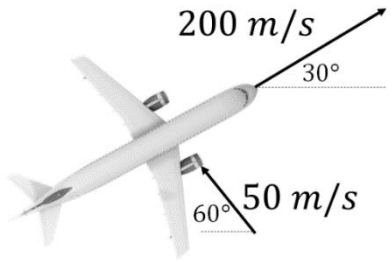
AP Physics 1

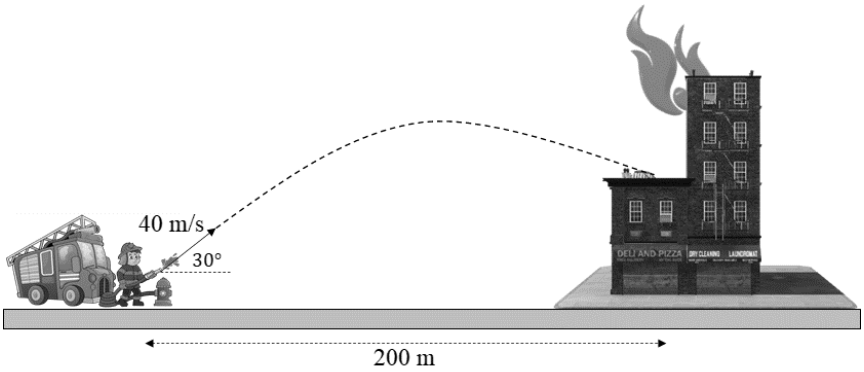
Unit 1: 2D Kinematics Test

Directions: **You must show all steps** required to arrive at the correct answer for the problem below.

1. (8 points) A rebellious pilot for Southwest airlines pilots a plane northeast as shown. The plane is piloted with a velocity of 200 m/s directly 30° above the positive x-axis. A strong wind of 50 m/s acts at 60° above the negative x-axis on the plane. Calculate the resultant velocity (magnitude and direction of the plane).



2. (24 points) A physics teacher lights a building on fire in order to make a relevant scenario for a projectile problem. A firefighter aims a fire-hose at 30° above the horizontal as shown and shoots water at 40 m/s at the building from a horizontal distance of 200 m away as shown. Assume the height of the hose above the ground is negligible.



a) Calculate maximum height of the water above the ground.

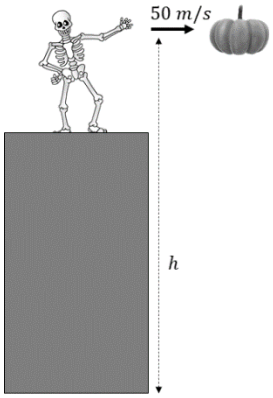
b) Calculate the height above the ground at which the water hits the building.

c) Calculate the final x and y components of the water's velocity.

d) Sketch graphs of the horizontal components of the acceleration, velocity, and position of the water's motion. Label any maximum and minimum values on the y-axes.

e) Sketch graphs of the vertical components of the acceleration, velocity, and position of the water's motion. Label any maximum and minimum values on the y-axes.

3. (24 points) To mark the start of Spooktober, a spooky skeleton throws a pumpkin horizontally off a cliff at an initial speed of 50 m/s as shown. The pumpkin is in the air for a total of 8 seconds.



a) Calculate how far from the base of the cliff the pumpkin lands.

b) Calculate how high off the ground the pumpkin was when it was launched.

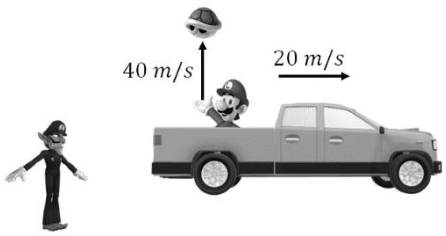
c) Calculate the pumpkin's final velocity (magnitude and angle with the ground).

d) Suppose the pumpkin was throw horizontally with the same speed, but from a higher cliff.

i. How would the magnitude of the final velocity from c) be affected? Justify your answer with words.

ii. How was the answer the angle the final velocity makes with the ground from c) be affected? Justify your answer with words.

4. (14 points) A truck drives east at 20 m/s as shown. Luigi rides in the back of the truck and throws a turtle shell directly upwards at 40 m/s. Waluigi stands on the side of the road and watches the whole ordeal.



a) Describe the path of the shell according to:

i. Luigi ii. Waluigi

b) Calculate the speed of the shell 2 seconds after being thrown relative to:

i. Luigi ii. Waluigi

c) Waluigi now starts to run in the same direction that the car is traveling in. Will the speed of the shell relative to him increase or decrease? Justify your answer.