

Simple Harmonic Motion of a test tube

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At equilibrium a test tube floats because the upthrust due to the water is equal to its weight. At a displacement x from equilibrium the volume of water displaced is $(x + x_0) A$ where A is the cross-sectional area of the test-tube.

1. Write down a formula for the balanced forces at equilibrium. Your formula should include x_0 . Also rearrange your formula to give $x_0 =$.
2. Write down a formula for the acceleration when the test tube is displaced a distance x from equilibrium and simplify it using the first equation to get the formula as a function of x and x_0 .
3. Rewrite the formula as a differential equation and complete the formula below which will enable a prediction of the natural frequency f of the system.

$$(2\pi f)^2 =$$

4. Carry out the experiment and use your expression above to determine g .