Virtual Learning

# Physics

# Problem Solving Using Newton's Laws Part II

April 20, 2020

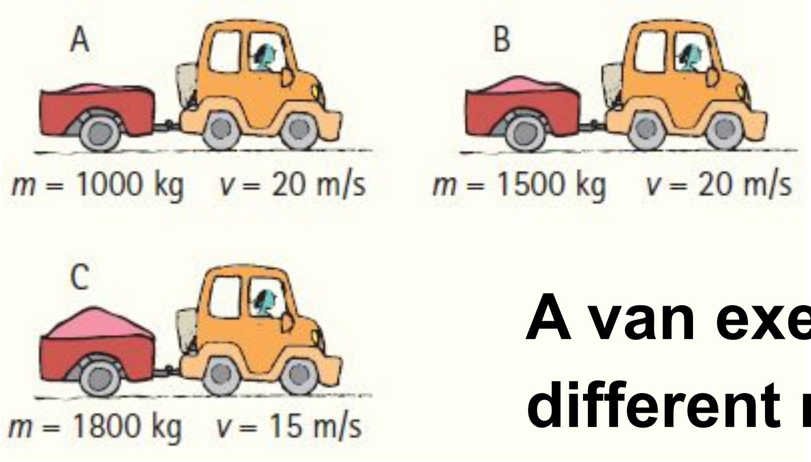
# Physics

## Problem Solving Using Newton's Laws Part II: April 20,2020

### Objective/Learning Target:

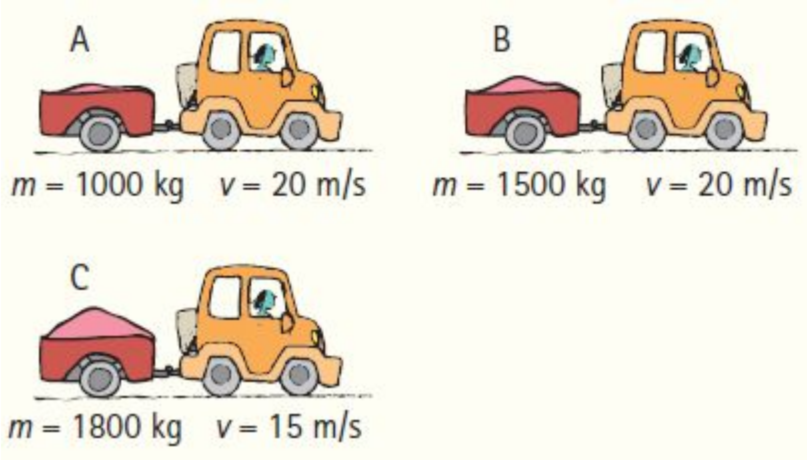
Students will practice solving a variety of problems using Newton's Laws of Motion.

# Quick Review #1




**A van exerts a force on trailers of different masses m. Compared with the force exerted on each trailer, rank the magnitudes of the forces each trailer exerts on the van.**

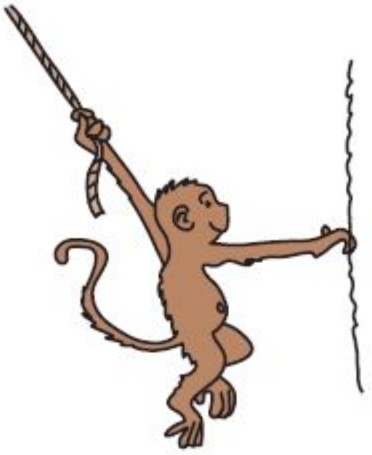
# Quick Review #1Answer




**A van exerts a force on trailers of different masses m. Compared with the force exerted on each trailer, rank the magnitudes of the forces each trailer exerts on the van.**

**Due to friction it would require more force to move the larger load, but the question asks you to rank the compared forces between trailer and truck. Following Newton's 3rd Law of Motion the truck pulls on the cart and the cart pulls on the truck equally. That being the case then A = B = C.**

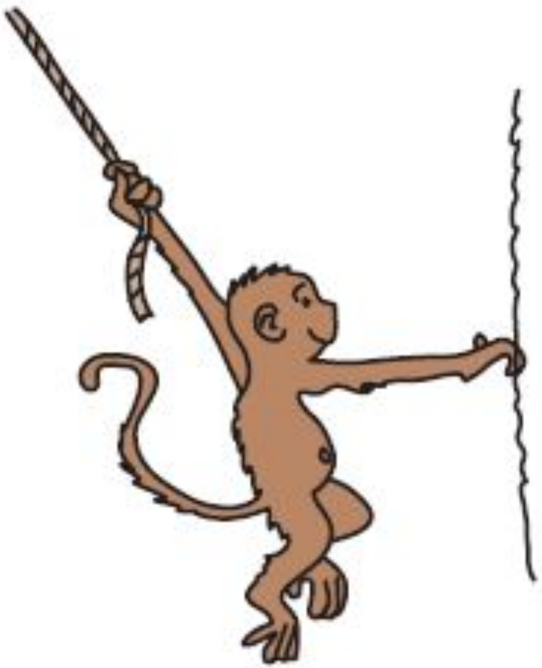
# Quick Review #2

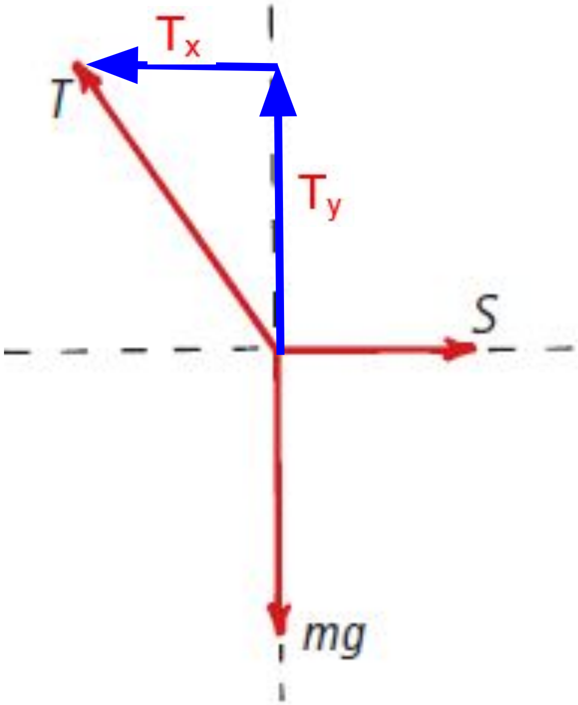


**The monkey Yazo hangs motionless as pictured to the left.**

**Draw a free body force diagram that shows all the forces are in equilibrium.**

# Quick Review #2 Answer






**$T_x = S$ and $T_y = mg$**

# Problem Solving ( Newton's Laws part II)

**Link:**[Further Applications of Newton's Laws]

**Directions:**

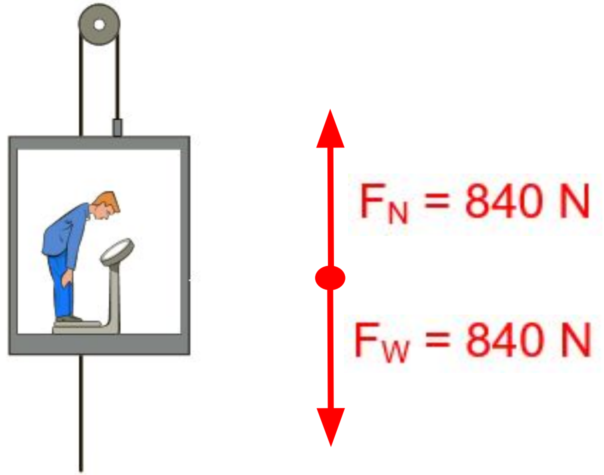
- Read through Further Applications of Newton's Laws.
- Work through any examples on a separate piece of paper before you scroll down to the solution.
- On a separate piece of paper complete the practice problems on the following slides.
- Check your answers.
- For additional practice check out the conceptual questions and the problems and exercises in the table of contents for the online text linked above.

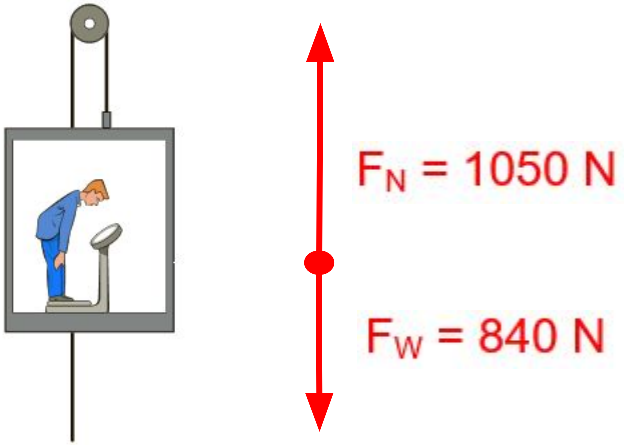
# Practice Problem #1

**A student, standing on a scale in an elevator at rest, sees that his weight is 840 N. As the elevator rises, his weight increases to 1050 N, then returns to normal. When the elevator slows to a stop at the 10th floor, his weight drops to 588 N, then returns to normal.**

a. **Determine the acceleration as the elevator begins to rise.**
b. **Determine the acceleration as the elevator slows to a stop.**

# Practice Problem #1a Answer




**Student's Mass**

$F_w = mg$ so…

$$m = \frac{F_w}{g} = \frac{840\ \text{N}}{9.8\ \text{m/s}^2}$$

$$= 85.7\ \text{kg}$$

**Scales read the Normal Force.** So when stationary, the scale reads a Normal Force that is equal to the student's weight. The Net force is equal to 0 N meaning no acceleration.

In this scenario there is a Net Force.

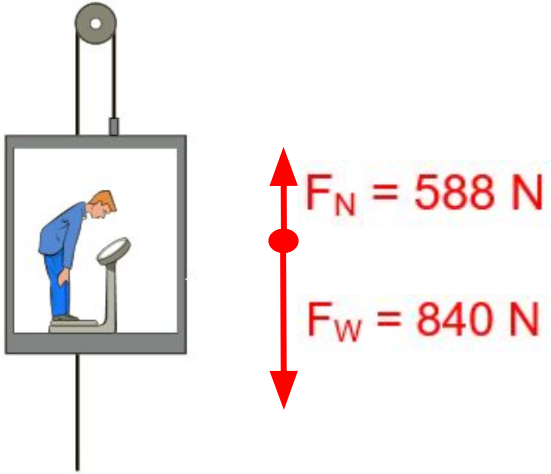
$$F_{Net} = F_N - F_W$$

$$= 1050\ \text{N} - 840\ \text{N} = 210\ \text{N}$$

So using Newton's 2nd Law and the student's mass

$$a = \frac{F_{net}}{m} = \frac{210\ \text{N}}{85.7\text{kg}} = \mathbf{15 m/s^2}$$

# Practice Problems #1b




In this scenario there is again Net Force.

$$F_{Net} = F_N - F_W$$
$$= 588\ \text{N} - 840\ \text{N} = -\ 252\ \text{N}$$

So using Newton's 2nd Law and the student's mass

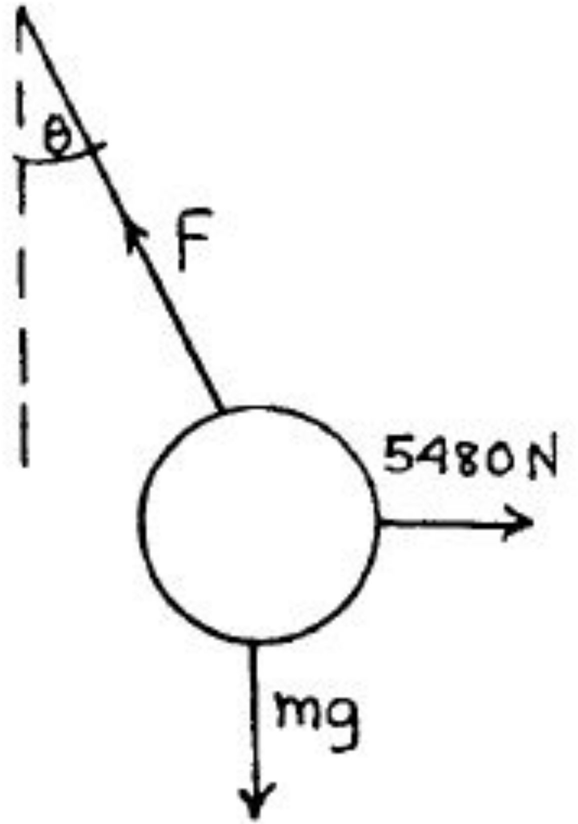
$$a = \frac{F_{net}}{m} = \frac{-\ 252\ \text{N}}{85.7\text{kg}} = \mathbf{-\ 2.94\ m/s^2}$$

# Practice Problem #2

**In the figure, a 12,400-N wrecking ball is pulled back with a horizontal force of 5480 N before being swung against the side of a building.**

a. **What angle does the wrecking ball make with the vertical when it is pulled back?**

b. **What is the tension in the ball's supporting cable when it is at this angle?**

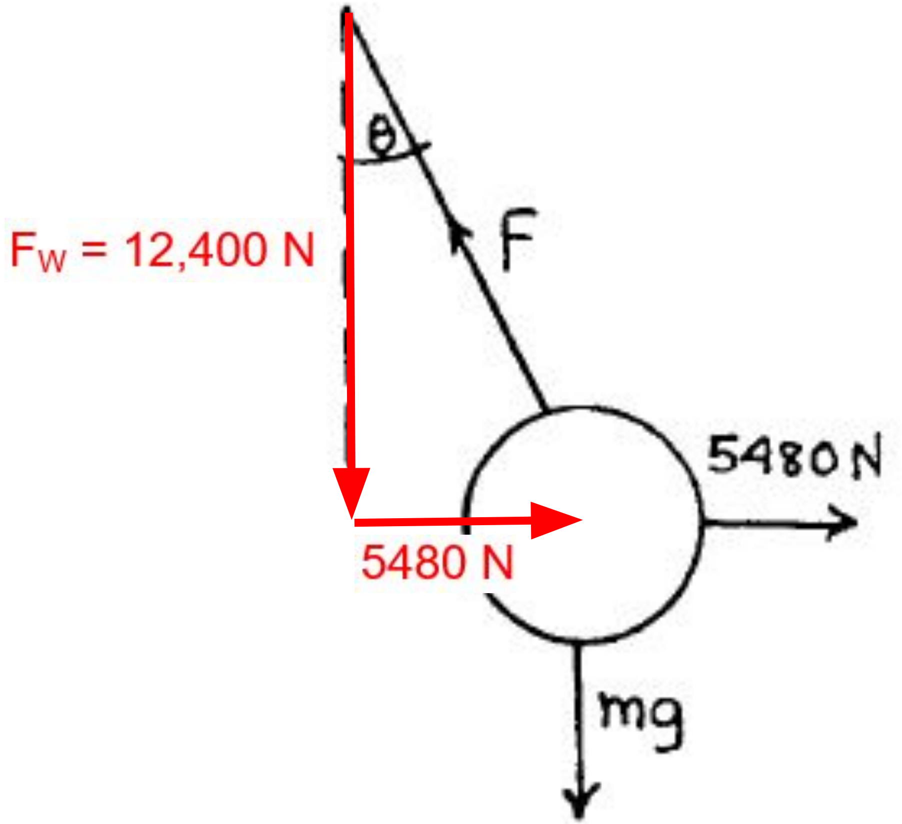


# Practice Problem #2

**a.**

$$\tan\theta = \frac{\text{Opp}}{\text{Adj}} = \frac{5480\text{ N}}{12400\text{ N}}$$

$$\theta = \tan^{-1}(0.442) = 23.8°$$



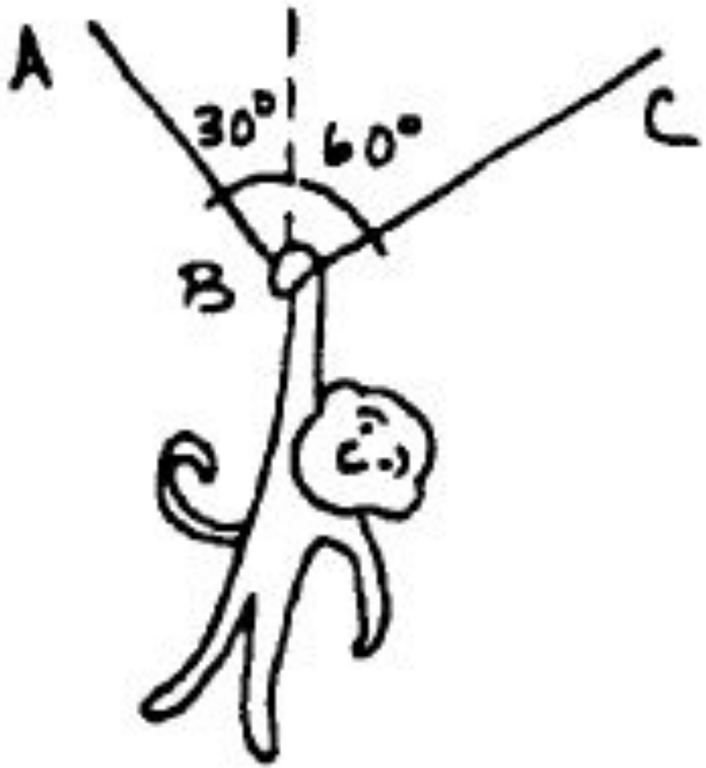

b. $c^2 = a^2 + b^2$

$= (5480^2 + 12400^2)$

$c = \sqrt{(183790400)}$

$= 13{,}557$ N

# Practice Problem #3




**Malcolm, the 200.-N monkey, hangs from a jungle vine, as shown.**

a. **What is the tension in the segment of vine labeled AB?**
b. **What is the tension in the segment of the vine labeled BC?**

# Practice Problem #3a Answer

Each side of the vine contributes to holding  Malcolm's weight.  Each side also holds Malcolm stationary side to side.

$AB_v + BC_v = 200 \text{ N}$  $AB_h = BC_h$

$AB \cos 30° + BC \cos 60° = 200 \text{ N}$  $AB \sin 30° = BC \sin 60°$

Looks like two equations and two unknowns, so let's solve for BC and substitute it in the other equation.  Hurray for Algebra!!!

$$BC = \frac{AB \sin 30°}{\sin 60°}$$

sub in

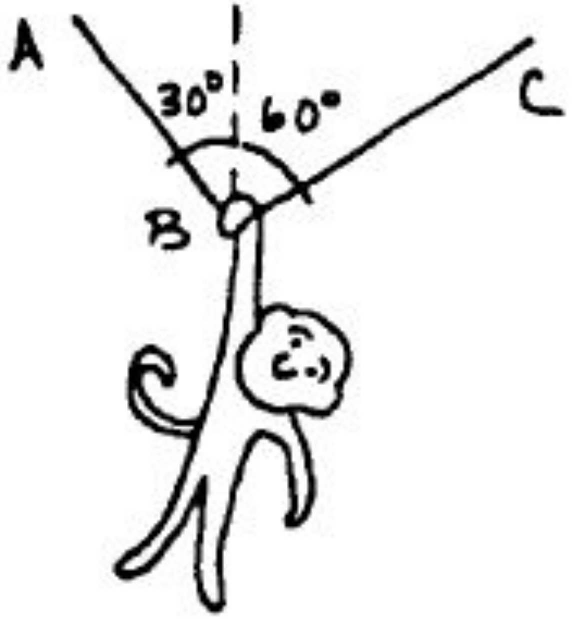
$$AB \cos 30 + \frac{AB \sin 30° \times \cos 60°}{\sin 60°} = 200 \text{ N}$$

$$AB (0.866) + \frac{AB (0.5) \times (0.5)}{0.866} = 200 \text{ N}$$

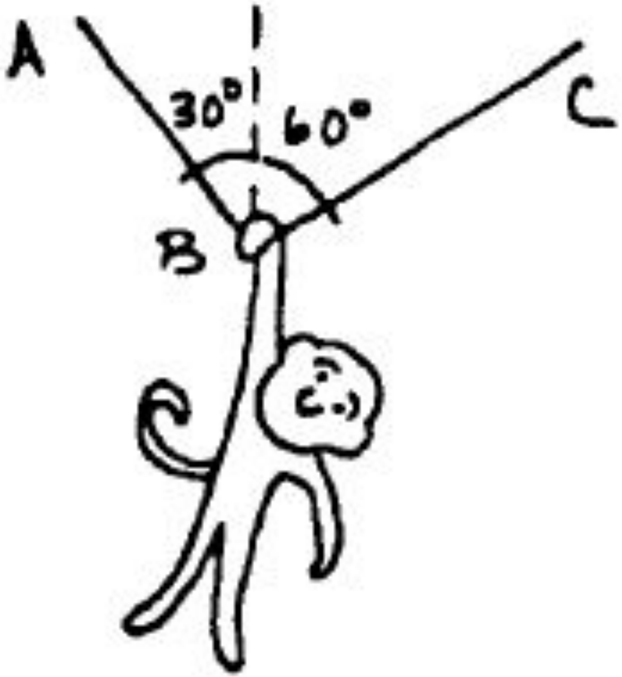
$$AB (0.866) + AB (0.289) = 200 \text{ N}$$

$$AB (1.155) = 200 \text{ N}$$

$$AB = 173 \text{ N}$$



# Practice Problem #3b Answer




$$AB \sin 30° = BC \sin 60°$$

$$BC = \frac{AB \sin 30°}{\sin 60°} = \frac{173\text{ N} \sin 30°}{\sin 60°} = \frac{173\text{ N}\ (0.5)}{0.866} = 100\text{ N}$$

# Additional Practice

For additional practice check out the conceptual questions and the problems and exercises in the table of contents from the online text linked above.