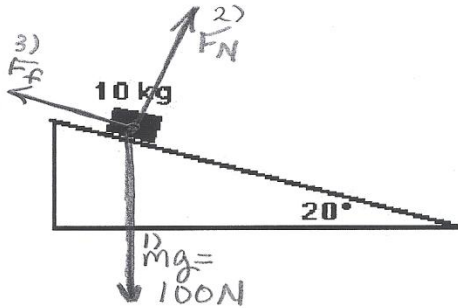


Practice with Solving problems using Forces and Newton's Laws:

From dynamics information - If you are given forces, or the physical description of the system and surroundings, use that information to draw a diagram and then **Draw and Label** all forces acting on the object. SO First step = draw a force diagram!

A 10 kg block is allowed to slide down a ramp with $\mu = 0.15$.

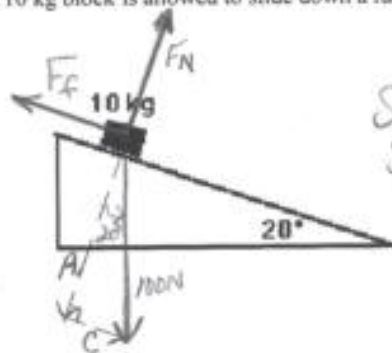


- 1) Draw in the weight pointing straight down and label it “mg” for Weight = mass times acceleration due to gravity.
- 2) Draw the Normal Force (F_N) pointing upward **perpendicular** to the ramp surface.
- 3) Since they gave you a coefficient of friction, then there must be a friction force (F_f) acting on the block...Draw it on the diagram - the direction of the vector for friction is pointing in direction that opposes the motion of the block.
- 4) In this example - there is no other force acting – no push or pull or tension, SO you are finished drawing in the forces.
- 5) In this example, one of the forces is not aligned with the x and y direction, then that force must be resolved into its perpendicular components (this will not always be the case – sometimes the forces will already form an axis). In many situations, it is the weight vector that must be broken into its components matching the x and y axis.
 - A. First extend the normal force downward through the ramp. This will form an adjacent side to an angle with the Weight force vector you already drew.
 - B. The angle will be identical to the angle of the ramp.
 - C. Finish the right triangle by closing the bottom with a side opposite the angle and is drawn **PARALLEL** to the ramp surface. Use the angle of the triangle and the sine and cosine to solve for the components of the weight.

$$A = mg \cos 20^\circ$$

$$C = mg \sin 20^\circ$$

Example: A 10 kg block is allowed to slide down a ramp with $\mu = 0.15$.



$$\begin{aligned} \text{Side A} &= (100\text{ N}) \cos 20^\circ \\ \text{Side C} &= 100 \sin 20^\circ \end{aligned}$$

- THEN Ask yourself: "Is the system accelerating?" If yes, then the forces do NOT add up to zero. $\sum F = ma$.

↻ in direction of acceleration

- If the system is moving at constant velocity or is motionless (in equilibrium), then the forces must cancel out. $\sum F = 0$.

- Write the two $\sum F$ statements – one for the x direction and one for the y direction.

$$\sum F_x = ma \qquad \sum F_y = 0$$

- Solve for unknowns, such as:

$$\begin{aligned} ma &= 100 \sin 20^\circ + (-F_f) & 0 &= F_N + (-100 \cos 20^\circ) \\ & & & F_N = 100 \cos 20^\circ = 94.0\text{ N} \end{aligned}$$

- a. What is the value of the frictional force opposing the block's slide down the ramp?

$$F_f = \mu F_N = .15(94.0) = 14.1\text{ N}$$

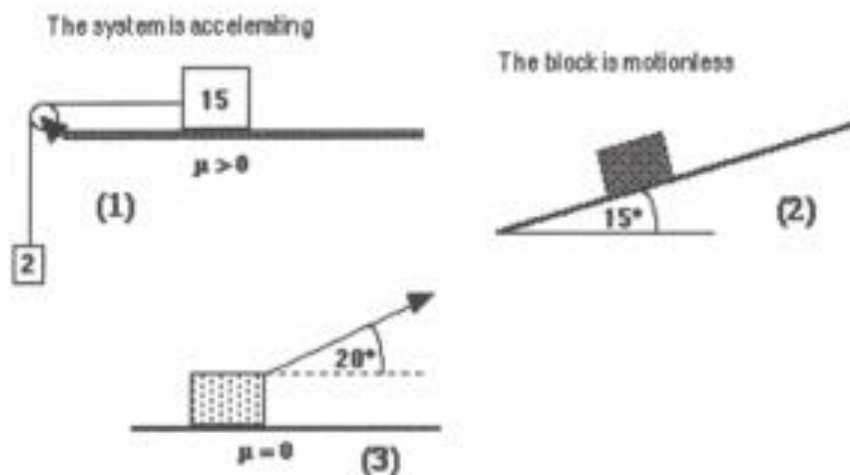
- b. What is the acceleration of the block?

$$ma = 100 \sin 20 - 14.1$$

$$a = \frac{34.2 - 14.1}{10} = \frac{20.1}{10} = 2.01 \text{ m/s}^2$$

2 m/s² w/ 1 sig fig

See if you can do these examples of diagrams and equations.



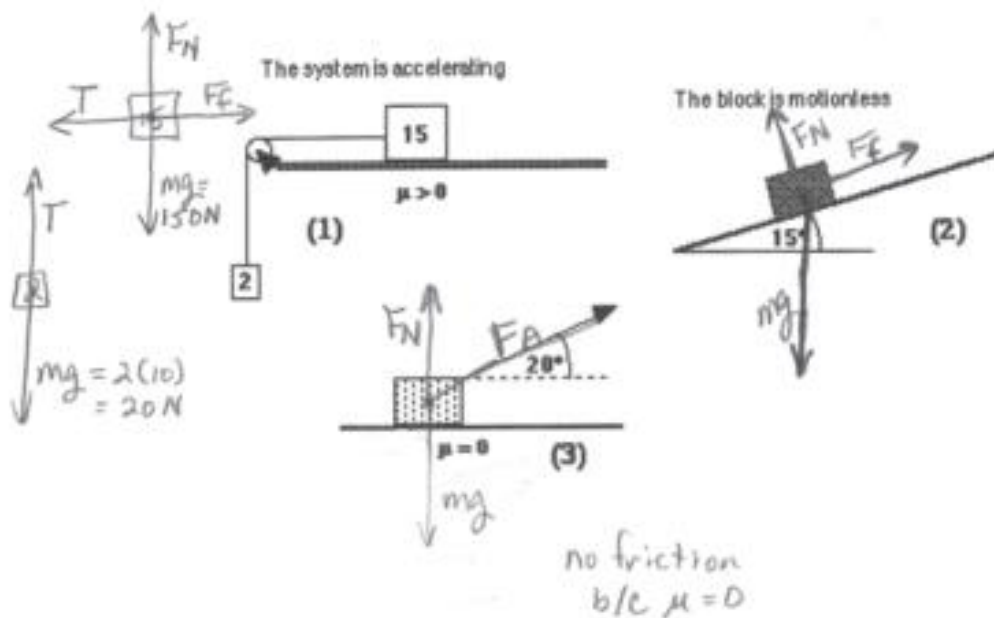
Sketch a force diagram for each of the objects above.

Write the equation for the sum of the forces in the x-direction in (2).

Write the equation for the sum of the forces in the y-direction in (3).

Treat the masses in (1) as a system and write the Newton 2 equations for the two blocks.

See if you can do these examples of diagrams and equations.



Sketch a force diagram for each of the objects above.

Write the equation for the sum of the forces in the x-direction in (2). $\sum F_x = 0$
 $0 = F_f + (-mg \sin 15^\circ)$ or $F_f = mg \sin 15^\circ$

Write the equation for the sum of the forces in the y-direction in (3). $\sum F_y = 0$
 $0 = F_N + F_A \sin 20^\circ + (-mg)$
 or $mg = F_N + F_A \sin 20^\circ$

Treat the masses in (1) as a system and write the Newton 2 equations for the two blocks.