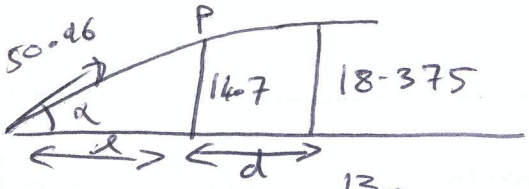
1996 HLC Q3 (a)



$\tan\alpha = \frac{5}{12} \Rightarrow$ 

$\Rightarrow \cos\alpha = \frac{12}{13}, \sin\alpha = \frac{5}{13}$

$\vec{r}(t) = 50\cdot96(\cos\alpha)t\,\vec{i} + (50\cdot96\sin\alpha t - \frac{g}{2}t^2)\vec{j}$ (5)

$\vec{r}(t) = 47\cdot04\vec{i} + (19\cdot6t - 4\cdot9t^2)\vec{j}$. (5)

At wall P:

$(r)_{\vec{j}} = 14\cdot7 \Rightarrow 19\cdot6t - 4\cdot9t^2 = 14\cdot7$

$\Rightarrow t^2 - 4t + 3 = 0$

$\Rightarrow (t-3)(t-1) = 0$

$\Rightarrow t = 3$ or $t = 1$. (5)

Take $t=1$

At wall Q:

$(r)_{\vec{j}} = 18\cdot375 \Rightarrow 19\cdot6t - 4\cdot9t^2 = 18\cdot375$

$\Rightarrow t^2 - 4t + 3\cdot75 = 0$

$\Rightarrow t = 1\cdot5$ or $t = 2\cdot5$. (5)

when $t=1$ $l = (r(1))_{\vec{i}} = 47\cdot04(1)$

$\Rightarrow \boxed{l = 47\cdot04}$

when $t=1\cdot5 \Rightarrow l+d = 47\cdot04(1\cdot5)$

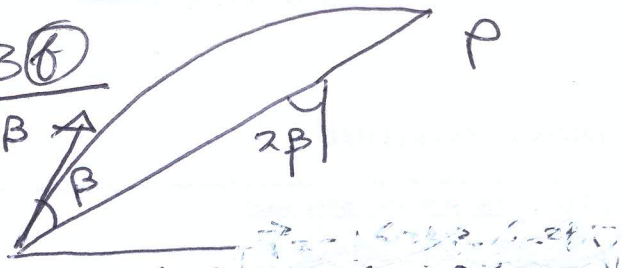
$\Rightarrow \boxed{d = 23\cdot52}$ (5)

when $t=2\cdot5 \Rightarrow l+d = 47\cdot04(2\cdot5)$

$\Rightarrow \boxed{d = 70\cdot56}$ (5)

(30)

Q3 (b)



$\vec{g} = -g\cos2\beta\,\vec{i} - g\sin2\beta\,\vec{j}$

$\vec{u} = (u\cos\beta)\cos\beta\,\vec{i} + (u\cos\beta)\sin\beta\,\vec{j}$

$\vec{r} = [(u\cos\beta)\cos\beta\,t - \frac{g}{2}\cos2\beta\,t^2]\vec{i} + [(u\cos\beta)\sin\beta t - \frac{g}{2}\sin2\beta t^2]\vec{j}$. (10)

(i) At P, $(r)_{\vec{j}} = 0$

$\Rightarrow u\cos\beta\sin\beta t - \frac{g}{2}\sin2\beta t^2 = 0$

$\Rightarrow t[u\cos\beta\sin\beta - \frac{g}{2}\sin2\beta t] = 0$

$\Rightarrow t = 0$ or $u\cos\beta\sin\beta - \frac{g}{2}\sin2\beta t = 0$

$\Rightarrow T = \frac{2u\cos\beta\sin\beta}{g\sin2\beta}$

$T = \frac{u}{g}\frac{\sin2\beta}{\sin2\beta} = \frac{u}{g}$. (5)

(ii) Range $= (r(T))_{\vec{i}}$

Range $= u\cos\beta\cos\beta[\frac{u}{g}] - \frac{g}{2}\cos2\beta[\frac{u}{g}]^2$

$= \frac{u^2}{g}[\cos^2\beta - \frac{1}{2}\cos2\beta]$

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$= \frac{u^2}{g}[\cos^2\beta - \frac{1}{2}[2\cos^2\beta - 1]]$

$= \frac{u^2}{g}[\cos^2\beta - \cos^2\beta + \frac{1}{2}]$

$= \frac{u^2}{2g}$. (5)