**PROJECTILE PROBLEM – OBJECT MOVES BOTH VERTICALLY AND HORIZONTALLY**

Use this procedure for objects that were launched at an angle other than 90o with the ground and then move only under the influence of gravity.

STEP 1: Sketch the situation.

STEP 2: Identify the system – the moving object.

STEP 3: Assign UP as positive direction vertically, assign positive horizontal direction to the direction the

 object moves, and assign a reference point.

**STEP 4: ASSIGN A “FROM” POSITION AND A “TO” POSITION!**

Step 5: List the variables for accelerated motion for both the vertical motion and for the horizontal motion.

 Assign numbers from the problem to the symbols.

**The most important ideas for projectile motion are:**

**1. the horizontal and vertical motions of the object can be treated independently.**

**2. the horizontal acceleration is zero - motion horizontally is uniform.**

**3. the vertical acceleration is due only to gravity.**

launch speed, V = \_\_\_\_ m/s launch angle, **Θ** = \_\_\_\_ degrees

VERTICAL HORIZONTAL

V0 = **+(V)(sin Θ)** = V0 = **+(V)(cos Θ)** =

V = V = **+(V)(cos Θ)** =

a = **-*g*** = ***-9.8 m/s2*** a = **0**

equal

Δt = Δt =

ΔX = ΔX =

Step 6: Choose and equation for accelerated motion, substitute, and solve.

The horizontal time and the vertical time are always equal.

Time, launch speed, and launch angle are the same for both HORIZONTAL and VERTICAL data.

The time in the air is determined by the vertical motion, but you can find time in the air if you are given horizontal distance and horizontal speed.

If the object is released from a moving platform then V = speed of moving platform and Θ = angle of velocity vector of moving platform.

If the TO and FROM positions are at the same altitude then vertical Vf = -vertical V0, vertical ΔX = 0, and the time to the object’s highest point is 1/2 the time from the FROM position to the TO position.

If the object is projected upward then at the object's highest point its vertical V = 0.