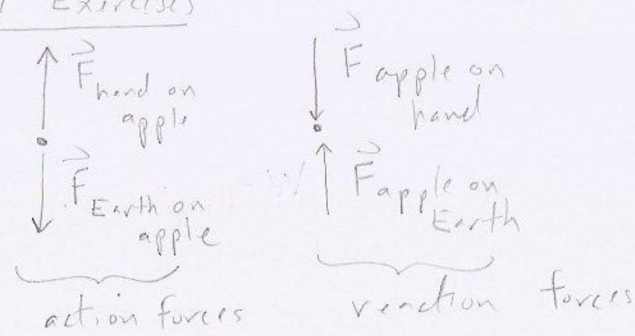
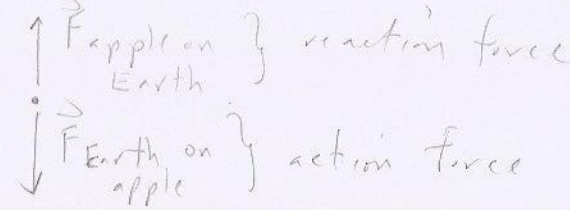
PHY 101 HW 2 Solutions

Chapter 4 Exercises

17) a)



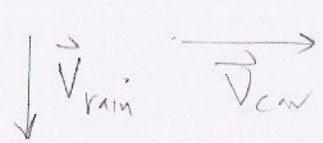
b)



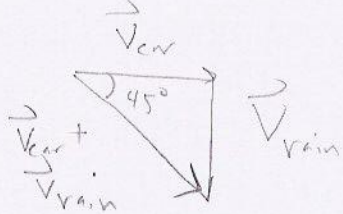
18) The forces on an object determine it's acceleration. In 17b, the only force (neglecting air resistance) on a free-falling object is gravity ($\vec{F}_{Earth\ on\ object}$), which is given by $m\vec{g} = \vec{F}_{E\ on\ object} = \vec{F}_g = \vec{W}$. Newton's 2nd law tells us that $\vec{F}_{tot} = m\vec{a}$, or $\vec{a} = \frac{\vec{F}_{tot}}{m} = \frac{\vec{W}}{m} = \frac{m\vec{g}}{m}$ for a freely falling object, i.e. the acceleration does not depend on the mass.

25) By Newton's third law, the force exerted on each cart will be equal in magnitude and opposite in direction. However, since their masses are different, the acceleration of the larger cart will be half the amount of the smaller cart.

42)

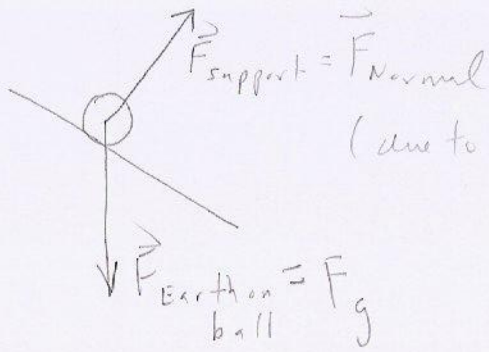


add them together vectorially to get

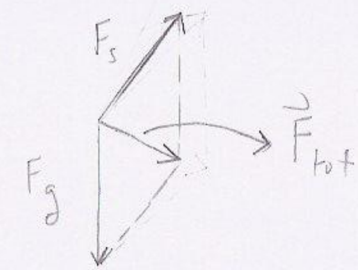


Using $\tan\theta = \tan(45^\circ) = \frac{\vec{V}_{rain}}{\vec{V}_{car}} = 1$.

48)



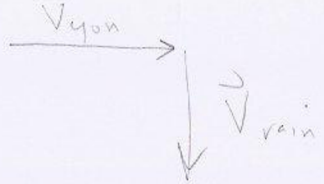
So $\vec{F}_{support}$ and $\vec{F}_g = \vec{F}_{Earth\ on\ ball}$ are the only two forces on the ball. F_{Normal} is normal to the surface and F_g is always straight down. The vector sum determines the ball's $m\vec{a}$.

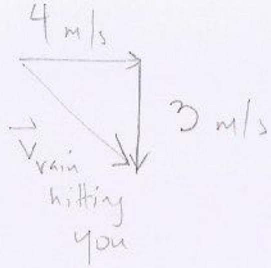


Chapter 4 Problems

2) The total force on the box is $20N - 12N = 8N$. Remember friction opposes your pushing. Using Newton's Second law, $\vec{F}_{tot} = m\vec{a}$, $\vec{a} = \frac{8N}{2kg} = 4\ m/s^2$.

10) The wall pushes back on you w/ a strength of 30N. Using Newton's Second law, $\vec{F}_{tot} = m\vec{a}$, $\vec{a} = \frac{30N}{60kg} = .5\ m/s^2$. This calculation neglects friction.

11) 

$\Rightarrow$ 

Using $|\vec{V}_{\text{rain hitting you}}|^2 = |\vec{V}_{you}|^2 + |\vec{V}_{rain}|^2$

$$|25\,m/s|^2 = 16\,m^2/s^2 + 9\,m^2/s^2$$

$$\Rightarrow |\vec{V}_{\text{rain hitting you}}| = 5\,m/s$$

15) a) The total force on Phil + rocket is F_{tot} and that force doesn't change when Zephrem is added, so

$$F_{tot} = Ma = (M+m)A \Rightarrow A = \frac{M}{(M+m)}a \text{, where}$$

M is the mass of Phil + rocket, m is mass of Zephrem and a = acceleration of Phil + rocket initially.

b) $A = \frac{70\,kg}{(45\,kg + 70\,kg)}(3.6\,m/s^2) = 2.2\,m/s^2$. For b) we just have to plug in some numbers.

<u>EC</u> Start w/ $-v_y = -gt = -4.5\,m/s \rightarrow t = \frac{4.5\,m/s}{9.8\,m/s^2} = \underline{0.46\,s}$. Now use $\Delta y = -\frac{1}{2}g(t)^2$, or $\Delta y = -\frac{1}{2}(9.8\,m/s^2)(0.46)^2 = \underline{1.0\,m}$. It turns out that $\frac{vV_t}{g}$ has units of m. If $v = V_t$, then the distance for the ping-pong ball is $\frac{V_t^2}{g} \rightarrow \frac{(9\,m/s)^2}{9.8\,m/s^2} = \underline{9.25\,m}$.