**Q SCI 291**

**Application Problem Answers from our Text for Weeks 7 and 8**

**Problem 98, page 253**

C(t) = .3t/(t2 + 6t + 9), where 0<t<12 and represents hours since the drug is taken orally. Find C’(t) = [.3(t2 + 6t + 9) - .3t(2t + 6)] /(t2 + 6t + 9)2 = .3(3-t)/(t+3)3. The critical value of C(t) is t=3 as t=-3 not in the domain. Because C(t) is also a polynomial, its critical values are also partition numbers for C’(t). Thus, for t (0,3), C’(t) is + so C(t) is increasing. For t (3,12), C’(t) is – and C(t) is decreasing. The only local extrema is t=3 a local maximum. The procedure on p. 273 shows how this is determined. C’(t) changes from + to – at t=3.

**Problem 94, page 269**

N’(x) = -x3 + 39x2 – 360x and N”(x) = -3x2 + 78x – 360

Find partition number using N”: -3(x – 6)(x – 20) so x = 20 (x = 6 not in domain of x)

Use sign chart to find where N” is positive or negative which also means where N’ is increasing and decreasing. We see that N’ is increasing on (15,20) and decreasing on (20,24).

X = 20 is an inflexion point for N and is the point of diminishing returns. The maximum rate of change N’ is at x = 20 where N’ = 400. Note that N’ = 0 at x = 15 and x = 24.

**Problem 98, page 270**

T(x) = x2(1 - x/9), where 0<x<6 and represent the # of milligrams of a drug administered and T is the body temperature in degrees F one hour after drug administration. Find T’(x).

T’(x) = -x2/9 + 2x(1-x/9) = -x2/3 + 2x. Also, need to calculate T’’(x) as 2 – 2x/3. To determine where T’(x) is increasing or decreasing we form a simple table:

t T’ T’’ T

0 0 2 0

2 2.67 .67 3.1

3 3 0 6

4 2.67 -.67 8.9

6 0 -2 12

Clearly, T’(x) describes a parabola which opens downward and reaches its maximum value of 3 at x=3. Where T’’(x) is +, T’(x) is increasing and T(x) is concave upward. This occurs for x (0,3). Where T’’(x) is -, T’(x) is decreasing and T(x) is concave downward. This occurs for x (3,6). The inflection point of T(x) is at x=3. It is at this point where concavity changes direction.

**Problem 82, page 291**

A) N’(t) = 900/(t + 9)2 and t > 0, so N’ > 0 and N is increasing on (0,∞). Never decreases.

B) N”(t) = -[900(2t + 18)/(t + 9)4] = -1800/(t + 9)3 so N”(t) < 0 for t > 0 and the graph of N is concave downward on (0,∞).

C) No vertical asymptotes. Use L’Hopital’s Rule to find lim t → ∞ N(t) = 100 so 100 is a horizontal asymptote.

D) y intercept: N(0) = 0 and x intercept: N(t) = 0 , t = 0 so (0, 0) is both an x and y intercept.

**Problem 90, page 292**

Use the four step graphing strategy and graph.

Step 1: domain w > 5 or [5, ∞); no intercepts; vertical asymptote is w = 0; horizontal asymptote = 0.06

Step 2: S’(w) = -26/w2 which is < 0 for w > 5. Thus, S is decreasing on [5, ∞).

Step 3: S”(w) = 52/w3 which is > 0 for w > 5. Thus, S is concave upward on [5, ∞).

Step 4; Graph of S.

**Problem 20, page 310**

A) R(x) = xp = 400x – 0.4x2 and R’(x) = 400 – 0.8x. To find max R, set R’ = 0 and solve for x. So, 400 – 0.8x = 0 and x= 500. R”(x) = - 0.8 which is < 0 for all x. Thus, a production of 500 cameras a week will max weekly revenue. The max weekly revenue is = 400(500) – 0.4(500)2 = $100,000/week and the price /camera = 400 – 0.4(500) = $200

B) P(x) = R(x) – C(x) = 240x – 0.4x2 – 2000 and P’(x) = 240 – 0.8x. To find max P, set P’ = 0 and solve for x. So, 0.8x = 240 and x = 300. P”(x) = - 0.8 which is < 0 for all x. Thus, a production of 300 cameras a week will max weekly profit. The max weekly profit is = 240(300) – 0.4(300)2 – 2000 = $34000/week and the price/camera = 400 – 0.4(300) = $280

**Problem 30, page 311**

R(t) = xp and x = 60 + 6t and p = 0.3 – 0.02t, thus R = (60 + 6t)(0.3 – 0.02t) = 18 + 0.6t – 0.12t2

R’(t) = 0.6 – 0.24t so t = 2.5 weeks. R’ > 0 on [0, 4] and R”(t) = - 0.24 < 0 on [0, 4]

Thus, max R = 18 + 0.6(2.5) – 0.12(2.5)2 = $18.75

**Problem 38, page 312**

Let x = number of bottles order and y = number of times orders placed per year. Then total cost is: C(x) = 40y + 5x We also know that: xy = 200, so y = 200/x so we can write C(x) = 40(200/x) + 5x = 8000/x + 5x

C’(x) = - 8000/x2 + 5 which we set = 0 and find x2 = 1600 and x = 40 (the only critical value as x > 0). Also, we see that y = 200/40 = 5

C”(x) = 8000/x3 > 0 for all x so the critical point is a min. C(40) = 40y + 5x = 40(5) + 5(40) = $400

**Problem 48, page 313**

C’(x) = -16k/x3 + 2k/(10 – x)3 = [-16k(10 – x)3+ 2kx3]/ (x3(10 – x)3 Now we set C’ = 0 to find the critical point.

We have: 2kx3 = 16k(10 – x)3 so x3 = 8(10 – x)3 and x = 2(10 – x) and x = 20/3

C”(x) = 48k/x4 + 6k/(10 – x)4 and is > 0 for all x. Thus, we have a local min at x = 20/3

Need to check the end points for x to see if we have a global min.

C(0.5) = 32.01k; C(20/3) = 0.27k; C(9.5) = 4.09k

Thus, x = 20/3 is a global or absolute min.