Physics 20

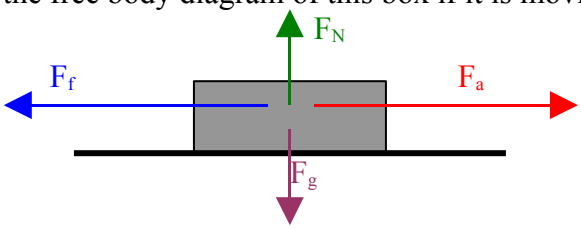
Chapter 5 Worksheet

1. **Determine** the force required to accelerate a 20kg cart from rest to 0.50m/s in 2.0s.

$a = (v_f - v_i) / t$
$= (0.50 - 0) / 2.0$
$a = 0.25\ m/s^2$

$F = ma$
$= (20)(0.25)$
$\mathbf{F = 5.0\ N}$

2. A 15.0kg box is sitting on the floor. The coefficient of static friction is 0.40 and the coefficient of kinetic friction is 0.30.
   a) **Sketch** the free body diagram of this box if it is moving.



   b) **Determine** if the box will move if I push with a force of 20N. If it does move, **determine** its acceleration.

$F_N = F_g = mg$
$= (15.0)(9.81)$
$F_N = 147\ N$

$F_f = \mu_s F_N$
$= (0.40)(147)$
$F_f = 59\ N$

Since the static friction can be ***as high as*** 59N, it will be 20N against this applied force and the box will not move at all.

   c) **Determine** if the box will move if I push with a force of 70N. If it does move, **determine** its acceleration.

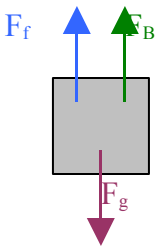
This applied force is more than the static friction maximum, so the box will be moving. We need to calculate the kinetic force of friction, to be able to get the net force. Then we can calculate the acceleration.

$F_f = \mu_k F_N$
$= (0.30)(147)$
$F_f = 44\ N$

$F_{NET} = F_a + F_f$
$= 70 + -44$
$F_{NET} = 26\ N$

$F_{NET} = ma$
$a = F_{NET} / m$
$= 26 / 15.0$
$a = 1.7\ m/s^2$

3. I have decided to try to learn how to swim again (I know, this must be some sort of delusion!). As soon as I get into the water I start to sink! I have a mass of 57.5kg. When I am in the water my body has a buoyancy of 412 N. I know that if my entire body is moving through the water, it feels a force due to friction of 34 N.



   a) **Determine** the net force acting on my body when I am in the water (a free body diagram might help). Be sure to give the direction!

$F_{NET} = F_g + F_f + F_B$
$= (57.5 * -9.81) + 34 + 412$
$F_{NET} = -118\ N$ [down]

   b) **Determine** my acceleration in the water. Be sure to give the direction!

$F_{NET} = ma$
$a = F_{NET} / m$
$= -118 / 57.5$
$a = -2.05\ m/s^2$ [down]

4. You are flipping through an old science book when you come across the following table:

Planet	***Acceleration Due to Gravity (m/s^2)***
Mercury	3.69
Venus	8.86
Earth	9.81
Moon	1.62
Mars	3.73
Jupiter	23.0
Saturn	11.4
Uranus	11.3
Neptune	11.7
Pluto	0.648

Looking across the room at your family cat, Mister Potato Head, you imagine what his mass and weight would be on each of the planets. You were told that he was 8.23 kg when you were at the vet last week. **Determine** the values for the second table.

Planet	***Mister Potato Head's Mass***	***Mister Potato Head's Weight***
Mercury	8.23 kg	30.4 N
Venus	8.23 kg	72.9 N
Earth	8.23 kg	80.7 N
Moon	8.23 kg	13.3 N
Mars	8.23 kg	30.7 N
Jupiter	8.23 kg	189 N
Saturn	8.23 kg	93.8 N
Uranus	8.23 kg	93.0 N
Neptune	8.23 kg	96.3 N
Pluto	8.23 kg	5.33 N

5. I am trying to weigh a fish on a scale while standing in a freight elevator. I find out later the fish has a true weight of 40N . **Determine** its apparent mass if the elevator accelerates…
   a) down at 2.00 m/s^2

$F_g = mg$
$m = F_g / g$
$= -40 / -9.81$
$m = 4.1$ kg

$F_{NET} = F_g + F_e$
$= mg + ma$
$= m (g + a)$
$= 4.1 (-9.81 + 2.00)$
$F_{NET} = -32$ N

$F_{NET} = mg$
$m = F_{NET} / g$
$= -32 / -9.81$
$m = 3.3$ kg

It will appear that the fish has a mass of 3.3kg. This is false and is only because of the acceleration of the elevator. Mass is a constant. The fish really has a mass of 4.1 kg.

   b) up at 2.00 m/s^2

$F_{NET} = F_g + F_e$
$= mg + ma$
$= m (g + a)$
$= 4.1 (-9.81 + -2.00)$
$F_{NET} = -48$ N

$F_{NET} = mg$
$m = F_{NET} / g$
$= -48 / -9.81$
$m = 4.9$ kg

It will appear that the fish has a mass of 4.9kg. This is false and is only because of the acceleration of the elevator. Mass is a constant. The fish really has a mass of 4.1 kg.