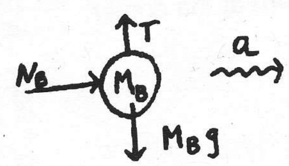
83-2. *(continued)*

$(\vec{F} = M\vec{A}\ ,\ \ Mg = Ma\ ,\ a = g)$

Then it will be second nature in a problem like this where you really need it!

Draw a Free Body Diagram (FBD) for Brian.



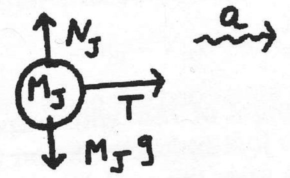
T is tension in rope acting up on Brian. $M_B g$ is gravitational force acting down on Brian. N_B is the contact force exerted on Brian by the cube surface. It is normal to the frictionless surface. Brian's acceleration has no vertical component since he does not slide up or down.

Now apply $\vec{F} = M\vec{A}$ to Brian in the upward vertical direction. Just take upward vertical components of the two vectors, $\vec{F}$ and $\vec{A}$.

$$T - M_B g \ = M_B\,(0) = 0$$

$$T \ = M_B g = 60g$$

Now draw an FBD for John.



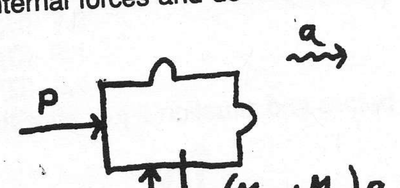
$M_J g$ and N_J are similar to above. The light rope has the same tension T throughout, and it acts to the right on John. John's acceleration is exactly the same as Brian's, since both are equal to that of the cube.

We now apply $\vec{F} = M\vec{A}$ to John in the sensible horizontal direction.

$$T \ = M_J a$$

$$a \ = T/M_J = (60g)/(80) = (3/4)\ g$$

For our third FBD, choose Brian plus John plus the cube and the rope. (An alternate choice is given below). This means the rope tension and the contact forces between the block and its passengers are internal forces and do not affect the chosen body.



P is the horizontal push applied by Joe to the block.

The acceleration of the block is the same as that of Brian and John.

Once again apply $\vec{F} = M\vec{A}$ in the obvious horizontal direction to see

$$P = (M_B + M_J)\ a = (60 + 80)\ (3/4)\ g = 105g$$

(Aside: See how easy it would be to extend the problem to a cube with mass?? I backed away from that one for the test.)