

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Mark Schemes

Q1.

- (a) 6.75 ✓

CAO

1

- (b) any sensible answer describing possible consequences of use of the thimble, e.g. can cause the wire to be distorted/damaged; or reduces the diameter. ✓

Accept 'the frame of the micrometer might become warped' / 'damage might occur to the screw thread mechanism' / 'may lead to the reading shown being smaller than true value'

Condone 'squeezed'. Condone 'change diameter'.

Reject 'might change the reading', 'affect results', 'cause a reading below zero', 'could lead to systematic error', 'over-tighten' or 'holds wire more securely'.

1

- (c) fully correct calculation
- ₁
- ✓
- ₂
- ✓

ORpartly correct calculation ₁₂✓

$((2 \times 1.2\%) + 2.0\%) = 4.4\%$ ₁✓₂✓

For ₁₂✓ allow any of $(2 \times 1.2\%)$ OR 2.4% OR $1.2\% + 2.0\%$ OR 3.2% OR $1.44\% + 2.0\%$ OR 3.4% seen in working.

For 1 mark condone misreading leading to $(2 \times 2.0\%) + 1.2\% = 5.2\%$ OR $4\% + 1.2\% = 5.2\%$.

2

- (d) length of wire between oscillator and pulley
- ₁
- ✓

mass of **M** ₂✓

For ₁✓ allow 'distance between oscillator and pulley' or 'length of horizontal/oscillating wire' or use of annotation to Figure 2 to identify correct dimension with a symbol, eg L.

For ₁✓ 'length of wire' is insufficient.

For ₂✓ allow 'weight of M' or 'suspended mass'.

For ₂✓ accept 'tension in wire'.

Reject bland 'M' or 'the mass' or 'tension'.

Treat 'mass per unit length of wire' as neutral.

2

- (e) calculates $d \times f$ at least twice $_1 \checkmark$

states how their calculations support a conclusion that f is inversely proportional to d $_2 \checkmark$

d / mm	f / Hz	$(d \times f) / \text{mm s}^{-1}$
0.85	28.5	24.2 (24.23)
0.68	36.0	24.5 (24.48)
0.54	44.5	24.0 (24.03)
0.44	55.5	24.4 (24.42)
0.37	65.0	24.1 (24.05)

Allow reverse working or use of readings from a line of best-fit.

For $_1 \checkmark$ condone misreading of scale of one axis, or one misreading.

For $_2 \checkmark$ apply list principle to calculations i.e. for 2 or 3 calculations, all must be correct; for 4 calculations, condone 1 error; for 5 calculations, condone 2 errors.

Do not allow 1 sf for constant of proportionality.

2

- (f) f values increase $_1 \checkmark$

by $\sqrt{2}$ $_2 \checkmark$

For $_1 \checkmark$ allow (all) points / line / graph move(s) up.

Must not imply d changes **OR** points / line moves right **OR** that μ changes.

Treat 'graph is stretched upwards / in the y - direction' as neutral.

2

[10]

Q2.

- (a) identifies appropriate equipment and makes a relevant comment about how it is used $\checkmark$

Use of plumb line (accept 'mass / weight on string')

OR

use of a metre ruler made vertical with a set-square in contact with the floor

OR

using a (long) spirit level.

Comments that the string of the plumb line / edge of metre ruler / edge of spirit level should be in contact with the projecting end of the track.

Give credit for suitable annotation to Figure 4

1

- (b) rejects anomalous mark (at 607) $_1 \checkmark$

calculates mean from readings of marks $_2 \checkmark$

For $_2 \checkmark$ expect to see readings of 581, 583, 583, 586, 588 (and 607) for centres of circles. Allow readings from left edge or from right edge, but not a mix. Reject readings given to a precision greater than 0.5 mm.

Allow an arithmetic error. Expect to see $\frac{2921}{5}$ or $\frac{3528}{6}$.

584 (mm) $_3✓$

For $_3✓$ allow 588 (mm)

For $_3✓$ 3 sf answer only.

3

(c) ruled best-fit line passing below 3rd plot and above 2nd and 4th plots $_1✓$

finds gradient and multiplies by $\frac{7}{20}$ $_2✓$

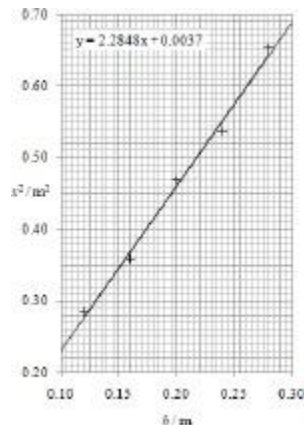
H in result in range 0.78 to 0.83 $_3✓$

Withhold $_1✓$ if line is poorly marked.

For $_2✓$ condone one read-off error. Gradient from h step ≥ 0.10 m.

Expect gradient in range 2.20 - 2.37. Allow any appropriate use of $\frac{7}{20}$.

h / m	x^2 / m^2
0.12	0.285
0.16	0.360
0.20	0.470
0.24	0.535
0.28	0.655



For $_3✓$ 2 sf only.

Allow $_1✓ \times _2 \times _3✓ = 2$ MAX for H in range obtained using co-ordinates of a point on the line.

Allow $_1 \times _2 \times _3✓ = 1$ MAX for H in range obtained using a plotted point if no best-fit line is drawn.

3

(d) idea that absolute uncertainty is the same but value of t is larger $✓$

Allow sample calculation or reference to equation.

Condone 'uncertainty' for 'absolute uncertainty'.

1

(e) draw a best-fit curve/line and read-off (α) where value of t is a minimum $_1✓$

For $_1✓$ 'draw a line' is not enough.

Accept read off at 'bottom of curve' / 'where the gradient is zero' / 'at the turning point'.

Annotations to Figure 8 can earn MP1; any line of best-fit drawn does not need to be neat.

take more readings around α when t has minimum value, or words to that effect (owtte) $_2✓$

For z ✓ reject bland 'repeat readings'.

2

[10]