

Worksheet

s is meters

①  $s = t^3 - 12t^2 + 36t ; t \geq 0$  where t is seconds

②  $v(t) = 3t^2 - 24t + 36$

③  $v(3) = 27 - 72 + 36 = -9 \text{ m/s}$

④  $v(t) = 3(t^2 - 8t + 12) = 3(t-2)(t-6) = 0$

At rest  $v(t) = 0 \rightarrow$  At rest when  $t = 2 \text{ sec. and } t = 6 \text{ sec}$

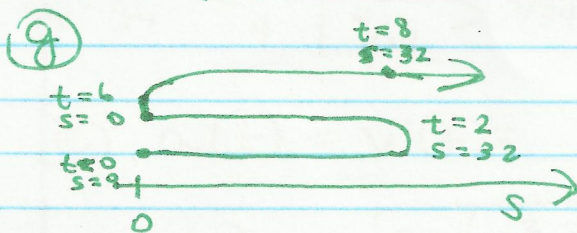
⑤  $v(t)$   $\begin{matrix} + & - & + \\ | & | & | \\ 0 & 2 & 6 \end{matrix}$  moving forward  
 $s(t)$  for  $0 \leq t < 2 + t > 6$

⑥ Find Displacement =  $s(8) - s(0) = 32 - 0 = 32 \text{ meters}$

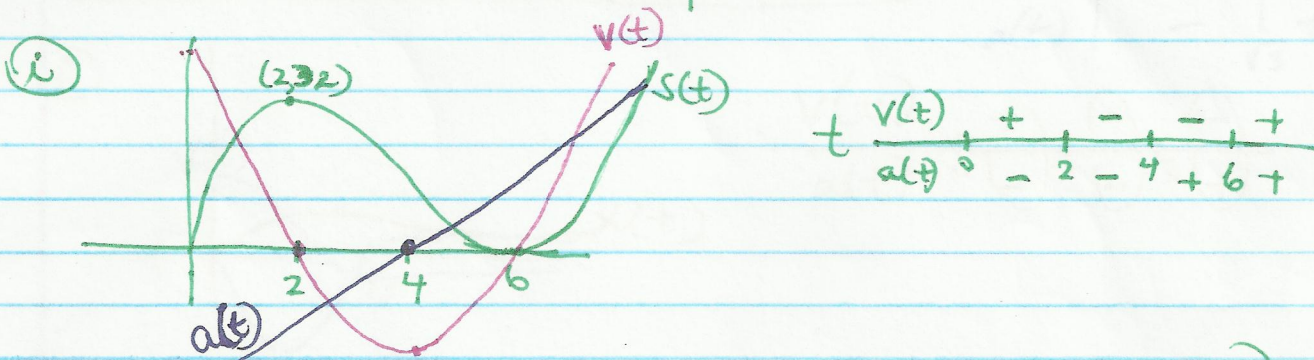
⑦

t	s(t)
0	0
2	32
6	0
8	32

} 96 meters



⑨  $a(t) = 6t - 24$   
 $a(3) = 18 - 24 = -6 \text{ m/sec}^2$



⑪ Speeding up when velocity pos & inc. so  $t > 6$   
 + when velocity is neg & dec. so  $2 < t < 4$   
 Slowing down when vel. is pos & dec. so  $0 < t < 2$   
 + when velocity is neg & inc. so  $4 < t < 6$



②  $x(t) = \frac{t}{1+t^2} \quad t \geq 0$

①  $v(t) = \frac{1+t^2 - t(2t)}{(1+t^2)^2} = \frac{1-t^2}{(1+t^2)^2}$

③  $\frac{v(t)}{x(t)} \quad \begin{array}{c} + \\ - \end{array}$  moving right for  $0 \leq t < 1$   
moving left for  $t > 1$

4 sec. ④ Displacement =  $x(4) - x(0) = \frac{4}{17} - 0 = \frac{4}{17}$  meter.

4 sec. ⑤

t	x(t)
0	0
1	$\frac{1}{2}$
4	$\frac{4}{17}$

total Distance  $\frac{26}{34}$   
=  $\frac{13}{17}$  meters

$\frac{17}{34} - \frac{8}{34} = \frac{9}{34}$

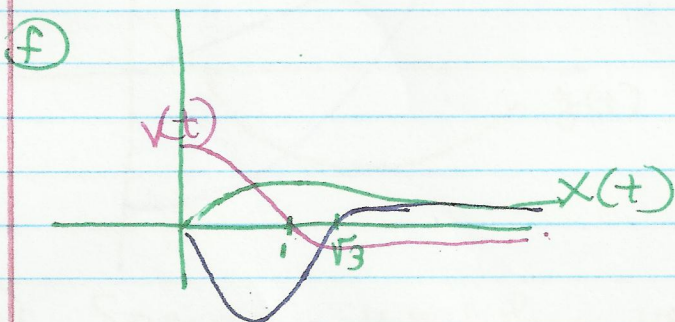
$\frac{1}{2} > \frac{1}{2}$   
 $\frac{4}{17} > \frac{9}{34}$

⑥  $a(t) = v'(t) = \frac{(1+t^2)^2(-2t) - (1-t^2)(2)(1+t^2) \cdot 2t}{(1+t^2)^4}$

$a(t) = \frac{2t(t^2-3)}{(1+t^2)^3}$

$a(t) = 0$  when  $t = 0$  and  $t = \sqrt{3}$

$\frac{v(t)}{a(t)} \quad \begin{array}{c} 0 \quad 1 \\ + \quad - \\ - \quad \frac{1}{\sqrt{3}} \quad + \end{array}$



$\frac{v(t)}{a(t)} \quad \begin{array}{c} + \quad - \quad - \\ - \quad \frac{1}{\sqrt{3}} \quad + \end{array}$

⑧ Speeding up when  $v$  +  $a$  have same sign  
do  $1 < t < \sqrt{3}$

slowing down when  $v$  +  $a$  have opp. signs  
do  $0 < t < 1$  and  $t > \sqrt{3}$



③  $y(t) = t^3 - 12t + 3 ; t \geq 0$

a)  $v(t) = 3t^2 - 12$   
 $a(t) = 6t$

b)  $v(t) = 3(t+2)(t-2)$        $t = -2, t = 2$

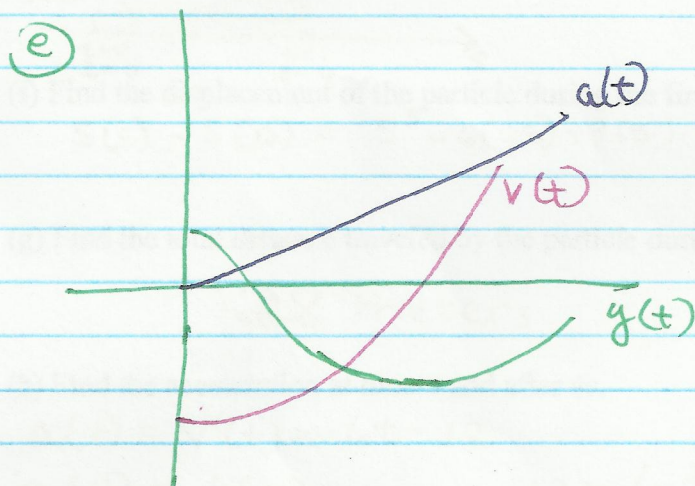
$\frac{v(t)}{y(t)} \begin{matrix} - & + \\ 0 & \frac{1}{2} \end{matrix}$       downward for  $0 \leq t < 2$   
 upward for  $t > 2$

c) Displacement  $y(3) - y(0) = -6 - 3 = -9$

d)

t	y(t)
0	3
2	-13
3	-6

$> 16$       total Dist  $23$  meter  
 $> 7$



$\frac{v(t)}{a(t)} \begin{matrix} - & + \\ 0 & \frac{1}{2} \end{matrix}$

f) Speeding up when vel + acc have same sign; so  $t > 2$   
 Slowing down when vel + acc have opp signs so  $0 < t < 2$