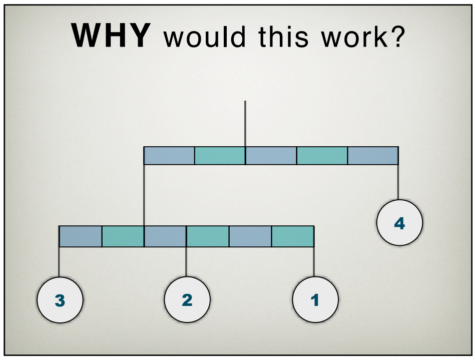
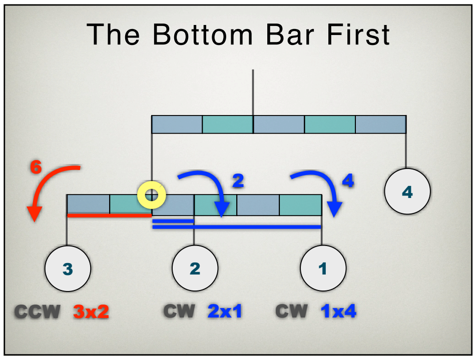
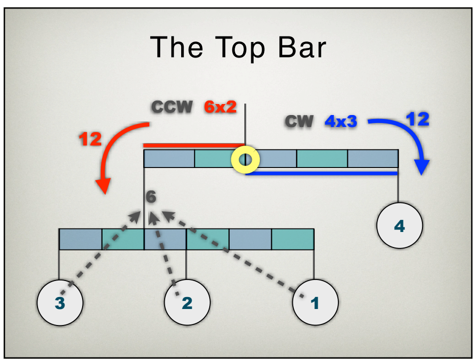

WHY would this work?
4
3
2
1

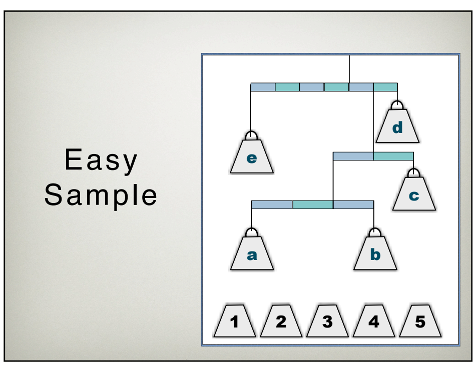
1


The Bottom Bar First
6
2
4
4
3
2
1
CCW 3x2
CW 2x1
CW 1x4

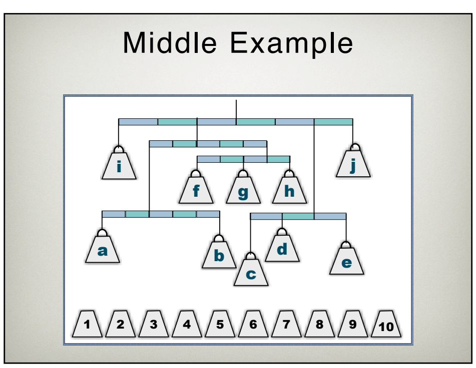
2


The Top Bar
CCW 6x2
CW 4x3
12
12
6
4
3
2
1

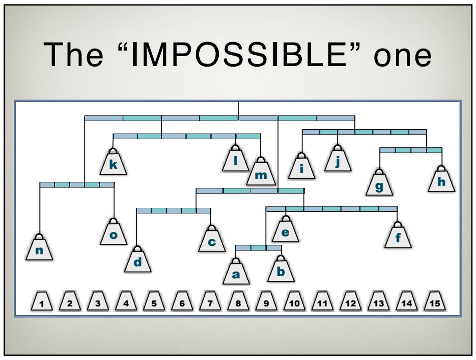
3


Easy Sample
d
e
c
a
b
1
2
3
4
5

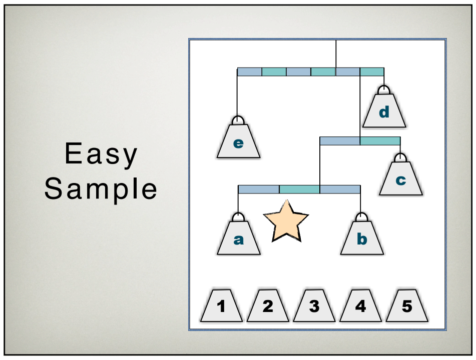
4


Middle Example
i
j
f
g
h
a
b
c
d
e
1
2
3
4
5
6
7
8
9
10

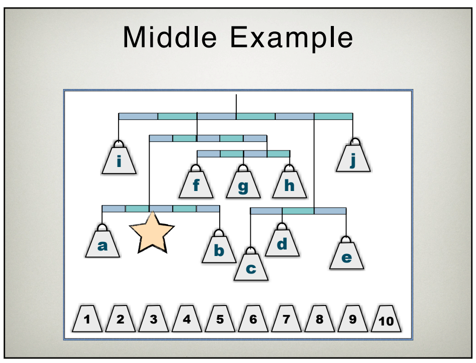
5


The “IMPOSSIBLE” one

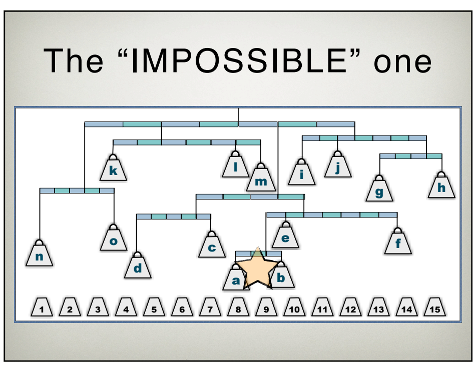
6


Easy
Sample

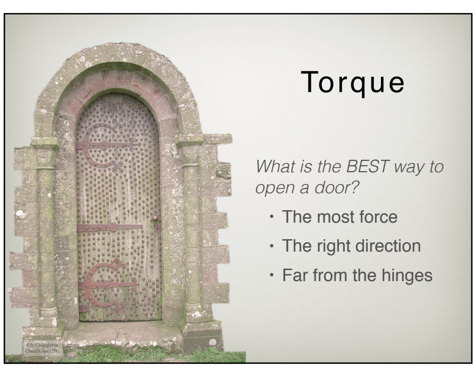
7


Middle Example

8

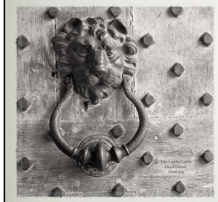

The “IMPOSSIBLE” one

9


Torque
What is the BEST way to open a door?
• The most force
• The right direction
• Far from the hinges

10

$T = F\ d\ \sin\theta$



Torque (Nm)
Force (N)
distance (m)
or r for radius or l for lever arm
θ the angle between F and d

so, push on a door at a right angle with a force of 25N, 80cm from the hinges...

Torque (Nm)= **25**N **0.8**m sin90°

11

Three States of Equilibrium

Vertical Forces -
"Ups" equal "Downs"

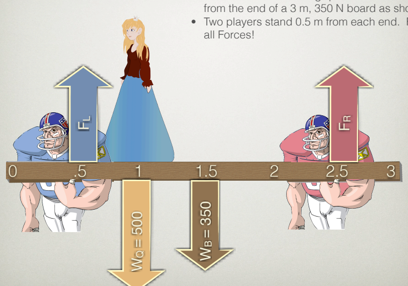
Horizontal Forces-
"Lefts" equal "Rights"

Torques -
"Clockwise" equals "Counter-clockwise"

12

Create a Free Body Diagram of the Board

- The 500 N homecoming queen stands 1 m from the end of a 3 m, 350 N board as shown.
- Two players stand 0.5 m from each end. Find all Forces!

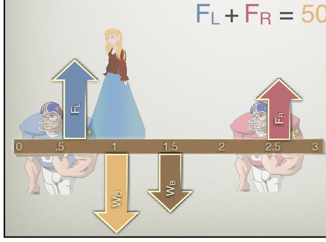


13

Vertical (y direction) Forces

Up = Down

$F_L + F_R = 500 + 350$



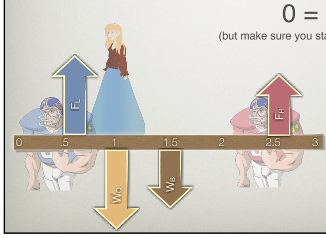
14

Horizontal (x direction) Forces

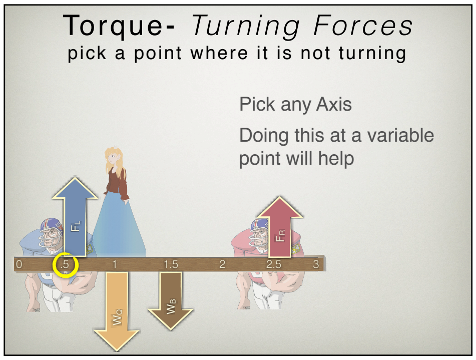
Left = Right

0 = 0

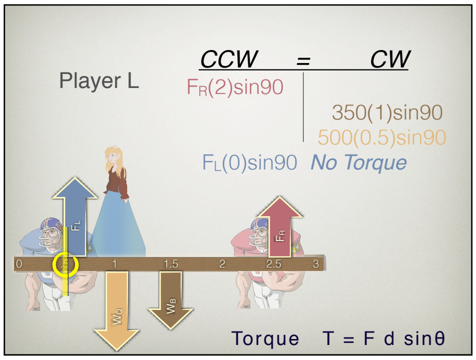
(but make sure you state this anyway)



15



16



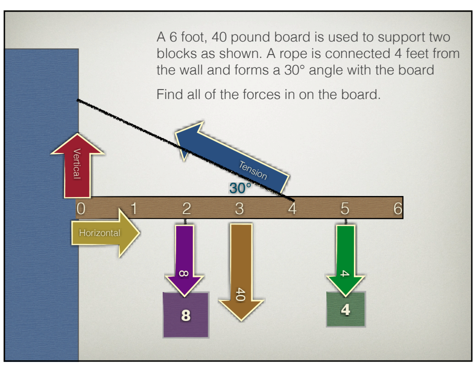
17

Check

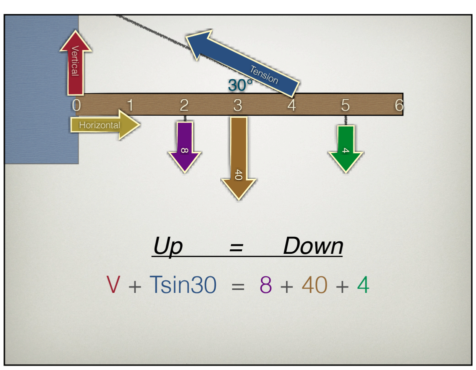
If you have picked a good place for your axis of rotation, you should have only simple algebra to handle.

If you have time, pick another axis of rotation and be sure that you get the same answer.

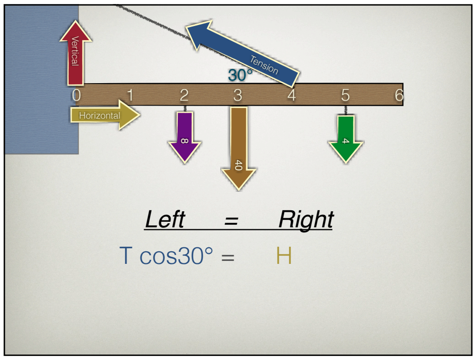
18



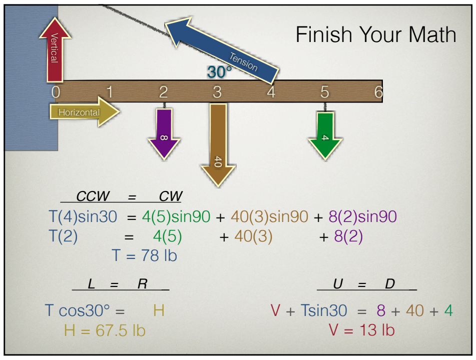
19



20


Vertical
Tension
30°
0 1 2 3 4 5 6
Horizontal
8
40
4
Left = Right
T cos30° = H

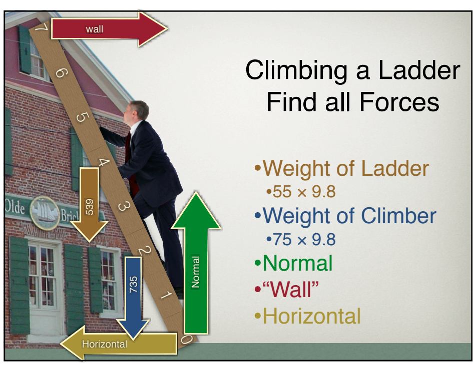
21


Finish Your Math
Vertical
Tension
30°
0 1 2 3 4 5 6
Horizontal
8
40
4
CCW = CW
T(4)sin30 = 4(5)sin90 + 40(3)sin90 + 8(2)sin90
T(2) = 4(5) + 40(3) + 8(2)
T = 78 lb
L = R
T cos30° = H
H = 67.5 lb
U = D
V + Tsin30 = 8 + 40 + 4
V = 13 lb

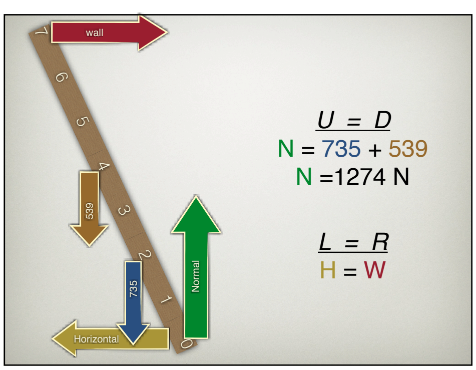
22


Climbing a Ladder
Find all Forces
A 75 kg man has climbed 2 meters up a 7 meter ladder. The ladder has a mass of 55kg, and it forms a 60° angle with the ground.
Find all forces.

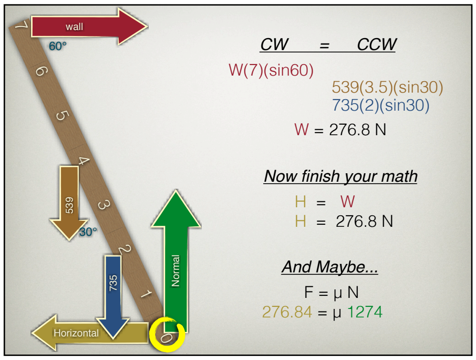
23


wall
539
735
Normal
Horizontal
Climbing a Ladder
Find all Forces
•Weight of Ladder
•55 x 9.8
•Weight of Climber
•75 x 9.8
•Normal
•"Wall"
•Horizontal

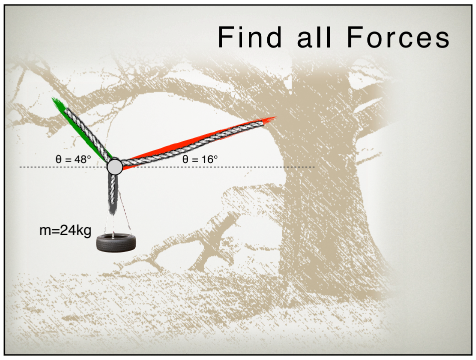
24


wall
539
735
Normal
Horizontal
U = D
N = 735 + 539
N =1274 N
L = R
H = W

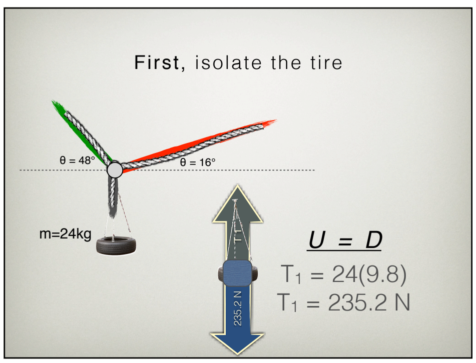
25


wall
60°
7
6
5
4
3
2
1
0
539
30°
735
Normal
Horizontal
CW = CCW
W(7)(sin60)
539(3.5)(sin30)
735(2)(sin30)
W = 276.8 N
Now finish your math
H = W
H = 276.8 N
And Maybe...
F = μ N
276.84 = μ 1274

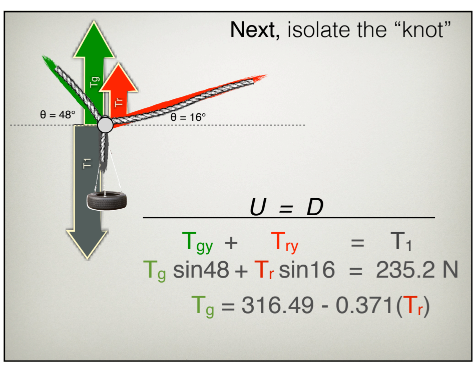
26


Find all Forces
θ = 48°
θ = 16°
m=24kg

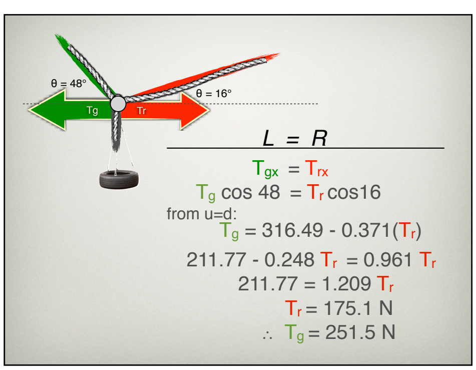
27


First, isolate the tire
θ = 48°
θ = 16°
m=24kg
T1
235.2 N
U = D
T1 = 24(9.8)
T1 = 235.2 N

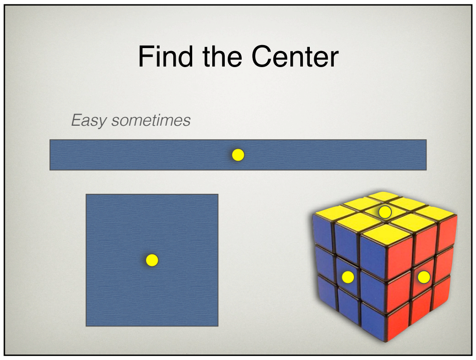
28


Next, isolate the "knot"
Tg
Tr
θ = 48°
θ = 16°
T1
U = D
Tgy + Try = T1
Tg sin48 + Tr sin16 = 235.2 N
Tg = 316.49 - 0.371(Tr)

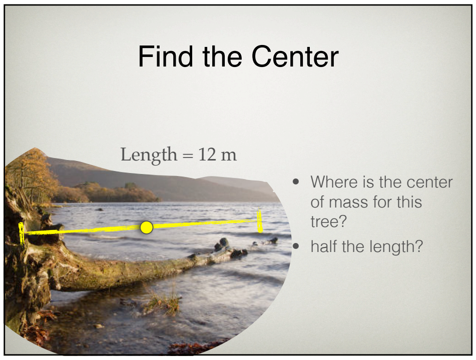
29


θ = 48°
θ = 16°
Tg
Tr
L = R
Tgx = Trx
Tg cos 48 = Tr cos16
from u=d:
Tg = 316.49 - 0.371(Tr)
211.77 - 0.248 Tr = 0.961 Tr
211.77 = 1.209 Tr
Tr = 175.1 N
∴ Tg = 251.5 N

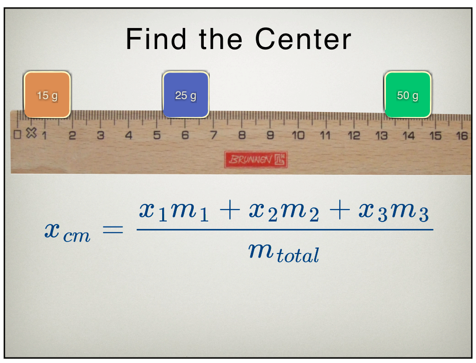
30


Find the Center
Easy sometimes

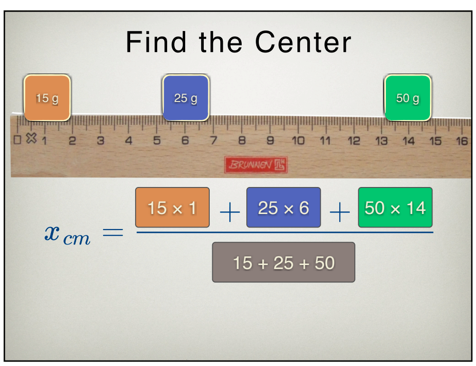
31


Find the Center
Length = 12 m
Where is the center of mass for this tree?
half the length?

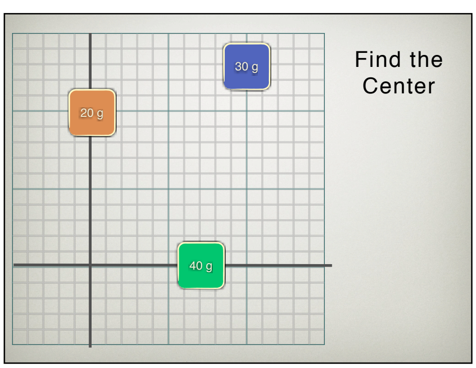
32


Find the Center
15 g
25 g
50 g
$x_{cm} = \frac{x_1 m_1 + x_2 m_2 + x_3 m_3}{m_{total}}$

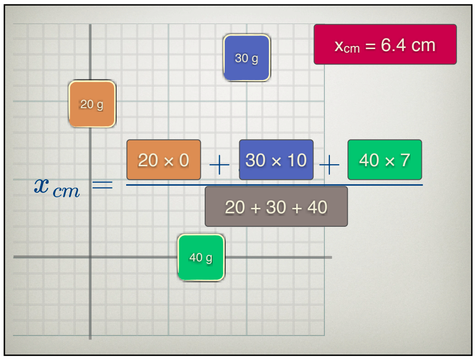
33


Find the Center
15 g
25 g
50 g
$x_{cm} = \frac{15 \times 1 + 25 \times 6 + 50 \times 14}{15 + 25 + 50}$

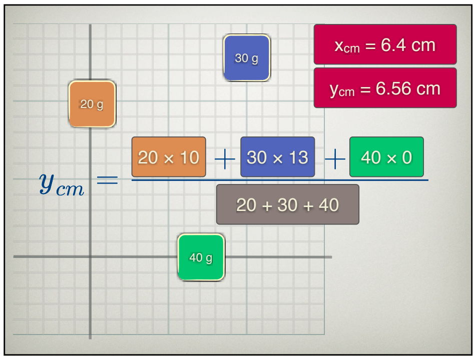
34


Find the Center
30 g
20 g
40 g

35


30 g
20 g
40 g
x_cm = 6.4 cm
$x_{cm} = \frac{20 \times 0 + 30 \times 10 + 40 \times 7}{20 + 30 + 40}$

36


30 g
20 g
40 g
x_cm = 6.4 cm
y_cm = 6.56 cm
$y_{cm} = \frac{20 \times 10 + 30 \times 13 + 40 \times 0}{20 + 30 + 40}$

37