Putting It All Together

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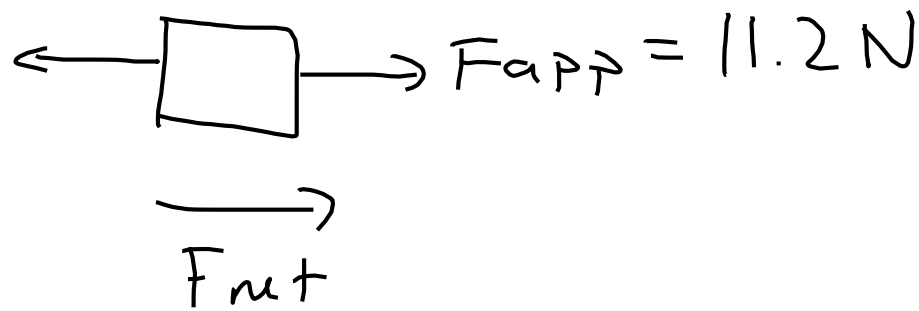
- When solving complex dynamics problems, a series of steps should be followed.

1. Draw a free-body diagram of the situation, include the given, identify the direction of F_{net} and the variable you need to find.
2. Write an F_{net} equation.
3. Substitute the variables.
4. Rearrange and solve.

Example 1:

Determine the acceleration of a toy across a carpet, if the toy has a mass of 500 g, the coefficient of friction between the plastic wheels and the carpet is 0.12 and a force of 11.2 N is applied.

$\mu = 0.12$



$m = 500\,g$
$= 0.500\,kg$

$a = ?$

Determine the acceleration of a toy across a carpet, if the toy has a mass of 500 g, the coefficient of friction between the plastic wheels and the carpet is 0.12 and a force of 11.2 N is applied.

$$a = \frac{F_{app} - \mu mg}{m}$$

$$F_{net} = F_{app} - F_f$$

$$ma = F_{app} - \mu mg$$

$$(0.500)a = 11.2 - (0.12)(0.500)(9.8)$$

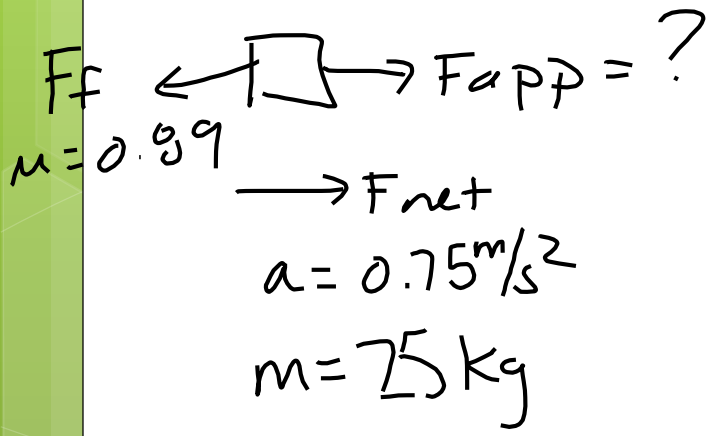
$$0.500a = 10.612$$

$$a = 21.224\ m/s^2$$

$$a = 21\ m/s^2$$

Example 2:

Determine the applied force required to start accelerating a lawnmower, mass 25 kg, at 0.75 m/s^2, over a surface with a coefficient of static friction of 0.89.



$$F_{net} = F_{app} - F_F$$

$$ma = F_{app} - \mu mg$$

$$(25)(0.75) = F_{app} - (0.89)(25)(9.8)$$

$$18.75 = F_{app} - 218.05$$

$$F_{app} = 236.8\,N$$

$$240\,N$$

Determine the applied force required to accelerate a lawnmower, mass 25 kg, at a rate of 0.75 m/s^2, over a surface with a coefficient of static friction of 0.89.

Kinematics & Dynamics

- As F_{net} is the product of mass and acceleration, we can use kinematics equations to help solve problems as well!
- The key is to separate the kinematics and dynamics variables given in the problem

Example 3:

A 1300 kg car is travelling at 16 m/s with an air resistance force of F_k = 340 N when its brakes are applied to produce an additional force, F_{app}, to slow the car. Determine F_{app}, if the brakes slow the car from 16 m/s to 14 m/s in 2.0 s.

A 1300 kg car is travelling at 16 m/s with an air resistance force of F_k = 340 N when its brakes are applied to produce an additional force, F_a, to slow the car. Determine F_a, if the brakes slow the car from 16 m/s to 14 m/s in 2.0 s.

A 1300 kg car is travelling at 16 m/s with an air resistance force of F_k = 340 N when its brakes are applied to produce an additional force, F_a, to slow the car. Other forces acting on the car are gravity and the normal force. Determine F_a, if the brakes slow the car from 16 m/s to 14 m/s in 2.0 s.

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Example 4:

A 75 kg baseball player is running at 2.8 m/s [forward] when he slides into home plate for a distance of 3.8 m before coming to rest. Calculate the coefficient of kinetic friction.

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