(1) (10 points) Use your calculator to compute the following

(a) \( \int_{-1}^{2} xe^{x^2} \, dx = \) __________

(b) \( \int_{0}^{3} \frac{1 - p^2}{1 + p^2} \, dp = \) __________

(2) (8 points) For the points labeled in the figure answer the following.

(a) Which of the labeled points are local maximums? __________

(b) Which of the labeled points are local minimums? __________

(c) Which of the labeled points are critical points? __________

(d) Which of the labeled points are a global maximum? __________

(3) (7 points) For the points labeled in the figure answer the following.

(a) Which of the labeled points has \( f''(x) > 0? \) __________

(b) Which of the labeled points is \( f(x) \) concave down? __________

(c) Which of the labeled points are critical points? __________
(4) (10 points) Find the inflection points of \( y = -2x^3 + 24x^2 - 9x + 7 \).

(5) (10 points) When you cough, your wind pipe contracts. The velocity with which air comes out is depends on the radius \( r \) of your wind pipe. If \( R \) is the normal (i.e. rest) radius of our wind pipe, then for 0 ≤ \( r \) ≤ \( R \) the velocity is given by

\[
v = a(R - r)r^3
\]

where \( a \) is a positive constant.

What value of \( r \) maximizes the velocity?

\( r = \) _________________

(6) (10 points) A car starts moving at time \( t = 0 \). Its velocity is shown in the following table. Give an upper, lower and best estimate of the distance the car has traveled during the 20 seconds.

<table>
<thead>
<tr>
<th>( t ) (seconds)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity (ft/sec)</td>
<td>0</td>
<td>8</td>
<td>20</td>
<td>35</td>
<td>50</td>
</tr>
</tbody>
</table>

Upper estimate _____________________

Lower estimate _____________________

Best estimate _____________________
(7) (10 points) The velocity, \( v \) in miles per hour, of a car as a function of time, \( t \) in hours, is given by the following graph.

(a) How far does the car travel in the first two hours?  

(b) If the car starts 100 miles from Columbia, and moves directly away from Columbia, then how far is it from Columbia after 3 hours?  

(8) (15 points) Consider the graphs of \( y = 3x^2 \) and \( y = -9x \).

(a) Find where these graphs intersect (give both the \( x \) and \( y \) coordinates of the point so intersection.)  

(b) Graph them on the same axis.  

(c) Find the area between the two graphs.  

Area = __________________________
(9) (10 points) A tank with 300 gallons of water springs a leak. After \( t \) hours the water is leaking at \( r(t) = \frac{10}{1 + t} \) gallons/hour. How much water is left in the tank after 24 hours?

(10) (5 points) Let \( f(x) = 2x^3 + 6x^2 - 18x + 3 \).
   (a) Compute the derivative \( f'(x) \) and explain why \( x = 1 \) is a critical point.

   (b) Compute the second derivate \( f''(x) \) and use this to explain why \( f(x) \) has a local minimum at \( x = 1 \).

(11) (5 points) Draw a graph of a function on \([0, 10]\) that has two local maximums one local minimum and no other critical points.

(12) (5 points) One form of the fundamental theorem of calculus is that the integral of a rate of change is the total change. Use this to complete the following equation:

\[
\int_a^b F'(t) \, dt = \______________
\]

Have a nice Thanksgiving.