# PHYS 170 Study Notes

# Mechanics

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# 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<br>m | kilogram<br>kg | second<br>s | force<br>$\mathrm{kg\,m\,s^{-2}}$ |
| foot<br>ft | slug<br>$\mathrm{lb\,s^2\,ft^{-1}}$ | second<br>s | pound<br>lb |

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

## 1.3. Gravity

$$F = G\frac{m_1 m_2}{r^2} \tag{1.1}$$

$$F = ma \tag{1.2}$$

In this course, we will use

$$g = 9.81\ \mathrm{m\,s^{-2}} \tag{2}$$

which happens to be true for Vancouver.

## 1.4. Vector Notation

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

$$\mathbf{A} \text{ has a magnitude of } \boldsymbol{A}. \tag{3}$$

## 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.

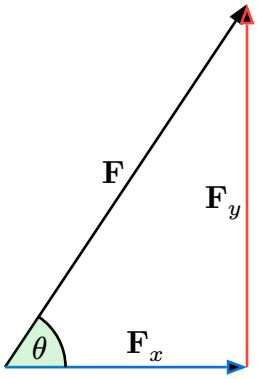
## 2.1. Addition

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

$$\mathbf{F} = x\mathbf{i} + y\mathbf{j} \tag{4}$$

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 $\mathbf{F}_y$

$$\mathbf{F} = \mathbf{F}_x + \mathbf{F}_y \tag{5}$$

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

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

# 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