

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Mark Schemes

Q1.

- (a) Y-shift ✓

auto-marked: CAO

1

- (b) use of (transit distance) =
- 2×0.870
- ✓
- ₁

for 1 ✓ allow 1.74

1

use of (contact time) = 6 ± 0.2 major divisions $\times 50 \times 10^{-6}$ ✓₂*for 2 ✓ allow POT error in time-base value;**allow 2.9, 3(.0) or 3.1 ($\times 10^{-4}$ s) seen in working*

1

speed in range 5600 to 6000 (m s^{-1}) ✓₃*for 3 ✓ no credit for $c = f \times \lambda$ approach;**speed in range 2800 to 3000 (m s^{-1}) from**valid calculation eg $\frac{0.870}{3 \times 10^{-4}}$ award 2 ✓₁₃ ✓ = 2;**speed in range 1120 to 1200 (m s^{-1}) from valid calculation (using minor divisions) eg* *$\frac{2 \times 0.870}{5 \times 3 \times 10^{-4}}$ award 1 ✓₂₃ ✓ = 2;**for speed = length of rod / ($0.5 \times$ time-base) 1 ✓₂ ✗₃ ✗**no credit for speed = length of rod / timebase**speed correct from valid calculation earns 1 ✓₂ ✓₃ ✓*

1

- (c) quantitative effect on contact time ✓
- ₁

*for 1 ✓ expect '(contact) time is doubled' / '600 μs '*quantitative effect on waveform ✓₂*for 2 ✓ expect 'double the number of cycles would be produced' / 'would require 12 divisions';**accept 'waveform extended horizontally $\times 2$ ' 'waveform is twice as long' or wtte;**condone 'number of wave(length)s doubled';**reject 'trace is twice as long' / 'wavelength doubled' / 'waveform stretched';*

allow 'increased (contact) time so more waves / longer waveform seen'
for $_{12}$ ✓ = 1 MAX

waveform extends beyond screen / scale or wtte $_3$ ✓

for $_3$ ✓ consequences eg waveform could not be (fully) displayed /
would not fit;
only penalise 'trace' once

Max 2

adjustment to time-base control $_4$ ✓

for $_4$ ✓ allow (any) change time-base;
allow 'time (per) div';
condone 'X-scale'

1

to 0.1 ms (div^{-1}) $_5$ ✓

for $_5$ ✓ CAO

1

[8]

Q2.

(a) $(\pm) 0.04 \text{ (m)}$ ✓

Correct answer only

1

(b) G_{\max} line ruled through bottom of first error bar and through top of fifth error bar **OR**
 G_{\min} line ruled through top of first error bar and through bottom of sixth error bar $_1$
✓

$_1$ ✓ requires at least one line to be well-drawn i.e. thin, single,
continuous

G_{\max} between 10.7 and 10.9 $_2$ ✓

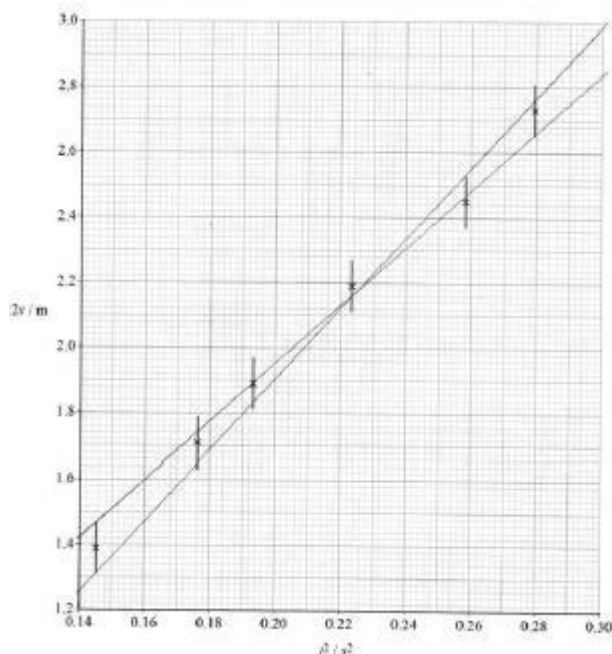
For $_2$ ✓ expect a 3 sf value. Accept 2 sf value only if it comes from
expected range. Condone 4 sf value.

G_{\min} between 8.7 and 8.9 $_3$ ✓

For $_3$ ✓ accept 2 or 3 sf values only

For $_{23}$ ✓ at least one Δt^2 step $\geq 0.08 \text{ (s}^2\text{)}$ (i.e. half width of grid)

Ignore any unit given with G_{\max} or G_{\min}



3

(c) uses $g = \frac{G_{\max} + G_{\min}}{2}$ with their values from part (b) $_1 \checkmark$

evaluates mean of their G_{\max} and G_{\min} to 2 sf $_2 \checkmark$

If no other mark given, allow 1 mark for a value of 9.7 ($m\ s^{-2}$) from a well-drawn best-fit line.

Give no credit for an unsupported answer.

Treat "10" as a 2 sf answer.

2

(d) absolute uncertainty in g $_1 \checkmark$

Mark each point independently. If no other mark given, allow 1 mark for a percentage uncertainty (1 or 2 sf) based on the full range (rather than half the range).

*For $_1 \checkmark$ must use their G_{\max} **AND/OR** their G_{\min} e.g.*

$$\Delta g = \frac{G_{\max} - G_{\min}}{2} \quad \text{OR} \quad G_{\max} - \text{their } g \quad \text{OR} \quad \text{their } g - G_{\min}$$

May be seen in working for percentage uncertainty e.g.

$$\left(\frac{G_{\max} - g}{g} \right) \times 100 \quad \text{OR} \quad \left(\frac{g - G_{\min}}{g} \right) \times 100$$

$$\text{OR} \quad \left(\frac{G_{\max} - G_{\min}}{G_{\max} + G_{\min}} \right) \times 100$$

$$\text{percentage uncertainty in } g = \frac{\text{their } \Delta g}{\text{their } g} \times 100 \quad _2 \checkmark$$

For $_2 \checkmark$ allow 1 or 2 sf

2

(e) systematic error \checkmark

'zero error' is neutral

(f) points/line displaced to right owtte

OR

line moves down

OR

(vertical) intercept is decreased / now has negative intercept ✓

Must refer to a property of the graph; comments about error bars are neutral; ignore (new) calculated values of t^2 .

Accept 'gradient is decreased' / 'graph (or line) becomes a curve of decreasing gradient' owtte.

No credit for 'points move down' / 't2 values are increased'.

*Allow answers in form of their own diagram or on **Figure 2**.*

1

[10]