Physics 2A
Fall 2024

ave. = 6.0
σ = 3.1

Name Answer Key

Lab: early late (circle one)

Quiz #3: Vectors and Motion in Two Dimensions

Problem 1 (2 points)
A girl kicks a soccer ball with an initial velocity of 15 m/s at an angle of 30°. Which one of the following statements is true?

$(v_x)_i = (15\ m/s)\cos 30°$

$(v_y)_i = (15\ m/s)\sin 30°$

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a) The horizontal component of the ball's initial velocity is 15 m/s.
b) The vertical component of the ball's initial velocity is zero.
c) The vertical component of the ball's velocity remains constant during the ball's flight. → false
d) The horizontal component of the ball's velocity is zero at the ball's highest point.
e) none of the above

$v_y = 0\ m/s$

$v_x = (v_x)_i$

Problem 2 (4 points)
Find the magnitude and direction of $\vec{A} - \vec{B}$. Vector $\vec{A}$ has components $A_x = 5.0$ m and $A_y = -2.0$ m. Vector $\vec{B}$ has components $B_x = -7.5$ m and $B_y = 4.0$ m.

let $\vec{C} = \vec{A} - \vec{B}$

$C_x = A_x - B_x = 5.0\ m - (-7.5\ m) = 12.5\ m$

$C_y = A_y - B_y = -2.0\ m - 4.0\ m = -6.0\ m$

$C = \sqrt{C_x^2 + C_y^2} = \sqrt{(12.5\ m)^2 + (-6.0\ m)^2} = 13.9\ m$

$\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{-6.0\ m}{12.5\ m}\right)$

$\theta = -25.6°$ or $334°$

Problem 3 (5 points)
A football is kicked upward from the ground with an initial velocity of 25.0 m/s at an angle of 35.0° above the horizontal. **(a)** How long a time does it take for the ball to reach its maximum height? **(b)** What is the ball's maximum height? **(c)** What is the ball's speed at its maximum height?

$(v_x)_i = (25.0\,m/s)\cos 35.0^\circ = 20.5\,m/s$

$(v_y)_i = (25.0\,m/s)\sin 35.0^\circ = 14.3\,m/s$

y_i	y_f	$(v_y)_i$	$(v_y)_f$	a_y	Δt
0 m	?	14.3 m/s	0 m/s (highest point)	$-9.80\,m/s^2$	?

(a) $(v_y)_f = 0 = (v_y)_i + a_y \Delta t \longrightarrow \Delta t = \dfrac{-(v_y)_i}{a_y}$

$\Delta t = \dfrac{-(14.3\,m/s)}{-9.80\,m/s^2} \longrightarrow \boxed{\Delta t = 1.46\,s}$

(b) $y_f - y_i = (v_y)_i \Delta t + \frac{1}{2} a_y (\Delta t)^2$ ($y_i = 0$)

$y_f = (14.3\,m/s)(1.46s) + \frac{1}{2}(-9.80\,m/s^2)(1.46s)^2$

$\boxed{y_f = 10.4\,m}$

(c) $v_{min} = (v_x)_i = \boxed{20.5\,m/s}$