Numerical Answers to Review Problems

14. (a) 223 N (b) 629 N (c) 18.6 N
15. 6.4 N
16. 2.9×10^2 N
17. 3.1×10^4 N
18. (b) 2.8×10^2 m/s
    (c) 39 m/s², 9.8 m/s² (d) 4.9×10^4 N
19. 3.4×10^3 N
20. 4.2 m/s²[down]
21. (a) 7.2×10^4 N[up]
    (b) 2.1×10^4 N[up]
22. 2.2 s
23. (a) 80 N (b) 1.0 m/s² (c) 60 N
    (d) 2.0×10^2 N (e) 2.6×10^2 N
    (f) 2.6×10^2 N (g) 0.23
24. 544 N
25. (a) 3.0×10^4 N (b) 2.3×10^4 N
26. (a) 1.8×10^2 N (b) 1.5 m/s²[down]
    (c) 0
27. (a) (ii) 7.8 N (iii) 2.0 m/s² (iv) 1.4 m
    (b) (ii) 24 N (iii) 2.3 m/s² (iv) 1.6 m
    (c) (ii) 1.2 N, 1.6 N (iii) 2.0 m/s²
    (iv) 1.4 m
28. (a) 2.8 m/s² (b) 23 N (c) ≥ 0.46
29. 1.6 m/s²
30. 3.3 m/s²
31. (a) 2.9×10^3 N (b) 4.8 m/s²
32. (a) 6.9 N (b) 10 s
33. 54 N
34. 0.26
35. 8.1 N
36. (a) 3.9×10^2 N (b) 1.2×10^2 N
    (c) 1.1 m/s²
37. 1.0 m
38. 75 m
39. (a) 0.050 s
    (b) 0.80 m/s, 1.2 m/s, 1.6 m/s,
    2.0 m/s, 2.3 m/s, 2.5 m/s, 2.6 m/s
    (c) (i) 0.40 m/s, 0.40 m/s, 0.40 m/s,
    0.30 m/s, 0.20 m/s, 0.10 m/s
    (ii) 8.0 m/s², 8.0 m/s², 8.0 m/s²,
    6.0 m/s², 4.0 m/s², 2.0 m/s²
40. 1.6×10^2 N, 0.61 s
41. (a) 9.9 m/s (b) 3.5×10^3 N
42. 1.2×10^2 m, 50 m
43. 3.3×10^3 m
44. (a) 3.0 s (b) 7.4×10^2 m (c) 29 m/s
45. (a) 2.0×10^2 m/s (b) 8.0×10^2 m
    (c) 1.6×10^2 m/s, 1.71×10^2 m/s
46. (a) 26.5 m/s
47. (a) 42.9 s (b) 15.4 km

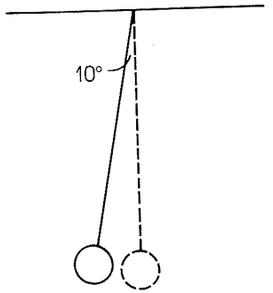
(b) What properties of falling bodies did you assume in making your calculation in (a)?
(c) State whether your answer in (a) is an overestimate or an underestimate, and why.

47. An artillery gun is fired so that its shell has a vertical component of velocity of 210 m/s and a horizontal component of 360 m/s. If the target is at the same level as the gun, and air friction is neglected,
    (a) how long will the shell stay in the air?
    (b) how far down-range will the shell hit the target?
48. A baseball, thrown from shortstop position to first base, travels 32 m horizontally, rises 3.0 m, and falls 3.0 m. Find the initial velocity of the ball.
49. If you can hurl a ball so that its initial speed is 30 m/s, what is the widest river you can throw it across?
50. A player kicks a football with an initial velocity of 15 m/s at an angle of 42° above the horizontal. A second player standing at a distance of 30 m from the first, in the direction of the kick, starts running to meet the ball at the instant it is kicked. How fast must he run in order to catch the ball before it hits the ground?
51. A rifle with a muzzle velocity of 460 m/s shoots a bullet at a small target 800 m away at the same height. At what angle above the horizontal must the gun be aimed so that the bullet will hit the target?
52. You have determined the following results when doing an investigation. Using proportioning techniques, find the new value for the centripetal force.

Before	*After*
mass = 1 ball	mass = 3 balls
radius = 0.75 m	radius = 1.50 m
frequency = 1.5 Hz	frequency = 3.0 Hz
centripetal force = 8.0 units	centripetal force = ? units

53. A 200 g ball on the end of a string is rotated in a horizontal circle of radius 10.0 m. The ball completes 10 rotations in 5.0 s. What is the centripetal force of the string on the ball?
54. In the Bohr model of the hydrogen atom, the electron revolves around the nucleus. If the radius of the orbit is 5.3×10^{-11} m and the electron makes 6.6×10^{15} r/s, find
    (a) the acceleration of the electron and
    (b) the centripetal force acting on the electron. (This force is due to the attraction between the positively charged nucleus and the negatively charged electron.) The mass of the electron is 9.1×10^{-31} kg.

55. A string pendulum 1.12 m long has a bob with a mass of 200 g.
    (a) What is the tension in the string when the pendulum is at rest?
    (b) What is the tension at the bottom of the swing, if the pendulum is moving at 1.2 m/s?
56. When you whirl a ball on a cord in a vertical circle, you find a critical speed at the top for which the tension in the cord is zero. This is because the force of gravity on the object itself supplies the necessary centripetal force. How slowly can you swing a 2.5 kg ball like this so that it will just follow a circle with a radius of 1.5 m?
57. An object of mass 3.0 kg is whirled around in a vertical circle of radius 1.3 m with a constant velocity of 6.0 m/s. Calculate the maximum and minimum tension in the string.
58. Snoopy is flying his vintage war plane in a "loop the loop" path chasing the Red Baron. His instruments tell him the plane is level (at the bottom of the loop) and travelling with a speed of 180 km/h. He is sitting on a set of bathroom scales, and notes that they read four times the normal force of gravity on him. What is the radius of the loop? Answer in metres. (SIN '75)
59. An Australian bushman hunts kangaroos with the following weapon, a heavy rock tied to one end of a light vine of length 2 m. He holds the other end above his head, at a point 2 m above ground level, and swings the rock in a horizontal circle. The cunning kangaroo has observed that the vine always breaks when the angle θ (measured between the vine and the vertical) reaches 60°. At what minimum distance from the hunter can the kangaroo stand with no danger of a direct hit? (SIN '72)
60. A pendulum of mass 1.0 kg is suspended from the roof of a car travelling on a level road. An observer in the car notices that the pendulum string makes an angle of 10° with the vertical. What is the acceleration of the car?



48. 22 m/s [21° to the horizontal]
49. 92 m
50. 3.6 m/s
51. 1.1°
52. 192 units
53. 3.2×10^2 N
54. (a) 9.1×10^{22} m/s² (b) 8.3×10^{-8} N
55. (a) 1.96 N (b) 2.2 N
56. 3.8 m/s
57. 1.1×10^2 N, 54 N
58. 85 m
59. 3.0 m
60. 1.8 m/s²