Quiz 8

Solutions

Choose the best answer.

1. A system that would oscillate without damping at angular frequency ω_0 is being driven in a steady state by a force $F_0 \sin \omega t$, with variable ω. The system also has some damping. Which of these is *wrong*?

   A. For very large values of ω the amplitude of the oscillation is small.

   B. For very small values of ω the amplitude of the oscillation is small.

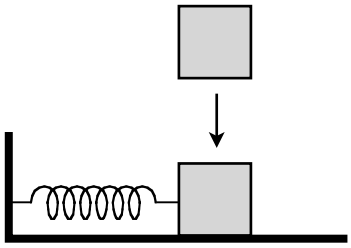
   C. The angular frequency of the driven oscillation is always ω.

   ☛D. The amplitude of the oscillation when $\omega = \omega_0$ is independent of the amount of damping.

Choose T or F depending on whether the statement is true or false.

2. The motion of a particle subject to a conservative force near a point of stable equilibrium is approximately SHM, if the particle has small kinetic energy. **T**

3. A block of mass *m* is attached to a spring of stiffness *k* as shown. It slides on a frictionless table. It is pushed to the left, compressing the spring through distance A_0 and released from rest. The next time it is at that location, momentarily at rest, an identical block is gently placed at rest on top of it. There is static friction between the blocks, with coefficient μ_s.



   a. Which of these quantities is changed by the addition of the new block (assuming μ_s is large enough to keep the blocks together)? Amplitude, angular frequency, total energy.

   b. Give the old and new values of the one(s) that changed.

   c. How large must μ_s be for the blocks to stay together?

a. Only angular frequency. The amplitude is still A_0, and the energy $E = \frac{1}{2}kA_0^2$ is not changed by putting the top block on, since both are at rest.

b. Original: $\omega_0 = \sqrt{k/m}$. New: $\omega = \sqrt{k/2m}$.

c. The largest acceleration occurs right at the start, and is $a_{\max} = \omega^2 A_0$. The only horizontal force on the top block is friction, and the maximum is $\mu_s mg$, so we have $\mu_s mg = ma_{\max} = m\omega^2 A_0$. This gives $\mu_s = \omega^2 A_0 / g = kA_0 / 2mg$.