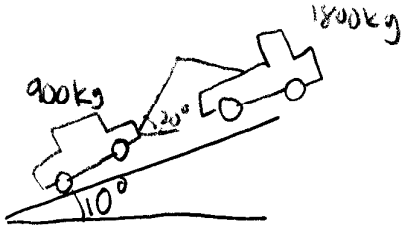


# Problem A

## Context-Rich Problems: Solutions Outline

### FOCUS the PROBLEM

Draw a picture of the situation including ALL the information given in the problem.



maximum Tension = 4000 N  
 10 seconds to 20 m/s  
 $\mu = 0.10$

Question(s): What is the problem asking you to find?

What is the tension in the cable? Is it more than 4000 N?

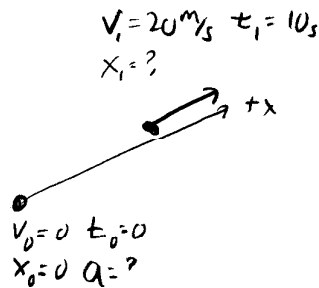
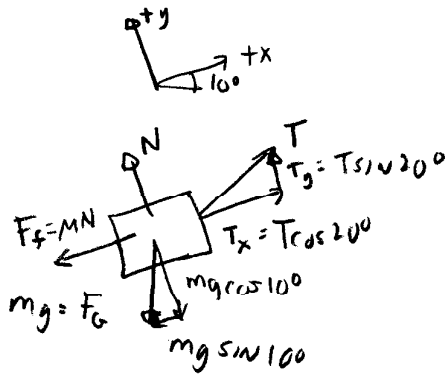
Approach: Outline the approach you will use.

Use dynamics to see the forces on the car.

Use kinematics to determine acceleration

### DESCRIBE the PHYSICS

Draw physics diagram(s) and define ALL quantities uniquely.



Which of your defined quantities is your Target variable(s)?

T

Quantitative Relationships: Write equations you will use to solve this problem.

$$\sum \vec{F} = m\vec{a}$$

$$V_2 = V_1 + a(t_2 - t_1)$$

PLAN the SOLUTION

Construct Specific Equations (Same Number as Unknowns)

Along x:

$$\Sigma F_x = ma_x$$

$$T_x - F_{gx} - F_f = ma$$

UNKNOWN

$$\textcircled{1} T \cos 20^\circ - mg \sin 10^\circ - \mu N = ma$$

T, a, N

Along y:

$$N + T \sin 20^\circ - mg \cos 10^\circ = 0$$

$$\textcircled{2} N = mg \cos 10^\circ - T \sin 20^\circ$$

Use kinematic equations

$$v_1 = v_0 + a(t_1 - t_0)$$

$$\textcircled{3} a = \frac{v_1}{t_1}$$

Plug  $\textcircled{3}$  and  $\textcircled{2}$  into  $\textcircled{1}$

$$T \cos 20^\circ - mg \sin 10^\circ - \mu (mg \cos 10^\circ - T \sin 20^\circ) = m v_1 / t_1$$

$$T (\cos 20^\circ + \mu \sin 20^\circ) = mg (\mu \cos 10^\circ + \sin 10^\circ) + m v_1 / t_1$$

$$T = \frac{mg (\mu \cos 10^\circ + \sin 10^\circ) + m v_1 / t_1}{(\cos 20^\circ + \mu \sin 20^\circ)}$$

Check Units

$$[m] \frac{[L]}{[T]^2} + [m] \frac{[L]}{[T][T]} = [F] \text{ ok}$$

EXECUTE the PLAN

Calculate Target Quantity(ies)

$$T = (900 \text{ kg})(9.8 \text{ m/s}^2)(0.10 \cos 10^\circ + \sin 10^\circ) + (900 \text{ kg})(20 \text{ m/s}) / (10 \text{ s}) \div [\cos 20^\circ + (0.10)(\sin 20^\circ)] = 4300 \text{ N}$$

EVALUATE the ANSWER

Is Answer Properly Stated?

Yes, in newtons

Is Answer Unreasonable?

No, close to maximum

Is Answer Complete?

No, the cable will break. The driver can't carry out his plan

(extra space if needed)