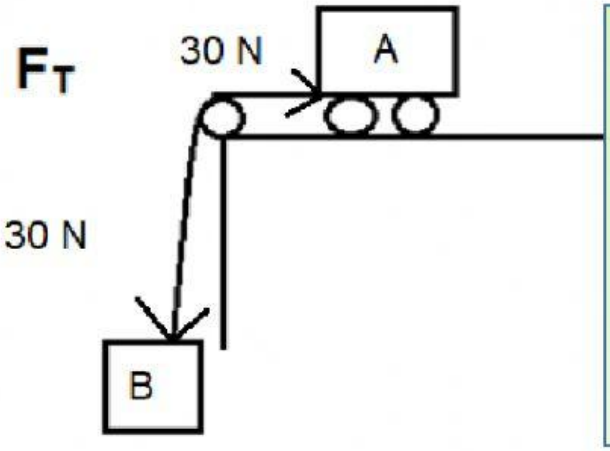
Newton laws worksheet 10

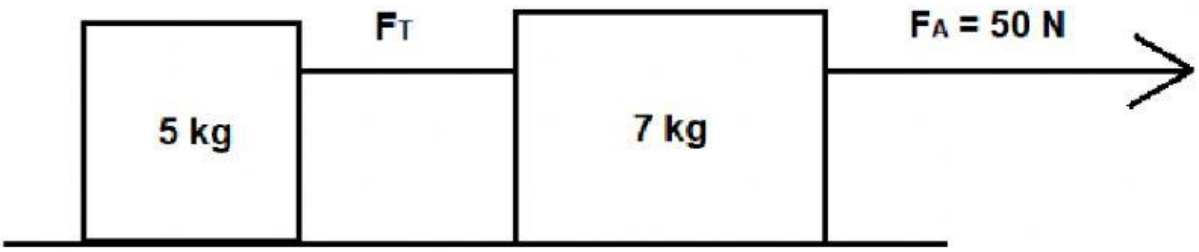
Questions including tension forces (2 or more objects)

When calculating tension force between 2 objects remember:



The tension pulling in both directions will be the same within the same rope. For example if the tension in this string is 30N then the tension force trying to pull box A down is 30 N and the tension trying to keep box B from dropping to the floor is also 30N

Eg 1. Calculate the (a) acceleration and (b) the tension in the string between the two boxes (F_T) of the system below



To calculate the acceleration of a system like this it is often useful to think of it as one object.

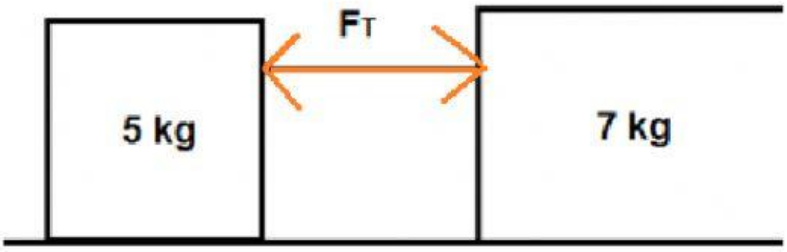
Fnet = m.a

*F_A = m.a

50 = (5 +7).a

50 = 12.a

a = 4,17 $m.s^{-2}$ right



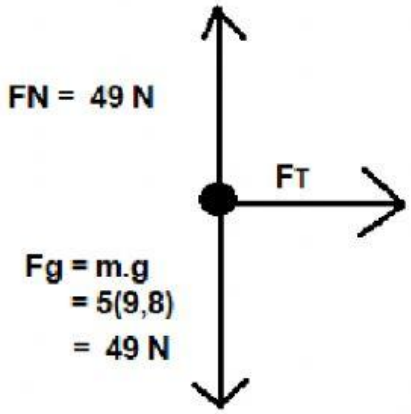
***The FT is not included when you look at the whole system since the tension in the string (F_T) pulling the 5kg to the right and the tension pulling the string pulling the 7 kg to the left is equal, and thus they would just cancel out.**

However, when you are asked to calculate the tension in-between the boxes, then you will have to look at the boxes individually.

It's most useful here to break the system up and draw a free body diagram for each box separately.

5 kg

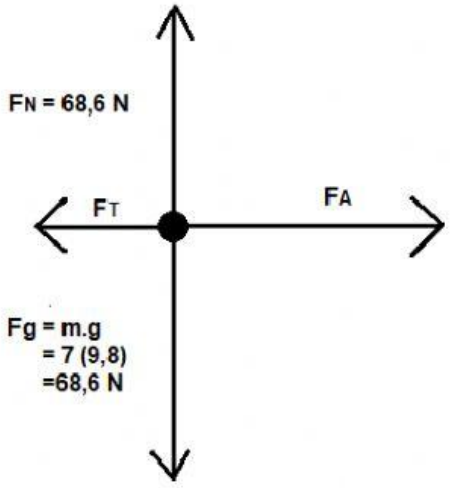
Or



The F_g and the F_N equal to each other and it is not necessary to calculate them. But we'll show them on the worksheets just to give more examples of calculating FN.

Fnet = m.a
F_T = m.a
F_T = 5 (4,17)
= <u>20,85 N right</u>

7 kg



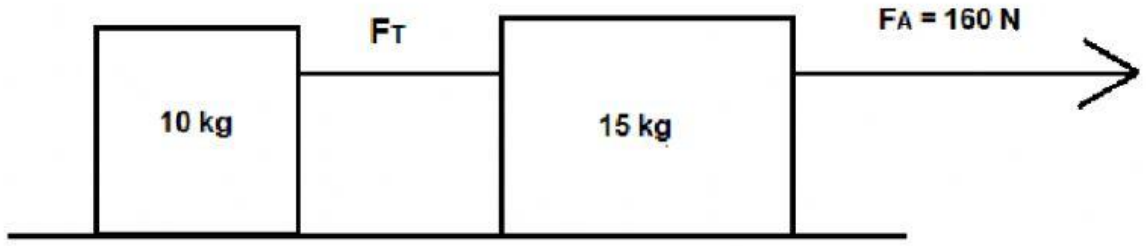
Fnet = m.a
$F_A - F_T$ = m.a
50 – F_T = 7(4,17)
FT = <u>21,81 N left</u>

Notice the 2 answers are pretty much the same. If we hadn't rounded off the acceleration in (a) then the answers would have been the same.

Thus you do not need to calculate the tension for both boxes- it'll always be the same (perhaps with a decimal difference)

Eg 2. Calculate the (a) acceleration and (b) the tension in the string between the two boxes (F_T) of the system below

Try this one yourself first, before looking at the answer.



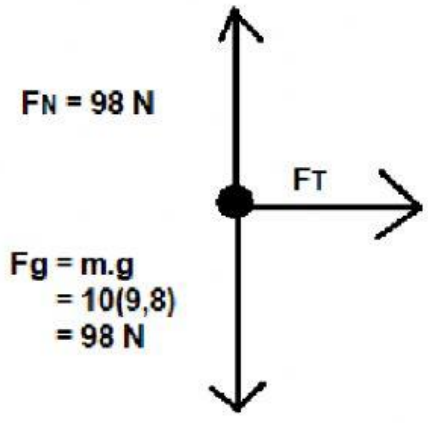
Fnet = m.a

160 = (10 +15).a

160 = 25.a

a = 6,4 $m.s^{-2}$ right

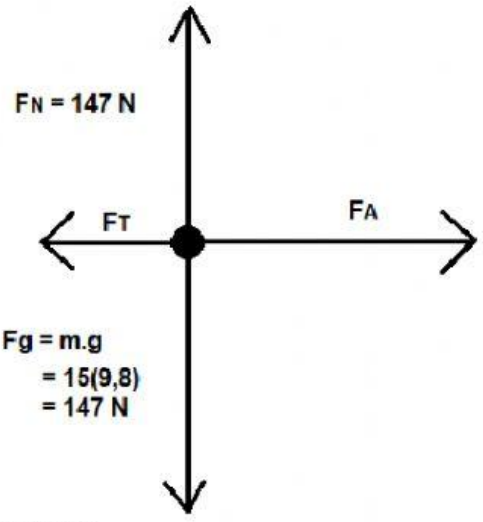
10 kg



Or

The F_g and the F_N equal to each other and it is not necessary to calculate them. But we'll show them on the

15 kg



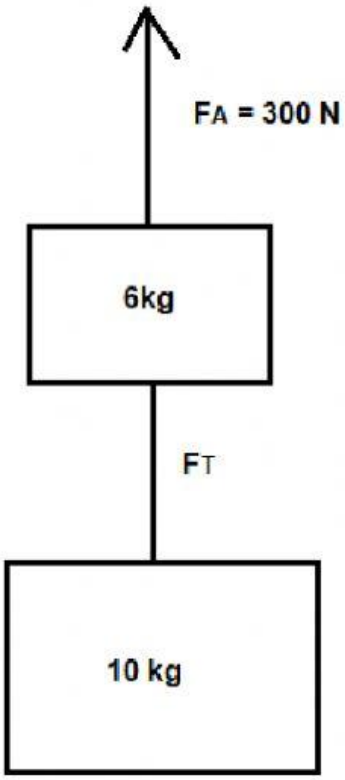
Fnet = m.a

$F_A - F_T$ = m.a

160 – F_T = 15(6,4)

worksheets just to give more examples of calculating FN. Fnet = m.a F_T = m.a F_T = 10 (6,4) = 64 N right	FT = 64 N left

Eg 3. Calculate the (a) acceleration and (b) the tension in the string between the two boxes (F_T) of the system below



a) For the acceleration look at the system as a whole

Fnet = m.a

$F_A - F_{g(6kg)} - F_{g(10kg)} = m.a$

$300 - m.g - m.g = m.a$

$300 - 6(9.,8) - 10\ (9,8) = 16.a$

$143,2 = 16.a$

$a = 8,95\ m.s^{-2}$ right

6 kg

There is no normal force on t object, since it is not resting on a surfa
Fnet = m.a
$F_A - F_T - Fg = m.a$
300 – FT – m.g = m.a
300 – FT – (6)(9,8) = 6(8,95)
F_T = 187,5 N

10 kg

Fnet = m.a
$F_T - Fg = m.a$
$F_T - m.g = m.a$
$F_T - (10)(9,8) = 10.(8,95)$
F_T= 187,5 N

Since you don't know the value for F_T yet, you can't exactly draw that force to scale yet. Thus you don't need to draw F_T to scale here.

Eg 4. Calculate the (a) acceleration and (b) the tension in the string between the two boxes (F_T) of the system below

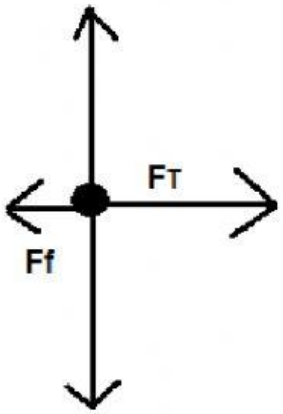
a) Fnet = m.a

$F_A - Ff_{5kg} - Ff_{7kg} = m.a$

$80 - 5 - 7 = 12.a$

$a = 5{,}67\ m.s^{-2}$

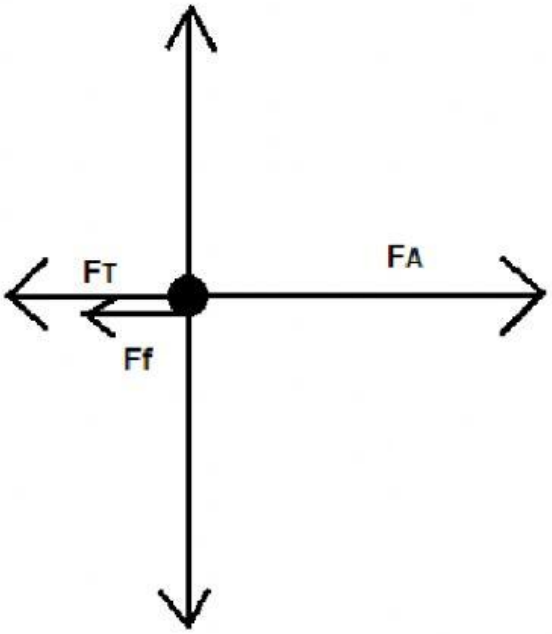
5 kg



Fnet = m.a
F_T - Ff = m.a
$F_T - 5 = 5\ (5{,}67)$
= 33,35 N right

Or

7 kg

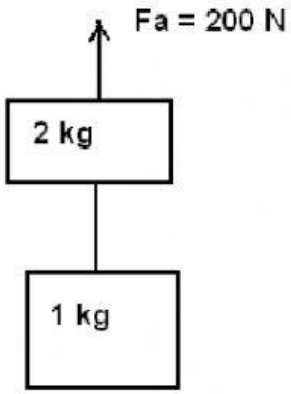


Fnet = m.a
$F_A - F_T - Ff = m.a$
$80 - F_T - 7 = 7(5{,}67)$
FT = 33,31 N left

Exercise 8:

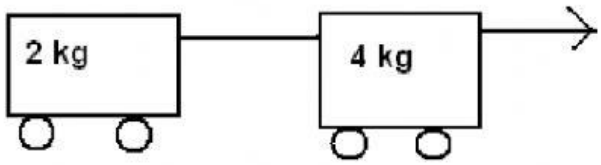
1. Calculate the acceleration of the system on the right.

   (Ignore air resistance)



a = _____ _____

2.



If a 30 N force is applied to the 4 kg trolley to the right, calculate:

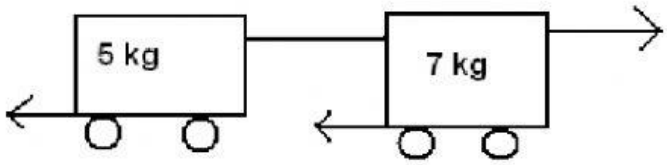
2.1 The acceleration of the system

a = _____ _____

2.2 the tension in the string

F_T = _____ _____

3.



A force of 80 N is applied to the 7 kg trolley to the right. The 5 kg trolley experiences a frictional force of 1N and the 7 kg trolley experiences a frictional force of 1,5 N. Determine the:

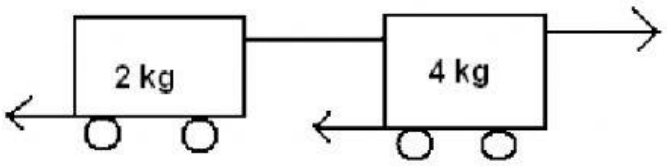
3.1 acceleration of the 7 kg trolley

a = _____ _____

3.2 the tension in the cable

F_T = _____ _____

4.



If a the system experiences an acceleration of $4 m.s^{-2}$, and the 2 kg trolley experiences a frictional force of 2 N and the 4 kg trolley experiences a frictional force of 4 N, calculate the applied force on the 4 kg trolley.

F_A = _____ _____