This quiz is due at the beginning of Monday's class. Do everything on a separate sheet of paper. Keep this sheet for study purposes.

1. Doug's bicycle has a speedometer attached. During yesterday's ride, he checked the speedometer at noon and every 15 minutes thereafter until 1:00 PM. At noon, his speed was 18.3 MPH; at 12:15 PM it was 22.4 MPH; at 12:30 PM it was 27.3 MPH; at 12:45 PM it was 33.4 MPH; and at 1:00 PM it was 40.8 MPH. Assume that Doug's speed was always increasing between noon and 1:00 PM.

   (a) Use the data given above in order to find the best possible underestimate for the total distance that Doug traveled between noon and 1:00 PM.

   (b) Use the data given above in order to find the best possible overestimate for the total distance that Doug traveled between noon and 1:00 PM.

2. By using a left-hand sum with 2 rectangles, approximate the value of \( \int_{6}^{14} \frac{7}{1.1^t} \, dt \). Sketch a graph of the integrand along with the two rectangles that you used.

3. Using the graph of \( f(x) \) shown below, compute the exact value of \( \int_{-2}^{3} f(x) \, dx \).

![Graph of f(x) with x-axis from -2 to 3, y-axis from -10 to 15, and f(x) function plotted with three distinct segments: a line from (0, 10) to (3, 0), a line from (-2, 15) to (0, 10), and a line from (-2, 0) to (-2, -10).]
4. (6 points) The graphs of \( f(x) = x + 3 \) and \( g(x) = 5 - x^2 \) are sketched below and the area between the two curves is shaded in.

(a) Find the points of intersection of these two graphs.

(b) Set up, but do not evaluate, the definite integral (or integrals) which represent the exact area between these two graphs.

(c) Use the built-in features of your calculator to get a very good approximation of this area.

5. Deep in a Hundred Acre Wood where Christopher Robin plays, it has been raining at the rate of \( r(t) \) inches per hour since 8:00 AM. I've recorded these rates every 1.5 hours in the table below. The rain has continued to fall down harder and harder until my last recorded entry.

<table>
<thead>
<tr>
<th>time (t)</th>
<th>rate ( r(t) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM</td>
<td>0.5</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>1.2</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>1.7</td>
</tr>
<tr>
<td>12:30 AM</td>
<td>2.5</td>
</tr>
</tbody>
</table>

(a) Use the information in the table to give the best possible underestimate for the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.
(b) Use the information in the table to give the best possible overestimate for the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.

(c) Piglet would really like a better estimate. Show how you can combine your answers above in an attempt to find a closer estimate to the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.

6. At noon, the number of bacteria in Gordon’s sink was 500 and was growing very rapidly. In fact, the number of bacteria was growing at a rate of \( r(t) = 200(1.6)^t \) bacteria per hour, where \( t \) represents the number of hours since noon.

(a) Set up, but do not evaluate, the definite integral needed to compute the total change in the bacteria population between noon and 3:00 PM.

(b) Use the built-in integrator on your calculator to get a good approximation to the value of the definite integral used in part (a).

(c) How many bacteria were there in Gordon’s sink at 3:00 PM?