

Physics 121 Homework Problems, Winter 2009

Section 2, Karine Chesnel

- 24-1. What is the density of a spherical marble, knowing that its mass is 275 g and its radius is [01] _____ cm?
[2000, 9000 kg/m³]
- 24-2. A car is traveling on the freeway at a speed of [02] _____ mi/h. What would be its speed in standard units?
[20.0, 40.0 m/s]
- 24-3. The position of a particle is given by the equation, $x = Ae^{-3qt} \sin(4pt^2)$.
(a) Which of the following is a relevant unit for the coefficient q ? m, m/s, s·m, 1/s
(b) Which of the following is a relevant unit for the coefficient p ? m/s², 1/s², m·s², m
- 24-4. A humanitarian packet is dropped with no initial vertical speed from an airplane traveling at 275 km/h at an elevation $H = [03]$ _____ m above the ground. Assuming that air resistance is negligible, how long will it take for the packet to reach the ground?
[10.0, 25.0 s]
- 24-5. On a chess board, a rook is standing at the lowest left corner, and a queen is standing five squares to the right of the rook and seven squares up from the rook. Knowing that the actual size of each square is [04] _____ cm, what is the the actual distance between the rook and the queen?
[15.0, 40.0 cm]
- 24-6. A baseball is thrown with an initial speed $v_0 = [05]$ _____ m/s at an angle of 35° above the horizontal. Assume that air resistance effects are negligible.
(a) How high will the ball go?
(b) What distance will the ball have covered when it comes back to the same height?
[(a) 40.0, 99.9 m (b) 200, 600 m]
- 24-7. A person of mass 75 kg jumps with a parachute from an airplane and falls with an acceleration of [06] _____ m/s² downward. What is the strength of the force with which the parachute pulls on the person?
[300, 600 N]

- 24-8. A person of mass 65 kg is sitting on a carnival Ferris wheel moving at a speed of [07] _____ m/s in a vertical circle of radius $R = 15$ m. What is the strength of the force with which the seat pushes up on the person at the lowest point of the circle?
[600, 750 N]
- 24-9. A man is moving a box of mass $m = 80$ kg on a carpet. The coefficient of kinetic friction between the carpet and the box is [08] _____. How much work should the man produce in order to move the box at a constant speed over a distance of 12 m?
[3000, 8500 J]
- 24-10. During a crash test, a car of mass $M = 1050$ kg is crashed against a wall at a speed of [09] _____ km/h.
(a) What is the magnitude of the impulse exerted by the car on the wall?
(b) What is the change in the internal energy of the system (car + wall) caused by the crash?
[(a) 30000, 45000 kg·m/s, (b) 4.00×10^5 , 8.00×10^5 J]
- 24-11. A sphere of mass $M = 500$ g and radius R of [10] _____ cm is rolling down an incline starting from rest at a height H of [11] _____ cm.
(a) What is the moment of inertia of the sphere?
(b) What is the final speed of the sphere at the bottom of the incline?
[(a) 2.00×10^{-5} , 8.00×10^{-5} kg·m², (b) 1.00, 3.00 m/s]
- 24-12. A large bicycle wheel of mass $M = 1.80$ kg and radius $R = 35.0$ cm is mounted on a wall so it can freely rotate about its center. A force of [12] _____ N is applied tangentially to the wheel on its rim.
(a) What is the net torque exerted on the wheel?
(b) What is the angular acceleration of the wheel?
(c) Assuming that the wheel starts from rest, what will be its angular momentum after [13] _____ s?
[(a) 10.0, 25.0 N·m, (b) 40.0, 99.0 rad/s², (c) 20.0, 99.0 N·m·s]

- 24-13. Three children, Kelly, Tom, and Sarah, are playing on a seesaw. Kelly of mass $m = 45.0$ kg is sitting on the left side at a distance of 3.50 m from the rotation axis. Tom of mass $M = 55.0$ kg is sitting on the right side at a distance of 2.50 m from the rotation axis. Sarah has a mass of [14] _____ kg and is trying to climb onto the seesaw. At what distance from the rotation axis should Sarah sit in order to bring the seesaw to equilibrium?
[0.50, 0.99 m]
- 24-14. A satellite is orbiting around the Earth at an elevation $h = [15]$ _____ km (above the surface of the Earth). The mass of the satellite is 525 kg, the mass of the Earth is 5.98×10^{24} kg, the radius of the Earth is 6370 km, and the universal gravitational constant is 6.67×10^{-11} N·m²/kg².
(a) What is the linear speed of the satellite?
(b) What is the period of rotation of the satellite?
[(a) 4.00, 6.00 km/s, (b) 3.00, 7.00 h]
- 24-15. A 200-g ball is attached to the end of a horizontal spring of force constant $k = 450$ N/m and moves along a horizontal frictionless surface. The spring is initially compressed [16] _____ cm from its equilibrium length, at which point the ball is released. What will be the ball's speed when it reaches the point where the spring is no longer compressed?
[2.00, 4.00 m/s]
- 24-16. An object of mass $m = 5.00$ kg oscillates in simple harmonic motion under the influence of a spring whose spring constant is $k = [17]$ _____ N/m. What is the period of the motion?
[1.00, 3.00 s]
- 24-17. A 15-kg object sitting on a frictionless horizontal surface is attached to the end of a horizontal spring whose spring constant is 440 N/m. The spring is initially compressed [18] _____ m from its equilibrium point. How much work does the spring do as the object slides back to equilibrium point?
[200, 900 J]

Answers to Homework Problems, Physics 121, Fall Semester, 2008

24-1a. 30000, 45000 kg·m/s

24-1b. 4.00×10^5 , 8.00×10^5 J

24-2a. 2.00×10^{-5} , 8.00×10^{-5} kg·m²

24-2b. 1.00, 3.00 m/s