TUTORIAL ANSWERS_OSCILLATIONS

Question 1

a.) $T = 2\pi\sqrt{[(6.3+73.2) / 1540]}$

$T = 1.43$ s

b.) $\Delta T / T = ½ (\Delta m/m) = ½ (0.5/79.5) = 3.14 \times 10^{-3}$

$\% \Delta T / T = 3.14 \times 10^{-3} \times 100\% = 0.31\ \%$

Question 2

a.) a cosine graph with the same period, 4s.

b.) $f = 1/T = ¼ = 0.25$ Hz

c.) $\omega = 2\pi f = 1.57\ rads^{-1}$

d.) $\pi/2$ rad, or 90°

Question 3

a.) Resonance

b.) $\omega = 78.5\ rads^{-1}$

$T = 1/f = 8.0 \times 10^{-2}$ s

c.) amplitude at all frequencies must be less with the peak about (slightly less than) 12.5 Hz.

d.) tuning a radio, vibration of quartz crystal.

Question 4

a.) simple pendulum. Because of friction or air resistance, so amplitude will gradually fall.

b.) amplitude = 0.11 m; period = 1.70 s; frequency = 0.59 Hz; angular frequency = 3.70 $rads^{-1}$

c.) 1 answer for each case:

i.) 0 s / 1.7 s / 3.4 s / 5.1 s

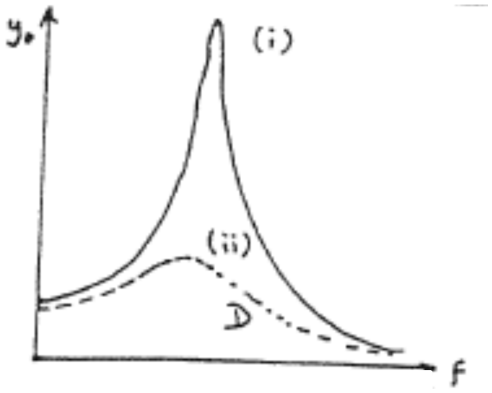
ii.) 1.3 s / 3.0 s / 4.7 s

iii.) 0.4 s / 2.1 s / 3.8 s / 5.5 s

iv.) 0 s / 0.8 s / 1.7 s / 2.6 s / 3.4 s / 4.2 s / 5.1 s / 5.9 s

v.) 0.4 s / 1.3 s / 2.1 s / 3.0 s / 3.8 s / 4.7 s / 5.5 s

d.)



i.) show resonance peak & dropping to low y_0 for higher frequency.

ii.) Increase damping curve must be lower and peak y_0 occur at lower frequency and lower value.

e.) If the frequency of an earthquake equals to the natural frequency of the building, then building will oscillate with maximum amplitude, thus causing it to collapse eventually.

By using absorbers to dampen the oscillations.

Question 5

a.) Spring constant is the constant of proportionality in Hooke's Law, which is the force per unit extension.

b.) The oscillation of the load refers to the motion of the load which moves in such a way that the motion repeats after a fixed time. OR

Repetitions of back and front motion on either side of a fixed position.

c.) i.) The motion is undamped as the amplitude of the oscillation remains unchanged at 0.5 cm.

ii.) $f = 1/2\pi\ [\sqrt{(k/m)}]$;

$k = 4\pi^2 f^2 m$

$k = 4\pi^2 (6 / 0.4)^2\ (90 \times 10^{-3})$; $k = 799\ Nm^{-1}$

Question 6

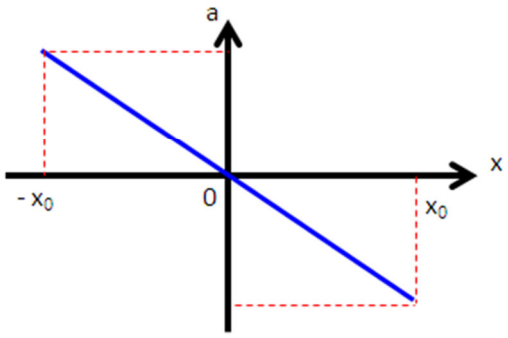
a.) Number of vibrations / oscillations per unit time.

b.) Displacement is the distance of object from its rest position in a specific direction.

Amplitude is the maximum displacement.

c.) i.)

acceleration – displacement graph



ii.) $\omega = 2\pi\ (13) = 81.7\ rads^{-1}$

iii.) $a = -\omega^2 x$

$9.81 = (81.7)^2 x$; $x = 1.47$ mm (ignore "negative sign")

iv.) Sand will fall off / leave the plate.

Question 7

a.) speed, $v = \omega\sqrt{(x_0^2 - x^2)}$

$v = 15.7\ cms^{-1}$

acceleration, $a = \omega^2 x$

$a = 0\ cms^{-2}$

b.) $v = 0\ cms^{-1}$

$a = 49.4\ cms^{-2}$

c.) $v = 14.4\ cms^{-1}$

$a = 19.7\ cms^{-2}$