



Rewarding Learning

ADVANCED
General Certificate of Education
2014

Centre Number

71	
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Candidate Number

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Physics

Assessment Unit A2 3
Practical Techniques
Session 1

[AY231]

FRIDAY 9 MAY, MORNING



AY231

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 Examiner's use only		
Question Number	Marks	Remark
1		
2		
3		
Total Marks		

INSTRUCTIONS TO CANDIDATES

Answer **all** questions in this paper. Rough work and calculations must also be done in this paper. Except where instructed, do not describe the apparatus or experimental procedures. The supervisor will tell you the order in which you are to answer the questions. Not more than 30 minutes are to be spent in answering each question. You may be told to start with the experimental tests in Section A, or with the single question in Section B.

Section A consists of two experimental tests. A 28-minute period is allocated for you to use the apparatus. Two minutes is allocated to the supervisor to prepare the station for the next candidate. At the end of the 30-minute period you will be instructed to move to the area set aside for your next question. Section B consists of one question in which you will be tested on aspects of planning and design.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.

All questions 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.

Section A

- 1 In this experiment you will investigate the oscillation of a pendulum in the form of a metre rule. The period of oscillation of the pendulum depends on the distance of the point of suspension to the centre of mass of the rule.

The aims of the experiment are:

- to obtain the period of oscillation of the metre rule when it swings from each point of suspension
- to analyse the results and determine the values of two constants.

Apparatus

You are provided with a metre rule which has holes drilled in it at distance D of 20 cm, 25 cm, 30 cm, 35 cm, 40 cm from the end of the rule.

Procedure

Suspend the rule from the pin clamped on the stand, using the hole drilled in the rule at the 40 cm mark, as shown in **Fig. 1.1**.

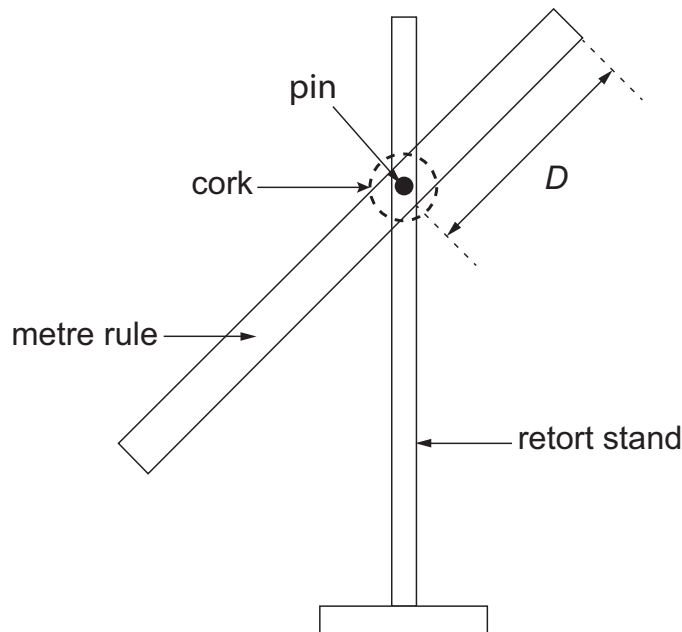


Fig. 1.1

- (a) (i) Set the rule into oscillations of small amplitude and take readings to allow you to determine an accurate value of the period T of the oscillation. Record your readings in **Table 1.1**.

Repeat the procedure, suspending the rule in turn from the holes at 35 cm, 30 cm, 25 cm and 20 cm. Record your readings in **Table 1.1**. The other columns in the table are for use later.

Table 1.1

D/cm		Period T/s	d/cm	$T^2d/\text{s}^2\text{cm}$	d^2/cm^2
40					
35					
30					
25					
20					

[6]

- (ii) d is the distance from the centre of mass (assumed to be at the 50 cm mark) to the point of suspension, hence

$$d = 50 - D$$

Insert values for d in **Table 1.1**.

[1]

- (b) A relationship between T and d is given by **Equation 1.1**

$$T^2 - Ad - \frac{B}{d} = 0 \quad \text{Equation 1.1}$$

where A and B are constants.

- (i) Use **Equation 1.1** to show that a graph of T^2d (y -axis) against d^2 will be linear.

[2]

Examiner Only

Marks Remark

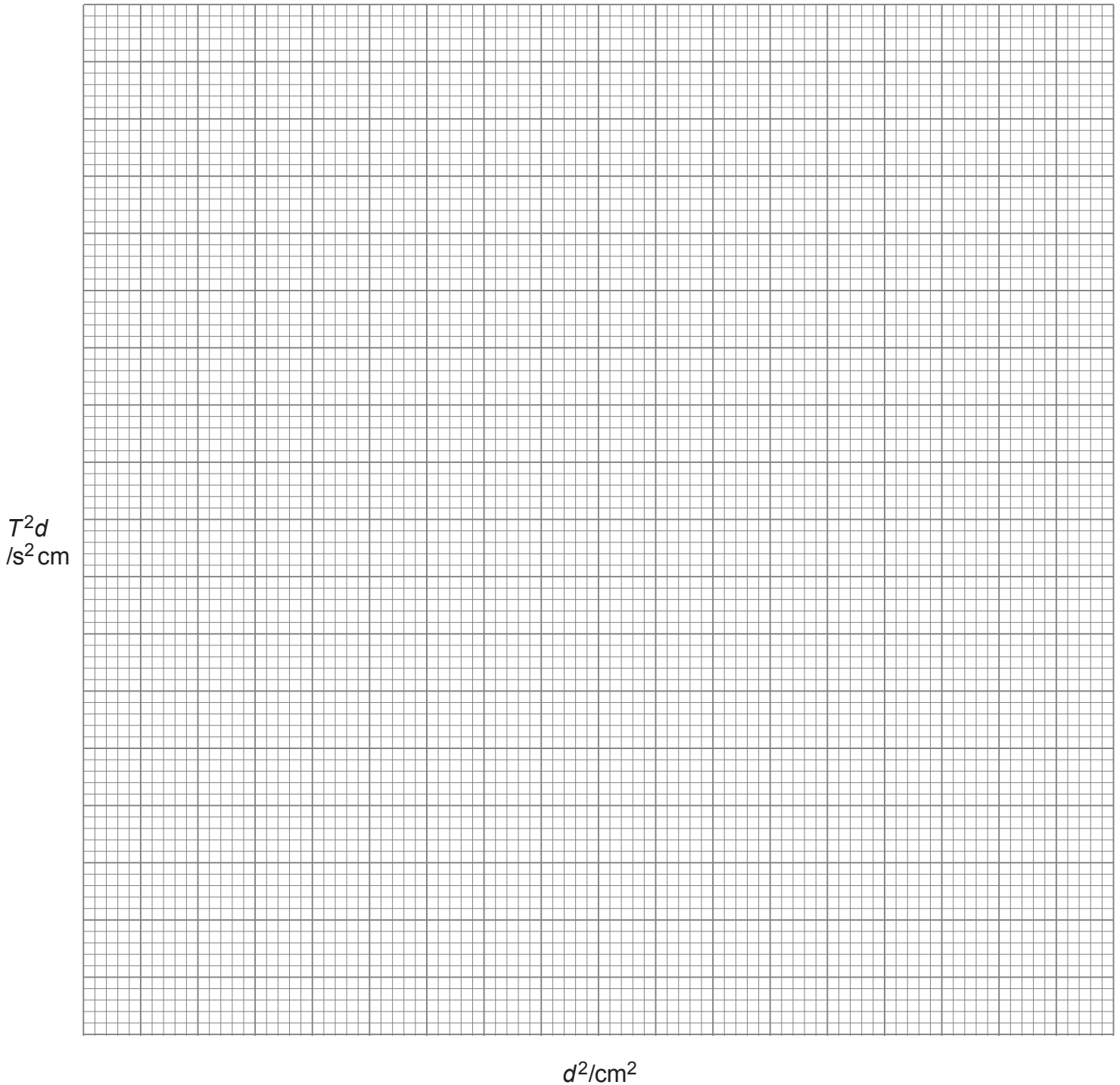
- (ii) To draw this graph, it is necessary to calculate T^2d and d^2 . Complete the last two columns of **Table 1.1** by inserting values calculated from your results.

[1]

Examiner Only	
Marks	Remark

- (iii) You are to draw the graph T^2d against d^2 . Choose suitable scales for the graph grid in **Fig. 1.2**. Plot the points and draw the best fit straight line.

[4]



d^2/cm^2

Fig. 1.2

(iv) From your graph, find the numerical values of the constants A and B. Show clearly how the values are obtained. Enter the values, with appropriate units, below.

A = _____ Unit _____

B = _____ Unit _____

[6]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

- 2 In this experiment you will investigate how the power dissipated by a small bulb varies with the voltage applied.

The aims of the experiment are:

- to measure current and voltage
- to plot a graph to find the relationship between the power dissipated by the bulb and the applied voltage.

- (a) The circuit shown in **Fig. 2.1** has been set up.

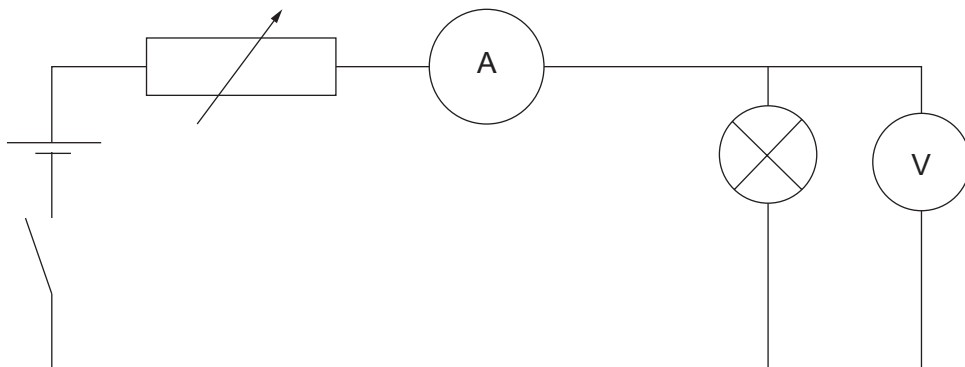


Fig. 2.1

- (i) You are to take a series of five readings of the voltage, V across the bulb, and the current, I flowing through it. Using the variable resistor, vary the voltage from about 0.7 V to about 1.4 V.

Record these readings in **Table 2.1**.

Table 2.1

V/V	I/A	$P/$ ___	$\lg_{10}(P/\text{unit})$	$\lg_{10}(V/V)$

[5]

- (ii) For each pair of the readings of V and I calculate the corresponding value of the power, P dissipated by the bulb.
(Reminder: *power = voltage \times current*)

Enter the values in the column headed P in **Table 2.1**.

Include a unit for P .

[2]

- (b) The power dissipated by the bulb is related to the voltage across the bulb by the relationship given by **Equation 2.1**

$$P = BV^n \quad \text{Equation 2.1}$$

where B and n are constants.

Examiner Only

Marks Remark

- (i) Use **Equation 2.1** to show that a graph of $\lg_{10} P$ (y -axis) against $\lg_{10} V$ will be linear.

Examiner Only	
Marks	Remark

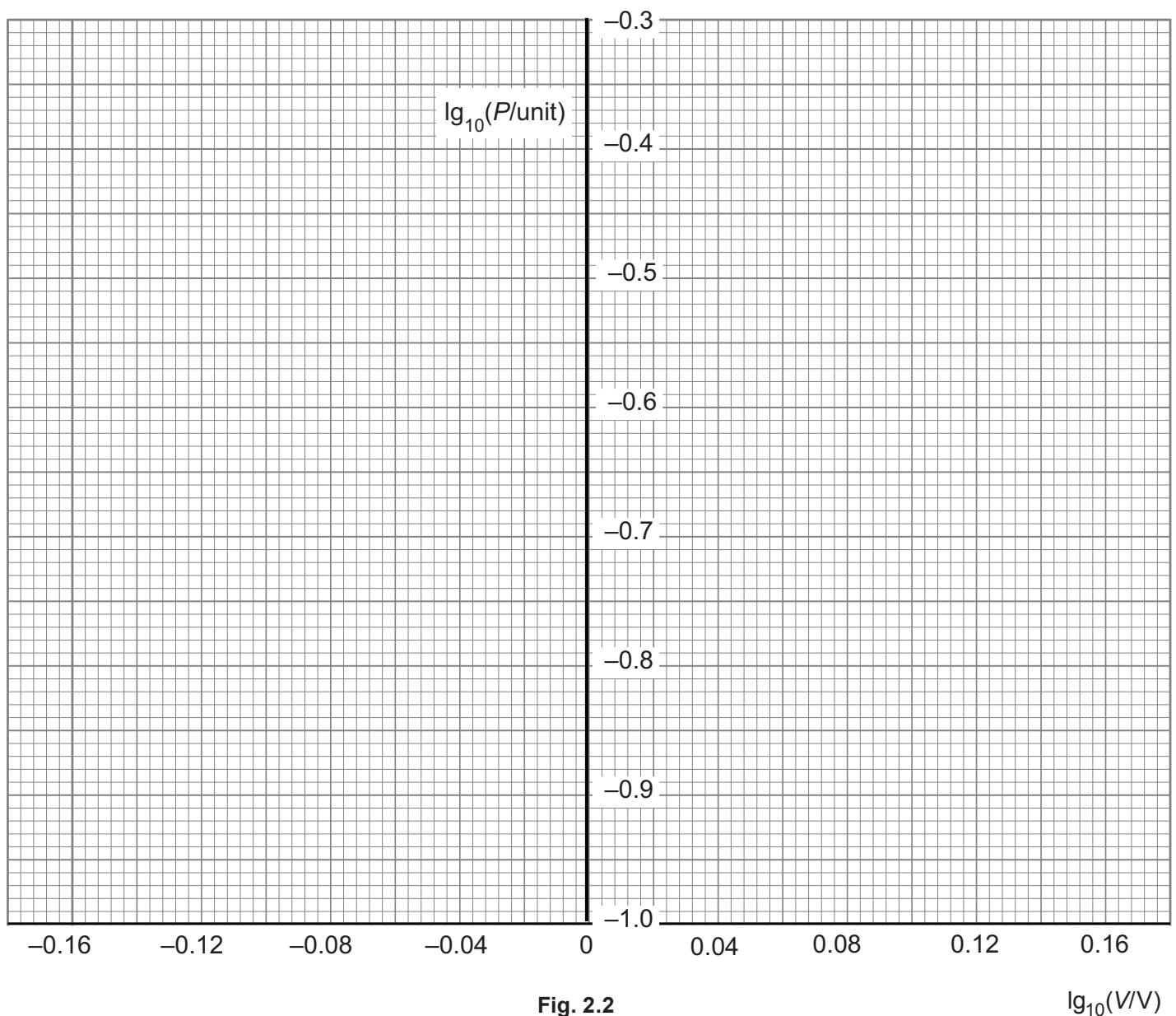
[2]

- (ii) To draw this graph, it is necessary to calculate additional quantities from your results. Complete the two blank columns of **Table 2.1** with quantities calculated from your results.

[2]

- (iii) Plot the points on **Fig. 2.2** and draw the best fit straight line.

[3]



(iv) From your graph, find the value of n . Show clearly how the value is obtained.

$n =$ _____

[3]

(v) Determine the percentage uncertainty in the value for n obtained in (iv) using your graph in **Fig. 2.2**.

Uncertainty in $n =$ _____ %

[3]

Examiner Only	
Marks	Remark

BLANK PAGE

(Questions continue overleaf)

Section B

Examiner Only	
Marks	Remark

3 In this question you will plan an experiment to investigate the behaviour of solid steel cylinders, of various diameters, as they roll down a slope as shown in **Fig. 3.1**.

The cylinder diameters are in the range 30 mm–100 mm but they all have a length L of 42.0 mm. You have access to any equipment normally found in a physics laboratory except that used to measure mass. However, a value for the density of steel is provided, and density = mass/volume.

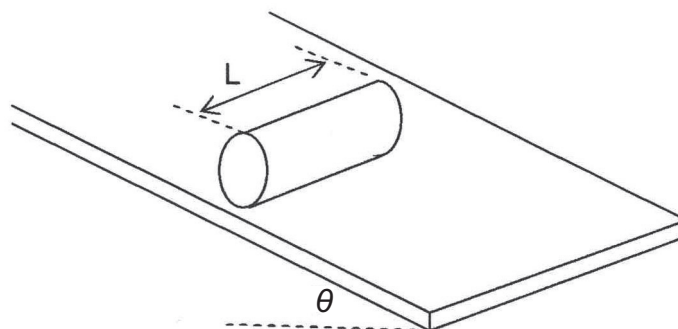


Fig. 3.1

The plan

(a) (i) Describe a suitable method, based on the arrangement of **Fig. 3.1**, that will allow you to investigate the relationship, if any, that exists between the mass of the cylinders and their average velocity, v , as they travel down the slope.

Your method should also include:

- the measurements you will take
- the instruments used, include the uncertainty in any measurement taken with each instrument
- an explanation as to how the average velocity and mass of the cylinder are determined from your measurements
- how you will maximise the reliability of your results.

[8]

Examiner Only	
Marks	Remark

- (ii) One cylinder has a diameter of 62.0 mm. The density of the steel used to make the cylinders is 7850 kg m^{-3} . Find the mass of this cylinder and estimate the uncertainty in this value. Assume the uncertainty in the value for the density is negligible.
(Cylinder volume = $\pi r^2 L$)

Mass = _____ kg

Uncertainty = \pm _____ kg [5]

- (b) (i) A student suggests that another factor which changes the average velocity is the angle θ of the slope to the horizontal. Suggest an accurate method for measuring this angle.

_____ [2]

- (ii) State another factor which will affect the average velocity.

_____ [1]

- (c) Explain how the results taken can be used to determine the acceleration experienced by the cylinder as it rolls down the slope.

[2]

- (d) (i) In one experiment a cylinder of mass 1.60 kg loses 2.35 J of potential energy and acquires a velocity of 1.42 m s^{-1} at the bottom of the slope. Calculate the kinetic energy gained.

Kinetic energy = _____ J [1]

- (ii) From what vertical height was the cylinder released in this experiment? (The acceleration of free fall is 9.81 m s^{-2} .)

Height = _____ m [1]

Examiner Only

Marks Remark

THIS IS THE END OF THE QUESTION PAPER

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2014

Physics

Assessment Unit A2 3

assessing

Practical Techniques

[AY231] [AY232]

FRIDAY 9 MAY AND MONDAY 12 MAY

CONFIDENTIAL INSTRUCTIONS TO TEACHERS

CONFIDENTIAL INSTRUCTIONS FOR PHYSICS A2 PRACTICAL TEST

Confidentiality

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

General

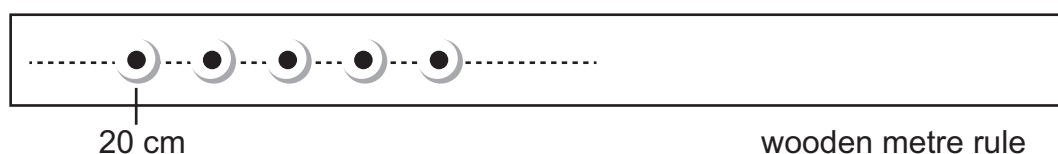
The Practical Test will contain three compulsory questions, of which two are 30-minute experimental tests and the third is a 30-minute question testing Planning and Design. The total time allowed is 1 hour 30 minutes. The order in which candidates are to take the questions is to be decided by the Supervisor. Candidates will have access to the apparatus in the experimental tests for 28 minutes each, the final two minutes being reserved for adjustment of the apparatus by the Supervisor. The question paper includes spaces for answers; candidates will write their answers in the Question/Answer booklet.

Question 1 (Session 1 and Session 2)

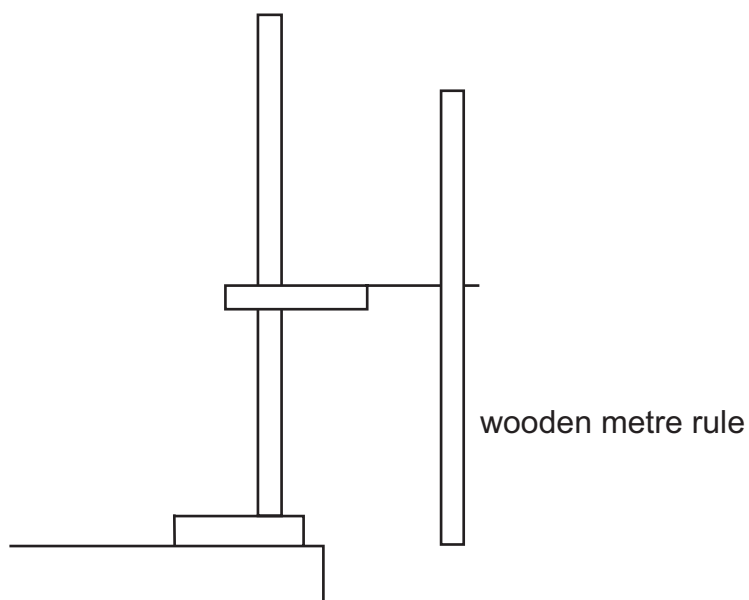
Ref	Component	Session 1	Session 2
1.1	Wooden metre rule	1	1
1.2	Retort stand	1	1
1.3	Boss and clamp	1	1
1.4	G clamp	1	1
1.5	Cork and pin, e.g. an optical pin	1	1
1.6	Digital timer	1	1

Preparation

Drill small holes, large enough for the head of the pin to fit through, to take the pin at the 40 cm, 35 cm, 30 cm, 25 cm and 20 cm marks along the central axis of the metre rule.



Clamp the retort stand securely to the bench top using the G clamp. Place the cork and pin in the clamp attached to the boss on the retort stand so that when it is inserted in any of the holes in the metre rule, the metre rule can swing steadily and freely.



Before the examination

Set up the apparatus as in the Preparation above.
Leave the digital timer and metre rule beside the apparatus. Ensure the timer is zeroed.

Action at Changeover

Remove the metre rule from the retort stand and zero the timer.

Information required by Examiners

None.

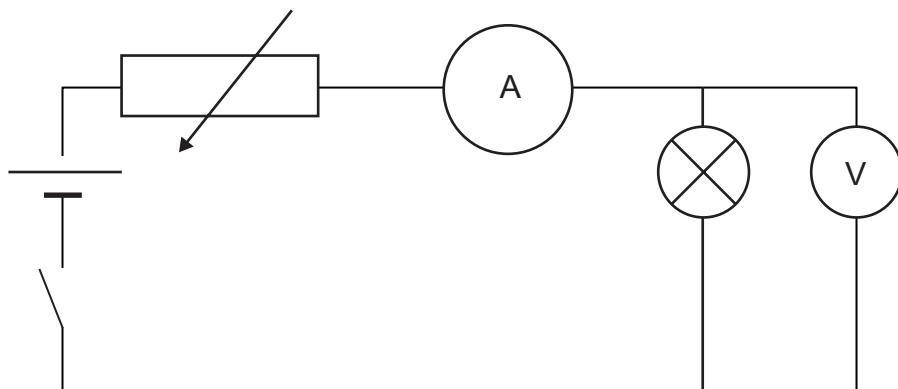
Question 2 (Session 1 and Session 2)

Ref	Component	Session 1	Session 2
2.1	Digital voltmeter reading to 0.01 V	1	1
2.2	Digital ammeter reading to 0.01 A	1	1
2.3	1.5 V 300 mA bulb	1	1
2.4	Bulb holder with 4 mm sockets	1	1
2.5	1.5 V battery and holder	1	1
2.6	Variable resistor, e.g. 25 Ω , 3 W	1	1
2.7	Connecting leads; 4 mm plugs at each end	7	7
2.8	Toggle switch	1	1

Preparation

Set up the circuit shown below and test that a range of **five** voltages and currents can be obtained: from 1.4 V to 0.7 V and about 0.3 A–0.2 A.

Ensure the power values (VI) range between 0.5 W and 0.1 W.



Before the Examination

Leave the circuit on the bench with the switch open and the variable resistor set to mid-range.

Action at Changeover

Set up circuit as for “Before the Examination”.

Information required by Examiners

None.

Question 3

Apart from the provision of a suitable working area, no apparatus is required for this planning question.



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Physics

Assessment Unit A2 3

assessing

Practical Techniques
Sessions 1 and 2

[AY231] [AY232]

FRIDAY 9 MAY AND MONDAY 12 MAY

APPARATUS AND MATERIALS LIST

A2 PHYSICS UNIT 3 (A2 3) APPARATUS AND MATERIALS REQUIRED FOR PRACTICAL ASSESSMENTS

CONFIDENTIAL

Information about the apparatus and materials required for the A2 Practical Assessments **must not** be communicated to candidates sitting the examination.

This document gives preliminary information on the apparatus and materials required for the A2 Practical Assessments.

Teachers will be given detailed instructions for setting up the experiments in the *Confidential Instructions for Physics (A2) 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 A2 3 Practical Techniques Assessment is a test of practical skills consisting of Section A and Section B. Section A comprises 2 experimental tests (40 marks) and Section B consists of one question which tests aspects of planning and design (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 apparatus for the next candidates. In each of the experimental tests (Q1 and Q2), candidates must stop using the apparatus after 28 minutes. At the end of each 28 minute period, a changeover time of 2 minutes will be set aside for the supervisor to re-set the apparatus for the next candidates. During the changeover periods, candidates may write-up anything they have not completed, however they will not have access to the apparatus. Candidates will move on to the next question after 30 minutes. The time allocation for **question 3** (planning and design) is 30 minutes. As the time allocation for each question is effectively the same, the supervisor can decide in which order the candidates should attempt the questions.

The apparatus in the following list will allow for **one experiment** to be set up for each of the practical tests which make up **questions 1 and 2**. In other words, each set of apparatus (as listed on page 4) will accommodate three candidates.

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

Friday 9 May 2014 Physics A2 3A (AY231)

(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**

Monday 12 May 2014 Physics A2 3B (AY232)

(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 A2 3A (AY231) will therefore be sufficient for twelve candidates on **9 May** if the Main Session and all three alternatives are used. Similarly, one set of apparatus for A2 3B (AY232) will be sufficient for twelve candidates on **12 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 three, six, nine 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.

Question 1

Ref	Component	Session 1	Session 2
1.1	Wooden metre rule	1	1
1.2	Retort stand	1	1
1.3	Boss and clamp	1	1
1.4	G clamp	1	1
1.5	Cork and pin, e.g. an optical pin	1	1
1.6	Digital timer reading to 0.01 s	1	1

Question 2

Ref	Component	Session 1	Session 2
2.1	Digital voltmeter reading to 0.01 V	1	1
2.2	Digital ammeter reading to 0.01 A	1	1
2.3	1.5 V 300 mA bulb	1	1
2.4	Bulb holder with 4 mm sockets	1	1
2.5	1.5 V battery and holder	1	1
2.6	Variable resistor, e.g. 25 Ω , 3 W	1	1
2.7	Connecting leads; 4 mm plugs at each end	7	7
2.8	Toggle switch	1	1