Phys 13 - Giancoli Ch 3, 4, 6 - week 2 (due week 3)

Ch 3 - Finish from last week + 24, 56, 62

Ch 4 - Newton's Laws - 5, 21, 34, 40, 72, 55 (not 22)

next week

Ch 6 - Candidate Q: 4, 6, 8, 11, 13, 14, 18

p. 152 : 22, 27, 28, 36, 38

p. 153 : 42, 47, 53, 54, 57, 59

p. 154 : 60, 62

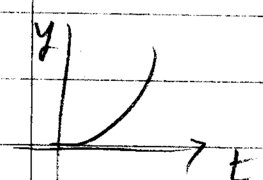
Ch 3

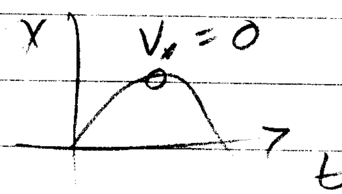
24. (II) A particle starts from the origin at $t = 0$ with an initial velocity of 5.0 m/s along the positive x axis. If the acceleration is $(-3.0\mathbf{i} + 4.5\mathbf{j})\ \mathrm{m/s^2}$, determine the velocity and position of the particle at the moment it reaches its maximum x coordinate.

$V_o = V_{x_0} = 5\ \frac{m}{s}$

$a_x = -3\ m/s^2$

$a_y = 4.5\ m/s^2 = 4\frac{1}{2} = \frac{8}{2} + \frac{1}{2} = \frac{9}{2}\ m/s^2$





$V_{y_0} = 0$

$y(t) = \frac{1}{2} a_y t^2$

$V_y(t) = \frac{dy}{dt} = \frac{1}{2}(2 a_y t)$

$V_y(t) = a_y t$

$x(t) = V_o t + \frac{1}{2} a_x t^2$

$V_x(t) = \frac{dx}{dt} = V_o + a_x t$

At peak, $V_x(t) = 0 = V_o + a_x t$

At peak, $t = -\frac{V_o}{a_x} = \frac{-5\ m/s}{-3\ m/s^2} = \frac{5}{3}\ s$

$V_y(t = \frac{5}{3}\ s) = a_y t = \left(\frac{9}{2}\ \frac{m}{s^2}\right)\left(\frac{5}{3}\ s\right) = 3 \cdot \frac{5}{2} = 7.5\ m/s = V_{peak}$

Position at peak: $x = 5\ \frac{m}{s}\left(\frac{5}{3} s\right) + \frac{1}{2}\left(-3\ \frac{m}{s^2}\right)\left(\frac{5}{3} s\right)^2 = \underline{4.2}\ m$

$y = \frac{1}{2} a_y t^2 = \frac{1}{2}(4.5\ m/s^2)(5/3\ s)^2 = \underline{6.3}\ m$

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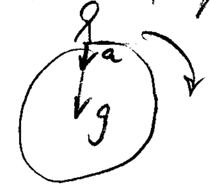
Looking down on N pole



(56) (II) Because the Earth rotates once per day, the effective acceleration of gravity at the equator is slightly less than it would be if the Earth didn't rotate. Estimate the magnitude of this effect. What fraction of g is this?

$a = \frac{v^2}{R}$ $\quad v = \frac{2\pi R}{T}$ $T = 1\,\text{day}$ $\quad a = \frac{\left(\frac{2\pi R}{T}\right)^2}{R} = \frac{4\pi^2 R}{T^2}$

If Not spinning: Weight $= mg$ $\quad T = 1\,\text{d} \,\Big|\, \frac{24\,\text{hr}}{\text{d}} \,\Big|\, \frac{3600\,\text{s}}{\text{hr}} \,\Big|$

$T = 8.64 \times 10^4\ \text{s}$

If spinning: part of g contributes to a: $W' = mg'$

$g' = g - a$

$a = \frac{4\pi^2 R}{T^2} \approx \frac{40\,(6.4 \times 10^6\,\text{m})}{(8.64 \times 10^4\ \text{s})^2} = 0.038\ \frac{\text{m}}{\text{s}^2}$

At the equator, effective gravity is less:

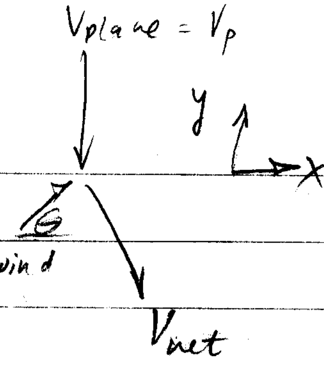
$g' = 9.8\,\frac{\text{m}}{\text{s}^2} - 0.038\,\frac{\text{m}}{\text{s}^2} \approx g$

Too small to notice an effect: $\frac{\Delta g}{g} = \frac{0.038}{9.8} \approx 0.3\%$

(62) (II) An airplane is heading due south at a speed of 550 km/h. If a wind begins blowing from the southwest at a speed of 90.0 km/h (average), calculate: (*a*) the velocity (magnitude and direction) of the plane, relative to the ground, and (*b*) how far off course it will be after 12.0 min if the pilot takes no corrective action. [*Hint*: First draw a diagram.]

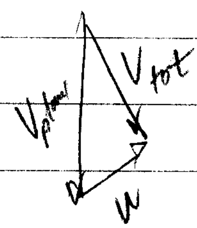
$V_p =$ south

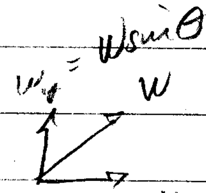
$W =$ 90.0 km/h



$\vec{V}_{net} = \vec{V}_{plane} + \vec{W}$

(a)





$\cos\theta = \cos 45^\circ = \frac{\sqrt{2}}{2} = \sin\theta$

$W_x = W_y = \frac{\sqrt{2}}{2} W = \frac{\sqrt{2}}{2}\left(90.0 \frac{km}{hr}\right) = \underline{63.6 \frac{km}{hr}}$

$V_{net_x} = 0 + W_x = \underline{63.6} \frac{km}{hr}$ EAST

$V_{net_y} = -V_{plane} + W_y = -550 \frac{km}{hr} + \underline{63.6} \frac{km}{hr}$

$= + \underline{486} \frac{km}{hr}$ SOUTH

$V_{net} = \sqrt{V_{net_x}^2 + V_{net_y}^2} = \underline{490} \ km/hr$ (SLOWER)

(b) After 12 min, plane should have been at $r_0 = V_p t$

but it's actually at

$\phi = \tan^{-1}\left(\frac{V_{net\,y}}{V_{net\,x}}\right) = 8^\circ$

$\vec{r}_{net} = \vec{V}_{net}\, t$

$t = 12\ min \left| \frac{hr}{60 min} \right| = \frac{1}{5}\ hr$

$r_0 = 550 \frac{km}{hr} \cdot \frac{1}{5}\ hr = 110\ km$ due SOUTH

$\vec{r}_{net} = \vec{V}_{x_{net}}\, t + \vec{V}_{y_{net}}\, t$ where $V_{x_{net}} t = W_x t = \underline{63.6} \frac{km}{hr} \frac{1}{5} hr = \underline{12.7} \ km$ EAST TOO FAR

and $V_{y_{net}} t = \left(486 \frac{km}{hr}\right) \frac{1}{5} hr = \underline{97}$ km SOUTH NOT FAR ENOUGH

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