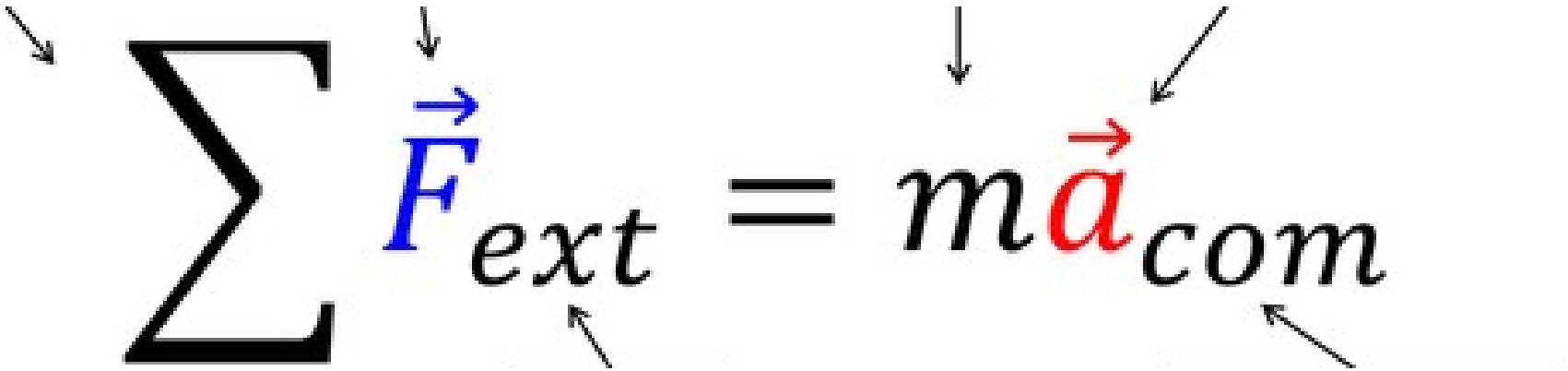
PH201 Recitation 5

Forces Part 1: 2nd Law Application

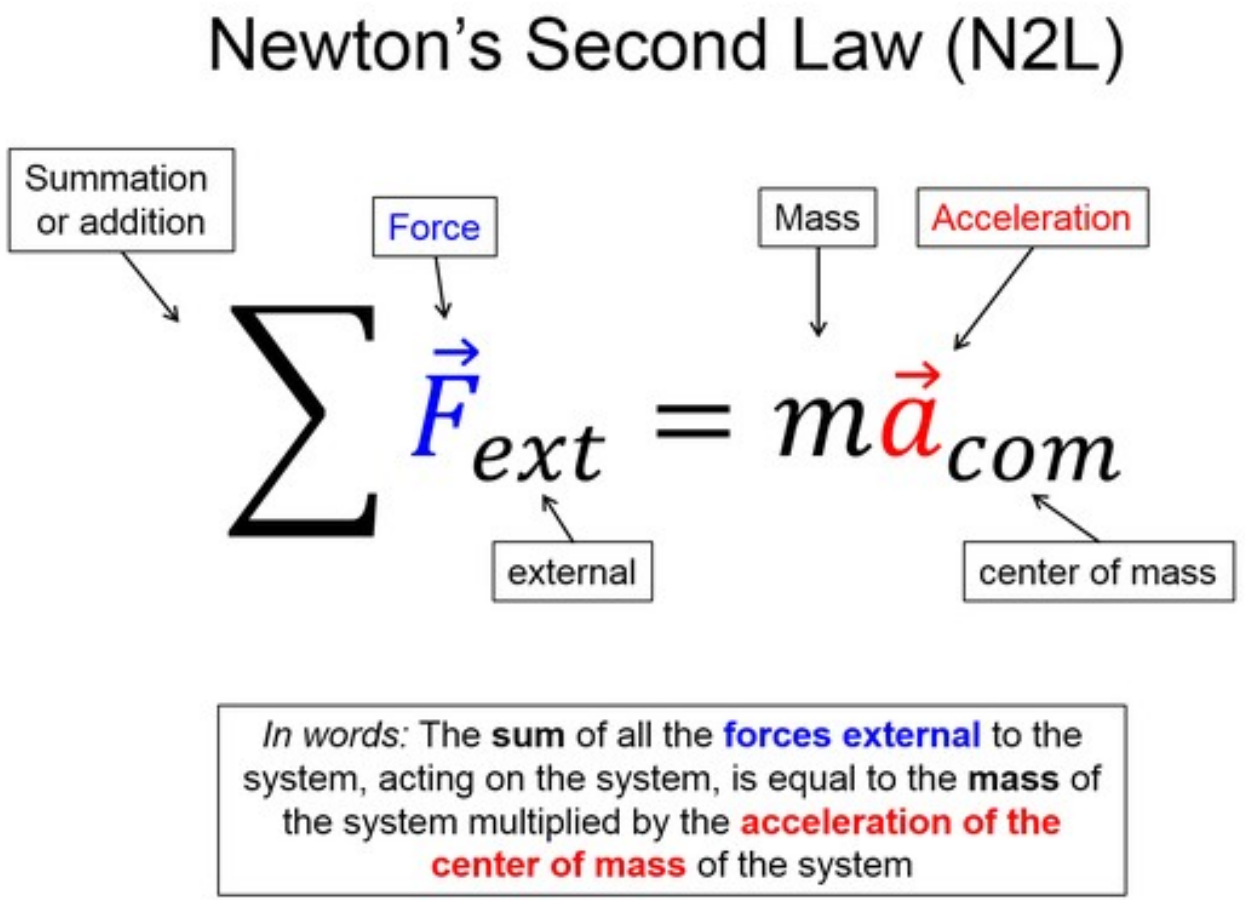
Warm-Up 1: 1 minute

- Label each of the following quantities
- Say the equation in words



To find the infographics on BoxSand go to Tips & Tricks => Mathematical Representation

Warm-Up 1: Solution



Discussion Question 1: 3 minutes

- A constant force is applied to object A and causes it to accelerate at 5 m/s^2. The same force is applied to object B and causes it to accelerate at 3 m/s^2. Applied to object C it accelerates at 8 m/s^2.
- Rank the objects from least mass to greatest mass.

Discussion Question 2: 3 minutes

- An object experiencing a constant force accelerates at 10 m/s^2. What will the acceleration of this object be if
  A. The force is doubled? Explain
  B. The mass is doubled?
  C. The force and mass is doubled?

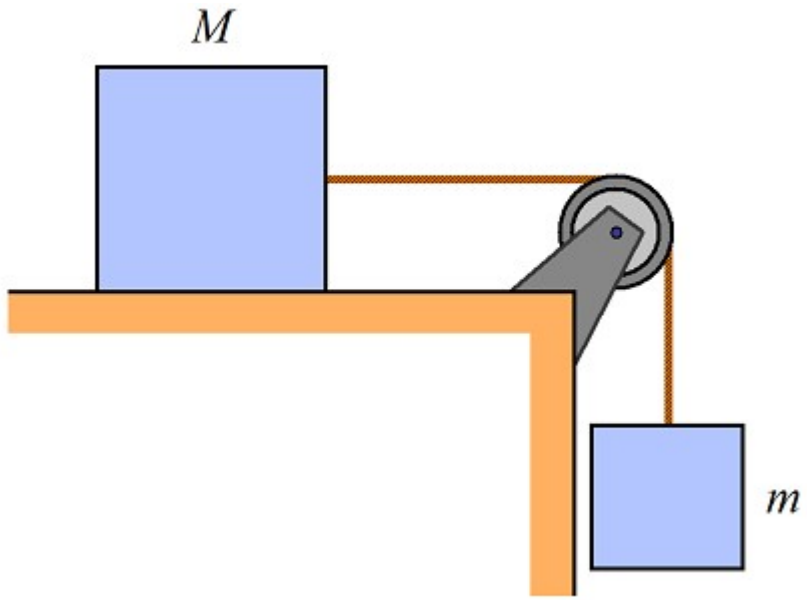
- If an object is at rest, are there any forces acting on it?

Discussion Question 3: 3 minutes

- A semi is going with velocity 10m/s hits a car (going with velocity 30m/s) head on. How does the force the car applies to the semi relate to the force the semi applies to the car?
  A. Bigger than
  B. Less than
  C. Same
  D. Not enough info

Discussion Question 4: 3 minutes

- In the figure, block m is falling and dragging block M across a frictionless table. Draw a free body diagram for both m and M.



Problem of the Day

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Problem Orientation: 8 min

1. Read and Visualize: 2 min
2. Discuss with your group: 1 min
3. Individually draw your FBD: 2 min
4. Compare with your group and come to consensus: 1 min
5. List knowns and unknowns: 1 min
6. What's being asked and what physics is needed to solve the problem: 1 min

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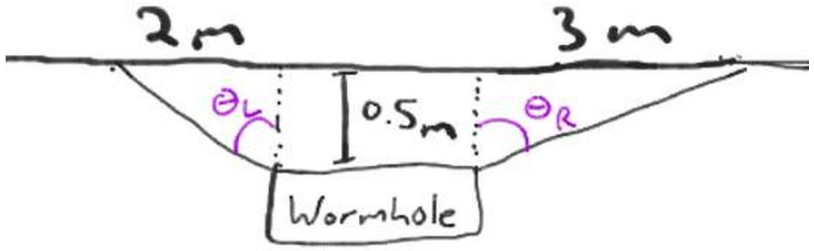

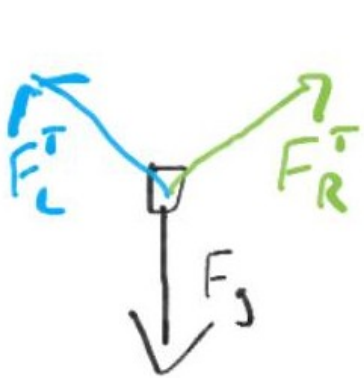

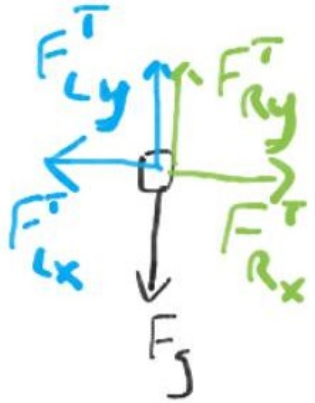

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K

Problem Orientation: 8 min

$F_g = mg$ $\quad \Delta x_R = 3m$

$m = 8kg$ $\quad \Delta x_L = 2m$

$g = 9.8 m/s^2$ $\quad \Delta y_R = \Delta y_L = 0.5m$

$\tan\theta_L = \frac{2m}{0.5m}$ $\quad \tan\theta_R = \frac{3m}{0.5m}$

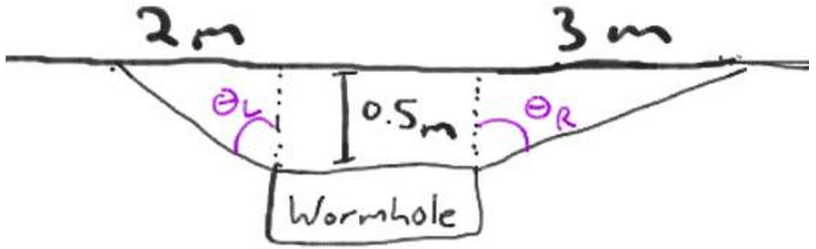
$\theta_L = \tan^{-1}(4)$ $\quad \theta_R = \tan^{-1}(6)$

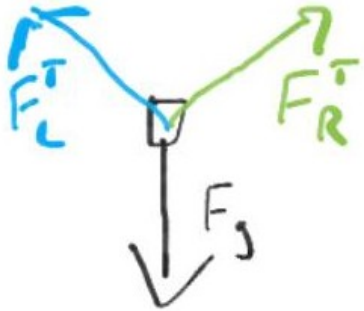
$= 76.0°$ $\quad = 80.5°$

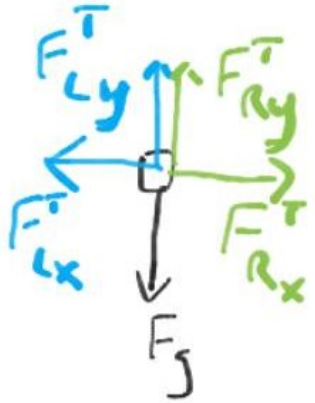
UK

F_R^T ?

F_L^T ?







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Solve the problem: 8 min

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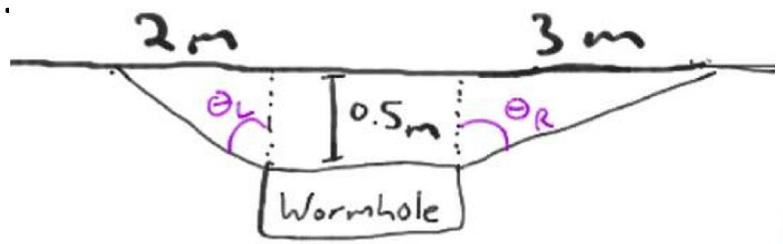

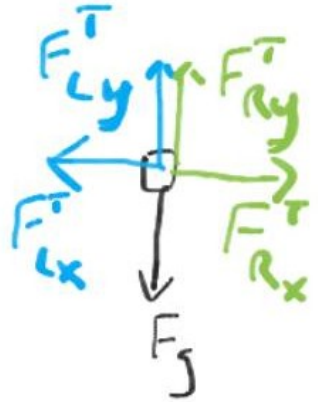

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Solve the problem: 8 min

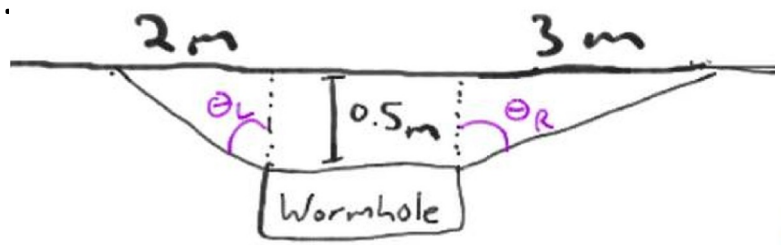
$\Sigma F_x = ma_x$

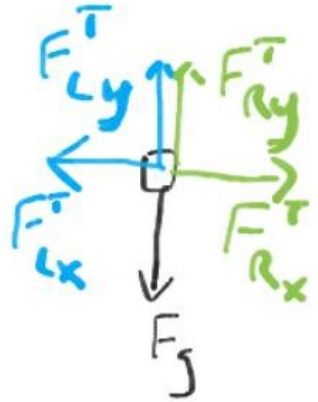
$F_{Lx}^T + F_{Rx}^T = 0$

$F_{Lx}^T = -F_{Rx}^T$

$\Sigma F_y = ma_y$

$F_{Ly}^T + F_{Ry}^T + F_g = 0$





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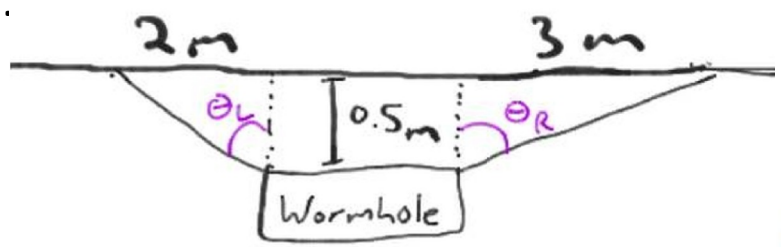
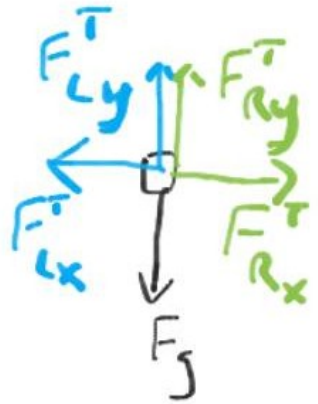
$|F_L^T| \sin\theta_L = |F_R^T| \sin\theta_R$

$|F_L^T| = |F_R^T| \frac{\sin\theta_R}{\sin\theta_L}$

$\Sigma F_y = ma_y$

$F_{Ly}^T + F_{Ry}^T + F_g = 0$





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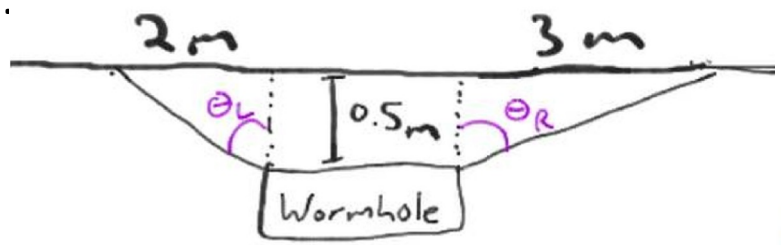
$F_L^T\cos\theta_L + F_R^T\cos\theta_R = F_g$

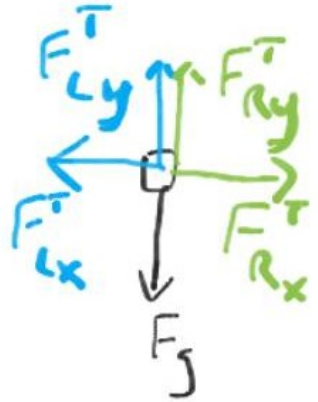
$F_R^T\frac{\cos\theta_L}{\sin\theta_L}\sin\theta_R + F_R^T\cos\theta_R = mg$

$F_R^T\left[\frac{\sin\theta_R}{\tan\theta_L} + \cos\theta_R\right] = mg$

$F_R^T = \frac{mg}{\left[\frac{\sin\theta_R}{\tan\theta_L} + \cos\theta_R\right]}$

$F_R^T = 190.8\ N$





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$|F_L^T| = 194.0\,N$

$\Sigma F_y = ma_y$

$F_{Ly}^T + F_{Ry}^T + F_g = 0$

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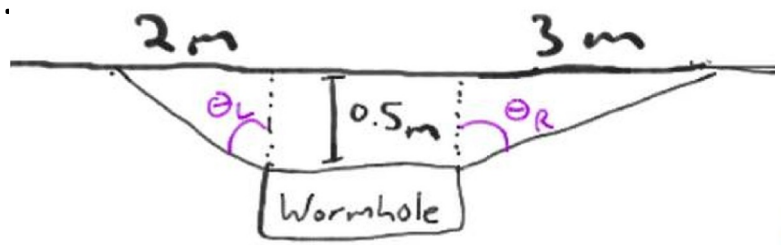

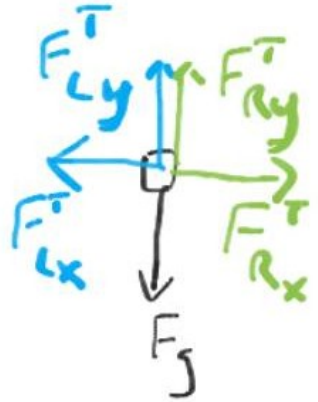

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UK

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F_L^T ?

Problem Orientation

You're flying your 10,000-kg Scooty Puff Pro spaceship at a constant speed of 20 km/s in the positive x-direction. All of the sudden it malfunctions and many of the thrusters are stuck on. The main thruster is stuck on producing a 800 kN force in the positive x-direction. Two of the small maneuvering thrusters are also stuck on, one producing a 100 kN force in a direction 30° from the positive y-direction towards the negative x-direction, and the other is producing a 150 kN force in a direction 10° from the negative y-direction towards the negative x-direction. After 2 minutes of this the two maneuvering thrusters shut off and the main thruster decreases in magnitude to 200 kN, while still applying the force in the positive x-direction. It takes an additional 6 minutes to fix the problem and turn all of them off. How far and in what direction would you have to travel to get to where you would have been if the malfunction had not occurred.

Wrap-Up

- What did we learn?