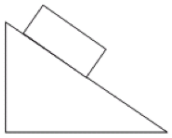
Equilibrium

What are some properties of an object in equilibrium?



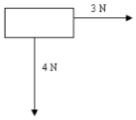
Sketch a free-body diagram for this box at rest on a hill.

Then, find the resultant of the vectors you drew.

Based on your drawings above, what is another property of an object in equilibrium?

Is the system below in equilibrium? Draw the resultant.

Now, draw a single vector that will put the system into equilibrium.



Equilibrant: A single force vector that puts system into equilibrium

What is the relationship between the resultant and the equilibrant?

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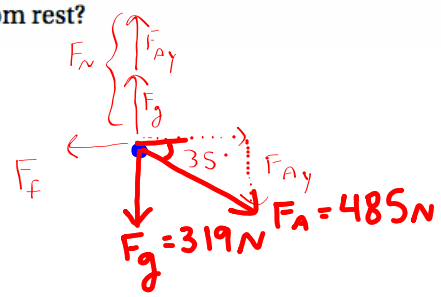
47. A box of books weighing 319 N is shoved across the floor by a force of 485 N exerted downward at an angle of 35° below the horizontal.

a. If μ_k between the box and the floor is 0.57, how long does it take to move the box 4.00 m, starting from rest?

b. If μ_k between the box and the floor is 0.75, how long does it take to move the box 4.00 m, starting from rest?



a) FBD

b) find mass

c) find components of $\mathbf{F}_a$

d) Find $\mathbf{F}_N$

e) Find $\mathbf{F}_f$

f) use f=ma to find accl

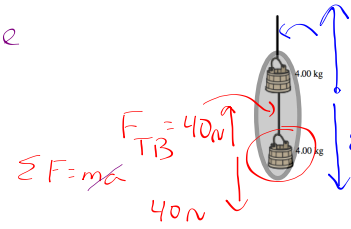
g) use acc, dist, initial vel (0) to find t

Two body problems

IB

1. Two buckets are hanging motionless from ropes as shown.. What is the tension in the top rope? The middle rope? What would change, if anything, if they moved upwards at a constant speed?

same



$F_{TA} = 80N$

$F_{TB} = 40N$

$\Sigma F = ma$

$80N$

$40N$

$\Sigma F = ma$

$120N$

$60N$

$40N$

2. The two buckets are now accelerated upwards at a rate of 5 m/s^2. What is the tension in each rope?

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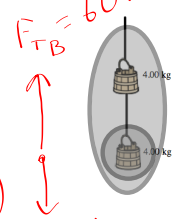
$\Sigma F = ma$

$F_g + F_{TB} = ma$

$F_{TB} = ma - F_g$

$4kg \cdot 5m/s^2 - (-40N)$



$F_{TB} = 60N$

$F_g = 40N$

$F_{TA} =$

$F_g = 80N$

$\Sigma F = ma$

$F_{TA} + F_g = ma$

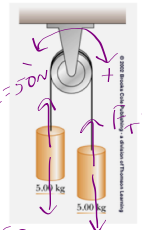
$F_T = ma - F_g$

$8kg \cdot 5m/s^2 - (-80N)$

$= \boxed{120N}$

3. Determine the tension in the string and the acceleration of each of the two objects connected by a light string over a light, frictionless pulley, as shown in each diagram.

a)



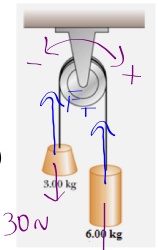
$F_T = 50N$

$F_T = 50N$

$50N$

$50N$

b)



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$30N$

$60N$

$\Sigma F_A = m_A a$

$F_T + F_{gA} = ma$

$F_T = ma - F_{gA}$

$3kg \cdot 3.3m/s^2 - (-30N)$

$= 40N$

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$30N \leftarrow$ 9kg $\rightarrow 60N$

1) solve for accl w/system

$\Sigma F = ma$

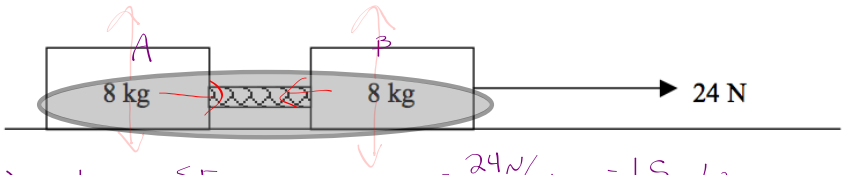
$F_{gA} + F_{gB} = ma$

$a = \frac{(-30N) + (60N)}{9kg}$

$= \boxed{3.3m/s^2} = a_B = a_A$

4. In each case below, two boxes connected by ropes are pulled across a frictionless floor by a horizontal force of 24 newtons. Find the tension in each inner rope and the acceleration of each box.

a)

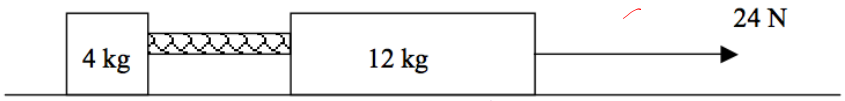


1) system: $\Sigma F = ma$ $\quad a = 24N/16kg = 1.5 m/s^2$

2) $\Sigma F_n = m_n a$

$F_T = ma = 8kg \cdot 1.5 m/s^2 = 12N$

b)

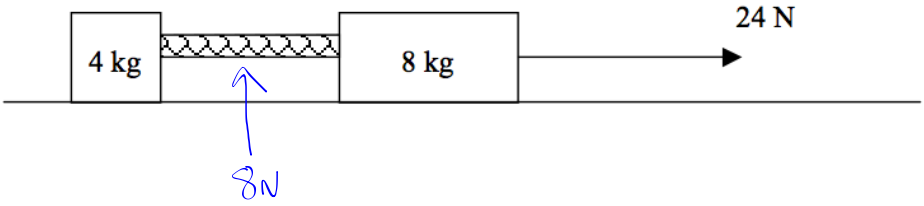


1) system: $\Sigma F = ma$ $\quad a = 24N/16kg = 1.5 m/s^2$

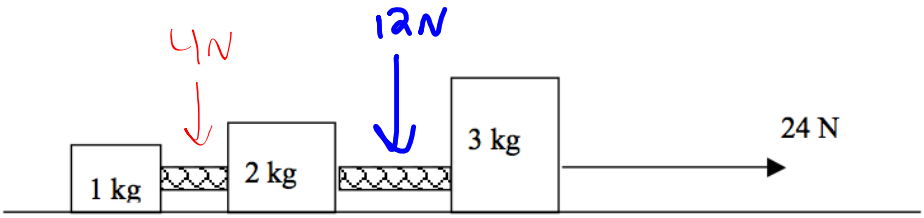
2) $\Sigma F_n = m_n a$

$F_T = ma = 4kg \cdot 1.5 m/s^2 = 6N$

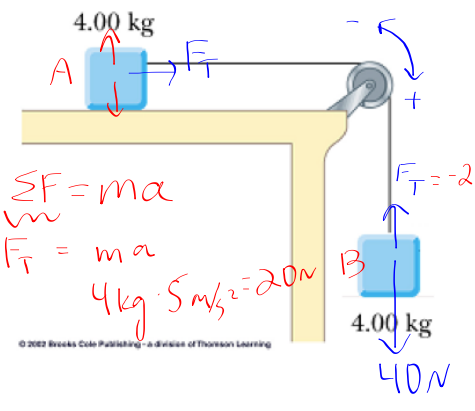
c)



d)

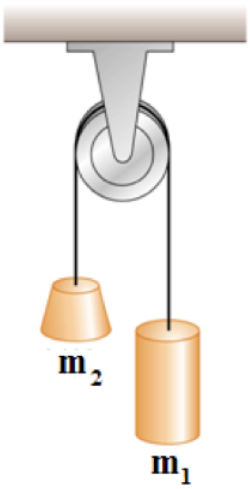


5. Find the acceleration of these two objects and the tension in the string as the block slides across a frictionless table.



6. Determine the acceleration of each system.

a)



b)