

PHYS 170 Study Notes

Mechanics

Yecheng Liang

Contents

1. General Principles	3
1.1. The Four Horseman of Mechanics	3
1.2. US Customary Units	3
1.3. Gravity	3
1.4. Vector Notation	3
1.5. Angle Unit	3
2. Force Vectors	4
2.1. Addition	4
2.2. Force Components	4
3. Equilibrium of a Particle	5
4. Force System Resultants	6
5. Equilibrium of a Rigid Body	7
6. Friction	8
7. Kinematics of a Particle	9
8. Kinetics of a Particle: Force and Acceleration	10
9. Kinetics of a Particle: Work and Energy	11
10. Kinetics of a Particle: Impulse and Momentum	12

1. General Principles

1.1. The Four Horseman of Mechanics

- Length
- Mass
- Time
- Force

So you basically take three of them and solve the 1 left.

1.2. US Customary Units

LENGTH	MASS	TIME	FORCE
meter m	kilogram kg	second s	force kg m s^{-2}
foot ft	slug $\text{lb s}^2 \text{ft}^{-1}$	second s	pound lb

Table 1: SI and US Customary (FPS) Units for Mechanics

1.3. Gravity

$$F = G \frac{m_1 m_2}{r^2} \quad (1.1)$$

$$F = ma \quad (1.2)$$

In this course, we will use

$$g = 9.81 \text{ m s}^{-2} \quad (2)$$

which happens to be true for Vancouver.

1.4. Vector Notation

In this course, vectors are upright bold, and vector magnitudes are italicized bold.

$$\mathbf{A} \text{ has a magnitude of } \mathbf{A}. \quad (3)$$

1.5. Angle Unit

In this course, angles are in degrees.

2. Force Vectors

Force, having both magnitude and direction, is a vector. Intuitively, we can apply all kinds of vector operations to forces, as you would learn in MATH 152.

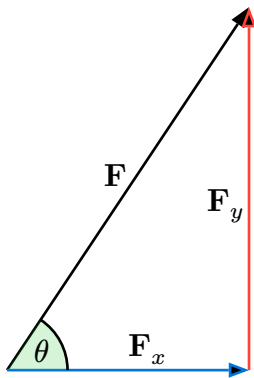
2.1. Addition

Use “Tip to tail” for triangular method of addition: draw the vectors head to tail, and the resultant vector is the vector from the tail of the first vector to the head of the last vector.

2.2. Force Components

$$\mathbf{F} = x\mathbf{i} + y\mathbf{j} \quad (4)$$

where x, y are magnitudes of the force in the \mathbf{i}, \mathbf{j} directions.



Force \mathbf{F} can be represented as a combination of \mathbf{F}_x and \mathbf{F}_y

$$\mathbf{F} = \mathbf{F}_x + \mathbf{F}_y \quad (5)$$

or as a polar coordinate of angle $\theta = \arctan\left(\frac{\mathbf{F}_y}{\mathbf{F}_x}\right)$ and magnitude \mathbf{F}

$$\mathbf{F} = \mathbf{F}(\cos(\theta) + \sin(\theta)) \quad (6)$$

3. Equilibrium of a Particle

4. Force System Resultants

5. Equilibrium of a Rigid Body

6. Friction

7. Kinematics of a Particle

8. Kinetics of a Particle: Force and Acceleration

9. Kinetics of a Particle: Work and Energy

10. Kinetics of a Particle: Impulse and Momentum