Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Measurement And Their Errors

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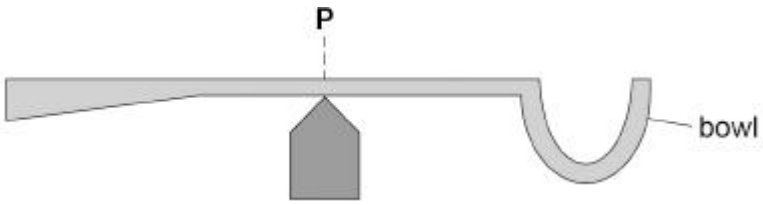
Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1

Figure 1 shows a spoon used to measure the mass of food.

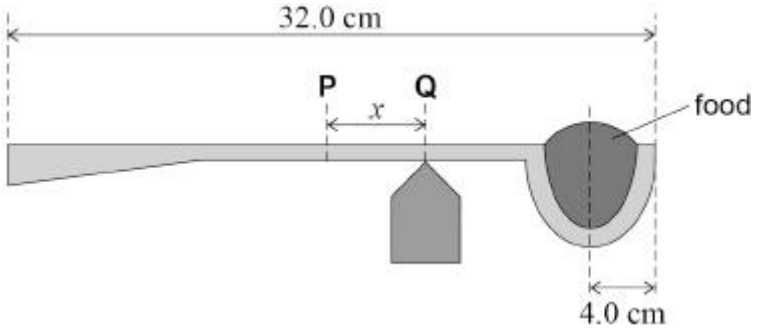
The empty spoon balances when a pivot is placed under a point **P** halfway along the spoon.

Figure 1



The spoon tilts when food of mass M is placed in the bowl. The spoon is rebalanced by moving the pivot a distance x to the right of **P**. The new position of the pivot is under point **Q** in **Figure 2**.

Figure 2



The total length of the spoon is 32.0 cm. The weight of the food acts through a line at a distance of 4.0 cm from the right-hand edge of the spoon.

(a) Explain why the spoon in **Figure 2** is balanced when the pivot is at **Q**.

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(2)

(b) The empty spoon has mass m .

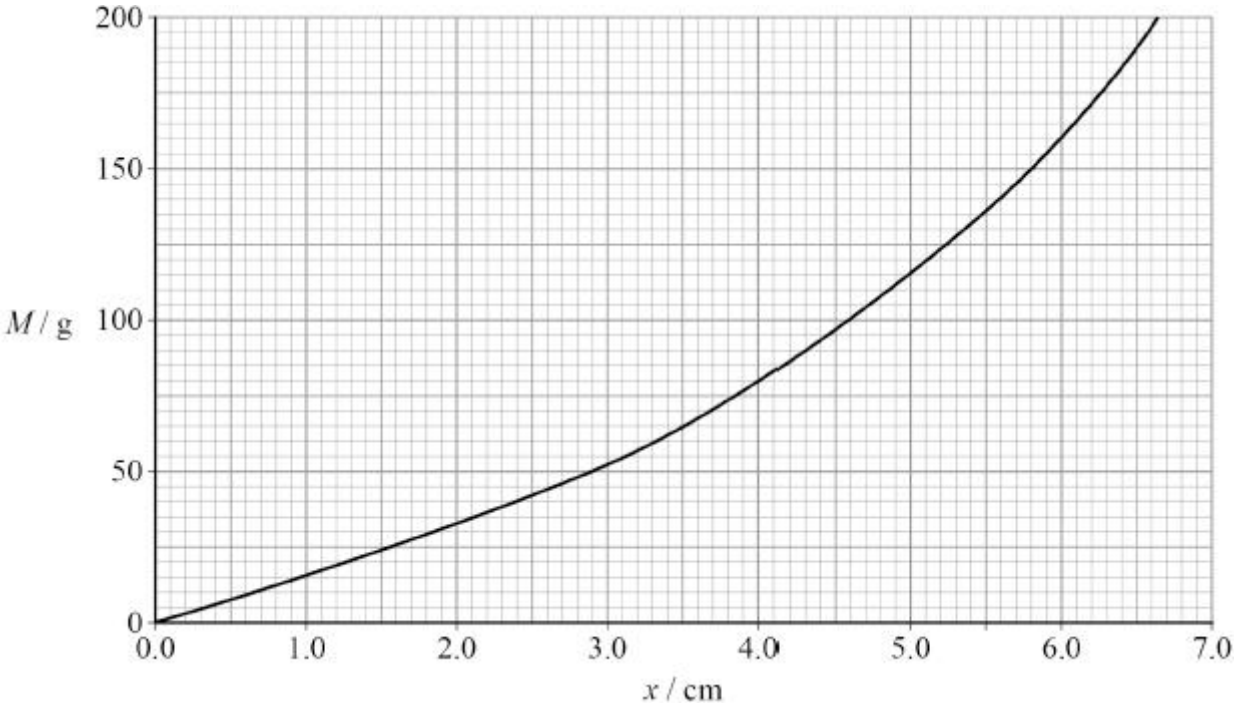
Show that, for the arrangement in **Figure 2**,

$$\frac{m}{} = \frac{(12.0 - x)}{}$$

(2)

(c) **Figure 3** shows how x varies with M.

Figure 3



Determine, using **Figure 3**, the weight of the empty spoon.

weight = _____ N

(3)

(d) A scale, in grams, is marked on the spoon between **P** and the bowl. **Figure 3** is used to calibrate this scale in intervals of 25 g.

M can be measured by balancing the spoon. The value is read from the point of the scale directly above the pivot.

State and explain how the uncertainty in the value read from the scale changes as M increases.

_____

(3)

(Total 10 marks)

Q2.

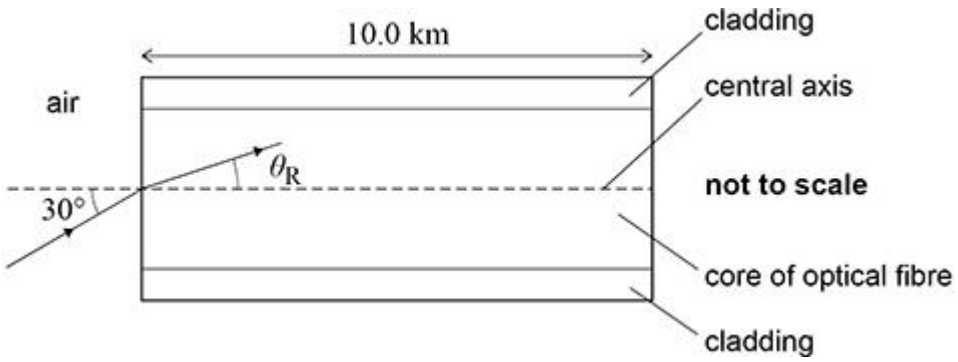
Optical fibres are used to carry pulses of light.

(a) Explain what is meant by modal dispersion in an optical fibre.

(2)

Figure 1 shows a ray of light incident on the central axis of an optical fibre at an angle of incidence of 30°. The optical fibre is straight and horizontal and has a length of 10.0 km.

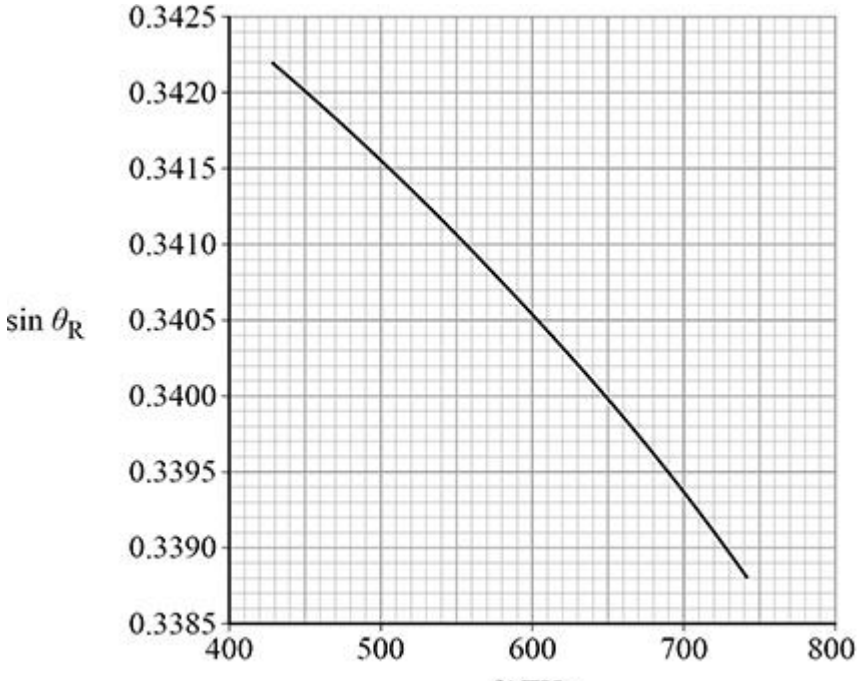
Figure 1



For light incident on the core at a given angle of incidence, the angle of refraction θ_R varies with the frequency f of the light.

Figure 2 shows how sin θ_R varies with f when the angle of incidence is 30°.

Figure 2



The transit time is the time between a pulse of light entering and leaving the optical fibre.
A single pulse of blue light is incident on the air−core boundary at an angle of incidence of 30°.

The transit time of this pulse along the 10 km length of the optical fibre is 5.225×10^{-5} s.

(b) Show that the horizontal component of the velocity of the pulse is approximately 1.9×10^{8} m s^{-1}.

(1)

(c) The frequency of the blue light in the pulse is 720 THz.

Calculate the speed of the blue light in the core of the optical fibre.

speed = _____ m s^{-1}

(3)

(d) Two pulses of monochromatic light are incident normally on the air−core boundary. They then travel along the central axis of the core.

One pulse consists of blue light; the other consists of red light.

Explain, with reference to refractive index, why the pulse of red light has a shorter transit time than the pulse of blue light.

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(2)

(e) Another two pulses, identical to the pulses in part (d), are incident on the central axis of the optical fibre and travel along its length.
However, the pulse of red light and pulse of blue light are now incident on the air−core boundary at an angle of incidence of 30°.

Suggest **one** reason why the difference in their transit times may **not** be the same as in part (d).

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(1)

(Total 9 marks)