

Answer on Question #50339, Physics, Mechanics | Kinematics | Dynamics

Task:

Particle mass of 0.5 kg. The particle has a initial velocity with horizontal component of 30 m/s. The particle rises to a max height of 20m above p.

particle is on a cliff 60 m high. Find velocity in the y direction (vertical). Find horizontal and vertical components when the particle reaches b at the bottom

Answer:

Equations of motion:

$$x(t) = V_{x0}t + x_0$$

$$y(t) = -gt^2/2 + V_{y0}t + y_0$$

Initial conditions: $x_0=0$ $y_0=0$ $V_{x0}=30$

Thus, $x(t) = V_{x0}t$ $y(t) = -gt^2/2 + V_{y0}t$

1) velocity in the y direction (vertical) V_{oy} :

the maximum height of the particle is a value of $y(t)$ at time, when $dy(t)/dt=0$.

$dy(y)/dt = -gt + V_{y0} = 0$, $t = V_{y0}/g$, $y(V_{y0}/g) =$ a max height of 20m $= -g(V_{y0}/g)^2/2 + V_{y0}(V_{y0}/g) = V_{y0}^2/2g$, thus $V_{oy} = (2gh)^{1/2} = (2*10*20)^{1/2} = 20\text{m/s}$.

2) horizontal and vertical components when the particle reaches b at the bottom:

$V_y = V_{oy} + gt$, $t = (V_{oy} + (V_{oy}^2 + 2gh)^{1/2})/g = 6\text{s}$; so $V_y = 80\text{m/s}$.