Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Practical skills

Time allowed: 2 hours 10 minutes

Subject code **0625**

Physics

Questions from Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 86

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 86 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 **(a)** A pendulum swings with a time period of approximately one second.

Describe how to use a stop-watch to determine the time period of the pendulum.

.....

.....

.....

..... [3]

(b) Complete Table 2.1 by writing in each space of the right-hand column which **one** of the following devices is used to measure the quantity in the left-hand column.

digital balance | measuring cylinder | metre rule

micrometer screw gauge | stop-watch | thermocouple

Table 2.1

quantity	device
volume of water in a glass	
width of a small swimming pool	
thickness of a piece of aluminium foil	

[3]

[Total: 6]

Measuring length, volume, time and temperature Click for more variations

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1(a)	(use stop-watch to) time oscillations	**B1**
	(use of fiduciary) aid to determine a complete cycle	**B1**
	(use of) multiple oscillations **AND** division (to determine period)	**B1**
1(b)	quantity / device volume of water in a glass / measuring cylinder width of a small swimming pool / metre rule thickness of a piece of aluminium foil / micrometer screw gauge 1 mark for each correct response	**B3**

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2 The IGCSE class is investigating the rate of cooling of water under different conditions.

The apparatus is shown in Fig. 2.1.

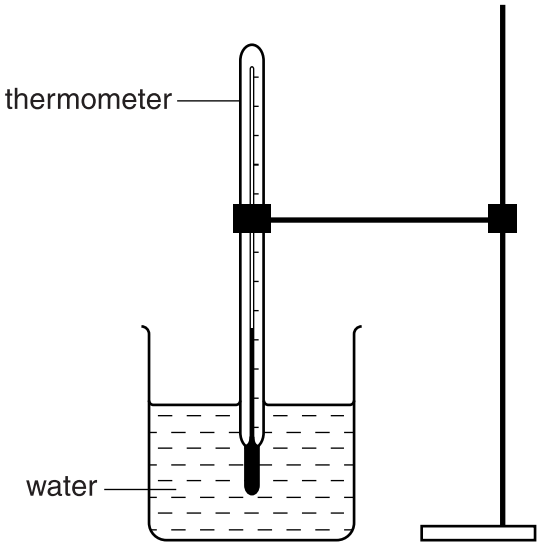


Fig. 2.1

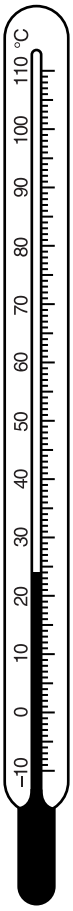


Fig. 2.2

(a) Record the value of room temperature θ_R shown on the thermometer in Fig. 2.2.

θ_R = ...[1]

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(b) A student pours 150 cm^3 of hot water into a beaker. She measures the temperature θ of the water at time $t = 0$ and records it in a table.

She starts a stopclock and records the temperature of the water at 30 s intervals until she has a total of six values up to time $t = 150$ s. The readings are shown in Table 2.1.

She repeats the procedure, using 250 cm^3 of hot water.

Table 2.1

	volume of water	
	150 cm^3	250 cm^3
t/	θ/	θ/
0	84	85
30	79	79
60	74	75
90	70	72
120	68	70
150	66	68

(i) Complete the column headings in the table. [1]

(ii) State whether the rate of cooling is significantly faster, slower, or about the same when using the larger volume of hot water. Justify your answer by reference to the readings.

statement .....

justification .....

.....

.....

[2]

(c) If this experiment were to be repeated in order to check the results, it would be important to control the conditions. Suggest two such conditions that should be controlled.

1. .....

2. .....

[2]

[Total: 6]

Readings, tables, graphs and conclusions Click for more variations

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2 **(a)** $\theta_R = 24(°C)$ [1]

(b) **(i)** Table:
s, °C, °C [1]

(ii) About the same [1]
Justified with reference to numbers in table [1]

(c) Any two from:
Volumes of water
Room temperature/draughts
Same beaker
Initial water temperature [2]

[Total: 6]

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3 A student is investigating whether the diameter of a pendulum bob affects the period of a pendulum. The period is the time taken for one complete oscillation of the pendulum. Fig. 3.1 shows a pendulum.

Fig. 3.2 shows one complete oscillation.

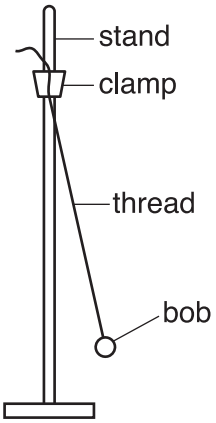


Fig. 3.1

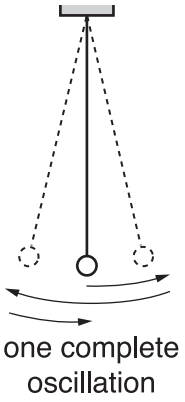


Fig. 3.2

The student has the following apparatus:

pendulum bobs made of polystyrene with diameters 1 cm, 2 cm, 3 cm, 4 cm and 5 cm
a supply of thread and a pair of scissors
clamp and stand.

Plan an experiment to investigate whether the diameter of a pendulum bob affects the period of a pendulum.

You should:

- list additional apparatus that you would require
- explain briefly how you would carry out the investigation
- state the key variables that you would control
- draw a table with column headings, to show how you would display your readings (You are **not** required to enter any readings in the table.)
- explain briefly how you would use your readings to reach a conclusion.

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.....[7]

[Total: 7]

Planning an experiment Click for more variations

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3	**MP1**	Stopwatch (or equivalent) AND (metre) rule / ruler	**1**
	MP2	Measure time for 5 (+) oscillations	**1**
	MP3	Divide by number of oscillations to find period (T)	**1**
	MP4	Repeat for each bob	**1**
	MP5	Variable; one from: Initial amplitude / starting position Length of pendulum / thread Number of oscillations	**1**
	MP6	Table with column headings for t, or period (T), or both AND d, with correct units	**1**
	MP7	Conclusion: Plot graph(s) of d against period (T) or t (or vice versa) OR compare period (T) or t values for different diameters	**1**

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4 A student investigates the resistance of a wire.

Plan an experiment which enables him to investigate how the length of a wire affects the resistance of the wire.

Resistance R is calculated from the equation: $R = \frac{V}{I}$

where V is the potential difference (p.d.) across the wire and I is the current in the wire.

The apparatus available includes:

- a selection of wires
- a variable power supply
- an ammeter
- a voltmeter.

In your plan:

- list any additional apparatus needed
- complete Fig. 4.1 to show a voltmeter connected to measure the potential difference across the wire
- explain briefly how to do the experiment, including the measurements to take so that the resistance can be determined
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

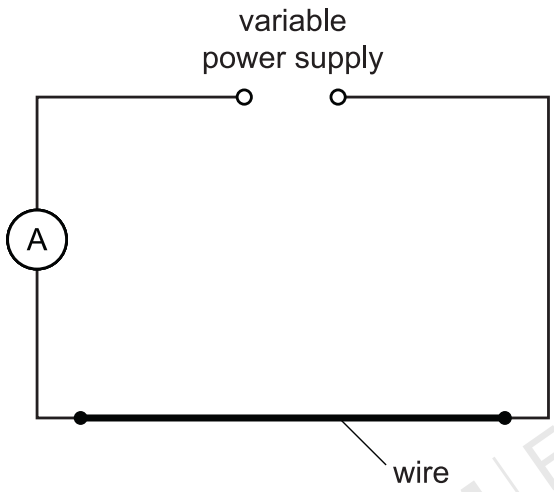


Fig. 4.1

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[7]

Planning an experiment Click for more variations

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4	**MP1**	**circuit diagram:** correct voltmeter circuit symbol shown in parallel with all or part of wire	**1**
	MP2	**apparatus:** metre ruler	**1**
	MP3	**method:** measure / record length; measure p.d. and current; specific reference to repeating with different length	**1**
	MP4	**key / control variable:** constant diameter / radius / gauge of wire material of wire / same wire / same type of wire	**1**
	MP5	**table:** columns, with units, for length, p.d., current, resistance	**1**
	MP6	**analysis:** compare readings in the table to see <u>if</u> change in length produces change in resistance plot resistance-length or length-resistance graph	**1**
	MP7	**additional point** (one from)**:** at least 5 sets of data taken; repeat for each length <u>and</u> take average; 2nd control variable: diameter / material / temperature of wire; use of protective resistor	**1**

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5 A student investigates the horizontal distance travelled by a metal ball after it rolls off the end of a plastic track. Fig. 4.1 shows the set-up.

The ball rolls down a plastic track. The left-hand side of the track is fixed. The right-hand side can be adjusted so that the ball comes off the track at different angles.

The student measures the horizontal distance that the ball travels from the right-hand end of the track to the point that it hits the floor.

Plan an experiment to investigate how the horizontal distance travelled by the metal ball depends on the angle that the right-hand end of the track makes with the bench.

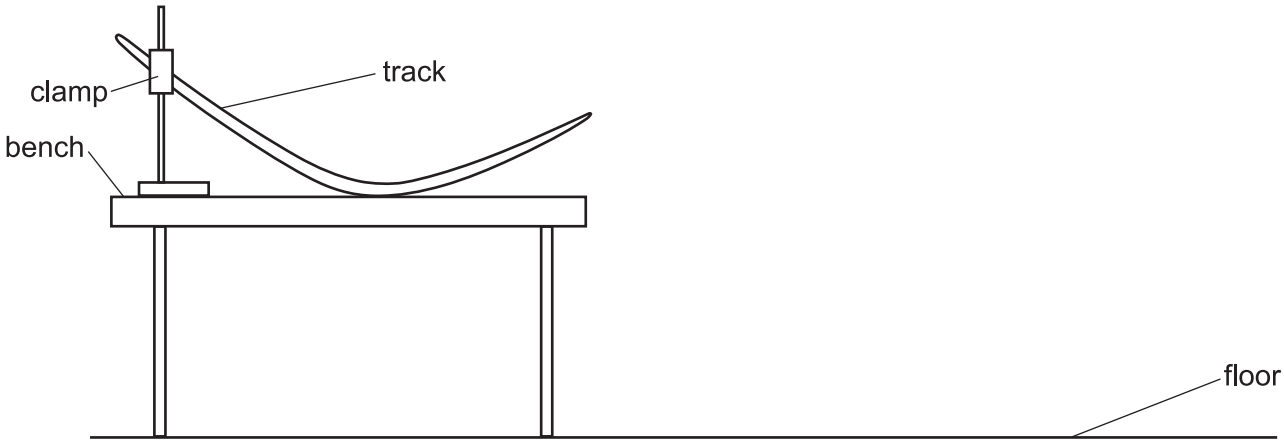


Fig. 4.1

The following apparatus is available to the student:

- track with stand, boss and clamp
- selection of metal balls.

Other apparatus normally available in a school laboratory can also be used.

In your plan, you should:

- list any additional apparatus required
- explain briefly how you would do the investigation, including the measurements you would take
- state the key variables to be kept constant
- draw a suitable table, with column headings, to show how you would display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the results to reach a conclusion.

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..... [7]

Planning an experiment Click for more variations

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5	**MP1** (Metre) rule / tape measure	**1**
	MP2 Release ball to roll down track, measure how far it travels.	**1**
	MP3 Repeat for at least 2 more <u>different angles</u> of right-hand side of track	**1**
	MP4 Clear identification of the correct distance to be measured (e.g. from table leg or other point identified on floor to point of impact with track) OR clear explanation of how to identify point of impact (e.g. using a sand tray)	**1**
	MP5 Constant variable identified Release height for ball Or same ball every time / same weight / mass / size of ball	**1**
	MP6 Table <u>consistent with their method</u> (if method correct with columns for distance travelled and angle of track, with units)	**1**
	MP7 Analysis <u>based on their table</u> Graph of angle against distance travelled, or compare angle with distance travelled (or the equivalents for their method)	**1**

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6 The IGCSE class is studying the acceleration of a toy car that is pulled along a track by a force *F*.

The arrangement is shown in Fig. 1.1.

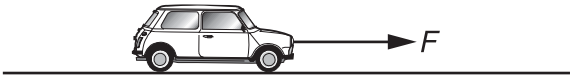


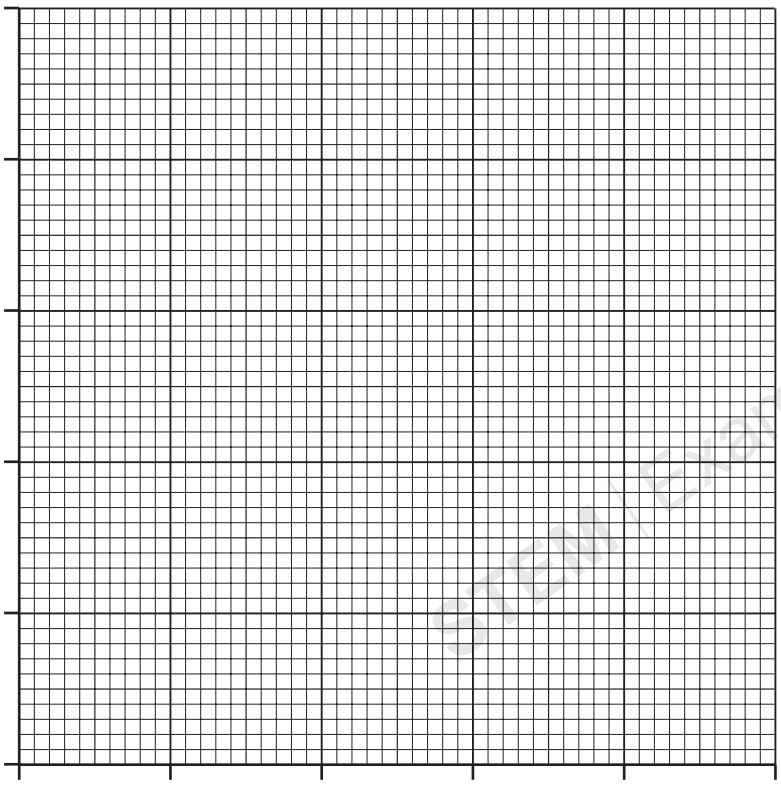
Fig. 1.1

A student uses a force *F* of 0.5 N to pull a toy car along a track and electronically measures the acceleration *a*. He records the results in a table. He repeats the procedure using a range of different forces up to 2.5 N. The readings are shown in Table 1.1.

Table 1.1

$\frac{F}{\text{N}}$	$\frac{a}{\text{m/s}^2}$
0.5	0.35
1.0	0.72
1.5	1.02
2.0	1.44
2.5	1.74

(a) Plot a graph of $\frac{F}{\text{N}}$ (*y*-axis) against $\frac{a}{\text{m/s}^2}$ (*x*-axis).



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[5]

(b) Theory suggests that the acceleration is directly proportional to the force applied to the toy car. State whether the results support this suggestion and justify your statement by reference to the graph.

statement .....

justification .....

.....[2]

(c) The gradient of the graph is equal to the mass of the toy car. From the graph, determine the mass *m* of the toy car. Show clearly how you obtained the necessary information.

m = ... [3]

[Total: 10]

Readings, tables, graphs and conclusions Click for more variations

6 **(a)** graph: axes labelled and scales suitable [1]
all plots correct to nearest ½ small square [2]
well judged best fit line [1]
thin best fit single line/no 'blobs' [1]

(b) statement matches line (expect YES) [1]
justification matches statement
(expect straight line through origin) [1]

(c) triangle method with more than half the line used [1]
clear how obtained – shown on graph [1]
m correct in kg, 2 or 3 significant figures [1]
1.39 – 1.45 kg - unit penalty

[Total: 10]

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7 The class is investigating the stretching of a spring.

Fig. 1.1 shows the apparatus.

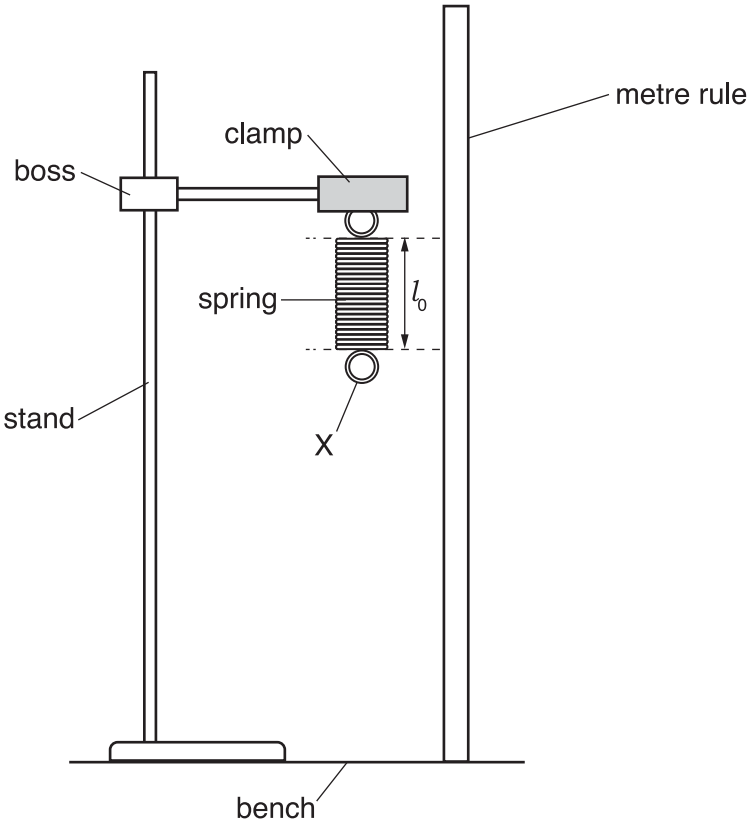


Fig. 1.1

(a) **(i)** On Fig. 1.1, measure the length l_0.
Record l_0 in Table 1.1 at load L = 0.0 N. [1]

(ii) Explain why l_0 is **not** measured to point X on the spring.

.....

.....[1]

(b) A student hangs a 1.0 N load on the spring. He records the new length l of the spring.

He repeats the procedure using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

Table 1.1

L/N	0.0	1.0	2.0	3.0	4.0	5.0
l/mm		17	20	21	23	25

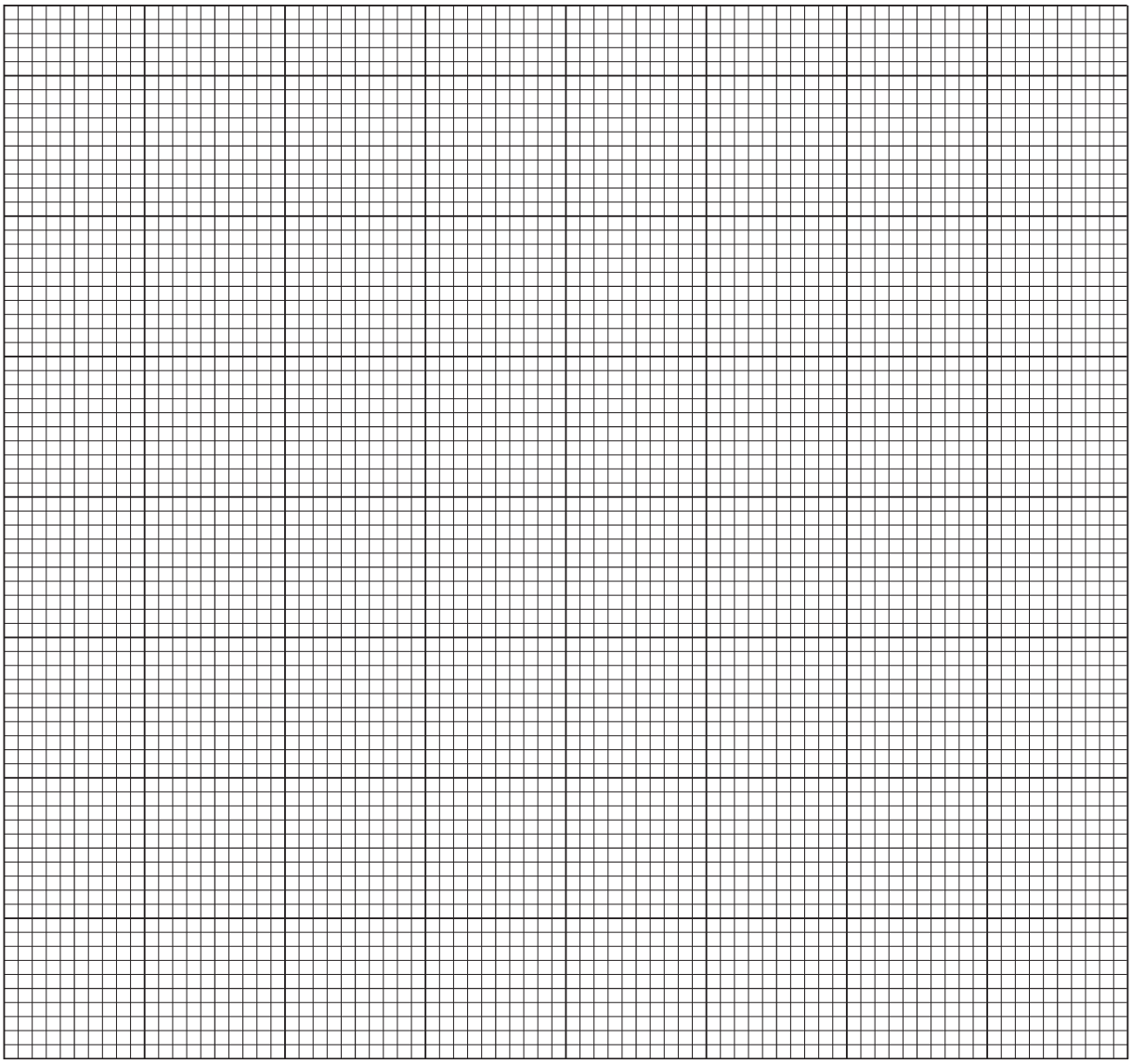
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Describe **one** precaution that you would take in order to obtain reliable readings.

.....

.....[1]

(c) Plot a graph of l/mm (y-axis) against L/N (x-axis).



[4]

(d) A student suggests that the length l of the spring is directly proportional to the load L.

State whether your readings support this suggestion. Justify your answer by reference to the graph line.

.....

.....[1]

(e) Use the results to predict the load L that would give a length l twice the value of l_0. Show clearly how you obtained your answer.

load L = ...[2]

[Total: 10]

Readings, tables, graphs and conclusions Click for more variations

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7(a)(i)	15	**1**
7(a)(ii)	Ring(s) do not extend (owtte)	**1**
7(b)	Use of set square to line up with scale OR perpendicular viewing	**1**
7(c)	Graph:	
	Axes correctly labelled and right way round	**1**
	Suitable scales	**1**
	All 6 plots correct to ½ small square	**1**
	Good line judgement, thin, single, continuous line	**1**
7(d)	(NO);line does not pass through origin	**1**
7(e)	*L* in range 6–8	**1**
	L in range 7.2–7.8	**1**
	Total:	**10**

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8 A student investigates the cooling of hot water in a beaker.

She uses the apparatus shown in Fig. 2.1.

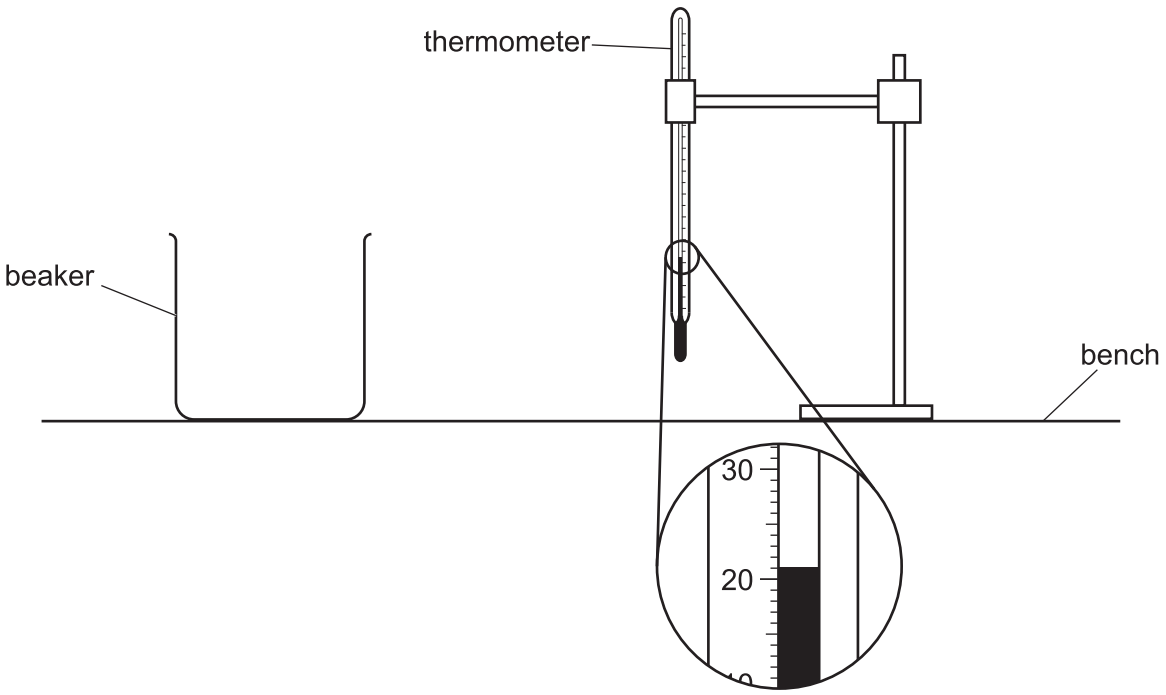


Fig. 2.1

(a) Record room temperature θ_R shown on the thermometer in Fig. 2.1.

θ_R = ... [1]

(b) The student pours hot water into the beaker and records the initial temperature θ in Table 2.1. She then records the temperature θ every 30 s. Her values are shown in Table 2.1.

Describe **one** technique that you use to ensure that temperature readings in this type of experiment are as accurate as possible.

.....

..... [1]

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Table 2.1

t/s	θ/°C
0	93.0
30	90.5
60	88.5
90	87.0
120	85.5
150	84.0
180	83.0
210	82.0
240	81.5
270	81.0

(c) Estimate what the temperature θ_{300} is at 300 s. Use the readings from Table 2.1 to guide you.

θ_{300} = ...°C [1]

(d) **(i)** Calculate the average cooling rate x_1 during the first 90 s of the experiment. Use the readings from Table 2.1 and the equation:

$$x_1 = \frac{\theta_0 - \theta_{90}}{T}$$

where T = 90 s and θ_0 and θ_{90} are the temperatures at t = 0 and t = 90 s.
Include the unit for the cooling rate.

x_1 = ... [1]

(ii) Calculate the average cooling rate x_2 during the middle 90 s of the experiment. Use the readings from Table 2.1 and the equation:

$$x_2 = \frac{\theta_{90} - \theta_{180}}{T}$$

where T = 90 s and θ_{90} and θ_{180} are the temperatures at t = 90 s and t = 180 s.

x_2 = ... [1]

(iii) Calculate the average cooling rate x_3 during the last 90 s of the experiment. Use the readings from Table 2.1 and the equation:

$$x_3 = \frac{\theta_{180} - \theta_{270}}{T}$$

where T = 90 s and θ_{180} and θ_{270} are the temperatures at t = 180 s and t = 270 s.

x_3 = ... [1]

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(e) **(i)** Use your results from **(d)** to describe the overall pattern of the rate of cooling of the water in the experiment. Justify your answer by reference to your results.

.....

.....

..... [1]

(ii) Estimate the final temperature θ_F of the water after several hours.

θ_F = ... [1]

(f) **(i)** Another student does the same experiment. He starts with the hot water at a lower initial temperature.

Suggest how his cooling rates are likely to compare with those in **(b)**. Use your results to explain your answer.

suggestion .....

.....

explanation .....

.....

.....

[2]

(ii) State **one** variable, other than the initial water temperature, that the student needs to control.

.....

..... [1]

[Total: 11]

Planning an experiment Click for more variations

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8(a)	θ_R = 21 (°C)	**1**
8(b)	read scale perpendicularly / or words to that effect (e.g. at eye level, at right angles)	**1**
8(c)	81.0 $>$ $\theta_{300} \geqslant$ 80.5 (°C)	**1**
8(d)(i)	x_1 = 0.067 **AND** x_2 = 0.044 **AND** x_3 = 0.022	**1**
8(d)(ii)	units °C / s	**1**
8(d)(iii)	consistent 2 or consistent 3 significant figures	**1**
8(e)(i)	description matching results e.g. 'cooling rate falls steadily as time goes on' **AND** reference to cooling rate values to show this	**1**
8(e)(ii)	θ_F near or equal to θ_R	**1**
8(f)(i)	cooling rates likely to be lower	**1**
	(e.g.) x_2 lower than x_1 and second 90 s has lower starting temperature	**1**
8(f)(ii)	any **one** suitable control variable from: • volume of water • size / material of beaker • room temperature / other valid environmental factor	**1**

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9 A student investigates the period of a pendulum. Fig. 1.1 and Fig. 1.2 show the set-up.

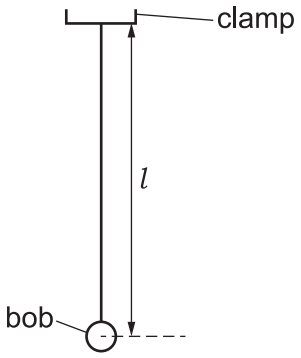


Fig. 1.1

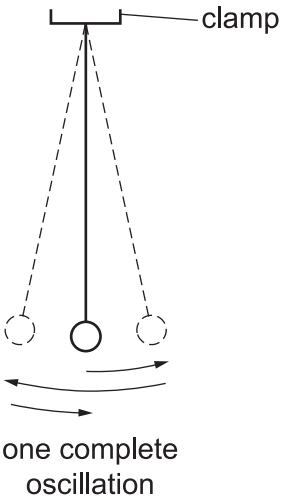


Fig. 1.2

(a) Explain briefly how to measure to the centre of the pendulum bob as accurately as possible.

.....

..... [1]

(b) The student adjusts the length of the pendulum until the distance l, measured from the bottom of the clamp supporting the pendulum to the centre of the pendulum bob, is 50.0 cm.

He displaces the bob slightly and releases it so that it swings. Fig. 1.2 shows one complete oscillation of the pendulum.

He measures and records the time t for 20 complete oscillations.

(i) Calculate, and record in Table 1.1, the period T of the pendulum. The period is the time for one complete oscillation. [1]

(ii) Calculate, and record in Table 1.1, the value of T^2. [1]

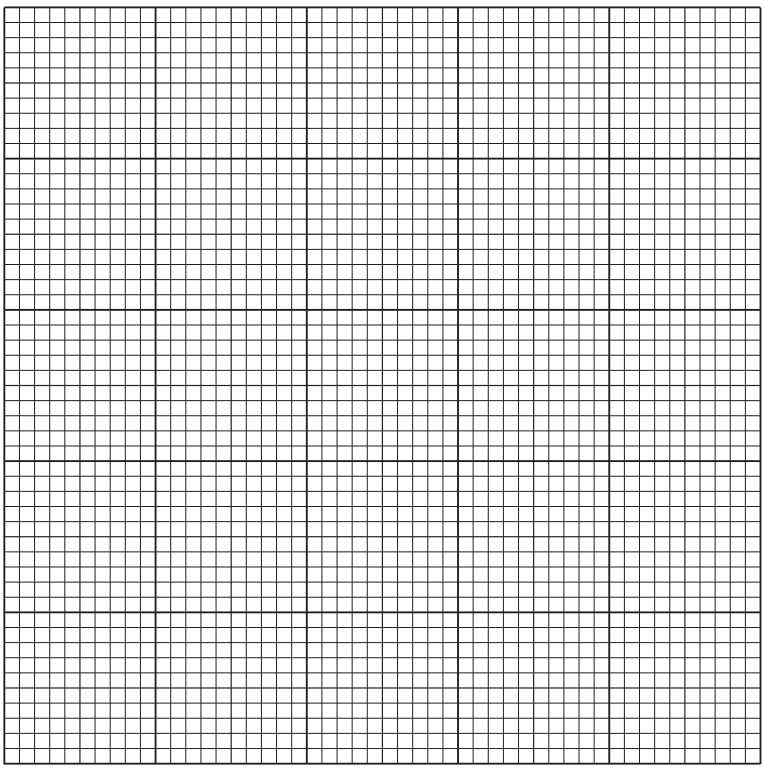
Table 1.1

l/cm	t/s	T/s	T^2/s^2
50.0	28.2		
60.0	31.2	1.56	2.43
70.0	33.6	1.68	2.82
80.0	35.8	1.79	3.20
90.0	38.2	1.91	3.65

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He repeats the procedure using l values of 60.0 cm, 70.0 cm, 80.0 cm and 90.0 cm. The readings and results are shown in Table 1.1.

(c) Plot a graph of T^2/s^2 (y-axis) against l/cm (x-axis). Start the T^2/s^2 axis at a convenient value close to the minimum value of T^2/s^2.



[4]

(d) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [3]

(e) Explain briefly why timing 20 oscillations gives a more accurate result for the period T than timing 1 oscillation.

.....

..... [1]

[Total: 11]

Readings, tables, graphs and conclusions Click for more variations

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9(a)	Clear use of horizontal aid OR bob touching rule	**1**
9(b)(i)	$T = 1.41$	**1**
9(b)(ii)	$T^2 = 1.99$ (to 2 decimal places only, correctly rounded)	**1**
9(c)	Axes of graph correctly labelled with quantity and unit and right way round	**1**
	Suitable scales	**1**
	All plots correct to ½ small square	**1**
	Good line judgement, thin, continuous line	**1**
9(d)	Triangle method clear on graph	**1**
	Triangle at least half the length of the line between extreme plots used	**1**
	G value in range 0.038 – 0.044	**1**
9(e)	Reaction time / human error a smaller part of time measured	**1**

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10 A student investigates the balancing of a metre rule.

Fig. 3.1 shows the set-up.

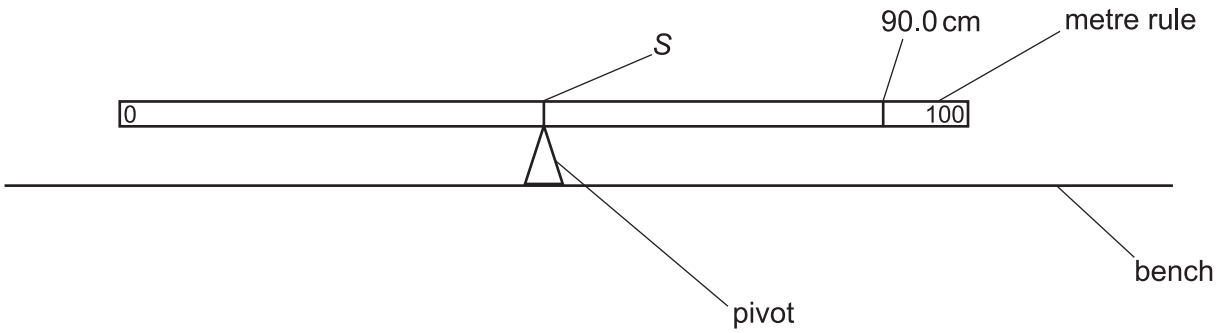


Fig. 3.1

(a) The student places the metre rule on the pivot so that the metre rule is as near as possible to being balanced. Fig. 3.2 shows the position of the pivot.

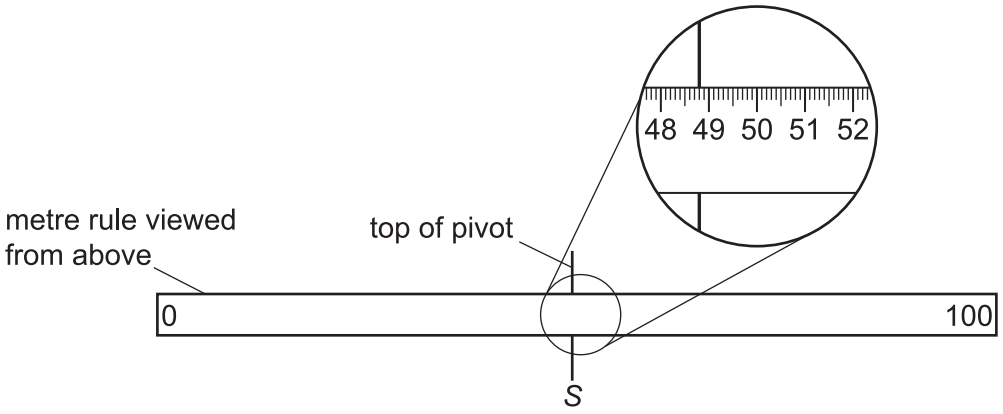


Fig. 3.2

Record the scale reading *S* on the metre rule at the point where the rule balances on the pivot.

S = ... cm [1]

(b) The metre rule is 4 mm thick. The pivot is under the metre rule. The scale is on the top of the metre rule. Suggest how you would obtain an accurate value of the scale reading *S*.

.....

..... [1]

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(c)

- The student places an object Q with its centre on the metre rule at the 90.0 cm mark. The position of Q is not changed during the experiment.
- He places a load P of weight P = 1.0 N on the metre rule.
- He adjusts the position of load P so that the metre rule is as near as possible to being balanced with the pivot directly below the scale reading S.
- He records, in Table 3.1, the distance a from the centre of load P to the centre of load Q.
- He repeats the procedure using loads of weight P = 2.0 N, 3.0 N, 4.0 N and 5.0 N.
- He records all the values of a in Table 3.1.

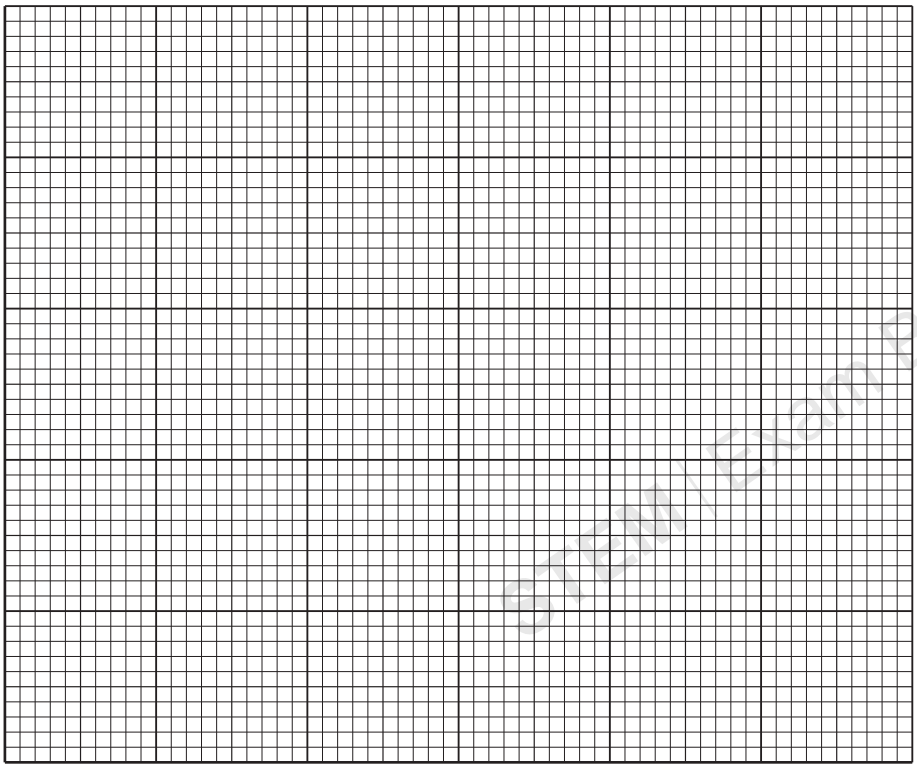
Complete the column headings in Table 3.1 by inserting the unit in the $\frac{1}{P}$ column.

Table 3.1

P/N	a/cm	$\frac{1}{P}$/
1.0	80.0	1.00
2.0	59.5	0.50
3.0	54.5	0.33
4.0	50.4	0.25
5.0	47.8	0.20

[1]

(d) Plot a graph of a/cm (y-axis) against $\frac{1}{P}$ (x-axis). Start the y-axis at a/cm = 30.



[4]

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(e) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [3]

(f) The gradient G is numerically equal to the distance d between the pivot and the centre of load Q. Record the value of d to a suitable number of significant figures for this experiment.

d = ... cm [1]

[Total: 11]

Readings, tables, graphs and conclusions Click for more variations

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10(a)	S = 48.8 (cm)	**1**
10(b)	perpendicular viewing (of scale)	**1**
10(c)	1/N or N^{-1}	**1**
10(d)	axes correctly labelled with quantity and unit and correct way round	**1**
	suitable scales with a axis starting from 30	**1**
	all plots correct to ½ small square	**1**
	good line judgement with thin continuous line	**1**
10(e)	triangle method clearly shown on graph	**1**
	(triangle) covering at least ½ of candidate's line between the extreme plots	**1**
	G = 40.0 ± 1.0 (i.e. any answer between 39.0 and 41.0 inclusive)	**1**
10(f)	d = G and given to 2 or 3 significant figures	**1**

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