Chapter 4 Part 2 Problems

1. A 50 kg object hanging at the end of rope is accelerating upward at 1.6 m/s^2. What is the tension in the rope?

2. Same problem as above, except the object is accelerating downward.

3. Two blocks connected by a string are being pulled upward by a rope attached to the top block. The top block has a mass of 4 kg, and the bottom one has a mass of 2 kg. (a) If the acceleration of the blocks is 3 m/s^2, what is the tension in the connecting string? (b) What is the tension in the rope?

4. A 6-kg object on a tabletop is connected by a string that passes over a pulley and is connected to a 2 kg object hanging at the other end of the string. What is the tension in the string, and the acceleration of the falling object?

5. An object whose mass is 40 kg is hanging from two wires that are attached to the ceiling. One of the wires makes an angle of 30 degrees with respect to the horizontal, while the other makes an angle of 50 degrees. What is the tension in each wire?

6. A block of mass M = 20 kg is being pushed over a tabletop by a 100 N force directed along an angle of 30 degrees below the horizontal. The coefficient of friction for the block and table is 0.20. What is the block's acceleration?

Chapter 4 Part 2 Problem Solutions

1. $a = 1.6\ m/s^2$ $F = ma$ $T - 50\ (9.8) = 50\ (1.6)$ $T = 570\ N$	2. $a = -1.6\ m/s^2$ $F = ma$ $T - 50(9.8) = 50\ (-1.6)$ $T = 410\ N$

3.

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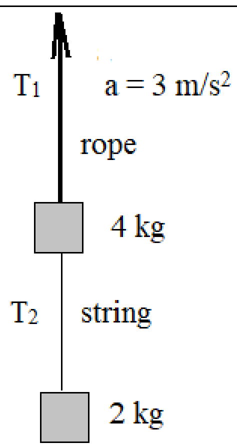

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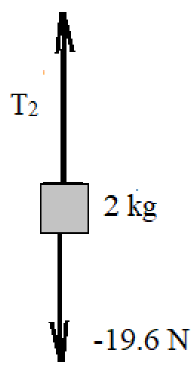
Isolate bottom block:


$F = ma$
$T_2 - mg = ma$
$T_2 - 19.6 = 2\ (3)$
$T_2 = 25.6\ N$
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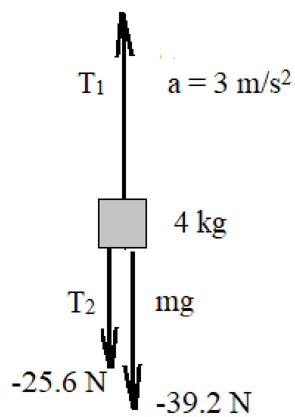
Isolate top block:


$F = ma$
$T_1 - T_2 - mg = ma$
$T_1 - 25.6 - 39.2 = 4(3)$
$T_1 = 76.80\ N$
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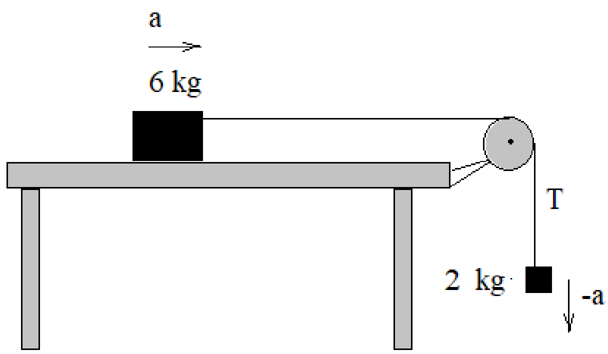
4.



The two blocks accelerate together; the acceleration of the block sliding on the tabletop is positive, while the falling block has the same acceleration, except it's negative.

6-kg Block's Acceleration = a
2-kg Block's Acceleration = -a

<u>Apply Newton's 2nd Law to 6-kg Block</u>

F = ma
T = 6a (Equation 1)

<u>Apply Newton's 2nd Law to 2-kg Block</u>

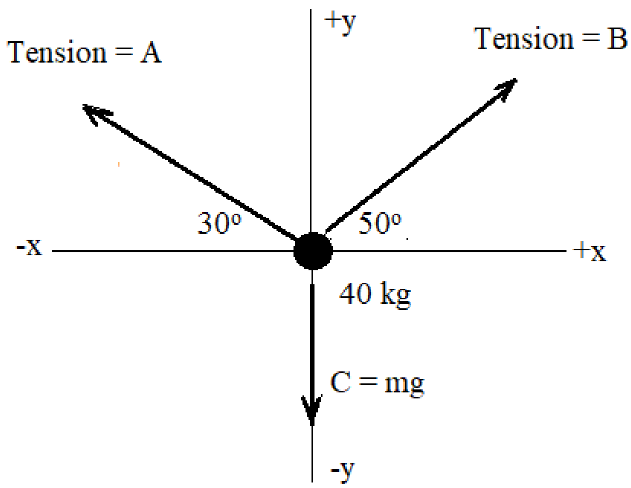
F = ma
T - 2 (9.8) = 2 (-a) (Equation 2)
T = 19.6 - 2a

Replace T with 6a from Equation 1:
6a = 19.6 - 2(a)
a = 2.45 m/s^2

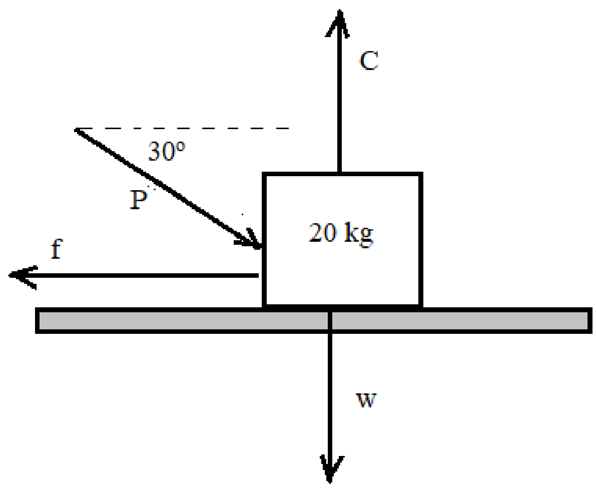
Use this value in Equation 2:

T = 19.6 - 2 (2.45)
= 14.70 N

Acceleration of hanging block: -2.45 m/s^2

5.  **F = A + B + C**	<u>Sum of x-Forces = 0</u> $F_x = 0$ $A_x + B_x + C_x = 0$ $- A \cos 30 + B \cos 50 + 0 = 0$ $B = A \cos 30/\cos 50$ $= 1.35\ A$ <u>Sum of y-Forces = 0</u> $F_y = 0$ $A_y + B_y + C_y = 0$ $A \sin 30 + B \sin 50 - 40\ (9.8) = 0$ Replace B with 1.35 A: $A \sin 30 + 1.35\ A \sin 50 - 392 = 0$ $A = 256$ N $B = 1.35\ (256)$ $= 346$ N

6.



$a_y = 0$

$F_y = 0$

$C_y + P_y + f_y + w_y = 0$

$C - 100 \sin 30 + 0 - (20)(9.8) = 0$

$C = 246\ N$

$f = 0.20\ (246)$

$= 49.2\ N$

Apply Newton's 2nd Law to the x-Direction

$F_x = 20\ a_x$

$C_x + P_x + f_x + w_x = 20\ a_x$

$0 + 100 \cos 30 - 49.2 + 0 = 20\ a_x$

$a_x = 1.87\ m/s^2$