Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Waves

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Name of the Student:____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) f (from $\frac{1}{T}$) in range 61 ± 1 Hz $_1$✔ $_2$✔

OR

61 ± 3 Hz $_{12}$✔

maximum 1 mark for POT error OR incorrect rounding

no credit for 1 sf; treat 60 as 2 sf unless clearly rounded to 6×10^1

*for $_1$✔ $_2$✔ **require ≥ 2 sf** that rounds to not less than 60 and not more than 62*

*for $_{12}$✔ **require ≥ 2 sf** that rounds to not less than 58 but less than 60*

OR

*for $_{12}$✔ **require ≥ 2 sf** that rounds to more than 62 but not more than 64*

if incorrect rounding leads to 60 treat this as 1 sf and give no credit

use of $\frac{1}{T}$ does not have to be seen; marks are for final answer seen

2

(b) (figures) 804 and 226 seen in working $_1$✔

λ = difference between their readings × 2;

given to nearest mm; expect 1.156 (m)

OR

to nearest cm; expect 1.16 (m) $_2$✔

for $_1$✔ 578 is not enough

for $_2$✔ range is based on x = (804 – 226 =) 578 ± 2mm;

give no credit for POT errors eg 115.6 / 116 etc

accept 1156 mm etc if unit on answer line is amended

2

(c) c correctly evaluated to ≥ 2 sf from their f × their λ ✔

substituted data may be from 03.1/2 final answers or unrounded (intermediate) data from working *expected answer = 61 × 0.578 × 2 = 70.5 m s–1*

1

(d) μ correct to 2 sf based on their f and their λ earns both marks $_1$✔ $_2$✔

for incorrect / missing μ

EITHER

use of $c = \sqrt{\frac{T}{\mu}}$

OR

use of $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

for $_1$✔ their value of μ can be given to ≥ 2 sf but

must agree with $\frac{0.5 \times g}{(\text{their } f \times \lambda)^2}$ OR $\frac{0.5 \times g}{(\text{their } c)^2}$ ***when rounded to 2 sf****;*
use of g = 9.81 or 9.8 only; no ecf for mixed units

expected answer $\mu = 9.9 \times 10^{-4}$ (kg m^{-1}): be wary of which approach has been taken by the candidate

for $_{12}$✔ 'use of' means allow ***either***

rearranges so that μ is the subject eg $\mu = \frac{T}{c^2}$

(accept $\mu = \frac{mg}{c^2}, \frac{T}{c^2} = \mu$ *etc)* ***or***
substitution of all relevant data including their c into a correct expression with μ as the only unknown

for T allow 4.9 / 4.91 / 4.905 (accept 0.5 × 9.81 or 0.5 × 9.8); allow mixed units; allow 0.5g

OR 'use of' means allow ***either***

rearranges to $\mu = \frac{T}{(2 \times l \times f)^2}$ OR $\frac{T}{4 \times l^2 \times f^2}$ ***or***

substitution of all relevant data including their l and f leaving μ as the unknown; allow sub of λ for $2l$

watch for possible error $\lambda = L$

2

(e) 0.71 (mm) ✔

only answer that gets mark

1

(f) ANY TWO FROM

repeat readings at different points along the rod and calculate an average / mean $_1$✔

repeat readings in different directions (perpendicular to the rod) and calculate an average / mean $_2$✔

reject / discard anomalous readings before calculating an average / mean $_3$✔

award $_{123}$✔ = 1 MAX for checking at different points / in different directions to confirm that the rod is uniform / that there are no anomalies

allow 'cylinder' / 'wire' etc for rod

for $_1$✔ $_2$✔ and $_3$✔ averaging idea only needs to be seen once;

if averaging idea missing then allow 'repeat at different points and in different directions, then remove anomalies' $_{123}$✔= 1 MAX

if 'calculate' is not seen allow 'work out' / /'determine' / 'compute'; anything that sounds like a mathematical process is ok;

'find' / 'obtain' / 'take' / 'do an average' are just ok;

'get' is not ok

for $_1$✔ allow repeat at 'different positions' / 'down / along the rod'

for $_2$✔ allow (repeat in different directions) 'around the rod' / 'different orientations' / 'angles' / 'planes' / 'sides'

for $_3$✔ allow 'ignore anomalies'; 'outlier' = 'anomaly'

reject 'calculate an average to eliminate effect of anomalies'

treat as neutral: 'turn the wheel to close the callipers' / suggestions about calibration

treat as neutral: 'zero callipers before use' this is a procedure to eliminate a source of systematic error

2

(g) (for use of expected 0.71)

$\rho = 8.9(41) \times 10^3$ (kg m^{-3})

OR

(for use of 0.53)

$\rho = 1.6(05) \times 10^4$ (kg m^{-3})

OR

$$\rho = \frac{4.51\times10^{-3}}{(\text{their } d \text{ from (e)})^2}$$

OR

attempts to use μ OR $3.5(4) \times 10^{-3}$ divided by their (recognisable) cross-sectional area $_1$✔

AND/OR

evidence showing cross-sectional area = $\frac{\pi d^2}{4}$ using their d from (e) (allow πr^2 using their d) $_2$✔

correct answer scores $_{123}$✔✔✔

for $_{123}$✔✔✔ allow an answer that rounds to the correct 2 sf value

sample results for expected d

d/mm	A/m^2	ρ/kg m^{-3}
0.71	3.96×10^{-7}	$8.9(41) \times 10^3$

0.53	2.21×10^{-7}	$1.6(05) \times 10^{4}$

for $_1$✔ accept use of symbols, eg

$$\rho = \frac{\mu}{A} \ / = \frac{3.54\times10^{-3}}{A(\times1)} \ / = \frac{4\times\mu}{\pi\times d^2} \ / = \frac{4\times3.54\times10^{-3}}{\pi\times d^2(\times1)}$$

$$= \frac{3.54\times10^{-3}}{\pi\times r^2(\times1)}$$

for $_2$✔ expect correct value of A seen or correct values of A or d in working, eg

$$\rho = \frac{3.54\times10^{-3}}{3.96\times10^{-7}(\times1)} / = \frac{4\times3.54\times10^{-3}}{\pi\times(0.71\times10^{-3})^2\times(1)}$$

accept values ≥ 2 sf for A; allow ecf d and don't penalise POT error in A or d (eg missing 10^{-7}, 10^{-3})

1
2

[13]

Q2.

(a) Use of $n_A = \frac{c}{c_A}$ to make c_A the subject of the equation

Condone truncation without appropriate rounding mid-calculation

OR

speed in glass **A** = $2.05(2) \times 10^{8}$ ms^{-1} $_1$✔

Speed in glass **B** = $1.985(3) \times 10^{8}$

Condone use of $c = 3 \times 10^{8}$

But must see answer to 4 sf answer

OR

their speed in glass **A** × 0.96748 (or equivalent) $_2$✔

Values obtained using $c = 3\times10^{8}$:

- *speed in glass A = $2.05(3)\times 10^{8}$ ms^{-1}*
- *speed in glass B = $1.98(7) \times 10^{8}$*
- *n = 1.510*

OR

Alternative 1st and 2nd marks

Use of $n_A/n_B = c_B/c_A$ by substitution for n_A $_1$✔

Use of $n_A/n_B = c_B/c_A$ by substitution for n_A and $c_B = c_A \times 0.96748$ $_2$✔

OR

$n_B = 1.461 / 0.96748$ $_1$✔$_2$✔

Watch for maths errors:

Dividing by 1.03252 ≠ multiplying by 0.96748

Multiplying by 1.03252 ≠ dividing by 0.96748

1.510 cao to 4 sf only $_3$✔

Correct answer to 4 sf obtains all 3 marks

Penalise any unit on final answer

3

(b) **Relationship:**

Increase in tension (or stress) in cable produces increase in strain resulting in increase in λ_R

OR

Decrease in tension (or stress) causes decrease in strain resulting in decrease in λ_R $_1$✔

Variation due to motion:

As the lift accelerates downwards, (the tension is less than the weight in the cable, a decrease in tension results) in λ_R decreasing $_2$✔

At constant velocity (the tension again equals the weight and) λ_R returns to the initial, at rest value $_3$✔

Allow a correct comment on the directional relationship between tension, strain and λ_R independent of the motion of the lift for first mark

3

(c) **P** because it will produce a larger increase in λ_R for the (same) increase in strain

OR

P because it has a larger gradient (must be a sense of larger increase in λ_R for the (same) increase in strain) ✔

Hence smaller accelerations (which produce small changes in strain) can produce measurable changes in λ_R

OR

Hence gauge **P** will have a higher resolution ✔

Selecting Q gains zero marks

Linking steeper gradient to being able to withstand a larger force negates this mark

Allow more accurate measurement of acceleration

Allow more readings of acceleration can be taken (over the range)

More sensitive treat as neutral

2

[8]