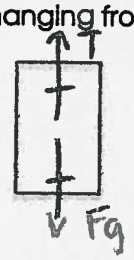
Forces Worksheet 1 (FBD's and Net Force)

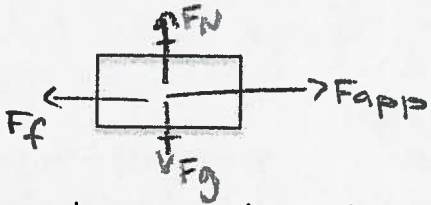
Name: Key

1) Draw a free body diagram to show the forces involved in the situations below.

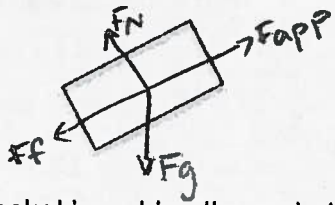
a) A holiday decoration is hanging from the ceiling by a light (massless) string.



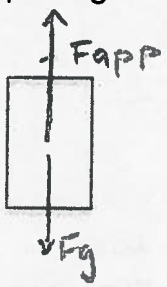
b) A child is pulling his younger brother in a sled on snow (friction is involved).



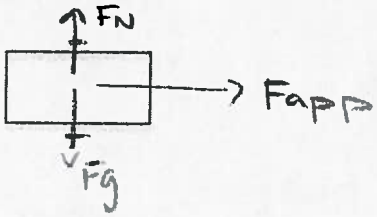
c) In order to move a piano, movers have set up a ramp. They are pulling the piano up the ramp, which is not frictionless. Draw the forces acting on the piano.



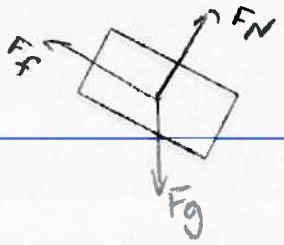
d) The engine of a rocket is pushing the rocket towards the sky.



e) A girl is pushing a box on a frictionless surface.



f) A box is sitting on a rough (friction) inclined plane.

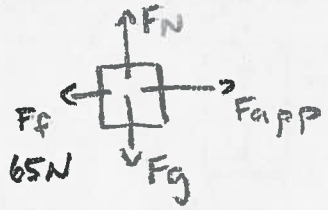


5) A student raises their 15 kg backpack from the floor at a constant velocity of 5.0 m/s. How much force must the student apply? $F = ma$

$F = 15(9.8)$

$= \boxed{150\ N}$

8) A 45 kg chimpanzee on a skateboard accelerates from rest to 13.0 m/s over a distance of 8.0 m. A force of friction of 65 N acts on the board. What force must the chimp apply?



$F_{net} = ma$

$F_{app} - F_f = ma$

$F_{app} = ma + F_f$ ← find!

$V_f = 13$, $V_i = 0$, $d = 8.0$, $a = ?$, $t =$

$V_f^2 = V_i^2 + 2ad$

$169 = 0 + 2(a)8$

$a = 10.6\ m/s$

$F_{app} = 45(10.6) + 65$

$= \boxed{540\ N}$

6) A physics teacher attaches a 4.0 kg brick to a light string (boy do you need a new hobby!) and pulls straight up on it. The brick accelerates upwards at 3.2 m/s^2. How much force did the teacher apply to the brick?

$F_g = 4(9.8)$

$= 39.2$

$F_{net} = ma$

$F = 4(3.2)$

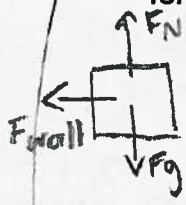
$= 12.8$

$F_T = 12.8 + 39.2$

$= \boxed{52\ N}$

9) A 1350 kg crash test car strikes a cement wall at 24.0 m/s and bounces back at 8.0 m/s.

a. If it is in contact with the wall for 0.90 s, what force did the wall exert on the car?



→ 24.0 m/s

← 8.0 m/

$F_{net} = ma$

$F_{wall} = ma$

$V_i = 24.0$, $V_f = -8.0$, $d = x$, $a = ?$, $t = .90$

$V_f = V_i + at$

$-8 = 24 + a(.9)$

$a = 35.6\ m/s^2$

$F_{net} = 1350(35.6)$

$= \boxed{4.8 \times 10^4\ N}$

7) A 75kg skydiver falls at terminal velocity (220 km/h) before pulling the chute. If she slows to 25 km/h in 3.8 s, determine the average force of air friction that acts on her during her deceleration.

$F_g = (75)(9.8)$

$= 735N$

$F_{net} = ma$

$F_{air} - F_g = ma$

$V_o = 220\ km/hr = 61.1\ m/s$

$V_f = 25\ km/hr = 6.94\ m/s$

$d = x$, $a = ?$, $t = 3.8$

$V_f = V_i + at$

$6.9 = 61 + a(3.8)$

$a = -14.25\ m/s^2$

$F_{air} = ma + F_g$

$= 75(14.25) + 735$

$= \boxed{1800N}$

b. If the same car had no crumple zones then it would only be in contact with the wall for 0.080 s. What force would the wall exert in this case?

$F_{wall} = ma$

$V_f = 8.0$, $V_i = 24.0$, $d = x$, $a = ?$, $t = 0.080s$

$V_f = V_i + at$

$8 = 24 + a(.08)$

$a = -400\ m/s^2$

$F_{wall} = ma$

$= 1350(400)$

$= \boxed{5.4 \times 10^5 N}$

1) 3400 N 2) 1800N 3) 350 N 4) a. 260 N b. 0.94 m/s^2 5) 150 N 6) 52 N 7) 1800N 8) 540 N 9)a 4.3×10^4 N b 5.4×10^5 N