

$$1. s(t) = \frac{1}{3}t^3 - 4t^2 + 12t$$

$$a. v(t) = t^2 - 8t + 12$$

$$(t-2)(t-6) = 0$$

$$t=2, t=6$$



$$t=2) \quad - \quad + \quad +$$

$$t=6) \quad - \quad - \quad +$$

$$t=2, t=6$$

$$b. 2 < t < 6$$

$$c. \text{disp} = s(3) - s(0)$$

$$= 9 - 0 = 9$$

$$\text{start pos } s(0) = 0$$

$$\text{turn pos } s(2) = \frac{32}{3}$$

$$\text{stop pos } s(3) = 9$$

$$\text{right} = \left| \frac{32}{3} - 0 \right| = \frac{32}{3}$$

$$\text{left} = \left| 9 - \frac{32}{3} \right| = \frac{5}{3}$$

$$\text{distance} = \frac{32}{3} + \frac{5}{3} = \frac{37}{3}$$

$$e. a=0$$

$$a(t) = 2t - 8 = 0$$

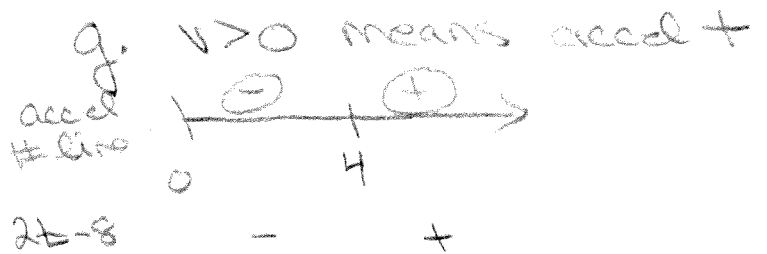
$$t=4$$

$$v(4) = -4$$

$$f. v=0 \text{ at } t=2, t=6$$

$$a(2) = -4$$

$$a(6) = 4$$



$$t > 4$$

$$f. 2 < t < 4, t > 6$$

$$2. s(t) = -2t^3 + 9t^2 - 6t - 5$$

$$a. v(t) = -6t^2 + 18t - 6$$

$$0 \leq t < .382, t > 2.618$$

$$b. t = .381, t = 2.618$$

$$c. a(t) = -12t + 18$$

$$0 \leq t < 1.5$$

$$d. .381 < t < 1.5, t > 2.618$$

$$e. s(t) = 5$$

$$t = 2.5$$

$$3. a. y = 2.5 \text{ million}$$

$$b. y' > 0$$

$$c. y < 0$$

4. The population increases from  $t=0$  to  $t=12$  yrs.  
 The population decrease from  $t=12$  to  $t=16$  yrs.  
 The minimum population occurs at  $t=0$  while  
 the maximum population is at  $t=12$  yrs.  
 The growth rate increases for  $0 \leq t < 4$  and  
 decreases for  $4 < t < 7$  and  $t > 11$ . The growth  
 rate is constant for  $7 \leq t < 11$ .

5.  $x(t) = t^3 - 6t^2 + 9t + 11$

a.  $v(t) = 3t^2 - 12t + 9$

$v(0) = 9$

b.  $3(t^2 - 4t + 3) = 0$

$(t-1)(t-3) = 0$

$t=1, t=3$



$(t-1) \quad - \quad + \quad +$

$(t-3) \quad - \quad - \quad +$

$1 < t < 3$

c. start pos  $s(0) = 11$   
 turn pos  $s(1) = 15$   
 stop pos  $s(2) = 13$

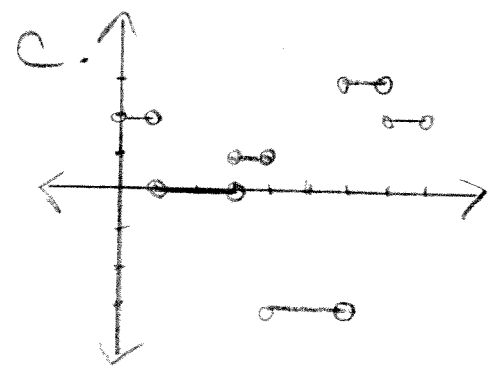
right =  $|15 - 11| = 4$

left =  $|13 - 15| = 2$

dist =  $4 + 2 = 6$

6. a)  $4 < t < 6$

b.  $1 < t < 3$

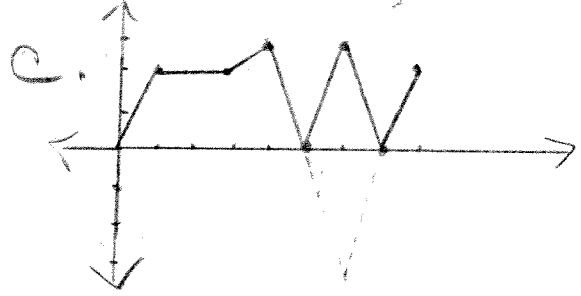


d. speed = |velocity|  
 flip all pieces below the  
 x-axis above the x-axis

e.  $1 < t < 3$

7. a.  $5 < t < 7$

b.  $t=0, t=5, t=7$



d.  $0 \leq t < 1, 3 \leq t < 4, 6 \leq t < 8$

e. See # 6 c ab