Another thing FBDs are good for: Inclined Planes

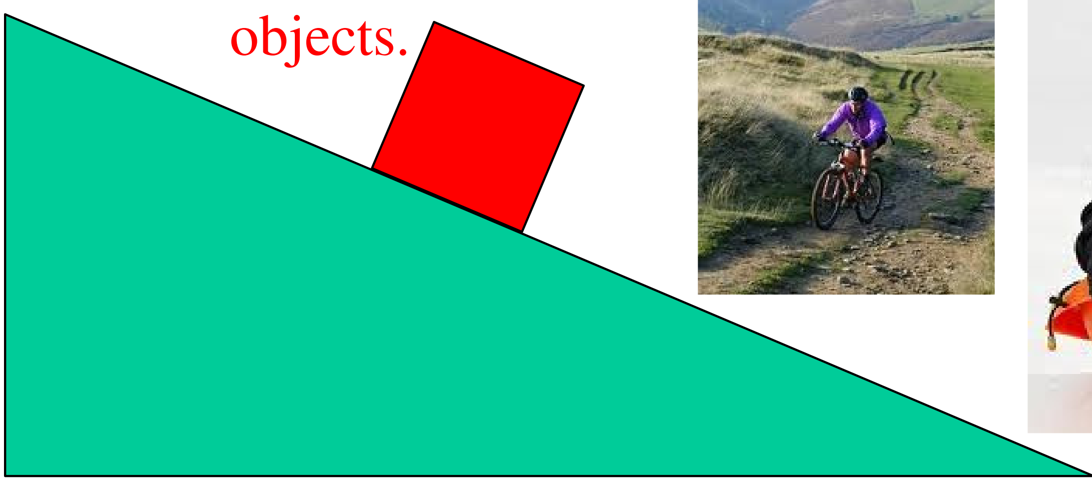
Physics is infamous for sliding blocks down inclined planes

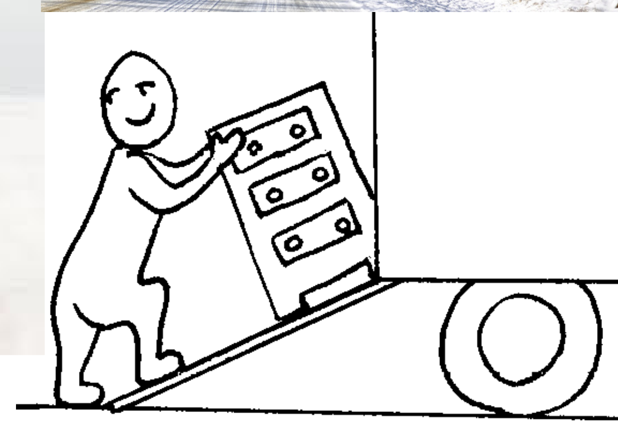
How boring! Why do we study it?

Many things we do involve inclines.

Blocks are an easy way to simplify many complex objects.

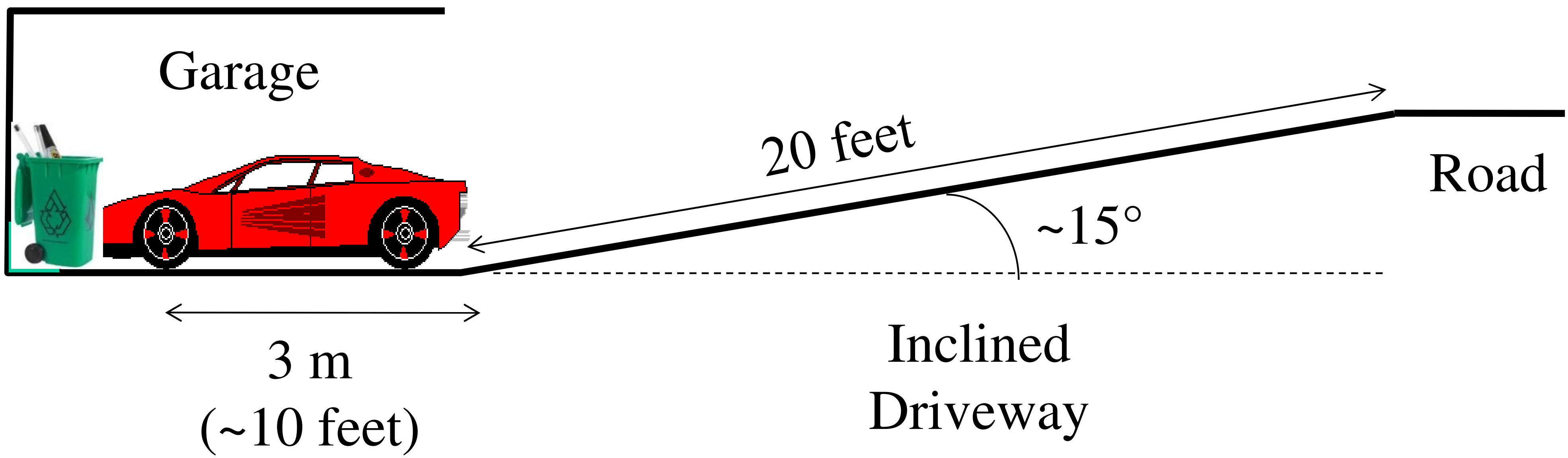
In physics, we approximate things as blocks or round objects.





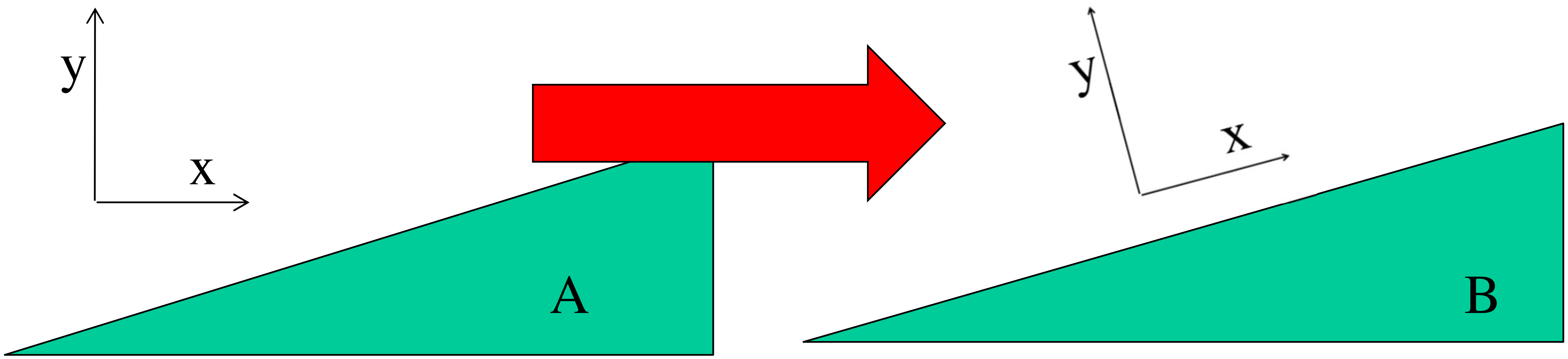
A real example: My Icy Driveway

When my driveway is a sheet of ice (ignore friction), how fast do I need to be driving to get to the top of my driveway?



Making 2 dimensions only 1!

Better, unless if going around an inclined curve (Ch. 7)



Why would I change x and y?

In Case A, need v_x, v_y, Δx, Δy?

Have to break up the vector components

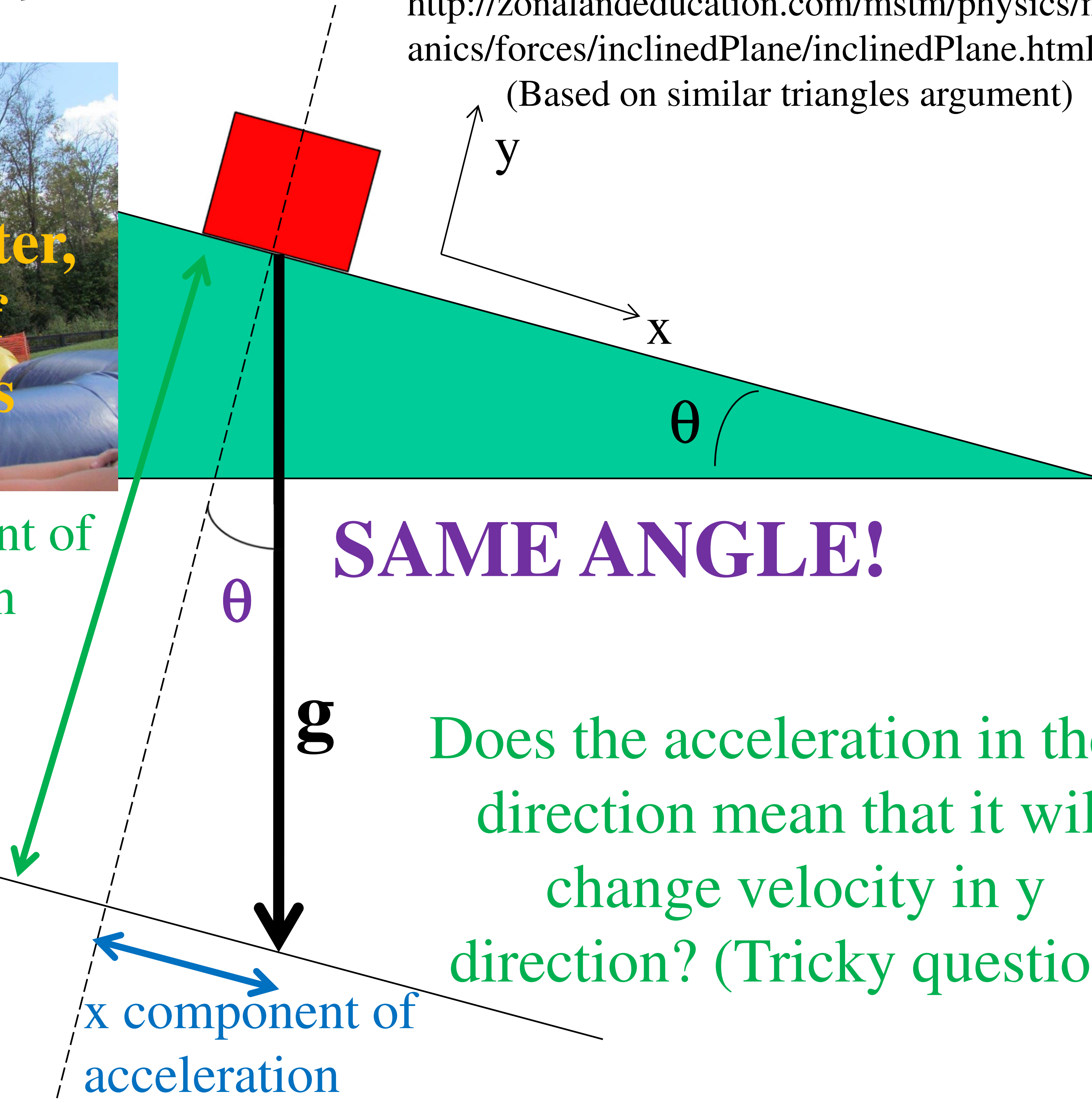
In Case B: $\Delta y=0$, $v_y=0$

Acceleration changes though: $a_x=\pm 9.8 \sin\theta$

Why $a_{g,x}=\pm 9.8 \text{ Sin}\theta$?

http://zonalandeducation.com/mstm/physics/mechanics/forces/inclinedPlane/inclinedPlane.html

(Based on similar triangles argument)



y component of acceleration

SAME ANGLE!

Breaking up vector components:

Draw a line parallel to y axis from start of the vector

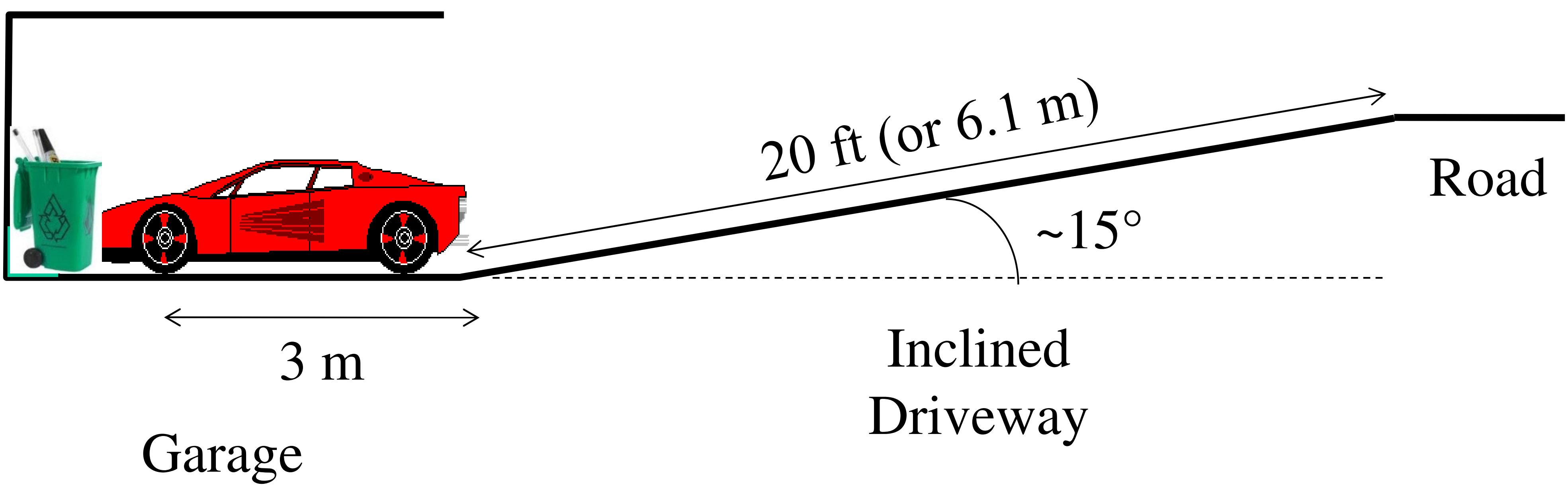
Draw a line parallel to x axis from end of vector

x component of acceleration

Does the acceleration in the y direction mean that it will change velocity in y direction? (Tricky question)

My Icy Driveway

When my driveway is a sheet of ice (ignore friction on slope), (a) how fast do I need to be driving to get to the top of my driveway? (b) Is this feasible on an icy day? (c) Is it feasible if my car was not in a garage?

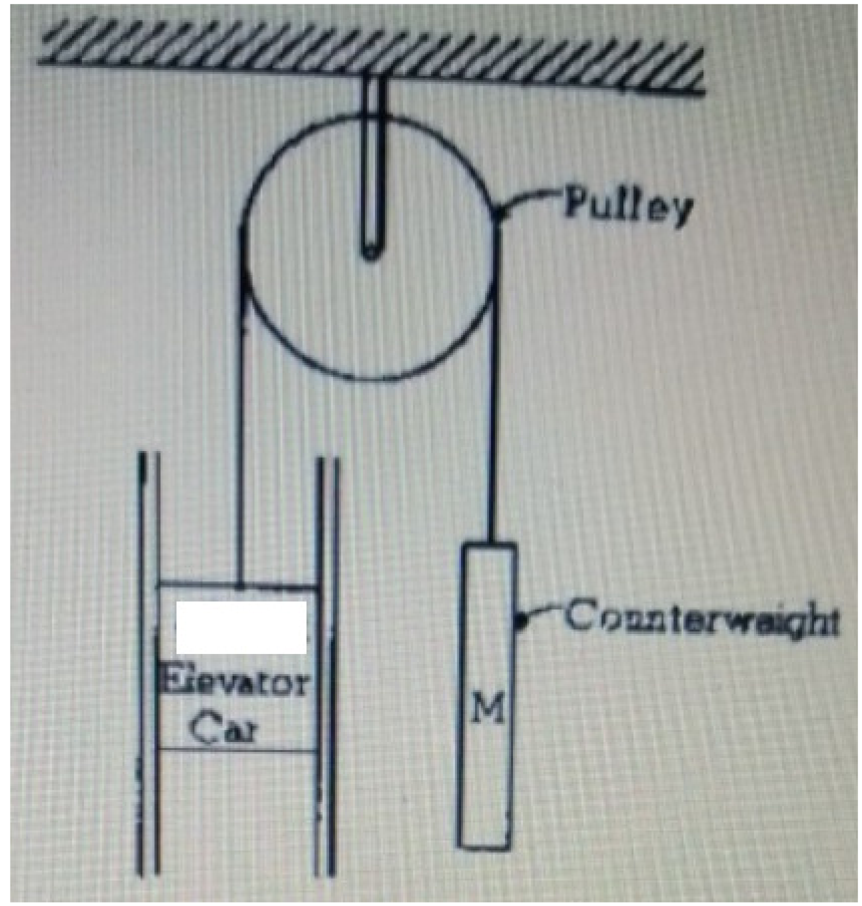


Acceleration of starting for a typical car is only 0.5g. So, how could I get out of my driveway?

Tension

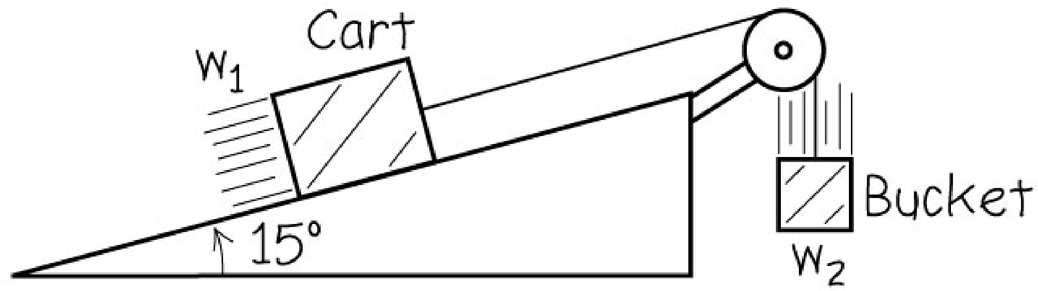
A 1200 kg elevator car accelerates upward at 1 m/s^2. Find the tension in the cable.

The weight and tension the cable can support limit the acceleration that is safe.



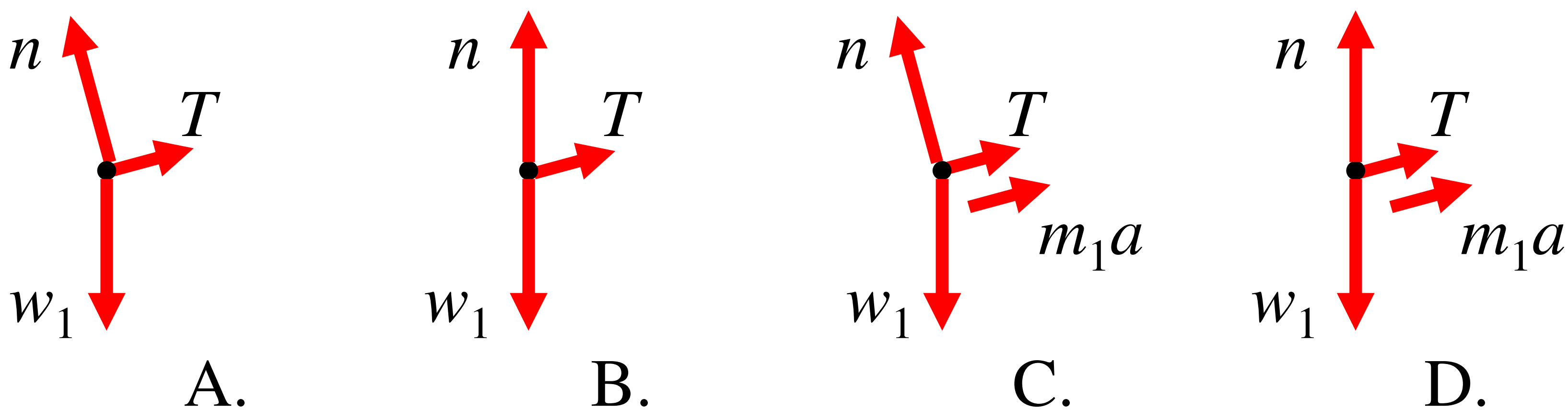
Let’s practice solving problems with pushing something at an angle with a constant force.

A cart (weight w_1) is attached by a lightweight cable to a bucket (weight w_2) as shown. The ramp is frictionless.



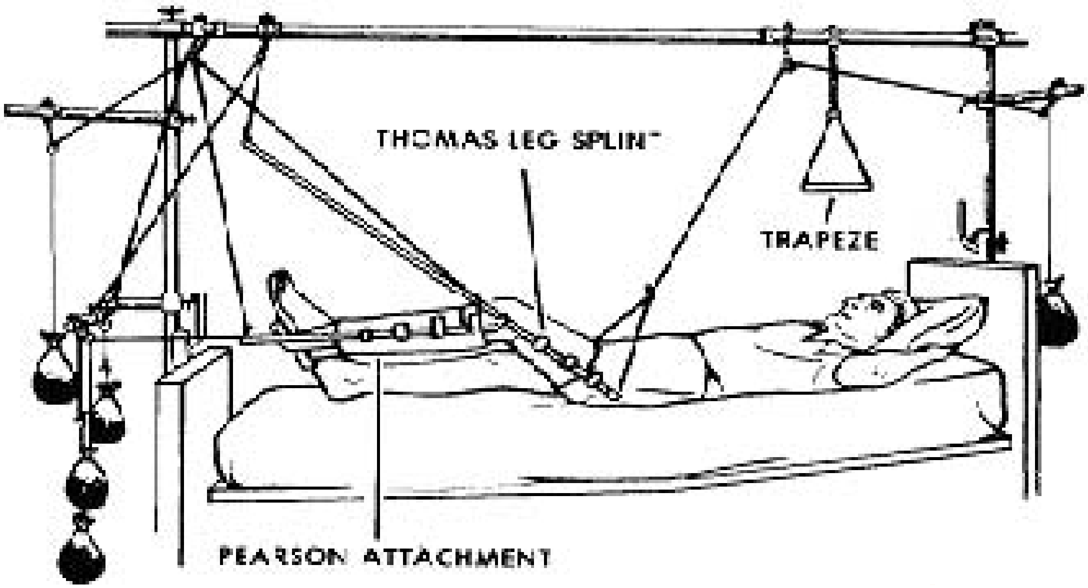
When released, the cart accelerates up the ramp.

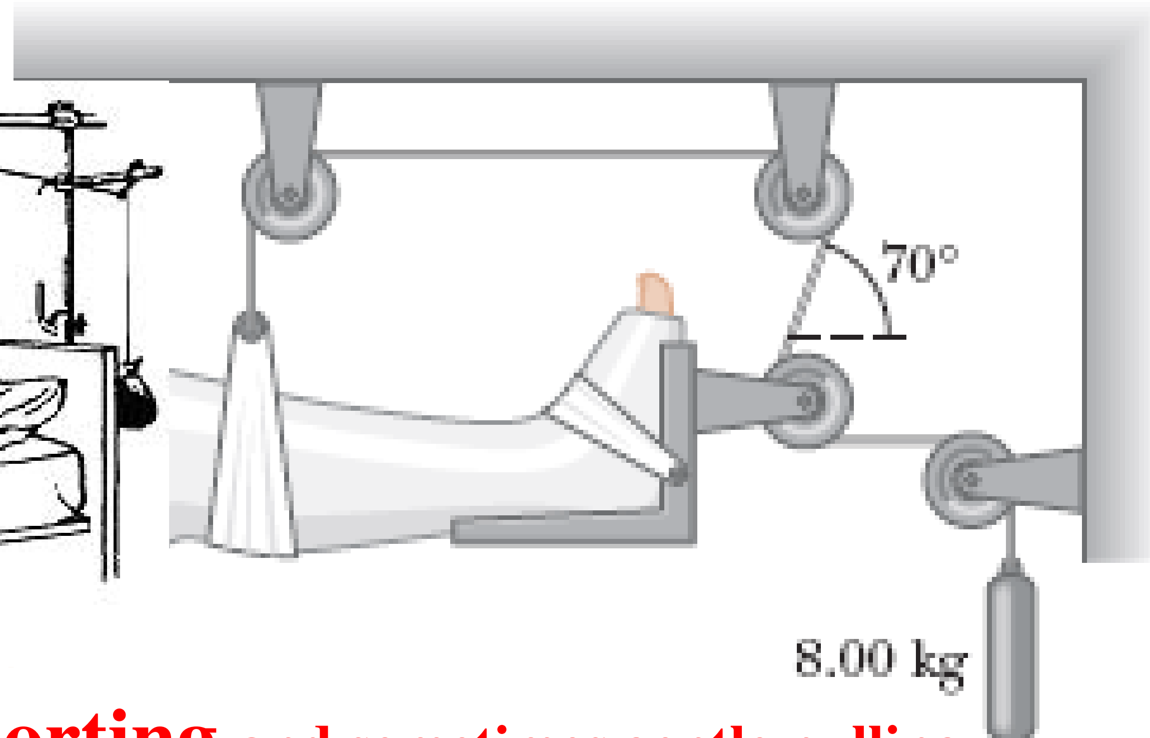
Which of the following is a *correct* free-body diagram for the *cart?*



Q44

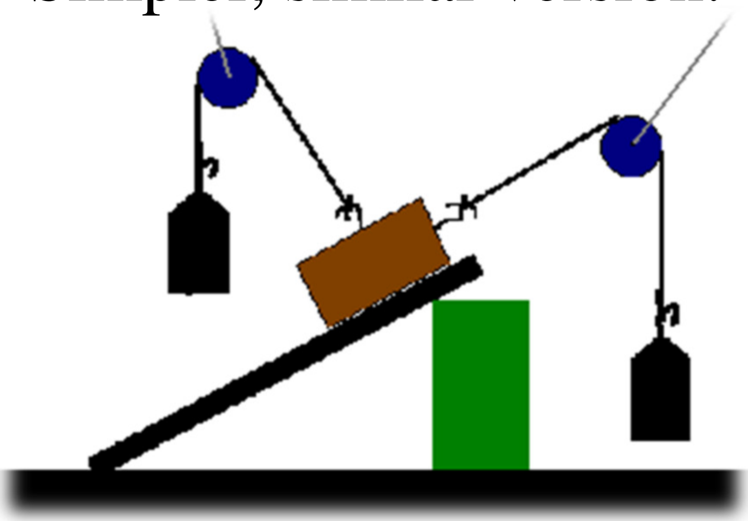
Free Body Diagrams in Medical Treatment

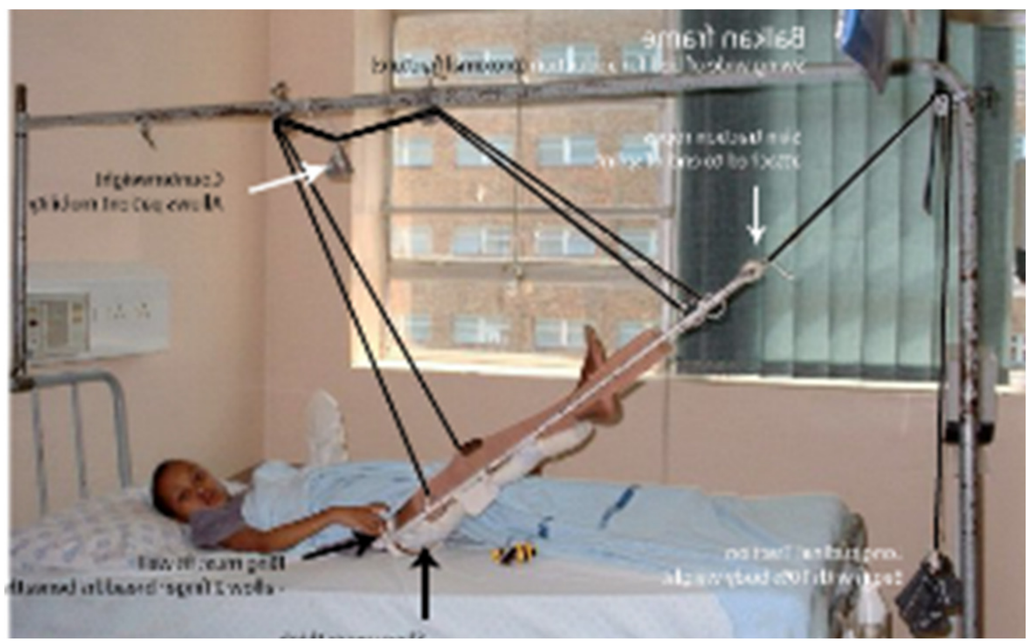




Healing Depends on Supporting and sometimes gentle pulling

Simpler, similar version:





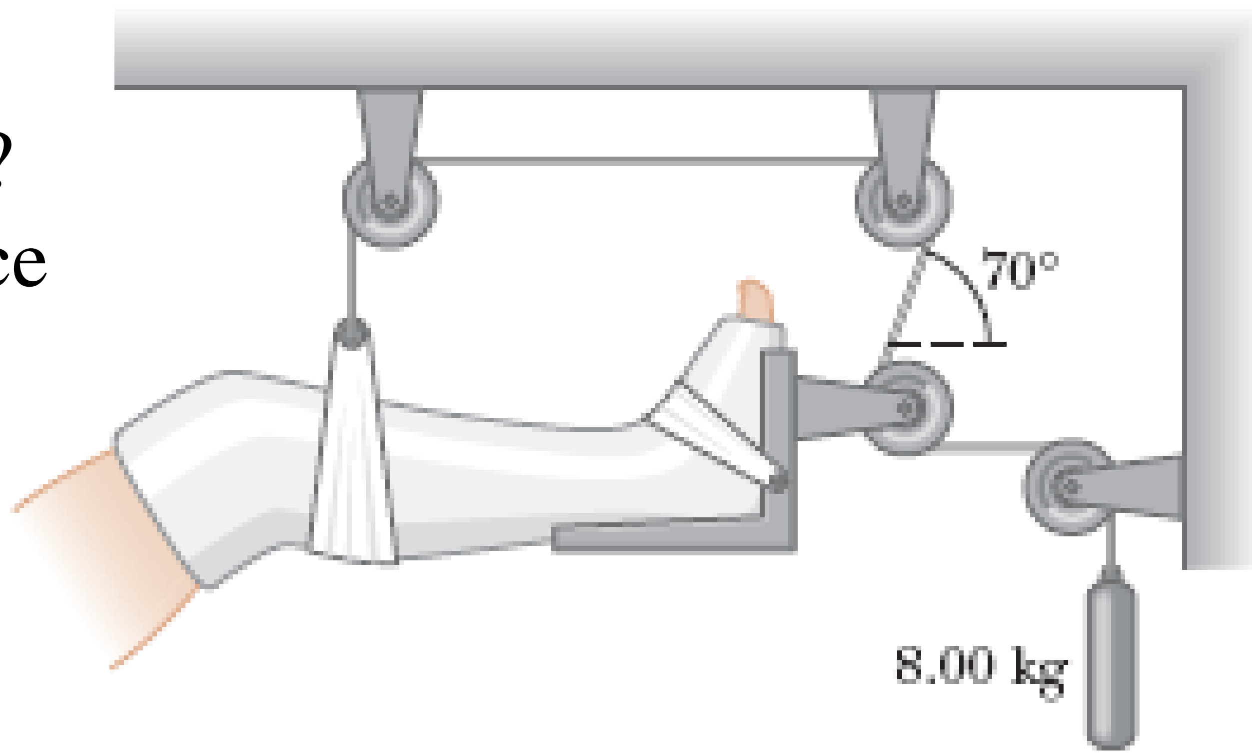
Medical Application: Support for Recovery

A setup similar to the one shown in the figure below is often used in hospitals to support and apply a traction (pulling) force to an injured leg.

The problem seems to suggest the leg, but you don't know much about the leg.

(a)Determine the force of tension in the rope supporting the leg (the upward force).

(b) What is the traction force exerted on the leg? Assume the traction force is horizontal.

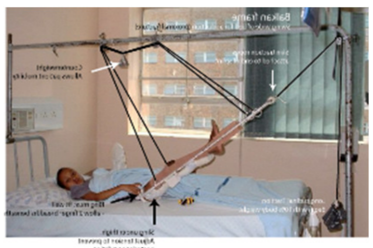


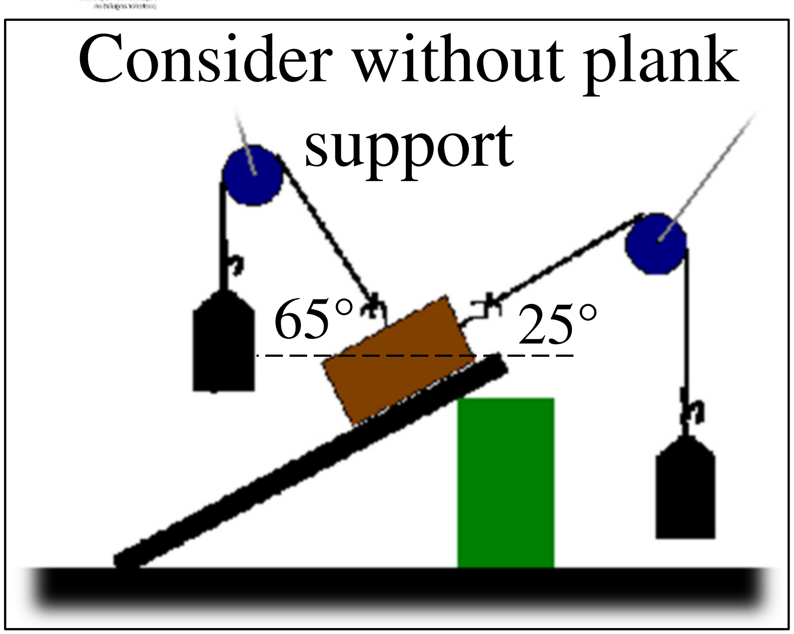
The trick with force problems like this is to figure out what to take a free body diagram of.

Net Force is Zero When an Object is in Equilibrium

If we want this 4 kg block (or leg) not to move when the black board is removed, what weights should we add to the ropes?

Draw the free body diagram when the black board is removed.

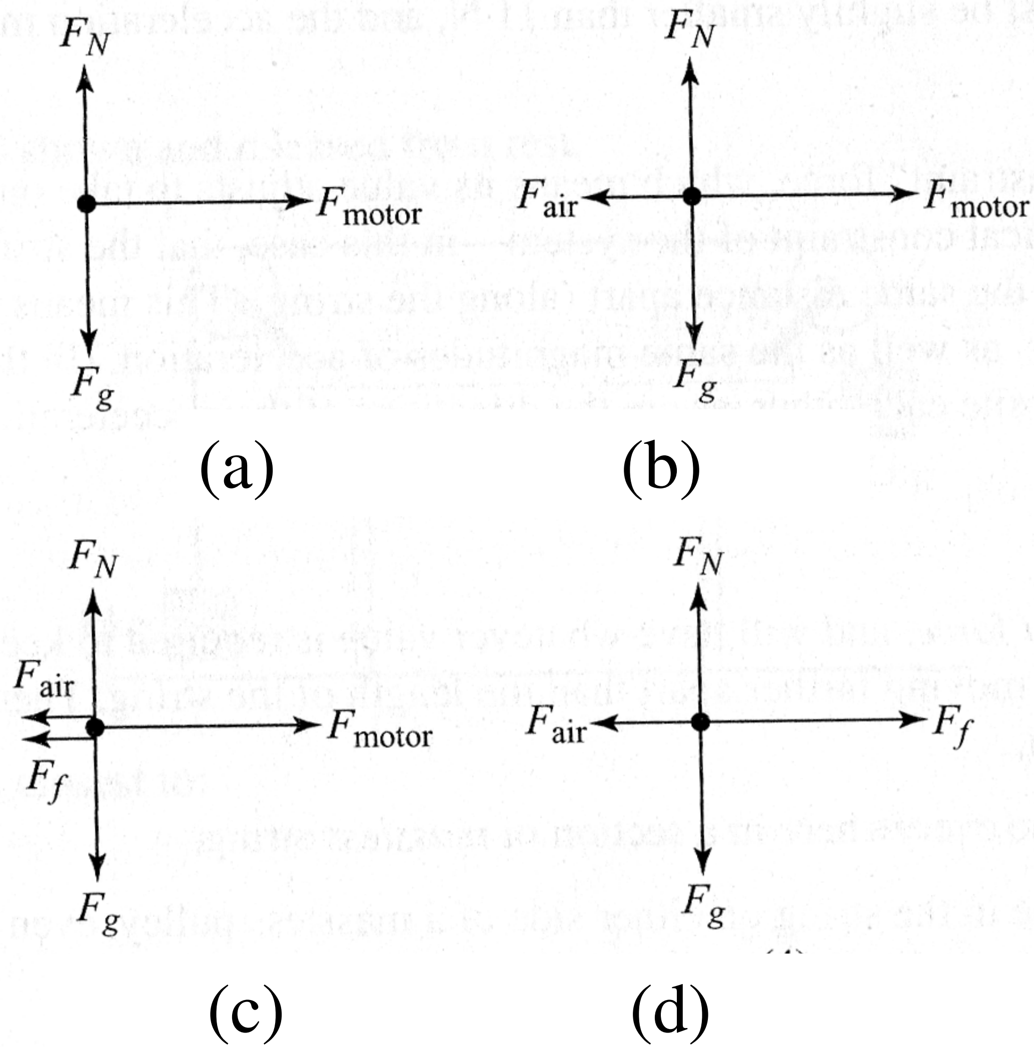




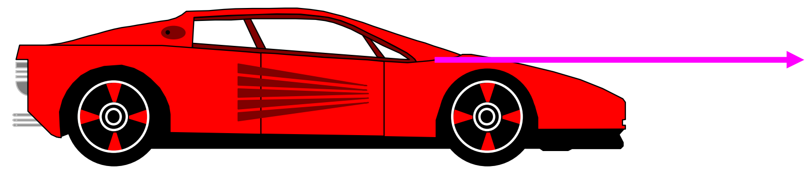
As long as the rope is free to move (e.g. on a pulley), the tension in the rope is the same at all locations on the rope.

Q46

Forces on Cars



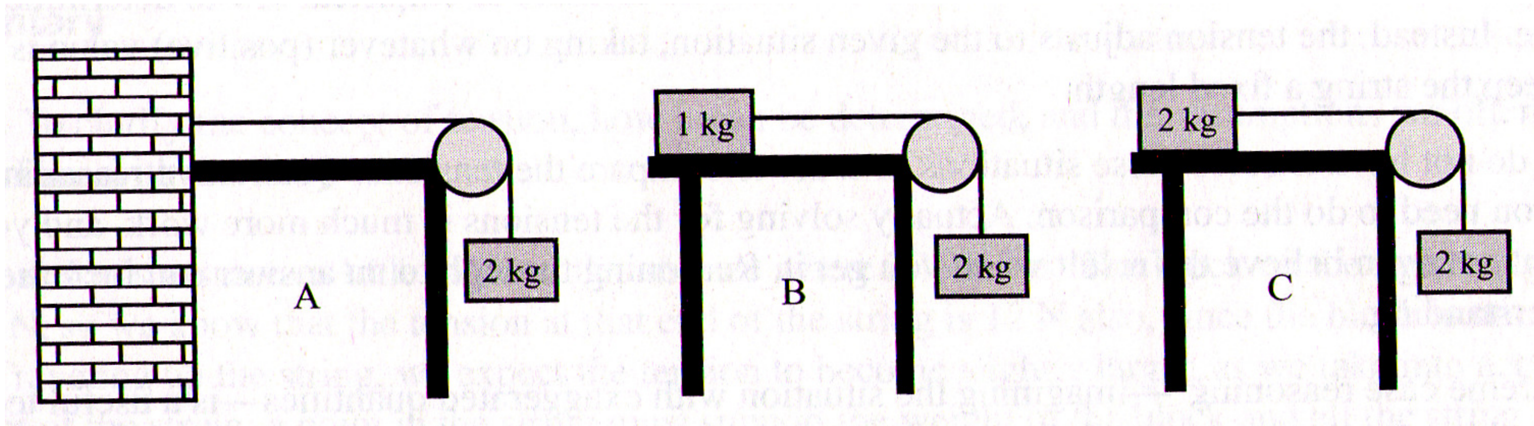
(e) None of the Above



A car accelerates down a straight highway. Which of the free-body diagrams shown best represents the forces on the car?

Friction prevents the wheels from just spinning in place. This is why a car on ice sometimes can't move.

Consider the 3 situations below, labeled A, B and C. Ignore friction.



After each system is released from rest, how do the tensions in the strings compare?

<u>More challenging question</u>

If you struggle to think conceptually about it, it is easier to determine if you draw FBD & sum forces

A. A = B = C
B. A < B < C
C. A < C < B
D. B < A < C
E. B < C < A

Q47

Clicker Answers

Chapter/Section: Clicker #=Answer

44=A, 45=C, 46=D, 47=E