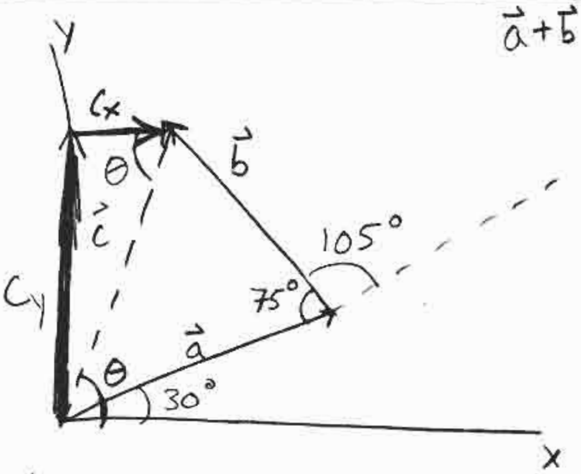
Ch 3 - 21, 26

Ch 4 - Q → 3, 4, 6 P → 15, 18, 28, 36, 37

#21

$\vec{a} + \vec{b} = c$

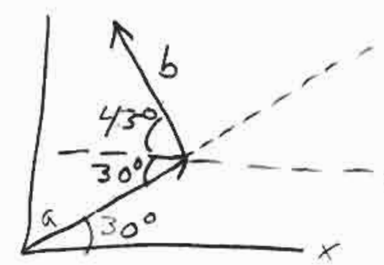


$a_x = a \cos 30°$

$a_y = a \sin 30°$

$|a| = 10m$

The angle b makes with x is $75° - 30° \rightarrow$
$= 75°$



So $b_x = -b \cos 45$

$b_y = b \sin 45$ $|b| = 10m$

So a) $C_x = a_x + b_x = a \cos 30 - b \cos 45 = \underline{1.59m}$

b) $C_y = a_y + b_y = a \sin 30 + b \sin 45 = \underline{12.07m}$

c) So $|C|$ is given by $c^2 = c_x^2 + c_y^2 \Rightarrow C = \sqrt{c_x^2 + c_y^2} = \underline{12.17m.}$

d) now its angle is given by

$$\tan \theta = \frac{c_y}{c_x} \Rightarrow \underline{\theta = 82.5°}$$

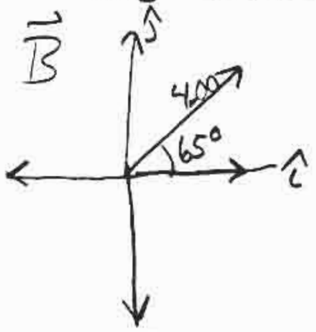
26

$\vec{A} = 2.00m\,\hat{i} + 3.00m\,\hat{j}$ $\vec{B} = 4.00m$ @ $65.0°$

$\vec{C} = -4.00m\,\hat{i} - 6.00m\,\hat{j}$ $\vec{D} = 5.00m$ @ $-235°$

So it's easiest to turn $\vec{B}$ + $\vec{D}$ into Unit-vector notation first

$\vec{B}$

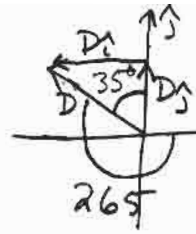


$B_{\hat{i}} \Rightarrow \cos 65 = \frac{B_{\hat{i}}}{B} = (B)\cos 65 = B_{\hat{i}} \Rightarrow B_{\hat{i}} = 1.69m$

$B_{\hat{j}} \Rightarrow \sin 65 = \frac{B_{\hat{j}}}{B} = (B)\sin 65 = B_{\hat{j}} \Rightarrow B_{\hat{j}} = 3.63m$

26 (cont) $\vec{D}$

$|D| = 5.00\,m$



$D_{\hat{i}} = D\sin 35° = -2.87\,m = D_{\hat{i}}$

$D_{\hat{j}} = D\cos 35° = 4.10\,m = D_{\hat{j}}$

now we'll say $\vec{A} + \vec{B} + \vec{C} + \vec{D} = \vec{G}$ G is just a generic term for the resulting vector

So

$G_{\hat{i}} = A_{\hat{i}} + B_{\hat{i}} + C_{\hat{i}} + D_{\hat{i}} \Rightarrow (2.00m) + 1.69m - 4.00m - 2.87m = -3.18m$

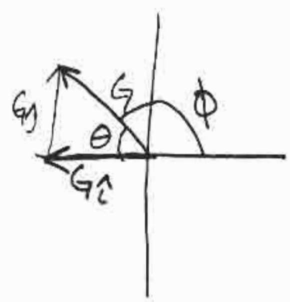
$G_{\hat{j}} = A_{\hat{j}} + B_{\hat{j}} + C_{\hat{j}} + D_{\hat{j}} \Rightarrow 3.00m + 3.63m - 6.00m + 4.10m = 4.73m$

So $\vec{G} = (-3.18)\hat{i} + 4.73\hat{j}$

b) So $G_{\hat{i}}$ + $G_{\hat{j}}$ are Perpindicular Componants of a right triang.

$|G|^2 = G_{\hat{i}}^2 + G_{\hat{j}}^2 \Rightarrow G = \sqrt{G_{\hat{i}}^2 + G_{\hat{j}}^2} = G = 5.70\,m$

c)



$\phi = 180° - \theta$ (phi, ϕ, is what we want)

$\tan\theta = \frac{|G_{\hat{j}}|}{|G_{\hat{i}}|} \Rightarrow \theta = 56.09°$ So

$\vec{G}$: 5.70m @ 123.9°

Chapter 4

Q3) greatest (a), (b), (c) → least speed

Q4) Yes. The highest point in a tragectory will be when $V_{\hat{j}} = 0$, after that the ball goes down ($V_{\hat{j}} < 0$)

Q6) $\vec{V}_f$ (at y = 2m above ground) $= (2\hat{i} - 4\hat{j})\,m/s$

Reason: $V_{fx} = V_{ox} + \cancel{a_x}^{0} t \Rightarrow \underline{V_{fx} = V_{ox}}$

y) $\cancel{\Delta y}^{0} = V_{oy}t + \frac{1}{2}a_y t^2 \Rightarrow$

$-V_{oy} = \frac{1}{2}a_y t$

$t = -\frac{2V_{oy}}{a_y}$

$V_{fy} = V_{oy} + a_y t$

$V_{fy} = V_{oy} - \cancel{a_y}\left(\frac{2V_{oy}}{\cancel{a_y}}\right)$

$V_{fy} = V_{oy} - 2V_{oy}$

$\underline{V_{fy} = -V_{oy}}$

15) So $\Delta x = 29m.$ $a_x = 4.0 m/s^2$

$V_{oy} = 8.0\, m/s$ $a_y = 2.0 m/s^2.$

$V_{ox} = 0 m/s$

a) let's find how long it took the particle to move 29m ?

$$\Delta x = \cancel{V_{ox}}^{0} t + \tfrac{1}{2} a_x t^2 \Rightarrow \Delta x = \tfrac{1}{2} a_x t^2 \Rightarrow t = \sqrt{\frac{2\Delta x}{a_x}} = 3.81 s$$

now $\Delta y = V_{oy} t + \tfrac{1}{2} a_y t^2 \Rightarrow \Delta y = 8 m/s (3.81 s) + \tfrac{1}{2}(2.0 m/s^2)(3.81 s)^2$

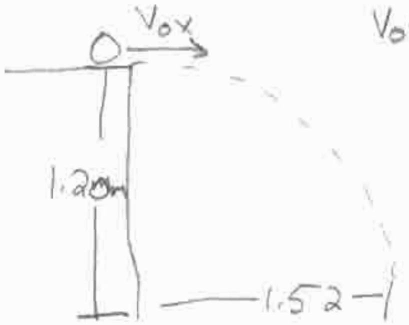
$$\underline{\Delta y = 44.96 m}$$

b) $V_{fx} = \cancel{V_{ox}}^{0} + a_x t \Rightarrow V_{fx} = (4.0 m/s^2)(3.81 s) = 15.24 m/s$

$V_{fy} = V_{oy} + a_y t = \;\; V_{fy} = (8.0 m/s) + (2 m/s^2)(3.81 s) = 15.62 m/s$

$$|V|^2 = V_{fx}^2 + V_{fy}^2 \Rightarrow V = \sqrt{V_{fx}^2 + V_{fy}^2} = \underline{21.82 m/s^2}$$

18)



$V_{oy} = 0 m/s$

$a_y = +9.81 m/s^2$

$\Delta x = 1.52 m$

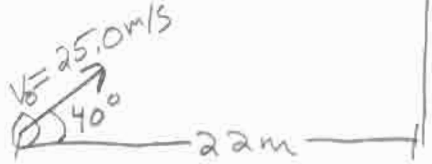
$\Delta y = 1.20 m$

a) $\Delta y = \cancel{V_{oy}}^{0} t + \tfrac{1}{2} a_y t^2$

$\sqrt{\frac{2\Delta y}{a_y}} = t \Rightarrow t = .495 s$

b) $\Delta x = V_{ox} t + \tfrac{1}{2} \cancel{a_x}^{0} t^2 \Rightarrow \frac{\Delta x}{t} = V_{ox} = 3.07 m/s$

28)



$V_{ox} = V_0 \cos 40° = 19.15 m/s$

$V_{oy} = V_0 \sin 40° = 16.07 m/s$

a) $\Delta x = V_{ox} t + \tfrac{1}{2} \cancel{a_x}^{0} t^2$ $\Delta x = V_{ox} t \Rightarrow t = \frac{\Delta x}{V_{ox}} = \frac{22 m}{19.15 m/s} \Rightarrow$

$t = 1.15 s$

$\Delta y = V_{oy} t + \tfrac{1}{2} a_y t^2 = (16.07 m/s)(1.15 s) + \tfrac{1}{2}(9.81 m/s^2)(1.15 s)^2 = 25.0 m$

b) $V_{fx} = V_{ox} + \cancel{a_x}^{0} t = V_{fx} = V_{ox} = 19.15 m/s$

$V_{fy} = V_{oy} + at = 16.07 m/s - 9.81 m/s^2 (1.15 s) = 4.79 m/s$

c) no. The ball is still travelling up (positive y-velocity)

$V_{ox} = V \cos 45 = 13.79 m/s$

$V_{oy} = V \sin 45 = 13.79 m/s$

36)

So we'll find how long the ball is in the air

$\Delta y = V_{oy} t + \frac{1}{2} a_y t^2 \quad \Delta y = 0 \Rightarrow \quad 0 = V_{oy} \cancel{t} + \frac{1}{2} a_y t^{\cancel{2}} \Rightarrow$

$-V_{oy} = \frac{1}{2} a_y t \Rightarrow t = \frac{-2V_{oy}}{a_y} = 2.81$

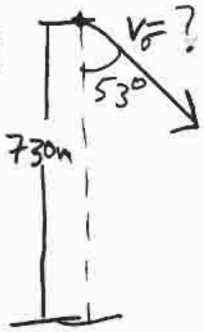
now $\Delta X = V_{ox} t + \frac{1}{2} \cancel{a_x}^{0} t^2 \Rightarrow \Delta x = V_{ox} t \Rightarrow \Delta x = (13.79 m/s)(2.81 s)$

$\Delta x = 38.75 m$

So the soccer player must move $\Delta x'$ (38.75m − 55m) in the same amount of time (t) in order to meet the ball

$\Delta x' = V_{ox}' t + \frac{1}{2} \cancel{a_x}^{0} t \Rightarrow V_{ox}' = \frac{\Delta x'}{t} = \frac{-16.25 m}{2.81 s} = \underline{-5.78 m/}$

37)



a) $\Delta y = V_{oy} t + \frac{1}{2} a t^2 \Rightarrow \Delta y - \frac{1}{2} a t^2 = V_{oy} t \Rightarrow$

$\frac{\Delta y}{t} - \frac{1}{2} a t = V_{oy} = \frac{730 m}{5 s} - \frac{1}{2}(9.81 m/s^2)(5 s) = V_{ox} = 12$

So $\cos 53° = \frac{V_{oy}}{V_o} \Rightarrow V_o = \frac{121.5 m/s}{\cos 53} = \underline{202 m/s}$

b) $\Delta x = V_{ox} t + \frac{1}{2} a_x t^2 \Rightarrow \Delta x = V_{ox} t \qquad V_{ox} = V \sin 53 = 161. m/s$

$\Delta x = (161 m/s)(5 s) = \underline{805 m}$

c) $V_{fx} = V_{ox} + \cancel{a_x}^{0} t \qquad V_{fx} = V_{ox} = 161 m/s$

d) $V_{fy} = V_{oy} + a_y t = \quad V_{fy} = 121.5 m/s + 9.81 m/s^2 (5 s) = 171 m/s$