1. 78 km, 47°
2. a. 144 N, 16.5°
   b. 144 N, 16.5°
   c. result is same, order doesn't matter
3. (in order: x,y)
   a. 12.0 m/s, 32.9 m/s
   b. –6.1 m, 6.1 m
   c. 0.0 km, –842 km
   d. 13.6 km/h, 0.0 km/h
   e. 117 cm, –31.6 cm
   f. –2.1 m/s^2, –5.6 m/s^2
4. 193 km north, 230 km east
5. a. 48.1 m, 315.0°
   b. 150.0 km, 90.0°
   c. 10 m/s^2, 143°
   d. 23.4 m/s, 219.8°
   e. 7.8 cm/s, 71°
   f. 10.0 mm, 180.0°
6. 510 km, 259°
7. 6.40 m, 128.7° from widget
8. 16 m/s^2, 67°
9. 230 km/h, 318.5°
10. a. 210 s
    b. 2.1 m/s
11. The two aircraft arrive at same time because northward components are essentially the same.
12. a. 89.8 m/s
    b. 88.9 m/s
13. a. 43 mph
    b. Will read zero if track perpendicular, would never be greater if car is at rest.
14. a. 3350 m, 90.0°
    b. 73 km/h, 0°
    c. 26.2 m/s, 63.4°
    d. 27 cm, 207°
    e. 247 m/s, 15.0°
15. a. 2.62 m/s, 182.5°
    b. 0.523 m/s^2, 182.5°
16. a. 276 km/h
    b. 23.1 km, 276.2°
17. 47 km/h, 195° (subtract given vectors!)
18. a. 4.1 m/s, 23° downstream
    b. 63 s
    c. 100 m
19. a. 12 m/s (form a right triangle
    b. 13 m/s with the given directions)
20. Yes time is increased with any wind.
    no wind: $t = \frac{2d}{v}$ $v_{avg} = v$
    N wind: $t = \frac{2dv}{v^2-u^2}$ $v_{avg} = v - \frac{v^2}{u}$
    E wind: $t = \frac{2d}{\sqrt{v^2-u^2}}$ $v_{avg} = \sqrt{v^2 - u^2}$
21. g is not constant in magnitude for great changes in elevation, nor constant in direction for great ranges
22. Although 45º produces max range for a given speed it would not be practical here. The best bet is to run as fast as possible to maximize v_{ix} and jump upward as much as possible to maximize time in the air.
23. 32 m
24. a. 0.500 s
    b. 0.800 m/s
25. a. 4.54 s
    b. 158 m
    c. 56.4 m/s
26. a. 28 m/s
    b. 45 m
27. a. $y = \frac{gd^2}{2v^2}$
    b. 3.7 cm
28. a. 31 m
    b. 210 m
29. 108 m (= range of ball + distance run)
30. a. 15.2 m/s, 347.5°
    b. 43.4 m, 31.1° from cannon
31. a. 492 m (set $d_y = -90$ m, solve for t)
    b. 77.4 m/s, 316.7°
32. 12.1 km (set angle to 45º)
33. 50 mph, 62°
34. speed (in m/s) and angle must satisfy:
$$v = \sqrt{\frac{882}{6\cos\theta\sin\theta - 5\cos^2\theta}}$$
$$39.8^\circ < \theta < 90.0^\circ$$
35. a. 9.8 m/s^2, down
    b. parabolic like a projectile
    c. 170 m/s
    d. range: 3.1 km, elevation: 770 m