

Answer on Question #67215-Physics-Solid State Physics

A particle is projected vertically upwards. After a time t , another particle is sent up from the same point with the same velocity and meets the first at a height h during the downward flight of the first. Find the velocity of projection.

Solution

$$y = vT - \frac{gT^2}{2}$$
$$y = v(T - t) - \frac{g(T - t)^2}{2}.$$

A height h :

$$vT - \frac{gT^2}{2} = h \rightarrow T = \frac{v \pm \sqrt{v^2 - 4\left(\frac{g}{2}\right)h}}{2\left(\frac{g}{2}\right)}$$

It meets the first at a height h during the downward flight of the first:

$$T = \frac{v + \sqrt{v^2 - 2gh}}{g}.$$

So,

$$v\left(\frac{v + \sqrt{v^2 - 2gh}}{g} - t\right) - \frac{g\left(\frac{v + \sqrt{v^2 - 2gh}}{g} - t\right)^2}{2} = h$$

$$2\sqrt{v^2 - 2gh} = gt$$

$$v^2 = 2gh + \left(\frac{gt}{2}\right)^2$$

The velocity of projection is

$$v = \sqrt{2gh + \left(\frac{gt}{2}\right)^2}$$