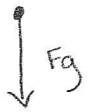
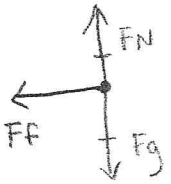
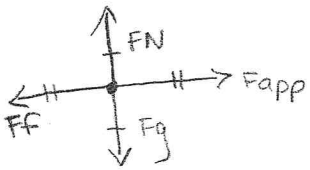
Mark:_____ / 20 **Name:** Anne Sikes

SPH3U Forces Quest

Free Body Diagrams

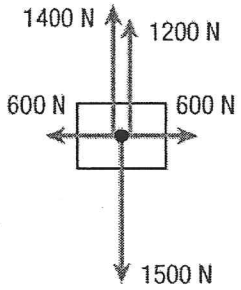
Draw an appropriate FBD for the underlined object. Include and label all forces acting on that object in the given situation, correctly show relative sizes of vectors, and indicate vectors of equal magnitudes with tick marks. In all cases you may ***ignore air friction****. [6]*

A baseball while it is on it's way up *after* being popped up vertically through the air.	A soccer ball rolling to the right on *rough grass after* being kicked.	A car moving at a constant speed of 100 km/h to the right.
		

Problems

Solve each problem. Show all work in organized, stepwise solutions. ***Remember to include directions!***

1. The following object has a mass of 320 kg. Determine the acceleration of the object. [4]



$F_{net} = 1400\,N + 1200\,N - 1500\,N$

$\vec{F}_{net} = 1100\,N\ [\uparrow]$

$\vec{F}_{net} = m\vec{a}$

$\frac{1100}{320} = \frac{320a}{320}$

$3.44 = a$

$\therefore\ \vec{a} = 3.44\ m/s^2\ [\uparrow]$

2. A student slides a box across the floor to his friend. The mass of the box is 25 kg and the coefficient of kinetic friction between the floor is 0.52. If the initial velocity of the box is 7.0 m/s how far will the box slide before it stops? [5]

Right → (+)

$F_N = F_g = 245\ N$

F_K

$F_g = mg$

$= 25(9.8)$

$= 245N$

$F_K = \mu_K F_N$

$= 0.52(245)$

$= 127.4\ N$

$\vec{F}_{net} = 127.4\ N\ [\leftarrow]$

$F_{net} = ma$

$\frac{127.4}{25} = \frac{25a}{25}$

$5.1 = a$

$\vec{a} = 5.1\ m/s^2\ [\leftarrow]$

$V_1 = +7.0\ m/s$

$V_2 = 0$

$a = -5.1\ m/s^2$

$\Delta d = ?$

$\Delta t =$

$V_2^2 = V_1^2 + 2a\Delta d$

$0 = 7^2 + 2(-5.1)(\Delta d)$

$-49 = -10.2\,\Delta d$

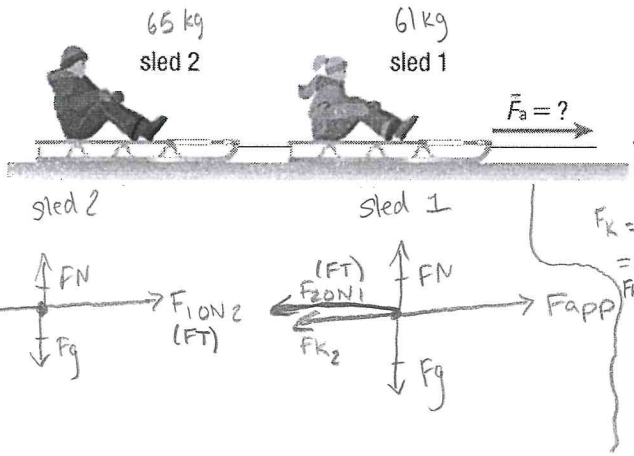
$\frac{-49}{-10.2} = \frac{-10.2\,\Delta d}{-10.2}$

$4.8 = \Delta d$

$\therefore \Delta d = 4.8\ m$

3. A mom is pulling her son and daughter who are sitting in two sleds that are connected by a rope. The mass of the girl and sled 1 is 61 kg, the mass of the boy and sled 2 is 65 kg. The mom is pulling so that the sleds accelerate at a rate of 0.42 m/s^2 and the coefficient of kinetic friction between the sleds and the ice is 0.22.

a) What is the force with which the mom is pulling? [3]



126 kg system

$F_N = F_g = 1234.8N$

Fapp

F_{K_3}

$F_g = mg$

$F_K = \mu_K F_N = 126(9.8)$

$= 0.22(1234.8) = 1234.8N$

$F_K = 271.66N$

$F_{net} = ma$

$= 126(0.42)$

$F_{net} = 52.92N\ [\rightarrow]$

$F_{net} = F_{app} - F_K$

$52.92 = F_{app} - 271.66$

$324.58 = F_{app}$

$\therefore \vec{F}_{app} = 324.58\ N\ [\rightarrow]$

b) What is the tension between the sleds? [2]

sled 2

65kg

$F_N = F_g = 637\ N$

F_{K_1}

F_{1ON2} (FT)

$F_g = mg$

$= 65(9.8)$

$= 637N$

$F_K = \mu_K F_N$

$= 0.22(637)$

$= 140.14\ N$

$F_{net} = ma$

$= 65(0.42)$

$= 27.3\ N\ [\rightarrow]$

$F_{net} = F_T - F_K$

$27.3 = F_T - 140.14$

$F_T = 167.44\ N$

$\therefore F_T = 167.44\ N$

(Check)

sled 1

61 kg

$F_T = 167.44N$

$F_N = F_g = 597.8\ N$

F_T

F_K

$F_{app} = 324.58N$

$F_g = mg$

$= 61(9.8)$

$F_K = \mu_K F_N$

$= 0.22(597.8) = 597.8N$

$F_K = 131.52N$

$F_{net} = ma$

$= 61(0.42)$

$= 25.62N\ [\rightarrow]$ ✓

$F_{net} = F_{app} - F_T - F_K$

$= 324.58 - 167.44 - 131.$

$\vec{F}_{net} = 25.62\ N\ [\rightarrow]$ ✓