



ME 121 (3,0)

Engineering Statics

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Ch 1 Introduction to Statics



Engineering Mechanics

- Physical science dealing with effects of **forces**
- Plays greater role in engineering
- Principles of mechanics are few but with wider application in engineering

particularly for the research and development in the field of vibration, stability of structures and machines, robotics, rocket and spacecraft design, control, engine performance, fluid flow, electrical machines and nuclear engineering

- We are concerned with the development and applications of principles of mechanics
- These principles are based on mathematics
- Mathematics required for the formulation and solution of mechanics problems
- Mechanics is divided into two parts
- Statics and Dynamics
- Statics --- force only
- Dynamics ---- force and effect -- motion

Basic Concepts

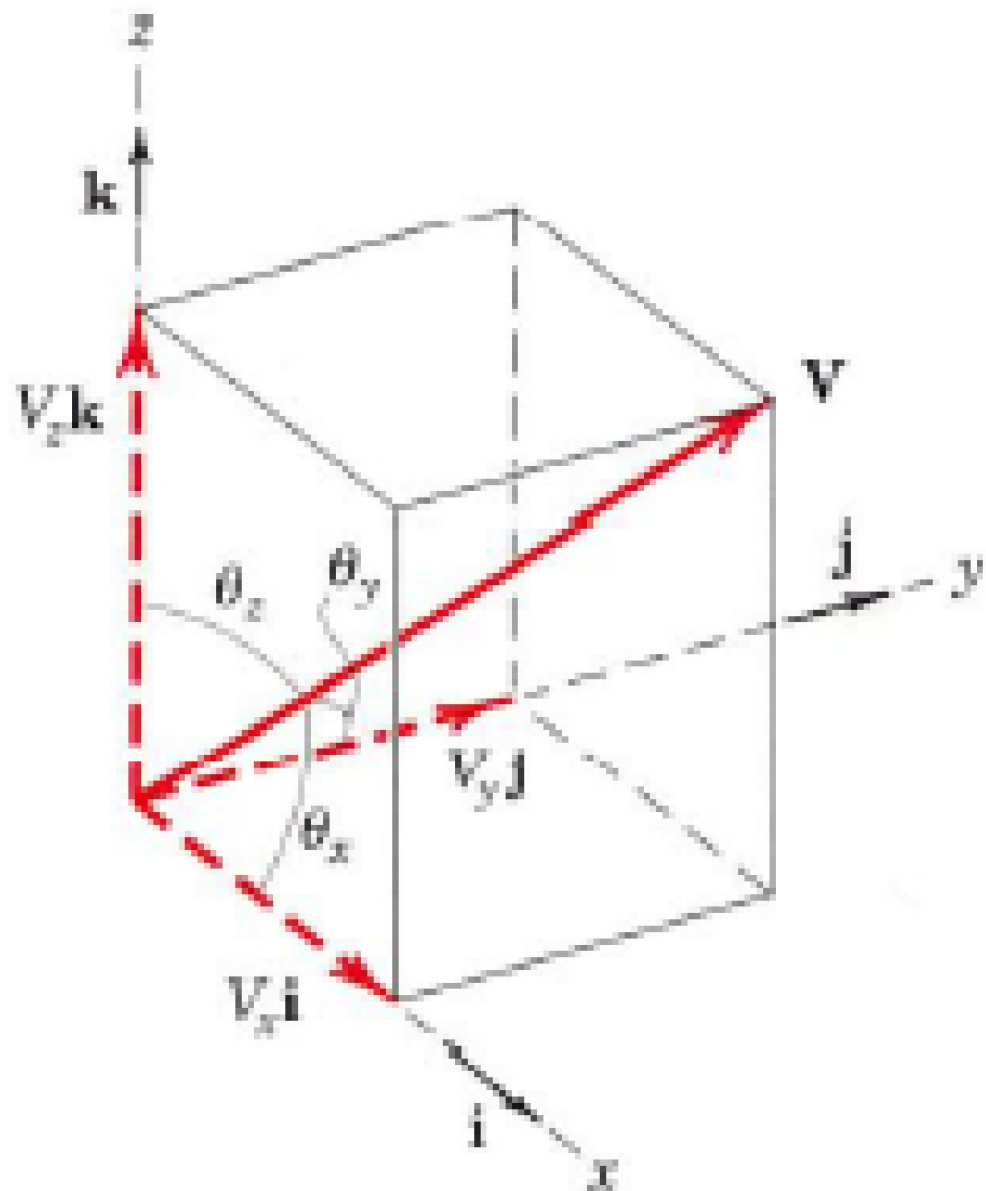
- Space: geometric region occupied by bodies
- Time: measure of succession of events
- Mass: measure of inertia of body
- Force: action of a body on another one
- Particle: body of negligible dimensions
- Rigid Body:

Scalars and Vectors

- Scalars
- Vectors
- Free vector
- Sliding vector
- Fixed vector
- Vector diagrams and conventions

Working with Vectors

- Vector sum
- Difference
- Components
- Unit vector
- Direction cosines



Newton's Laws

- Law I
- Law II
- Law III

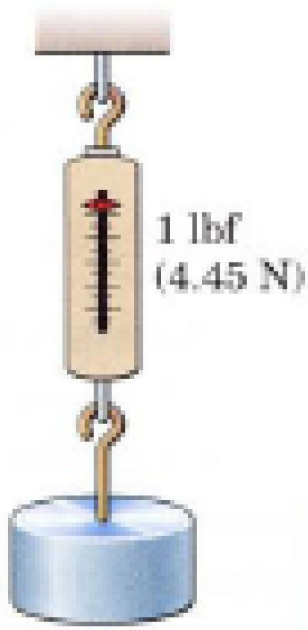
- Units---- SI units, customary units
- Units conversions
- Primary Standards
- Law of Gravitation



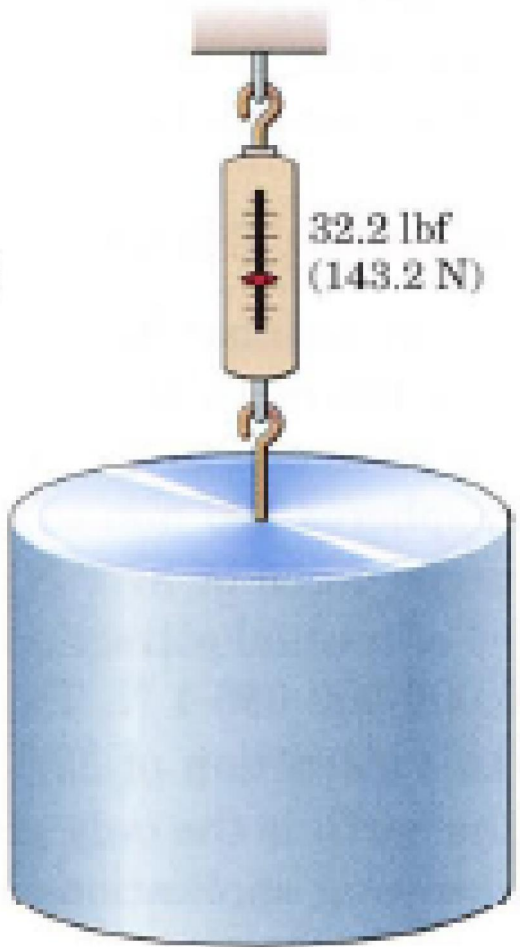
FORCE



9.81 N
(2.20 lbf)



1 lbf
(4.45 N)



32.2 lbf
(143.2 N)

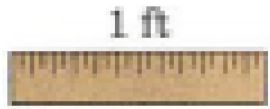
MASS

1 kg
(2.20 lbfm)

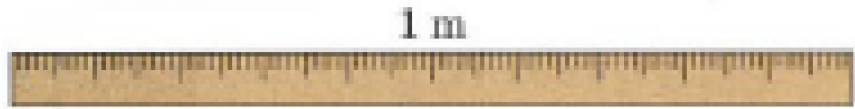
1 lbfm
(0.454 kg)

1 slug or 32.2 lbfm
(14.61 kg)

LENGTH



1 ft
(0.305 m)



1 m
(3.28 ft)

Free Body Diagram

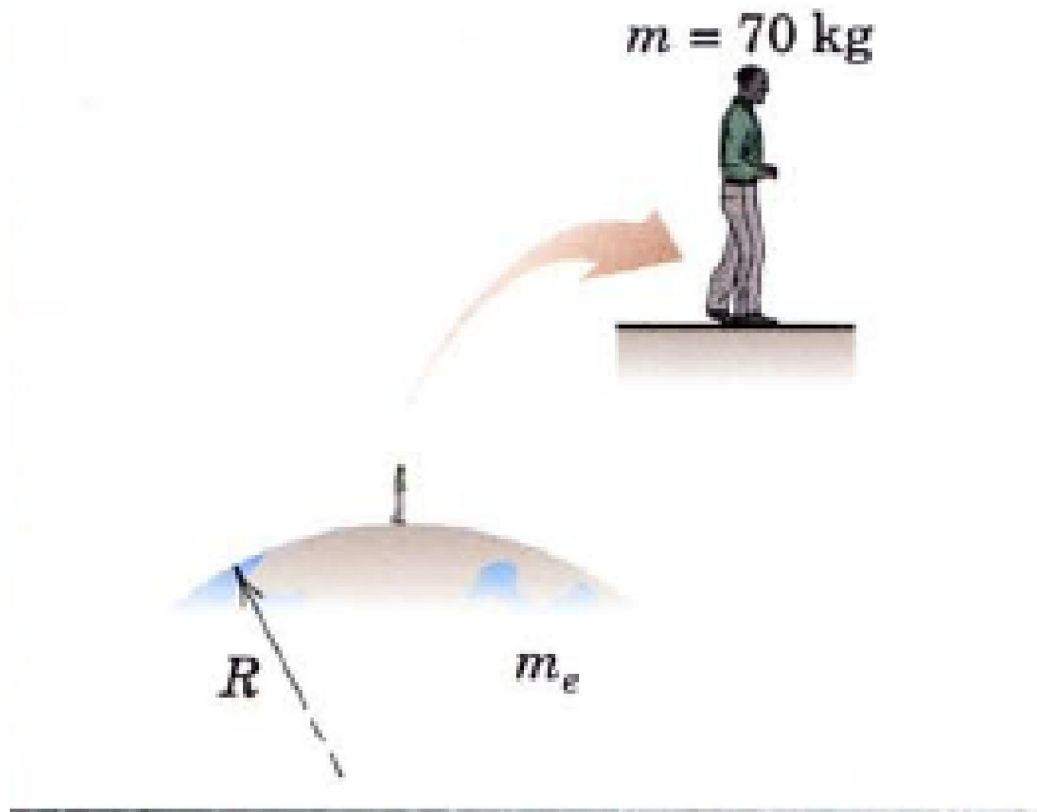
- Isolate the body from all other bodies
- Account all the forces acting on the body accurately
- Isolation should exist mentally, presented on the paper
- Diagram of such isolated body with all external forces shown acting on it, is called free body diagram
- Isolation of a body is the tool for identifying cause and effect

Sample problem 1/1

- Determine the weight in newtons of a car whose mass is 1400 kg. Convert the mass of the car to slugs and then determine its weight in pounds.

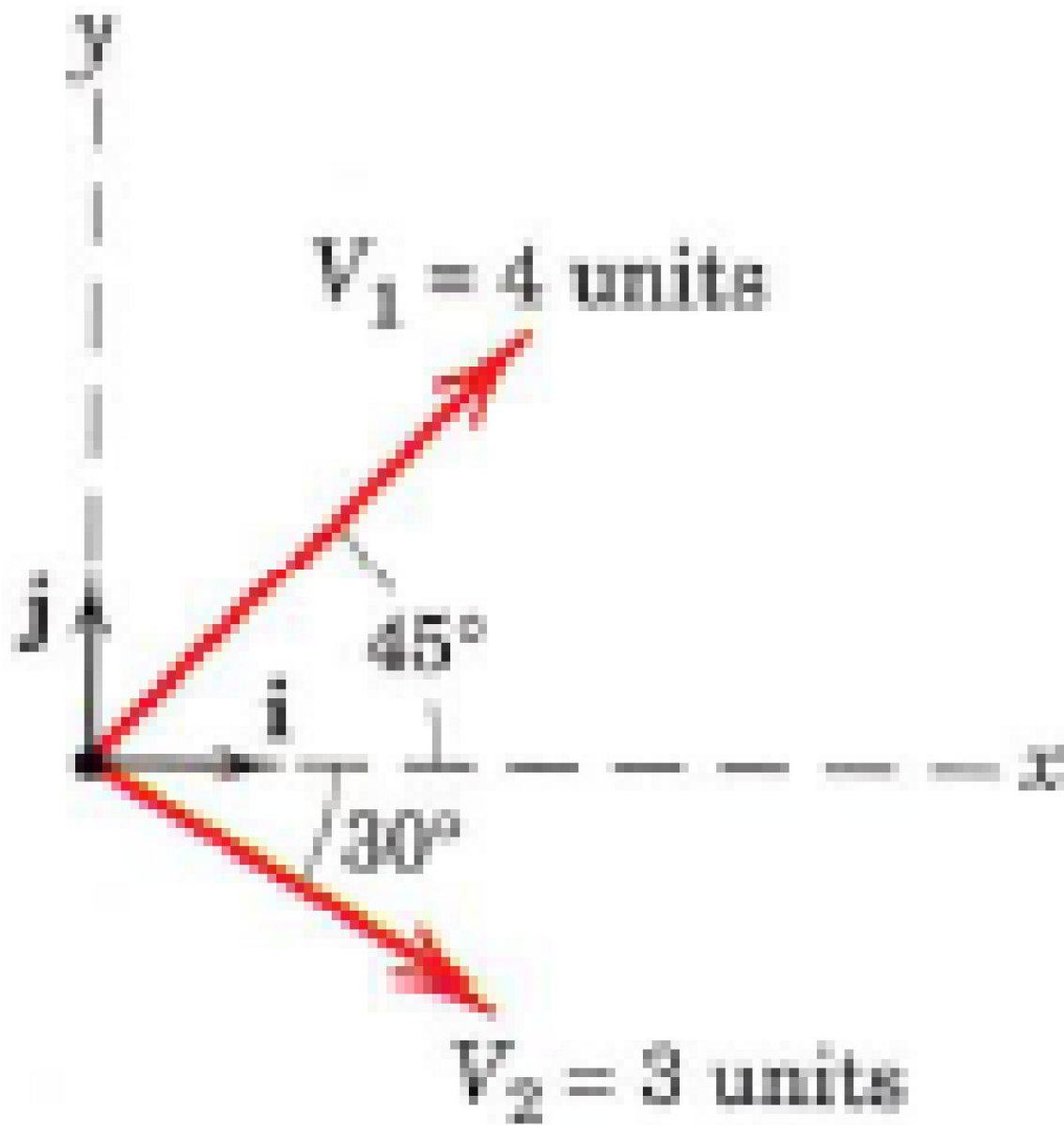


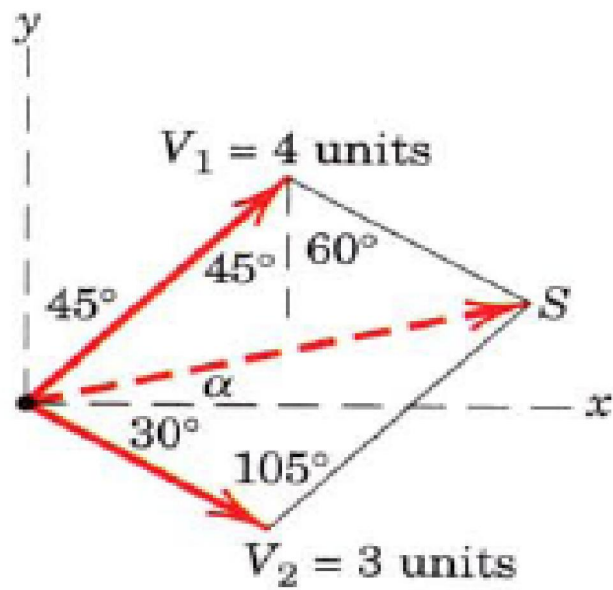
Problem 1/2



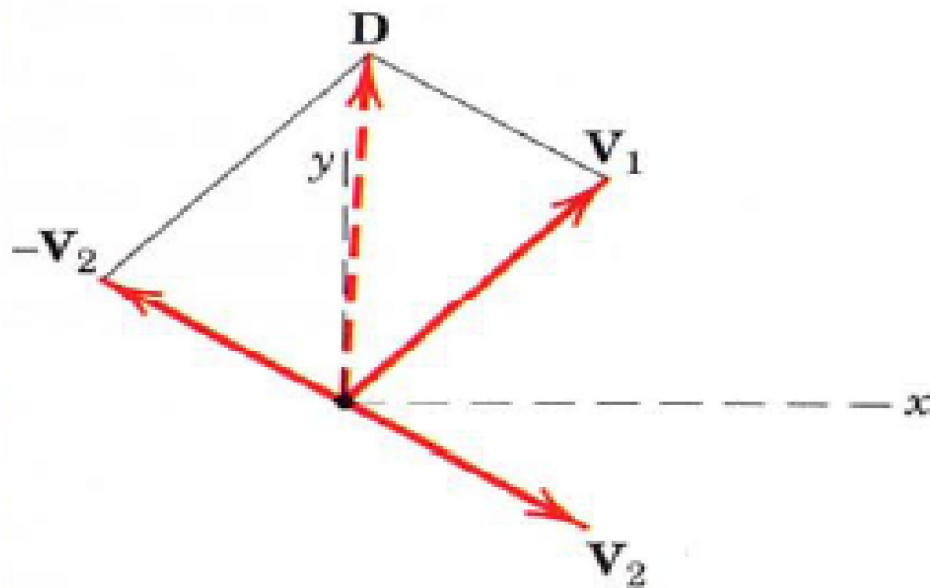
Sample problem 1/3

- Find the vector V_1 and V_2 shown in the figure
- (a) determine the magnitude S of their vector sum $S = V_1 + V_2$
- (b) determine the angle α between S and the positive x-axis
- © write S as a vector in terms of the unit vectors i and j and then write a unit vector n along the vector sum s
- (d) determine the vector difference $D = V_1 - V_2$





(a)

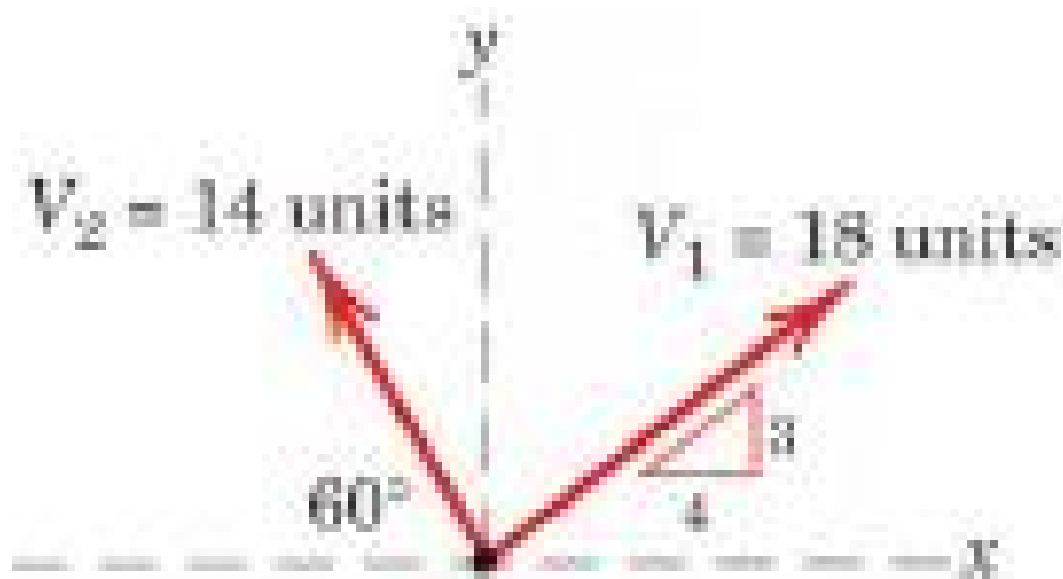


Problem 1/1

- Determine the angle made by the vector $V = -10i + 24j$ with the positive x-axis. Write the unit vector 'n' in the direction of V.

Problem 1/2

- determine the magnitude of the vector sum $V = V_1 + V_2$ and the angle θ_x which V makes with the positive x-axis. Complete both graphical and algebraic solutions.



- 1/3 For the given vectors V_1 and V_2 of prob. 1/2, determine the magnitude of vector difference $V' = V_2 - V_1$ and the angle θ_x which V' makes with the positive x-axis. Complete both graphical and algebraic solutions.
- 1/4 A force is specified by the vector $F = 80i - 40j + 60k$ lb. Calculate the angles made by F with x-, y-, and z-axes.
- 1/5 What is the weight in both newtons and pounds of a 75 kg beam?