

Chapter 19

MECHANICAL VIBRATIONS

PROBLEM NO. 1

Determine the maximum velocity and maximum acceleration of a particle which moves in simple harmonic motion with an amplitude of 3 mm and a frequency of 20 Hz.

SOLUTION:

Frequency:

$$f = 20 \text{ Hz}$$

Amplitude:

$$\omega_n = 2\pi f = (2\pi)(20) = 125.66 \text{ rad/s}$$

$$x_m = 3 \text{ mm}$$

Simple harmonic motion:

$$x = x_m \sin(\omega_n t + \phi)$$

$$v = \dot{x} = \omega_n x_m \cos(\omega_n t + \phi)$$

Maximum velocity:

$$v_m = \omega_n x_m = (125.66 \text{ rad/s})(3 \text{ mm})$$
$$= 377 \text{ mm/s}$$

$$\underline{v_m = 0.377 \text{ m/s}}$$

Maximum acceleration:

$$a_m = \omega_n^2 x_m = (125.66 \text{ rad/s})^2 (3 \text{ mm})$$
$$= 47.3 \times 10^3 \text{ mm/s}^2$$

$$\underline{a_m = 47.3 \text{ m/s}^2}$$

Mechanical Vibrations Study Guide

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