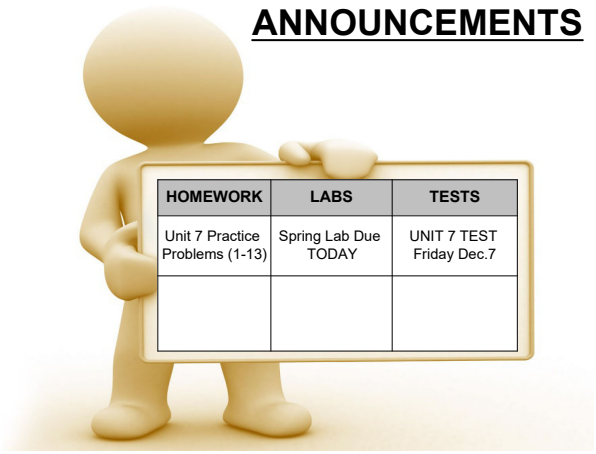
## ANNOUNCEMENTS



| HOMEWORK | LABS | TESTS |
|---|---|---|
| Unit 7 Practice Problems (1-13) | Spring Lab Due TODAY | UNIT 7 TEST Friday Dec.7 |
| | | |

# 7.4 TENSION

LEARNING TARGETS

| | |
|---|---|
| 7.3 | I can define, analyze, and solve dynamic problems involving tension forces and connected objects. |

## REVIEW

| Some Types of Forces | | | |
|---|---|---|---|
| **Force** | **Symbol** | **Definition** | **Direction** |
| Friction | $F_f$ | The contact force that acts to oppose sliding motion between surfaces | Parallel to the surface and opposite the direction of sliding |
| Normal | $F_N$ | The contact force exerted by a surface on an object | Perpendicular to and away from the surface |
| Spring | $F_{sp}$ | A restoring force; that is, the push or pull a spring exerts on an object | Opposite the displacement of the object at the end of the spring |

## REFERENCE PAGE

$$|\vec{F}_f| \leq \mu |\vec{F}_n|$$

$$|\vec{F}_s| = k|\vec{x}|$$

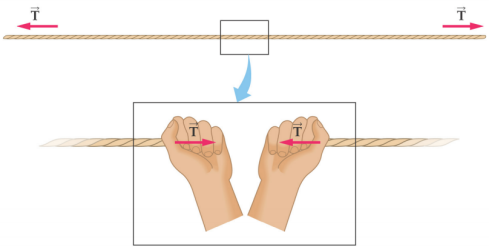
$F$ = force

$k$ = spring constant

$\mu$ = coefficient of friction

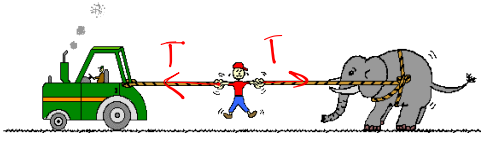
## tension

**When you pull on a string or rope, it becomes taut. We say that there is tension in the string.**



## TENSION

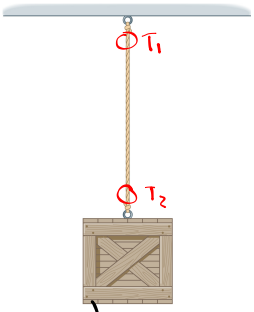
**Tension (T)** is a pulling force exerted by a string, rope, cable, or similar object on another object.

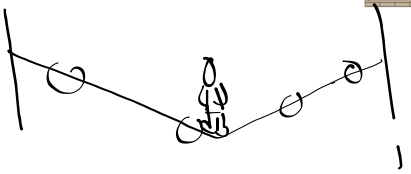


# TENSION

The tension in a real rope will vary along its length, due to the weight of the rope.

We will assume that all ropes, strings, wires, etc. are massless unless otherwise stated.



# TENSION

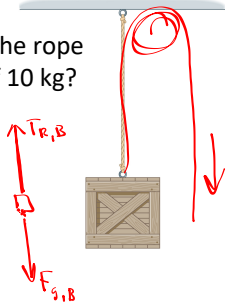
What is the tension in the rope if the box has a mass of 10 kg?

$F_{net} = 0$

$T_{R,B} = F_{g,B}$

$T_{R,B} = mg$

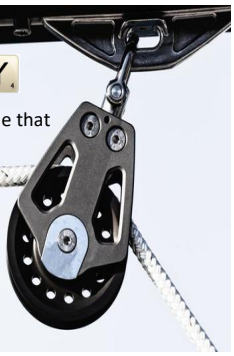
$T_{R,B} = 98\ N$

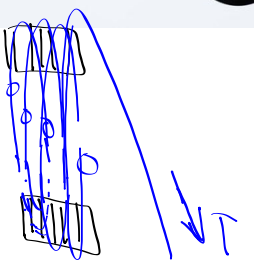



## PULLEY

A **pulley** is a simple machine that redirects tension forces.

An **ideal pulley** has no mass, and no friction. It simply changes the direction of the tension in a string, without changing its magnitude.

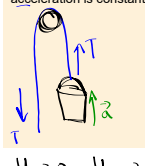





# TENSION

A 50.0-kg bucket is being lifted by a rope. The rope will not break if the tension is 525 N or less. The bucket started at rest, and after being lifted 3.0 m, it is moving at 3.0 m/s. If the acceleration is constant, is the rope in danger of breaking?

490 N




$F_{net} = T_{R,B} - F_{g,B}$

$ma = T_{R,B} - mg$

$ma + mg = T_{R,B}$

$y_0 = 0 \quad y_f = 3.0\ m$

$V_0 = 0 \quad V_f = 3.0\ m/s$

$a = ?$

$(50)(1.5) + (50)(9.8) = T$

$565\ N = T_{R,B}$

$V_f^2 = V_0^2 + 2a(y_f - y_0)$

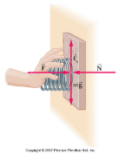
$\frac{V_f^2}{2y_f} = a = 1.5\ m/s^2$

## Applications of Tension

# PRACTICE

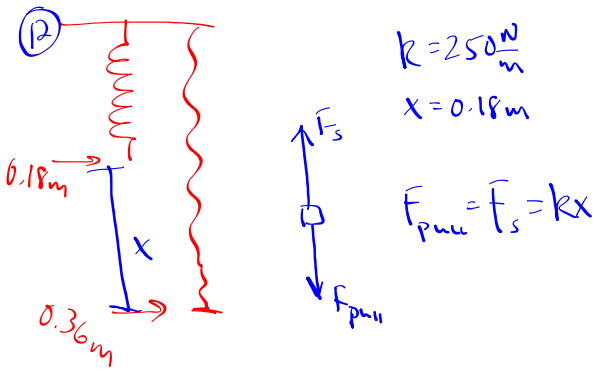
## UNIT 7 PROBLEMS (14-16)

12. The equilibrium length of a certain spring with a force constant of k = 250 N/m is 0.18 m. **(a)** What is the magnitude of the force that is required to hold this spring at twice its equilibrium length? **(b)** Is the magnitude of the force required to keep the spring compressed to half its equilibrium length greater than, less than, or equal to the force found in part (a)? Explain.
13. A spring with a force constant of 120 N/m is used to push a 0.27-kg block of wood against a wall, as shown in the figure to the right. **(a)** Find the minimum compression of the spring needed to keep the block from falling, given that the coefficient of static friction between the block and the wall is 0.46. **(b)** Does your answer to part (a) change if the mass of the block of wood is doubled? Explain.



**7.4 TENSION FORCES**

14. Pulling up on a rope, you lift a 4.25-kg bucket of water from a well with an acceleration of 1.80 m/s². What is the tension in the rope?
15. A 50.0-kg person takes a nap in a backyard hammock. Both ropes supporting the hammock are at an angle of 15.0° above the horizontal. Find the tension in the ropes.
16. You are helping to repair a roof by loading equipment into a bucket that workers




$k = 250 \frac{N}{m}$

$x = 0.18m$

$F_{pull} = F_s = kx$