Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q 1.

(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 $_1$✔$_2$✔

OR

partly correct calculation $_{12}$✔

((2 × 1.2%) + 2.0% =) 4.4% $_1$✔$_2$✔

*For $_{12}$✔ allow any of (2 × 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 × 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 $_1$✔

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

d / mm	f / Hz	$(d \times f)$ / 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 $_1$✔ condone misreading of scale of one axis, or one misreading.

For $_2$✔ 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 $_1$✔

by $\sqrt{2}$ $_2$✔

For $_1$✔ 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]

Q 2.

(a) identifies appropriate equipment and makes a relevant comment about how it is used ✔

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) $_1$✔

calculates mean from readings of marks $_2$✔

For $_2$✔ 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 $\frac{7}{20}$ $_2$✔

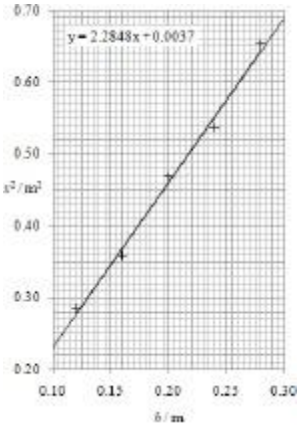
H in result in range 0.78 to 0.83 $_3$✔

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 $_1$✔$_2$×$_3$✔ *= 2 MAX for H in range obtained using co-ordinates of a point on the line.*

Allow $_1$×$_2$×$_3$✔ *= 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 $_2$✔ reject bland 'repeat readings'.

2

[10]