New Specification

Rewarding Learning

Centre Number

71

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010

Physics

Assessment Unit AS 3

assessing

Practical Techniques (Internal Assessment)
Session 1

[AY131]

AY131

MONDAY 10 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Turn to page 2 for further Instructions and Information.

For Teacher's use only

Question 5(a)

	YES	NO
Was the candidate told the equation for *P*?	☐	☐
Was the candidate told the equation for *R*?	☐	☐

Question Number	Marks	
	Teacher Mark	Examiner Check
1		
2		
3		
4		
5		
Total Marks		

INSTRUCTIONS TO CANDIDATES

Answer **all** the questions in this booklet. Rough work and calculations must also be done in this booklet. Except where instructed, do **not** describe the apparatus or experimental procedures.
The Teacher/Supervisor will tell you the order in which you are to answer the questions.
One hour is to be spent on Section A and 30 minutes on Section B.
Section A consists of four short experimental tests. **You will have access to the apparatus for 13 minutes for each of the tests.** At the end of this 13-minute experimental period there is a 2-minute changeover to the area set aside for the next test. Any spare time before the start of the next test may be used to write up anything you have not yet completed.
At the end of your Section A work you will be told to move to the area set aside for Section B.
Section B consists of one question in which you will analyse a set of experimental results.

INFORMATION FOR CANDIDATES

The total mark for this paper is 40.
Section A and Section B carry 20 marks each.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each part question.
You may use an electronic calculator.

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Section A

Teacher Mark	Examiner Check	Remark

1 In this experiment you are to use a converging lens to obtain focused images of an illuminated object. The apparatus has been set up as shown in **Fig. 1.1**, with the light box and screen a fixed distance apart, *L*.
Do not attempt to alter distance *L* during this experiment.

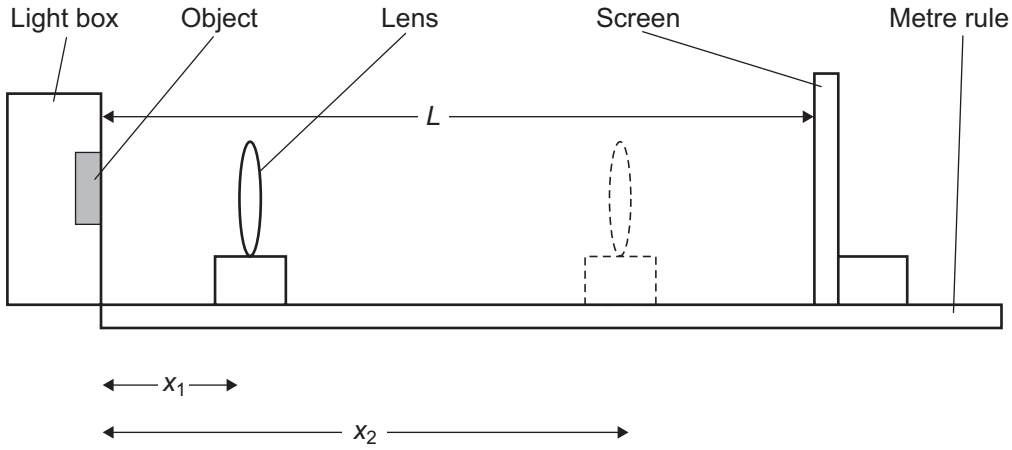

Fig. 1.1

(a) (i) Measure and record the distance from the object to the screen, *L*.

L = _____ mm

(ii) First move the lens until a sharp image is formed on the screen with the lens nearer to the light box than the screen. Record this distance x_1.

x_1 = _____ mm

(iii) Then move the lens until a sharp image is formed on the screen this time with the lens nearer to the screen than the light box. Record this distance x_2.

x_2 = _____ mm [3]

Teacher Mark	Examiner Check	Remark

(b) The focal length of the lens, f may be found using the formula

$$f = \frac{L^2 - (x_2 - x_1)^2}{4L}$$

Calculate the value of f.

f = _____ mm [1]

(c) State one aspect of this method that would affect the accuracy of the focal length.

_____

_____

_____ [1]

Teacher Mark	Examiner Check	Remark

2 In this experiment you are to measure the supply voltage and the current flowing at various points in a network of resistors.

The circuit shown in **Fig. 2.1** has been set up.

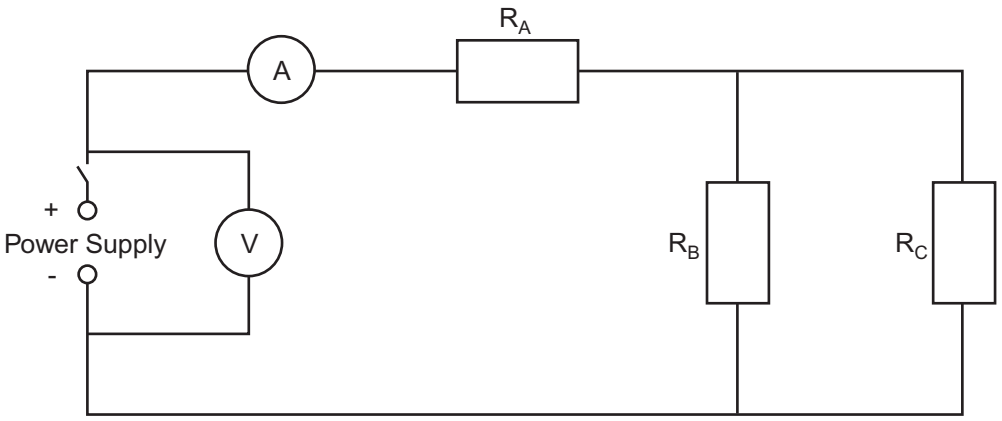

Fig. 2.1

(a) Record the values indicated by the voltmeter and ammeter and hence calculate the circuit resistance.

Voltmeter reading = _____ V

Ammeter reading, I_A = _____ mA

Circuit resistance = _____ Ω [2]

(b) (i) Change the position of the ammeter so as to record the current I_B flowing through resistor R_B in this circuit.

Current I_B = _____ mA [1]

(ii) Change the position of the ammeter again so as to record the current I_C flowing through resistor R_C in this circuit.

Current I_C = _____ mA [1]

(iii) Calculate the sum of the currents I_B and I_C through resistors R_B and R_C and state how this can be used to verify the conservation of charge in this circuit.

Teacher Mark	Examiner Check	Remark

$I_B + I_C =$ _____ mA

_____

_____ [1]

Teacher Mark	Examiner Check	Remark

3 In this experiment you are going to investigate the period of oscillation of a steel ball rolling in a watch glass, see **Fig. 3.1**. The experiment is repeated for a larger steel ball.

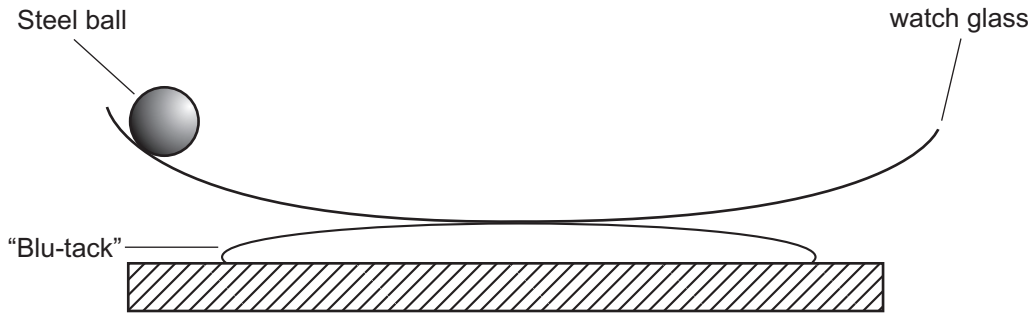

Fig. 3.1

(a) (i) Hold the smaller steel ball near the edge of the watch glass and release it, so that it runs to and fro along a diameter of the glass. Record measurements to determine the period of oscillation.

Period of oscillation = _____ s

(ii) Repeat the procedure to determine the period of oscillation of the larger steel ball.

Period of oscillation = _____ s [3]

Teacher Mark	Examiner Check	Remark

(b) The diameter of the small steel ball is given on a card on the bench. Measure the diameter of the larger steel ball using the micrometer screw gauge.

Diameter = _____ mm [1]

(c) From the results in parts **(a)** and **(b)**, what can you deduce about any relationship between the period and the diameter of a steel ball?

_____

_____ [1]

Teacher Mark	Examiner Check	Remark

4 In this experiment you are going to measure the extension of a spiral spring as the load is changed and use these results to find values for the spring constant *k*.

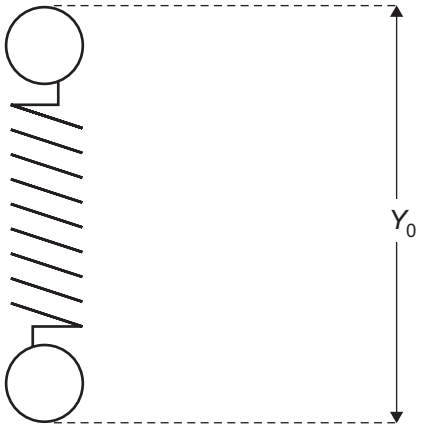

Fig. 4.1

(a) (i) Measure and record the unstretched length Y_0.

Y_0 = _____ mm

(ii) Suspend the spring from the clamp. Add the mass hanger to the lower loop of the spring and record the new total length of the spring Y_1.

Y_1 = _____ mm

(The mass of the mass hanger is 100 g.)

(iii) Add two 100 g masses to the hanger and record the new length of the spring Y_2.

Y_2 = _____ mm [2]

Teacher Mark	Examiner Check	Remark

(b) The spring constant k can be found from the relationship $F = kx$, where F is the force required to produce an extension x.
Use your value of Y_0, Y_1 and the load to find a first value for the spring constant k, k_1.
Use your value of Y_0, Y_2 and the load to find a second value for the constant k, k_2.

k_1 = _____ N mm^{-1}

k_2 = _____ N mm^{-1} [2]

(c) Explain briefly why the value k_2 is likely to be more accurate.

_____

_____

_____ [1]

Section B

Teacher Mark	Examiner Check	Remark

5 Maximum Power Transfer and Load Resistance

The power transferred from an electrical source such as a battery to an external circuit called the load resistance depends on the internal resistance of the source and the resistance of the load.

A student uses the circuit shown in **Fig. 5.1** to investigate the relationship between the power delivered to the load and the value of the load resistance.

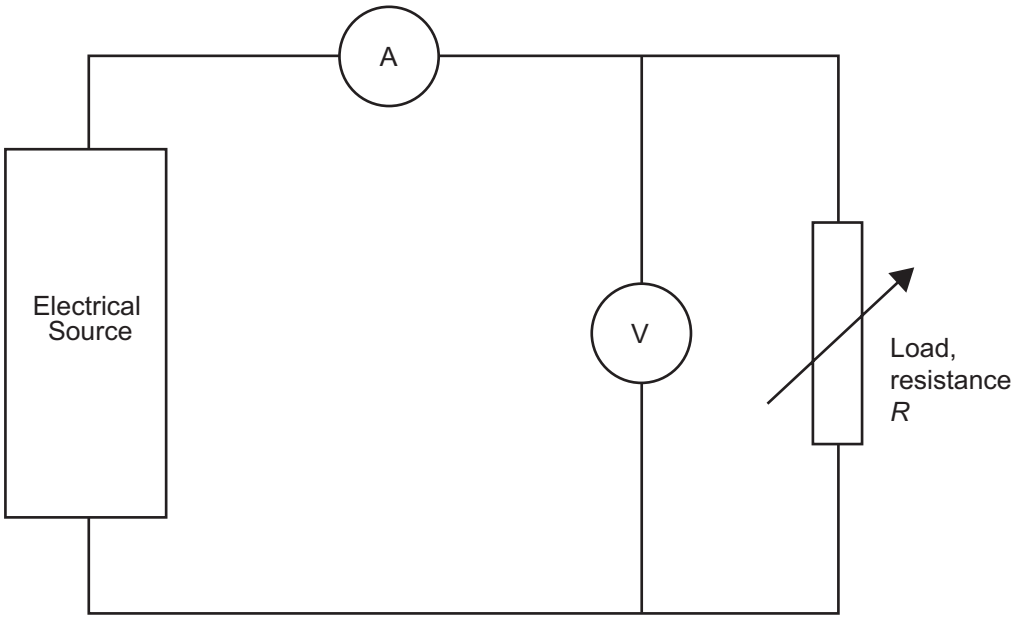

Fig. 5.1

The variable resistor represents the load resistor *R*. The ammeter A measures the current I delivered by the source and the voltmeter V measures the voltage *V* across the load resistor. The student takes a set of values of *V* and I corresponding to different values of the load resistor *R*. The results are recorded in **Table 5.1**.

Table 5.1

V/V	I/mA	Power *P*/	Resistance *R*/
0.00	1250		
0.909	1140		
2.38	952		
3.85	769		
5.79	526		
6.67	417		

Teacher Mark	Examiner Check	Remark

Theory

(a) The student plans to plot a graph of the power *P* delivered (on the *y*-axis) against the load resistance *R* (on the *x*-axis).

State the equations that enable the power *P* and the load resistance *R* to be calculated from the data in **Table 5.1**.

P = _____

R = _____ [2]

If you are unsure about the equations to calculate *P* or *R* from the values given in the table, you may ask for assistance. A deduction of up to 2 marks may be made.

Data processing

(b) (i) Calculate the values of power and load resistance needed to complete the table and record them to an appropriate number of significant figures in **Table 5.1**. Include appropriate units in the column heading. [5]

(ii) On the grid of **Fig. 5.2**, draw the graph of the processed data in **Table 5.1**. Choose suitable scales and label the axes. Plot the points and draw the best smooth curve through them. The graph should reach a maximum value for the power and then decrease as *R* increases. [5]

Teacher Mark	Examiner Check	Remark

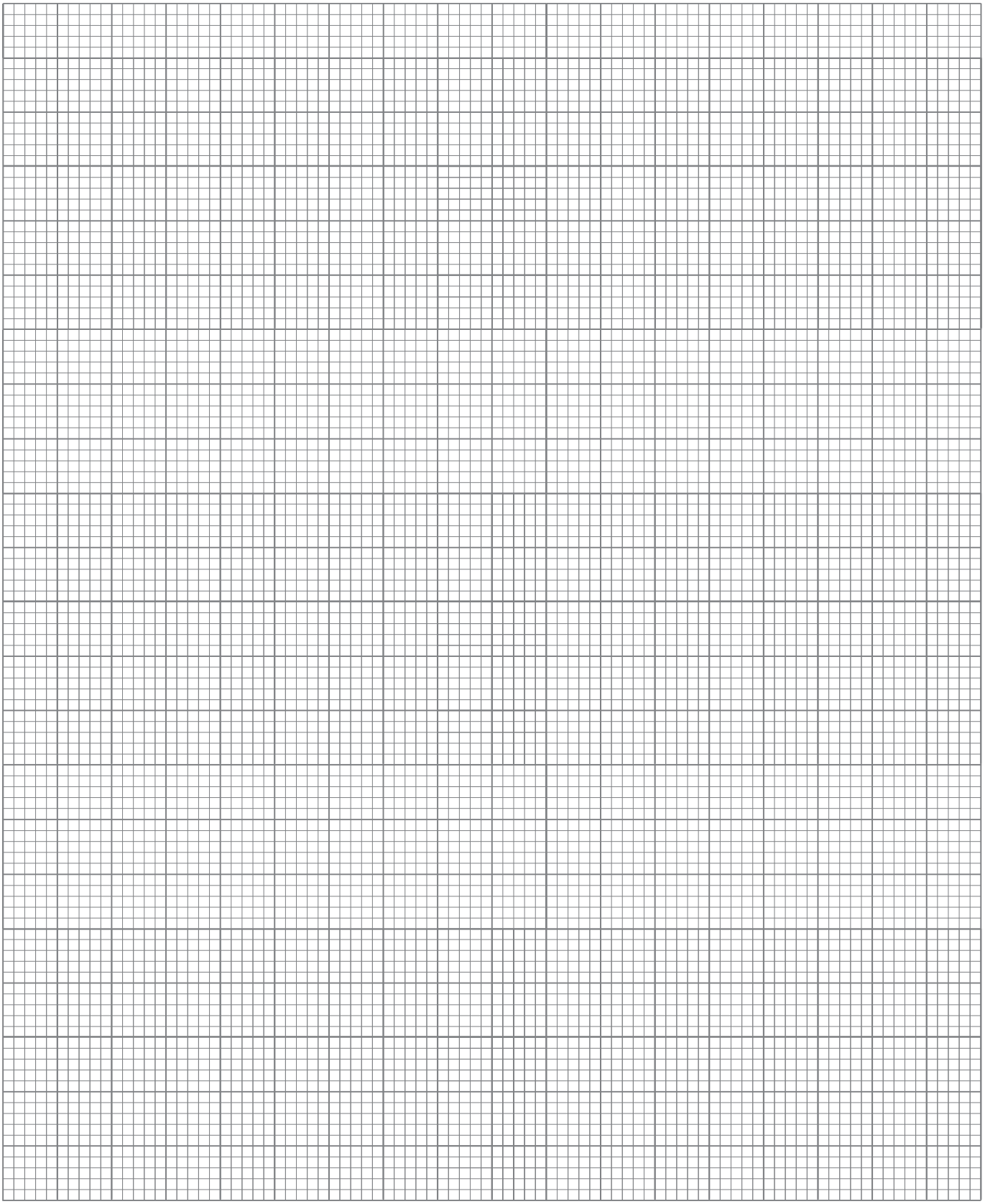

Fig. 5.2

Teacher Mark	Examiner Check	Remark

Analysis

(c) From the graph find the maximum power P_{max} delivered by the source and the value of the load resistance R_m when this occurs, include appropriate units.

P_{max} = _____

R_m = _____ [2]

Evaluation

(d) **(i)** How could the student have improved the experiment so that the accuracy of the values of P_{max} and R_m obtained from the graph are more precise?

_____

_____ [1]

It can be shown that the internal resistance of the source will equal the load resistance when maximum power is delivered from the source to the load.

(ii) Under these conditions, what is the total resistance of the circuit?

Total resistance = _____ Ω [1]

(iii) Deduce the efficiency of the power source when maximum power transfer occurs.

Efficiency = _____ % [2]

(iv) A fellow student looks at **Table 5.1**, comments on the first reading of V and I and asks "how can there be a current round the circuit when there is no voltage across the external load?".
Explain how this situation arises.

_____

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER