Physics Problem Set Solutions

1. (a) Momentum increases by a factor of 3.

(b) Kinetic energy increases by a factor of 9.

2. (a) The acceleration due to gravity doubles.

(b) The acceleration due to gravity becomes 1/4th.

3. (a) Time to hit the ground = sqrt(2 * height / g) = sqrt(2 * 45 / 9.81) ? 3.03 s.

(b) Horizontal distance = velocity * time ? 20 * 3.03 = 60.6 m.

4. (a) Angular frequency ? = 2?f = 2? * 140 ? 879.6 rad/s.

(b) Maximum speed = ? * xmax = 879.6 * 0.0013 ? 1.14 m/s.

5. (a) Distance = v^2 / (2 * ? * g) ? 6.5^2 / (2 * 0.2 * 9.81) ? 10.8 m.

(b) Work done by friction = ? * m * g * d ? 0.2 * m * 9.81 * 10.8.

6. (a) Linear acceleration = (2/3) * g * sin(?).

(b) Speed at the bottom = sqrt(2 * g * sin(?) * ramp length) ? sqrt(2 * 9.81 * sin(30°) * 5).

7. (a) g at altitude / g at surface = (R / (R + h))^2 ? (6371 / (6371 + 295))^2 ? 0.933.

(b) Orbital speed = sqrt(GM / r).

8. (a) Potential energy = (1/2) * k * x^2 = (1/2) * 200 * 0.5^2 = 25 J.

(b) Speed = sqrt(2 * PE / m) ? sqrt(2 * 25 / 2) ? 5 m/s.

9. (a) Period T = 2? * sqrt(L / g) ? 2? * sqrt(2.5 / 9.81) ? 3.17 s.

(b) Doubling the length increases the period by ?2.

10. (a) Centripetal force = m * v^2 / r ? 1500 * 25^2 / 200 = 4687.5 N.

(b) Work done = 0 (force is perpendicular to displacement).