Physics 4A
Spring 2025

ave. = 7.7
σ = 2.2

Name Answer Key

Lab: 8:00 am 11:10 am 2:30 pm

Quiz #10: Oscillations

Problem 1 (1.5 points)
A 0.20 kg mass attached to a spring whose spring constant is 500 N/m executes simple harmonic motion. If its maximum speed is 5.0 m/s, the amplitude of its oscillation is:

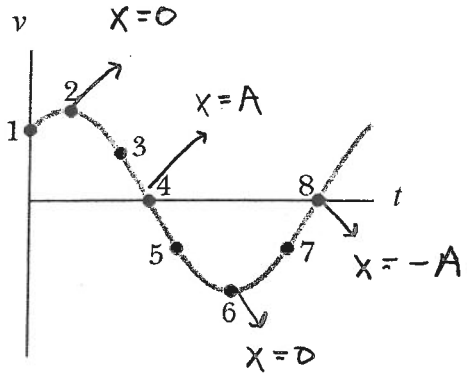
C

a) 0.0010 m
b) 0.0020 m
c) 0.10 m
d) 0.20 m
e) none of the above

$v_{max} = \omega A = \sqrt{\frac{k}{m}} A$

$A = \sqrt{\frac{m}{k}} v_{max} = \sqrt{\frac{(0.20kg)}{500N/m}} (5.0m/s) = 0.10\,m$

Problem 2 (1.5 points)
The velocity $v(t)$ of a particle undergoing SHM is graphed in the figure below. (a) Which of the labeled points corresponds to the particle at -A? (b) At point 3, is the acceleration of the particle positive, negative, or zero? (c) At point 5, is the particle at -A, at +A, at 0, between -A and 0, or between 0 and +A?



a) point 8 (v=0 at X=±A)

b) negative (slope of v vs. t)

c) between 0 and +A

Problem 3 (2 points)
A tire swing hangs from a branch nearly to the ground. How could you estimate the height of the branch using only a stopwatch? Include an appropriate equation with your explanation.

$T = 2\pi\sqrt{\frac{L}{g}} \rightarrow \boxed{L = \frac{T^2 g}{4\pi^2}}$

You can estimate the height by letting the tire swing oscillate at small amplitudes and measure the period of oscillation. From the period of oscillation (T) you can use the above equation to get the length L.

Problem 4 (5 points)
An object of mass 0.50 kg is connected to a horizontal spring. The object is pulled 25 cm and released from rest. The object then oscillates about its equilibrium position with a period of 1.75 s.

a) What is the spring constant of the spring?

$m = 0.50\,kg$

$A = 0.25\,m$

$T = 1.75\,s$

$K = ?$

$\omega = 2\pi/T = 2\pi/1.75\,s \rightarrow \omega = 3.59\,rad/s$

$\omega = \sqrt{\frac{K}{m}} \rightarrow K = m\omega^2$

$K = (0.50\,kg)(3.59\,rad/s)^2 = \boxed{6.45\,N/m}$

b) What is the object's maximum speed?

$$v_{max} = \omega A = (3.59\,rad/s)(0.25\,m)$$

$$\boxed{v_{max} = 0.90\,m/s}$$

c) What is the object's speed when it is at x = 7.50 cm?

$$E = \tfrac{1}{2}mv^2 + \tfrac{1}{2}Kx^2 = \tfrac{1}{2}KA^2$$

$$v = \sqrt{K/m\,(A^2 - x^2)}$$

$$v = \sqrt{\frac{(6.45\,N/m)}{0.50\,kg}\left[(0.25\,m)^2 - (0.075\,m)^2\right]}$$

$$\boxed{v = 0.86\,m/s}$$