APPLIED MATHS 2003

QUESTION ONE

a.

$|pq|$		$|pr|$	
u	u	u	u
v		v	
a	f	a	f
s	125	s	250
t	10	t	25

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

$|pq|$ $125 = 10u + 50f$ × 25

$|pr|$ $250 = 25u + \overset{312.5}{\cancel{125}}f$ ×-10

$|pq|$ $3125 = 250u + 1250f$

$|pr|$ $-2500 = -250u - 3\cancel{125}f$

$625 = -1875f$ ⟹ $f = -\frac{625}{1875}$ $\boxed{f = -\frac{1}{3}}$

ii. at $|rs|$

u	$-14\frac{1}{6}$
v	0
a	$-\frac{1}{3}$
s	?
t	

find u : $u = \dfrac{50 \cdot -\frac{1}{3} - 125}{10} = -14\frac{1}{6}$

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

$0 = \left(-14\frac{1}{6}\right)^2 + 2 \cdot \left(-\frac{1}{3}\right)s$

$s = 301\frac{1}{24}$ $301 - 250 = \boxed{51m \text{ after } r}$

b.

man		bus	
$u = V_m$		u	0
$V_m = V_b$		$V_b = V_m$	
a	0	a	
s	$S_b + 40$	s	S_b
t	20	t	20

using $s = \left(\dfrac{v+u}{2}\right)t$

man : $S_b + 40 = \left(\dfrac{2V_m}{2}\right)20$

$S_b = 20V_m - 40$

bus : $S_b = \left(\dfrac{V_m + 0}{2}\right)20$

$S_b = 10V_m$

⟹ $10V_m = 20V_m - 40$

⟹ $10V_m = 40$

$\boxed{V_m = 4\,ms^{-1}}$

also:

$a_b = \dfrac{v-u}{t}$

$= \dfrac{4-0}{20} = \dfrac{1}{5}$

ii.

man		bus	
u 3		u 0	
v 3		v	
a 0		a $\frac{1}{5}$	
$s = S_b + 40$		$s = S_b$	
t = t		t = t	

$S_b = 0 \cdot t + \frac{1}{2} \cdot \frac{1}{5} \cdot t^2$

$S_b = \dfrac{t^2}{10}$

$S_b + \cancel{40} = \left(\dfrac{3+3}{2}\right)t$

$S_m = 3t$

$3t - 40 = \dfrac{t^2}{10}$

$0 = t^2 - 30t + 400$

distance between $= 40 + S_b - S_m$

$= 40 + \dfrac{t^2}{10} - 3t$

$= 40 + 0.1t^2 - 3t$

$\dfrac{d(distance)}{dt} = 0.2t - 3$

$0.2t - 3 = 0 \Rightarrow t = 15$

closest distance $= 40 + 0.1(15)^2 - 3(15)$

$\boxed{= 17.5m}$