

1999 A/L Structured Essay Question No (01)

In an experiment to find the density of glass, using the principle of moments, you are provided with only the following.

- (1) a piece of glass of irregular shape (mass $M \sim 50$ g).
- (2) four weights of masses (m) 0.4 g, 4.0 g, 40.0 g and 400.0 g.
- (3) a meter ruler.
- (4) a knife edge fixed to a support.
- (5) a beaker of water.
- (6) a piece of thread.

(a) Draw an experimental setup that you would use to find the mass M by balancing the ruler at its centre of gravity. Label the masses and their corresponding distances l_1 and l_2 from the knife edge.

(b) What is the advantage of balancing the meter ruler at its centre of gravity?

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(c) (i) Of the weights given in (2) above, which one is the most suitable for this experiment? Give the reason for your choice.

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(ii) Write down an expression for M in terms of m , l_1 and l_2 .

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(d) (i) What are the next experimental steps that you would perform in order to determine the density of glass without changing the position of the glass piece?

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(ii) What is the measurement that you would take? (say l_3)

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- (e) Obtain an expression for the density of glass ρ in terms of density of water ρ_w , l_3 and l_1 (or l_2).

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- (f) Mass of another irregular piece of glass made of the same material but with an air cavity inside is 100 g. The density obtained using the above procedure, was found to be $2.0 \times 10^3 \text{ kg m}^{-3}$. If the density of glass is $2.5 \times 10^3 \text{ kg m}^{-3}$, find the volume of the air cavity.

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