



Cambridge International AS & A Level

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PHYSICS

9702/31

Paper 3 Advanced Practical Skills 1

May/June 2026

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].

For Examiner's Use

1	
2	
Total	

This document has **12** pages.

You may not need to use all of the materials provided.

- 1** In this experiment, you will investigate an electrical circuit.

You have been provided with several resistors, each with a different value of resistance.

- (a)**
- Set up the circuit shown in Figure 1.1.
 - Select the 18Ω resistor and connect it so that resistance R is 18Ω .

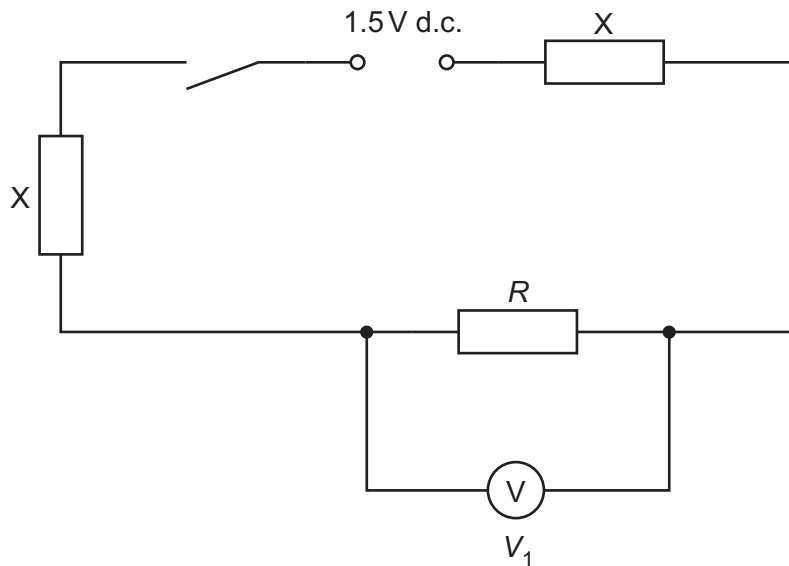


Figure 1.1

- Close the switch.
- Record R and the voltmeter reading V_1 .

$R =$

$V_1 =$

- Open the switch.

[1]



- (b) (i) • Connect a wire W as shown in Figure 1.2.

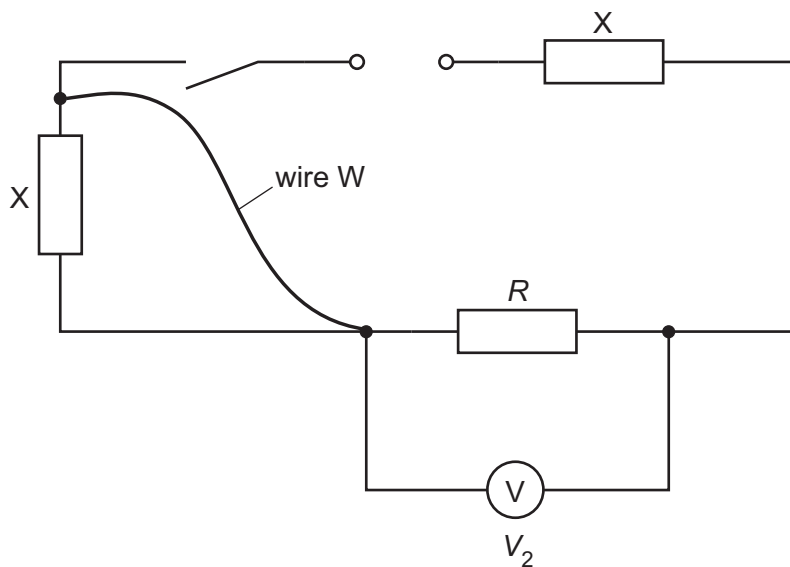


Figure 1.2

- Close the switch.
- Record the voltmeter reading V_2 .

$$V_2 = \dots\dots\dots$$

- Open the switch.
- Remove wire W .

[1]

- (ii) Calculate $\frac{V_1}{V_2 - V_1}$.

$$\frac{V_1}{V_2 - V_1} = \dots\dots\dots [1]$$



- (c) Vary R by using a different resistor. Record R , V_1 and V_2 . Repeat until you have six sets of readings of R , V_1 and V_2 . Include your values from **1(a)** and **1(b)**.

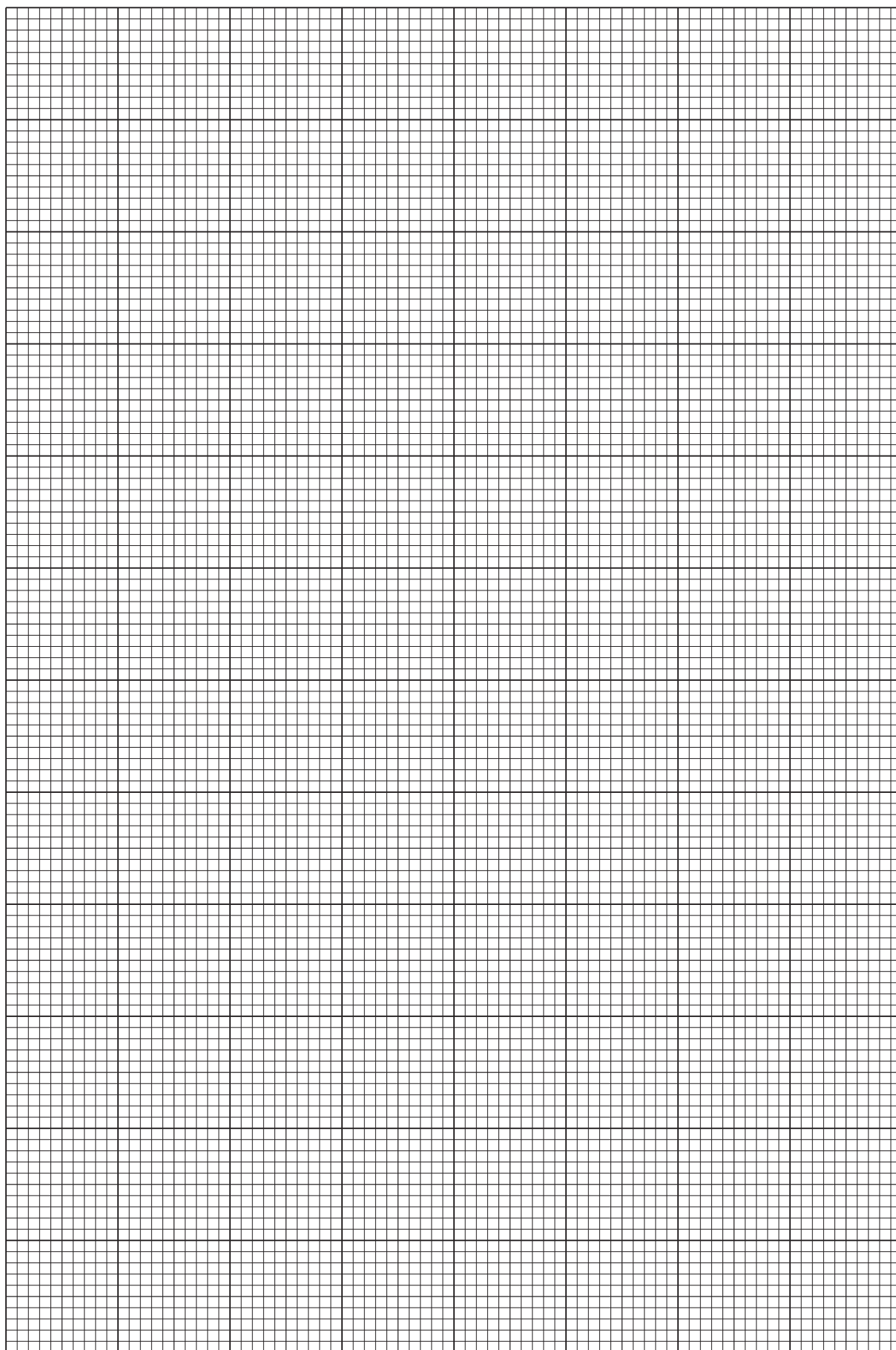
Record your results in a table. Include values of $\frac{V_1}{V_2 - V_1}$ in your table.

- (d) (i) Plot a graph of $\frac{V_1}{V_2 - V_1}$ on the y -axis against R on the x -axis. [8]
- (ii) Draw the straight line of best fit. [3]
- (iii) Determine the gradient and y -intercept of this line. [1]

gradient =

y -intercept = [2]





(e) It is suggested that the quantities V_1 , V_2 and R are related by the equation

$$\frac{V_1}{V_2 - V_1} = PR + Q$$

where P and Q are constants.

Using your answers in **1(d)(iii)**, determine values for P and Q .
Give appropriate units.

$P =$

$Q =$

[2]

(f) The resistance of each resistor X is X .

Theory suggests that $P = \frac{1}{X}$ and that Q is independent of X .

A student repeats the experiment using a smaller value of X .

Sketch a second line on the graph to show the expected results.
Label this line Z .

[1]

[Total: 20]



You may not need to use all of the materials provided.

- 2 In this experiment, you will investigate the oscillations of a spring system.

You have been provided with three springs connected together.

- (a)
- Choose one of the **end** springs (**not** the middle one). This is spring A.
 - The length of the coiled section of spring A is l_0 , as shown in Figure 2.1.

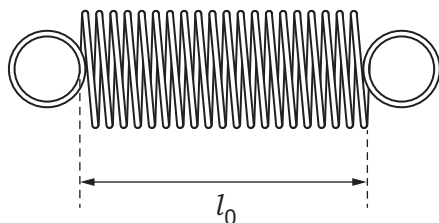


Figure 2.1

Measure and record l_0 .

$l_0 =$ [1]

- (b) • Set up the apparatus as shown in Figure 2.2.

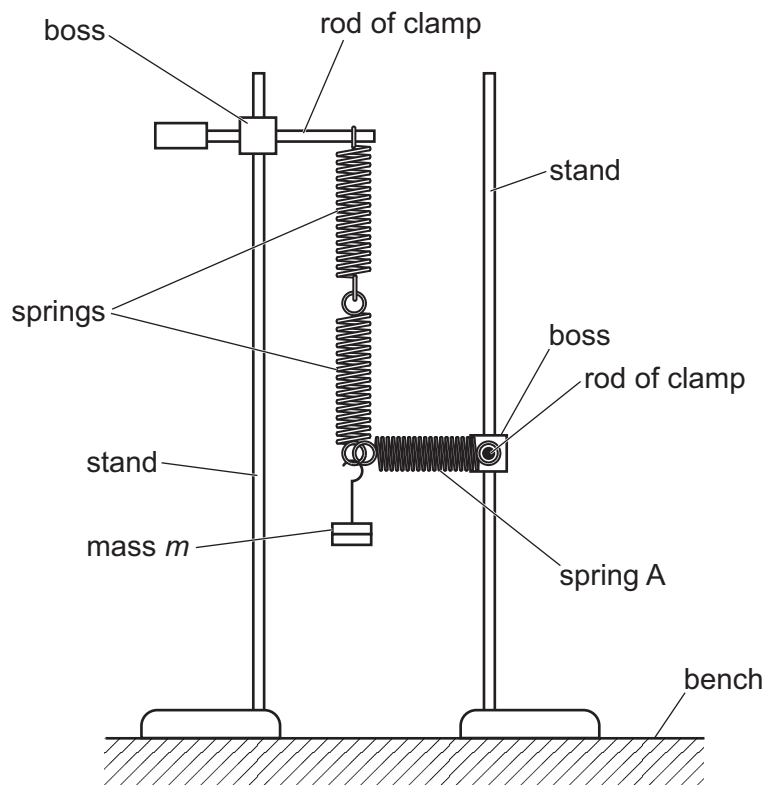


Figure 2.2

- Hang a mass m of 200 g from the springs as shown in Figure 2.2.
- Record the value of m .

$m = \dots\dots\dots$ g

- Adjust the apparatus until spring A is horizontal and unstretched with a coiled section of length l_0 and the other two springs are vertical.
- Gently pull the mass down through a short distance. When released, the mass will oscillate.
- Take measurements to determine the period T_0 of the oscillations.

$T_0 = \dots\dots\dots$ [2]



- (c) (i) • Adjust the apparatus so that the coiled section of spring A is extended to a length of approximately $l_0 + 4.5\text{ cm}$ and spring A is horizontal, as shown in Figure 2.3.

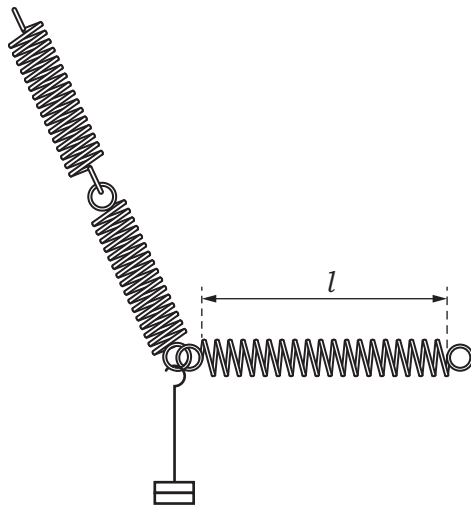


Figure 2.3

- Measure and record the extended length l of the coiled section of spring A.

$$l = \dots\dots\dots$$

- Calculate the extension e of spring A, where

$$e = l - l_0.$$

$$e = \dots\dots\dots [1]$$

- (ii) Estimate the percentage uncertainty in your value of e . Show your working.

$$\text{percentage uncertainty} = \dots\dots\dots \% [1]$$



- (d) (i) • Gently pull the mass down through a short distance. When released, the mass will oscillate.
- Take measurements to determine the period T of the oscillations.

$$T = \dots\dots\dots [1]$$

- (ii) Calculate $(T_0 - T)$.

$$(T_0 - T) = \dots\dots\dots [1]$$

- (e) Repeat **2(b)**, **2(c)(i)** and **2(d)** using a value of $m = 300\text{ g}$ and a value for the length of the coiled section of spring A of approximately $l_0 + 6.5\text{ cm}$.

$$m = \dots\dots\dots \text{ g}$$

$$T_0 = \dots\dots\dots$$

$$l = \dots\dots\dots$$

$$e = \dots\dots\dots$$

$$T = \dots\dots\dots$$

$$(T_0 - T) = \dots\dots\dots [3]$$



- (f) It is suggested that the relationship between T_0 , T , e and m is

$$(T_0 - T) = \frac{Ce}{\sqrt{m}}$$

where C is a constant.

Using your data, calculate **two** values of C .

first value of C =

second value of C =

[1]

- (g) It is suggested that the percentage uncertainty in the values of C is 15%.

Using this uncertainty, explain whether your results support the relationship in **2(f)**.

.....

.....

.....

..... [1]

- (h) (i) Describe **four** sources of uncertainty or limitations of the procedure for this experiment.

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

- 1
.....
- 2
.....
- 3
.....
- 4
.....
- [4]

- (ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

- 1
.....
- 2
.....
- 3
.....
- 4
.....
- [4]

[Total: 20]

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