2-D Motion and Forces - Expectations

1. Students should understand the difference between a vector quantities and scalar quantities. They should be able to use vectors to describe the magnitude and direction of the following quantities: force, displacement, velocity, acceleration

Scalar =

Vector =

2. Students should be able to add vectors using the tip-to-tail method and us trigonometry to determine vector components and add vectors.
    a. Examples:

3. Students should understand that the horizontal and vertical components of projectile motion are independent. They should understand how these two components combine to create parabolic projectile motion.
    a. Horizontal motion equations:
    b. Vertical motion equations:
    c. Picture:

4. Students should understand how launch angle and initial velocity effect projectile motion (height, time in air, range). They should be able sketch the motion graphs of projectiles and to decompose the initial velocity into Vx and Vy components using trigonometry.

5. Students should be able to solve problems where a projectile is launched horizontally from some height above the ground.
   make up your own problem and solve it:

6. (Honors) Students should be able to solve problems where a projectile is launched at an angle from the ground, or from some height above the ground.

Practice Problems:

Draw a picture and show all work for each problem

1. A boat is crossing a river that is 170 m wide. It can go up to 15 m/s in still water. The river has a current of 6 m/s to the south. The captain points the boat directly north, perpendicular to the shore and goes at full power.
   a) Draw a vector diagram
   b) What is the boats velocity (magnitude and direction)?
   c) How far downstream is the boat when it reaches the opposite shore?
   d) What is the total distance the boat traveled?
   e) How long does it take to cross?
2. Two cars sit at an intersection. When the light turns green one goes straight and one turns right. They each drive at a constant velocity of 25 m/s in a straight line. How far apart are they after 2 minutes of driving?
3. A hiker, hiking at a constant 4 mi/hr, hikes north for 2 hours, then heads east for 1 hour, then north again for 1 more hour, then west for 30 minutes (where he reaches a beautiful lake and takes a dip).
   a) Draw a vector diagram that represents his journey.
   b) What is his total displacement and total distance traveled?
   c) What is his average speed? What is his average velocity? (hint: it's not the same as the speed).
4. Ancient hunters would chase mammoths off of cliffs to kill them. If Zog and Kruk chase a 1500Kg mammoth at 7 m/s off a 27 m cliff…
   a) How long will it take the mammoth to hit the ground?
   b) Where will the mammoth land?
   c) How fast will the mammoth hit the ground (magnitude and direction).
5. 2 more ancient hunters, Bork and Ruk, chase another mammoth off the same cliff. After it hits the ground, they climb down and measure where it lands. They find it landed 14m from the edge of the cliff.
   a) Draw a freebody diagram for the mammoth while it is in the air.
   b) How long was it in the air?
   c) How fast was it running when it left the cliff?
6. (Honors) Joe throws a football at an angle of 27 degrees with a speed of 34 m/s.
   a) Draw a diagram showing the horizontal and vertical components of the initial velocity.
   b) What is the velocity when it reaches the top of it's flight?
   c) How long is it in the air, and how far away should the receiver be to catch it?
   d) Draw a freebody diagram of the football when it is at the top of its flight path.
7. (Honors) A potato is launched from a hairspray-powered potato-zuka at an angle of 45 degrees. The end of the barrel is 1.2 meters above the ground. It lands 75m away after a time of 3.87s. How fast did the potato leave the barrel of the gun?