1. AP Calculus AB 2006 Form B #6 (No Calculator)
   a. $\int_{30}^{60} |v(t)|dt$ is the change in distance of the car from time 30 to time 60. Using a trapezoidal approximation, $\int_{30}^{60} |v(t)|dt$ is $\frac{1}{2}\,(5 * \ (14 + 10)\ +\ 15 * (10 + 0) +\ 10 * (0 + 10))$ = 185 ft
   b. $\int_{0}^{30} a(t)\,dt$ is the change in speed from time 0 to time 30. 3-

      $\int_{0}^{30} a(t)\,dt$ = $\int_{0}^{30} v'(t)\,dt\ =\ v(30) - v(0)\ =\ 6ft/s$

   c. Yes. Using IVT, since v(35) = -10 and v(50)=0, and -10> -5 > 0, there exists an x in (35,50) such that v(x) = -5.
   d. On the interval (0,60), yes, there must be a time x such that a(x) =0. Because a(0) = a(25), and v(x) is continuous and differentiable on (0,25), By Rolle’s Theorem, v’(x)= 0 =a(x) for some x on the interval(0,25).

2. AP Calculus AB 2008 #2 (Calculator Allowed)

   a. The rate of people waiting in line changing at time 5.5 is L’(5.5).

      L’(5.5) ≃ L(7)-L(4)/ (7-4) = 8 people/h.

   b. The average number of people waiting in line during the first 4 hours using a trapezoidal approximation is

      ¼ * ½((120+156)*1 + (176+156)*2 + (176+126)*1) = 1242/8 = 155.25 people.

   c. For the interval [0,9], there must exist at least 3 xs such that L’(x) =0. Because L is a twice differentiable function, it must also be continuous, and we can use MVT. By MVT, L’(t)>0 must exist for a t in the intervals (1,3) and (4,7), L’(t)<0 must exist for a t in the intervals (3,4) and (7,8). Since L must also be continuous, IVT states that there must be at least 3 times that L’(t)=0 on the interval [0,9].
   d. $\int_{0}^{3} r(t)\,dt$ = 972.784, about 973 tickets sold by 3pm.

3. AP Calculus AB 2009 #5 (No Calculator)

   a. f’(4) ≈ $\frac{f(5)-f(3)}{5-3}\ =\ \frac{-2-4}{2}\ = -\mathbf{3}$
   b. $\int_{2}^{13} (3 - 5 * f'(x))dx$ = $\int_{2}^{13} 3dx\ -\ \int_{2}^{13} 5 * f'(x)\,dx$

= (13-2)*3 - $5 * \int_2^{13} f'(x)\,dx$

= 33- 5* (f(13)- f(2))

= 33- 5* (5)

= 8

c. $\int_2^{13} f(x)dx$ evaluated with a left riemann sum:

f(2) * (3-2) + f(3) * (5-3) + f(5)*(8-5) + f(8)*(13-8) = 1 + 8 + -6 + 15 = 18

d. Tangent Line at x=3 : y= 3x -17.

Because f''(x)<0 on the interval [5,8] , this means the graph is concave down on this interval. On the interval [5,8], the tangent line of y=f(x) at x=5 will always be >= f(x). Thus, f(7) <= 21-17.

Secant line from x=5 to x=8: y= 5/3 (x-5) - 2.

The interval [5,8] is concave down. This means the secant line connecting x=5 to x=8 is under the graph of f(x) on the interval (5,8). Thus, f(7)>=10/3 -2= 4/3.