Physics 113 - September 24, 2013

- Exam 1 - a week from Thursday - Oct. 3 at 0800 in Hubbell

  Thru this week's P.S. and Workshop
  Thru chapter 4 in Text
  - one side of 8.5x11 inch sheet
  - formula sheet incl. w/ exam too
  - Bring Scientific Calculator and Pen

- Next week workshop + lab as normal, no P.S.

- Past Exams on Web (still need to update)
  P121 also, caveats

- Tuesday lecture next week online (NOT here)

Newton's Laws

I: Law of Inertia

A body persists in its state of motion unless acted on by an external net Force.

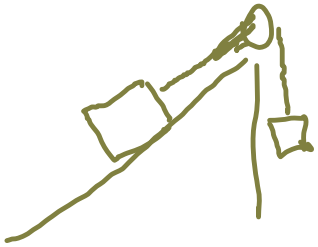
II: Force Law

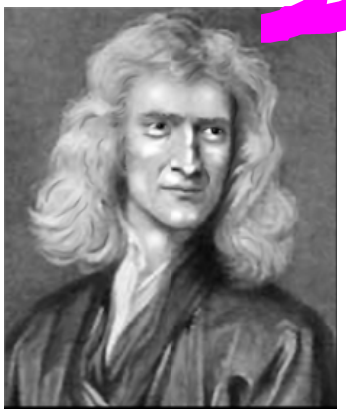
The acceleration of an object is proportional to the net force applied to it and inversely proportional to the mass of the object

$$\Sigma \vec{F} = m\vec{a}$$

III Law of Action and Reaction

For every Action there is an equal and opposite reaction

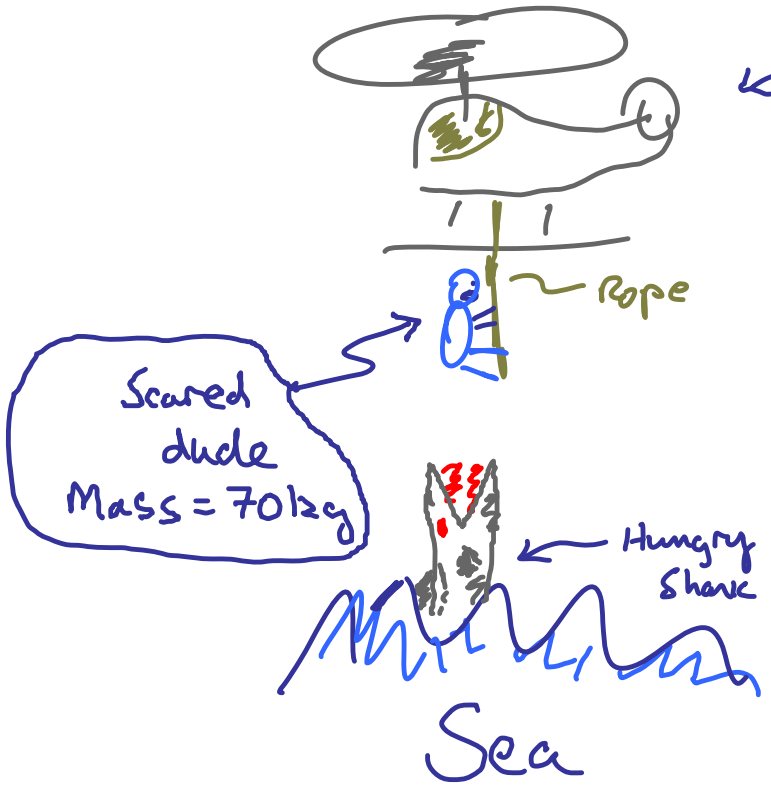




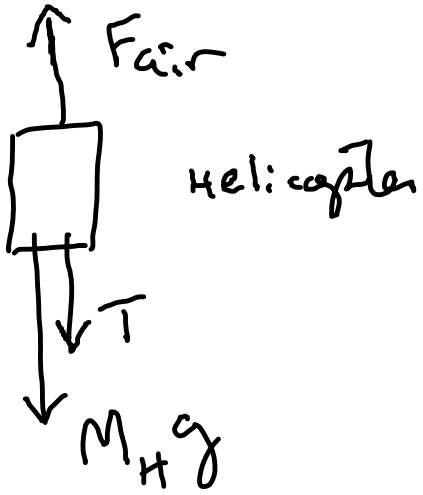
The Path to Enlightenment

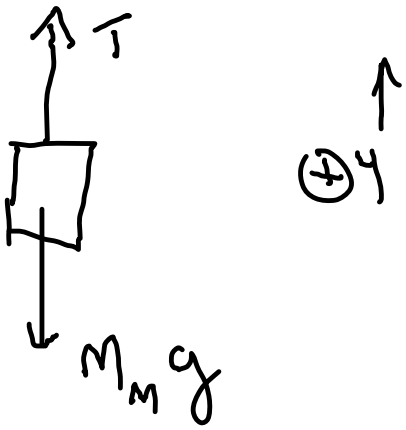
1. understand Problem, Draw neat diagram of overall problem
2. draw Free body diagram of ~~at~~ each relevant object - label with forces
3. Choose convenient coordinate system for each object
4. Apply Newton's second law $\Sigma \vec{F} = m\vec{a}$ in appropriate orthogonal coordinates (coordinates chosen for each body must be related to those chosen for other bodies)
5. Keeping Symbols in place (no #'s yet!) Solve resulting set of equations simultaneously
6. Check answer with limiting cases and dimensional Analysis!

Example



What tension must rope withstand?





$$\sum \vec{F}_y = M_m a_m = T - M_m g$$

$9.8\ m/s^2$

70 kg

4

70 kg

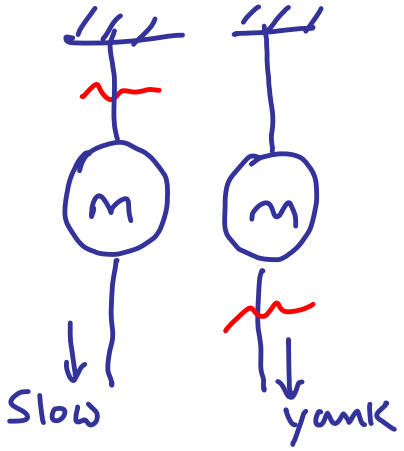
$$T = m_m(a+g) = 966\,N$$

The rope MUST withstand at least this Tension if it is Not to break under the conditions specified in the problem.

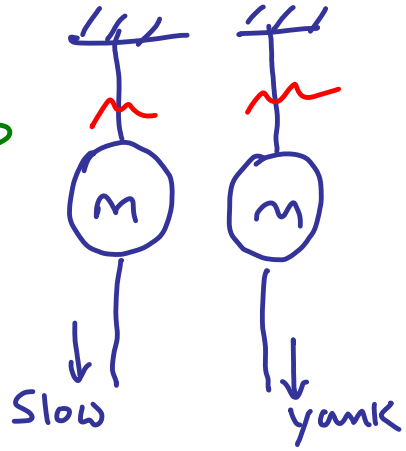
Demo

7

A



B



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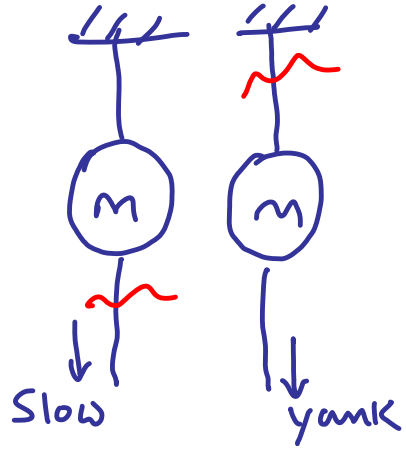
C



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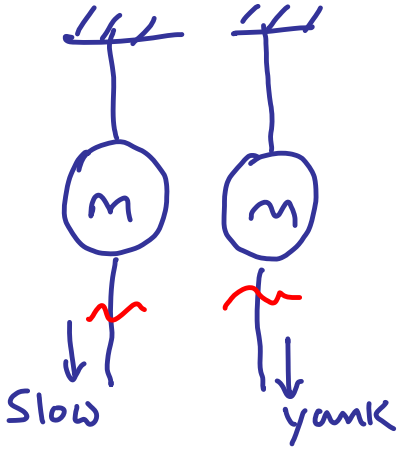
D



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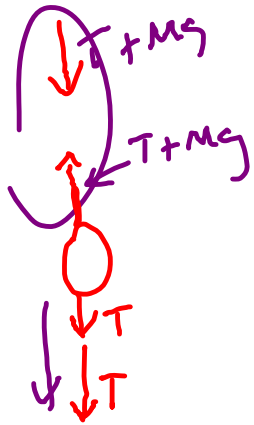
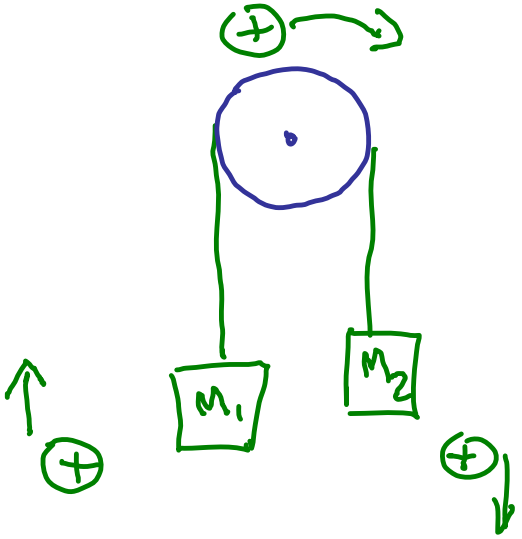


Example

Atwood's Machine

$m_1 = 6$ kg

$m_2 = 10$ kg



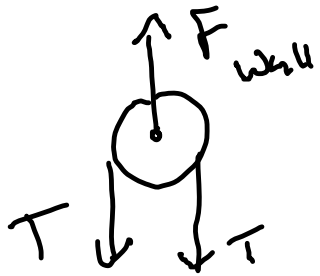
Massless

frictionless pulley

System is at rest

Then released

What is the acceleration of the system



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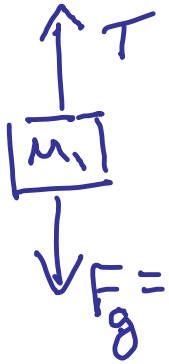
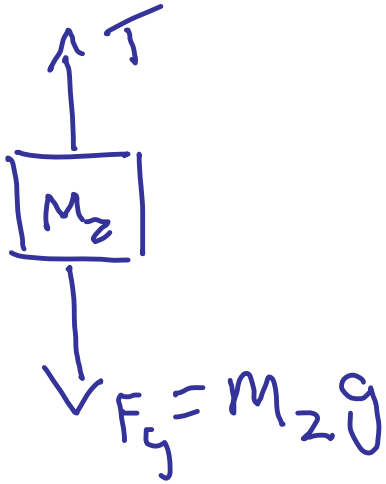




$$\Sigma \vec{F} = \Sigma F_y = m_1 a_{y_1} = T - m_1 g$$

$$\Sigma F_y = m_2 a_{y_2} = m_2 g - T$$

$$a = a$$

1 $m_1 a = T - m_1 g$

2 $m_2 a = m_2 g - T$

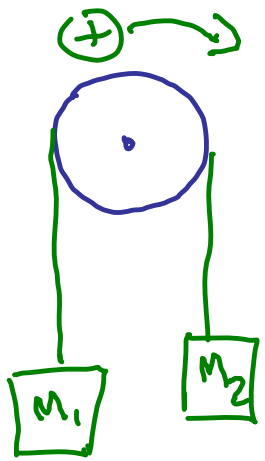
$T = m_1 (a+g)$

$m_2(a-g) = -m_1(a+g)$

$m_2 a - m_2 g = -m_1 a - m_1 g$

$a(m_2+m_1) = g(m_2-m_1)$

$$T = \frac{2g\, m_1 m_2}{(m_1+m_2)}$$



$$a = g\,\frac{(m_2-m_1)}{(m_2+m_1)}$$