1. [7 pts.] Find the area between $y = 2\cos(2x)$ and $y = 2x^2$. (Set up and do integral by hand–you may use your calculator for the simple calculations in the end.)

2. [4 pts.] If $t$ is in months and $r(t)$ is in dollars per month, what are the units of $\int_0^2 r(t)\,dt$? Also, draw a possible sketch for the integral. (Make sure EVERYTHING is labeled–axes, function, area, ...)

3. The total cost in dollars to produce $q$ units of a product is $C(q)$. Fixed costs are $20,000. The marginal cost is

$$C'(q) = 0.005q^2 - q + 56.$$  

(a) [3 pts.] Find the total cost to produce 174 units. (set up by hand–may use calculator to evaluate)

(b) [3 pts.] Find $C(175)$ using $C'(q)$. Interpret your answer. (set up by hand–may use calculator to evaluate)
4. The figure below shows the derivative $G'(x)$. If $G(3) = 7$:

(a) [3 pts.] Find $G(0)$, $G(1)$, and $G(4)$. (Show how you get each answer!)

(b) [4 pts.] Label all local maxima and minima, global maxima and minima and inflection points of $G(x)$ on the graph of $G'(x)$.

5. [6 pts.] Find an antiderivative $F(x)$ if $F\left(\frac{\pi}{4}\right) = -1$ and $F'(x) = f(x)$. (set up and work completely by hand–may use calculator at very end for simple calculations)

$$f(x) = \sin^3(x) \cos(x)dx$$

6. [3 pts.] Using the figure below, if $F(x)$ is an antiderivative of $f(x)$ and $F(0) = 25$, estimate $F(7)$ using the FTC.
7. [7 pts.] Find the exact area bounded by \( y = 2x^3 + 5x^2 - 1 \) and the \( x \)-axis. Graph and shade this area. (Set up integral(s) by hand—everything else can be done on the calculator.)

8. (a) [4 pts.] Estimate \( \int_{0}^{70} f(t)\,dt \) using Riemann sums and the following table. (set up by hand—may use calculator for calculations)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( E )</td>
<td>6.9</td>
<td>9.4</td>
<td>13.0</td>
<td>18.5</td>
<td>20.9</td>
<td>19.6</td>
</tr>
</tbody>
</table>

(b) [1 pt.] What is \( n \)?

(c) [1 pt.] What is \( \Delta t \)?

(d) [4 pts.] Represent the right-hand-sum of the above integral graphically.
9. Integrate the following problems. Simplify completely with coefficients in front and positive exponents!

(a) [7 pts.]
\[ \int \frac{\sqrt{2 + \sqrt{x}}}{\sqrt{x^2}} \, dx \]

(b) [7 pts.]
\[ \int \frac{5}{(-2e^{-x} + 1)e^x} \, dx \]

(c) [7 pts.]
\[ \int \frac{5}{x} \, dx \]
10. Consider the improper integral $\int_0^\infty e^{-x}dx$.

(a) [4 pts.] Find $\int_0^b e^{-x}dx$ using the FTC.

(b) [2 pts.] Evaluate (a) when $b = 100, 1000, 10, 000$. What does this tell you about the improper integral? (set up by hand–may use calculator to evaluate)

11. [4 pts.] List the following integrals in descending order based on the graph below. Also tell whether each integral is positive, negative, or approximately 0.

\[
\int_a^c f(x)dx, \quad \int_b^d f(x)dx, \quad \int_c^e f(x)dx, \quad \int_d^e f(x)dx
\]
12. A bicyclist is pedaling along a straight road for one hour with a velocity \( v \) shown in the figure below. She starts out eight kilometers from the lake and positive velocities take her towards the lake.

(a) [3 pts.] Does the cyclist ever turn around? If so, at what time(s)?

(b) [3 pts.] When is she going the fastest? How fast is she going then? Toward the lake or away?

(c) [3 pts.] When is she closest to the lake? Approximately how close to the lake does she get?

(d) [3 pts.] When is she farthest from the lake? Approximately how far from the lake is she then?