Cameron Whiting
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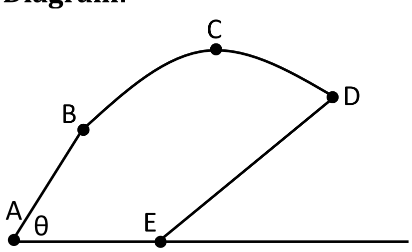
Section: S

Problem:
One breezy afternoon Algebra Alex decides to launch Hamster Huey into the air using a model rocket. The rocket is launched over level ground, from rest, at a specified angle above the East horizontal. The rocket engine is designed to burn for specified time while producing a constant net acceleration for the rocket. Assume the rocket travels in a straight-line path while the engine burns. After the engine stops the rocket continues in projectile motion. A parachute opens after the rocket falls a specified vertical distance from its maximum height. When the parachute opens the rocket instantly changes speed and descends at a constant vertical speed. A horizontal wind blows the rocket, with parachute, from the East to West at the constant speed of the wind. Assume the wind affects the rocket only during the parachute stage.

Diagram:



Givens:
θ = 55°
t_{AB} = 71. sec
a_{AB} = 7.3 m/s^2
Δy_{CD} = 86 m
v_{yD} = 11 m/s
v_{xD} = -14 m/s

The final answer I was looking for was a distance in the x direction so I needed to find that distance between every point which will add up to the final answer.

Distance A-B:

First, the distance between A and B was solved to get the hypotenuse for the triangle.

$$x_B = \frac{1}{2}at^2 + V_{iA}t + x_A$$
$$x_B = 3.65(7.1)^2$$
$$\underline{x_B = 184\ m}$$

With that information it was determined that:

$$y_B = \sin 55 * 184$$
$$\underline{y_B = 150.72\ m}$$
$$x_B = \cos 55 * 184$$
$$\underline{x_B = 105.54\ m}$$

Distance B-C:

The velocity at B was fo:

$$v_B = a\Delta t + v_A$$
$$v_B = 7.3(7.1) + 0$$
$$\underline{v_B = 51.83\ m/s}$$

With that velocity, the x and y velocities at B were defined:

$$v_{yB} = \sin 55 * 51.83$$
$$\underline{v_{yB} = 42.457\ m/s}$$
$$v_{xB} = \cos 55 * 51.83$$
$$\underline{v_{xB} = 29.729\ m/s}$$

The time from B-C was found:

y-dir:
$$v_C = a\Delta t + v_{yB}$$
$$0 = -9.8\Delta t + 42.457$$
$$\underline{t_{BC} = 4.3323\ sec}$$

With the velocity and time at B, distances for C could be found:

y-dir:
$$y_C = \frac{1}{2}at^2 + v_{yB}t + y_B$$
$$y_c = 4.9(4.3)^2 + 42.4(4.3) + 150$$
$$\underline{y_C = 242.69\ m}$$

x-dir:
$$x_C = \frac{1}{2}at^2 + v_{xB}t + y_B$$
$$y_c = 29.729(4.3) + 105.54$$
$$\underline{x_C = 242.69\ m}$$

Distance C-D:

Knowing the rocket drops 86 m from max height to get height D:

y-dir:
$$y_D = y_C - 86$$
$$y_D = 242.69 - 86$$
$$\underline{y_D = 156.69\ m}$$

With the height of D one could now find the time from C-D:

y-dir:
$$y_D = \frac{1}{2}at^2 + v_{yC}t + y_c$$
$$156.69 = -4.9t^2 + 0t + 242.69$$
$$\underline{t_{CD} = 4.1894\ sec}$$

Using that time to find the distance to D:

x-dir:
$$x_D = \frac{1}{2}at^2 + v_{xC}t + x_c$$
$$x_D = 29.729(4.1849) + 234.34$$
$$\underline{x_D = 358.89\ m}$$

Distance D-E:

The only thing missing from the final x distance equation from D to E was time:

y-dir:
$$y_E = \frac{1}{2}at^2 + v_{yD}t + y_D$$
$$0 = -11t + 156.69$$
$$\underline{t_{DE} = 14.245\ sec}$$

Now with the time solved, final x position can be found:

x-dir:
$$x_E = \frac{1}{2}at^2 + v_{xD}t + x_D$$
$$x_E = -14(14.425) + 358.89$$
$$\boxed{x_E = 159.5\ m\ east}$$