OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

PHYSICS A 2826/03/TEST

Practical Examination 2 (Part B – Practical Test)

Wednesday **1 FEBRUARY 2006** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Candidate's Plan (Part A of the Practical Examination)
Electronic Calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read the instructions and questions carefully.

INFORMATION FOR CANDIDATES

- In this Practical Test, you will be assessed on the Experimental and Investigative Skills:
  Skill I Implementing
  Skill A Analysing evidence and drawing conclusions
  Skill E Evaluating evidence and procedures.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- You will be awarded marks for the quality of written communication where this is indicated in the question.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
Planning	**16**	
1	**28**	
2	**16**	
TOTAL	**60**	

This insert consists of 12 printed pages.

Answer **all** the questions.

It is recommended that you spend about one hour on question 1.

1 In this experiment, you will investigate how $t_{1/2}$, the time taken for a capacitor to discharge to half its initial charge, varies with the capacitance C of the capacitor. You will use the results of your experiment to determine the resistance of a voltmeter. You may wish to make use of the following formulae:

for capacitors in parallel: $C_{total} = C_1 + C_2 + C_3$

for capacitors in series: $\dfrac{1}{C_{total}} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}$

(a) **(i)** Set up the circuit shown in Fig. 1.1. The capacitor C can be made using any series or parallel combination of the capacitors provided. Each of the capacitors has a capacitance of 1000 μF. Initially C should be a single capacitor. You must ensure that the terminal marked + on the capacitor is connected to the positive terminal on the power supply unit. Your Supervisor **must** check the circuit before you continue. [2]

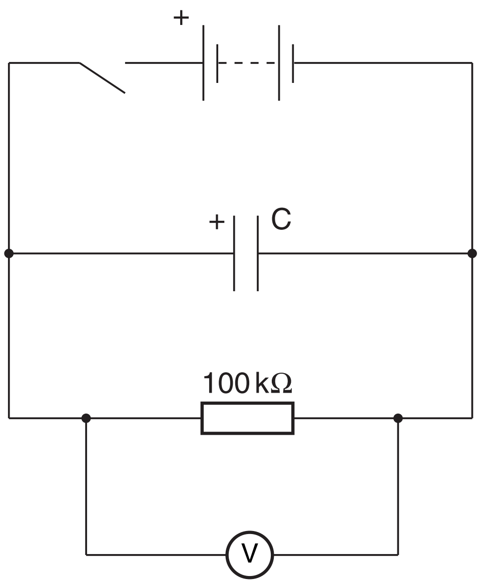

Fig. 1.1

For Examiner's Use

(ii) Close the switch and wait until the reading on the voltmeter is steady.

(iii) Open the switch. Make and record measurements to determine the time $t_{1/2}$ for the potential difference across the capacitor to halve.

$t_{1/2}$ = ... s [1]

(b) **(i)** Estimate the percentage uncertainty in $t_{1/2}$.

percentage uncertainty in $t_{1/2}$ = ... [2]

(ii) The reading from the voltmeter may be incorrectly taken if the needle of the meter is viewed from different angles. What is the name given to this effect?

.... [1]

(c) Change the capacitance C of the capacitor by adding or removing capacitors to give different series and parallel arrangements. For each arrangement, you **must** ensure that the + terminal of each capacitor is towards the + terminal of the power supply unit. Repeat **(a)(ii)** and **(a)(iii)** until you have six sets of readings for $t_{1/2}$ and C.

[8]

(d) **(i)** Plot a graph of $t_{1/2}$/ s (y-axis) against C/ μF (x-axis).

(ii) Draw the best straight line through the points.

(iii) Determine the gradient of the line.

gradient = ... [6]

For Examiner's Use

[Turn over

For Examiner's Use

(e) The variation of potential difference V across a capacitor with time t as the capacitor discharges through a resistor is given by the expression

$$V = V_0 e^{-t/CR}$$

where V_0 is the initial potential difference across the capacitor and R is the combined resistance of the 100 kø resistor and the voltmeter.

(i) Show that the time $t_{1/2}$ for the potential difference across the capacitor to fall to half of its initial value is given by

$$t_{1/2} = CR \ln 2.$$

[2]

(ii) Use your answer from **(d)(iii)** to find a value for R.

[2]

(iii) Hence determine a value for the resistance of the voltmeter.

[3]

(f) State one way in which the accuracy of your results in this experiment could be improved.

....

.... [1]

[Total: 28]

It is recommended that you spend about 30 minutes on question 2.

Approximately half of this time should be spent on the evaluation exercise in part (f).

2 In this question, you will determine the density of water by partially immersing a mass, suspended by a spring, into a beaker of water.

(a) **(i)** The apparatus has been set up as shown in Fig. 2.1.

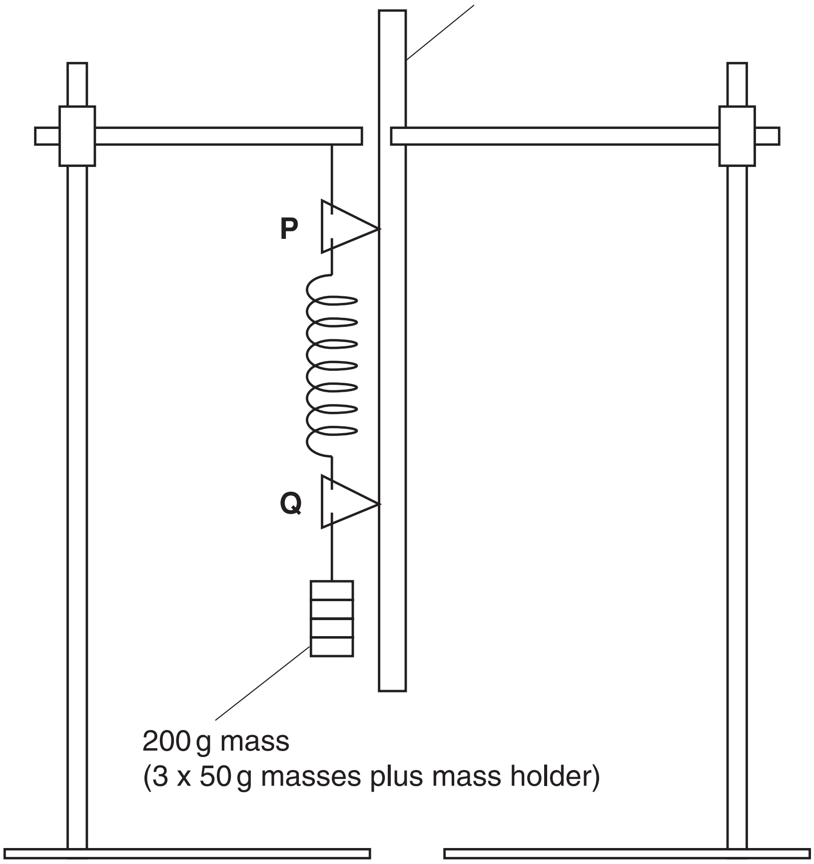

Fig. 2.1

(ii) Record the reading from pointer **Q**.

reading from pointer **Q** = ... m

(iii) Add a further mass of 100 g (0.98 N weight) to the mass holder and record the new reading from pointer **Q**.

new reading from pointer **Q** = ... m

(iv) Hence determine the extension of the spring when an additional force of 0.98 N is applied to the spring.

extension = ... m [1]

For Examiner's Use

(b) Hooke's law can be expressed in the form

$$F = kx$$

where F is the force required to produce an extension x, and k is the spring constant.

Use your answer from **(a)(iv)** to determine a value for k. You may assume that the spring obeys Hooke's law.

k = ... $N\,m^{-1}$ [1]

(c) **(i)** Remove one of the masses and measure its diameter.

diameter = ... m [1]

(ii) Calculate the cross-sectional area A, in m^2, of the mass.

A = ... m^2 [1]

(d) **(i)** Replace the mass onto the mass holder so that the spring supports a total mass of 300 g. Place a beaker of water under the mass and adjust the position of the boss so that part of the mass is immersed in the water as shown in Fig. 2.2.

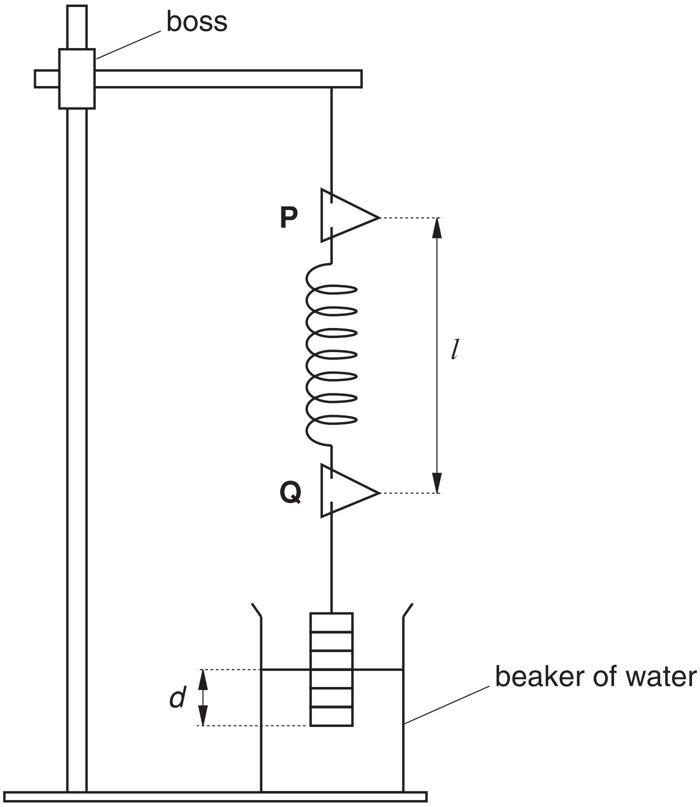

Fig. 2.2

(ii) Make and record measurements to determine the depth *d* of the submerged part of the mass and the length *l* between the pointers.

d = ... m

l = ... m

(e) Theory suggests that l and d are related by the equation

$$kl - kl_0 = mg - \rho_w dAg$$

where ρ_w is the density of water, $g = 9.81\,\text{N kg}^{-1}$, $m = 0.300\,\text{kg}$ and l_0 is the distance between the pointers when the spring is not supporting a load.

(i) Remove the mass holder and the masses. Measure and record the distance l_0.

l_0 = ... m

(ii) Use your values of k, A, l and l_0 to determine a value for the density of water ρ_w.

ρ_w = ... [2]

For Examiner's Use

(f) In this section, two marks are available for the quality of written communication.

Write an evaluation of the procedure which you have followed to measure the density of water by this method. You should include some of the limitations of this procedure and suggest ways in which this experiment may be improved, giving reasons for your suggestions.

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Quality of Written Communication [2]

[Total: 16]

END OF QUESTION PAPER