

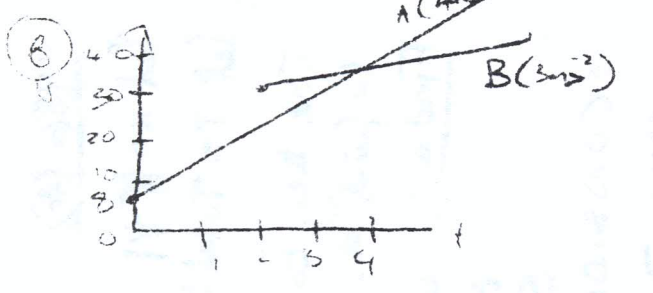
Shortest time A accel followed by decel.

Total S = $\frac{1}{2} v T$
 $\Rightarrow 1200 = \frac{1}{2} v T$ (X)

But $t_1 + t_2 = 8:4 \rightarrow t_1 : t_2 = 2:1$
 $\Rightarrow t_1 = \frac{2}{3} T$ and $t_2 = \frac{1}{3} T$

Find v in terms of T
 $v = u + at \Rightarrow v = 0 + 4(\frac{2}{3}T)$
 $v = \frac{8}{3}T$

(*) $\Rightarrow 1200 = \frac{1}{2} (\frac{8}{3} T) T$
 $\Rightarrow 1200 = \frac{4}{3} T^2$
 $\Rightarrow T^2 = 900 \Rightarrow T = 30 \text{ sec}$



Expressions for S_A and S_B (distance travelled)

S_A (Time measured from A start)
 $S_A = S_A$
 $u_A = 4$
 $a_A = 8$
 $S = 8t + \frac{1}{2} 4t^2 = 8t + 2t^2$

S_B (Time = $t-2$)
 $S_B = S_B$
 $u_B = 3$
 $a_B = 30$
 $S_B = 3(t-2) + \frac{1}{2} 3(t-2)^2$
 $= 30t - 60 + \frac{3}{2} [t^2 - 4t + 4]$
 $= 30t - 60 + \frac{3}{2} t^2 - 6t + 6$
 $S_B = \frac{3}{2} t^2 + 24t - 54$

gap between A and B
 (ie the difference in the distance away from the starting position)

$S_B - S_A = \frac{3}{2} t^2 + 24t - 54 - (8t + 2t^2)$

[See Footnote]

gap = $-\frac{1}{2} t^2 + 16t - 54$

To maximize gap put

$\frac{d \text{ gap}}{dt} = 0$

$\Rightarrow -t + 16 = 0$
 $\Rightarrow t = 16 \text{ secs}$

So After 16 secs there is the max gap between A and B when B is ahead of A.

gap = $-\frac{1}{2} (16)^2 + 16(16) - 54$
 $= -128 + 256 - 54$
 $= 74 \text{ m}$

Maximum gap = 74 m
 [when B is ahead of A]

Footnote 1) Sequence of events

- (I) B at rest A in lead
- (II) B moving A still ahead
- (III) B passes out A and stays ahead for a little while
- (IV) A passes B out and then stays ahead forever!

\therefore It would be impossible to ask the question: Find the max dist A will be ahead of B.

mathematically

$S_A - S_B = +\frac{1}{2} t^2 - 16t + 54$
 which is U shaped and doesn't have a max only a min

Footnote 2) gap formula can be reached by relative motion work also.