

7-3 day 2 (skip 76, 80, 83)

Ex 1) An object moving vertically is at the given heights at the specified times. Find the position equation  $s = \frac{1}{2}at^2 + v_0t + s_0$  for the object if:

at  $t = 1$  second,  $s = 128$  feet  
 at  $t = 2$  seconds,  $s = 80$  feet  
 at  $t = 3$  seconds,  $s = 0$  feet

**Step 1:**  $t=1, s=128$   
 $\frac{1}{2}a(1)^2 + v_0(1) + s_0 = 128$   
 $\frac{1}{2}a + v_0 + s_0 = 128$  (1)

**Step 2:**  $t=2, s=80$   
 $\frac{1}{2}a(2)^2 + v_0(2) + s_0 = 80$   
 $2a + 2v_0 + s_0 = 80$  (2)

**Step 3:**  $t=3, s=0$   
 $\frac{1}{2}a(3)^2 + v_0(3) + s_0 = 0$   
 $4.5a + 3v_0 + s_0 = 0$  (3)

**Step 4:** Subtract (1) from (2):  
 $(2a + 2v_0 + s_0) - (\frac{1}{2}a + v_0 + s_0) = 80 - 128$   
 $1.5a + v_0 = -48$  (4)

**Step 5:** Subtract (1) from (3):  
 $(4.5a + 3v_0 + s_0) - (\frac{1}{2}a + v_0 + s_0) = 0 - 128$   
 $4a + 2v_0 = -128$   
 $2a + v_0 = -64$  (5)

**Step 6:** Subtract (5) from (4):  
 $(1.5a + v_0) - (2a + v_0) = -48 - (-64)$   
 $-0.5a = 16$   
 $a = -32$

**Step 7:** Substitute  $a = -32$  into (5):  
 $2(-32) + v_0 = -64$   
 $-64 + v_0 = -64$   
 $v_0 = 0$

**Step 8:** Substitute  $a = -32$  and  $v_0 = 0$  into (1):  
 $\frac{1}{2}(-32) + 0 + s_0 = 128$   
 $-16 + s_0 = 128$   
 $s_0 = 144$

**Final Equations:**  
 Position:  $s = \frac{1}{2}(-32)t^2 + 0t + 144$   
 $s = -16t^2 + 144$   
 Acceleration:  $a = -32$

Ex 2) Find the equation of the parabola  $y = ax^2 + bx + c$  that passes through the points  $(0,0)$ ,  $(2,-2)$ , and  $(4,0)$ . To verify your result, use a graphing utility to plot the points and graph the parabola.

**Point (0,0):**  
 $0 = a(0)^2 + b(0) + c$   
 $0 = c \Rightarrow c = 0$

**Point (2,-2):**  
 $-2 = a(2)^2 + b(2) + c$   
 $-2 = 4a + 2b + c$

**Point (4,0):**  
 $0 = a(4)^2 + b(4) + c$   
 $0 = 16a + 4b + c$

**System of Equations:**  

$$\begin{cases} c = 0 \\ 4a + 2b + c = -2 \\ 16a + 4b + c = 0 \end{cases}$$

**Step 1:**  $c = 0$   
 $4a + 2b = -2$  (1)  
 $16a + 4b = 0$  (2)

**Step 2:** Multiply (1) by 2:  
 $8a + 4b = -4$  (3)  
 $16a + 4b = 0$  (2)

**Step 3:** Subtract (3) from (2):  
 $(16a + 4b) - (8a + 4b) = 0 - (-4)$   
 $8a = 4$   
 $a = \frac{1}{2}$

**Step 4:** Substitute  $a = \frac{1}{2}$  into (1):  
 $4(\frac{1}{2}) + 2b = -2$   
 $2 + 2b = -2$   
 $2b = -4$   
 $b = -2$

**Final Equation:**  
 $y = \frac{1}{2}x^2 - 2x$

Ex 3) **Borrowing:** A small corporation borrowed \$775,000 to expand its software line. Some of the money was borrowed at 8%, some at 9%, and some at 10%. How much was borrowed at each rate if the annual interest was \$67,000 and the amount borrowed at 8% was four times the amount borrowed at 10%?

$$x = \text{amount at } 8\%$$

$$y = \text{amount at } 9\%$$

$$z = \text{amount at } 10\%$$

$$x = 4z$$

$$x + y + z = 775,000$$

$$0.08x + 0.09y + 0.1z = 67,000$$