Harmonic motion problems

Solutions

1. *f =* 1/T = 1/0.500 = 2.0 Hz

angular velocity is given by ω = 2Πf = 2Π(2) = 4Πrad/s = 12.6 rad/s

ax = – ω2 A cos θ = – ω2 A cos ωt ; this occurs when A cos (ωt) = – A or

– 2.00 cm. so ax = – (4Π)2 ( – 2.00) = 316 m/s2

Max velocity: vmax = – ωA = 4Π (2.0 cm) = – 25.1 cm/s

Acceleration when displacement = 1.0 cm

A = – ω2x = – (4Π)2 (1.0 cm) = 158 cm/s2

1. a = ω2A ; - 20 cm/s2 = ω2 (5.0 cm) **ω = 2.0 rad/s** = 2Π*f*

*f* = ω/2Π = 1/3.14 = 0.318/s

*vmax*  = – ωA = – (2 rad/s)(5 cm) = – 10 cm /s

1. *f =* 1/T = 1/7.7 = 0.13 Hz

vmax = – ωA = 2Π*f*A = 2Π(0.13)(0.40 m) = – 0.33 m/s

amax = – ω2A = – (2Π*f*)2 A) = – 0.27 m/s2

1. 4 cycles/10 s = 1 cycle /x sec = T = 2.5 s f = 1/T = 0.4 Hz

Max v at T/4 or 0.625 s

Vmax = – ωA = 2Π*f* (A) = 2Π (0.4) (0.10m) = – 0.25 m/s (need for next part)

Position and vel at t = 4

x4 = A cosωt = A(cos2Π*f*t) = 0.10 cos(10.05) = – 0.081 m

v4 = – vmax sinωt = – vmax (sin 10.05) = 0.15 m/s

1. x = A cos ωt = 0.15 m cos (2Π*f*t) = 0.15 m (2Π (0.2)(3.1 s) = – 0.11 m

3.1 s/ 5s/cycle = 0.62 cycles ; That is between Π/2 and ¾ Π so direction is up.