Tutorial problems 3.

Topics:

- Vectors and their properties
- Motion in two dimensions
- Projectile motion
- Relative velocity

1. A surveyor measures the distance across a straight river by the following method: starting directly across from a tree on the opposite bank, she walks 100 m along the riverbank to establish a baseline. Then she sights across to the tree. The angle from her baseline to the tree is 35.0°. How wide is the river? *(70.0 m)*
2. A vector has an *x* component of −25.0 units and a *y* component of 40.0 units. Find the magnitude and direction of this vector. *(47.2 units, 122°)*
3. A person walks 25.0° north of east for 3.10 km. How far would she have to walk due north and then due east to arrive at the same location? *(4.12 km)*
4. A plane flies from base camp to lake A, a distance of 280 km at a direction of 20.0° north of east. After dropping off supplies, the plane flies to lake B, which is 190 km and 30.0° west of north from lake A. Graphically determine the distance and direction from lake B to the base camp. *(approx.. 310 km, 57° N of E)*
5. Movie stunt driver on a motorcycle speeds horizontally off a 50.0-m-high cliff. How fast must the motorcycle leave the cliff-top if it is to land on level ground below, 90.0 m from the base of the cliff? *(28.2 m/s = 101 km/h)*
6. A rifle is aimed horizontally at the centre of a large target 60 m away. The initial speed of the bullet is 240 m/s. What is the distance from the centre of the target to the point where the bullet strikes the target? *(31 cm)*
7. A projectile is launched on the Earth with a certain initial velocity and moves without air resistance. Another projectile is launched with the same initial velocity on the Moon, where the acceleration due to gravity is 1/6 as large. How does the range of the projectile on the Moon compare with that of the projectile on the Earth? *(6 times larger)*
8. A rock is projected from the edge of the top of a building with an initial velocity of 12.2 m/s at an angle of 53º above the horizontal. The rock strikes the ground a horizontal distance of 25 m from the base of the building. Assume that the ground is level and that the side of the building is vertical. How tall is the building? *(23.6 m)*

9. A placekicker must kick a football from a point 36.0 m from the goal. The crossbar is 3.05 m high. When kicked, the ball leaves the ground with a speed of 20.0 m/s at an angle of 53° to the horizontal. (a) By how much the ball clear or fall short of clearing the crossbar? (b) Does the ball approach the crossbar while still raising or while falling?
   (a) 0.89 m clear (above the crossbar); (b) falling)
10. An airplane, whose air speed is 600 km/h, is supposed to fly in a straight path 35° North of East. But a steady 100 km/h wind is blowing from the north. In what direction should the plane head? (*42.8° N of E*)
11. A 0.20-km wide river has a uniform flow speed of 4.0 m/s toward the east. It takes 20 s for a boat to cross the river to a point directly north of its departure point on the south bank. (a) In what direction must the boat be pointed in order to accomplish this? (b) What is the boat's speed with respect to the river? *(a) 22° W of N (b) 11 m/s*