**Kinetics of Particles ”Newton’s Second Law”**

2-1 NEWTON’S SECOND LAW OF MOTION

*If the resultant force acting on a particle is not zero, the particle will have acceleration proportional to the magnitude of the resultant and in the direction of this resultant force*



 



where Frepresents the sum, or resultant, of all the forces acting on

 the particle.

2-2 SYSTEMS OF UNITS

A-International System of Units (SI Units)







B- U.S. Customary Units





C- Conversion from One System of Units to Another





2-3 EQUATIONS OF MOTION

1. **Rectangular Components**

Resolving each force **F** and the acceleration **a** into rectangular components, we write







1. **Tangential and Normal Components**





**Example -1**: A 200-lb block rests on a horizontal plane. Find the magnitude of the force **P** required to give the block an acceleration of 10 ft/s2 to the right. The coefficient of kinetic friction between the block and the plane is μ*k* = 0.25.



**Example -2:** The two blocks shown start from rest. The horizontal plane and the pulley are frictionless, and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each cord.







**Example -3:** The bob of a 2-m pendulum describes an arc of circle in a vertical plane. If the tension in the cord is 2.5 times the weight of the bob for the position shown, find the velocity and the acceleration of the bob in that position.



**Example -4:** Determine the rated speed of a highway curve of radius ρ = 400 ft banked through an angle φ = 18°. The rated speed of a banked highway curve is the speed at which a car should travel if no lateral friction force is to be exerted on its wheels.





**Example-3:** A 20-kg package is at rest on an incline when a force **P** is applied to it. Determine the magnitude of **P** if 10 s is required for the package to travel 5 m up the incline. The kinetic coefficients of friction between the package and the incline are both equal to 0.3.



**Example-4:** A light train made up of two cars is traveling at 90 km/h when the brakes are applied to both cars. Knowing that car *A* has a mass of 25 Mg and car *B* a mass of 20 Mg, and that the braking force is 30 kN on each car, determine (*a*) the distance travelled by the train before it comes to a stop, (*b*) the force in the coupling between the cars while the train is showing down.





**Example-5:** Each of the systems shown is initially at rest. Neglecting axle friction and the masses of the pulleys, determine for each system (a) the acceleration of block A, (b) the velocity of block A after it has moved through 10 ft, (c) the time required for block A to reach a velocity of 20 ft/s.





**Example-5:** The two blocks shown are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block *A* and the incline, determine (*a*) the acceleration of each block, (*b*) the tension in the cable.









**Example-6:** During a hammer thrower’s practice swings, the 7.1-kg head A of the hammer revolves at a constant speed v in a horizontal circle as shown. If r = 0.93 m and u = 60°, determine (a) the tension in wire BC, (b) the speed of the hammer’s head





**Example-7:** The coefficients of friction between the load and the flat-bed trailer shown are μ= 0.30. Knowing that the speed of the rig is 72 km/h, determine the shortest distance in which the rig can be brought to a stop if the load is not to shift.



