Questions I have asked on past 142 Final Exams

1. A bond fund earns 8.5% per year compounded continuously. How long will it take for an initial investment of $1000 to grow to $1500 (to two decimal places).

   (a) 459.26 years  
   (b) 73.11 years  
   (c) 6.13 years  
   (d) 4.97 years  
   (e) 4.77 years

2. For which of the following does \( f(g(x)) = \sqrt{x^2 - 9} \)?

   (a) \( f(x) = x + 3, \ g(x) = x - 3 \)
   (b) \( f(x) = \sqrt{x^2}, \ g(x) = x - 9 \)
   (c) \( f(x) = \sqrt{x}, \ g(x) = x^2 - 9 \)
   (d) \( f(x) = x^2 - 9, \ g(x) = \sqrt{x} \)
   (e) Both (c) and (d) are correct.

3. The demand for a Christmas-tree light untangler is given in the chart below. Using the data, find the average rate of change in \( p \) (dollars per item) from 170 to 66 untanglers.


<table>
<thead>
<tr>
<th>quantity ( x )</th>
<th>170</th>
<th>125</th>
<th>90</th>
<th>66</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>price ( p ) ($)</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>

   (a) −0.20  
   (b) −0.14  
   (c) −0.16  
   (d) −5.01  
   (e) −6.93

4. Evaluate \( \lim_{{h \to 0}} \frac{{(x + h)^8 - x^8}}{h} \)

   (a) 0  
   (b) \( h^7 \)  
   (c) \( \frac{1}{9}x^9 \)  
   (d) \( 8x^7 \)  
   (e) None of these
5. Find the derivative of \( \frac{(x+3)(2x+1)}{x} \).

(a) 2  
(b) 4x + 5  
(c) \( \frac{2x^2 + 10x - 3}{x^2} \)  
(d) 2 + 3 ln |x|  
(e) \( 2 + \frac{3}{x^2} \)

6. Find the slope of the line tangent to \( f(x) = x^3 e^{-x^2} \) at the point where \( x = 2 \).

(a) \( 8e^{-4} \)  
(b) \( -24e^{-4} \)  
(c) \( -48e^{-5} \)  
(d) \( -20e^{-4} \)  
(e) \( 12e^{-4} - 32e^{-5} \)

7. Given the cost function \( C(x) = 4x^{2.5} + 4x^{-1} + 12 \) in dollars (\( x \) is in items), use the marginal cost to estimate the cost of producing the second item.

(a) \$27.28  
(b) \$36.63  
(c) \$16.63  
(d) \$6.00  
(e) undefined

8. \( \int (x^2 + 2x + 3) \, dx = \)

(a) \( 2x + 2 + C \)  
(b) \( \frac{1}{3}x^3 + 2 + C \)  
(c) \( \frac{1}{3}x^3 + 5 + C \)  
(d) \( \frac{1}{3}x^3 + x^2 + C \)  
(e) \( \frac{1}{3}x^3 + x^2 + 3x + C \)
9. If \( f'(x) = 3e^x \) and \( f(0) = -1 \), find \( f(x) \).

(a) \( 3xe^{x-1} - 1 \)
(b) \( \frac{3}{x+1} e^{x+1} - 1 \)
(c) \( \frac{3}{x+1} e^{x+1} - 9.15 \)
(d) \( 3e^x - 4 \)
(e) \( 3e^x - 1 \)

10. A drag racer’s speed, in feet per second \( t \) seconds after accelerating is given in the table below:

<table>
<thead>
<tr>
<th>time (sec)</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>speed (ft/sec)</td>
<td>0</td>
<td>16</td>
<td>63</td>
<td>141</td>
<td>250</td>
</tr>
</tbody>
</table>

Using only the data, which of the following is a lower estimate of the distance (in feet) traveled during the first 12 seconds?

(a) 660
(b) 220
(c) 470
(d) 1410
(e) 1004

11. Given \( f(x, y) = 2x^2 + 2xy \), compute \( f(3, 5) \).

(a) 80
(b) 48
(c) 22
(d) 26
(e) 6

12. Which of the following are demand equations of competitive products?

(a) \( x = 800 - 4p^2 - 3q^2 \), \( y = 600 - 3p^2 - 2q^2 \)
(b) \( x = 500 - 5p - q^2 \), \( y = 1000 - 8p - 10q^2 \)
(c) \( x = 8000 - 9p^2 + 8q^2 \), \( y = 15000 + 4p^2 - 3q^2 \)
(d) \( x = 200 - 5p - 4q \), \( y = 200 - 2p - 4q \)
(e) \( x = 700 - 8p + 5q \), \( y = 1000 - 10p - 6q \)
13. The equation \( y = \frac{790}{1 + 791.4e^{-1.155x}} \) models \( y \), the total number of swimsuits sold by the end of month \( x \) (with the end of January being \( x = 1 \)). During which month did the store sell its 200th swimsuit?

14. The demand for a Christmas card at House of Cards is given by \( p = 4.5 - 0.5x \), where \( x \) is the number of thousands of cards and \( p \) is the price of a card in dollars. If the supply equation is given by \( p = 0.4x \), algebraically find the equilibrium price and quantity.

15. Using the demand equation above, if the cost (in thousands of dollars) of producing \( x \) thousand cards is given by \( C(x) = 0.75x + 1 \), use Calculus to determine how many cards should be sold and at what price in order to maximize profit.

16. Use calculus to determine the interval(s) on which \( f(x) = x^3 - 3x^2 - 45x - 50 \) is:

   (a) increasing
   (b) decreasing
   (c) concave up
   (d) concave down

17. A box with a square base and no top is to contain 96 cubic inches of volume. If the base costs $3 per square inch and the sides cost $1 per square inch, what should the dimensions of the box be in order to minimize cost?

18. The velocity of a marathoner's final dash is given by \( v(t) = \frac{t}{2} + 10 \), where \( t \) is time in seconds and \( v \) is in feet per second. Find the distance traveled in the first 10 seconds of the dash.

19. The demand for the Veggie Tales video Silly Songs, Too is given by \( p = D(x) = -4x + 32 \), where \( x \) is the number of thousand videos and \( p \) is the price in dollars. If the supply equation is given by \( p = S(x) = x^2 \), use Algebra and Calculus to find the Consumers' and Producers' Surplus. Graph each function and identify the regions representing your answers.

20. Given \( f(x, y) = x(x^2 + y^2)^{-1/2} \), find the following:

   (a) the exact value of \( f_x(2, -1) \)
   (b) \( \frac{\partial f}{\partial y} \)

21. The daily profit generated by the sale of \( x \) aluminum Christmas trees and \( y \) wooden Christmas trees is given by \( P(x, y) = x^3 - 6x^2 - 2y^2 + 24y \). Find and classify all critical points of this function.