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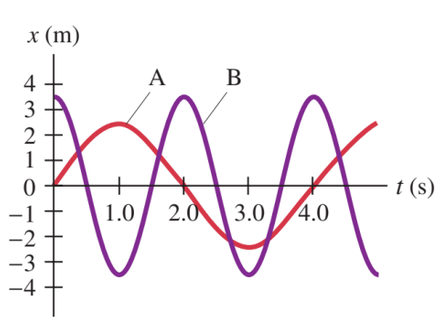
TUTORIAL MODULE 6, ELEMENTARY PHYSICS IB (FI-1102))
1st Semester, Academic Year 2020-2021
TOPIC : Elasticity and Oscillation

A. QUESTION

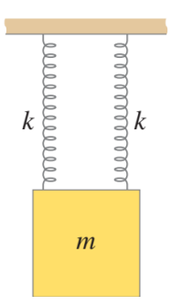
1. Is the Young's modulus for a bungee cord smaller or larger than that for an ordinary rope?
2. Real springs have mass. Will the true period and frequency be larger or smaller than given by the equations for a mass oscillating on the end of an idealized massless spring? Explain
3. How could you double the maximum speed of a simple harmonic oscillator (SHO)?
4. For a simple harmonic oscillator, when (if ever) are the displacement and velocity vectors in the same direction? When are the displacement and acceleration vectors in the same direction?
5. Examine how a pair of scissors or shears cuts through a piece of cardboard. Explain.

B. SOAL

1. A steel wire 2.3 mm in diameter stretches by 0.030% when a mass is suspended from it. How large is the mass?
2. A scallop forces open its shell with an elastic material called abductin, whose Young's modulus is about 2.0×10^6 Nm^2. If this piece of abductin is 3.0 mm thick and has a cross-sectional area of 0,5 cm^2, how much potential energy does it store when compressed 1.0 mm?
3. One liter of alcohol in a flexible container is carried to the bottom of the sea, where the pressure is 2.6×10^6 N/m^2. What will be its volume there? It is known that the pressure at sea level is the atmospheric pressure and bulk modulus of alcohol is 10^9 N/m^2.
4. A plank 2.00 cm thick and 15.0 cm wide is firmly attached to the railing of a ship by clamps so that the rest of the board extends 2.00 m horizontally over the sea below. A man of mass 80.0 kg is forced to stand on the very end. If the end of the board drops by 5.00 cm because of the man's weight, find the shear modulus of the wood.
5. A high-speed lifting mechanism supports an 800-kg object with a steel cable that is 25.0 m long and 4.00 cm^2 in cross-sectional area. (a) Determine the elongation of the cable. (b) By what additional amount does the cable increase in length if the object is accelerated upward at a rate of 3.0 m/s^2? (c) What is the greatest mass that can be accelerated upward at 3.0 m/s^2 if the stress in the cable is not to exceed the elastic limit of the cable, which is 2.2×10^8 Pa?
6. The following figure shows two examples of SHM, labeled A and B. For each, what is (*a*) the amplitude, (*b*) the frequency, and (*c*) the period?



7. A block of mass *m* is supported by two identical parallel vertical springs, each with spring stiffness constant *k* (see fig.). What will be the frequency of vertical oscillation?



8. A 1.60-kg object oscillates at the end of a vertically hanging light spring once every 0.45 s. (*a*) Write down the equation giving its position y (+ upward) as a function of time *t*. Assume the object started by being compressed 16 cm from the equilibrium position (where y = 0), and released. (*b*) How long will it take to get to the equilibrium position for the first time? (*c*) What will be its maximum speed? (*d*) What will be the object's maximum acceleration, and where will it first be attained?

9. A 0.650-kg mass oscillates according to the equation $x = 0.25 \sin 4.7t$, where *x* is in meters and is in seconds. Determine (*a*) the amplitude, (*b*) the frequency, (*c*) the period, (*d*) the total energy, and (*e*) the kinetic energy and potential energy when *x* is 15 cm.

10. A mass attached to the end of a spring is stretched a distance from equilibrium and released. At what distance from equilibrium will it have (*a*) velocity equal to half its maximum velocity, and (*b*) acceleration equal to half its maximum acceleration?