



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2013

Centre Number

71	
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Candidate Number

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## Physics

### Assessment Unit AS 3

*assessing*

Practical Techniques (Internal Assessment)

Session 1

[AY131]



TUESDAY 14 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.

Question Number	Marks		Remark
	Teacher Mark	Examiner Check	
1			
2			
3			
4			
5			
<b>Total Marks</b>			



## 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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**(Questions continue overleaf)**

### Section A

Teacher Mark	Examiner Check	Remark

1 In this experiment you are to investigate how the period of oscillation of a chain of paperclips varies as the distance  $y$ , shown in Fig. 1.1, is changed.

(a) The apparatus in Fig. 1.1 has been set up for you. Measure the distance  $y$  and record the value in Table 1.1.

When the paperclip chain is displaced slightly in a plane perpendicular to the metre rule it will oscillate as shown in the side view.

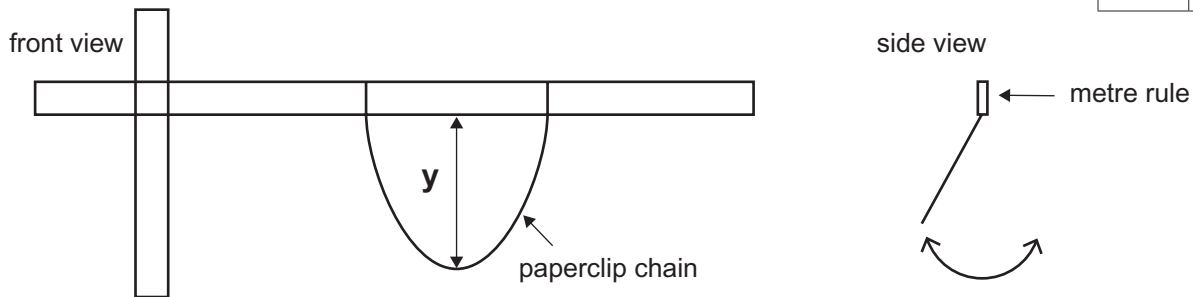


Fig. 1.1

Displace the chain a small distance horizontally and allow it to oscillate. Take readings to allow you to determine  $T$ , the period of oscillation, by measuring and recording the time for 10 oscillations. Record all your results in Table 1.1.

Adjust  $y$  by sliding the loops of string along the metre rule so that  $y$  is half of its initial value and repeat the above procedure.

Table 1.1

y/mm	Time for 10 oscillations/s	T/s

[2]

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(b) (i) Without calculation, how can you tell from your results in **Table 1.1** that **y** and **T** are not inversely proportional?

\_\_\_\_\_ [1]

(ii) Carry out calculations using the results in **Table 1.1** to determine whether or not **y** and **T** are proportional. Explain your answer.

Is **T** proportional to **y**?

Yes

No

Explanation:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

Teacher Mark	Examiner Check	Remark

2 In this experiment you will take measurements to enable you to calculate the area of an A4 sheet of paper and find the associated uncertainty in your answer.

(a) Use the ruler provided to measure the length and breadth of the blank A4 page provided. State the uncertainty in each of your measurements.

Length = \_\_\_\_\_  $\pm$  \_\_\_\_\_ cm

Breadth = \_\_\_\_\_  $\pm$  \_\_\_\_\_ cm [1]

(b) Calculate the area of the sheet of paper, and the uncertainty in your value of area. Show all of your working out clearly.

Area = \_\_\_\_\_  $\pm$  \_\_\_\_\_ cm<sup>2</sup> [3]

(c) In order to calculate the volume of the sheet of paper the thickness of the sheet would also be required. Describe how you would measure the thickness of the paper to ensure an accurate value.

\_\_\_\_\_

\_\_\_\_\_

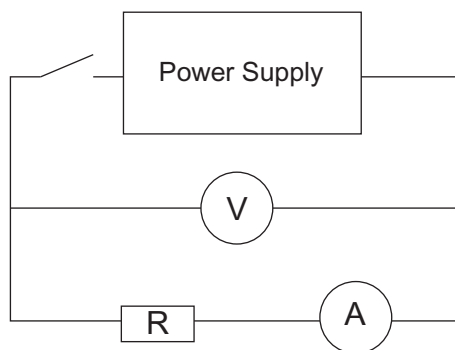
\_\_\_\_\_ [1]

Teacher Mark	Examiner Check	Remark

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**(Questions continue overleaf)**

- 3 In this experiment you will take measurements of current and potential difference to enable you to work out the internal resistance of a power supply. You are provided with the circuit shown in **Fig. 3.1**. The resistor R in the circuit initially has a value of  $10\ \Omega$ .



**Fig. 3.1**

- (a) Close the switch and record values in **Table 3.1** for the current in the circuit and the potential difference across the supply. Replace R with the resistor of value  $22\ \Omega$  and repeat the procedure. Finally, replace this resistor with the  $47\ \Omega$  resistor and again repeat the procedure. Record all the results in **Table 3.1**. [1]

**Table 3.1**

Resistance/ $\Omega$	Current/A	Voltage/V	Power/W
10			
22			
47			

- (b) Calculate the power dissipated in the resistor in each case and use the final column of **Table 3.1** to record the values. [1]

Teacher Mark	Examiner Check	Remark



(c) The power reaches a maximum value when the resistance,  $R$  is equal to the internal resistance of the supply. Which value of resistance from **Table 3.1** is closest to the internal resistance of the supply? Describe how you could find a more accurate value for the internal resistance of the supply.

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[3]

Teacher Mark	Examiner Check	Remark

4 In this experiment you will take measurements to allow you to calculate a value for the resistivity of a metal.

The multimeter has been set to allow you to measure the resistance of the sample of metal wire directly.

**Do not adjust the position of the crocodile clips on the wire.**

(a) The following measurements will be required to calculate the resistivity. Record these in **Table 4.1**.

- The resistance of the wire from the multimeter.
- The diameter of the metal wire using the micrometer screw gauge.
- The length of the wire between the crocodile clips.

**Table 4.1**

Measurement	Value		Unit
Resistance			$\Omega$
Diameter		Average	
Length		Average	

[2]

(b) Use the values in **Table 4.1** and the equation  $R = \frac{\rho l}{A}$  to calculate the resistivity of the sample of wire.

Resistivity = \_\_\_\_\_  $\Omega$  m

[3]

Teacher Mark	Examiner Check	Remark

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**(Questions continue overleaf)**

## Section B

### Water Waves

5 An experiment was carried out to investigate how the speed of a wave,  $v$ , travelling through deep water depends on the wavelength of the wave,  $\lambda$ . The times,  $t$ , for waves to travel a distance of **5.00 m** were measured and the results recorded in **Table 5.1**.

(a) Calculate the speed of the wave for each wavelength and record your values to an appropriate number of significant figures in the third column of **Table 5.1**. [2]

**Table 5.1**

$\lambda/\text{m}$	$t/\text{s}$	$v/\text{m s}^{-1}$	
0.45	5.97		
0.70	4.78		
0.95	4.14		
1.20	3.73		
1.45	3.31		

(b) The relationship between  $v$  and  $\lambda$  is given by **Equation 5.1** where  $P$  is a constant.

$$v = \sqrt{\frac{P\lambda}{2\pi}} \quad \text{Equation 5.1}$$

(i) Use **Equation 5.1** to show that a graph of  $v^2$  plotted against  $\lambda$  will result in a straight line graph **that will go through the origin**.

[2]

(ii) There are alternative plots to that suggested in **(b)(i)** that would also result in a straight line graph being obtained. Suggest one alternative that would result in a straight line graph being obtained.

y-axis: \_\_\_\_\_ x-axis: \_\_\_\_\_ [1]

Teacher Mark	Examiner Check	Remark

## Data Processing

- (c) (i) Head the blank column of **Table 5.1** with the quantity that needs to be calculated to draw the graph in **(b)(i)**, **not your alternative suggestion**. Include the appropriate unit. [1]
- (ii) Calculate the numerical values needed to complete the blank column in **Table 5.1**. [2]
- (iii) On the grid of **Fig. 5.1**, draw the graph given in **(b)(i)** using the processed data in **Table 5.1**. Label the axes and choose suitable scales. Plot the points and draw the best fit straight line. [5]

Teacher Mark	Examiner Check	Remark

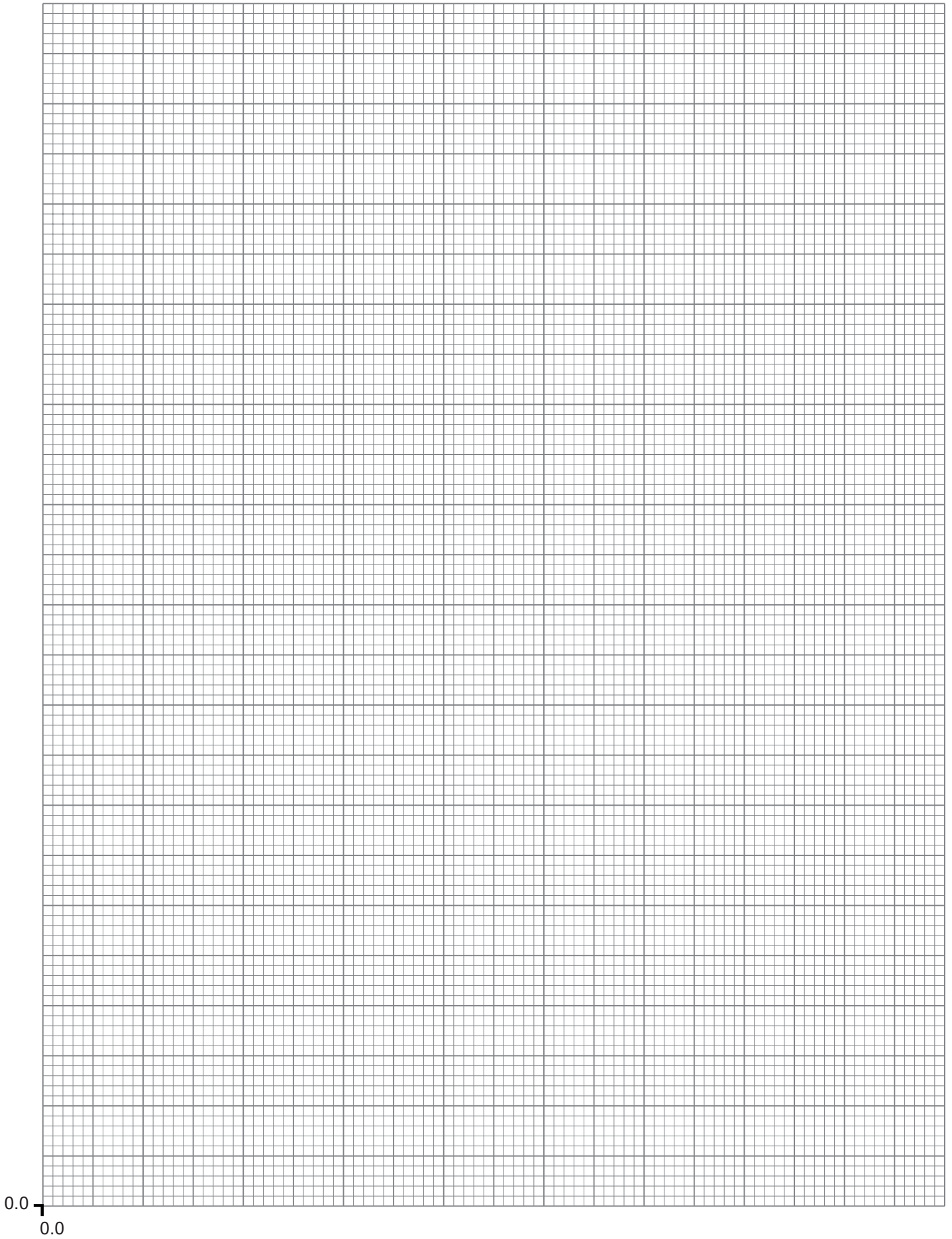


Fig. 5.1

## Analysis

(d) (i) Determine the gradient of the graph.

Gradient = \_\_\_\_\_

Units of gradient = \_\_\_\_\_ [3]

(ii) Use your value for the gradient to calculate a value for  $P$ .

$P =$  \_\_\_\_\_ [2]

(e) In shallow water the relationship between  $v$  and  $\lambda$  is given by **Equation 5.2**.

$$v = \sqrt{P\lambda} \quad \text{Equation 5.2}$$

On the grid of **Fig. 5.1** draw a line to show the graph that would have been obtained if the experiment had been carried out in shallow water instead of in deep water, label this line  $S$ . Use your value of  $P$  and the space below for any necessary calculations.

[2]

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**THIS IS THE END OF THE QUESTION PAPER**

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Teacher Mark	Examiner Check	Remark

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**Physics**

**Assessment Unit AS 3**

*assessing*

**Practical Techniques  
Sessions 1 and 2**

**[AY131] [AY132]**

**TUESDAY 14 MAY AND FRIDAY 17 MAY**

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AY131 AY132

**APPARATUS  
AND  
MATERIALS  
LIST**

# PHYSICS UNIT 3 (AS 3)

## APPARATUS AND MATERIALS REQUIRED FOR PRACTICAL ASSESSMENTS

### CONFIDENTIAL

Information about the apparatus and materials required for the AS Practical Assessments **must not** be communicated to candidates sitting the examination.

This document gives preliminary information on the apparatus and materials required for the AS Practical Assessments. The Practical Assessments will be marked by teachers as part of the internal assessment requirements for the GCE Physics Specification.

Teachers will be given detailed instructions for setting up the experiment in the *Confidential Instructions for Physics (Advanced Subsidiary) Practical Tests*, to which they will have confidential access from March 2013.

**Teachers will have confidential access to a copy of the experimental tests two working days (48 hours) before the start of the assessment.**

The AS 3 Practical Techniques Assessment is a test of practical skills consisting of Section A and Section B. Section A is comprised of 4 short experimental tests (20 marks) and Section B consists of one question requiring the analysis of experimental results (20 marks). The duration of the assessment is 1 hour 30 minutes. Some of this time will be set aside for supervisors to re-set the apparatus ready for the next candidates. **All** candidates should attempt Section A of the AS 3 assessment first followed by Section B. Section A of the assessment should be run as a circus of experiments with candidates moving to the next experiment at the designated time. The assessment should be timed as follows:

<b>Section A</b>	<b>Time</b>
Q1 ( <i>Short practical test</i> )	13 minutes
Changeover and practical write-up	2 minutes
Q2 ( <i>Short practical test</i> )	13 minutes
Changeover and practical write-up	2 minutes
Q3 ( <i>Short practical test</i> )	13 minutes
Changeover and practical write-up	2 minutes
Q4 ( <i>Short practical test</i> )	13 minutes
Changeover and practical write-up	2 minutes
<b>Section B</b>	<b>Time</b>
<i>Question on the analysis of experimental results</i>	30 minutes

In Section A, at the end of each 13 minute period, candidates must stop using the apparatus. During each 2 minute changeover period candidates may write up anything they have not completed however they will not have access to the apparatus.

The apparatus in the following list will allow for **one experiment** to be set up for each of the short practical tests which make up questions 1–4. In other words, each set of apparatus (as listed on pages 4 and 5) will accommodate four candidates when doing part A as a circus of experiments.

The apparatus can be used for alternative sessions according to the following schedule:

**14 May 2013 Physics AS 3A (AY131)**

(Main Session) **9.15 am–10.45 am**

(First Alternative) **11.00 am–12.30 pm**

(Second Alternative) **1.15 pm–2.45 pm**

(Third Alternative) **3.00 pm–4.30 pm**

**17 May 2013 Physics AS 3B (AY132)**

(Main Session) **9.15 am–10.45 am**

(First Alternative) **11.00 am–12.30 pm**

(Second Alternative) **1.15 pm–2.45 pm**

(Third Alternative) **3.00 pm–4.30 pm**

One set of apparatus for AS 3A (AY131) will therefore be sufficient for sixteen candidates on **14 May** if the Main Session and all three alternatives are used. Similarly, one set of apparatus for AS 3B (AY132) will be sufficient for sixteen candidates on **17 May** if the Main Session and all three Alternatives are used. A laboratory may contain one, two, three or more sets of apparatus. This means that four, eight, twelve or more candidates can be accommodated in the same session. **When alternative sessions are used care must be taken to segregate candidates who have taken the examination from those who have still to sit the examination.**

**IMPORTANT NOTICE**

**Centres are urged to order items needed for the Physics Practical Tests from the suppliers as soon as possible.**

## Apparatus and Materials List Summer 2013

### Question 1

Ref.	Component	Session 1	Session 2
1.1	Paper clips (30 mm long)	15	15
1.2	Metre rule	1	1
1.3	Retort stand	1	1
1.4	Boss head	1	1
1.5	Clamp	1	1
1.6	Stopclock/watch accurate to 0.01 s	1	1
1.7	String	✓	✓
1.8	Half-metre rule	1	0

### Question 2

Ref.	Component	Session 1	Session 2
2.1	Sheet of A4 paper	1	0
2.2	Sheet of A3 paper	0	1
2.3	Half-metre rule	1	1

### Question 3

Ref.	Component	Session 1	Session 2
3.1	1.5 V cells (size is not important)	4	4
3.2	Cell holder(s) capable of holding 4 cells	1	1
3.3	22 $\Omega$ resistor (1% tolerance, $\sim$ 0.6 W)	2	0
3.4	15 $\Omega$ resistor (1% tolerance, $\sim$ 0.6 W)	0	2
3.5	10 $\Omega$ resistor (1% tolerance, $\sim$ 0.6 W)	1	1
3.6	47 $\Omega$ resistor (1% tolerance, $\sim$ 0.6 W)	1	1
3.7	Opaque box (large enough to conceal the cells in series and a series resistor)	1	1
3.8	Ammeter 0 – >5 A (digital; accurate to 0.01 A)	1	1
3.9	Voltmeter 0 – >10 V (digital; accurate to 0.01 V)	1	1
3.10	Connecting wires	7	7
3.11	Switch	1	1
3.12	Component channels	3	3

### Question 4

Ref.	Component	Session 1	Session 2
4.1	Nichrome wire, 32 swg	1	0
4.2	Nichrome wire, 28 swg	0	1
4.3	Multi-meter (digital; measuring to < 50 $\Omega$ ; accurate to 0.1 $\Omega$ or 0.01 $\Omega$ )	1	1
4.4	Connecting wires	2	2
4.5	Crocodile clips	2	2
4.6	Half-metre rule	1	1
4.7	Micrometer screw gauge (accurate to 0.01 mm)	1	1











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## **Physics**

**Assessment Unit AS 3**

*assessing*

Practical Techniques (Internal Assessment)  
Session 1 (pp 3–9) and 2 (10–16)

**[AY131] [AY132]**

**TUESDAY 14 MAY AND FRIDAY 17 MAY**

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# **CONFIDENTIAL INSTRUCTIONS TO TEACHERS**

## **CONFIDENTIAL INSTRUCTIONS FOR PHYSICS (ADVANCED SUBSIDIARY) PRACTICAL TECHNIQUES (INTERNAL ASSESSMENT)**

### **Confidentiality**

To maintain the integrity of the Assessment, **no** question papers or any material pertaining to the Assessment should be publicly released until after the final session of the second day.

### **General**

The Internal Assessment will contain five compulsory questions, of which Section A is made up of four 15-minute experimental tests and Section B is a 30-minute question testing Data Analysis. The total time allowed is 1 hour 30 minutes. The order in which candidates are to take the questions in Section A is to be decided by the Supervisor. Candidates will have access to the apparatus in each experimental task for 13 minutes each, the final two minutes being reserved for adjustment of the apparatus by the Supervisor. During this 2 minute changeover period candidates may write-up anything they have not completed; however, they will not have access to the apparatus. At the end of Section A, candidates should be directed to an area set aside for Section B which consists of one question in which a set of experimental results will be analysed.

## SESSION 1

### Question 1

#### Principal Requirements

Paper clips

Metre rule

Half-metre rule

Retort stand

Boss head

Clamp

Stopclock/watch

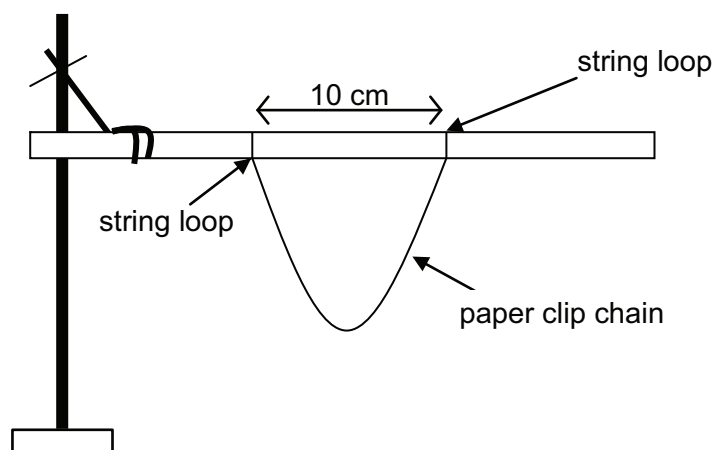
String

#### Preparation

Connect enough paperclips together to form a chain approximately 40 cm long.

Clamp one end of the metre rule into the retort stand so that it is horizontal. See **Fig. 1.1**.

Attach both ends of the paperclip chain to the metre rule using string loops that are tight enough not to slip but will allow some adjustment by the candidates. See **Fig.1.1**.



**Fig. 1.1**

Test: Ensure the chain oscillates freely for 10 oscillations.

**Before Examination**

Set up the apparatus as shown in **Fig. 1.1**.

Leave the stopclock/watch and the half-metre rule adjacent to the apparatus.

Set the distance,  $d$ , between the string loops to  $\sim 10$  cm.

**Action at changeover**

Leave the stopclock/watch and the half-metre rule adjacent to the apparatus.

Set the distance,  $d$ , between the string loops to  $\sim 10$  cm.

**Information required by examiners**

None.

## **Question 2**

### **Principal Requirements**

Sheet of A4 paper

Half-metre rule

### **Preparation**

Write “A4” on the sheet of paper.

### **Before Examination**

Leave the half-metre rule adjacent to the A4 paper.

### **Action at changeover**

Replace the A4 sheet with a fresh sheet (if necessary).

Leave the half-metre rule adjacent to the A4 paper.

### **Information required by examiners**

None.

### Question 3

#### Principal Requirements

1.5 V cells

Cell holder(s)

22  $\Omega$  resistors

10  $\Omega$  resistor

47  $\Omega$  resistor

Component channels

Opaque box

Ammeter

Voltmeter

Connecting wires

Switch

#### Preparation

Place four 1.5 V cells in a holder and connect one of the 22  $\Omega$  resistors in series with it.

Enclose battery/resistor arrangement in the sealed opaque box and label it "Power Supply".

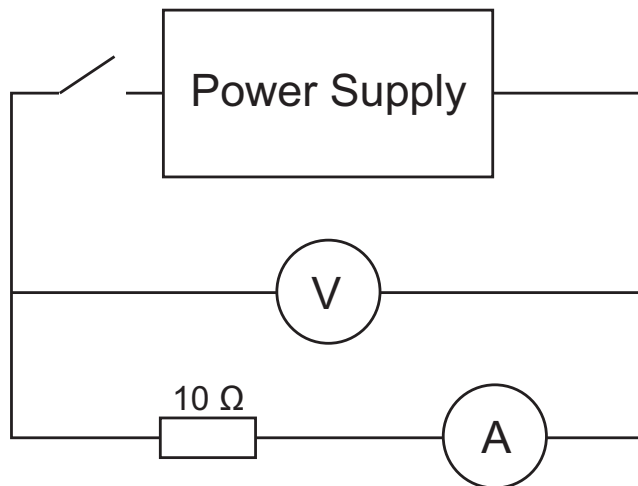
Place the 10  $\Omega$  resistor in a component holder and label it 10  $\Omega$ .

Place the 22  $\Omega$  resistor in a component holder and label it 22  $\Omega$ .

Place the 47  $\Omega$  resistor in a component holder and label it 47  $\Omega$ .

## Before Examination

Connect the circuit, as shown below, with the  $10\ \Omega$  resistor in the external circuit.



Test: The largest  $VI$  product (voltage  $\times$  current) obtained should occur when the  $22\ \Omega$  resistor is in the circuit.

### Action at changeover

Place the  $10\ \Omega$  resistor in the external circuit.

### Information required by examiners

None.

## Question 4

### Principal Requirements

Nichrome wire, 32 swg

Ohmmeter

Connecting wires

Crocodile clips

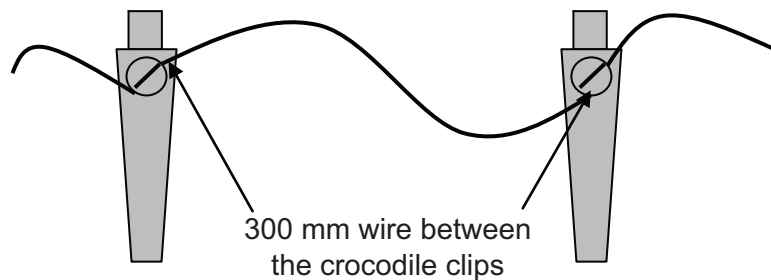
Half-metre rule

Micrometer screw gauge

### Preparation

Cut a length of ~40 cm of the nichrome wire.

Securely attach the nichrome wire to the **SCREWS** on the crocodile clips so that a wire length of 300 mm is trapped, as shown below.



Connect the ohmmeter to the crocodile clips using connecting leads and ensure that it is switched on so that it is measuring the correct resistance of the wire.

### Before Examination

Place the half-metre rule and micrometer screw gauge adjacent to the wire/ohmmeter arrangement described in "Preparation" above.

DO NOT attach the wire to the half-metre rule.

### Action at changeover

Ensure the wire is not attached to the half-metre rule.

Set the micrometer screw gauge to zero.

Ensure that the ohmmeter is switched on so that it is measuring the correct resistance of the wire.

### Information required by examiners

None.



### **Question 5**

Apart from the provision of a suitable working area, no apparatus is required for this Data Analysis Question.

#### **Information required by examiners**

None.

## SESSION 2

### Question 1

#### Principal Requirements

Paper clips

Metre rule

Retort stand

Boss head

Clamp

Stopclock/watch

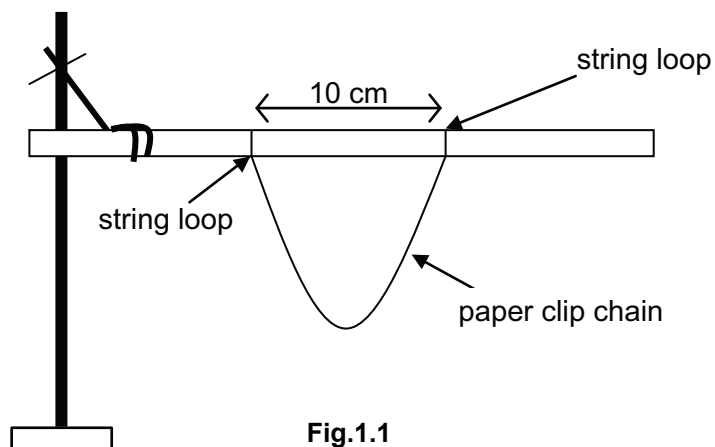
String

#### Preparation

Connect enough paperclips together to form a chain approximately 40 cm long.

Clamp one end of the metre rule into the retort stand so that it is horizontal. See **Fig. 1.1**.

Attach both ends of the paperclip chain to the metre rule using string loops that are tight enough not to slip but will allow some adjustment by the candidates. See **Fig.1.1**.



Test: Ensure the chain oscillates freely for 10 oscillations.

**Before Examination**

Set up the apparatus as shown in **Fig. 1.1**.

Leave the stopclock/watch adjacent to the apparatus.

Set the distance,  $d$ , between the string loops to 10 cm.

**Action at changeover**

Leave the stopclock/watch adjacent to the apparatus.

Set the distance,  $d$ , between the string loops to 10 cm.

**Information required by examiners**

None.

## **Question 2**

### **Principal Requirements**

Sheet of A3 paper

Half-metre rule

### **Preparation**

Write “A3” on the sheet of paper.

### **Before Examination**

Leave the half-metre rule adjacent to the A3 paper.

### **Action at changeover**

Replace the A3 sheet with a fresh sheet (if necessary).

Leave the half-metre rule adjacent to the A3 paper.

### **Information required by examiners**

None.

### Question 3

#### Principal Requirements

1.5 V cells

Cell holder(s)

15  $\Omega$  resistors

10  $\Omega$  resistor

47  $\Omega$  resistor

Component channels

Opaque box

Ammeter

Voltmeter

Connecting wires

Switch

#### Preparation

Place four 1.5 V cells in a holder and connect one of the 15  $\Omega$  resistors in series with it.

Enclose battery/resistor arrangement in the sealed box and label it "Power Supply".

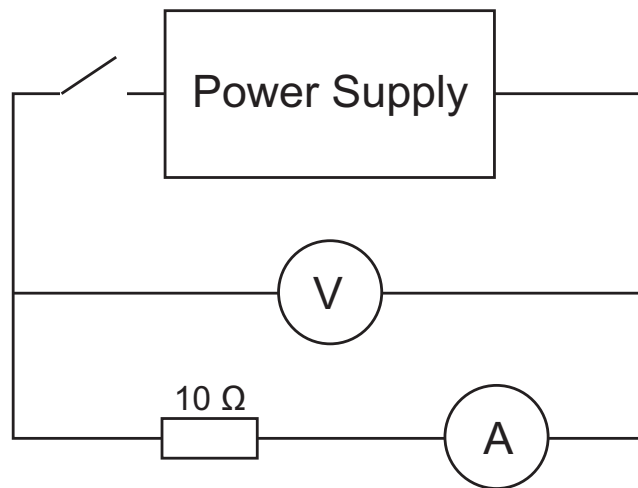
Place the 10  $\Omega$  resistor in a component holder and label it 10  $\Omega$ .

Place the 15  $\Omega$  resistor in a component holder and label it 15  $\Omega$ .

Place the 47  $\Omega$  resistor in a component holder and label it 47  $\Omega$ .

## Before Examination

Connect the circuit, as shown below, with the  $10\ \Omega$  resistor in the external circuit.



Test: The largest  $VI$  product (voltage  $\times$  current) obtained should occur when the  $15\ \Omega$  resistor is in the circuit.

### Action at changeover

Place the  $10\ \Omega$  resistor in the external circuit.

### Information required by examiners

None.

## Question 4

### Principal Requirements

Nichrome wire, 28 swg

Ohmmeter

Connecting wires

Crocodile clips

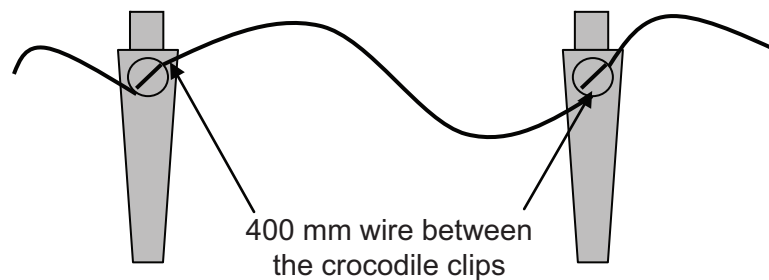
Half-metre rule

Micrometer screw gauge

### Preparation

Cut a length of ~50 cm of the nichrome wire.

Securely attach the nichrome wire to the **SCREWS** on the crocodile clips so that a wire length of 400 mm is trapped, as shown below.



Connect the ohmmeter to the crocodile clips using connecting leads and ensure that it is switched on so that it is measuring the correct resistance of the wire.

### Before Examination

Place the half-metre rule and micrometer screw gauge adjacent to the wire/ohmmeter arrangement described in "Preparation" above.

DO NOT attach the wire to the half-metre rule.

### Action at changeover

Ensure the wire is not attached to the half-metre rule.

Set the micrometer screw gauge to zero.

Ensure that the ohmmeter is switched on so that it is measuring the correct resistance of the wire.

### Information required by examiners

None.

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**Question 5**

Apart from the provision of a suitable working area, no apparatus is required for this Data Analysis Question.

**Information required by examiners**

None.