

Oscillations - Exercises (2 pages; 6/4/20)

Key to difficulty:

* easier

** moderate

*** harder

(1***) A lift has an elastic string suspended from its ceiling, with a mass of 10 grams at the end of the string. The string has natural length 80 cm, and modulus of elasticity 20N. Initially, when the lift is stationary, the mass is hanging in equilibrium. The lift then starts to ascend with an acceleration of 0.2 ms^{-2} . Show that the extension of the string after t secs is $0.4 - 0.008\cos(50t)$ cm.

[Assume that $g = 9.8\text{ms}^{-2}$]

(2***) A flexible bar is embedded horizontally in a wall. A particle rests on the free end of the bar, and the bar (with the particle) is pulled down 2cm below the horizontal, and then released. Given that the bar and particle start to perform simple harmonic motion about the horizontal position, with 5 cycles per second, how long is it before the particle loses contact with the bar, and what speed does it have at that point? [Note: The particle will not be in contact with the bar long enough to complete a cycle of the simple harmonic motion.]

(3***) A 0.2 kg mass is held between two elastic strings, as shown in the diagram. The upper string has original length 8m and modulus of elasticity 2N, and is initially extended by 4m. The lower string has original length 6m and modulus of elasticity 1N,

and is initially extended by 2m. When the mass is released, determine its subsequent motion (assume $g = 10$, and ignore any resistance to motion).

