FORCES and Acceleration Answers

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1) $D = \frac{(Vi+Vf)}{2} * T$

2) $Vavg = \frac{(Vi+Vf)}{2}$

3) $Vf = Vi + A*T$

4) $D = Vi*T + \frac{1}{2}*A*T^2$

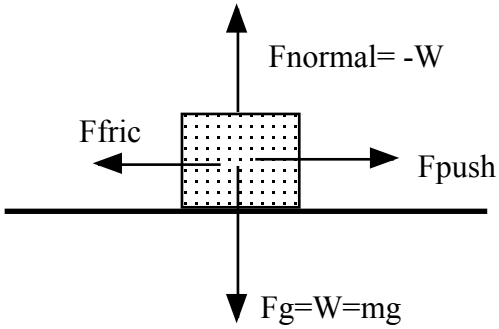
5) $Vf^2 = Vi^2 + 2*A*D$

Newton's Laws

Fnet = m * A F1 = F2

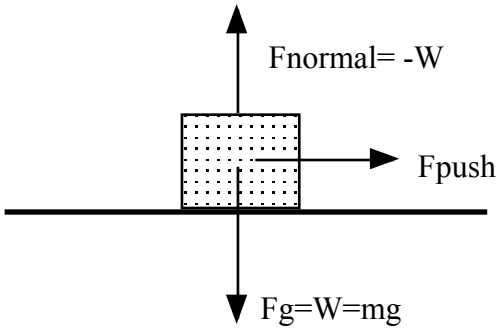
Weight = m * g

1) What net external force is required to give a 25 kg suitcase an acceleration of 2.2 m/s^2 to the right? Draw a free body diagram.



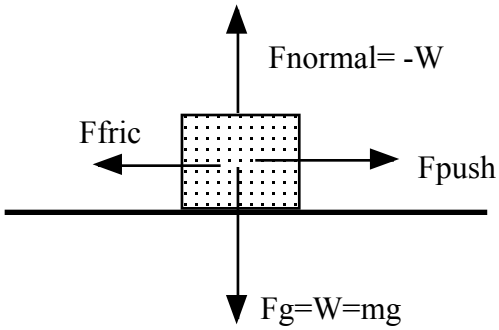
*Fnet=Fpush-Ffric= m * A ,m=25 kg, A = 2.2 m/s^2 so Fnet = 25*2.2 =* ***55 N***

2) What acceleration will you give to a 24.3 kg box if you push it with a force of 85.5 N?



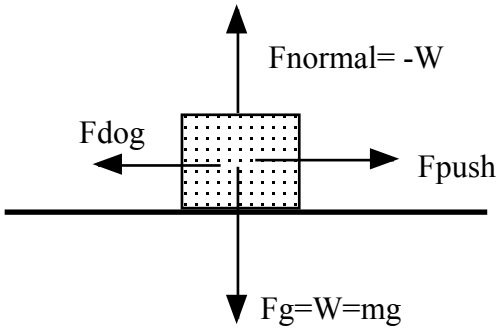
If no friction, Fnet=Fpush= 85.5 N, m = 24.3 kg,
*Fnet=m*A 85.5 = 24.3 * A A=85.5/24.3=* ***3.53 m/s^s***

3) A 1850 kg car is moving to the right at a constant velocity of 1.44 m/s. What is the net force on the cart?



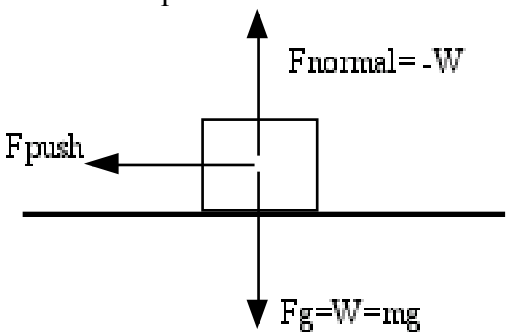
If velocity is constant, A=0, so ***Fnet=0****, Fnet=Fpush-Ffric*
so Fpush=Ffriction

4) A man is pushing a 200 Newton box with a force of 50 Newtons along the floor. A dog is pushing against him with a force of 4 N . What is the acceleration of the box? Draw a free body diagram for the box.



If no friction, Fnet=Fpush-Fdog= 50N-4N=46 N,
*W=mg, W=200N, 200=m*9.8, m=200/9.8, m = 20.4 kg,*
*Fnet=m*A 46 = 20.4 * A A=46/20.4=* ***2.254 m/s^s***

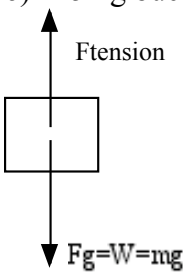
5) A train with a mass of 5000 kg is traveling down the track at 200 m/s . Superman stops the train with a force of 9000 N . What is the deacceleration of the train? How long does it take to stop?



If no friction, Fnet=Fpush= -9000 N, m = 5000 kg,
*Fnet=m*A -9000 = 5000 * A*
*A=-9000/5000=**-1.8 m/s^s***

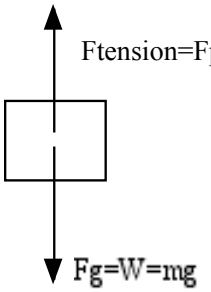
Vi= 200 m/s, Vf=0 m/s, A= -1.8m/s^2, T=???
*Use Equation # 3, Vf = Vi + A*T*
0= 200 -1.8T T= -200/-1.8
***T=111.11 sec** = 1.85 min!*

6) A 5 kg bucket is hanging on a rope. What is the net force on the object?



*If it is hanging, A=0, **Fnet =0**,*
*Ftension=W=mg=5*9.8=49N*

7) A 5 kg bucket is hanging on a rope. What force is needed to pull it up at an acceleration of 3 m/s^2?

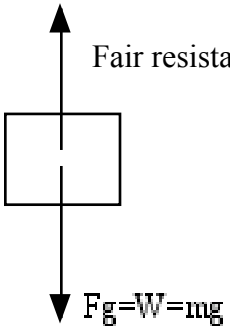


*Fnet = Fpull - W = m * A , A=3 m/s^2 ,*
*W=m*g=5*9.8=49 N,*
*Fnet = Fpull – 49 =5 * 3 = 15 N*

Fnet=15N = Fpull – 49 N

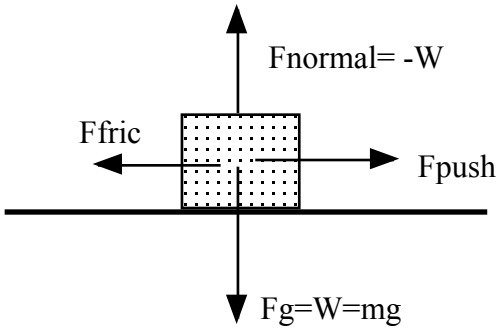
Fpull = 49N+15N = ***64 N***

8) A 3 kg ball is dropped from the roof of a building that is 200 m high. At 50 m off the ground, the force of air resistance equals the force of gravity. What happens to the ball at that time?



If W=Fair, then A =0, ball stays at a constant speed (terminal velocity)

9) A 1200 kg boat moves through the water with two forces acting on it. One is a 2100 N forward push by the motor, and the other is a 1800 N resistive force of the water.



A) What is the acceleration of the boat?

Fnet=Fpush-Ffric= 2100 N – 1800 N=300 N,

m = 1200 kg,

*Fnet=m*A 300 = 1200 * A A=300 / 1200 =* ***0.25 m/s^s***

B) If it starts from rest, how far will it move in 10 s?

Vi=0. T=10 s, A= 0.25 m/s^2, D=??

*Use Eq # 4, D = Vi*T + ½*A*T^2*

*D = 0*T +1/2*0.25*T^2*

*D = 0 .125 *10^2*

D = ***12.5 m***

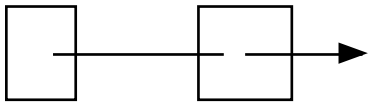
C) What will its velocity be at the end of this time?

Vi=0. T=10 s, A= 0.25 m/s^2, Vf=??

*Use Equation # 3, Vf = Vi + A*T*

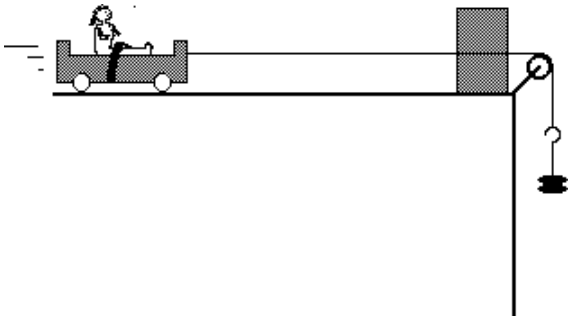
*Vf = 0 + 0.25*10* ***= 2.5 m/s***

10) A 1250 kg car is pulling a 325 kg trailer. Together, the car and the trailer have an acceleration of 2.15 m/s^2 forward. What is the net force on the car? On the trailer?



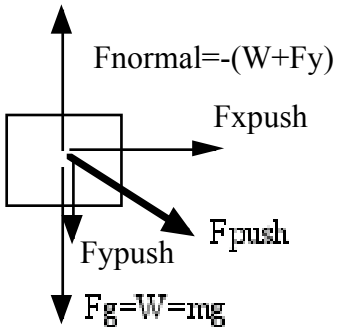
Since both are attached, the net force is the same on both together,
m= 1250+325=1575 kg
*Fnet = m*A = 1575 * 2.15 =* ***3386.25 N***

11) A 500 kg weight is hanging off the edge of a table attached to a rope attached to a 200 kg cart. What is the force causing the cart to move? What is the acceleration of the cart and weight? How long will it take to travel the 2 m distance to the edge of the table? What will the acceleration of the cart be when it falls?



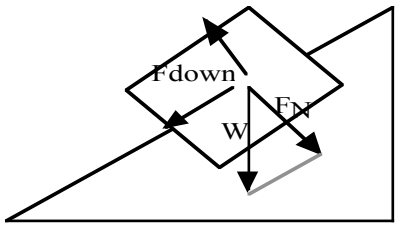
The force causing the cart and weight to move is the weight that is hanging.
Its weight is W=mg, W=500*9.8 = **4900 N**
This is also the net force pulling both the cart and the weight. m = 500 +200 = 700 kg
Fnet = 4900 N = m*A =700*A , A = 4900/700 = **7 m/s^s**
Vi=0, D=2m, A= 7, T=???
*Use Eq # 4, D = Vi*T + ½*A*T^2*
*2 = 0*T +1/2*7*T^2*
*2 = 3.5 *T^2*
T = sqrt(2/3.5) = ***0.76 sec***

** Honors:
12) A boy is pushing a 100 N wheelbarrow with a force of 200 N at an angle of 30 degrees downward. Draw a force diagram. What is the acceleration of the wheelbarrow and in what direction?



*W=100N=mg=m*9.8, m = 10.2 kg*
Fnet = Fx = Fpush cosθ
*Fx = 200 cos 30 = 173.2 N = m*A=10.2*A,*
A = 173.2/10.2= ***.0589 m/s^s***

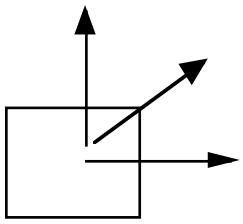
13) A block with a mass of 50 kg is sliding down a frictionless ramp that is at an angle of 60 degrees. What is the component of the force causing it to slide? What is its acceleration? Draw a picture and force diagram.



Fdown = W sin ø
Fnormal = W cos ø

*W = m * g = 50 * 9.8 = 409 N*
Fdown = W sin θ = 490 sin 60 = ***424.35 N***
*If Ff=0, then Fnet =Fdown =m*A*
*424.35= 50 * A* ***A = 8.487 m/s^2***

14) A boy pushes on a box to the right with a force of 400 N. A girl pushes perpendicular to the boy with a force of 300 N. The block moves 4 meters in 2 seconds. What was the mass of the block?



Fright = 400 N, F y = 300 N
Fnet = sqrt (400^2 + 300^2) = 500 N

$Fnet = m * A = 500N$

$500N = m * A,$

$Vi=0, D= 4, T =2, A=???$

Use Eq # 4, $D = Vi*T + ½*A*T^2$

$4 = 0*T +1/2*A*2^2$

$8 = A*2^2$

$A = 2\ m/s^2$

$500 = m* 2$

<u>m = 250 kg</u>