ID Number:\_\_\_\_\_\_\_\_ Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Superbowl Physics Worksheet 1: Mass

A controversy surrounded Tom Brady and the Patriots during the 2015-15 super bowl season. We will investigate a piece of this controversy using physics! This activity is designed to examine how mass of a football affects various outcomes such as velocity, contact time, acceleration, maximum vertical height, and the horizontal distance traveled. We will use newton’s laws, energy concepts and kinematics to determine this outcomes. Use g = 9.8 m/s^2. Carry out all mathematical operations to 3 decimal places.

Mass of the regulation football: \_\_\_\_ kg.

Mass of the deflated football: \_\_\_\_ kg.

The quarterback’s hand exerts a \_\_\_\_\_\_ newtons of forward force on the ball.

The quarterback’s hand is in contact with the ball for \_\_\_\_\_\_\_ meters during the throwing action.

The football is released by the quarterback at an angle of \_\_\_\_\_\_\_ degrees.

Solve each of the following questions for both the deflated and regulation masses.

1. Calculate the work done on the ball by the quarterback’s hand (hint: W = f\*d). Assume the force exerted on ball is in the same direction that the ball is traveling.
2. Solve for the acceleration of the football while in contact with the quarterback’s hand

(hint: Newton’s 2nd Law)

1. Assume that all work is converted into kinetic energy and that the ball begins at rest. Solve for the velocity of the football just as it leaves the quarterback’s hand.
2. For how much time was the quarterback’s hand in contact with the ball. Assume the ball begins at rest. (hint: use the 1st Kinematic Equation)
3. Find the Vx and Vy components of the initial velocity.

V1x: V2x:

V1y: V2y:

1. Use conservation of energy to solve for the maximum height reached by the football.
2. Use kinematics to verify your answer to the previous question.

(hint: use the 3rd Kinematic equation)

1. Solve for the ‘air time’ of the football. (hint: use the 2nd Kinematic Equation)
2. Solve for the horizontal distance traveled by the football. (hint: d=r\*t)
3. Find the percent horizontal distance improvement achieved by using the deflated football.
4. Find the increased distance traveled by the deflated football.
5. Based on your findings. Please give your opinion about whether or not the NFL should regulate the psi of footballs.