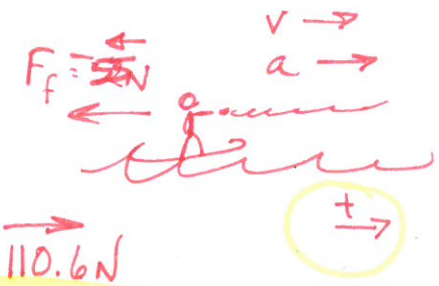
Worksheet: Newton's 2nd Law Name _____



1. A water skier has a mass of 79 kg and accelerates at 1.4 m/s^2.
   a. What is the net force acting on him? ($F_{net} = ma$)

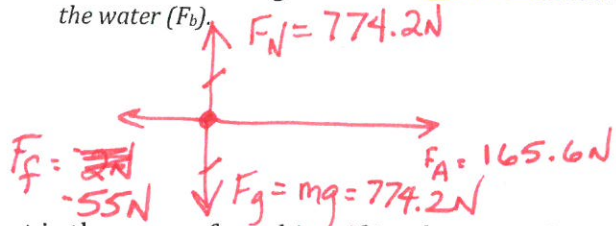
$m = 79kg$, $a = 1.4 m/s^2$ $F_{NET} = m\,a = (79kg)(1.4 m/s^2) = 110.6N$

   b. *If the water exerts a friction force (F_f) of 55 newtons on the skier, what is the applied force (F_A) from the ski boat? ($F_{net} = F_f + F_A$)

$F_{NET} = 110.6N$, $F_f = -55N$ $110.6N = -55N + F_A$

$F_A = 165.6N$

   c. Draw a force diagram for the skier. *Remember to include his weight (F_g) and the buoyant force from the water (F_b).*



2. What is the mass of an object if it takes a net force of 32 N to accelerate it at a rate of 0.88 m/s^2?

$F_{NET} = 32N$, $a = 0.88 m/s^2$ $F_{NET} = m\,a$ $32N = (m)\,0.88 m/s^2$ $m = 36.36 kg$

3. *What is the weight of the object in #2 if weight is calculated with this formula: $F_g = mg$ where $g = 9.8$ m/s/s

$m = 36.36 kg$, $g = 9.8 m/s^2$ $F_g = (36.36)(9.8) = 356.4N$

4. A net force of 15 N is applied to a cart with a mass of 2.1 kg.
   a. What is the acceleration of the cart?

$F_{NET} = 15N$, $m = 2.1kg$ $a = \frac{F_{NET}}{m} = \frac{15N}{2.1kg} = 7.14 m/s^2$

   b. **How fast will the cart be moving after 3 seconds have passed? ($v_f = v_i + at$) $v_i = 0$

$v_f = v_i + at = 0 + (7.14)(3) = 21.43 m/s$ (from #4A)

5. *A box weighing 666 N has a net force of 777 N acting on it.
   a. What is the mass of the box? (See #3 for the relationship between mass and weight.)

$F_g = 666N$, $g_E = 9.8 m/s^2$ $F_{gE} = m\,g_E$ $666N = m\,(9.8)$ $m = 67.9 kg$

   b. What is the acceleration of the box?

$F_{NET} = 777N$, $m = 67.9kg$ (from #4B) $F_{NET} = m\,a$ $777 = 67.9\,(a)$ $a = 11.4 m/s^2$

6. ***A car has a mass of 820 kg. It starts from rest and travels 45 m in 3.0 s. What is the net force applied to the car? (Use $x_f = x_i + v_i t + (0.5)at^2$ and $F = ma$)

m v_i x_f t

$m = 820\,kg$
$v_i = 0$
$x_f = 45m$
$x_i = 0$
$t = 3s$

$x_f = x_i + v_i t + (0.5)at^2$

$45 = 0 + 0 \cdot 3 + (0.5)a(3)^2$

$45 = (0.5)(9)a$

$45 = \frac{0.5}{4.5}a$

$a = 10\,m/s^2$

$F_{NET} = ma$

$= (820kg)(10\frac{m}{s^2})$

$F_{NET} = 8200\,N$

FINAL ANSWER

7. What is the net force needed to lift a full grocery sack (weighing 210 N) if the sack is lifted upward at a ***constant velocity***?

$F_g = 210\,N$ ↓ $a = 0$

So.... $F_{NET} = ma = 0$ (a = 0)

8. Next, the 210 N grocery sack is lifted with an upward acceleration of 1.5 m/s/s. What is the net force on the sack during the lift?

$F_g = 210N$ $F_g = mg$ → $210N = m(9.8)$ $m = 21.4kg$

$F_{NET} = ma$

$= (21.4)(1.5)$ $F = 32.1N$

$= 32.1N$

5. If 2.2 lbs = 1.0 kg, and Megan Progress weighs 130 lbs, what is her weight in newtons?

$F_g = 130lbs \cdot \frac{1kg}{2.2lbs} = 59N$

6. A box of unknown weight is lifted by a rope. The volume of the box is 1.4 cubic meters. The box has a density of 31 kg/m^3.

V d

a. Find the mass of the box. ($d = m/V$) $31 = \frac{m}{1.4}$ $m = 43.4\,kg$

b. If the box accelerates at 0.14 m/s/s during the lift, what is the net force on the box?

$F_{NET} = ma = (43.4)(0.14) = 6.076N$

c. What is the weight of the box? (See #3 for the relationship between mass and weight.)

$F_g = m g_E = (43.4kg)(9.8\,m/s^2) = 425.32\,N$

d. *What is the tension in the rope that is lifting the box? *(Use answers to b and c above. Also, use the concept for part b in number one)*

F_T ↑

F_g (−) ↓

$F_{NET} = F_T + F_g$

$6.076N = F_T + -425.32N$

$F_T = 431.4N$ ↑

7. ***What will be the final velocity of a 5.0 g bullet starting from rest, if a net force of 45 N is applied over a distance of 0.80 m?

$m = 5.0g = 0.005\ kg$

$V_i = 0$

$F_{NET} = 45N$

$X_i = 0$

$X_f = 0.80m$

$F_{NET} = ma$

$45 = (0.005)a$

$a = 0.225 m/s^2$

$V_f^2 = V_i^2 + 2ax$

$V_f^2 = 0^2 + 2(.225)(.8)$

$V^2 = 0.36$

$V = 0.6\ m/s$

8. *** A cart is moving to the left on a level surface. The cart decreases velocity from -50 m/s to -15 m/s over a 7 second period. If the net force on the box during the motion is 30 newtons to the right, find the following:

$V_i = -50\ m/s$ $V_f = -15\ m/s$ $t = 7s$ $F_{NET} = 30N$

a. The mass of the cart

1st

$V_f = V_i + at$

$-15 = -50 + a(7)$

$a = +5 m/s^2$

2ND

$F_{NET} = ma$

$30N = m(+5 m/s^2)$

$m = 6\ kg$

b. The distance the cart will move during its motion.

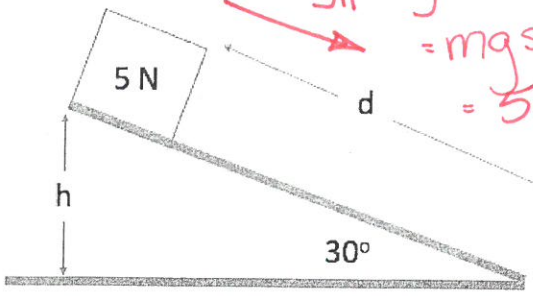
$X_f = X_i + V_i t + \frac{1}{2} a t^2$

$= 0 + (-50)7 + \frac{1}{2}(5)t^2$

$350 = 2.5 t^2$

$t^2 = 140$

$t = 11.8s$



$F_{g\parallel} = F_g \sin 30°$

$= mg \sin 30°$

$= 5 (\sin 30°)$

$= 2.5N$

9. *****A 5-Newton block begin from rest at the top of an incline. Assume friction is negligible.

a. Find the net force on the block if the surface is frictionless. (Use trigonometry to determine the component of the weight parallel to the incline).

See above $F_{NET} = 2.5N$

b. Determine the acceleration of the block along the incline.

$F_g = m\ g$

$5N = m\ (9.8)$

$m = 0.51 Kg$

$F_{NET} = m\ a$

$2.5N = (0.51kg)\ a$

$a = 4.9 m/s^2$

c. Determine the distance *d* from the top of the ramp to the base if the block reaches the base in 1.25 seconds.

$t = 1.25$ sec

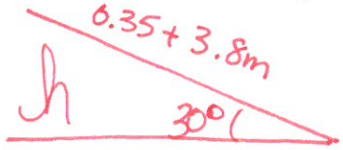
$V_i = 0$

$X_f = X_i + V_i t + \frac{1}{2} a t$

$= 0 + 0\ (t) + \frac{1}{2} (4.9)\ (1.25)^2$

$X_f = 3.8m$

d. How tall is the ramp? The box is a cube with 35 cm edges.



$\sin 30° = \frac{h}{.35 + 3.8}$

$\sin 30° = \frac{h}{4.15}$

$h = 4.15 \sin 30°$

$h = 2.075m$