Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 3

assessing

Practical Techniques
Session 2

[AY132]

AY132

WEDNESDAY 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
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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(Questions start overleaf)

Section A

Examiner Only	
Marks	Remark

1 In this experiment you are to investigate the refraction of a ray of light as it travels from air into a transparent block and emerges from the other side.
You are provided with a transparent rectangular block, a ray box, a protractor and a ruler.

(a) Place the transparent block on **Fig. 1.2** on the opposite page and mark its outline. The block should be as indicated in **Fig. 1.1**. Remove the block and draw a normal near the middle of one of the long sides of the block.

Draw a line to represent an incident ray at an angle of incidence of 15° to the normal. Replace the block on its outline. Place the ray box on the page and direct a ray of light along the line. Mark the path of the emergent ray.
Remove the block and construct the path of the ray through the block.
Repeat the above procedure for an angle of incidence of 30°, on **Fig. 1.3** on page 6. [3]

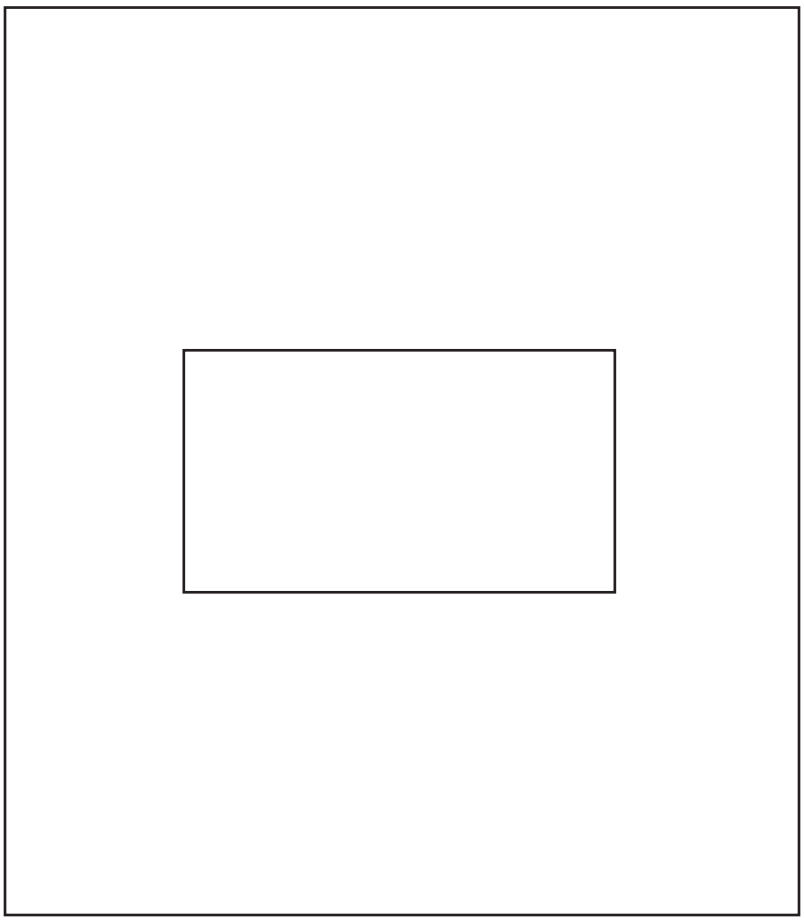


Fig 1.1

Fig. 1.2

Fig. 1.3

Examiner Only	
Marks	Remark

(b) The lateral displacement of a ray of light which has travelled through a transparent block is measured as the perpendicular distance between the emergent ray and the original path of the incident ray, see **Fig. 1.4**.

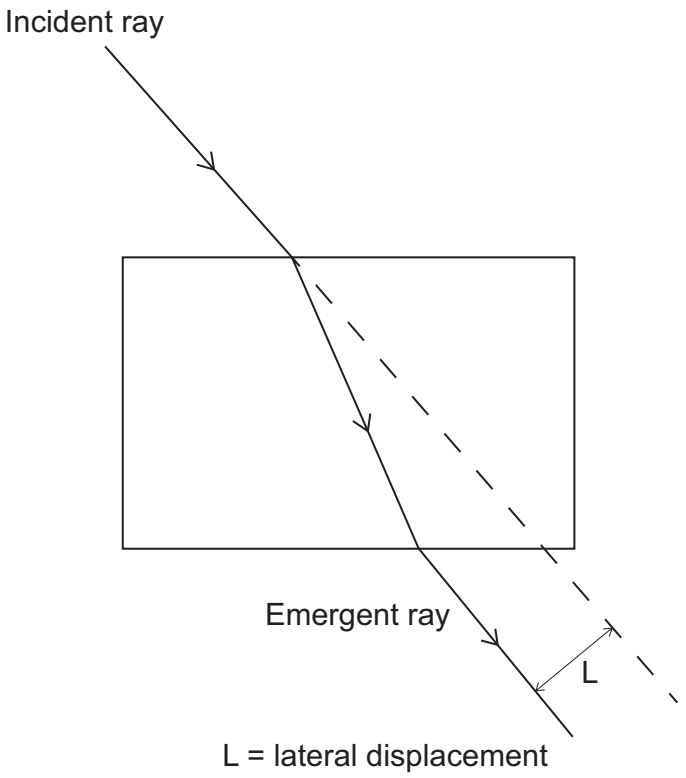


Fig. 1.4

(i) Use your diagrams in **Fig. 1.2** and **Fig. 1.3** to take measurements to find the lateral displacement for each incident ray.

Lateral displacement of ray with

angle of incidence 15° = _____ mm

Lateral displacement of ray with

angle of incidence 30° = _____ mm [1]

(ii) Other than incident angle, suggest one factor which will affect the value of the lateral displacement of a ray of light as it travels through a transparent block.

_____ [1]

Examiner Only	
Marks	Remark

2 In this experiment you are to obtain **reliable** values for some of the physical dimensions of a uniform wooden metre rule.

(a)

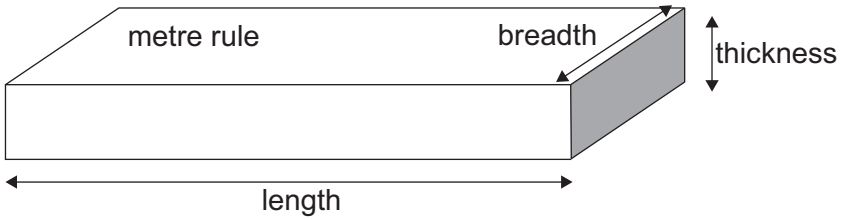


Fig. 2.1

Use the vernier callipers to measure the breadth of the suspended metre rule and the micrometer screw gauge to measure the thickness of the suspended metre rule. Enter all values in the **Table 2.1.**

Table 2.1

Physical dimension	Instrument	Measurement/mm
length	metre rule	1000
breadth	vernier calliper	
thickness	micrometer screw gauge	

[2]

(b) The metre rule is suspended from a retort stand at a point away from its centre of mass. Attach the mass hanger to the loop of string and move the loop until the metre rule is balanced horizontally, as shown in **Fig. 2.2.**

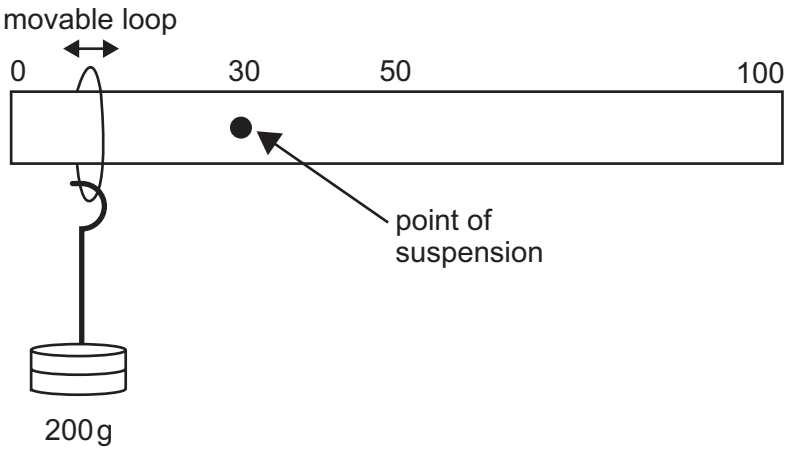


Fig. 2.2

Take suitable measurements to enable you to determine the mass of the metre rule.
Record these measurements and use them to determine the mass of the metre rule. Show clearly your working out.

Mass of metre rule = _____ g [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 In this experiment you are to determine a value for the acceleration of free fall by investigating the period of oscillation of a loaded spring.

Fig. 3.1 shows the arrangement of the apparatus.

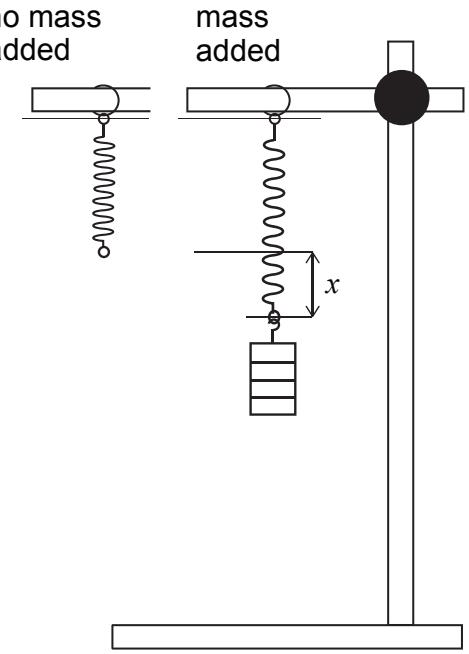


Fig. 3.1

A value for the acceleration of free fall, *g*, can be determined using **Equation 3.1**

$$g = \frac{4\pi^2 x}{T^2} \qquad \textbf{Equation 3.1}$$

where x is the extension of the spring produced by the load and T is the period of oscillation.

(a) Remove the mass from the spring and measure the unextended length of the spring.

Unextended length of the spring = _____ mm

Return the mass to the end of the spring and measure the new length of the spring.

New length of the spring = _____ mm

Determine the extension caused by the mass.

x = _____ mm [1]

(b) Displace the mass a small vertical distance downward and release it. Take suitable readings that will allow you to determine an accurate value for T, the period of the oscillation.

T = _____ s [2]

(c) Use **Equation 3.1** and your results to determine a value for the acceleration of free fall.

g = _____ m s^{-2} [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 In this experiment you are provided with a box containing seven **identical** resistors in three different arrangements.
A single resistor is connected between O and A.
Three resistors are connected between O and B and three resistors are connected between O and C.

(a) You are also provided with a pre-connected open circuit containing a power supply, an ammeter, a voltmeter and connecting leads as shown in **Fig. 4.1**. To complete the circuit, one lead should be connected to O and the other lead connected to A, B and C in turn.

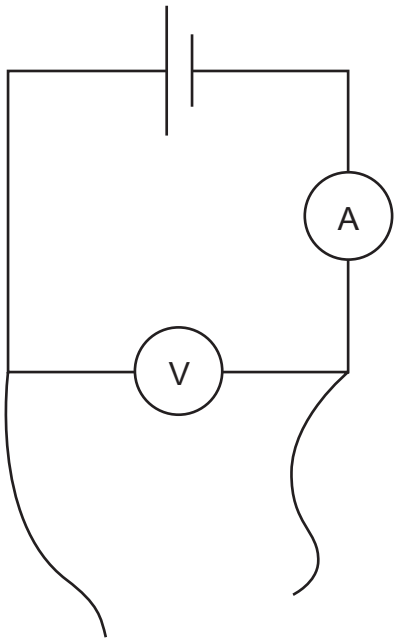


Fig. 4.1

Use the circuit to take readings of current and voltage for each connection and record the measurements in the **Table 4.1**.
Calculate the corresponding resistance for each connection and include this in **Table 4.1**.

Table 4.1

	OA	OB	OC
I/mA			
V/V			
R/Ω			

[3]

(b) Deduce how the resistors are arranged between OB and OC and draw a diagram to show the arrangement in each case.

(i) OB

(ii) OC

[2]

Examiner Only	
Marks	Remark

Section B

Examiner Only	
Marks	Remark

5 The density of air

The density of air was measured at atmospheric pressure P of 101 kPa for a range of temperatures. The results are shown in **Table 5.1.**

Table 5.1

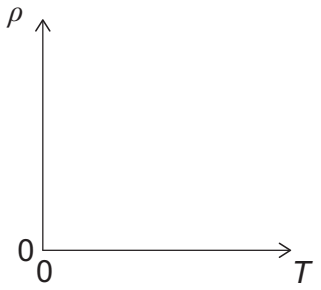
T / ___	ρ/kg m^{-3}	$\frac{1}{T}$/___
273	1.29	
293	1.21	
333	1.07	
373	0.950	
413	0.854	
453	0.779	

The relationship between the density of air, ρ, and its thermodynamic temperature T in kelvin is given by **Equation 5.1**

$$\rho = \frac{P}{BT} \qquad \textbf{Equation 5.1}$$

where B is a constant.

(a) Use **Equation 5.1** to sketch the graph obtained if ρ is plotted against T.



[2]

Data Processing

(b) (i) State the number of significant figures to which the densities have been recorded.

Number of significant figures = _____ [1]

(ii) In **Table 5.1**, insert the appropriate units for columns 1 and 3. [1]

(iii) In column 3 of **Table 5.1**, calculate $\frac{1}{T}$ for each temperature. [1]

Examiner Only	
Marks	Remark

(iv) On the grid of **Fig. 5.2**, draw the graph of ρ (y-axis) against $1/T$. Choose suitable scales and plot the points. Draw the best fit straight line. [4]

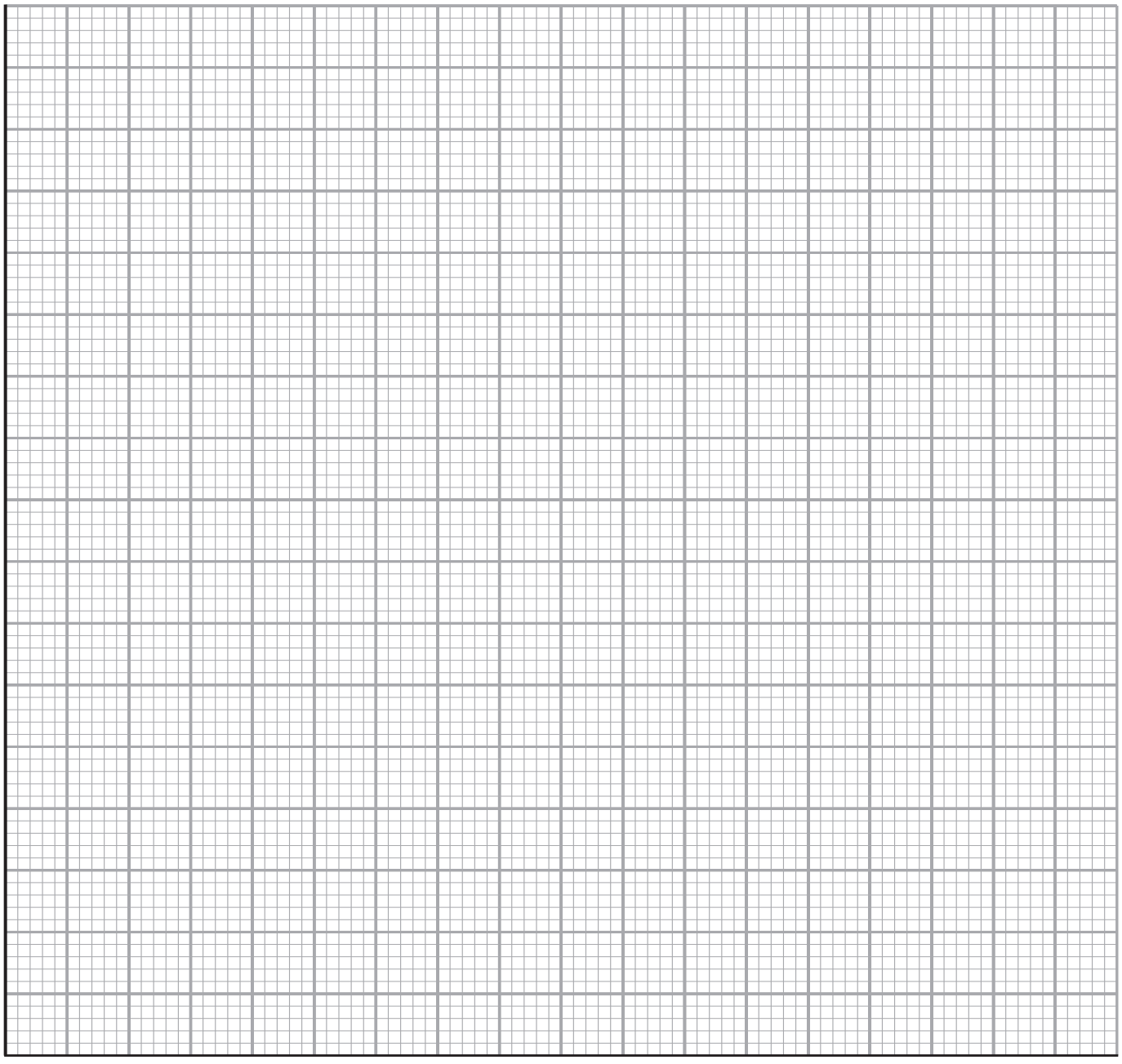


Fig. 5.2

(c) Analysis

(i) Determine the gradient of the graph. Include an appropriate unit.

Gradient = _____ Unit = _____ [4]

(ii) Determine the value of B. Include an appropriate unit.

B = _____ Unit = _____ [4]

(d) Evaluation

Use your graph to determine the percentage uncertainty in the value of B.

Uncertainty in B = _____ % [3]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 3

assessing

Practical Techniques
Sessions 1 and 2

[AY131] [AY132]

TUESDAY 13 MAY AND WEDNESDAY 14 MAY

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.

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 2014.

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:

Section A	**Time**
Q1 (Short practical test)	*13 minutes*
Changeover and practical write-up	2 minutes
Q2 (Short practical test)	*13 minutes*
Changeover and practical write-up	2 minutes
Q3 (Short practical test)	*13 minutes*
Changeover and practical write-up	2 minutes
Q4 (Short practical test)	*13 minutes*
Changeover and practical write-up	2 minutes
Section B	**Time**
Question on the analysis of experimental results	*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:

13 May 2014 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**

14 May 2014 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 **13 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 **14 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	Rectangular transparent optics block (smaller than 15 cm × 12 cm)	1	1
1.2	Ray box with single slit	1	1
1.3	12 V power supply unit (a.c. or d.c.)	1	1
1.4	Protractor	1	1
1.5	Rule (30 cm)	1	1

Question 2

Ref.	Component	Session 1	Session 2
2.1	Retort stand	1	1
2.2	Boss and clamp	1	1
2.3	Optical pin	1	1
2.4	Cork	1	1
2.5	Cord (thin)	✓	✓
2.6	Rule (metre)	1	1
2.7	Vernier callipers (analogue, accurate to 0.1 mm)	1	1
2.8	Micrometer screw gauge (accurate to 0.01 mm)	1	1
2.9	Mass hanger (100 g)	1	1
2.10	Slotted mass (100 g)	1	1
2.11	G-clamp	1	1
2.12	Tape	✓	✓

Question 3

Ref.	Component	Session 1	Session 2
3.1	Retort stand	1	1
3.2	Boss and clamp	1	1
3.3	Mass hanger (100 g)	1	1
3.4	Slotted masses (100 g)	2	3
3.5	Helical spring (≈ 25 mm length, disposable)	1	1
3.6	Rule (50 cm)	1	1
3.7	Stopwatch/stopclock (digital) to ± 0.01 s	1	1
3.8	Tape	✓	✓

Question 4

Ref.	Component	Session 1	Session 2
4.1	1.5 V cell	1	1
4.2	1.5 V cell holder (compatible with 4.1)	1	1
4.3	Ammeter; digital, reading to 20 mA	1	1
4.4	Voltmeter; digital, reading to 20 V	1	1
4.5	Leads: 4 mm	5	5
4.6	Opaque box; guide size 10 cm × 10 cm × 5 cm	1	1
4.7	Sockets; 4 mm, black	1	1
4.8	Sockets; 4 mm, red	3	3
4.9	Resistors; 470 Ω ± 10%, carbon, power rating not critical	7	7

Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2014

Physics

Assessment Unit AS 3

assessing

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

[AY131] [AY132]

TUESDAY 13 MAY AND WEDNESDAY 14 MAY

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

Rectangular transparent optics block (smaller than 15 cm × 12 cm)

Ray box with single slit

12 V power supply unit (a.c. or d.c.)

Protractor

Rule (30 cm)

Preparation

Connect the ray box to the power supply.

Before the examination

Place the following on the bench: ray box connected to power supply, transparent block, protractor and ruler.

Action at changeover

Return the apparatus to the original arrangement on the bench.

Information required by examiners

None

Question 2

Principal Requirements

Retort stand

Boss and clamp

Optical pin

Cork

Cord (thin)

Rule (metre)

Vernier callipers (analogue, accurate to 0.1 mm)

Micrometer screw gauge (accurate to 0.01 mm)

Mass hanger (100 g)

Slotted mass (100 g)

G-clamp

Tape

Preparation

Tape the 100 g mass to the mass hanger.
Cut 10 cm of cord and form a loop which loosely fits over the metre rule.
Attach a cork to the clamp, which is held by a boss to a retort stand. Close the jaws of the clamp, to ensure the cork is unable to move or become detached. Place an optical pin into the cork.
Drill a hole at the 35 cm mark in the centre of the metre rule. Suspend the metre rule from the pin at this hole. The hole should be sufficiently wide to enable the rule to move easily about the optical pin.
Clamp the retort stand to the bench.
Assemble the apparatus as shown in **Fig. 2.1**.

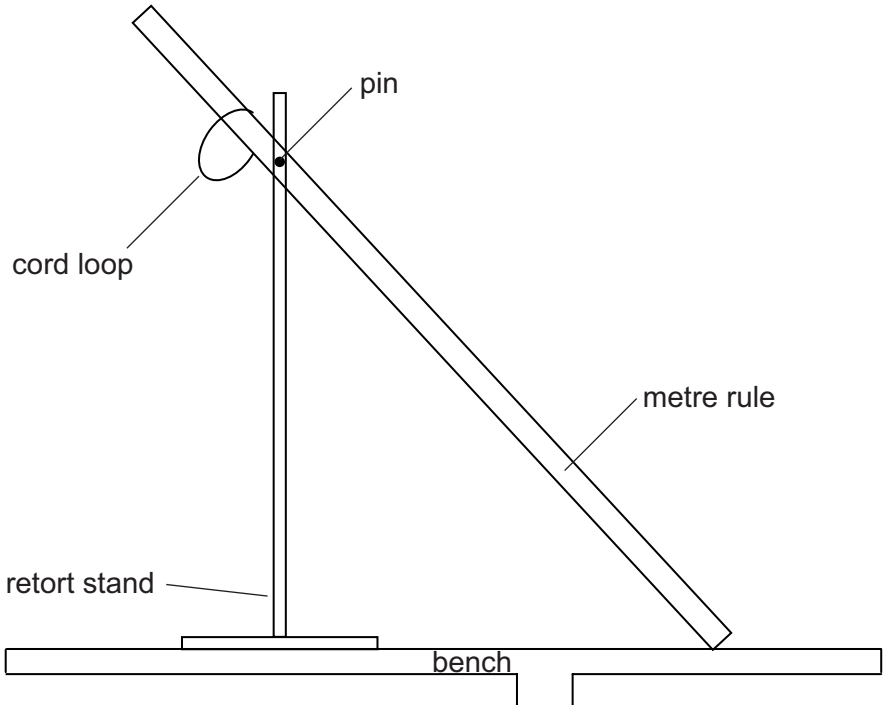


Fig. 2.1

Before the examination

Set up the apparatus as shown with the loop on the short end of the metre rule.
Place the mass on the bench.

Action at changeover

Return the apparatus to the original arrangement as shown in **Fig. 2.1**.

Information required by examiners

None

Question 3

Principal Requirements

Retort stand

Boss and clamp

Mass hanger (100 g)

Slotted masses (2 × 100 g)

Helical spring (≈ 25 mm length, disposable)

Rule (50 cm)

Stopwatch/stopclock (digital)

Tape

Preparation

Tape the two 100 g masses to the mass hanger. Attach the boss and clamp to the top of the retort stand. Suspend the spring from the clamp and secure by tightening the clamp.
Hang the slotted masses and hanger from the spring.
Zero the timer and leave adjacent to the retort stand with the rule.

Before the examination

Assemble the apparatus as described in “Preparation” above.

Action at changeover

Return the apparatus to the original arrangement with the timer zeroed and the mass suspended from the spring.

Information required by examiners

None

Question 4

Principal Requirements

1.5 V cell

1.5 V cell holder

Ammeter; digital, reading to 20 mA

Voltmeter; digital, reading to 20 V

Leads: 4 mm

Opaque box; guide size 10 cm × 10 cm × 5 cm

Sockets; 4 mm, black

Sockets; 4 mm, red

Resistors; 470 Ω ± 10%, carbon, power rating not critical

Preparation

(a) Resistor box

Fit the 4 mm sockets to the lid of the box in the arrangement shown in **Fig. 4.1**. Label the red sockets A, B and C, and the black socket O.

On the underside of the lid, solder the 470 Ω resistors to the terminals in the arrangement shown in **Fig. 4.2**. Replace the lid on the box and secure with screws or tape.

(b) Circuit to be provided to the candidates

Connect the circuit of **Fig. 4.3.** Confirm that when the circuit is connected to terminals A and O of the box, the voltage and current readings are approximately 1.5 V and 3.0 mA. Also confirm that when the circuit is connected to terminals B and O, the readings are approximately 1.5 V and 1.0 mA, and when the circuit is connected to terminals C and O, the readings are approximately 1.5 V and 2.0 mA.

Before the examination

Leave the circuit of **Fig. 4.3** connected on the bench beside, but not connected to, the box.

Action at changeover

Disconnect the box from the circuit. Make sure the circuit is set up as in **Fig. 4.3**.

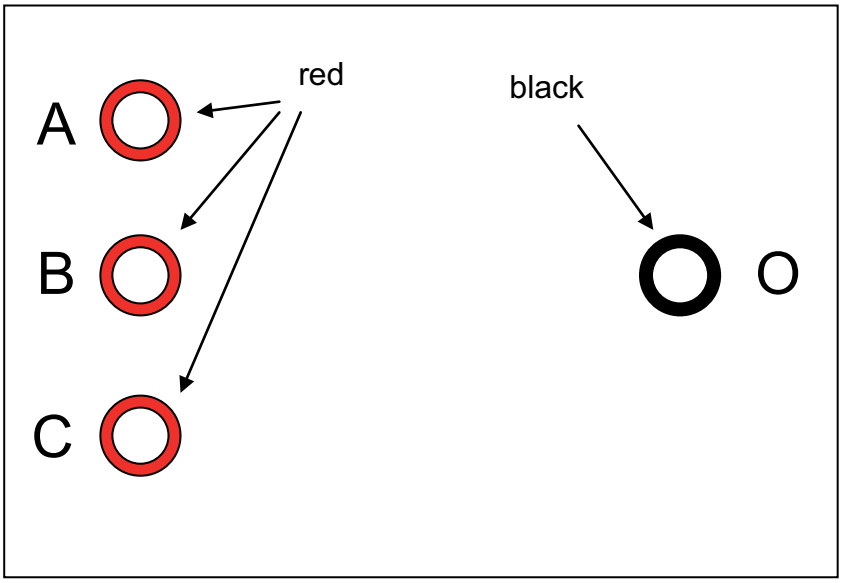


Fig. 4.1

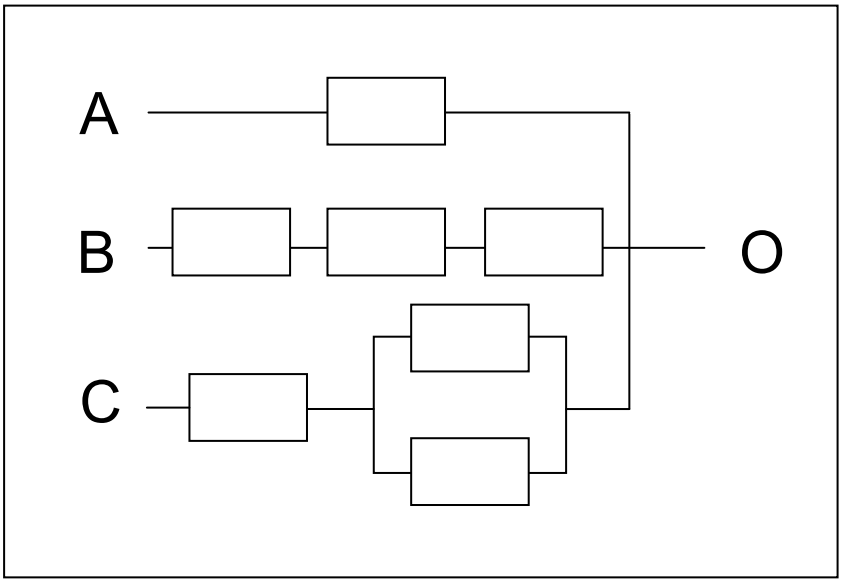


Fig. 4.2

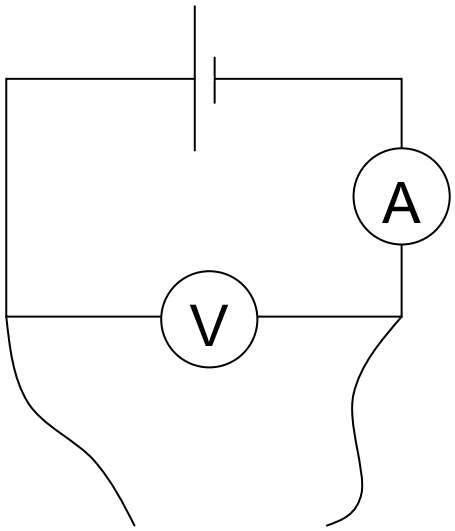


Fig. 4.3

Question 5

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

SESSION 2

Question 1

Principal Requirements

Rectangular transparent optics block (smaller than 15 cm × 12 cm)

Ray box with single slit

12 V power supply unit (a.c. or d.c.)

Protractor

Rule (30 cm)

Preparation

Connect the ray box to the power supply.

Before the examination

Place the following on the bench: ray box connected to power supply, block, protractor and ruler.

Action at changeover

Return the apparatus to the original arrangement on the bench.

Information required by examiners

None

Question 2

Principal Requirements

Retort stand

Boss and clamp

Optical pin

Cork

Cord (thin)

Rule (metre)

Vernier callipers (analogue, accurate to 0.1 mm)

Micrometer screw gauge (accurate to 0.01 mm)

Mass hanger (100 g)

Slotted mass (100 g)

G-clamp

Tape

Preparation

Tape the 100 g mass to the mass hanger.
Cut 10 cm of cord and form a loop which loosely fits over the metre rule.
Attach a cork to the clamp, which is held by a boss to a retort stand. Close the jaws of the clamp, to ensure the cork is unable to move or become detached. Place an optical pin into the cork.
Drill a hole at the 30 cm mark in the centre of the metre rule. Suspend the metre rule from the pin at this hole. The hole should be sufficiently wide to enable the rule to move easily about the optical pin.
Clamp the retort stand to the bench so that the end of the rule rests on the bench.
Assemble the apparatus as shown in **Fig. 2.1**.

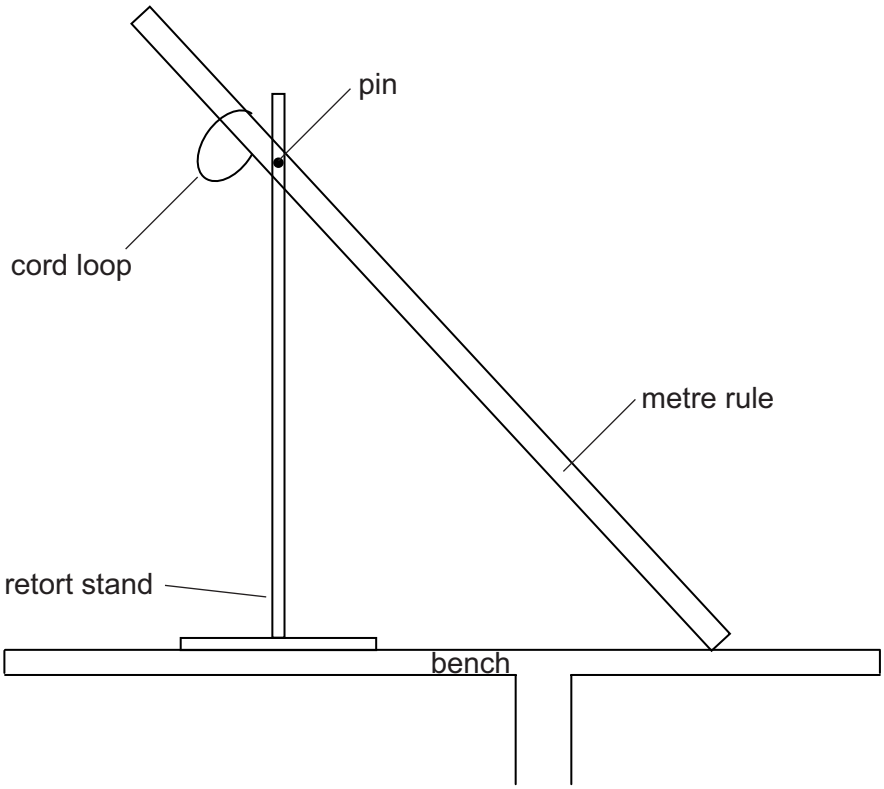


Fig. 2.1

Before the examination

Set up the apparatus as shown with the loop on the short end of the metre rule.
Place the mass on the bench.

Action at changeover

Return the apparatus to the original arrangement as shown in **Fig. 2.1**.

Information required by examiners

None

Question 3

Principal Requirements

Retort stand

Boss and clamp

Mass hanger (100 g)

Slotted masses (3 × 100 g)

Helical spring (≈ 25 mm length, expendable)

Rule (50 cm)

Stopwatch/stopclock (digital)

Tape

Preparation

Tape the three × 100 g masses to the mass hanger. Attach the boss and clamp to the top of the retort stand. Suspend the spring from the clamp and secure by tightening the clamp.
Hang the slotted masses and hanger from the spring.
Zero the timer and leave adjacent to the retort stand with the rule.

Before the examination

Assemble the apparatus as described in “Preparation” above.

Action at changeover

Return the apparatus to the original arrangement with the timer zeroed and the mass suspended from the spring.

Information required by examiners

None

Question 4

Principal Requirements

1.5 V cell

1.5 V cell holder

Ammeter; digital, reading to 20 mA

Voltmeter; digital, reading to 20 V

Leads: 4 mm

Opaque box; guide size 10 cm × 10 cm × 5 cm

Sockets; 4 mm, black

Sockets; 4 mm, red

Resistors; 470 Ω ± 10%, carbon, power rating not critical

Preparation

(a) Resistor box

Fit the 4 mm sockets to the lid of the box in the arrangement shown in **Fig. 4.1**. Label the red sockets A, B and C, and the black socket O.

On the underside of the lid, solder the 470 Ω resistors to the terminals in the arrangement shown in **Fig. 4.2**. Replace the lid on the box and secure with screws or tape.

(b) Circuit to be provided to the candidates

Connect the circuit of **Fig. 4.3.** Confirm that when the circuit is connected to terminals A and O of the box, the voltage and current readings are approximately 1.5 V and 3.0 mA. Also confirm that when the circuit is connected to terminals B and O, the readings are approximately 1.5 V and 2.0 mA, and when the circuit is connected to terminals C and O, the readings are approximately 1.5 V and 1.0 mA.

Before the examination

Leave the circuit of **Fig. 4.3** connected on the bench beside, but not connected to, the box.

Action at changeover

Disconnect the box from the circuit. Make sure the circuit is set up as in **Fig. 4.3**.

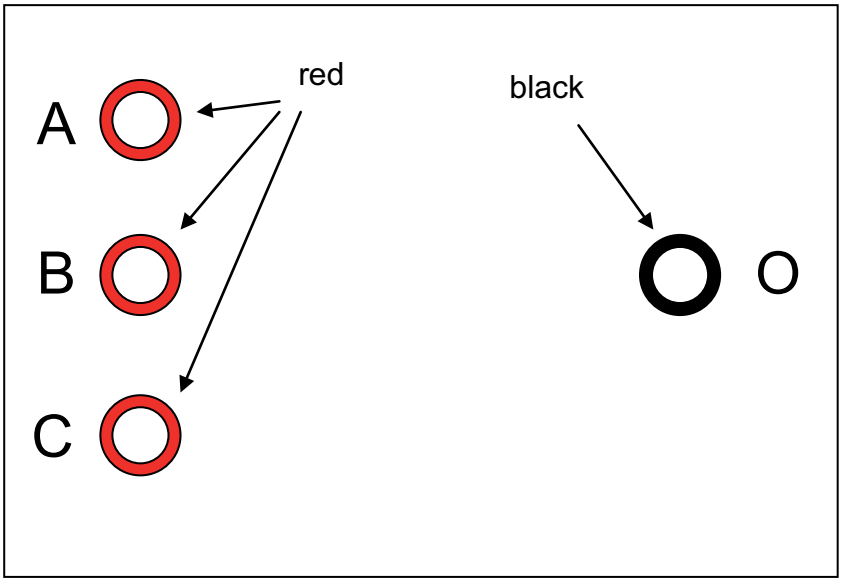


Fig. 4.1

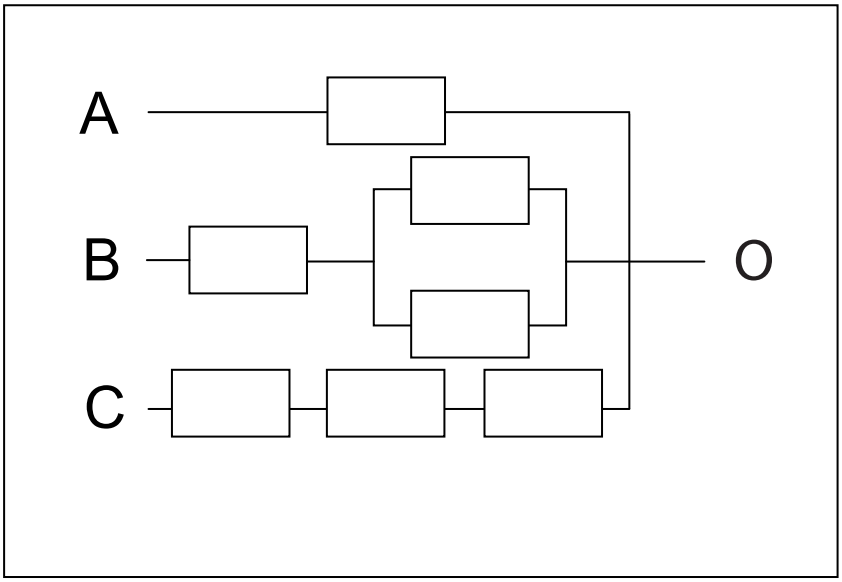


Fig. 4.2

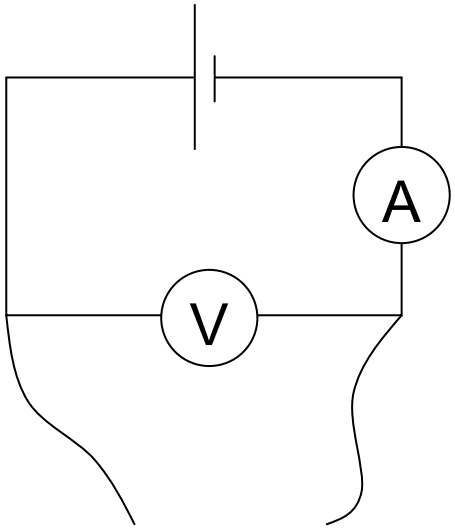


Fig. 4.3

Question 5

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