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STUDENT VERSION

Bobbing and Dropping

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Abstract: We present two exercises from a differential equations text in which we ask students to model (1) falling object experiencing terminal velocity and (2) bobbing block of wood in liquid. We model the motion using Newton's Second Law of Motion and Archimedes' Principle.

SCENARIO DESCRIPTION

Dropping

A body of weight 32 lb is dropped from rest from a height of 100 ft in a medium offering resistance proportional to the velocity. If the limiting or terminal velocity is 400 ft/sec, find the velocity and displacement at any time. Find the time at which the velocity is 200 ft/sec. [1, p. 71, Problem Set 3-2, #1].

Bobbing

A 360 lb block of wood in the form of a 2 ft cube is floating in liquid which has a density of 60 lb/ft^3. If the cube is depressed, so that its upper face is level with the surface of the liquid, and then released, find the differential equation of its motion. Solve the differential equaiton and find the period of the motion. [1, p. 165, Problem Set 6 - 2, #4].

Added: Now suppose (more realistically) the motion of the block at the base meets with resistance due to friction, motion, eddies, etc. at a rate proportional to the velocity of 3 lb/(ft/sec). How does this alter the motion?

Determine the time at which the box FIRST comes to within 1 inch of its static equilibrium from that time onward.

REFERENCES

[1] Ritger, Paul D. and Nicholas J. Rose. 1968. *Differential Equations with Applications*. New York: Dover Publications, Inc.