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Physics Department

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Sheet 1
Oscillations (Chapter 15)

P1. The position of a particle is given by the expression x =(2 m)*cos(5πt +0.5π), where x is in meters and t is in seconds. Determine
(a) the amplitude of the motion,
(b) the frequency and period of the motion,
(c) the phase constant, and
(d) the position of the particle at t=0.4 s.
Draw a diagram with the position x as function of time and mark the period and the amplitude in the diagram. Make a second diagram below and sketch the particle velocity as function of time. In a third diagram below, draw the acceleration as function of time.

P2. A vibration sensor, used in testing a washing machine, consists of a cube of aluminum 1.50 cm on edge mounted on one end of a strip of spring steel (like a hacksaw blade) that lies in a vertical plane. The mass of the strip is small compared to that of the cube, but the length of the strip is large compared to the size of the cube. The other end of the strip is clamped to the frame of the washing machine, which is not operating. A horizontal force of 1.43 N applied to the cube is required to hold it 2.75 cm away from its equilibrium position.

(a) Sketch the sensor.
(b) If the cube is released, what is its frequency of vibration?

P3. A harmonic oscillator x(t)=Acos(ωt+Φ) has a frequency of 10 Hz. Determine the amplitude and the phase constant for the following values of the initial position x_0 and the initial speed v_0 (for t=0s):

(a) x_0=2.5cm, v_0=0cm/s.
(b) x_0=0cm, v_0=157cm/s.
(c) x_0=2.5cm, v_0=157cm/s.

Q1. In an oscillator, the energy switches back and forth between potential and kinetic energy. Where is the potential energy stored? Where is the kinetic energy "stored"?

Q2. The energy oscillates in a harmonic oscillator between potential and kinetic energy with twice the frequency of the oscillator. Discuss why the energy oscillation is faster.

P4. A block–spring system oscillates with an amplitude of 3.50 cm. If the spring constant is 250 N/m and the mass of the block is 0.500 kg, determine
(a) the mechanical energy of the system,
(b) the maximum speed of the block, and
(c) the maximum acceleration.

P5. A damped mass spring system is released from an initial extension x_0=10cm. After 5 minutes, the remaining oscillation amplitude is only 5cm. What is the value of b/2m?

Q3. Describe two examples of forced oscillations with resonance in your daily life.