Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1

(a) idea that moments are balanced or that there is no resultant moment ✔

*Answer must relate to the context e.g. reference to **Q** or weight of food/spoon*

Allow 'force × distance' or 'F × d' for 'moment'.

(because)

(overall) centre of mass is now beneath/at **Q**

OR

line of action of (overall) weight is through **Q** ✔

*'Anticlockwise moment of weight of spoon about **Q** = clockwise moment of weight of M about **Q**' gains both marks.*

2

(b) statement of balanced moments seen e.g. $mgx = Mg(16 - 4 - x)$, leading to required formula ✔ ✔

For 1 mark: condone absent g if credible evidence for '12 - x' presented e.g. mx = M(16 - 4 - x) or mx = M(28 - 16 - x)

OR

condone lack of evidence for '12 - x' if g is shown e.g. mgx = Mg(12 - x).

Need to see g and evidence for '12 - x' for both marks. Evidence for '12 - x' need not be in an expression of a moment.

Allow 9.81 or 9.8 instead of g.

2

(c) max two from: ✔ ✔

- reads off a pair of values (e.g. 115 g, 5.0 cm)
- substitutes into formula
- multiplies their *m* by *g*

answer that rounds to 1.5 or 1.6 (N) ✔

Allow correct conversion of M to kg and/or x to m for read offs or in the substitution.

Expect to see 160 g for mass of spoon.

Allow credit for an algebraic solution to get m:

e.g. when m = M, $\frac{m}{M} = \frac{(12-x)}{x} = 1$

So, 12 = 2x, x = 6.0 cm. Reads off M at 6.0 cm to get 160 g.

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(d) (absolute) uncertainty in *M* increases as *M* increases ✔

(because) as *M* increases:

marks on the scale get closer **OR** range of values of *M* for a fixed range of *x* increases (or vice versa) ✔

the gradient (in Figure 3) increases so the scale markings are unequal owtte ✔

MP1 only awarded supported by some relevant explanation. Treat 'percentage' uncertainty as neutral.

Allow MP2 and MP3 for quantitative evidence given using Figure 3 e.g. from 0 g to 25 g, Δx ~ 1.5 cm; from 175 g to 200 g, Δx ~ 0.4 cm ***OR*** *calculates gradients at low and high M.*

3

[10]

Q2.

(a) Spreading of pulse / parts of a pulse take different times to travel through the fibre / pulse broadening✔

Do not credit material dispersion.

owtte

Due to different paths through the optical fibre / due to entering the optical fibre at different angles ✔

Accept a diagram showing different paths.

2

(b) $\text{speed } (= \frac{distance}{time}) = \frac{10 \times 10^{3}}{5.225 \times 10^{-5}}$ ✓ (= 1.91 x 10^8)

1

(c) Reads off Sin θ_R = 0.3391

or

use of $n_1 \sin\theta_1 = n_2 \sin\theta_2$✔

Use of $n = \frac{c}{c_s}$ seen✔

With their Sin θ_R

(Refractive index of core = 1.47)

Allow use of their refractive index where cs is the subject of the formula

$cs = 2.03 \times 10^8$ ✔

Alternative:

Reads off Sin θ_R = 0.3391

or

$\theta = 19.8°$ ✔

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$c_s \cos 19.8 = 1.9 \times 10^8$ ✔

$c_s = 2.03 \times 10^8$ ✔

Allow finding θ_R for their read off

Allow use of their θ_R

3

(d) The refractive index of core for blue light is greater than the refractive index for red / The refractive index of core for red light is less than the refractive index for blue ✔

Max 1 mark for stating that the refractive indices are different because their speeds are different

MP1 can come from graph or prior knowledge

The speed of the blue light is less than the speed of the red light and travel the same distance / The speed of the red light is greater than the speed of the blue light and travel the same distance✔

2

(e) the blue now travels a shorter distance than the red light (compared to (d))✔

or

the red light now travels a greater distance than the blue light (compared to (d))✔

or

the difference between the blue's velocity parallel to the central axis and the red's velocity (parallel to the central axis) has decreased (compared to (d)).✔

Allow: now travel different distances whereas previously travelled the same distance.

or

the difference between the horizontal velocity of the red light and the horizontal velocity of the blue light has decreased (compared to (d)).✔

1

[9]

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