**Unit 2 Vectors and 2-D motion**

**IB 1.3 and 2.1 Review Worksheet Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. Projectile motion true/false practice:
   1. A projectile does not have a horizontal velocity.

**F eliminate “not”**

* 1. A projectile with a rightward component of motion will have a rightward component of acceleration.

**F change “acceleration” to “velocity”**

* 1. The horizontal velocity of a projectile changes by 9.8 m/s each second.

**F change “horizontal” to “vertical”. Specifically it decreases by 9.8 m/s each second.**

* 1. A projectile with a horizontal component of motion will have a constant horizontal velocity.

**T**

* 1. The horizontal velocity of a projectile is 0 m/s at the peak of its trajectory.

**F change “horizontal” to “vertical”**

* 1. The horizontal velocity of a projectile is unaffected by the vertical velocity; these two components of motion are independent of each other.

**T**

* 1. The horizontal displacement of a projectile is dependent upon the time of flight and the initial horizontal velocity.

**T**

* 1. The final horizontal velocity of a projectile is always equal to the initial horizontal velocity.

**T**

* 1. As a projectile rises towards the peak of its trajectory, the horizontal velocity will decrease; as it falls from the peak of its trajectory, its horizontal velocity will decrease.

**F change both “horizontal” to “vertical”**

* 1. Consider a projectile launched from ground level at a fixed launch speed and a variable angle and landing at ground level. The horizontal displacement (i.e., the *range*) of the projectile will always increase as the angle of launch is increased from 0 degrees to 90 degrees.

**F change 90 to 45**

* 1. Consider a projectile launched from ground level at a fixed launch angle and a variable launch speed and landing at ground level. The horizontal displacement (i.e., the *range*) of the projectile will always increase as the launch speed is increased.

**T**

* 1. The vertical component of a projectile's velocity is a constant value of 9.8 m/s.

**F change “velocity” to “acceleration” and the number to – 9.8 m/s2**

* 1. The vertical component of a projectile's velocity is constant.

**F change “vertical” to “horizontal**

* 1. The vertical component of a projectile's velocity is changing.

**T**

* 1. The vertical component of a projectile's velocity is changing at a constant rate.

**T**

* 1. A projectile with an upward component of motion will have a upward component of acceleration.

**F change “upward” to “downward”**

* 1. A projectile with a downward component of motion will have a downward component of acceleration.

**T**

* 1. The magnitude of the vertical velocity of a projectile changes by 9.8 m/s each second.

**T**

* 1. The vertical velocity of a projectile is 0 m/s at the peak of its trajectory.

**T**

* 1. The vertical velocity of a projectile is unaffected by the horizontal velocity; these two components of motion are independent of each other.

**T**

* 1. The final vertical velocity of a projectile is always equal to the initial vertical velocity.

**F either change both “velocity” to “speed” OR change “equal” to “opposite”**

* 1. The vertical acceleration of a projectile is 0 m/s2 when it is at the peak of its trajectory.

**F change “acceleration” to “velocity” and the unit to m/s.**

* 1. As a projectile rises towards the peak of its trajectory, the vertical acceleration will decrease; as it falls from the peak of its trajectory, its vertical acceleration will decrease.

**F change both “acceleration” to “velocity”**

* 1. As a projectile rises towards the peak of its trajectory, the vertical acceleration is directed upward; as it falls from the peak of its trajectory, its vertical acceleration is directed downward.

**F change “upward” to “downward”**

* 1. The peak height to which a projectile rises above the launch location is dependent upon the initial vertical velocity.

**T**

* 1. As a projectile rises towards the peak of its trajectory, the vertical velocity will decrease; as it falls from the peak of its trajectory, its vertical velocity will decrease.

**T (however on the way down, the *magnitude* of the velocity will increase becoming more negative)**

* 1. Consider a projectile launched from ground level at a fixed launch speed and a variable angle and landing at ground level. The vertical displacement of the projectile during the first half of its trajectory (i.e., the *peak height*) will always increase as the angle of launch is increased from 0 degrees to 90 degrees.

**F change 90 to 45**

* 1. Consider a projectile launched from ground level at a fixed launch angle and a variable launch speed and landing at ground level. The vertical displacement of the projectile during the first half of its trajectory (i.e., the *peak height*) will always increase as the launch speed is increased.

**T**

**Vectors**

1. If **A** = 25 N at 120° and **B =** 10 N at 40° find
2. 2**A 50 N at 120**
3. **½ B 5 N at 40**
4. **–A 25 N at 300**
5. –3**B 30 N at 220**
6. For each of the following i. Add graphically using the parallelogram method, ii. Add graphically using the triangle method, and iii. Add analytically to get the actual answer. Show all work. (Use your own paper)

**For i. and ii. Sketches are fine.**

* 1. **A** = 20 N at 20° and **B =** 40 N at 60° **iii.** **57 N at 47**
  2. **A** = 30 N at 105° and **B =** 90 N at 20° **iii.** **97 N at 38**
  3. **A** = 25 N at 120° , **B =** 10 N at 40° and **C =** 40 N at 315° **iii. 23 N at -1 or 359**
  4. If **A** = 15 N at 100° and **B =** 30 N at 45° find **2A – B iii. 28 N at 163**

**Projectile Motion Practice Problems** (Complete on your own paper)

1. A projectile is launch from ground level to the top of a cliff which is 195 m away and 155 m high. If the projectile lands on top of the cliff 7.6 s after it is fired, find the initial velocity of the projectile (magnitude and direction). With what velocity does it land on the cliff (magnitude and direction)? Had the projectile passed the pinnacle of the trajectory when it landed on the cliff? What was the highest altitude obtained by the projectile? **a. 63.1 m/s at 66 b. 30.7 m/s at –33c. Yes, b/c vy <0 d. 170 m.**
2. At serve a tennis player aims to hit the ball horizontally. What minimum speed is required for the ball to clear the 0.90 m high net about 15.0 m from the server if the ball is “launched” from a height of 2.50 m? Where will the ball land if it just clears the net? Will it be “good” in the sense that it lands within 7.0 m of the net? How long will it be in the air? **a. 26.3 m/s b. 3.8 m c. Yes, good. d. 0.714 s**
3. A ball is thrown horizontally from the roof of a building 45.0 m tall and lands 24.0 m from the base. What was the ball’s initial speed? What was it’s final velocity (magnitude and direction)? How much time did the ball spend in the air? **a. 7.92 m/s b. 30.7 m/s at –75c. 3.03 s**
4. A football is kicked at ground level with a speed of 18.0 m/s at an angle of 35.0 to the horizontal. How much later does it hit the ground? How far away from the kicker does it land? What is the maximum height obtained by the ball? **a. 2.10 s b. 31.0 m c. 5.41 m**
5. A ball thrown horizontally at 22.2 m/s from the roof of building lands 36.0 m from the base of the building. How tall is the building? How much time does the ball spend in the air? With what velocity does it hit the ground (magnitude and direction)? **a. 12.9 m b. 1.62 s c. 27.3 m/s at –36**
6. An athlete executing a long jump leaves the ground at a 28.0 angle and travels 7.80 m. What was the takeoff speed? If this speed were increase by just 5% how much longer would the jump be?

**a. 9.61 m/s b. 0.80 m**

1. A hunter aims directly at a target (on the same level) 75.0 m away. If the bullet leaves the gun at a speed of 180 m/s, by how much will it miss the target? At what angle should the gun be aimed so as to hit the target? **a. shot hits 85.2 cm below the target. b. 0.65**
2. A shot putter throws the shot with an initial speed of 15.5 m/s at a 34.0 angle to the horizontal. Calculate the horizontal distance traveled by the shot if it leaves the athlete’s hand at a height of 2.20 m above the ground. How much time did the shot spend in the air? With what velocity (magnitude and direction) does the shot hit the ground? What was the maximum height obtained by the shot?

**a. 25.6 m b. 1.99 s c. 16.8 m/s at –40 d. 6.03 m**