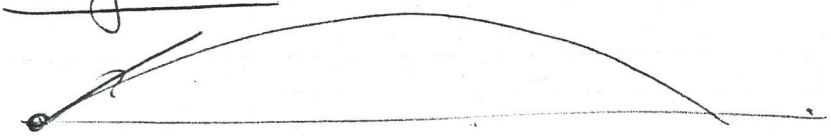
Projectiles:

M 1972

(2)



$\vec{u} = 28\vec{i} + 21\vec{j}$.

$\vec{g} = -g\vec{j}$.

$\vec{r}(t) = 28t\vec{i} + \left(21t - \frac{g}{2}t^2\right)\vec{j}$.

$\vec{v}(t) = 28\vec{i} + (21 - gt)\vec{j}$.

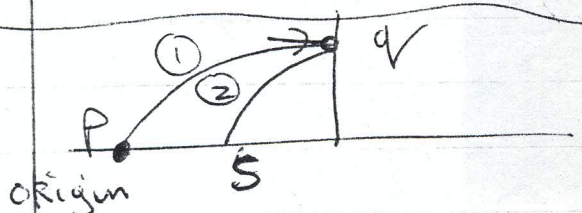
Highest point: $\left(\vec{v}(t)\right)\vec{j} = 0$

$\Rightarrow 21 - gt = 0$

$\Rightarrow t = \frac{21}{g}$

$\therefore \vec{r}\left(\frac{21}{g}\right) = 28\left(\frac{21}{g}\right)\vec{i} + \left(21\left(\frac{21}{g}\right) - \frac{g}{2}\left(\frac{21}{g}\right)^2\right)\vec{j}$

$= 60\vec{i} + 22.5\vec{j}$.



$\vec{u}$ before collision $\vec{u} = 28\vec{i} + 0\vec{j}$.

$\vec{u}$ after collision [the initial velocity for second projectile motion]

$\vec{u} = -\frac{1}{2}(28)\vec{i} = -14\vec{i}$.

position vector of Q

$\therefore \vec{r}_2(t) = \left(-14t\vec{i} + \left(0t - \frac{g}{2}t^2\right)\vec{j}\right) + \underbrace{60\vec{i} + 22.5\vec{j}}$.

Needed because origin at P.

$\vec{v}_2(t) = -14\vec{i} + (-gt)\vec{j}$.

Hits ground again when $\vec{j}(\vec{r}) = 0$.

$\Rightarrow \quad 22.5 - \frac{g}{2}t^2 = 0$.

$\Rightarrow \quad t^2 = \frac{45}{g} \Rightarrow t = 2.143$ secs.

$\Rightarrow \left(\vec{r}(t)\right)\vec{i} = (60 - 14t)\vec{i}$

$= (60 - 30)\vec{i}$.

$= 30\vec{i}$ metres.