Physics 1 Unit 2 – Vectors and 2D motion Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

IB 2.1 Projectile motion

**General 2D motion**

1. An ice boat sails across the surface of a frozen lake with constant acceleration produced by the wind. At a certain instant the boat’s velocity is 6.30 m/s East and 8.42 m/s South. Three seconds later, the boat is at rest. What is the magnitude and direction of the acceleration of the boat? What is the magnitude and direction of the displacement of the boat?

**Projectile motion**

1. A rifle is aimed horizontally at a target 35.0 m away. The bullet hits the target hits the target 2.10 cm below the aiming point. a) What is the bullet’s time of flight? b) What is its muzzle velocity?
2. A ball rolls along a table top at 1.35 m/s. How far from the edge of the table does the ball land if the table is 1.20 m tall? How much time does the ball spend in the air? What is the final velocity of the ball when it hits the ground? (magnitude and direction)
3. A volleyball is spiked so that it has an initial velocity of 15.0 m/s directed downward at an angle of 55° below the horizontal. With what velocity (magnitude and direction) does it hit the floor on the other side if it was spiked from a height of 2.25 m? How much time did the opposing player have to respond to the spike?
4. An airplane with a speed of 97.5 m/s is climbing upward at an angle of 50° with respect to the horizontal. When the plane’s altitude is 732 m, the pilot releases a package. a) Calculate the distance along the ground, measure from a point directly beneath the point of release, to where the package hits the level earth below. b) Determine the velocity of the package just before impact.
5. You throw a ball with a speed of 25.0 m/s at an angle of 40° above the horizontal directly toward a wall. The wall is 22.0 m from the release point of the ball. a) How long does the ball take to reach the wall? b) How far above the release point does the ball hit the wall? c) What are the horizontal and vertical components of its velocity as it hits the wall? d) Where it hits, has it passed the highest point on its trajectory?

**Range**

1. A projectile is fired with an initial speed of 30.0 m/s from the level ground at a target on the ground 20.0 m away. What are two possible projection angles that can be used to hit this target?
2. A football is kicked off with an initial speed of 18.5 m/s at an angle of 45°. A receiver is located 25.0 m away when the ball is kicked. What must be the receiver’s average velocity if he is to catch the ball just before it hits the ground?