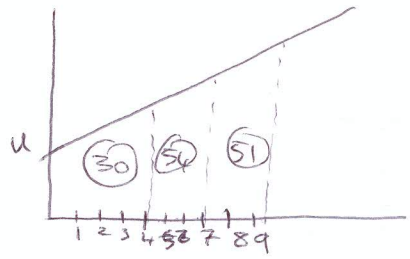
ALC 43: Rough diagram:



$s = ut + \frac{1}{2}at^2$

Reg I: first 4 secs, $s = 30$

$30 = u(4) + \frac{1}{2}a(16)$

$30 = 4u + 8f \quad -(1)$

Reg II: first 7 secs, $s = 30 + 54 = 84$

$84 = u(7) + \frac{1}{2}a(49)$

$84 = 7u + 24.5f \quad -(2)$

solve $\Rightarrow$ $u = 1.5\ m/s$, $a = 3\ m/s^2$

Reg III: first 9 secs, s should = 135.

$135 = u(9) + \frac{1}{2}(a)(81)$

$135 = 9u + \frac{81}{2}a \quad -(3)$

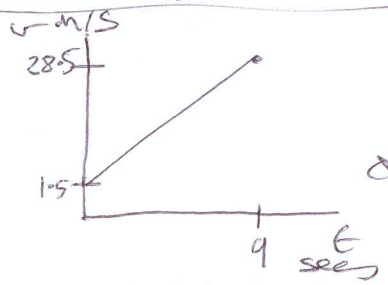
Check:

$135 = 9(-5) + \frac{81}{2}(3)$

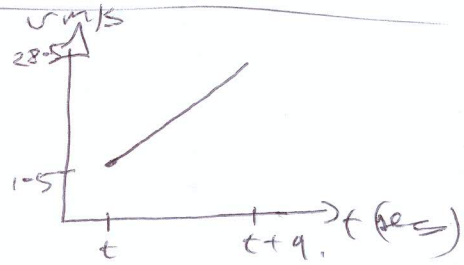
$135 = 135$ ✓

(Checking into (3) verifies ALM.)

(ii) graphs: (t, v): $(0, 1.5)$, $(4, 13.5)$, $(9, 28.5)$ using $v = u + at$



OR



(i) P: $u = 47$, $a = -9.8$, $t = t + 2$; Q: $u = 64.6$, $a = -9.8$, $t = t$ secs.

Let s = displacement above ground

$s_P = 47(t+2) - \frac{1}{2}(9.8)(t+2)^2$.

$s_Q = 64.6t - \frac{1}{2}(9.8)t^2$.

Collide when heights same $\Rightarrow$ $s_P = s_Q$

$64.6t - 4.9t^2 = 47(t+2) - 4.9(t+2)^2$.

$\Rightarrow$ $t = 2$

(ii) Collision occurs at $s_Q(2) = 64.6(2) - 4.9(2)^2$

$= 129.2 - 19.6$

$= 109.6\ m$.