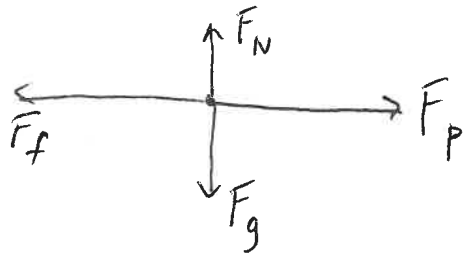
Checklist

A robot is pulling a 20 kg sled with a horizontal force of 30 N and accelerates at 0.9 m/s^2 along a level sidewalk.

a) (3 pts) Draw a free body diagram for the wagon with all forces identified and labeled.



_____ (1 pt) Force of friction, Push or Pull, Force due to Gravity (Weight), and Normal Force are all present

_____ (1 pt) Force of friction and push or pull are correctly represented in the horizontal direction and accurately labeled

_____ (1 pt) Force due to gravity and Normal force are correctly represented in the vertical direction and accurately labeled

b) (2 pts) What is the net force in the horizontal direction?

Given: $m = 20\,kg$ Find: $F_{net} = ?$ Equation: $F = ma$
$a = 0.9\,m/s^2$

Solve: $F_{net} = (20\,kg)(0.9\,m/s^2)$
$= 18\,N$

_____ (0.3 pt) Given information is correctly displayed, with correct units and variables included

_____ (0.2) Missing variable is identified, with correct variable

_____ (0.2) Correct equation is identified to be used

_____ (0.8) Values are substituted into the equation and math work is shown step by step

_____ (0.5) Correct answer is shown with correct units

c) (3 pts) What is the force of friction?

Given: $F_{net} = 18\,N$ Find: $F_f = ?$ Equation: $F_{net} = F_p - F_f$
$F_p = 30\,N$

Solve: $F_{net} = F_p - F_f$
$18\,N = 30\,N - F_f$
$18\,N + F_f = 30\,N$
$F_f = 12\,N$

_____ (1 pt) Correct equation for net force is shown and includes push or pull and friction
_____ (0.3 pt) Given information is correctly displayed, with correct units and variables included
_____ (0.2) Missing variable is identified, with correct variable
_____ (0.2) Correct equation is identified to be used
_____ (0.8) Values are substituted into the equation and math work is shown step by step
_____ (0.5) Correct answer is shown with correct units

d) (3 pts) What is the normal force? Show your work on how you determined this.

Find: $F_N = ?$ Given: $m = 20kg$ Equation: $F_g = m(9.8 m/s^2)$

$F_N = F_g$

$a = 9.8 m/s^2$ Solve! $F_g = (20kg)(9.8 m/s^2) = 196 N$

_____ (1 pt) Proof of reasoning that Normal Force and Force due to Gravity (Weight) are equal
_____ (0.3 pt) Given information is correctly displayed, with correct units and variables included
_____ (0.2) Missing variable is identified, with correct variable
_____ (0.2) Correct equation is identified to be used
_____ (0.8) Values are substituted into the equation and math work is shown step by step
_____ (0.5) Correct answer is shown with correct units

e) (2 pts) What is the coefficient of kinetic friction (μ)?

Given: $F_N = 196 N$ Find: $\mu = ?$ Equation: $\mu = \frac{F_f}{F_N}$

$F_f = 12N$

Solve! $\mu = \frac{12N}{196N} = 0.06$

_____ (0.3 pt) Given information is correctly displayed, with correct units and variables included
_____ (0.2) Missing variable is identified, with correct variable
_____ (0.2) Correct equation is identified to be used
_____ (0.8) Values are substituted into the equation and math work is shown step by step
_____ (0.5) Correct answer is shown with correct units