1. (a) A particle is released from rest at A and falls vertically passing two points B and C.

2011

It reaches B after t seconds and takes $\frac{2t}{7}$ seconds to fall from B to C, a distance of 2.45 m.

Find the value of t.

AB $\quad s = ut + \frac{1}{2}ft^2$

$h = 0 + \frac{1}{2}gt^2$ — 5

AC $\quad s = ut + \frac{1}{2}ft^2$

$h + 2.45 = 0 + \frac{1}{2}g\left(\frac{9t}{7}\right)^2$ — 5

$\frac{1}{2}gt^2 + \frac{1}{4}g = 0 + \frac{1}{2}g\left(\frac{81t^2}{49}\right)$ — 5

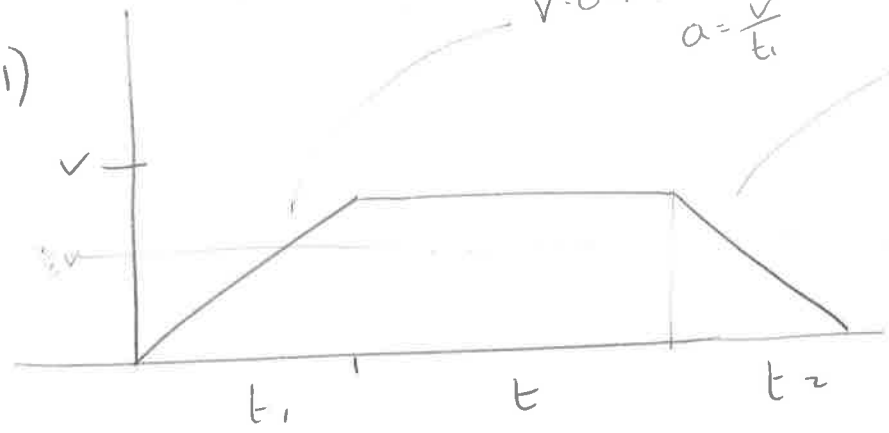
$2t^2 + 1 = \frac{162t^2}{49}$

$64t^2 = 49$

$\Rightarrow \quad t = \frac{7}{8}$ s — 5 — 20

2011 b

i)



ii) $\text{Av-speed} = \frac{3v}{4} = \frac{d}{t_1+t+t_2} = \frac{\frac{1}{2}t_1 v + tv + \frac{1}{2}t_2 v}{t_1+t+t_2}$

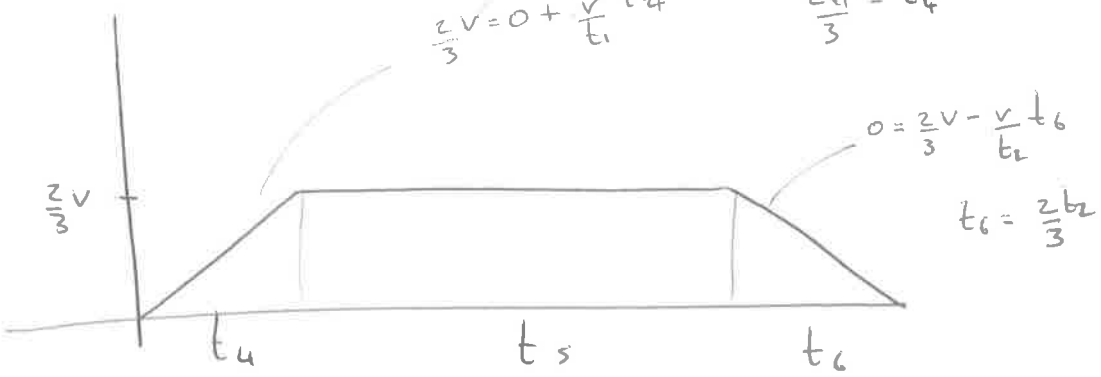
$3(t_1+t+t_2) = 4\left(\frac{1}{2}t_1 + t + \frac{1}{2}t_2\right)$

$3t_1 + 3t + 3t_2 = 2t_1 + 4t + 2t_2$

$$\boxed{t_1 + t_2 = t}$$

ii) $V_{max} = \frac{2v}{3}$

find t_4, t_5, t_6



$d = d$: $\frac{1}{2}t_1 v + tv + \frac{1}{2}t_2 v = \frac{1}{2}t_4 \frac{2v}{3} + t_5 \frac{2}{3}v + \frac{1}{2}t_6 \frac{2v}{3}$

$3t_1 v + 6tv + 3t_2 v = 2t_4 v + 4t_5 v + 2t_6 v$

$3t_1 + 6t + 3t_2 = 2t_4 + 4t_5 + 2t_6$

$3(t_1+t_2) + 6t$

$9t = 2t_4 + 4t_5 + 2t_6$

$$9t = 2(t_4 + t_6) + 4t_5$$

$$= 2\left(\frac{4}{3}t_1\right) + 4t_5$$

$$\frac{2}{3}(t_1 + t_2)$$

$$9t = \frac{4}{3}t + 4t_5$$

$$\frac{23}{3}t = 4t_5$$

$$\frac{23}{12}t = t_5$$

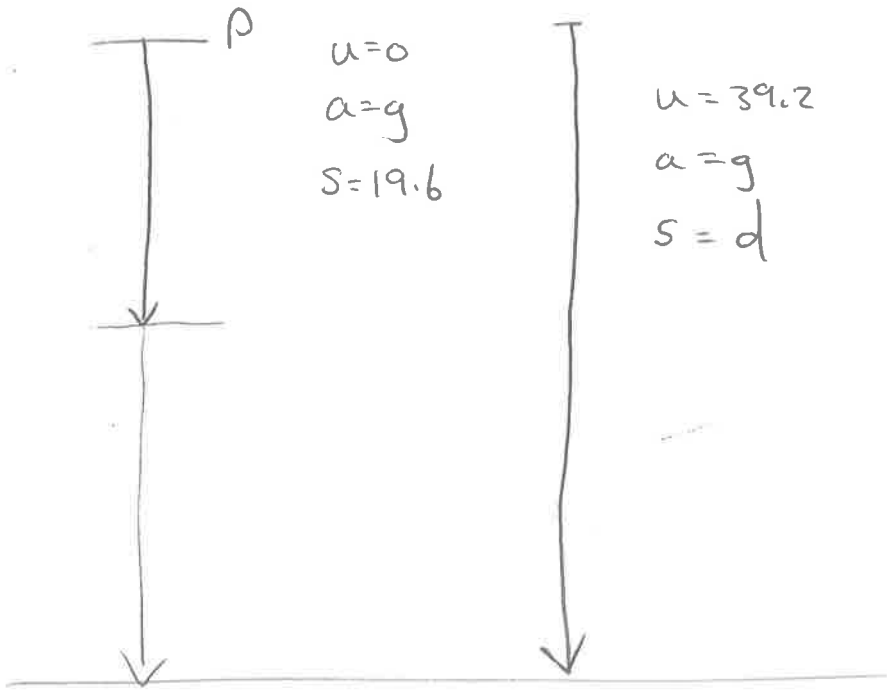
$$\text{time} = t_4 + t_5 + t_6$$

$$= \frac{2}{3}(t_1 + t_2) + \frac{23}{12}t$$

$$= \frac{2}{3}t + \frac{23}{12}t$$

$$= \frac{31}{72}t.$$

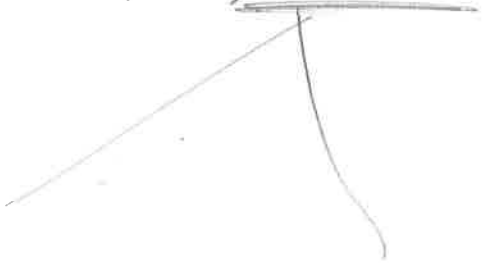
2012 9



collide 'd' from P

↓

same place, same time



$v = u + at$

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

$19.6 = \frac{1}{2}(9.8)t^2$

$t = 2$ when 2nd is thrown

1st one: $u=0$, $a=9.8$, $s=d$, $t=2+t$

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

$d = \frac{1}{2}(9.8)(t+2)^2$

2nd one: $u=39.2$, $a=9.8$, $s=d$, $t=t$

$d = 39.2t + \frac{1}{2}(9.8)t^2$

$d = d$

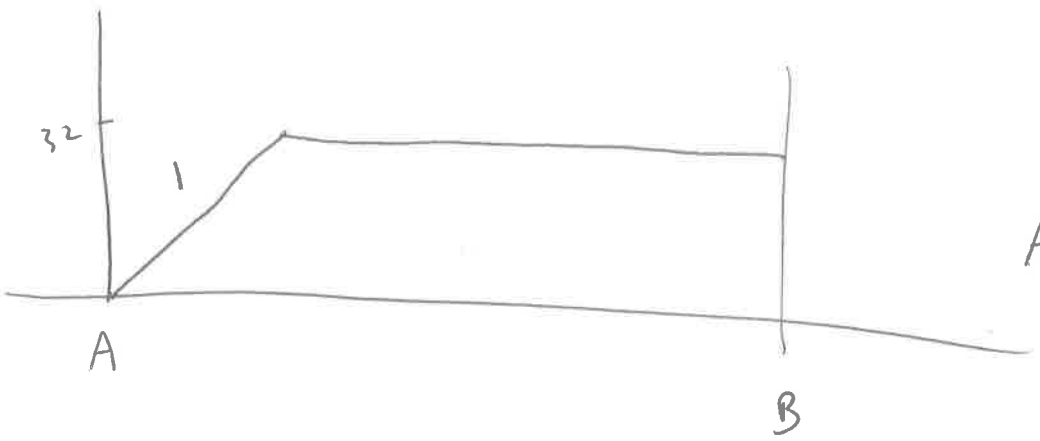
$\frac{1}{2}g(t+2)^2 = 39.2t + \frac{1}{2}gt^2$

$t^2 + 4t + 4 = 8t + t^2$

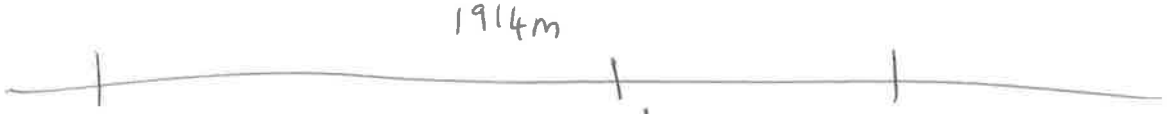
$t = 1$

$d = \frac{1}{2}g(3)^2 = 44.1$

2012 b



Area = 1914 m



A — meet after t sec. — B

Car → : $u=0$, $a=1$, $v=32$; then $u=32$, $v=32$, $a=0$

$v=u+at$, $t=32$

$v^2=u^2+2as$

$32^2=2(1)(s)$

$s=512$

Bus ← : $u=36$, $v=36$, $a=0$, $t=12$; then $u=36$, $a=-0.75$

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

$=36(12)+0$

$=432$

To meet : $S_c + S_B = 1914$

$$1914 = 512 + \left(32(t-32)\right) + 432 + \left(36(t-12) + \tfrac{1}{2}(-0.75)(t-12)^2\right)$$

$$3t^2 - 616t + 19840 = 0$$

$$t = 40$$

ii) 48 sec : after 40 sec together, in another 8?

~~car : $s = ut + S_c$ in (48 − 32 sec)~~

Car : $s = 32(8) + \frac{1}{2}(0)(8^2) = 256$ →

Bus : $v = u + at$

$v = 36 - 0.75(40-12)$

$v = 15$ when meet

$s = 15(8) + \frac{1}{2}\left(-\frac{3}{4}\right)64$

$= 96$ ←

⇒ $256 + 96 = 352$ apart.