Name: _____

Period: _____

Normal Force and Friction

Normal force (F_N) - The supporting force of a surface on an object. Without a normal force the object would break thru the surface.

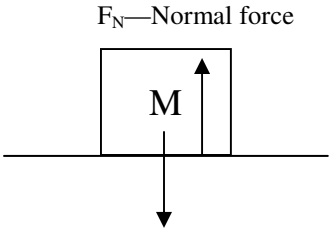
1) Use $\Sigma F_y = ma_y$ (The normal force is in the y-(vertical) direction)

2) $a = 0$ m/s^2 (since it is sitting on the table)

(Remember that the x and y directions are independent: it can be moving left or right and still be at rest vertically.)

Situation 1) - no other forces other than F_W and F_N.

$\Sigma F_y = ma_y$
$F_N - F_W = m(0)$
$F_N = F_W$
The normal force equals the weight of the object.

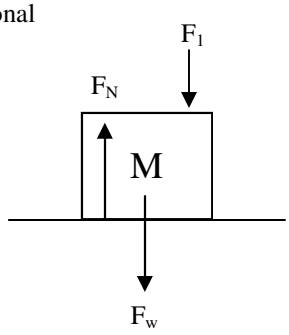


F_N—Normal force

F_w—Force of weight
$F_w = mg$
$g = 9.8$ m/s^2

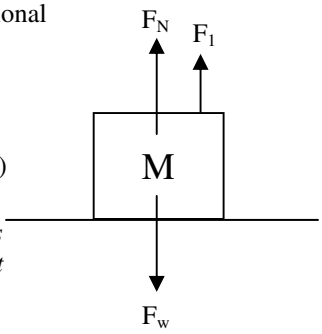
Situation 2) - an additional force is pushing down.

$\Sigma F_y = ma_y$
$F_N - F_1 - F_W = m(0)$
$F_N = F_W + F_1$
The normal force is greater than the weight of the object.



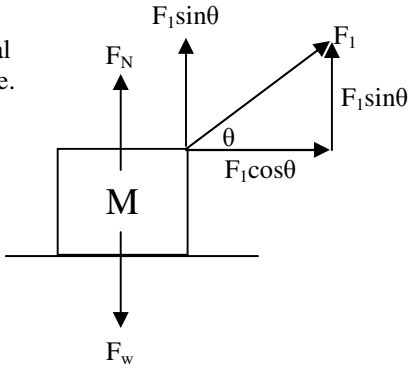
Situation 2) - an additional force is pulling up.

$\Sigma F_y = ma_y$
$F_N + F_1 - F_W = m(0)$
$F_N = F_W - F_1$
The normal force is less than the weight of the object.



Situation 2) - an additional force is pulling at an angle.

$\Sigma F_y = ma_y$
$F_N + F_1\sin\theta - F_W = m(0)$
$F_N = F_W - F_1\sin\theta$
You must remember to use the y-component of F_1.

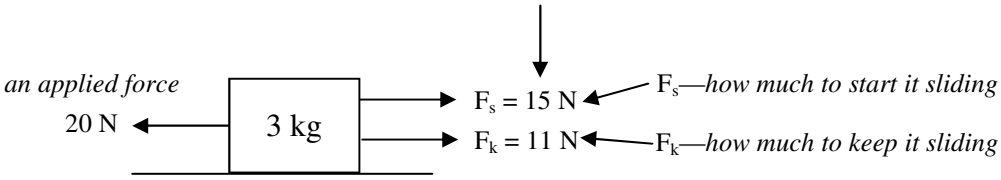


Friction (F_f) - Friction is a force that opposes motion. There are two kinds: static (F_s) and kinetic (F_k).

Static Friction—stationary friction; F_s tries to keep an object sticking to a surface. You must apply a force just greater than F_s to start the object sliding. F_s is usually greater than F_k. Use F_s to decide if the object moves.

Kinetic Friction—sliding friction; F_k tries to stop an object from sliding. You must use F_k to find acceleration, since an object must be moving to be accelerating.

NEVER add F_s and F_k—once it moves F_s no longer exists!



This object will move because 20 N > 15 N

$\Sigma F_x = ma_x$
$11 - 20 = 3a_x$
$-9 = 3a_x$
$a_x = -3$ m/s^2

Use F_k to calculate (because it's moving).

Negative means the object is accelerating to the left.

$F_s = \mu_s F_N$ and $F_k = \mu_k F_N$
(μ is the coefficient of friction)

Remember that you must find F_N first in order to find friction (*see top of page*).