

Name of the Student: _____

Max. Marks : 16 Marks

Time : 16 Minutes

Mark Schemes

Q1.

- (a) (mark should be at the equilibrium position) since this is where the mass moves with greatest speed [transit time is least] ✓

1

- (b) (i) mean time for $20T$ (from sum of times $\div 5$) = 22.7 (s) ✓
 (minimum 3sf)

uncertainty (from half of the range) = 0.3 (s) ✓ (accept trailing zeros here)

percentage uncertainty

$$\left(\text{from } \frac{0.3}{22.7} \times 100\right) \left[\frac{100}{5} \times \sum \frac{0.3}{20T}\right] = 1.3 \text{ (22)\%}_3 \quad \checkmark$$

(allow full credit for conversion from $20T$ to T , e.g. $1.135 =$ ✓
 $0.015 =$ ✓ ecf for incorrect ✓ and / or ✓ earns ✓
 3

3

- (ii) natural frequency $\left(\text{from } \frac{20}{22.7} \text{ and minimum } 2 \text{ sf}\right) = 0.88 \text{ (1) Hz [accept } \text{s}^{-1}]$ ✓

(ecf for wrong mean $20T$; accept $\geq 4 \text{ sf}$)

1

- (c) (i) linear scale with at least 3 evenly-spaced convenient values (i.e. not difficult multiples) marked; the intervals between 1 Hz marks must be $40 \pm 2 \text{ mm}$ ($100 \pm 5 \text{ mm}$ corresponds to 2.5 Hz) ✓

(ecf for wrong natural frequency: $100 \pm 5 \text{ mm}$ corresponds to

$$\frac{2.5f}{0.88} \text{ Hz})$$

1

- (ii) 4 mm [allow $\pm 0.2 \text{ mm}$] ✓

1

- (d) (i) student decreased intervals [smaller gaps] between [increase frequency / density of] readings (around peak / where A is maximum) ✓ ✓

[student took more / many / multiple readings (around peak) ✓]

(reject bland 'repeated readings' idea; ignore ideas about using data loggers with high sample rates)

2

- (ii) new curve starting within ± 1 mm of $A = 4$ mm, $f = 0$ Hz with peak to right of that in Figure 3
(expect maximum amplitude shown to be less than for 2 spring system but don't penalise if this is not the case; likewise, the degree of damping need not be the same (can be sharper or less pronounced)
Peak at $\sqrt{2}$ value given in (b)(ii); expect 1.25 Hz so peak should be directly over 50 ± 5 mm but take account of wrongly-marked scale ✓

2

[11]

Q2.

- (a) the travelling microscope won't interfere with / change the path / interrupt / affect the stream [flow] of water / affect the reading (being taken)
[vernier callipers will interfere with etc] ✓

(reject 'cannot grip / clamp the flow')

1

- (b) (i) straight best-fit line drawn passing within ± 2 mm of 1st and 5th points, 3rd and 4th points to be either side of line;

attempt to measure the gradient (i.e. using $\frac{d(\log s)}{d(\log d)}$ from the line or from two of the plotted points if these lie on the line; do not penalise for small steps, false read-off(s) (including failure to take account of false origin) or for calculation error ✓

$n = -4$ (integer value only, e.g. reject -4.0) ✓

2

- (ii) $k = 10^{\text{intercept}}$ [antilog of (log s) intercept] ✓

[take values of log s and log d and evaluate $10^{(\log s - (-4)\log d)}$ ✓]

('log k = intercept' is insufficient)

1

- (iii) units of $k = \text{cm}^5$ [accept m^5 or mm^5 ; allow ecf for wrong or non-integer value for n , eg ecf for $\text{cm}^{(1-n)}$ ✓

1

[5]