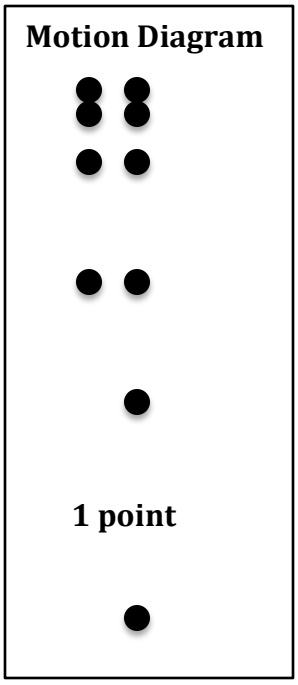
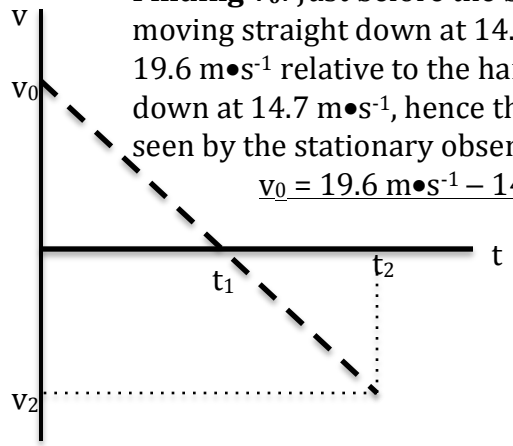
PHYS 1211, QUIZ 2, September 22, 2017

NAME: ID:

A helicopter is **descending straight** at **constant speed** of 14.7 m•s^{-1}. When it is at 1000m above ground the pilot (in the helicopter) throws a **ball straight up** at 19.6 m•s^{-1}, (speed is) **relative** to **his hand**. An **observer** on the **ground records** the event.

A) In panel below draw a **motion diagram** of the **ball**, as seen by the observer, from the time the pilot **first threw** the ball **till 1.5 seconds later**. Use information above, and 1d kinematic equation to determine, v_0, t_1, v_2, t_2, in plot (dashed line).





Finding v_0: Just before the ball is thrown, it is moving straight down at 14.7 m•s^{-1}. It is thrown at 19.6 m•s^{-1} relative to the hand, which is moving down at 14.7 m•s^{-1}, hence the initial velocity, as seen by the stationary observer on the ground is:

$v_0 = 19.6\ m\bullet s^{-1} - 14.7\ m\bullet s^{-1} = 4.9\ m\bullet s^{-1}$

1 point

Finding t_1: Use the 1D kinematic equation for **free-fall**, $v = v_0 - gt_1$, where it is clear from the **plot** that at this time $v = 0 \rightarrow 0 = v_0 - gt_1 \rightarrow t_1 = 4.9 m\bullet s^{-1} \div 9.8 m\bullet s^{-2} = 0.5 s$

1 point

Finding t_2: It is stated in the text above "…as seen by the observer, from the time the pilot **first threw** the ball **till 1.5 seconds later**". This **implicitly implies** that **t_2 = 1.5s**.

1 point

Please note that sometime you must infer physics data from "laymen" language.

Finding v_2: Use $v = v_0 - gt_2, t_2 = 1.5 s \rightarrow v = 4.9 m\bullet s^{-1} - \left(9.8 m\bullet s^{-2}\right)\left(1.5 s\right) = -9.8 m\bullet s^{-1}$.

The negative (–) sign means that the **direction** of the **velocity** is **down**.

1 point

B) Let the initial vertical position of the **ball** be y_0 = 1000m. Use **1d kinematic equations** to calculate **position** y, at 1.5 seconds later. Use **graphical integration** to calculate y 1.5 seconds after it was first thrown. You must **show work**!

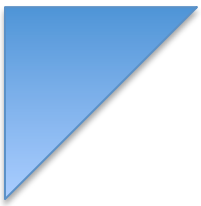
Use equation $y - y_0 = v_0 t - \frac{1}{2} g t^2 = \left(4.9 m \bullet s^{-1}\right)\left(1.5 s\right) - \frac{1}{2}\left(9.8 m \bullet s^{-2}\right)\left(1.5 s\right)^2$

$y - y_0 = -3.675 m \rightarrow y = 1000 m - 3.675 m = 996.3 m$ **1 point**

There was an error in the original handout where it was written $y_0 = 0$, in which case it is also acceptable to write $y = -3.675 m$.

Now use graphical method

2 points

$y - y_0 = \int_0^{1.5 s} v\, dt =$ Height1  base1 – Height2  base2

From part A, it is clear that

$\text{Height1} = 4.9 m \bullet s^{-1}$

$\text{base1} = 0.5 s$ **1 point**

$\text{Height2} = 9.8 m \bullet s^{-1}$

$\text{base2} = 1.0 s$

This part contribute negatively (–), since it is below the horizontal axis

$y - y_0 = \frac{1}{2}\text{Height1} \times \text{base1} - \frac{1}{2}\text{Height2} \times \text{base2}$

$y - y_0 = \frac{1}{2} 4.9 m \bullet s^{-1} \times 0.5 s - \frac{1}{2} 9.8 m \bullet s^{-1} \times 1.0 s = -3.675 m$ **1 point**