Chapter 5 Answers to Problems

1. 17 m **2.** 18 rev **3.** 0.105 rad/s **4.** (a) 0.524 rad (b) 2.36 rad (c) $\pi/2$ or 1.57 rad (d) 209 rad **5.** 26 rad/s **6.** (a) 0.56 rad/s (b) 1.1 rev **7.** (a) 3.49 rad/s (b) 0.45 m/s **8.** 4.2 rad **9.** 3800 ft **11.** (a) 31 m/s (b) 31 rad/s **12.** (a) static friction (b) 3.1 rad/s **13.** 3.37 cm/s^2 **14.** (a) 1.72×10^{-2} rad (b) 514 m/s perpendicular to the average velocity (c) 0.00595 m/s^2 perpendicular to the average velocity (d) a_r = 0.00595 m/s perpendicular to the velocity, which is the same as a_{av} within 3 significant figures **15.** 5.74 m/s **16.** (b) 3.64 N, 1.68 N **17.** (a) mv^2/L (b) $m\sqrt{(g^2+(v^2/L\cos\theta)^2)}$ **18.** (a) $mg/\cos\phi$ (b) $2\pi\sqrt{(L\cos\phi/g)}$ **19.** (a) $\sqrt{(\mu_s gR)}$ (b) the static frictional force is not large enough to keep the car in a circular path; the car skids toward the outside of the curve **20.** 5.08º **21.** 7.9 m/s **22.** 3900 N at 53º above the horizontal **23.** 59º **24.** (a) 3500 N (b) no **25.** (a) 2300 N (b) 19 m/s **26.** $\sqrt{(gR(\tan\theta+\mu_s)/(1-\mu_s\tan\theta))}$ **27.** $\tan^{-1}(v^2/rg)$ **28.** 0.204 **29.** 2.99×10^4 m/s **30.** (a) 10,400 km (b) 1.42 m/s^2 **31.** 130 h **32.** 1.613 h **33.** 420,000 km, 670,000 km **34.** 3.6×10^{22} N **35.** 2.04×10^7 m **36.** (a) 3.07 km/s in the $-y$-direction (b) 2.76 km/s at 45º above the x-axis (c) 0.201 m/s^2 at 45º below the $-x$-axis (d) 0.224 m/s^2 in the $+y$-direction **37.** 16 h **38.** 17.0 m/s **39.** (a) 13 N (b) the bob has an upward acceleration, so the net F_y must be upward and greater than the weight of the bob **40.** 438 N **41.** 23.2 m/s **42.** 0.39 rad/s^2 **43.** 4.0 rad/s^2 **44.** 190 rad/s^2 **47.** 2.54 m/s^2, 2.45 m/s^2, 11.9 N **48.** $g\sin\theta$ **49.** (a) 1.7 rad/s^2 (b) 0.56 rev **50.** (a) 270º (b) 450º **51.** (a) 17.7 m/s (b) 6.28 m/s^2 (c) 6.59 m/s^2 at an angle of 17.7º east of south **52.** (a) 7.1 rad/s^2 (b) 2.2 s (c) 0.35 m/s^2 **53.** (a) 1.3×10^6 s (b) 5.0×10^{10} rev **54.** (a) 1.0×10^5 m/s (b) 0.080 m/s^2 (c) 5.0×10^{10} m/s^2 **55.** 16g **56.** 0.045 Hz **57.** 7.0 rad/s **58.** 12 rad/s **59.** (a) 0.034 m/s^2 (b) less (c) 0.34% smaller (d) at the poles **60.** (a) $m(g-\omega^2R)$ (b) $m(g+\omega^2R)$ **61.** (a) 518.5 N (b) 521.5 N (c) 45 m **62.** 0.0257 m/s^2 **63.** 0.40ω **64.** 464 m/s **65.** 150 m/s **66.** 1.80×10^6 degrees **67.** (a) 3.00 m/s east (b) 3.00 m/s west **68.** (a) 12.0 Hz clockwise (b) 3.77 m/s **69.** 2.9 rotations, 5.7 rotations **70.** (a) 7.3×10^{-5} rad/s (b) 0.02 rad (c) 5 min **71.** (a) 38 m/s (b) You would need 135 km of tape to record one hour **72.** 200 km/s **73.** (a) $8.0\pi^2$ m/s^2 = 79 m/s^2 (b) $4.0\pi^2$ N = 39 N **74.** 2.0 N, 3.8 N **75.** smallest, 4.1 s **76.** (a) 2×10^{-10} m/s^2 (b) 4×10^{20} N **77.** 110 μm/s **78.** 2.93 s **79.** 8 cm **80.** (a) 0.60 m/s (b) the dolls do not stay on the record **81.** 120 km/h **82.** 1.04 rad/s **83.** (a) 90g (b) 7.9×10^{-11} N (c) 4.4×10^{-18} N (d) $5.0\times10^5 g$ **84.** (a) 14 m/s^2 (b) 1.4 (c) 33 m/s **85.** 1.4 rev/s **86.** (a) 90º (b) $T = 2\pi m/k$ (c) $r = mv/k$ **87.** 42,200 km