Chapter 5: Forces in Equilibrium

5.1 The Vector

5.2 Forces and Equilibrium

5.3 Friction
5.1 The Force Vector

• Vectors have magnitude (length) and direction

• Can show velocities or forces

• A scalar variable does not show direction
5.2 Forces in Equilibrium

• Pythagorean Theorem: \(100^2 + 100^2 = 141^2\)
Solving Equilibrium Problems

• The boat weighs 1500N

• One chain is holding 600N

• How much weight is the second chain holding?

• 1500N – 600N = 900N
Springs and Hooke’s Law

• Springs always try to return to their natural length

• The more force you apply to a spring, the more the spring moves
Hooke’s Law

• Hooke’s Law: the force exerted by a spring is proportional to its change in length
• $F = -kx$
• $K = \text{spring constant}$
More Hooke’s Law

• Doubling the mass stretches the spring twice as much

• This is how bathroom scales work
The Normal Force

• The book pushes down on the table

• The table pushes back up on the book

• This is how bathroom scales work
Scales in Different Places

• A person weights 400 N here on Earth.

• Will a spring scale on the Moon show the same weight?

• Will a balance show the same weight?
Spring Constant

- A spring has a constant \( k \) of 3 N/m

- The force needed to stretch the spring by 6m is what?

\[
k \times x = F
\]

- \( (3 \text{ N/m})(6\text{ m}) = 18\text{ N} \)
5.3 Friction

• What causes a loss of efficiency?

• Friction – converts the energy of motion into heat and wear

• Always opposes motion, which means its in the opposite direction of your motion
Types of Friction

• Static Friction – friction holds the two objects still

• Sliding Friction – the two objects are sliding against each other
The End