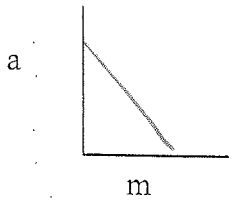
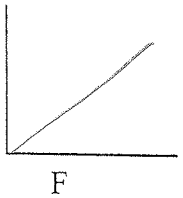
Force Review Sheet

Useful Equations: $\Sigma F=ma$ $F_f=\mu F_N$ $\Sigma F = F_{\text{one direction}} - F_{\text{opposite direction}}$

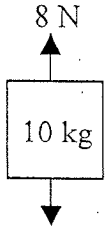
1. Which has more inertia, a mouse or an elephant. How does that relate to Newton's 1st Law?
2. What is equilibrium? What is the net force on an object at rest? What does that tell you about the amount of force to the right compared to the amount of force to the left.
3. Can an object be in motion if there is no net force on the object (equilibrium)? Why or why not?
4. Why do you have to keep pedaling a bike to maintain a constant speed?
5. In which direction does friction act? What happens to the force of friction as F_n increases?
6. What is the normal force? Which direction does it act (**the answer is not up**)?
7. A 1000. kg car is traveling down the road when the driver slams on the brakes, creating a frictional force that stops the car. The coefficient of friction is 0.35.
   a. What is the amount of frictional force acting on the car?
   b. What is the acceleration of the car?
8. A 15 kg crate is pushed to the right with a force of 25 N. The crate experiences an acceleration of +0.75 m/s^2.
   a. What is the net force acting on the crate?
   b. What is the frictional force?
   c. What is the coefficient of friction?
9. A student pulls a 15 kg box with a force of 40.0 N at an angle of 25° above the horizontal. If the coefficient of friction, μ, is 0.080:
   a. What are the components of the force?
   b. What is the normal force?
   c. What is the force of friction (F_f)?
   d. What is the acceleration of the box?
10. While walking through the airport, Mr. B pulls his luggage behind him at a constant velocity with a force of 200. N at 30.0° above the horizontal. If his luggage has a mass of 35 kg,
    a. What is the magnitude of the friction acting on the luggage?
    b. What is μ?
11. A boy kicks a soccer ball, creating what type of force (contact or field force)?
12. What is an example of a field force?
13. What does Newton's 1st Law have to do with wearing a seatbelt?
14. What does the inertia of an object depend on?
15. Show the correct relationship for Newton's 2nd Law on the graphs below.



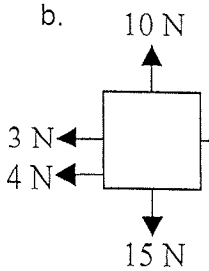


16. Find the **net force** on these objects:

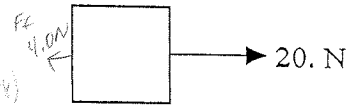
a.



b.

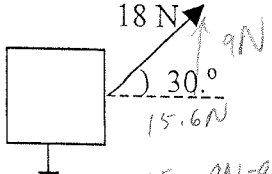


c.



Friction Force: 4.0 N

d.

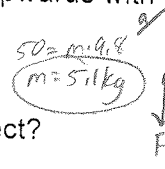


17. How do you calculate weight (also called force of gravity, Fg)? How is weight different from mass?

$Fg = m \cdot g$

18. An object with a weight of 50.0 N is lifted upwards with a force of 60. N.
    a. Draw a free-body diagram.
    b. What is the object's mass?
    c. What is the ΣF on the object?
    d. What is the acceleration of the object?

b. $Fg = mg$, $50 = m \cdot 9.8$, $m = 5.1\,kg$



c. $\Sigma F = Fa - Fg$, $\Sigma F = 60 - 50$, $\Sigma F = 10N \uparrow$

d.) $\Sigma F = m \cdot a$, $10 = 5.1 \cdot a$, $a = 1.96 m/s^2$

dependent on accel. of gravity — does not change

19. A force of 10 N is applied to a 10 kg object. Then, a force of 1 N is applied to the 10 kg object. Which force accelerates the object more? Why?

The 10N force. F↑, a↑ in $\Sigma F = m \cdot a$

20. A 10 N force is applied to a 10 kg object and a 5 kg object. Which object accelerates more? Why?

The 5kg object. m↓ a↑ in $\Sigma F = m \cdot a$

21. An object is started from rest by a force.
    a. Did this force overcome static friction or kinetic friction?
    b. The same object continues moving. How does the force of friction in this situation compare to the force in part a? Explain.

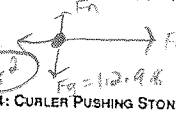
Less amount of force for kinetic friction

22. A 0.40 kg box of Kleenex is pulled to the right with a force of 11 N. If a resistive force of 8.3 N is present, what is the acceleration of the box?

$F_f = 8.3N$ ← → $11N = Fa$, $\Sigma F = 11 - 8.3$, $\Sigma F = 2.7N$, $\Sigma F = m \cdot a$, $2.7 = 0.4 \cdot a$, $a = 6.75\ m/s^2$

23. A 1.2 kg textbook slides across a tabletop due to a 14 N force. If the coefficient of kinetic friction is 0.38, what is the acceleration of the textbook?

$Fn = 1.2 \cdot 9.8 = 11.76$, $Ff = u \cdot Fn = 0.38 \cdot 11.76$, $Ff = 4.5N$

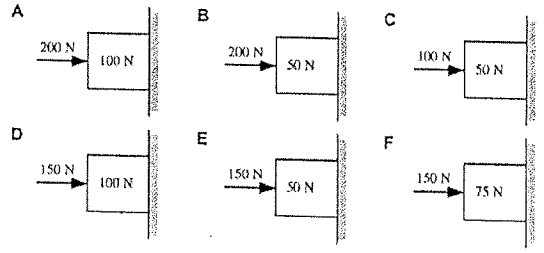


$\Sigma F = m \cdot a$, $14 - 4.5 = 1.2 \cdot a$, $a = 7.9 m/s^2$

$Fn = Fg$

NT5F-RT55: Boxes on Rough Vertical Surface—Normal Force on Wall

Boxes are held at rest against rough vertical walls by forces pushing horizontally on the boxes as shown.



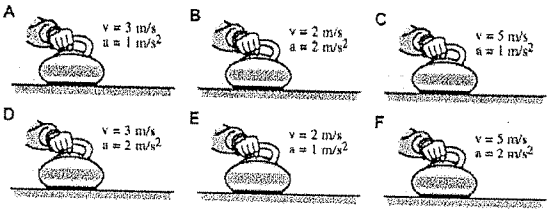
Rank the magnitude of the normal force exerted on the walls by these boxes.

A = B > D = E = F > C If at rest, F→ = F←

normal force

NT5B-RT4: Curler Pushing Stone—Force on Stone

The figures below show six identical curling stones (the playing pieces in the sport of curling) that are being pushed horizontally along the ice by the thrower. For each stone, the instantaneous velocity and acceleration of the stones are given. The positive direction is to the right. Assume the ice is frictionless for the curling stones.

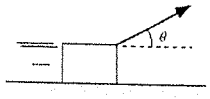


Rank these stones on the basis of the magnitude of the force the thrower is exerting on them at the instant shown.

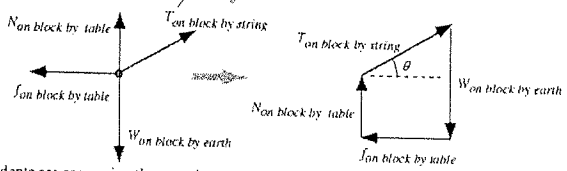
B = D = F > A = C = E Using $\Sigma F = m \cdot a$, same, only faster

NT5B-CCT19: Block Moving at Constant Speed—Forces on Block

A student uses a string to pull a block across a table at a constant speed of 2 meters per second. The string makes an angle θ with the horizontal. A second student makes a free-body diagram of the block, and then uses this free-body diagram to generate a vector sum diagram as shown.



Aiko: Fa



Three students are comparing the magnitudes of the forces in the vector sum diagram:

Anja: *The vector sum diagram allows us to compare the magnitudes of all four forces: The weight is the largest, then the tension, then friction, then the normal force.*

Barb: *Well, the weight is definitely greater than the normal force. But there should be a net force to the right in the vector sum because that's the way the block is moving, and there isn't. I don't think we can use it to rank the other forces.*

Cole: *I think we can use it to say that the weight is greater than the normal force. Also, the tension is greater than the friction, since the friction is the same length as the dashed line, and this is equal to the tension times the cosine of theta (θ). But we can't compare the vertical forces with the horizontal ones.*

Which, if any, of these students do you agree with?

Anja ____ Barb ____ Cole X None of them ____

Please explain your reasoning.

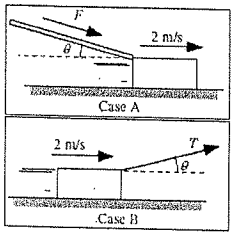
$\Sigma F = 0$ so $Fn + Fay = Fg$ so $Fg > Fn$

and $Fax = Ff$ so $Fa > Ff$

Cannot compare other forces

NT5B-CT21: Blocks Moving at Constant Speed—Force on Block

In both cases shown, a block is moving to the right across a rough table with a constant speed of 2 m/s. The tables and the blocks are identical. In Case A, the block is pushed with a stick and in Case B, the block is pulled with a string. The angle that the applied force makes with the horizontal is the same in both cases.



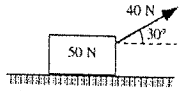
Will the magnitude of the force on the block by the stick in Case A be *greater than, less than,* or *equal to* the tension on the block by the string in Case B?

Explain.

Greater in Case A pushing down, increases Fn, so Ff and $\Sigma F = 0$ so more angle force, F↑

NT5F-CCT56: Pulling Box over Rough Horizontal Surface—Normal Force by Surface

A rope that makes an angle of 30° with the horizontal is attached to a 50 N box that is moving along the floor. The force applied by the rope is 40 N. The coefficient of static friction between the box and the floor is 0.6 and the coefficient of kinetic friction is 0.4. Four students are discussing the normal force exerted on the box by the rough floor for this situation:



Aiko: *"The normal force is 50 N since that is the weight of the box. The normal force makes a Newton's Third Law pair with the weight."*

Bahir: *"But in this case there is also an upward force of 40 N by the rope. The normal force is only 10 N."*

Chloe: *"Actually it is only a part of that 40 N force that is acting upward. We'd have to use trigonometry to figure out how much, and then subtract this from the weight to get the normal force."*

Delbert: *"We can't figure out the normal force until we know the acceleration. The greater the acceleration, the less the normal force will be."*

Which, if any, of these students do you think is right?

Chloe, $Fn = Fg - Fay$ (Fg = 50N; Fay = the upward component of applied force)