

# EQUILIBRIUM OF RIGID BODY

Background Music: Chiquitita

I hear and I forget,  
I see and I remember,  
I do and I understand  
Chinese Proverb

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**STATIC EQUILIBRIUM (2-D)**

# STATIC EQUILIBRIUM (2-D)

## Part-1

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**TWO FORCE MEMBERS**

# SUPPORTS



**IF A GIVEN BODY IS IN STATIC EQUILIBRIUM, THEN THE BODY HAS**

**a- NO TRANSLATIONAL MOTION, AND**

**b- NO ROTATIONAL MOTION.**

**IN OTHER WORDS, THE BODY IS IN  
A STATE OF REST**

**QUESTION**

**HOW CAN A BODY BE IN A STATE  
OF REST?**

**ANSWER**

**BY FIXING THE BODY TO ITS POSITION**



# QUESTION

**HOW CAN SUPPORTS PREVENT MOTION?**



**FOR A RIGID BODY IN EQUILIBRIUM  
THERE ARE TWO TYPES OF FORCES ACTING ON IT**



**LOADS**

**WEIGHTS AND  
EXTERNAL  
FORCES**

**REACTIONS**

**CREATED BY  
THE  
SUPPORTS**

# REACTION FORCES CREATED BY SUPPORTS



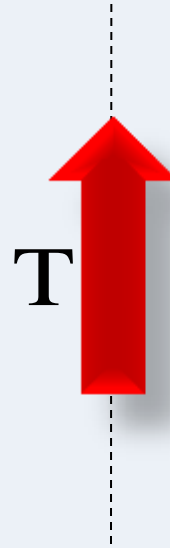
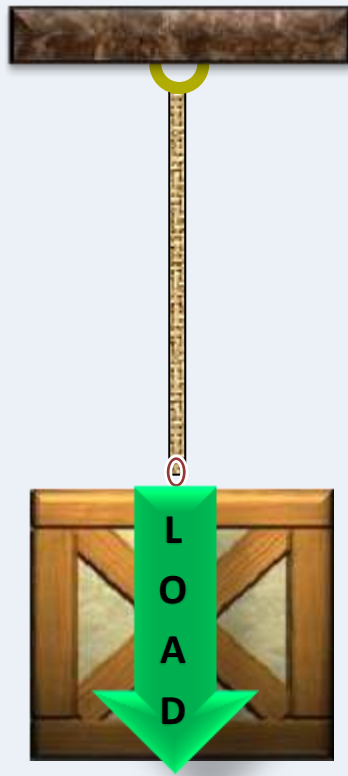


# ROPES, CABLES, AND CHAINS



# USAGE





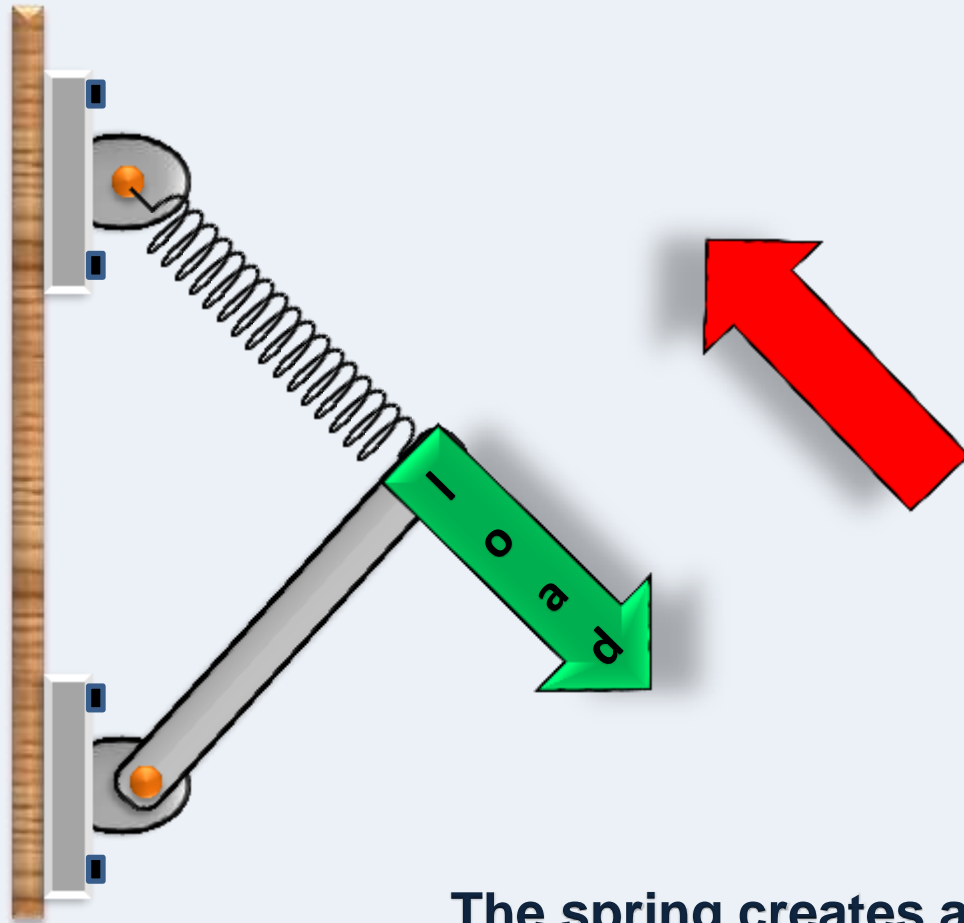
The rope creates a reaction force  
**(A TENSION FORCE)**  
(In the direction of the rope)



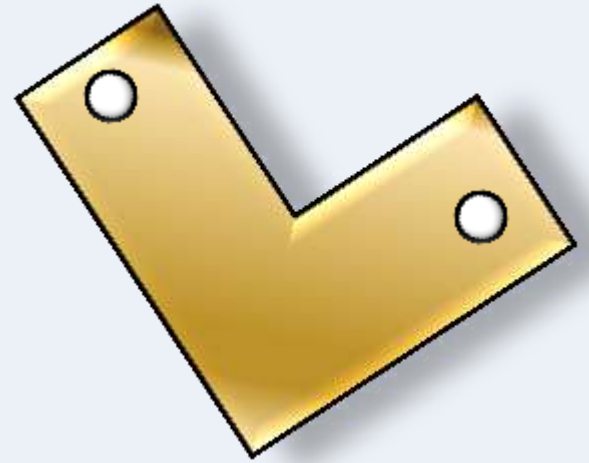
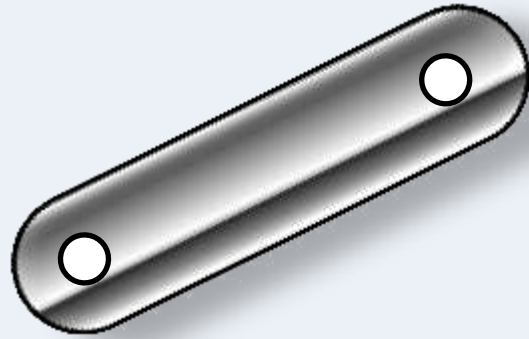
# ELASTIC SPRINGS

**usage**





The spring creates a reaction force  
**(A TENSION FORCE)**  
(In the direction of the spring)

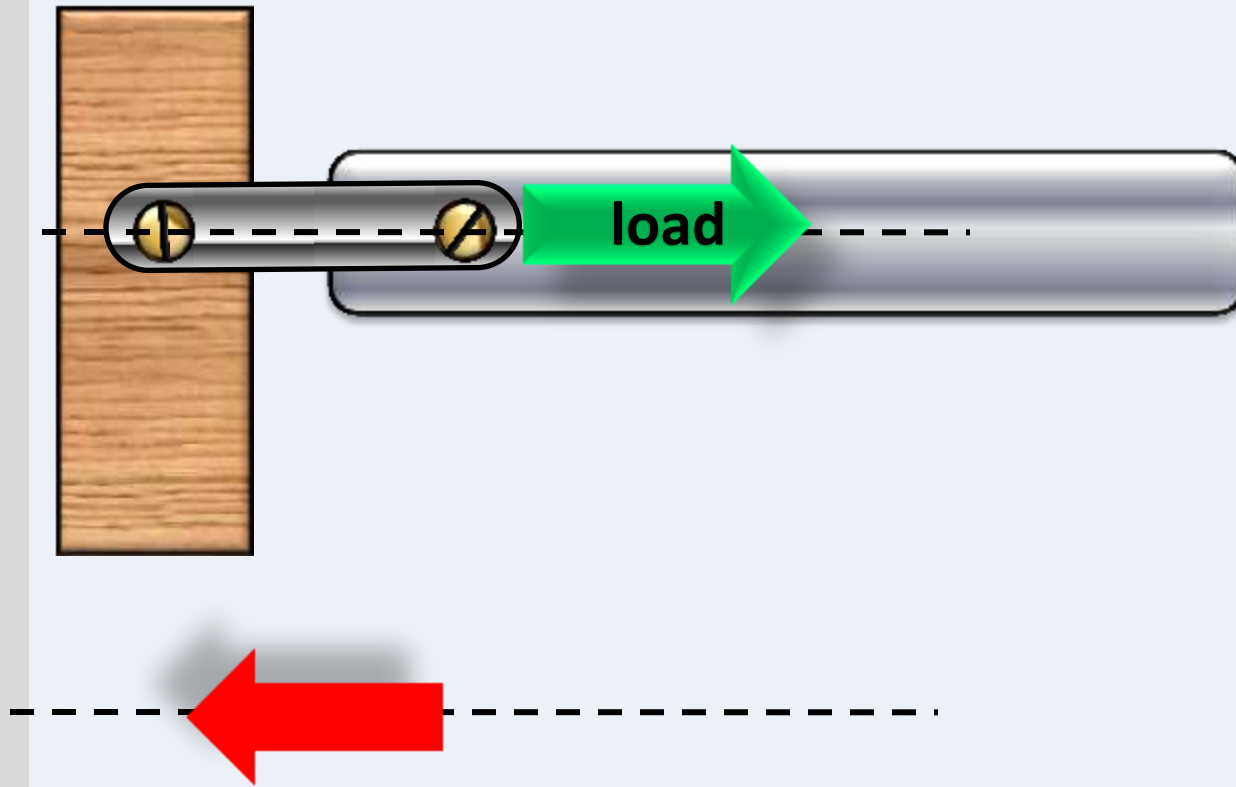


**SHORT LINKS**

usage







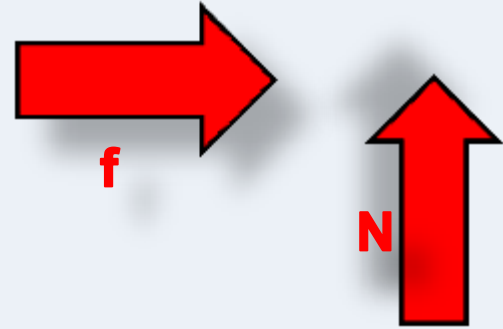
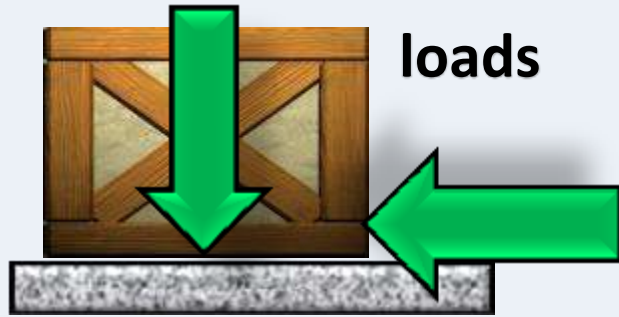
The short link creates a reaction force  
**A TENSION OR COMPRESSION FORCE**  
**(DIRECTED PARALLEL TO THE LINE JOINING THE TWO PINS)**



# ROUGH SURFACES

# USAGE





The rough surface creates two reactions

**A FRICTION FORCE  $f$**

**A NORMAL FORCE  $N$**

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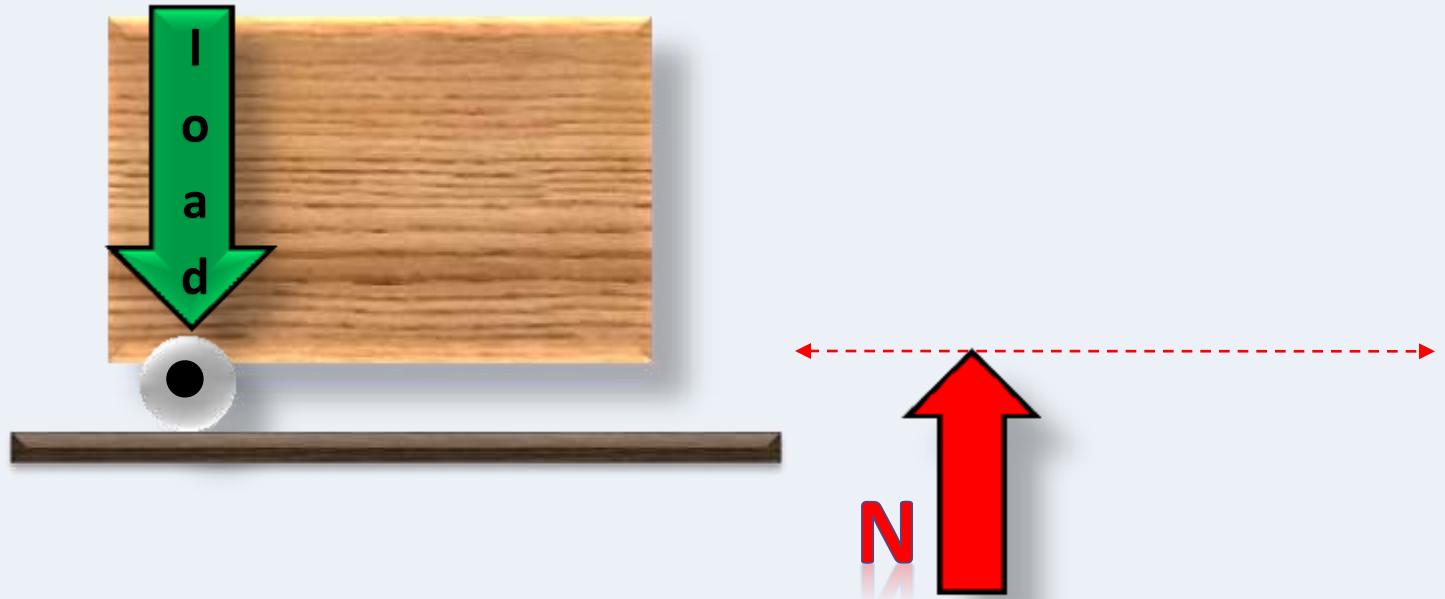
If the surface is smooth, then  $f=0$



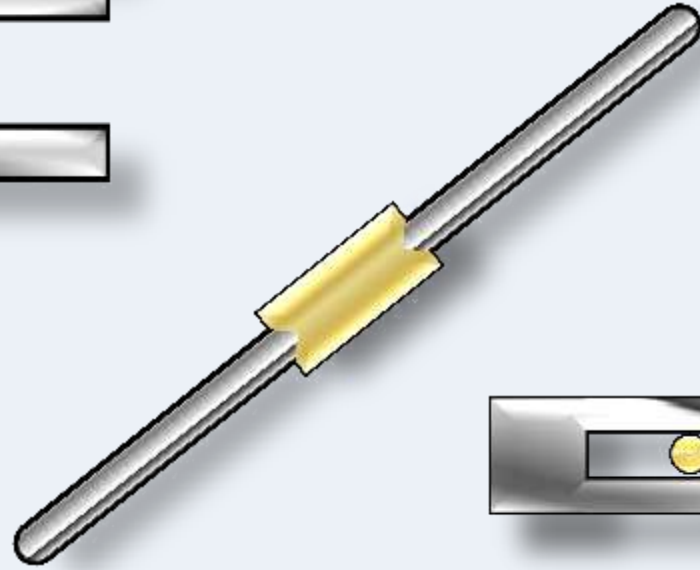
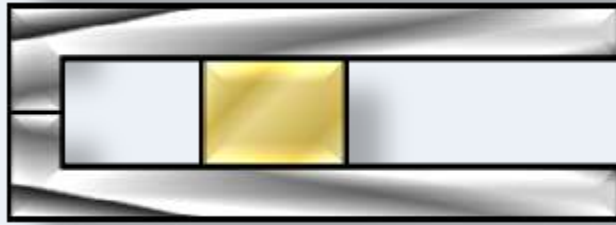
**ROLLERS**

**usage**





The roller creates a reaction force  
**A NORMAL FORCE**  
(normal to the direction of motion)

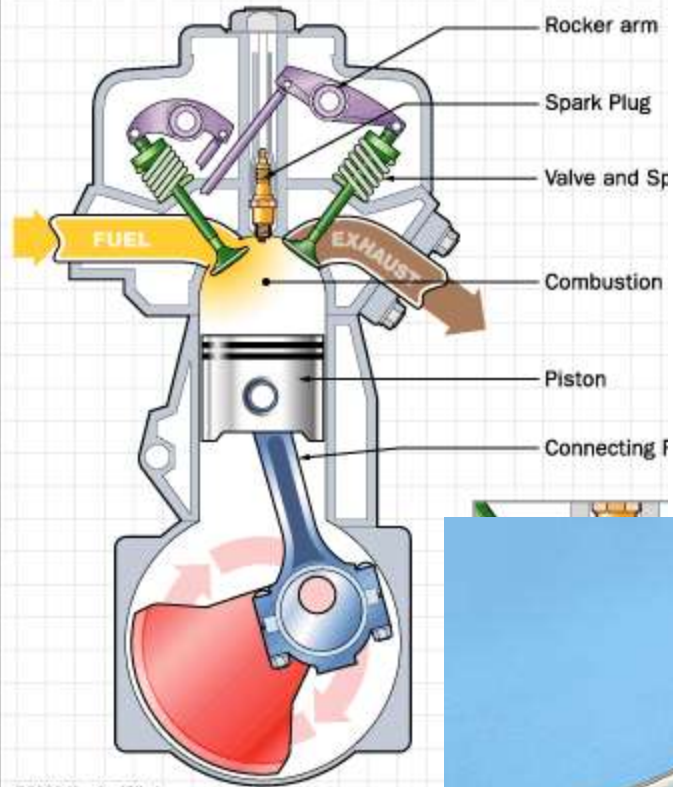


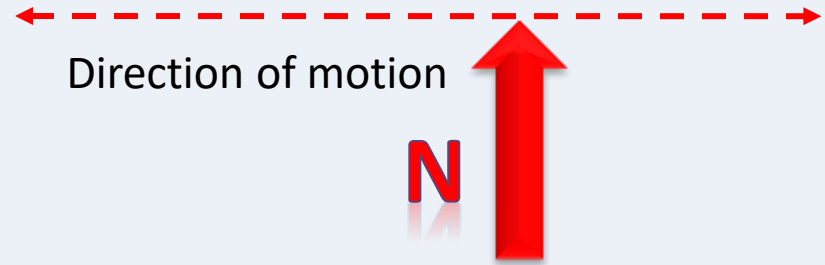
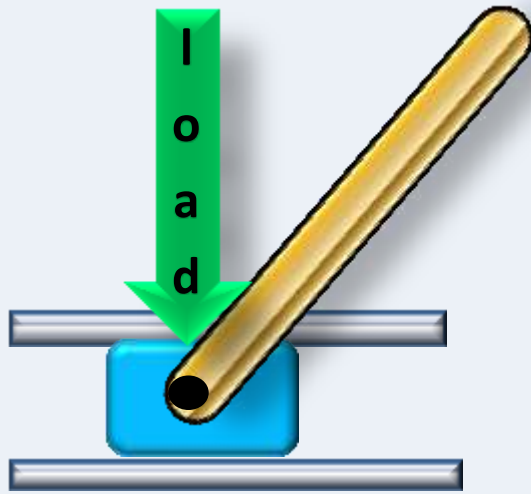
SMOOTH SLIDERS



# USAGE

## Basic Hemi Engine Design

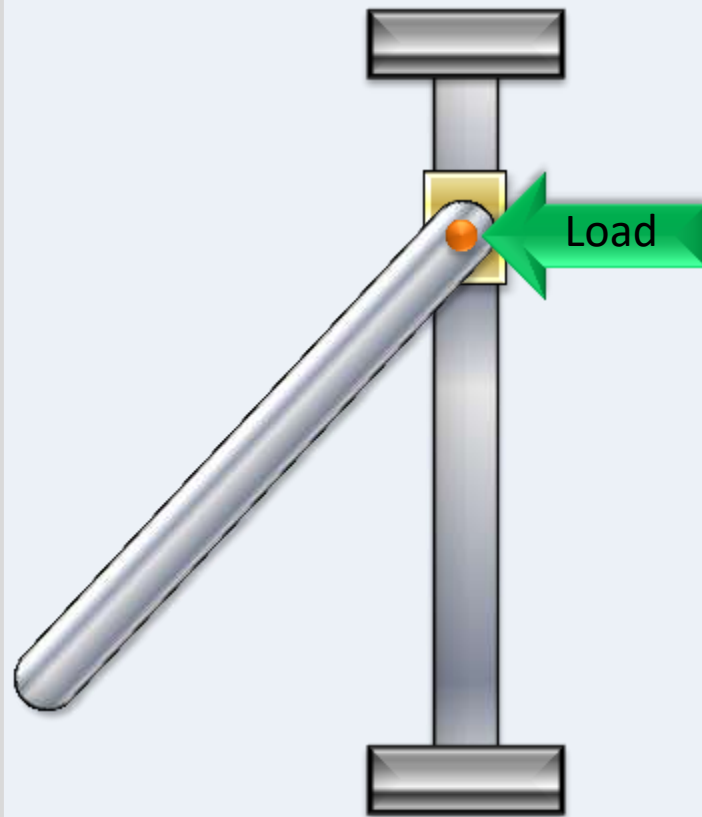




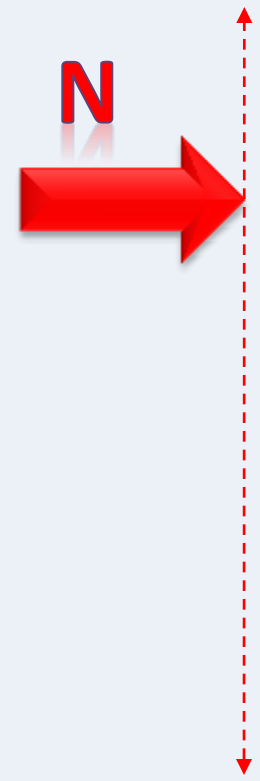
The slider creates a reaction force

**A NORMAL FORCE**

(normal to the direction of motion)

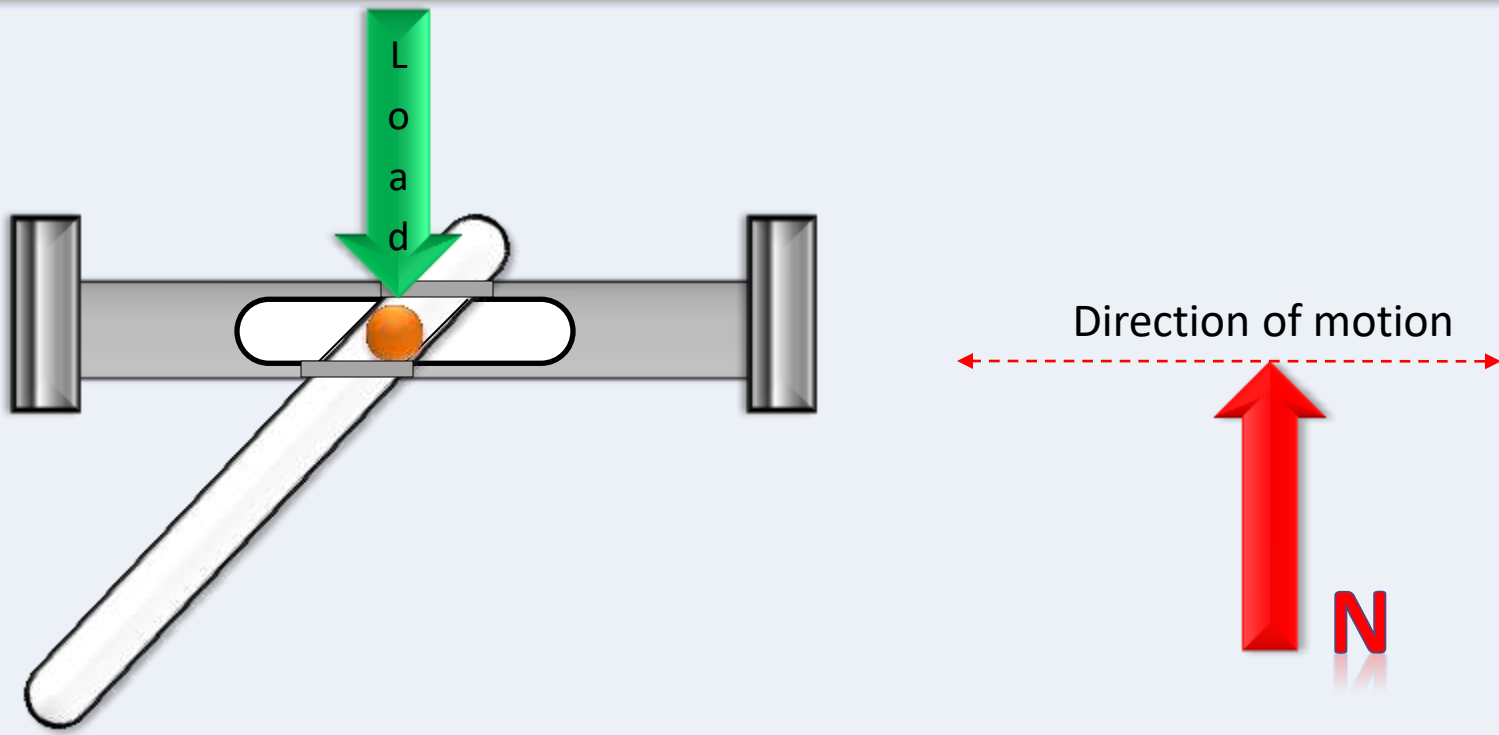


Direction of motion



The slider creates a reaction force

**A NORMAL FORCE**



The slider creates a reaction force  
**A NORMAL FORCE**



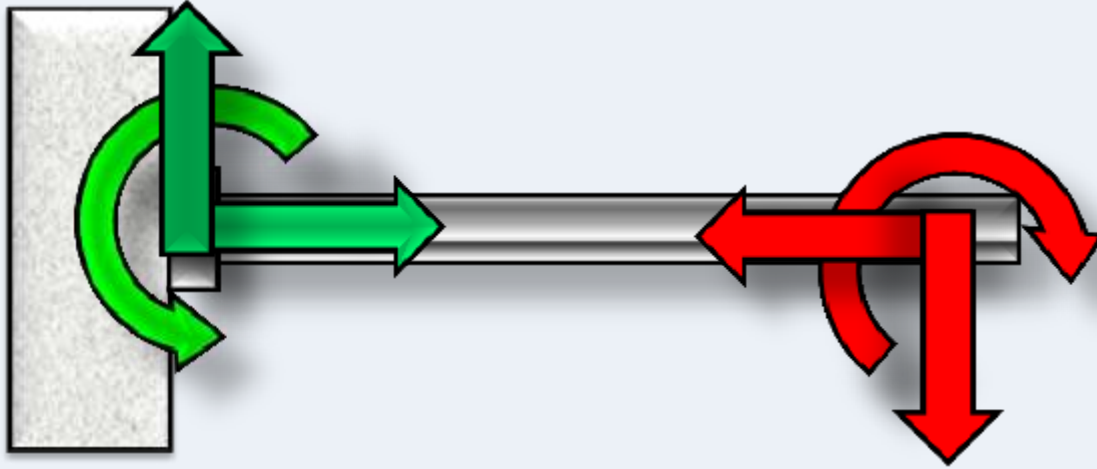
**SMOOTH PINS**



The pin creates two perpendicular reaction forces



**FIXED END**

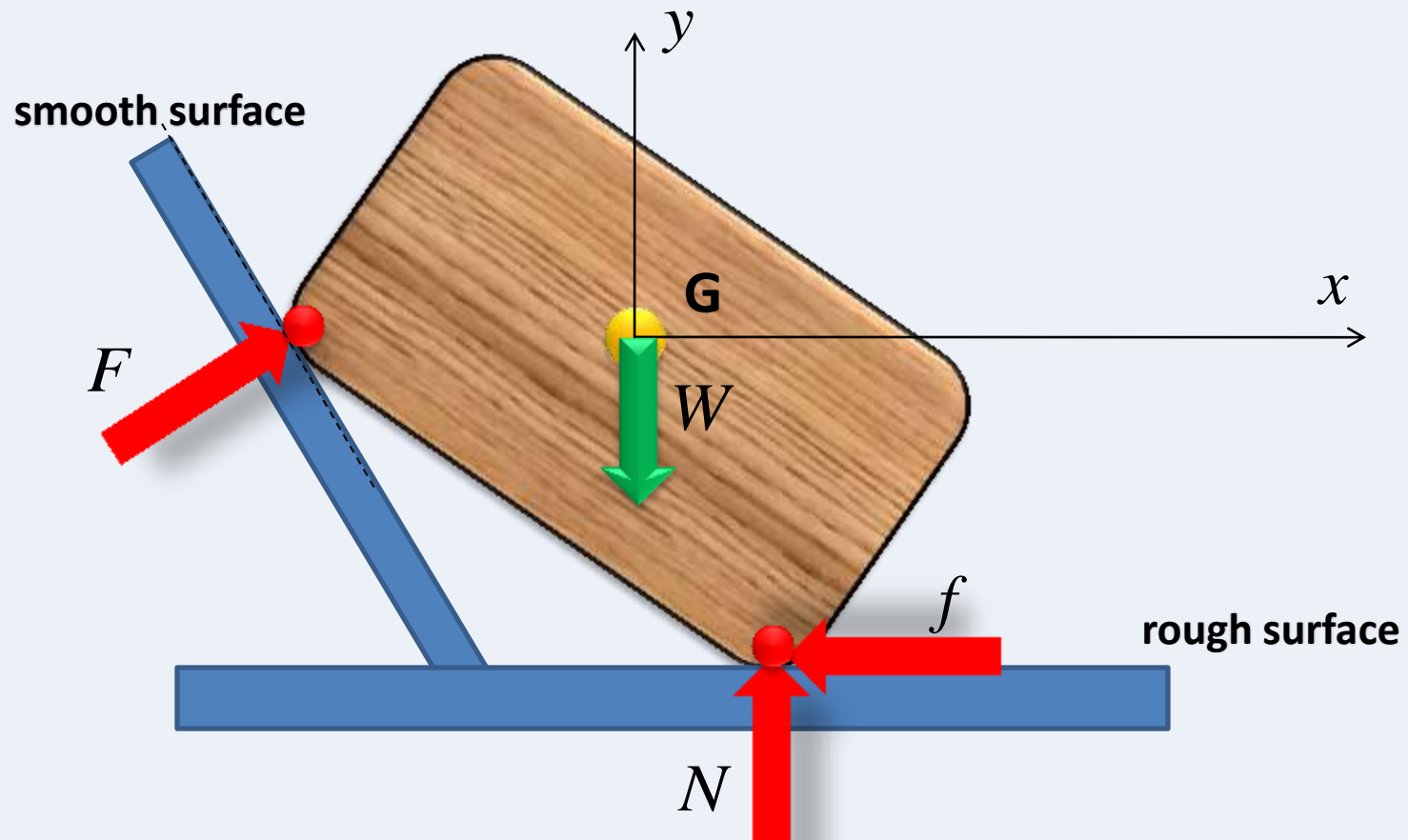


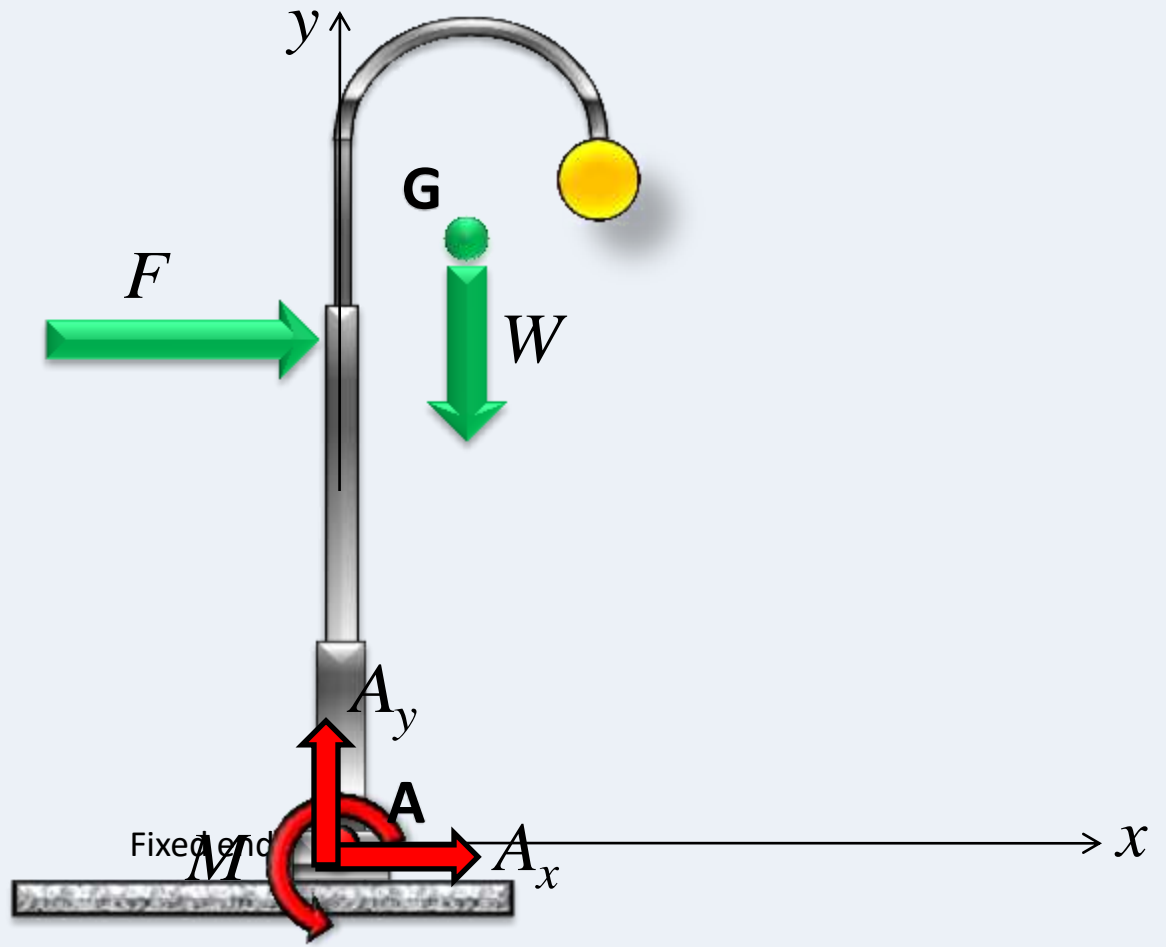
The fixed end creates three reactions

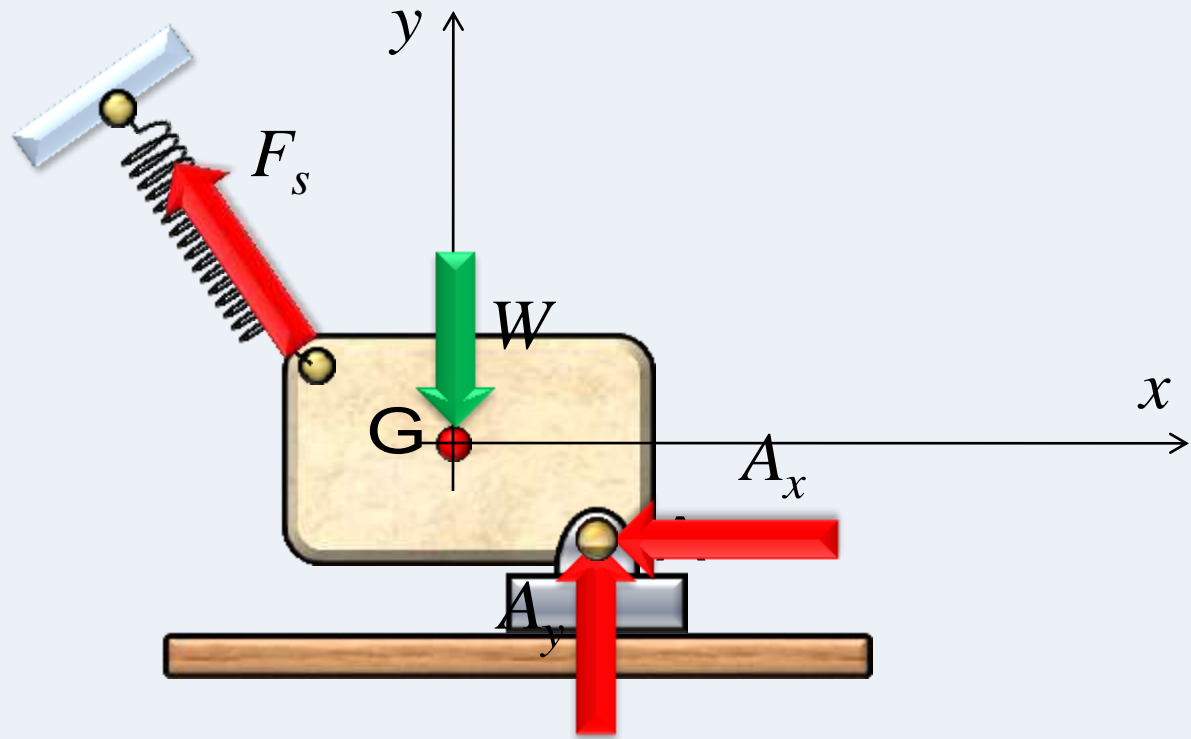
**TWO PERPENDICULAR FORCES  
AND, A MOMENT OF A COUPLE**



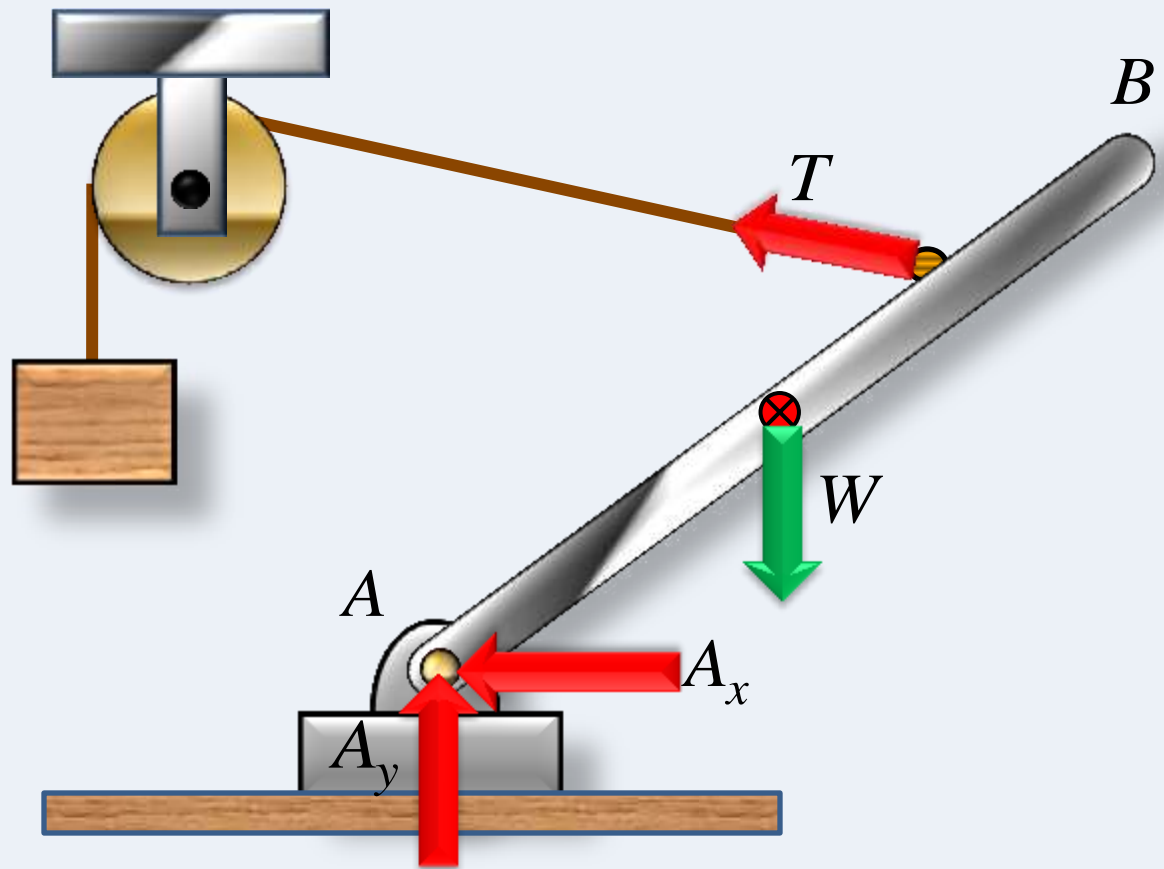
# FREE BODY DIAGRAM



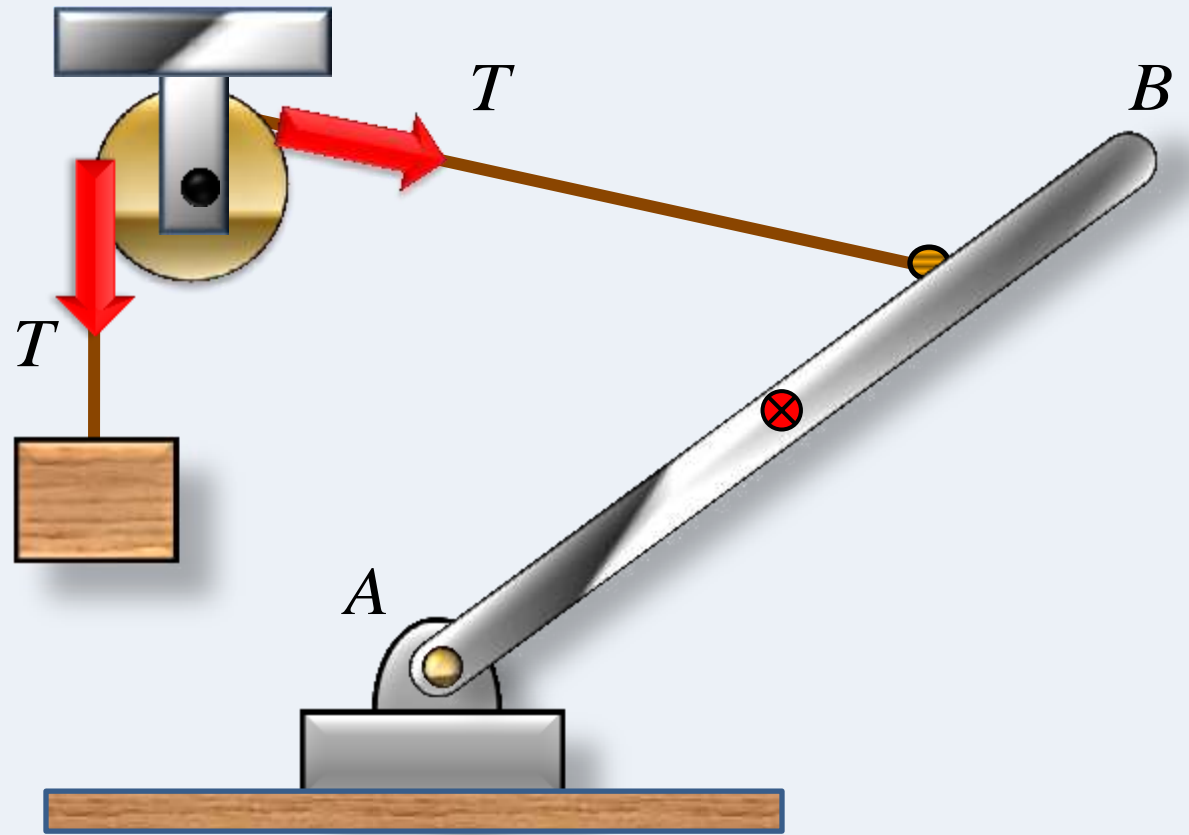




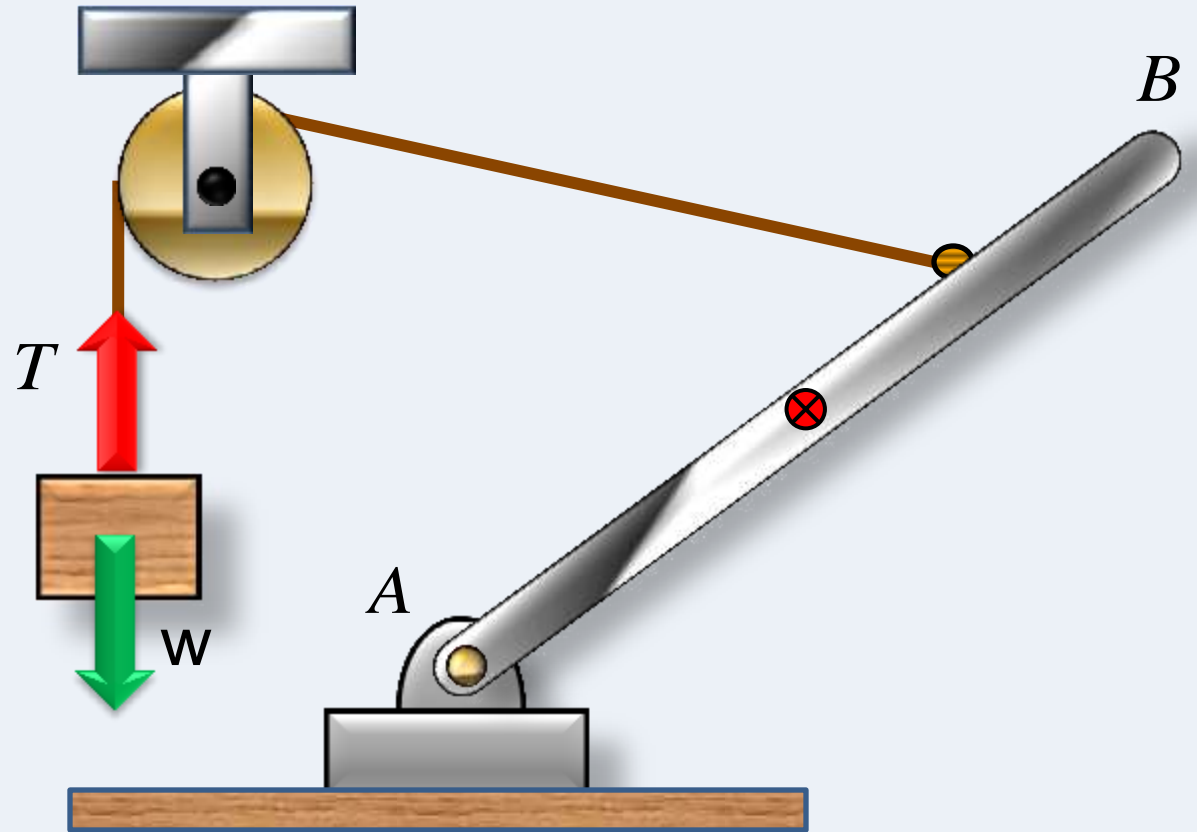
Bar AB



The smooth pulley (neglect its weight



# The box of weight $w$



# The whole system

