Recitation Questions – Snowball Fight

30 January

Question 1: a prankster

A mischievous SUOC student has climbed on the roof of a snow-covered building and is trying to hit her friend with snowballs as he walks through the Quad. She throws them at an angle of 20° above the horizontal at a speed of $v_0 = 5$ m/s. The building has a height $h = 6$ m.

1. Draw a cartoon of the problem, making clear your coordinate system and origin, and labelling interesting things.

2. Write expressions for $x(t)$, $y(t)$, $v_x(t)$, and $v_y(t)$, substituting in variables that you know.

3. Write sentences in terms of your algebraic variables that allow you to answer the following. You will need to incorporate vector language at times: for instance, you may need to use terms like "the magnitude of the velocity vector" (which will require you to solve for both v_x and v_y.)

   - How much time does it take for the snowballs to hit the Quad?

   - Where do the snowballs land on the Quad?

   - How fast are the snowballs traveling when they hit the Quad?

   - In what direction are they moving when they land on the Quad?

Question 2: retaliation!

He decides to throw a snowball back at her. He's standing a distance d from the side of the building, and throws a snowball at an angle θ above the horizontal at a speed v_0. However, the snowball slips out of his hand when he throws it, and it doesn't go very fast – instead of hitting her on top of the building, it hits the side of the building.

1. Draw a cartoon of the problem, making clear your coordinate system and origin, and labelling interesting things.

2. Write expressions for $x(t)$, $y(t)$, $v_x(t)$, and $v_y(t)$, substituting in variables that you know.

3. Write a sentence in terms of your algebraic variables that will let you figure out how far above the ground the snowball hits the side of the building.

4. Based on your sentence, figure out how far above the ground the snowball hits the building. Your answer should be in terms of v_0, θ, d, and g.

5. He doesn't give up, though, and throws another snowball at her – again at an angle θ above the horizontal. He throws this one harder, and it hits her feet as she stands on the edge of the building. Write a sentence in terms of your algebraic variables that will let you figure out how fast he had to throw it.

6. Now, based on your previous sentence, figure out the initial speed of the second snowball he threw.