1. \( \int (3x^2 - 2x + 3) \, dx = \)
   (A) \( x^3 - x^2 + C \)  \quad (B) \( 3x^3 - x^2 + 3x + C \)  \quad (C) \( x^3 - x^2 + 3x + C \)
   (D) \( \frac{1}{2} (3x^2 - 2x + 3)^3 + C \)  \quad (E) none of these

20. \( \int \frac{x^3 - x - 1}{x^2} \, dx = \)
   \[ \frac{\frac{1}{4} x^4 - \frac{1}{2} x^2 - x}{\frac{1}{3} x^3} + C \]
   (A) \( \frac{1}{4} x^4 - \frac{1}{2} x^2 - x \)
   (B) \( 1 + \frac{1}{x^2} + \frac{2}{x^3} + C \)  \quad A) 5
   (C) \( \frac{x^2}{2} - \ln|x| - \frac{1}{x} + C \)  \quad B) 6
   (D) \( \frac{x^2}{2} - \ln|x| + \frac{1}{x} + C \)  \quad C) 7
   (E) \( \frac{x^2}{2} - \ln|x| + \frac{2}{x^3} + C \)  \quad D) 8

3. Let \( f(x) \) be defined as below. Evaluate \( \int_0^6 f(x) \, dx \).
   \[ f(x) = \begin{cases} 
   x & 0 < x \leq 2 \\
   1 & 2 < x \leq 4 \\
   \frac{1}{2} x & 4 < x \leq 6 
   \end{cases} \]

77. The equation of the curve whose slope at point \((x, y)\) is \(x^2 - 2\) and which contains
   the point \((1, -3)\) is

   (A) \( y = \frac{1}{3} x^3 - 2x \)  \quad (B) \( y = 2x - 1 \)  \quad (C) \( y = \frac{1}{3} x^3 - \frac{10}{3} \)
   (D) \( y = \frac{1}{3} x^3 - 2x - \frac{4}{3} \)  \quad (E) \( 3y = x^3 - 10 \)

8. Which of the following statements are true?

I. If the graph of a function is always concave up, then the left-hand Riemann sums
   with the same subdivisions over the same interval are always less than the right-hand
   Riemann sum.

II. If the function \( f \) is continuous on the interval \([a, b]\) and \( \int_a^b f(x) \, dx = 0 \), then \( f \)
    must have at least one zero between \( a \) and \( b \).

III. If \( f'(x) > 0 \) for all \( x \) in an interval, then the function \( f \) is concave up in that interval.

A) I only

B) II only

C) III only

D) II and III only

E) None are true.
1101 (1999AB, Calculator). The rate at which water flows out of a pipe, in gallons per hour, is
given by a differentiable function $R$ of time $t$. The table below shows the rate as measured
every 3 hours for a 24-hour period.

<table>
<thead>
<tr>
<th>$t$ (hours)</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
<th>18</th>
<th>21</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R(t)$ (gal/hr)</td>
<td>9.6</td>
<td>10.4</td>
<td>10.8</td>
<td>11.2</td>
<td>11.4</td>
<td>11.3</td>
<td>10.7</td>
<td>10.2</td>
<td>9.6</td>
</tr>
</tbody>
</table>

a) Use a midpoint Riemann sum with 4 subdivisions of equal length to approximate the
value of $\int_0^{24} R(t) \, dt$. Using correct units, explain the meaning of your answer in terms of
water flow.

b) Is there some time $t$, $0 < t < 24$, such that $R'(t) = 0$? Justify your answer.

922. Oil is leaking out of a tanker damaged at sea. The damage to the tanker is worsening as
evidenced by the increased leakage each hour, recorded in the following table.

<table>
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<tr>
<th>Time (hours)</th>
<th>0</th>
<th>1</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage (gal./hour)</td>
<td>50</td>
<td>70</td>
<td>97</td>
<td>136</td>
<td>190</td>
<td>265</td>
<td>369</td>
<td>516</td>
<td>720</td>
</tr>
</tbody>
</table>

a) Give an upper and lower estimate of the total quantity of oil that has escaped after 5
hours.

An object's velocity during a 10 second time interval is shown by the graph below:

Velocity (m/s)

[Graph showing velocity over time]

a.) Determine the object's total distance traveled and displacement.
b.) At $t = 0$, the object's position is $x = 2$ m. Find the object's position at $t = 2$, $t = 4$. 

Scanned by CamScanner
1. \( \int (3x^2 - 2x + 3) \, dx = \)
   (A) \( x^3 - x^3 + C \)  \( \textbf{(B)} \) \( 3x^2 - x^3 + 3x + C \)  \( \textbf{(C)} \) \( x^2 - x^3 + 3x + C \)
   (D) \( \frac{1}{2} (3x^2 - 2x + 3)^3 + C \)  \( \textbf{(E)} \) none of these

20. \( \int \frac{x^3 - 3}{x} \, dx = \)
   \( \frac{x^3 - \frac{3x^3 - x}{2}}{3} + C \)
   (A) \( \frac{1}{4} x^4 - \frac{1}{2} x^3 - x \)
   (B) \( 1 + \frac{1}{x^2} + \frac{2}{x^3} + C \)
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3. Let \( f(x) \) be defined as below. Evaluate \( \int_0^6 f(x) \, dx. \)
   \( \frac{x^2}{2} \bigg| _0^6 \)
   \( 2 - 0 = 2 \)
   \( \frac{x^4}{4} \bigg| _0^4 \)
   \( \frac{1}{4} x^4 \bigg| _0^4 \)
   \( \frac{1}{4} x^4 \bigg| _1^4 \)
   \( A) 5 \)
   \( B) 6 \)
   \( C) 7 \)
   \( D) 8 \)
   \( E) 9 \)

77. The equation of the curve whose slope at point \((x, y)\) is \( x^2 - 2 \) and which contains the point \((1, -3)\) is
   (A) \( y = \frac{1}{3} x^3 - 2x \)
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III. If \( f'(x) > 0 \) for all \( x \) in an interval, then the function \( f \) is concave up in that interval.

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(a) Use a midpoint Riemann sum with 4 subdivisions of equal length to approximate the value of \( \int_0^{24} R(t) \, dt \). Using correct units, explain the meaning of your answer in terms of water flow.

(b) Is there some time \( t \), \( 0 < t < 24 \), such that \( R'(t) = 0 \)? Justify your answer.

\[ 6(10.9) + 6(11.2) + 6(11.3) + 6(10.2) = 258.6 \text{ gal} \]

Between 0 and 14 hrs, about 258.6 gal flow out.

922. Oil is leaking out of a tanker damaged at sea. The damage to the tanker is worsening as evidenced by the increased leakage each hour, recorded in the following table.

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(a) Give an upper and a lower estimate of the total quantity of oil that has escaped after 5 hours.

X Give an upper and a lower estimate of the total quantity of oil that has escaped after 8 hours.

LRAM: \( 1 \left( 50 + 70 + 97 + 136 + 190 \right) = 543 \text{ gal} \)

RRAM: \( 1 \left( 70 + 97 + 136 + 190 + 265 \right) = 758 \text{ gal} \)

An object's velocity during a 10 second time interval is shown by the graph below:

- Velocity (m/s)
- Time (seconds)
- dist = 17.5 m
- displacement = 9.5 m

a.) Determine the object's total distance traveled and displacement.

b.) At \( t = 0 \), the object's position is \( x = 2 \) m. Find the object's position at \( t = 2 \), \( t = 4 \).

\[ t = 2: \overline{0} + 3 = 5 \text{ m} \]

\[ t = 4: \overline{2} + 9 = 11 \text{ m} \]