Many problems in physics are solved with a free-body diagram. This diagram shows all the forces acting on the body and generates the equations that allow us to solve the problem.

Example. A 48N cart is pulled across a concrete path at a constant speed. A 42 N force is required to keep the cart moving. What is the coefficient of Kinetic friction between the path and the cart?

I've underlined key words that are important to your diagram and equation(s)

→ 48 N cart → this is the weight of the cart not it's mass. You can convert this to mass with $F_g = mg$

(F_g: weight, m: mass)

- concrete path → this suggest a rugged surface between the block and the concreate. μ (the coefficient of friction) will be high

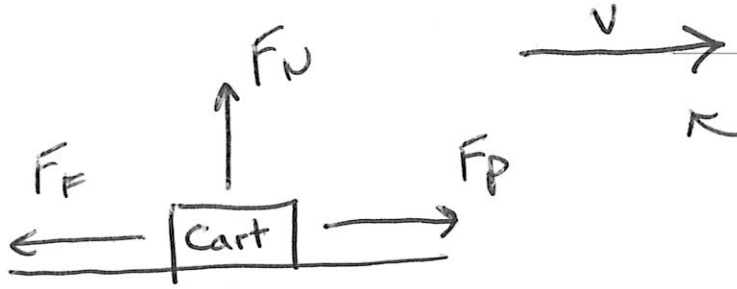
$0 < \mu < 1$

- Constant speed → no accelerating! The forces on the cart are <u>balanced</u>

- 42 N force → this is the force pushing (or pulling) the cart forward. Called the applied force (F_p)

- Coefficient of Friction (kinetic) → the symbol μ found in the equation $F_F = \mu F_N$ It describes the nature of the two surfaces.

Diagram



$\bar{v}$ → this tells us the cart is moving at a constant speed

Friction always opposes motion

$F_g = 48\,N$

Equation(s) → along the direction of motion (x-axis) the cart moves at some constant speed ($\bar{v}$) so the forces are balanced

$$F_p = F_F$$

- along the y-axis (up and down) the cart is also at rest ($\vec{v} = 0$) so the forces are balanced

$$F_N = F_g$$

usually 2 equations can be generated from each mass (object) - one in the x-dimension and one in the y-dimension

- You've now done the hardest part of the question. From here you simply have to isolate your variable, substitute and solve (basic math)

$F_p = F_F$ | $F_p = 42$, $F_F = \mu F_N$

$42 = \mu F_N$ | $F_N = F_g$

$42 = \mu F_g$ | $F_g = mg$

$42 = \mu mg$ | isolate μ

$\frac{42}{mg} = \mu$

$m = ?$ but $mg = 48$

↑ could solve for m but not necessary

$\mu = \frac{42}{48}$

$\mu = 0.875$ ← a rather high value

Try these Problems!

Diagram → Equations → Solve

(1) A force of 120 N is needed to push a box along a level road at a steady speed. If the force of gravity on the box is 250 N, what is the coefficient of friction between the box and the road?

(2) The coefficient of friction between a steel block and an ice rink surface is 0.0100. If a force 24.5 N keeps the steel block moving at a steady speed, what is the force of gravity on the block?