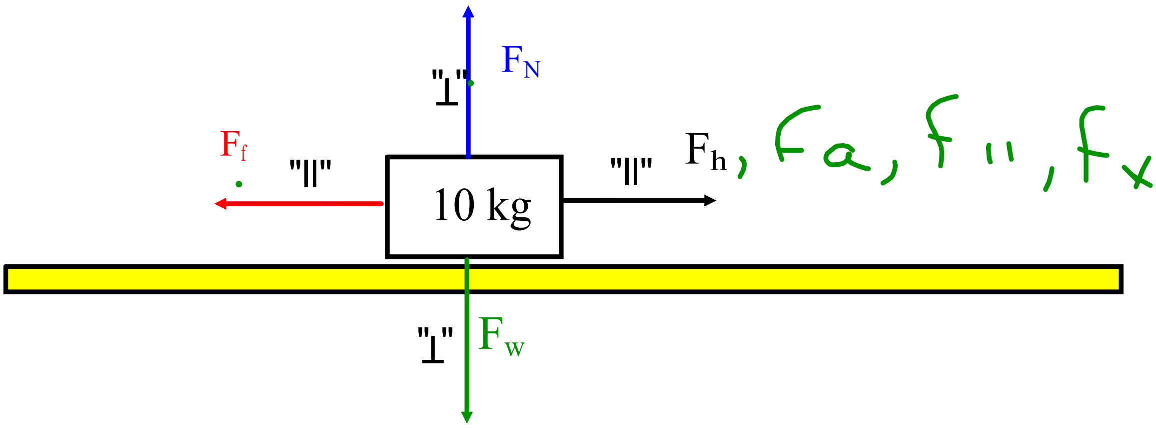
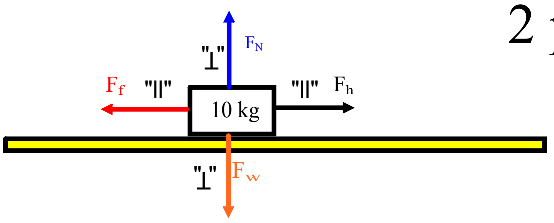
2 planes affecting motion?

Why analyze each plane?



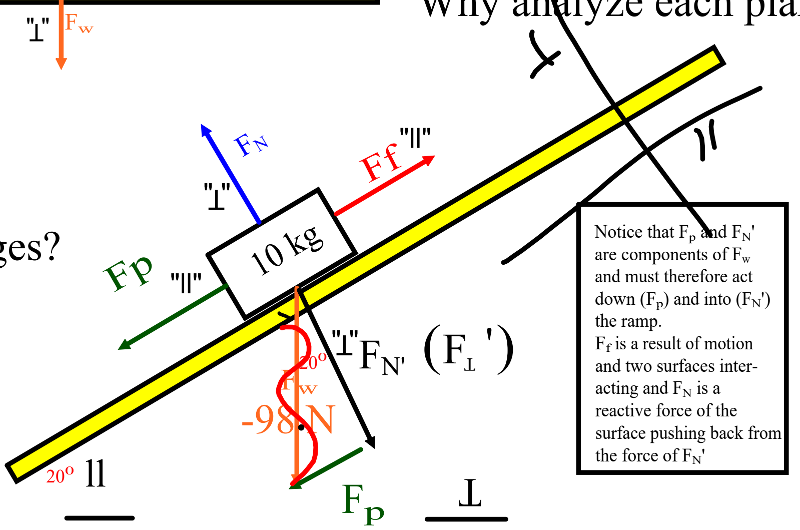
A 10 kg box is pulled across the floor at a constant velocity by force F_h

2 planes affecting motion?



Why analyze each plane?

What changes?



v_c ∴ 1st Law

$\Sigma F = 0$

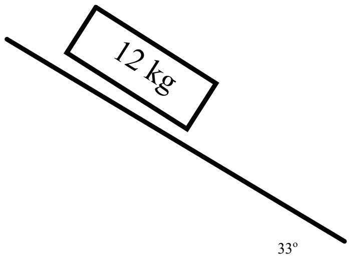
$F_p + F_f = 0$

rest ∴ 1st Law

$\Sigma F = 0$

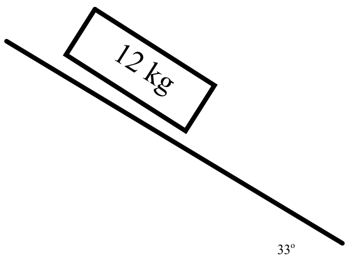
$F_N + F_N' = 0$

let's consider down the ramp as "-"



A 12 kg box slides down a 33° ramp at a constant velocity. What is μ ?

let's consider down the ramp as "-"



A 12 kg box slides down a 33° ramp at a constant velocity. What is μ ?

1)

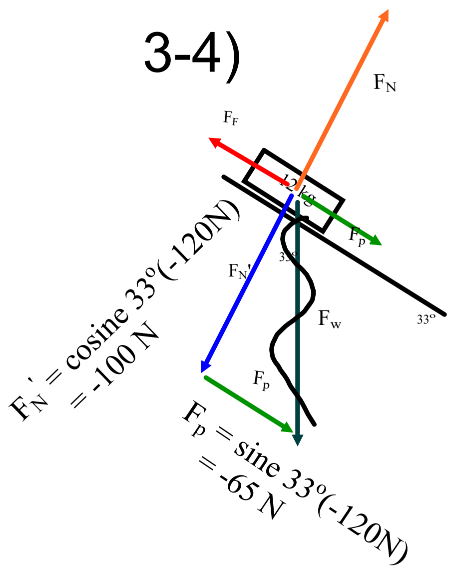
m = 12 kg
120 N

ramp = 33^0

v_c
μ ?

2) 33^0 ramp

3-4)



F_N' is the part of the weight of the box that pushes into the ramp.......F_N is the reactive force of the ramp pushing upward (⊥)on the box. It is always perpendicular to the surface.

A 12 kg box slides down a 33° ramp at a constant velocity. What is μ ?

The plane of motion is 33⁰ above the horizontal (the ramp)

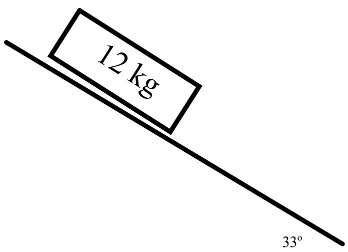
∥	⊥
v_c ∴ 1st .. $\Sigma F = 0$ $0 = F_p + F_f$	rest ∴ 1st .. $\Sigma F = 0$ $0 = F_N + F_N'$
$F_f = -F_p$ $F_f = -(-65n) = 65$ N	$F_N = -F_N'$ $F_N = -(-100N) = +100N$

5)

$\mu = F_f/F_N = 65\ N/100N = 0.65$

A 12 kg box slides down a 33° ramp that has a μ of .22. What is it acceleration ?

We changed the surfaces by pouring water on them and thus reducing μ to .22



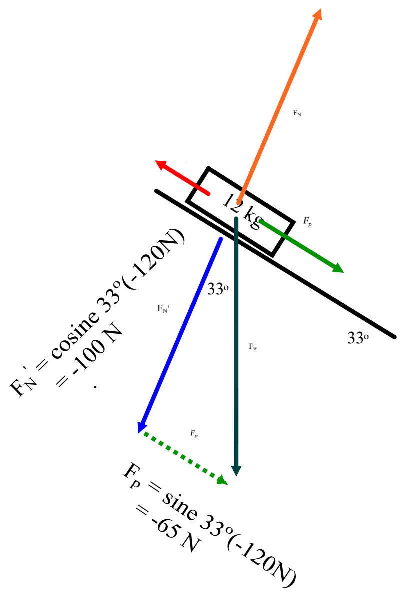
m = 12 kg
120 N

ramp = 33⁰

a = ?

μ = .22

A 12 kg box slides down a 33° ramp that has a μ of .22. What is it acceleration ?



∥ | ⊥

accel ∴ 2nd .. ΣF = ma

$F_p + F_f = ma$

$a = F_p + F_f /m$

$a = -65\ N + (+22N) /12kg$

$a = -3.6\ m/s^2$

rest ∴ 1st .. ΣF = 0

$0 = F_N + F_N'$

$F_N = -F_N'$

$F_N = -(-100N) = 100N$

$\mu = F_f/F_N$

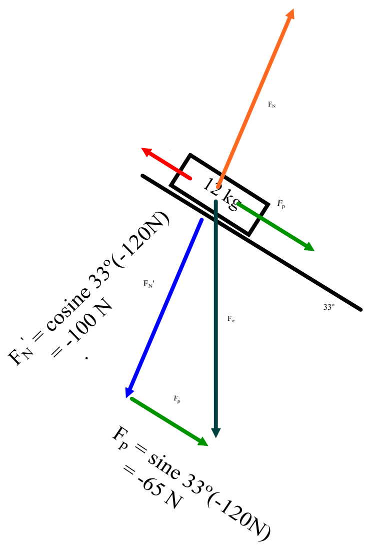
$F_f = \mu F_N$

$F_f = .22(100N) = 22N$

Note how this time F_p has to overcome friction and accelerate the box!!! Therefore, it must have more magnitude that F_f.

note how changing μ changed the friction force.

A 12 kg box slides down a 33° ramp that has a μ of .22. What is it acceleration ?
What velocity did it hit the bottom of the ramp at if the ramp is 1.2 m high?



∥ | ⊥

accel ∴ ΣF = ma

$F_p + F_f = ma$

$a = F_p + F_f /m$

$a = -65\ N + (+22N) /12kg$

$a = -3.6\ m/s^2$

rest ∴ ΣF = 0

$0 = F_N + F_N'$

$F_N = -F_N'$

$F_N = -(-100N) = 100N$

$\mu = F_f/F_N$

$F_f = \mu F_N$

$F_f = .22(100N) = 22N$

Note how this time F_p has to overcome friction and accelerate the box!!! Therefore, it must have more magnitude that F_f.

note how changing μ changed the friction force.

$a = -3.6\ m/s^2$

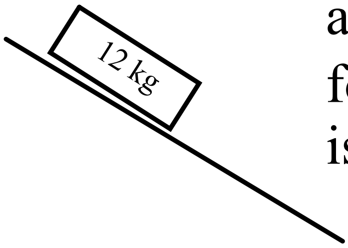
$\sin 33^0 = 1.2\ m/hyp$

hyp = -2.2 m long

$v = \sqrt{2ad}$

$v = \sqrt{2(-3.6\ m/s^2)(-2.2\ m)}$

$v = -4.0\ m/s$



A 12 kg box is accelerated up a 33° ramp at 2.2 m/s². What force is needed to do this if μ is 0.33 ?

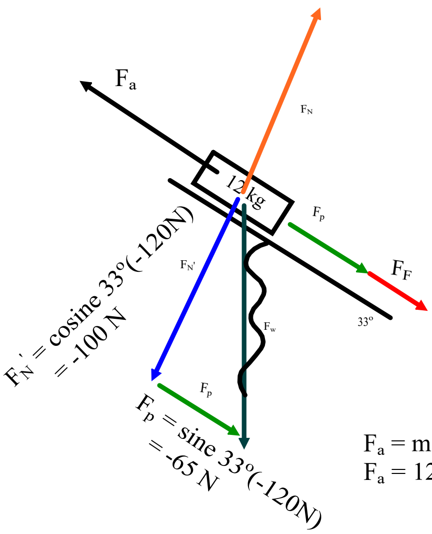
m = 12 kg
120 N

ramp = 33°

a = 2.2 m/s²

μ = .33

F_a = ?



A 12 kg box is accelerated up a 33° ramp at 2.2 m/s². What force is needed to do this if μ is 0.33 ?

F_a acts up the ramp to cause the box to accelerate up the ramp. Note how this force (F_a) must overcome friction (F_f) and F_p.

∥	⊥
accel ∴ $\Sigma F = ma$	rest ∴ $\Sigma F = 0$
$F_a + F_p + F_f = ma$	$0 = F_N + F_N'$
	$F_N = -F_N'$
	$F_N = -(-100N) = +100N$

$F_a = ma - (F_p) - (F_f)$

$F_a = 12\ kg(\ +2.2\ m/s^2) - (\ -65N) - (-33N)$

$F_a = +124N$

$\mu = F_f/F_N$

$F_f = \mu F_N$

$F_f = .33(100N) = -\ 33N$

how how the acceleration is +2.2 m/s² because the box moves up the ramp and we chose down as "-"

note how F_f acts opposite motion, down the ramp and is therefore "-"