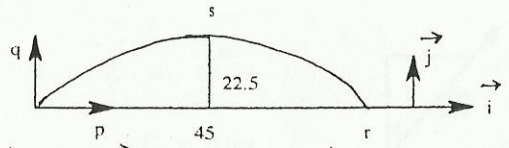
3(a) (i)

1994




$\vec{r} = (p.t)\vec{i} + (q.t - 0.5gt^2)\vec{j}$

$\vec{v} = (p)\vec{i} + (q - gt)\vec{j}$

At r $r_{\vec{j}} = 0$ $\Rightarrow$ $t = \frac{2q}{g}$

$\Rightarrow$ time to reach s $= \frac{q}{g}$

At s $r_{\vec{j}} = 22.5$ $\Rightarrow$ $q.t - 0.5gt^2 = 22.5$

$\frac{q^2}{g} - \frac{q^2}{2g} = 22.5$

$q^2 = 22.5(2g)$

$q = 21$

At r $r_{\vec{i}} = 45$ $\Rightarrow$ $p.t = 45$

$p.\frac{2q}{g} = 45$

$\Rightarrow$ $p = 10.5$

(ii) time of flight $= \frac{2q}{g} = \frac{42}{g}$

second player can be up to $\left(7 \times \frac{42}{g} = \right)$ 30 metres from r

(b) (i) $\vec{r} = ut\vec{i} + (0 - 0.5gt^2)\vec{j}$

$v = u\vec{i} - gt\vec{j}$

$r_{\vec{j}} = -0.3$ $\Rightarrow$ $0.5gt^2 = 0.3$

$t = \frac{\sqrt{3}}{7}$ or $0.247$

Range $= 3$

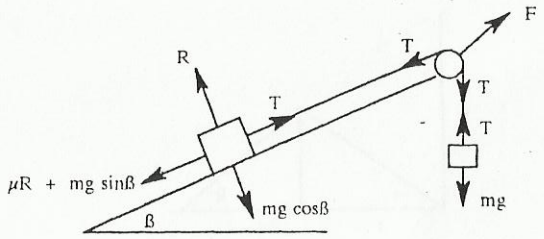
$ut = 3$

$u = 7\sqrt{3}$ or $12.12$

(ii) $v = 7\sqrt{3}\,\vec{i} - 1.4\sqrt{3}\,\vec{j}$

$|v| = 12.36$

4 (i)




(ii) $T - \mu R - mg\sin\beta = mf$

$mg - T = mf$

$\Rightarrow$ $T - \mu R - mg\sin\beta = mg - T$

$2T = \mu(mg\cos\beta) + mg\sin\beta + mg$

$2T = \frac{4}{13}mg + \frac{5}{13}mg + mg$

$T = \frac{11}{13}mg$

(iii) Stage 1 - first two seconds TWO STAGES.

From equation (2) $f = \frac{2g}{13}$

$s = ut + 0.5ft^2$

$= 0 + \frac{1}{2}\frac{2g}{13}(4)$

$= \frac{4g}{13}$

$v = 0 + \frac{2g}{13}(2) = \frac{4g}{13}$

Stage 2 $f = -\mu g\cos\beta - g\sin\beta = -\frac{9g}{13}$

$v^2 = u^2 + 2fs$

$0 = \frac{16g^2}{169} - \frac{18gs}{13}$

$s = \frac{8g}{117}$

Total distance $= \frac{36g}{117} + \frac{8g}{117} = \frac{44g}{117}$