Quiz 2

Name: _____ Student Number: _____

1. (4 marks) $\vec{x} = (2, a)$ $\vec{y} = (b, 3)$

a) Solve for a and b if $2\vec{x} + 5\vec{y} = \vec{0}$

$2(2, a) + 5(b, 3) = (0, 0)$

$(4, 2a) + (5b, 15) = (0, 0)$

$(4 + 5b, 2a + 15) = (0, 0)$

Equating $\hat{x}$ components $\Rightarrow$ $4 + 5b = 0$

$b = \frac{-4}{5}$

Equating $\hat{y}$ components $\Rightarrow$ $2a + 15 = 0$

$a = \frac{-15}{2}$

b) Find the lengths of $\vec{x}$ and $\vec{y}$.

$|\vec{x}| = |(2, a)|$

$= \sqrt{2^2 + a^2}$

$= \sqrt{2^2 + \left(\frac{15}{2}\right)^2}$

$= \sqrt{4 + \frac{225}{4}}$

$= \frac{\sqrt{241}}{2}$

$|\vec{y}| = \sqrt{b^2 + 3^2}$

$= \sqrt{\left(\frac{4}{5}\right)^2 + 3^2}$

$= \sqrt{\frac{16}{25} + 9}$

$= \frac{\sqrt{241}}{5}$

2. (6 marks) Consider a game of baseball where the x axis extends along the line connecting the batter at the origin and first base at 50 meters away. The y axis is the height of the ball above the ground. Suppose a batter hits a ball traveling in the x direction such that

$$x = 20\,t$$

$$y = 20\,t - 5t^2$$

a) When does the ball hit the ground?

$0 = y$

$= 20t - 5t^2$

$= 5t(4 - t)$

$\therefore t = 0, 4$

$\therefore$ ball hits ground in 4 seconds.

b) Where does the ball hit the ground?

$x(t=4) = 20 \times 4$

$= 80$ m.

$\therefore$ ball hits ground 80m from home plate.

c) What distance does the first baseman need to run to catch the ball? Assume the player is very short and catches ball at ground level.

Distance for first baseman

$= 80 - 50$

$= 30\ m$

d) What is the average speed of the first baseman?

Average speed to catch ball

$= \frac{30\ m}{4\ sec}$

$= 7.5\ m/sec$

Total = 10 marks