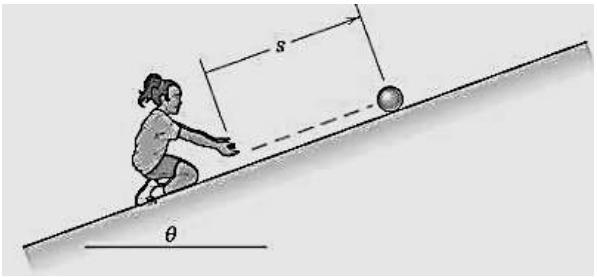
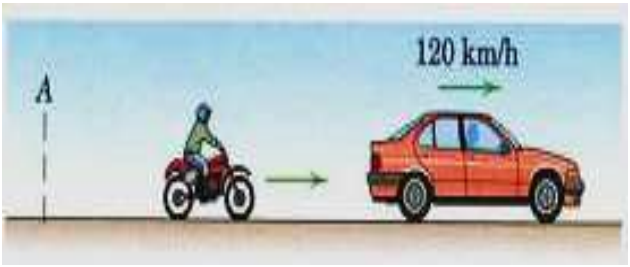
Worksheet 2 rectilinear motion

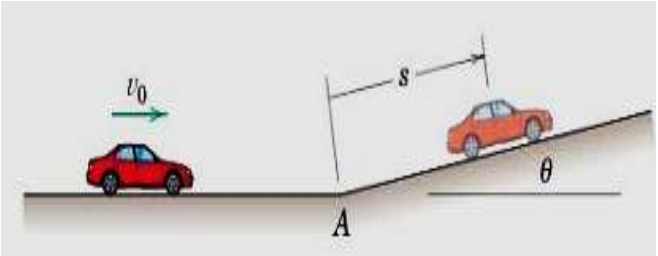
1. A jet aircraft with a landing speed of 200km/h has a maximum of 600m of available runway after touchdown in which to reduce its ground speed to 30km/h. compute the average acceleration a required of the aircraft during braking.
2. A train starts from rest at a station and travels with a constant acceleration of 1 m/s^2. Determine the velocity of the train when t= 30s and the distance traveled during this time.
3. A rocket is fired vertically up from rest. If it designed to maintain upward acceleration of 1.5g. Calculate the time t required for it to reach an altitude of 30km and its velocity at that position.
4. The pilot of a jet transport brings the engines to full takeoff power before releasing the brakes as the aircraft is standing on the runway. The jet thrust remains constant, and the air craft has a near constant acceleration of 0.4g. If the takeoff speed is 200km/h, calculate the distance s and time t from rest to takeoff.
5. A girl rolls a ball up an incline and allows it to return to her. For the angle θ and a ball involved, the acceleration of the ball along the incline is constant at 0.25g, directed down the incline. If the ball is released with a speed of 4m/s, determine the distance it moves up the incline before reversing its direction and the total time t required for the ball to return to the child's hand.



6. A motorcycle patrolman starts from rest at A two seconds after a car, speeding at the constant rate of$120\,km/hr$, passes point A. If the patrolman accelerates at the rate of $6\,m/sec^2$ until he reaches his maximum permissible speed of $150\,km/hr$, which he maintains, calculate the distance s from point A to the point at which he overtakes the car.



7. The car is traveling at a constant speed of $v_0 = 100km/h$ on the level portion of the rod. When the 6-percent (tanθ=6/100) inclined is encountered, the driver does not change the throttle setting and consequently the car decelerates at the constant rate $gsin\theta$. Determine the speed of the car
   I. 10 seconds after passing point A and B
   II. When it reaches a distance of s=100m

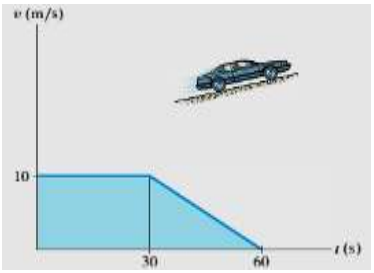


8. The velocity of a particle which moves along a straight line in 1D is given by;

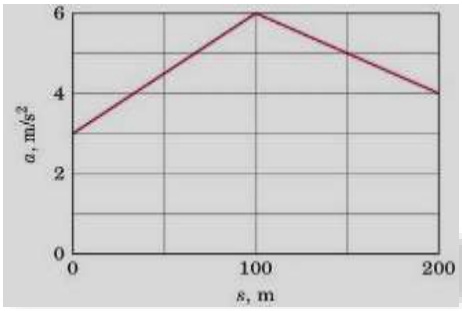
$$v(t) = 2 - 4t + 5t^{3/2}$$

Where t is in seconds and v is in meters per second. Evaluate the position s, velocity v, and acceleration a when$t = 3s$. The particle is at the position $s_0 = 3m$ when$t = 0$.

9. The velocity of a particle moving in a straight line is decreasing at the rate of $3m/s$ per meter of displacement at the instant when the velocity is$10m/s$. Determine the acceleration a of the particle at this instant.
10. The displacement of a particle which moves along the s-axis is given by; $s = (-2 + 3t)e^{-0.5t}$ Where s is in meters and t is in seconds. Determine the time at which the acceleration is zero.
11. A particle has an initial speed of $27m/s$. If it experiences a deceleration of $a = -6t$ in $\frac{m}{s^2}$ where t is in seconds, determine its velocity, after it has traveled 26 m. How much time does this take?
12. A car travels up a hill with the speed shown. Determine the total distance the car travels until it stops for the duration of 60s.



13. The acceleration of a particle traveling along a straight line is $a(s) = 8 - 2s$ in $\frac{m}{s^2}$, where s is in meters. If $v = 0$ at $s = 0$, determine the velocity of the particle at $s = 2m$, and the position of the particle when the velocity is maximum.

14. A vehicle enters a test section of straight road at $s = 0$ with a speed of $40km/h$. It then undergoes an acceleration which varies with displacement as shown. Determine the velocity v of the vehicle as it passes the position $s = 0.2km$

15. A motor cycle starts from rest with an initial acceleration of $3\,{}^{m}/_{s^2}$, and the acceleration then changes with distance s as shown. Determine the velocity v of the motorcycle when s=200m. At this point also determine the value of the derivative $\frac{dv}{ds}$.