner's Use	
1	
2	
3	
4	
Total	

This document consists of **11** printed pages and **1** blank page.

CAMBRIDGE International Examinations

Section A

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

1 *In this experiment, you will investigate the equilibrium of a mass.*

You have been provided with

- two springs that are attached to each other,
- Blu-Tack,
- two stands, bosses and clamps,
- a 100 g mass hanger,
- a 30 cm ruler,
- a protractor.

(a) The two springs are identical. Measure the unstretched length l of the coil of each spring as shown in Fig. 1.1.

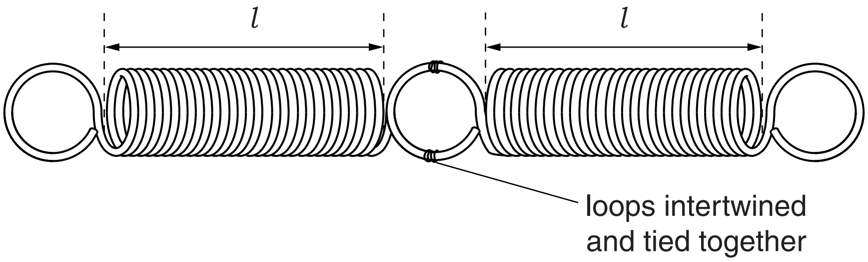

Fig. 1.1

Determine an average value for the unstretched length of the coil.

l = ... [1]

(b) Set up the apparatus as shown in Fig. 1.2. The ends of the clamps are to be used as the rods A and B.

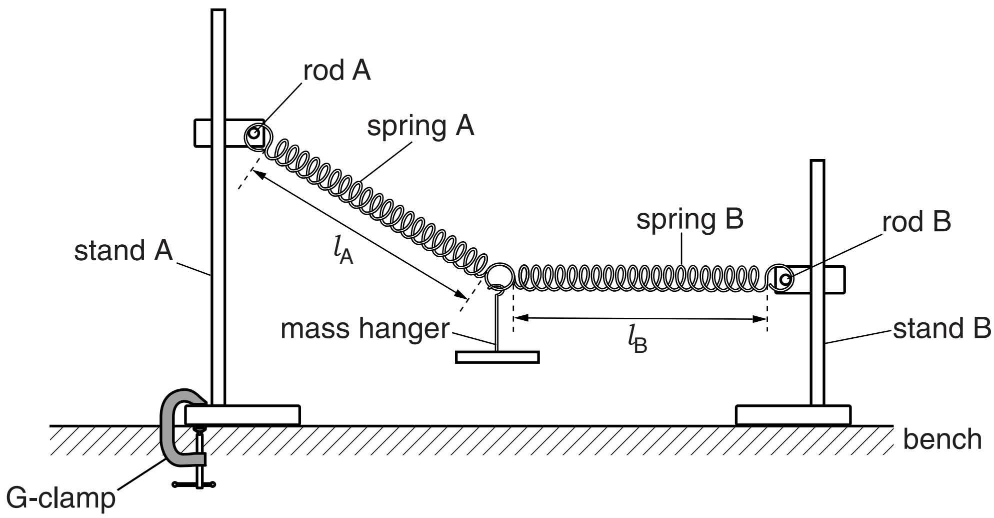

Fig. 1.2

Place the loop of spring B around rod B. **Do not adjust the height of rod B.** Place the loop of spring A around rod A. Using two pieces of Blu-Tack, secure the loops of the springs in position on the rods so that they do not slide off.

Suspend the mass hanger from the loop where the two springs are joined together so that the mass hanger goes through the loops of both springs. Adjust the height of rod A until the apparatus is set up as shown in Fig. 1.2 with spring B horizontal and the angle between spring A and the horizontal approximately 30°. You may need to adjust the separation of the stands by moving stand B along the bench.

Measure the stretched length l_A of the coiled part of spring A and the stretched length l_B of the coiled part of spring B.

l_A = ...

l_B = ...
[2]

(c) Determine

(i) the extensions x_A and x_B of the springs A and B, using the relationship

extension = stretched length – original length

x_A = ...

x_B = ...

(ii) the forces F_A and F_B that are exerted on the mass hanger by the springs, using the relationship

force = $k \times$ extension

where $k = 0.25\,N/cm$, and the extensions are measured in cm.

F_A = ...

F_B = ...
[2]

[Total: 5]

2 *In this experiment, you will investigate the mixing of water at room temperature with very cold water.*

You have been provided with

- a 250 cm^3 beaker labelled I containing an ice / water mixture,
- a 250 cm^3 beaker labelled R containing water at room temperature,
- a filter funnel with glass wool inside,
- a 100 cm^3 measuring cylinder,
- a thermometer,
- a stirrer.

(a) **(i)** Measure the temperature θ_R of the water in beaker R.

θ_R = ...

(ii) Place the filter funnel in the measuring cylinder. Pour the ice / water mixture from beaker I into the funnel until there is 50 cm^3 of cold water in the measuring cylinder. Quickly remove the funnel and place the thermometer and the stirrer into the measuring cylinder. Stir the water and record the lowest temperature θ_I of the water.

θ_I = ...

(iii) Remove the thermometer and stirrer from the measuring cylinder. Take care not to remove any water. Add water from beaker R to the measuring cylinder until the water reaches the 100 cm^3 mark. Place the thermometer and stirrer back into the measuring cylinder and stir the water. The temperature will rise quite quickly at first and then continue to rise very slowly. Record the highest temperature θ_H reached by the water before the slow rise begins.

θ_H = ...
[2]

(b) In **(a)(iii)**, warmer water is poured on top of cooler water. Explain why, to obtain a uniform temperature, it is particularly important to stir the water.

....

....

....[1]

(c) (i) Calculate the average temperature θ_{av} of the two temperatures θ_I and θ_R.

θ_{av} = ...

(ii) If the thermal energy gained by the cold water is exactly equal to the thermal energy lost by the warmer water, then θ_H equals θ_{av}.

1. Comment on whether your values of θ_H and θ_{av} are equal.

....

....

2. Explain your answer using ideas about thermal energy.

....

....

....
[2]

[Total: 5]

3 *In this experiment, you will investigate the oscillations of a metre rule.*

You have been provided with

- a metre rule with holes at the 5.0 cm mark and the 27.5 cm mark,
- a rod,
- a stand, boss and clamp to hold the rod,
- a pin in a cork,
- a stopwatch.

(a) Set up the apparatus as shown in Fig. 3.1.

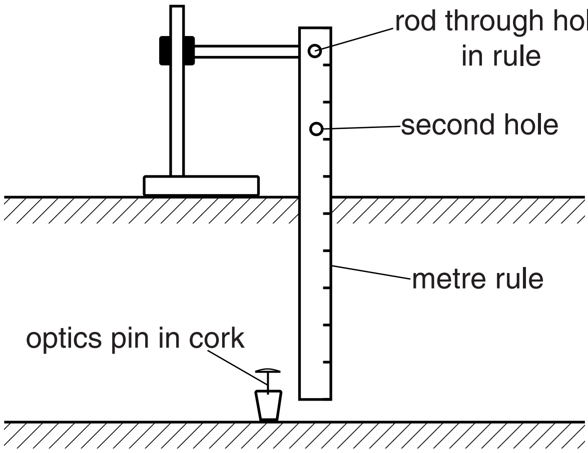

Fig. 3.1

The rod is held by the clamp. The metre rule is suspended from the rod using the hole at the 5.0 cm mark. The metre rule hangs vertically over the edge of the bench. The pin in the cork is placed on the floor close to the rest position of the metre rule. When the rule is displaced a small distance to the left and released, it moves to the right and then back to the left. One complete oscillation is shown in Fig. 3.2. You may use the pin to help you when you are counting oscillations.

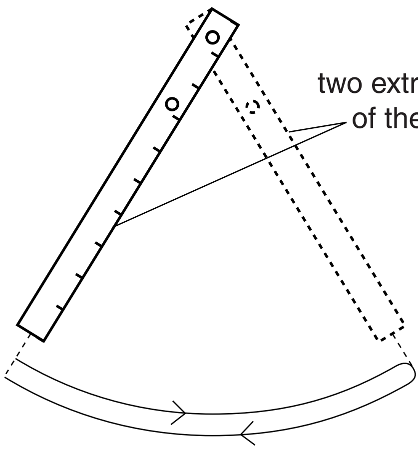

Fig. 3.2

(i) Assuming that the centre of mass of the rule is at the 50.0 cm mark, state the distance l_1 from the rod to the centre of mass of the rule.

l_1 = ...

(ii) The time for 20 complete oscillations is t_1. Take measurements to determine an accurate value of t_1.

t_1 = ...

(iii) Calculate the time T_1 for one complete oscillation.

T_1 = ...
[2]

(b) Remove the metre rule from the rod. Pass the rod through the hole at the 27.5 cm mark.

(i) State the new distance l_2 from the rod to the centre of mass of the rule.

l_2 = ...

(ii) Determine an accurate value for the time t_2 for 20 complete oscillations with the rule in its new position.

t_2 = ...

(iii) Calculate the time T_2 for one complete oscillation.

T_2 = ...
[1]

(c) The value of l_2 is half the value of l_1.

(i) Comment on your values of T_2 and T_1.

....

....

(ii) A student suggests that the time T for one complete oscillation is directly proportional to the distance l from the rod to the centre of mass of the rule. Explain whether your results support this suggestion.

....

....

....
[2]

[Total: 5]

Section B

4 *In this experiment, you will investigate the current-voltage characteristic of a filament lamp.*

You have been provided with an incomplete circuit consisting of

- a power supply,
- a switch,
- a filament lamp,
- connecting leads.

Three points in the circuit have been labelled A, B and C. Fig. 4.1 shows the arrangement of the components in the incomplete circuit.

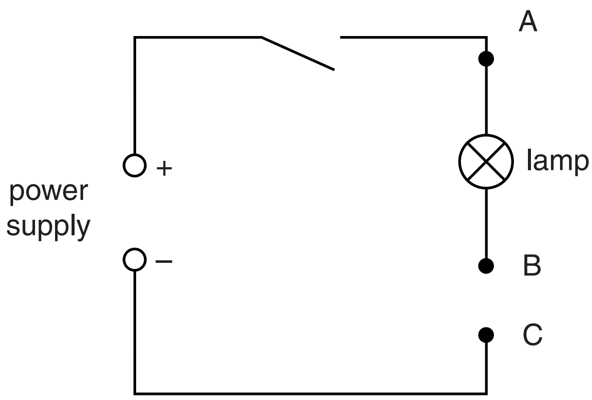

Fig. 4.1

You have also been provided with

- a voltmeter,
- additional connecting leads,
- three resistors labelled with the values of their resistance.

(a) Connect the 4.7 Ω resistor between points B and C.

(i) Connect the voltmeter between points A and B. Close the switch and record the reading V_{AB} on the voltmeter. If you are unable to connect the voltmeter into the circuit, ask the Supervisor for help.

V_{AB} = ...[1]

(ii) Open the switch. Disconnect the voltmeter from between points A and B and reconnect it between points B and C. Close the switch and record the reading V_{BC} on the voltmeter. Open the switch.

V_{BC} = ...[1]

(iii) Calculate the current I in the circuit using $I = \frac{V_{BC}}{R}$,

where R is the resistance of the resistor between B and C, which is 4.7 Ω in this case.

I = ...[1]

(b) Repeat **(a)** for the following resistors and resistor combinations between B and C:

- 10 Ω resistor alone,
- 22 Ω resistor alone,
- 4.7 Ω, 10 Ω and 22 Ω resistors in series,
- 4.7 Ω and 10 Ω resistors in parallel,
- one other series resistor combination of your choice.

In each case, always open the switch when you are changing resistors or moving the voltmeter.

Fig. 4.2 is on page 10 of this question paper. Put all your results, including those from **(a)**, in Fig. 4.2. Include columns for R, V_{AB}, V_{BC} and I.

The formulae for resistor combinations are given below.

For two resistors in series $R_{total} = R_1 + R_2$.

For two resistors in parallel $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$.

Fig. 4.2

[5]

(c) The best-fit line through the points of the graph of I against V_{AB} is either a straight line or a curved line.

Using the grid opposite,

(i) plot the points on a graph of I on the *y*-axis against V_{AB} on the *x*-axis,

[3]

(ii) tick one of the boxes below to indicate whether the best-fit line through your points will be straight or curved,

straight line ☐

curved line ☐

(iii) draw the best-fit line through your points.

[2]

(d) Using your graph, determine the resistance of the filament lamp for a value of V_{AB} of 1.5V.

....

....

....[2]

[Total: 15]

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