Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Physics

Assessment Unit AS 3

assessing

Practical Techniques (Internal Assessment)
Session 1

[AY131]

AY131

THURSDAY 12 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	
	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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(Questions start overleaf)

Teacher Mark	Examiner Check	Remark

Section A

1 In this experiment you are to investigate how the period of oscillation of a loaded chain of springs varies as the number of springs in the chain is increased.

(a) The apparatus with a chain of two springs has already been set up for you, see **Fig. 1.1**. Chains of three and four springs have also been provided on the bench.

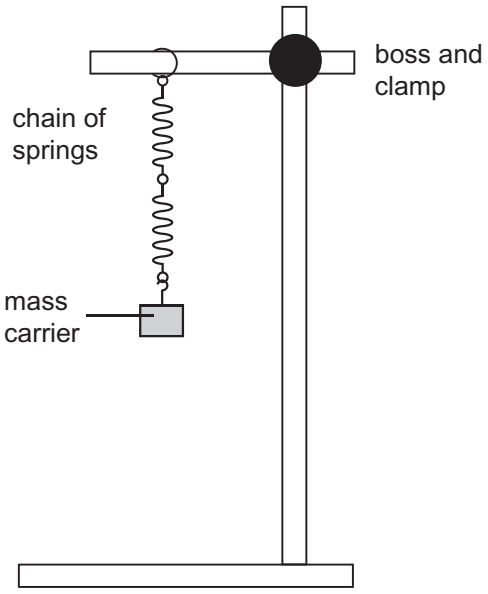

Fig. 1.1

Displace the mass carrier a small distance, release and allow it to oscillate. Take readings that will allow you to determine *T*, the period of the oscillation. Record **all** your results in **Table 1.1**.

Replace the chain of two springs with the chain of three springs and repeat the above procedure.

Finally replace the chain of three springs with the chain of four springs and repeat the above procedure.

Table 1.1

Number of springs		***T*/s**
2		
3		
4		

[3]

Teacher Mark	Examiner Check	Remark

(b) It is suggested that the relationship between the period T of the oscillations of the spring system and the number of springs N is one of the following:

(i) $T = 2\pi\sqrt{\frac{Nm}{k}}$

(ii) $T = 2\pi\sqrt{\frac{m}{Nk}}$

(iii) $T = 2\pi\sqrt{\frac{m}{k}}$ i.e. T is independent of N

where m and k are constants.

Using your results in **Table 1.1**, choose which of the equations best describes the trend of your results. Explain your answer.

Equation _____

Explanation:

_____

_____

_____ [2]

Teacher Mark	Examiner Check	Remark

2 In this experiment you are to obtain a value for the focal length of a converging lens.

Fig. 2.1 shows the arrangement of the apparatus which has already been set up for you.

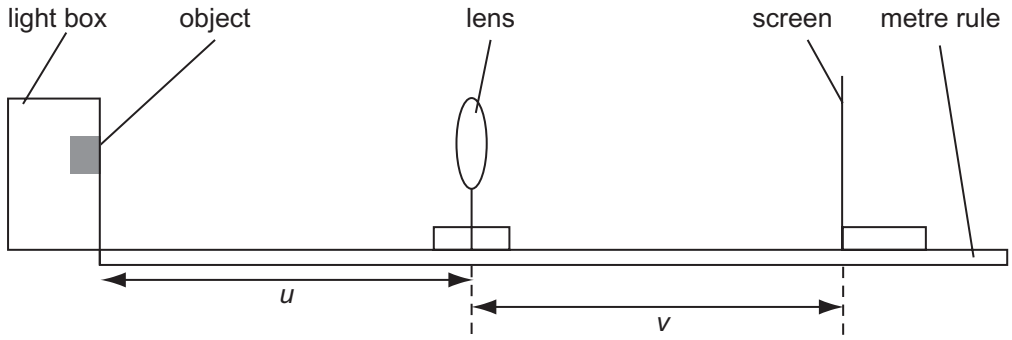

Fig. 2.1

The distance *u* has been set at 25.0 cm for your first reading.

(a) **Without moving the object or the lens**, adjust the position of the screen until a focused image is seen on the screen. Measure the distance *v* between lens and screen. Record the value of *v* in **Table 2.1**.

Repeat this procedure for $u = 30.0$ and 40.0 cm and record the corresponding values of *v* in **Table 2.1**.

Table 2.1

***u*/cm**	***v*/cm**
25.0	
30.0	
40.0	

[1]

Teacher Mark	Examiner Check	Remark

(b) A relationship between u and v is given by **Equation 2.1**.

$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f} \qquad \textbf{Equation 2.1}$$

(i) Use **Equation 2.1** and the result for $u = 25.0\,\text{cm}$ in **Table 2.1**, to calculate a value of f.

$f =$ _____ cm [2]

(ii) Explain how you could obtain a more accurate value for f using the results from **Table 2.1**.

_____

_____ [1]

(iii) What is the major source of uncertainty in this experiment?

_____

_____ [1]

Teacher Mark	Examiner Check	Remark

3 In this experiment you are to measure the diameter and thickness of a 50 g slotted mass and find the diameter to thickness ratio.

You are provided with two measuring instruments, a vernier calliper and a micrometer screw gauge.

(a) Which of the two measuring instruments are you going to choose to measure the **thickness** of the slotted mass? Give a reason for your choice and state the uncertainty in a measurement using the instrument.

Instrument: _____

_____

_____

Uncertainty: ± _____ mm [2]

For this question you are not expected to take repeat readings.

(b) Measure the thickness of the 50 g slotted mass. Give your answer to an appropriate number of decimal places.

Thickness = _____ mm [1]

(c) Measure the diameter of the 50 g slotted mass. Give your answer to an appropriate number of decimal places.

Diameter = _____ mm [1]

(d) Hence, calculate the ratio diameter/thickness of the 50 g slotted mass.

Ratio = _____ [1]

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(Questions continue overleaf)

Teacher Mark	Examiner Check	Remark

4 In this experiment you are to calculate the resistance of three wires of the same thickness, made of the same material and of lengths 10 cm, 15 cm and 20 cm. The wires are inside a sealed box. You are then to establish which wire has been connected to which pair of terminals.

Fig. 4.1 shows the circuit containing the sealed box, a power supply, switch, ammeter and voltmeter. The meters can be used to determine the resistance between selected pairs of terminals. One of the wires is soldered between terminals W and X, another is soldered between W and Y and the final wire is soldered between W and Z.

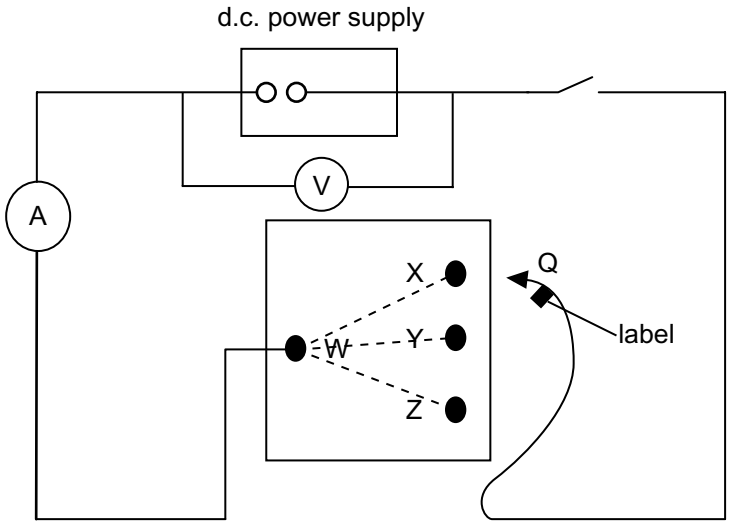

Fig. 4.1

(a) Connect lead Q to terminal X.
Hold the switch closed and record the value of current and voltage, shown on the meters, in **Table 4.1**. Repeat this process for lead Q connected to Y and then Z.
Note: the switch should only be closed as a reading is being taken.

Table 4.1

terminals	*V*/V	*I*/A	*R*/Ω
W and X			
W and Y			
W and Z			

[2]

Teacher Mark	Examiner Check	Remark

(b) Hence calculate the resistance of each length of wire and record your results in **Table 4.1**. [1]

(c) By examining your results, establish between which terminal a particular wire is soldered. Explain your reasoning.

10 cm wire connected between W and _____

15 cm wire connected between W and _____

20 cm wire connected between W and _____

Explanation:

_____

_____

_____ [2]

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Section B

Teacher Mark	Examiner Check	Remark

5 The potential divider circuit

A circuit diagram of a potential divider circuit is shown in **Fig. 5.1**.

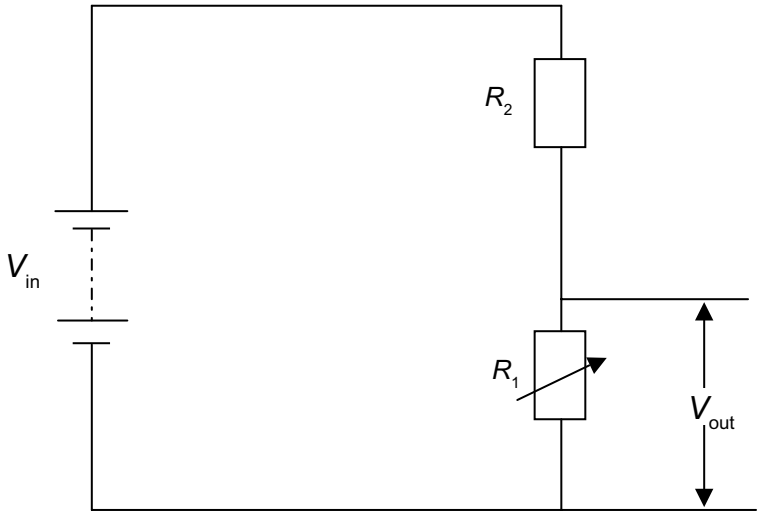

Fig. 5.1

R_1 is a variable resistor. The values of V_{in} and R_2 are not known. A student uses the apparatus to measure V_{out} for several values of R_1. The results obtained are recorded in **Table 5.1**.

Table 5.1

R_1/Ω	V_{out}/V		
5.0×10^1	3.8		
1.0×10^2	6.0		
1.5×10^2	7.2		
2.0×10^2	8.0		
2.5×10^2	9.1		

The relationship between R_1 and V_{out} is given by **Equation 5.1**.

$$\frac{1}{V_{out}} = \frac{R_2}{V_{in}\ R_1} + \frac{1}{V_{in}} \qquad \textbf{Equation 5.1}$$

Teacher Mark	Examiner Check	Remark

(a) Use **Equation 5.1** to show that a graph of $\frac{1}{V_{out}}$ plotted against $\frac{1}{R_1}$ will result in a straight line graph of gradient $\frac{R_2}{V_{in}}$ and intercept $\frac{1}{V_{in}}$.

[2]

Data Processing

(b) **(i)** Head the blank columns of **Table 5.1** with the quantities that should be plotted to draw the graph in **(a)** and include appropriate units for each. [1]

(ii) Calculate the numerical values required to complete the blank columns in **Table 5.1** to an appropriate number of significant figures. [3]

(iii) On the grid of **Fig. 5.2** opposite, draw the graph of 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]

Analysis

(c) **(i)** Determine the value of V_{in}.

V_{in} = _____ V [2]

Teacher Mark	Examiner Check	Remark

(ii) Determine the experimental uncertainty in V_{in} by drawing a line of extreme fit on **Fig 5.2**.

Uncertainty = ± _____ V [3]

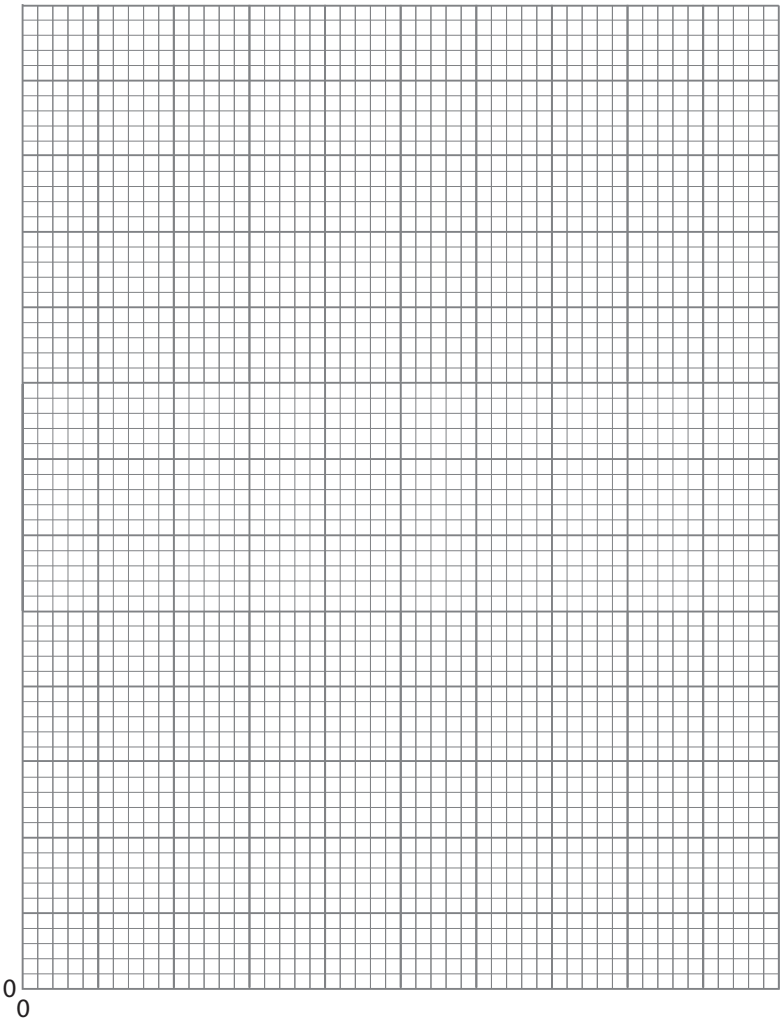

Fig. 5.2

(iii) Calculate the value of R_2

R_2 = _____ Ω [4]

THIS IS THE END OF THE QUESTION PAPER

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Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Physics

Assessment Unit AS 3

assessing

Practical Techniques
Sessions 1 and 2

[AY131] [AY132]

THURSDAY 12 MAY AND FRIDAY 13 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. 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 2011.

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 below) 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:

Thursday 12 May 2011 Physics AS 3A (AY131)

(Main Session) **9.15 a.m. – 10.45 a.m.**
(First Alternative) **11.00 a.m. – 12.30 p.m.**
(Second Alternative) **1.15 p.m. – 2.45 p.m.**
(Third Alternative) **3.00 p.m. – 4.30 p.m.**

Friday 13 May 2011 Physics AS 3B (AY132)

(Main Session) **9.15 a.m. – 10.45 a.m.**
(First Alternative) **11.00 a.m. – 12.30 p.m.**
(Second Alternative) **1.15 p.m. – 2.45 p.m.**
(Third Alternative) **3.00 p.m. – 4.30 p.m.**

One set of apparatus for AS 3A (AY131) will therefore be sufficient for sixteen candidates on **12 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 **13 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.

Session 1

The following list of apparatus for Questions **1–4** is sufficient to equip one experimental station.

	Session 1	Session 2
Question 1		
1.1 Retort stand, boss and clamp	1	1
1.2 Expendable springs (Philip Harris B8A 41397 or equivalent)	9	6
1.3 Small diameter wooden dowel 7 cm long	x	6
1.4 Mass and mass carrier 100 g total	1	x
1.5 Mass and mass carrier 400 g total	x	1
1.6 Small hooks (≈5 mm diameter)	x	3
1.7 Stopwatch or stop clock to read to 0.1 s or 0.01 s	1	1
1.8 G clamp	1	1
1.9 Large hooks (≈10 mm diameter)	x	3
Question 2		
2.1 Light box and power supply	1	1
2.2 Object for illumination, e.g. gauze or cross-wires	1	1
2.3 Biconvex lens + holder 15 cm focal length ±1 cm, 50 mm diameter	1	x
2.4 Biconvex lens + holder 20 cm focal length ±1 cm, 50 mm diameter	x	1
2.5 Metre rule	1	1
2.6 Screen	1	1

	Session 1	Session 2
Question 3		
3.1 50 g slotted mass	1	x
3.2 100 g slotted mass	x	1
3.3 Vernier callipers to read to 0.1 mm	1	1
3.4 Micrometer screw gauge	1	1

Note **3.3 and 3.4** Digital callipers and screw gauges are not permitted.

Question 4		
4.1 Power supply dc to supply 2.0 V	1	1
4.2 Ammeter digital capable of reading to 10 A	1	1
4.3 Voltmeter digital capable of reading to 10 V	1	1
4.4 Connecting leads fitted with 4 mm plugs	6	6
4.5 Box, metal or opaque plastic dimensions not critical	1	1
4.6 Switch (contact key), e.g. Philip Harris B8H 27209 or similar	1	1
4.7 Sockets 4 mm red	1	1
4.8 Sockets 4 mm black	3	3
4.9 Reel of Nichrome wire SWG 36	1	1
4.10 Heat shrink sleeving, e.g. Maplin BF 86T	✓	✓

Question 5
Apart from the provision of a suitable writing area, no apparatus is required for this Data Analysis Question.

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ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Physics

Assessment Unit AS 3

assessing

Practical Techniques (Internal Assessment)
Session 1 (pp 3–8) and 2 (pp 9–15)

[AY131] [AY132]

THURSDAY 12 MAY AND FRIDAY 13 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

Retort stand, boss and clamp
Expendable springs
mass carrier – 100 g total
stopwatch or stop clock to read to 0.1 s or 0.01 s
G clamp

Preparation

Join chains of 2, 3 and 4 springs in series. Hang the chain of 2 springs from the clamp and suspend the mass carrier from the other end of the spring. Check that the period of oscillation increases as the number of springs in the chain increases.

Before Examination

Clamp retort stand to bench using the G clamp. Suspend the 2 spring chain from the clamp on retort stand and hang the mass carrier from the lower end of the spring chain. The set up is shown in Fig. 1.1.

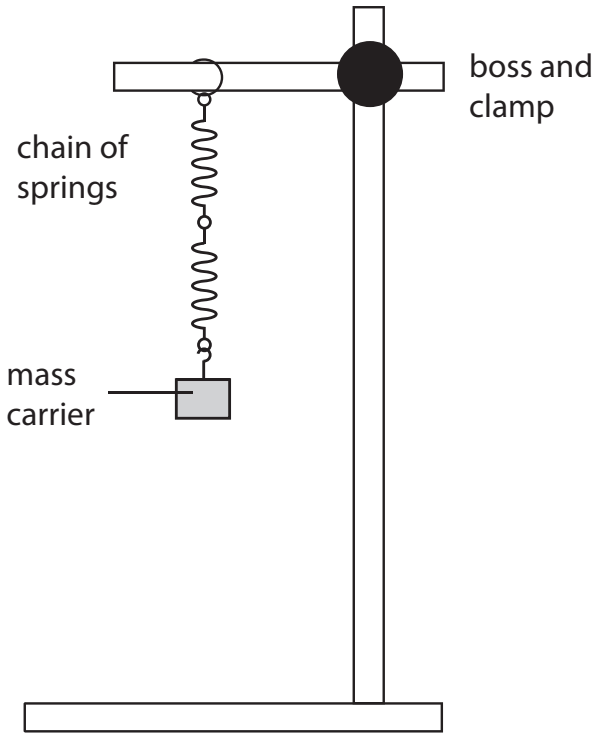

Fig. 1.1

Leave the chains of 3 and 4 springs and the stop clock on the bench near the apparatus.

Action at changeover

Replace the chain of 2 springs. Zero the stop clock.

Information required by examiners

None.

SESSION 1

Question 2

Principal Requirements

Light box and power supply
object for illumination, e.g. gauze or cross-wires
Biconvex lens + holder 15 cm focal length
Metre rule
Screen

Preparation

Set up apparatus as shown in Fig. 2.1.

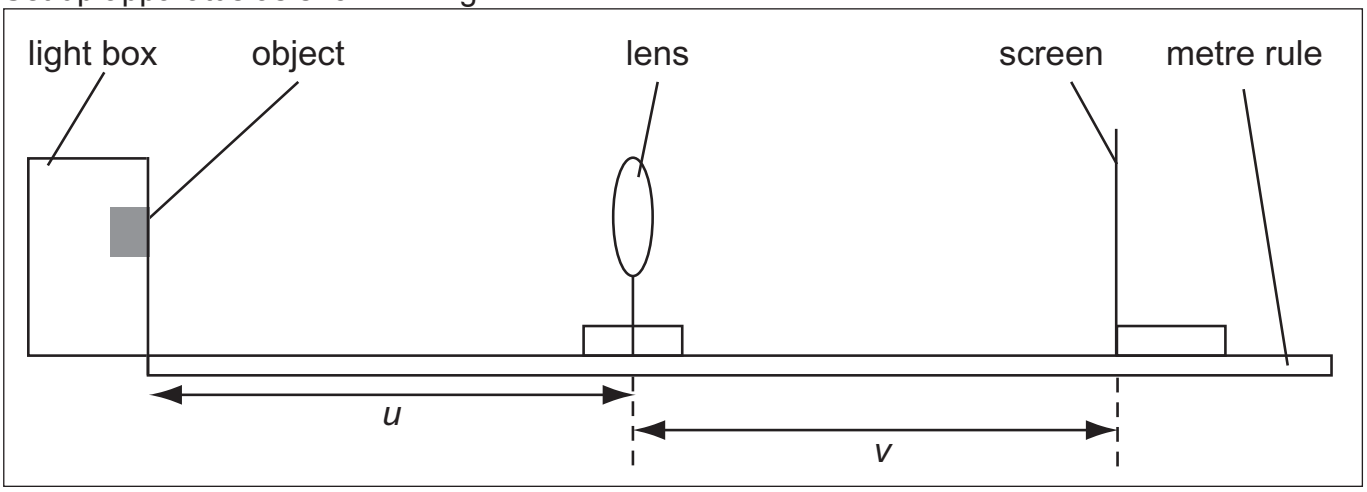

Fig. 2.1

Fix the metre rule to the bench. Set the object distance to 25 cm. Check that the image distance is approximately 37 cm.

Before Examination

Set up the apparatus as per preparation, but with the screen placed close to the lens in an out of focus position.

Action at changeover

Set the object distance to 25 cm, with the screen placed close to the lens in and out of focus position.

Information required by examiners

None.

SESSION 1

Question 3

Principal Requirements

50 g slotted mass
Vernier callipers to read 0.1 mm
micrometer screw gauge to read to 0.01 mm

Preparation

Leave the slotted mass, the micrometer screw gauge and the vernier callipers closed and side by side on the bench.

N.B. – The supervisor must record the thickness (using the micrometer) and diameter (using the callipers) of the slotted mass as these will be required for marking purposes.

Before examination

Set up apparatus as per preparation.

Action at changeover

Return vernier callipers and micrometer to zero.

Information required by examiners

None.

SESSION 1

Question 4

Principal Requirements

Power source dc, to supply 2.0 V
Ammeter, digital, capable of reading to 10 A
Voltmeter, digital, capable of reading to 10 V
Connecting leads fitted with 4 mm plugs
Box, metal or opaque plastic, dimensions not critical but a guide is about 10 cm × 10 cm × 5 cm
socket 4 mm red
sockets 4 mm black
Reel of Nichrome wire SWG 36
Push to make switch or contact key
Wire sleeving

Preparation

(a) Box

Fit the 4 mm sockets to the lid of the box in the arrangement shown in Fig. 4.1.
Label the red socket W and the black sockets X, Y and Z.

On the underside of the lid, solder the lengths of nichrome wire covered with sleeving as shown in Fig. 4.2. Ensure the length of wire between relevant terminals is 10 cm, 15 cm and 20 cm.

(b) Circuit to be provided to the candidates

Connect the circuit of Fig. 4.3. Set the voltage on the power supply to 2.0 V. Confirm that with connection made to Z, X then Y the current readings get successively smaller.

(c) Lead Q

Attach a label “Q” to the plug end of the flying lead (as Fig. 4.3).

Before Examination

Leave the circuit of Fig. 4.3 connected **without** Q connected to the box.

Action at changeover

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

Information required by examiners

None.

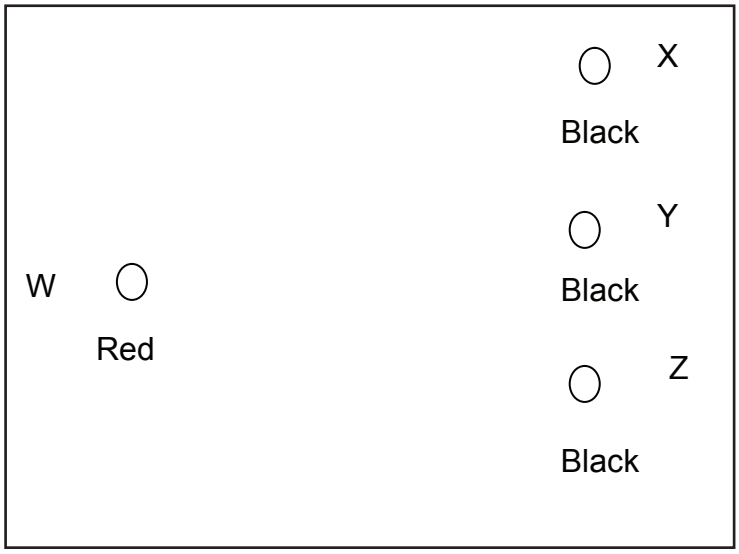

Fig. 4.1

Nichrome wire with sleeving

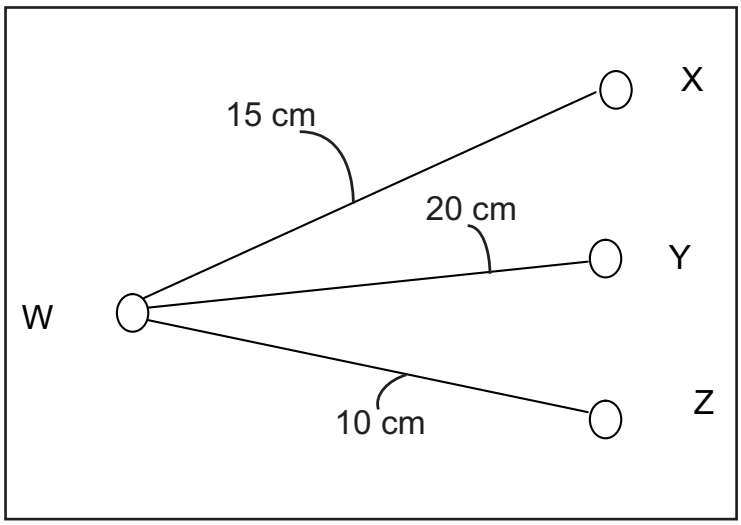

Fig. 4.2

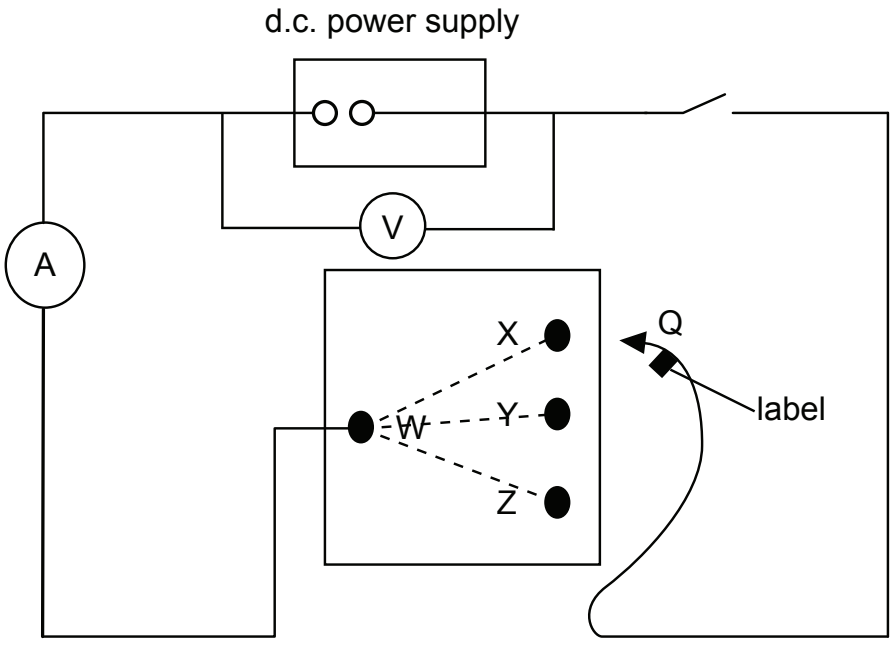

Fig. 4.3

SESSION 1

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

Retort stand, boss and clamp
Expendable springs
mass and mass carrier – 400 g total
wooden dowel (70 mm long and 10 mm diameter)
small hooks
stopwatch or stop clock to read to 0.1 s or 0.01 s
G clamp
large hooks

Preparation

Prepare the dowels by sawing two notches on the top of each dowel sufficiently wide to allow the tops of the springs to drop in as shown in Fig. 1.1.

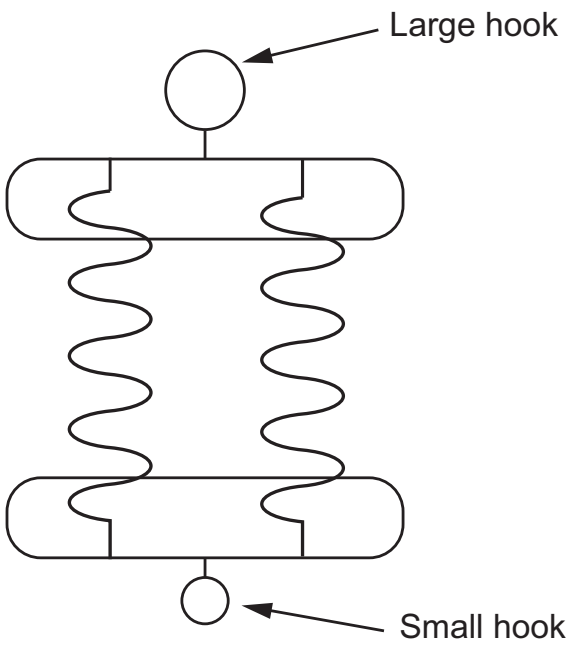

Fig. 1.1

Place a blob of glue to retain the springs in place. Screw a cup hook on the top and bottom surfaces of the dowels.

Repeat this procedure for a single spring and three springs in parallel.

Hang the single spring from the clamp and suspend the 400 g mass and mass carrier from the other end of the spring. Check that the period of oscillation decreases as the number of springs in parallel increases.

Before Examination

Clamp retort stand to bench using the G clamp. Suspend the single spring from the clamp shaft on the retort stand and hang 400 g mass and mass carrier from the lower end of the spring system.
The set up is shown in Fig. 1.1.

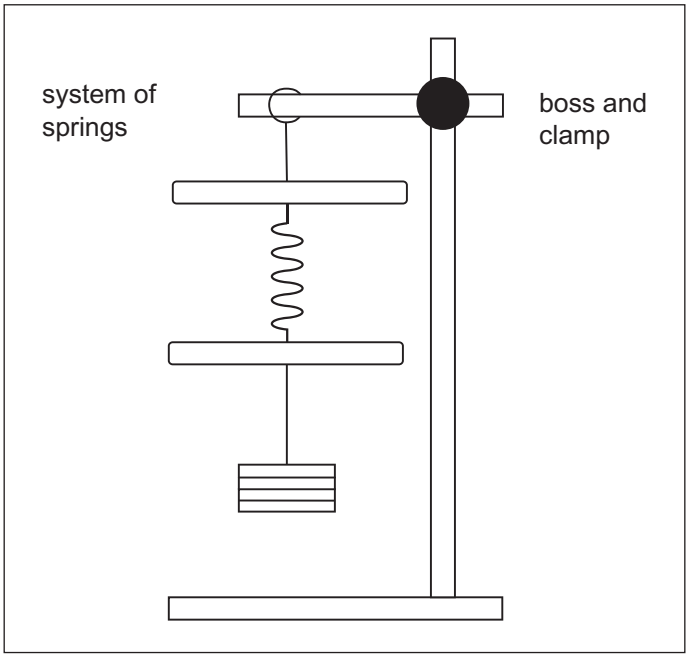

Fig. 1.1

Leave the other spring systems and the stop clock on the bench near the apparatus.

Action at changeover

Replace the 3 spring system with the single spring. Zero the timer.

Information required by examiners

None.

SESSION 2

Question 2

Principal Requirements

Light box and power supply
object for illumination
Biconvex lens + holder 20 cm focal length
Metre rule
Screen

Preparation

Set up apparatus as shown in Fig. 2.1.

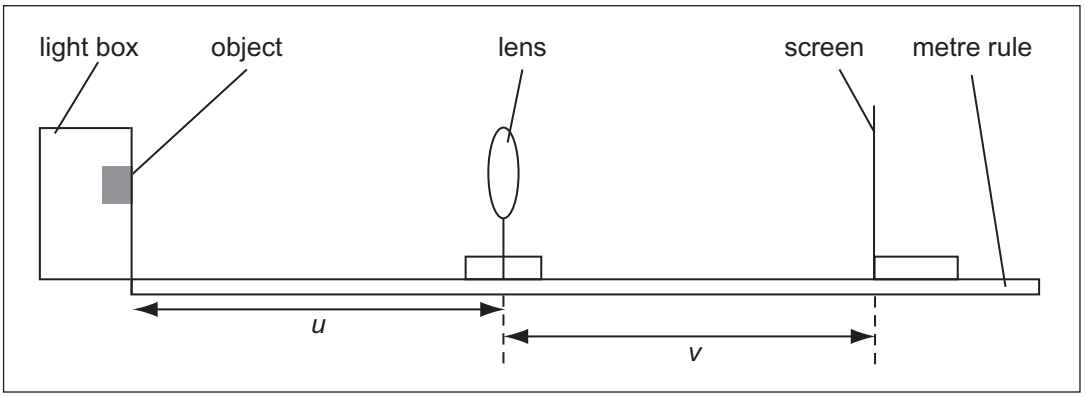

Fig. 2.1

Fix the metre rule to the bench. Set the object distance to 32 cm. Check that the image distance is approximately 53 cm.

Before examination

Set up the apparatus as per preparation but with the screen placed close to the lens in an out of focus position.

Action at changeover

Set the object distance to 32 cm, with the screen placed close to the lens in and out of focus position.

Information required by examiners

None.

SESSION 2

Question 3

Principal Requirements

100 g slotted mass
Vernier Callipers to read to 0.1 mm
Micrometer screw gauge to read to 0.01 mm

Preparation

Leave the slotted mass, the micrometer screw gauge and the vernier callipers closed and side by side on the bench.

N.B. – The supervisor must record the thickness (using the micrometer) and diameter (using the callipers) of the slotted mass as this will be required for marking purposes.

Before Examination

Set up apparatus as per preparation.

Action at changeover

Return vernier callipers and micrometer to read zero.

Information required by examiners

None.

SESSION 2

Question 4

Principal Requirements

Power source dc, to supply 2.0 V
Ammeter digital capable of reading to 10 A
Voltmeter digital capable of reading to 10 V
Connecting leads fitted with 4 mm plugs
Box, metal or opaque plastic, dimensions not critical
socket 4 mm red
sockets 4 mm black
Reel of Nichrome wire SWG 36
Push to make switch or contact key
Wire sleeving

Preparation

(a) Box

Fit the 4 mm sockets to the lid of the box in the arrangement shown in Fig. 4.1.
Label the red socket W and the black sockets X, Y and Z.

Cut six 10 cm lengths of wire. Take 2 lengths and twist tightly together.
Take 3 lengths and twist tightly together.

On the underside of the lid, solder the 10 cm lengths of nichrome wire covered in sleeving as shown in Fig. 4.2. Ensure the length of each wire is the same. Solder the single strand between WZ, the double strand between WX and the triple strand between WY.

(b) Circuit to be provided to the candidates

Connect the circuit of Fig. 4.3. Set the voltage on the power supply to 2.0 V. Confirm that with the connection made to Z, X then Y the current readings get successively larger.

(c) Lead Q

Attach a label “Q” to the plug end of the flying lead (as Fig. 4.3).

Before Examination

Leave the circuit of Fig. 4.3 connected **without** Q connected to the box.

Action at changeover

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

Information required by examiners

None.

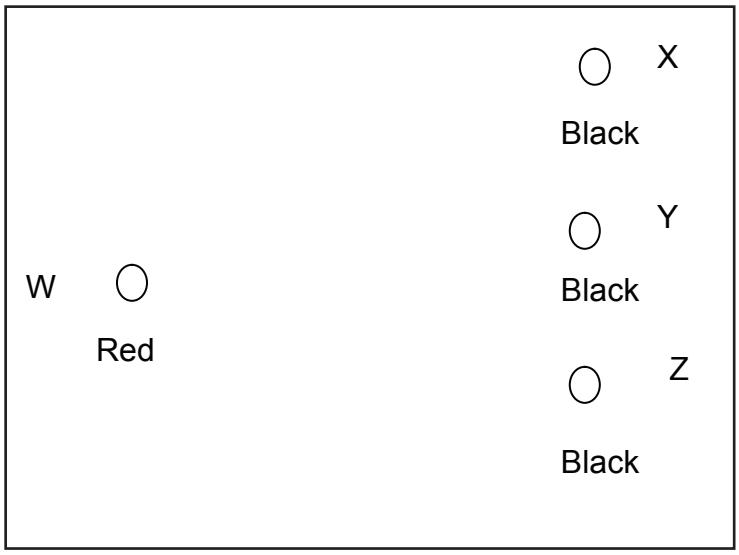

Fig. 4.1

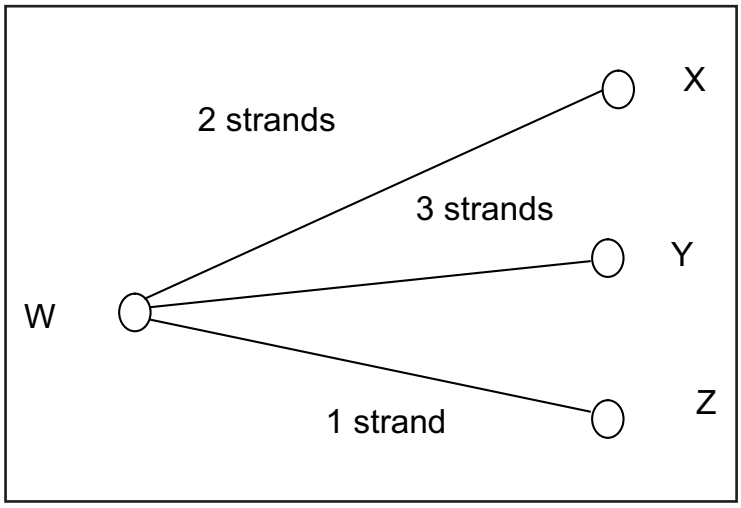

Fig. 4.2

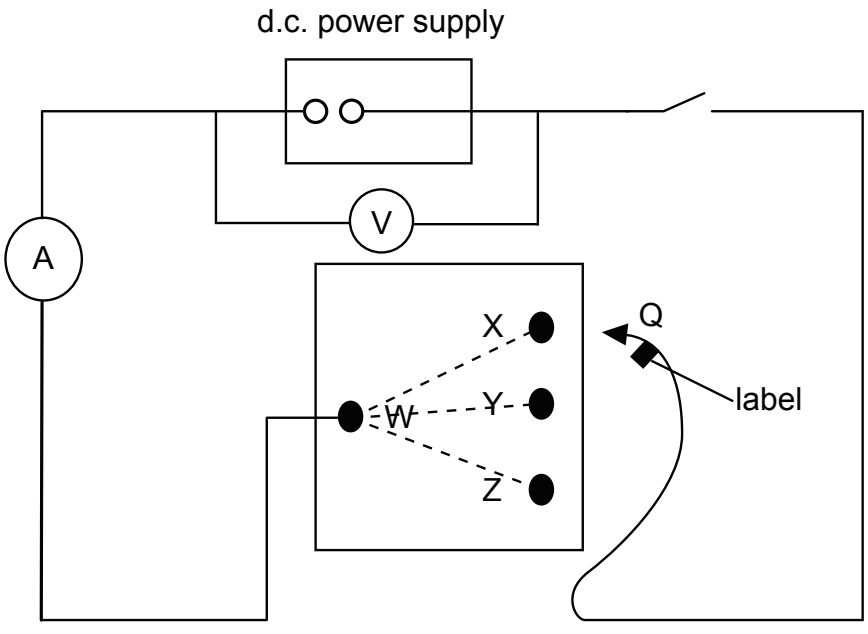

Fig. 4.3

SESSION 2

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.