Quizbit Week 5 Solutions

Monday, October 31, 2022 3:06 PM

Individual Quizbit 4

PH201, Fall 2022

You are encouraged to discuss these questions with others, but those conversations need to be only in words. Please do not write down steps for others, draw pictures, show math steps, or consult online resources. Any work shown here should be your own thoughts and not copied from any source. You will be graded on the clarity of how well you communicate your steps and reasoning, not on absolute correctness. Hand write your solutions (paper or tablet) and turn your work into Grad-escope.

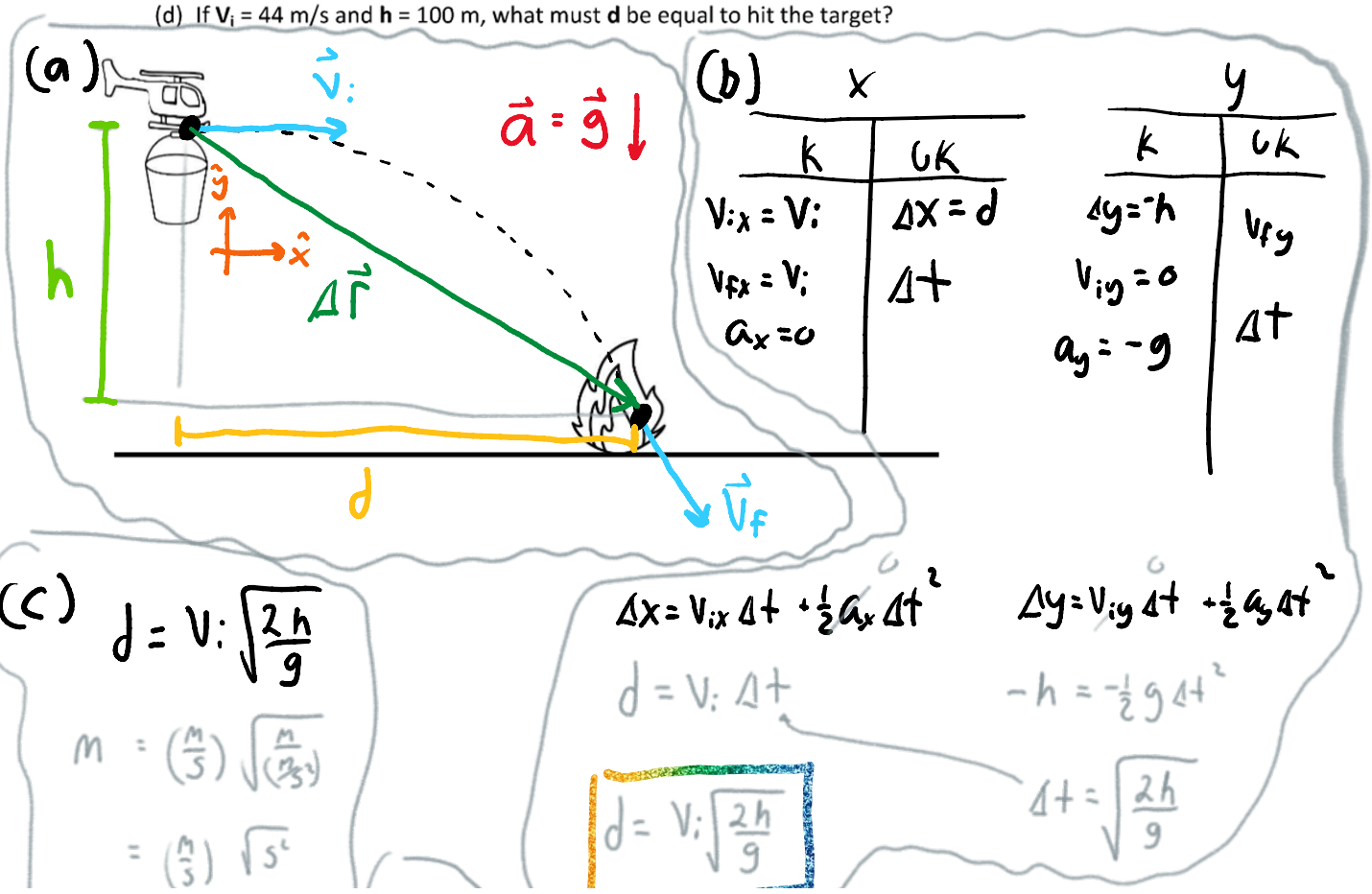
Problem Statement | Helicopters can be used to fight forest fires. One task they perform is to drop fire suppressant fluids on targeted hot spots. Consider a firefighting helicopter traveling horizontal with a constant speed $\mathbf{V_i}$. It flies at a vertical distance **h** above the ground. You've been tasked by the crew to calculate the horizontal distance **d** away from the fire, from which you must release the fluids to hit the fire. Assume air resistance is negligible.

(a) Draw a physical representation for this situation. Be sure to include representations of your coordinate system, the initial and final velocity, displacement, and acceleration of the dropped fluid.

(b) Find an equation for **d** in terms of $\mathbf{V_i}$, **h**, and **g**. This equation should have no numbers except for a number 2 from one of the equations used to construct it.

(c) Use Dimensional Analysis (or unit analysis) sensemaking to determine if your expression in part (b) is plausible.

(d) If $\mathbf{V_i}$ = 44 m/s and **h** = 100 m, what must **d** be equal to hit the target?



$= \left(\frac{m}{3}\right)\sqrt{5^2}$

$= \left(\frac{m}{3}\right)(5)$

$m = m$ ✓

$d = V_i\sqrt{\frac{2h}{g}}$

$\Delta t = \sqrt{\frac{2h}{g}}$

(d)

$d = (44)\sqrt{\frac{2\cdot 100}{9.8}} = 199\ m$

Group Quizbit 4

PH201, Fall 2022

You will be working with your group to create a single solution for these questions. You are encouraged to think about the questions beforehand, and discussing with your classmates is encouraged, but do not bring a solution to your group's working session. You are working to develop a shared solution, with the input and problem solving skills of all your group members. You will be graded on both the clarity of how well you communicate your steps and reasoning, and on absolute correctness.

Problem Statement | A small 2000-kg cargo ship, deep in outer space (i.e. no interactions with anything external), is traveling at a constant 1.20 km/s in the positive x-direction.

(a) What is net force acting on the cargo ship while it travels at a constant speed? Explain your reasoning.

(b) All of the sudden, the thrusters unexpectedly engage, providing the ship a net force equal to <-40.0 kN, -60.0 kN>. What is the acceleration of the ship when the thrusters are engaged?

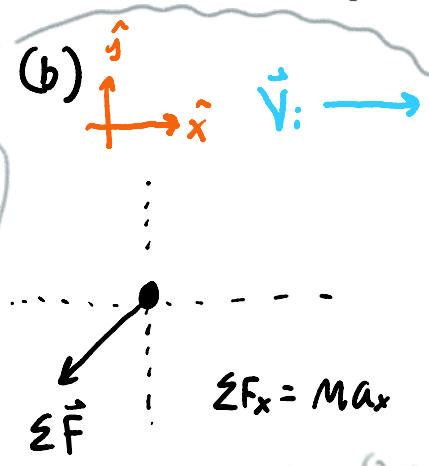
(c) If there are humans in the ship, would the acceleration felt by the occupants be survivable? Humans can sustain accelerations a few times larger than **g**, the free-fall acceleration. Explain your reasoning.

(a) $\Sigma\vec{F} = \vec{0}$

WITH A CONSTANT $\vec{V}$, THE $\vec{a} = \vec{0}$

SO THE $\Sigma\vec{F}$ MUST BE EQUAL TO $\vec{0}$

(b)



$\Sigma F_x = Ma_x$ $\Sigma F_y = Ma_y$

$-40000 = (2000)a_x$ $-60000 = (2000)a_y$

$a_x = -20\ m/s^2$ $a_y = -30\ m/s^2$

$\vec{a} = \langle -20, -30\ m/s^2 \rangle$

(c)

$|\vec{a}| = \sqrt{20^2 + 30^2}$

$a = 36.1\ m/s^2$

$a = 36.1\ m/s^2 \cdot \frac{1g}{9.8\ m/s^2}$

$a = 3.7\ g$