Centre Number	Candidate Number

Candidate Name _____

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

PHYSICS 5054/4

PAPER 4 Alternative to Practical

MAY/JUNE SESSION 2000 1 hour

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables
Protractor
Ruler (300 mm)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
TOTAL	

This question paper consists of 11 printed pages and 1 blank page.

[Turn over

1 In order to determine the centre of mass of a card ABCD, the card is hung from a hole near the corner at the point W. A plumb-line is also hung from the same support and the card is marked at a point P, on the line BC, behind the plumb-line. This is illustrated in Fig. 1.1.

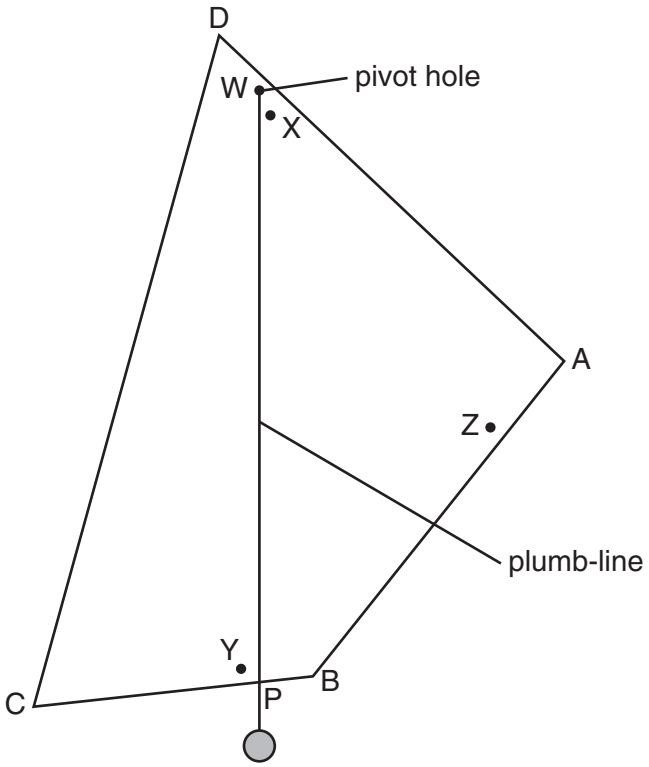

Fig. 1.1

The card is removed from the support and a line drawn from W to P.

(a) Explain the following points:

(i) why the card should move freely on the pivot,

(ii) the position of your eyes when looking at the plumb-line,

(iii) why the plumb-line should hang so that it almost touches the card.

You may draw a diagram if you wish.

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[3]

(b) In order to locate the position of the centre of mass of the card, the card is hung from a second point and the experiment is repeated. The card may be hung at point X or point Y or point Z.

Which point would you choose? Give a reason for your choice.

choice .....

reason

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..... [3]

2 The apparatus shown in Fig. 2.1 on page 5 is used in an optics experiment.

The broken line XY represents the principal axis of the converging lens. The object and the screen are placed at right angles to XY. The object consists of three small holes in a card. These are labelled N, O and P. The point O of the object and the centre S of the screen are placed on the line XY. The optic centre of the lens is labelled C. A focused image of the object is formed on the screen.

(a) Draw neat, thin lines from N, O and P through C to the screen. [1]

(b) By using one of the words *above*, *at* or *below*, complete the following statement about the image formed on the screen.

The light from point N forms an image that is ..... S. [1]

(c) State three things about the image of the complete object.

1 .....

2 .....

3 .....
[2]

(d) Another student has placed the lens as shown in Fig. 2.2.

Explain why the image on the screen does not consist of three patches of light.

You may draw a diagram if you wish.

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..... [1]

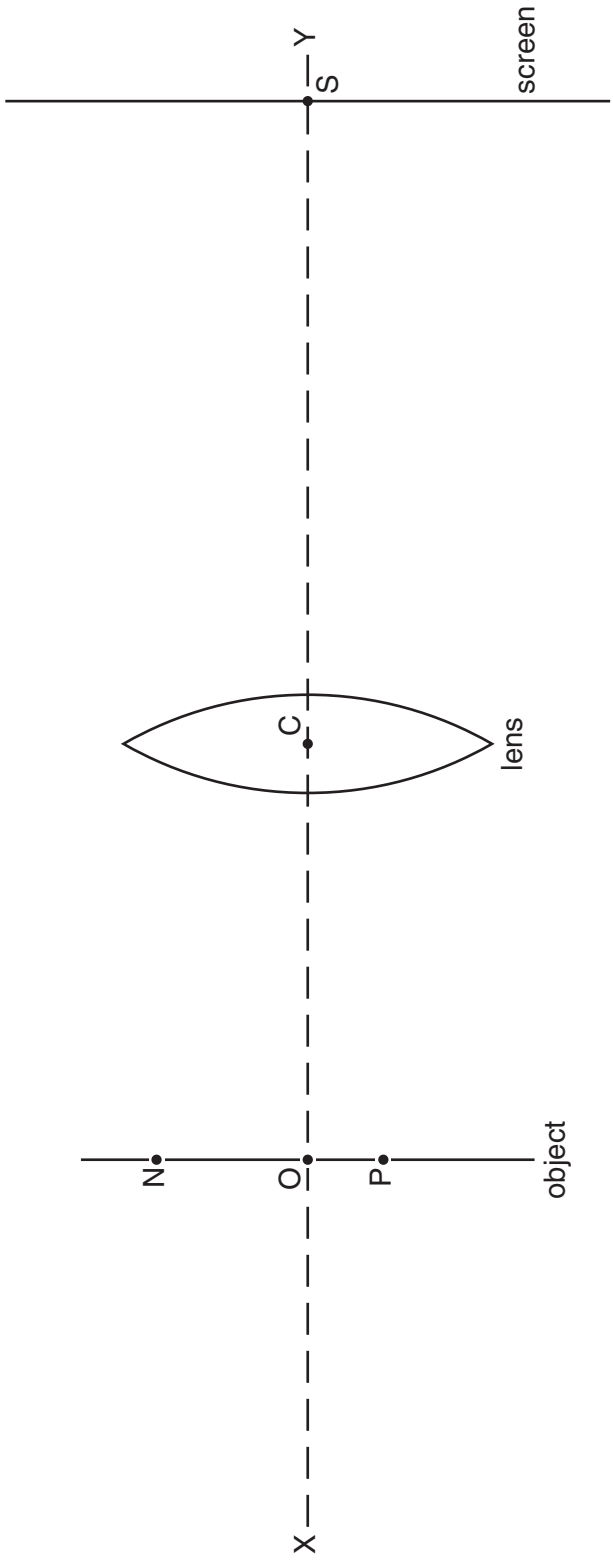

Fig. 2.1

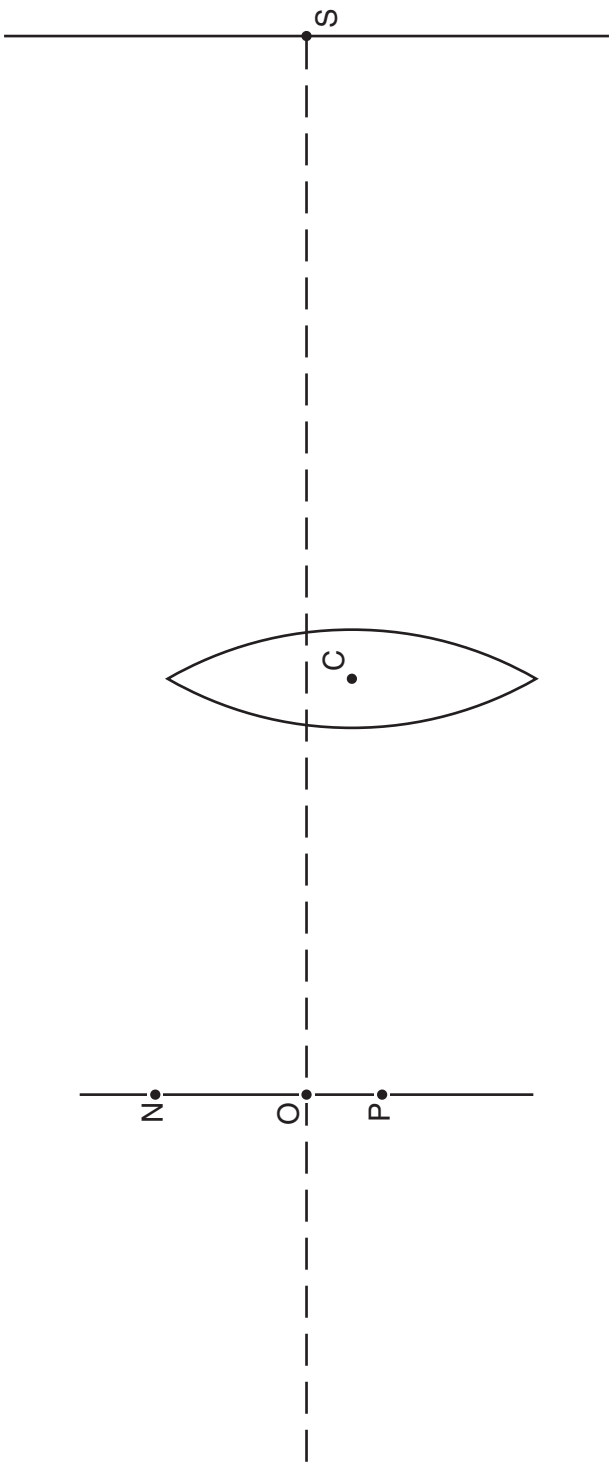

Fig. 2.2

3 "Does a shield placed round a hot substance affect its rate of cooling?" To answer this question, a student designed the following experiment in which a thermometer is used as the cooling body.

A thermometer is heated in boiling water. It is then removed and allowed to cool, shielded by a beaker. This beaker is arranged so that one third of the thermometer stem is shielded. This is illustrated in Fig. 3.1. The thermometer is allowed to cool to 40 °C and the time taken is recorded.

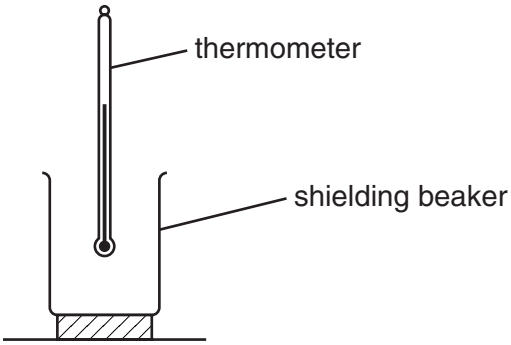

Fig. 3.1

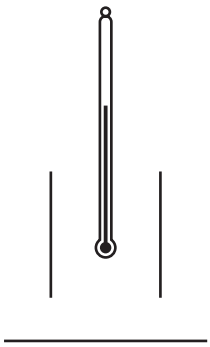

Fig. 3.2

The experiment is repeated using a shield that is open at the bottom. Once again, one third of the stem is placed in the shield. This is illustrated in Fig. 3.2.

The experiment is performed a third time. This time, a shield is not used at all.

The table gives the results of the experiments. The table includes the average fall of temperature per second.

experiment	$\frac{\text{time taken to fall to 40 °C}}{\text{s}}$	average temperature change per second / (°C / s)
shielded, closed at the bottom	36	1.1
shielded, open at the bottom	28	1.4
no shield used	22	1.8

Fig. 3.3

(a) Fig. 3.4 shows the upper part of the thermometer used in the experiment.

Fig. 3.4

On Fig. 3.4, draw

(i) a vertical line so as to show a temperature of 60.5 °C

(ii) a second vertical line so as to show what is meant by a **change** of temperature of 1.8 degrees C.

[1]

(b) A problem with this experiment is that the change in temperature per second is very large. The three trials take less than two minutes in total. The teacher says that the choice of a thermometer as a cooling body was the cause of this fast rate of cooling.

(i) Suggest a more suitable object for the cooling body. Remember that the cooling must be slower and that you will need to take the temperature of the cooling body. You may draw a diagram if you wish.

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(ii) Draw a diagram to show how the cooling body in **(i)** may be supported so that it does not touch the bench.

(iii) With the new cooling body, the same three trials are carried out. How would you do the experiment so that the temperature range for each of the three trials is the same?

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..... [4]

(c) What is your answer to the question "Does a shield placed round a hot substance affect its rate of cooling?" Use the information recorded in Fig. 3.3 to help you explain your answer.

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..... [1]

4 A metal washer is placed in the middle of a square card. The card is supported by four vertical threads hanging from a square, held in a clamp, as illustrated in Fig. 4.1.

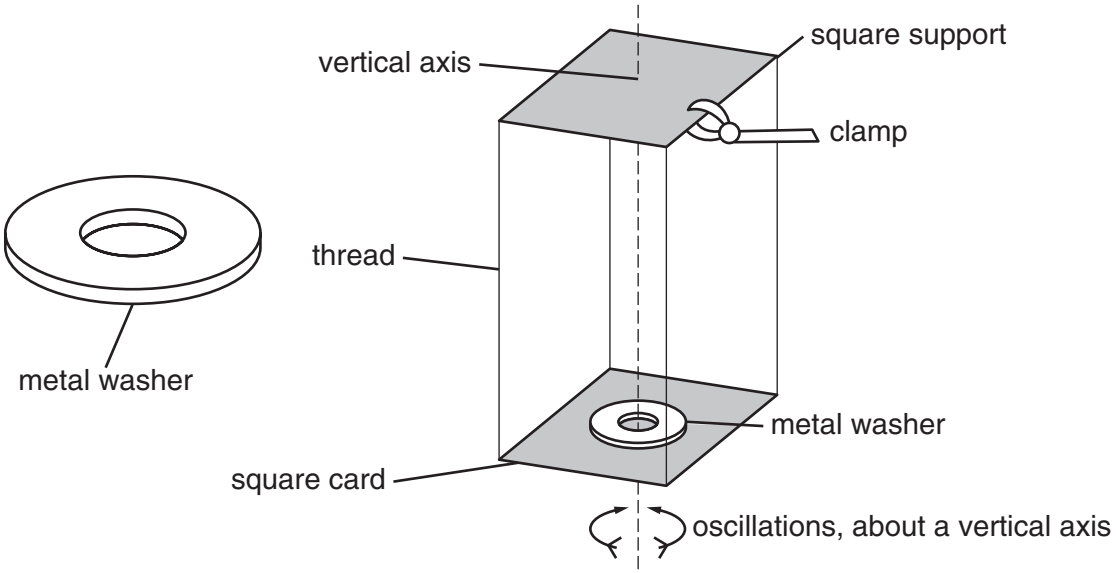

Fig. 4.1

The lower card is slightly rotated about the vertical axis and, when released, the card begins to oscillate. The time t for N complete oscillations is determined. The period T for one oscillation is calculated. The experiment is repeated with a different number W of washers placed on top of the first. In all, six experiments are performed for $W = 0, 1, 2, 3, 4$ and 5 washers of the same size.

(a) Draw up a carefully labelled table, suitable for your laboratory notebook, in which you could record the values of W, N, t and T.

[2]

(b) Fig. 4.2 shows a graph of the period T plotted against the number W of washers.

(i) When doing the experiment, 40 oscillations are timed. Discuss the reason for timing 40 oscillations. In your answer, you should make some comment about the value of T for $W = 5$ washers.

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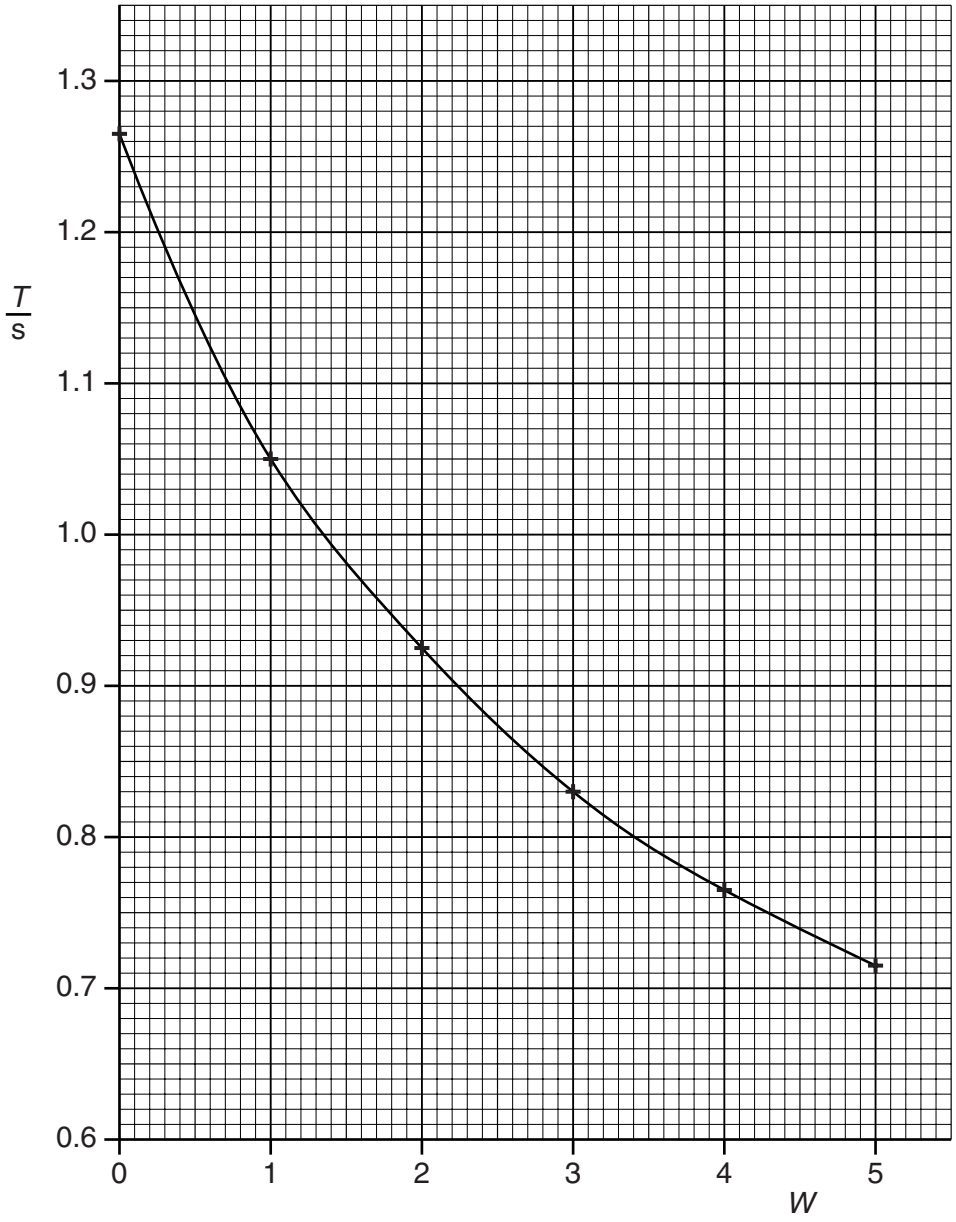


Fig. 4.2

(ii) The number W of similar washers is plotted along the x-axis. What other physical property of the washers increases as W increases?

.....

[3]

(c) A different set of washers is used in order to repeat the investigation. *Compared with the first set*, the different washers

(i) are made of the same material,

(ii) have the same inner and outer radius,

(iii) are only half as thick.

What is the value of the period T when 5 of the new (thinner) washers are on the lower card?

T = ... [1]

5 The circuit shown in Fig. 5.1 is set up to investigate how the potential difference across the fixed resistor R varies when extra resistance is included in the circuit. The extra resistance is obtained from different lengths of two resistance wires P and Q. From the results, the resistance of the two wires is to be compared.

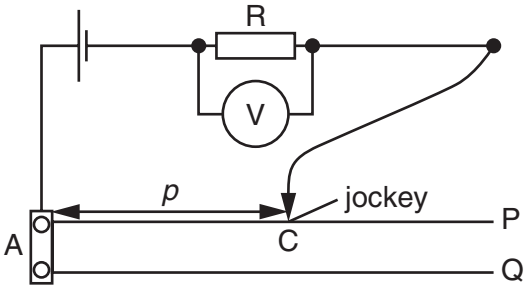


Fig. 5.1

The resistance wires P and Q are both connected to the same terminal block at A. Each wire is made from the same material but their diameters differ.

In the experiment, the jockey (sliding contact) is placed on wire P at a point C so that AC (= p) is 120 mm. The reading V of the voltmeter is recorded. The jockey is now placed on wire Q. The jockey is moved along Q to find the length q that gives the same reading on the voltmeter. The experiment is then repeated so as to obtain a set of readings, using values of p between 100 mm and 800 mm.

V/V	1.73	1.43	1.20	1.10	0.98
p/mm	120	300	505	625	790
q/mm	80	190	325	395	500

(a) From the table, it can be seen that V decreases as p increases. How do the results show that V is **not** inversely proportional to p?

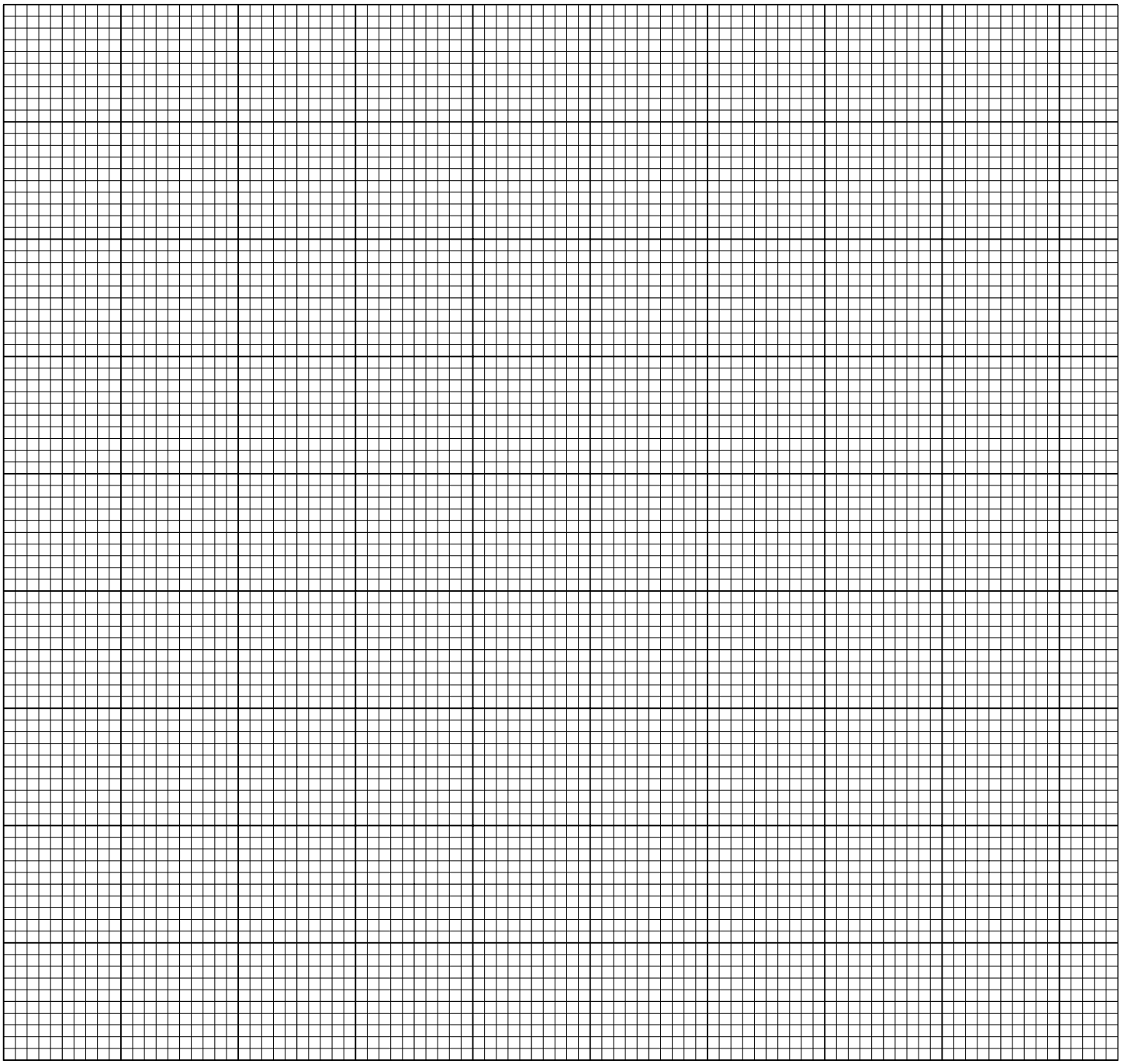
.....

..... [1]

(b) **(i)** Plot the graph of p/mm (y-axis) against q/mm (x-axis).

(ii) Determine the gradient G of the line. Mark your graph to show clearly what values you have used.

G = ... [6]



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