Name :		Centre/Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

H2 PHYSICS

9749/04

Paper 4 Practical

27 August 2021
2 hours 30 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your centre number, index number, name and class at the top of this page.
Give details of the practical shift and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions in the spaces provided on the question paper.

The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Shift
Laboratory

For Examiner's Use	
1	14
2	10
3	19
4	12
Total	55

This document consists of **18** printed pages and **0** blank page.
This document consists of **25** printed pages and **1** blank page.

1 In this experiment, you will investigate the oscillations of a square shape.

(a) (i) Bend the wire to form a square shape so that the length L of each side is approximately 12 cm, as shown in Fig. 1.1.

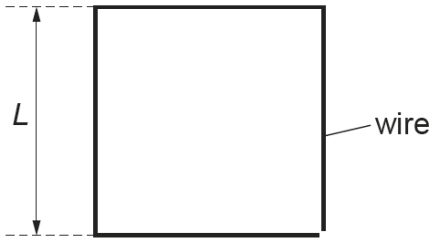


Fig. 1.1

Use the wire cutter to remove any excess wire.

Measure and record L.

L = ... [1]

(ii) Estimate the percentage uncertainty in your value of L.

percentage uncertainty = ... [1]

(b) (i) Place the cork in the clamp and attach the clamp to the stand using the boss.

Hang the square wire from the pin as shown in Fig. 1.2.

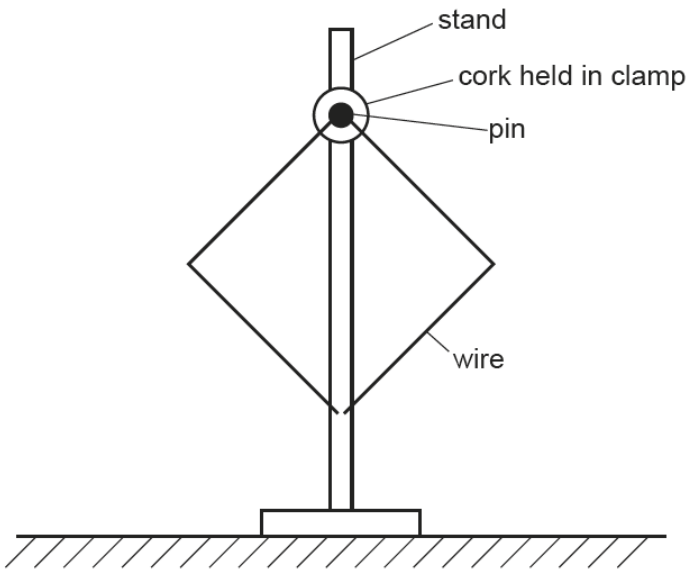


Fig. 1.2

Gently displace the square wire and release it so that it oscillates as shown in Fig. 1.3.

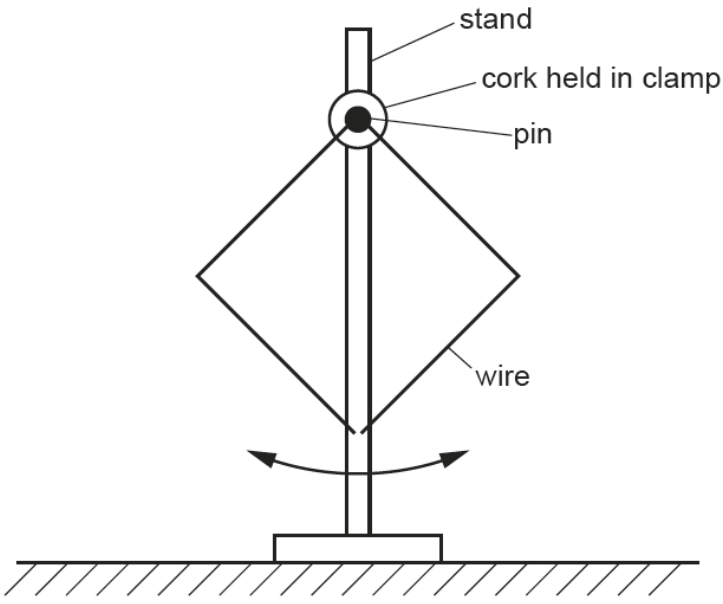


Fig. 1.3

Determine the period T of the oscillations.

T = ... [3]

(ii) Calculate T^2.

T^2 = ... [1]

(iii) Justify the number of significant figures you have given for your value of T^2.

.....

.....

..... [1]

(c) (i) Remove the square wire from the pin.

Form a new square shape from the wire so that L is approximately 6 cm.

Use the wire cutter to remove any excess wire.

Measure and record L.

L = ... [1]

(ii) Repeat **(b)(i)** and **(b)(ii)**.

T = ...

T^2 = ... [1]

(d) It is suggested that the relationship between T and L is

$$T^2 = \frac{L}{k^2}$$

where k is a constant.

(i) Use your values from **(a)(i)**, **(b)(ii)**, **(c)(i)** and **(c)(ii)** to determine two values of k.

Give your values of k to an appropriate number of significant figures.

first value of k = …….

second value of k = ……. [2]

(ii) State and explain whether the results of your experiment support the suggested relationship in **(d)**.

Justify your conclusion by referring to your values in **(a)(ii)**.

……...

……...

……..…… [2]

(e) A value for the acceleration of free fall g near the surface of the Earth is given by

$$g = \frac{20\pi^2}{3\sqrt{2}}k^2$$

Use your second value of k to calculate a value for g.

g = ……. m s^{-2} [1]

[Total: 14 marks]

2 In this experiment, you will investigate combinations of resistors in an electrical circuit.

(a) You have been provided with three identical resistors A, B and C.

Take measurements to determine the resistance of each resistor.

The resistance of resistor A is R_A.
The resistance of resistor B is R_B.
The resistance of resistor C is R_C.

R_A = ...

R_B = ...

R_C = ... [2]

(b) Set up the circuit as shown in Fig. 2.1 with resistor A between F and G.

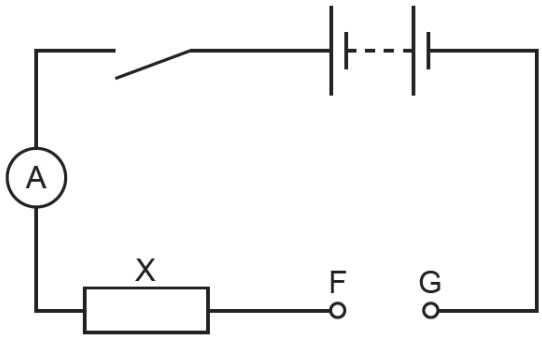


Fig. 2.1

Record the total resistance R between F and G.

R = ...

Close the switch.

Record the ammeter reading I.

I = ... [1]

Open the switch.

(c) Use various arrangements of the three resistors A, B and C to provide six other different total resistances between F and G.

For each arrangement, record R and I in a table.

Include values of **(b)** and $\frac{1}{I}$ in your table.

[5]

(d) It is suggested that the quantities I and R are related by the equation

$$E = I\,(R + X)$$

where E is the electromotive force (e.m.f.) of the power supply and X is the resistance of resistor X.

Suggest how you would use the data collected in **(c)** to determine the value of X.

……...

……...

……...

……... [2]

[Total: 10 marks]

3 In this experiment, you will determine the force constant of a spring.

(a) You have been provided with three identical springs, attached to a ring.

The length of an unstretched spring is *S*, as shown in Fig. 3.1.

Measure and record *S* for **one** of the springs using a vernier calliper.

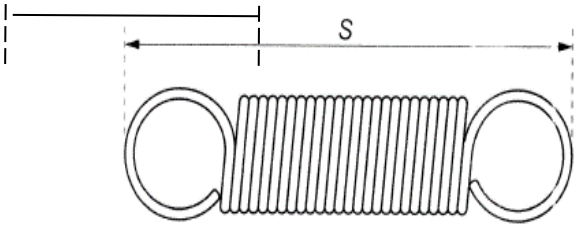


Fig. 3.1

S = ... [1]

(b) (i) Set up the apparatus as shown in Fig. 3.2.

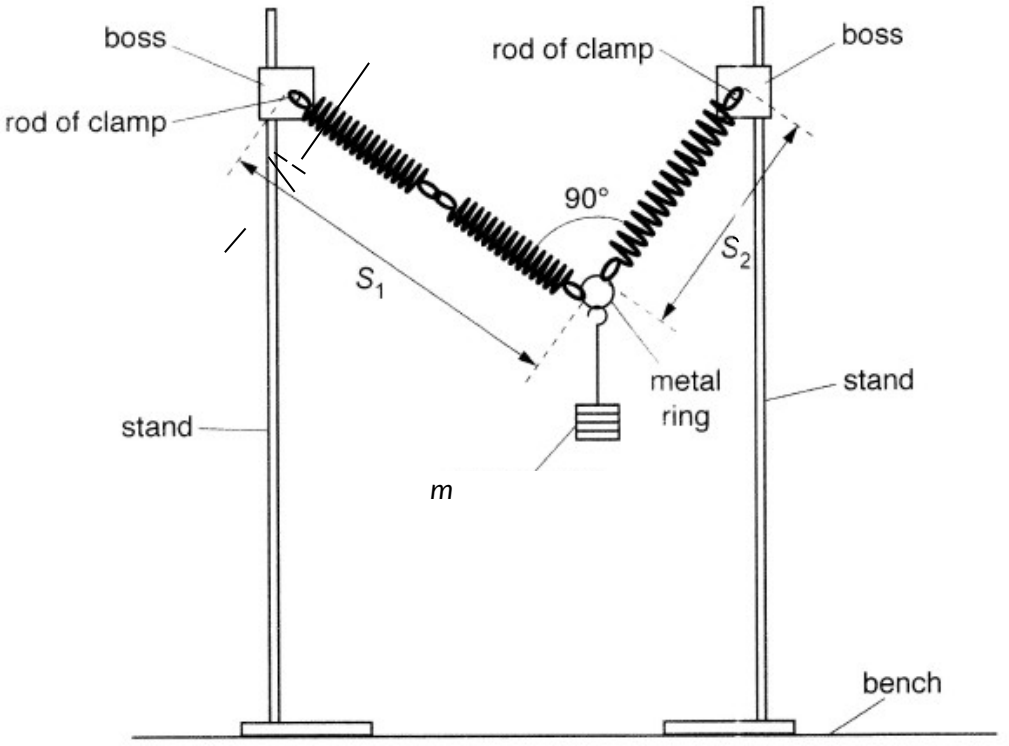


Fig. 3.2

The extended length of the double spring is S_1 and the extended length of the single spring is S_2.

The extensions are p and q where

$$p = S_1 - 2S \text{ and } q = S_2 - S.$$

(ii) Hang appropriate masses on the mass hanger so that m is 400 g.

(iii) Adjust the apparatus so that the angle between the springs is 90°.

Measure and record S_1 and S_2 using a metre ruler.

S_1 = ...

S_2 = ...
[1]

(iv) Calculate p and q.

p = ...

q = ...
[1]

(c) Vary m, obtaining a suitable range of values between 100 g and 400 g inclusive, and repeat **(b)(iii)** and **(b)(iv)**, keeping the angle between the springs 90° throughout.

[4]

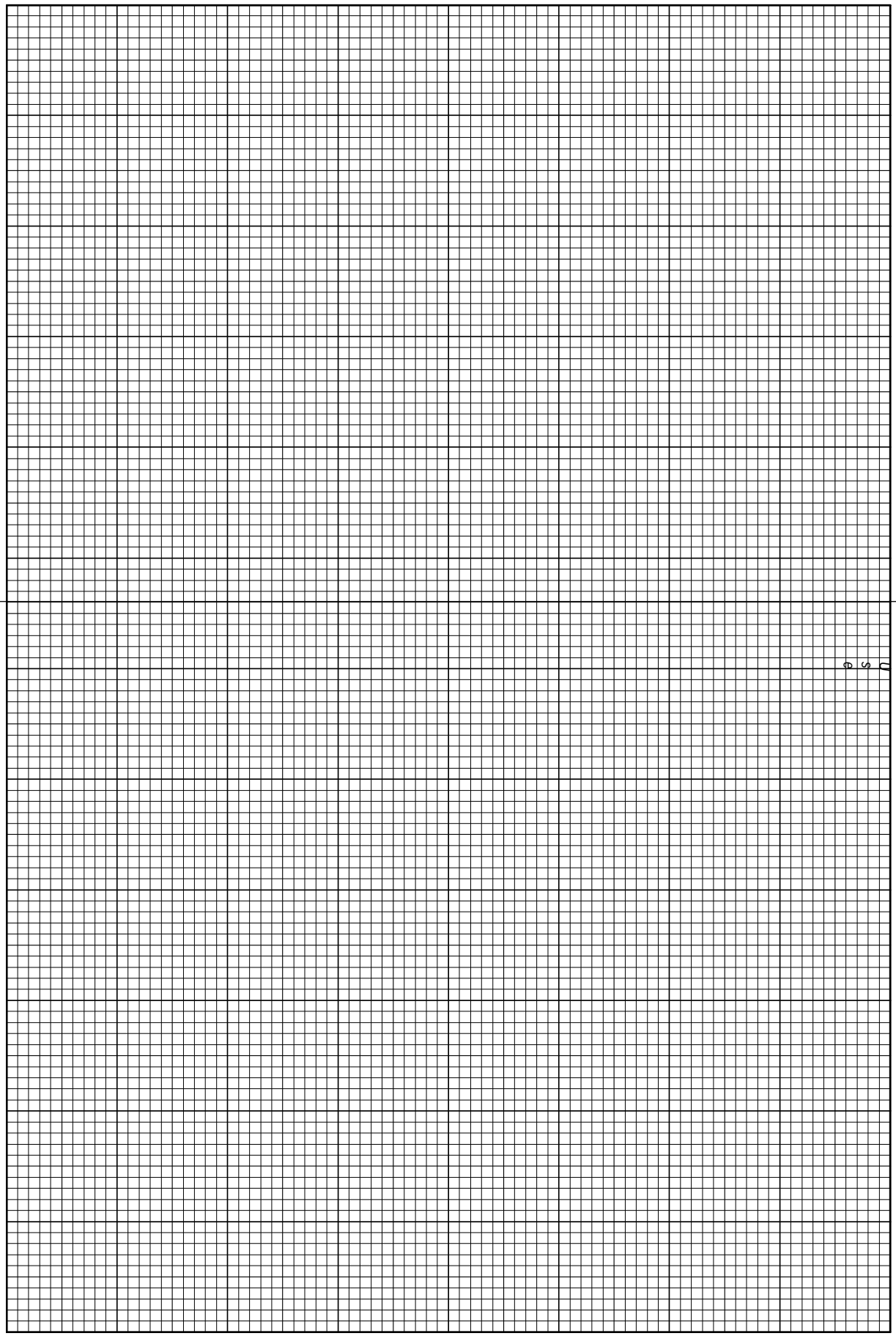
(d) Theory suggests that

$$m^2g^2 = + k^2q^2$$

where k is the spring constant of one of the springs and g = 9.81 m s^{-2}.

Plot a suitable graph to determine k.

k = ... [3]



Examiner's Use

[3]

(e) Comment on any anomalous data or results that you may have obtained. Explain your answer.

…..……...

..……...

…..……...

…..…… [1]

(f) (i) Suggest one significant source of uncertainty in this experiment.

…..……...

..……...

…..……...

…..…… [1]

(ii) Suggest an improvement that could be made to the experiment to reduce the uncertainty identified in **(f)(i)**.

You may suggest the use of other apparatus or a different procedure.

…..……...

..……...

…..……...

…..…… [1]

(g) The force constant *k* of a spring can be found by another method.

Plan an investigation to find *k* for a fixed length of a spring in tension.

You would be provided with several masses.

You may suggest the use of any additional apparatus commonly found in a school physics laboratory.

Your account should include:

- a diagram
- your experimental procedure
- control of variables

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…… [3]

[Total: 19 marks]

4 As incident light passes through a glass block, the intensity decreases. This is known as light attenuation.

A student suggests that the ratio $\frac{\text{amplitude of light transmitted through glass, } A}{\text{initial amplitude of light, } A_0}$ is related to the thickness t of glass and the frequency f of light.

He suggests the following relationship $A/A_0 = k\, t^{p} f^{q}$

where k, p and q are constants.

Design a laboratory experiment to investigate the relationship between A/A_0, t and f.

You are provided with several identical glass blocks. You are also provided with several lasers of unknown frequencies and other equipment usually found in a Physics laboratory.

Draw a diagram to show the arrangement of your apparatus. You should pay particular attention to

(a) the equipment you would use

(b) the procedure to be followed

(c) how the ratio A/A_0 is measured

(d) the control of variables

(e) any precautions that should be taken to improve the accuracy and safety of the experiment

Diagram

Examiner's Use

[12]