

<table>
<thead>
<tr>
<th>t (minutes)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>v(t) (miles per minute)</td>
<td>7.0</td>
<td>9.2</td>
<td>9.5</td>
<td>7.0</td>
<td>4.5</td>
<td>2.4</td>
<td>2.4</td>
<td>4.3</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Work for problem 3(a)

\[
\text{Area} = 10(f(2) + f(7.5)) \\
\text{area} = 10(f(5) + f(15) + f(25) + f(35)) \\
= 10(9.2 + 7 + 2.4 + 4.3) \\
\text{area} = 229 \text{ miles}
\]

\[\int_{0}^{40} v(t) \, dt \text{ is the total distance traveled between } t=0 \text{ and } t=40 \text{ minutes} \]

Work for problem 3(b)

a(t) = 0

on the intervals [0, 15] and [25, 30]

the smallest number of instances the acceleration can equal zero is 2 by MVT and Rolle's Theorem

Continue problem 3 on page 9.
Work for problem 3(c)

\[ f'(t) = \frac{-1}{10} \sin \frac{t}{10} + 3.7 \cos \frac{7\pi}{40} \]
\[ f'(t) = \frac{-1}{10} \sin \frac{t}{10} + 2\frac{1}{40} \cos \frac{7\pi}{40} \]
\[ f'(23) = \frac{-1}{10} \sin \frac{23}{10} + 2\frac{1}{40} \cos \frac{7\pi}{40} \]
\[ f'(23) = -0.408 \text{ miles per minute}^2 \]

Work for problem 3(d)

Average \( v = \frac{f(40) - f(0)}{40 - 0} \)

\[ = \frac{7.317 - 6}{40} \]
\[ = 0.033 \text{ miles per minute} \]

\[ \frac{1}{40-0} \int_0^{40} (6 + \cos(\frac{t}{10}) + 3\sin(\frac{7\pi}{40})t) \, dt \]

Average velocity = \[ \frac{1}{40} \cdot 236.65079 \]
\[ = 5.916 \text{ miles per minute} \]

END OF PART A OF SECTION II

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON PART A ONLY. DO NOT GO ON TO PART B UNTIL YOU ARE TOLD TO DO SO.
\[ \int_0^{40} v(t) \, dt = \frac{40}{4} \left[ 9.2 + 9.5 + 7.0 + 4.5 + 2.4 + 2.4 + 4.3 \right] \]

\[ = \frac{40}{4} \left[ 22.9 \right] = 229 \text{ miles} \]

Distance plane flies.

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Work for problem 3(b)

Acceleration of the plane equals 0 where the graph changes concavity. There are 2 such instances: one at \( t = 10 \text{ min} \) and the other \( t \in (25, 30) \).

Continue problem 3 on page 9.
Work for problem 3(c)

\[ a(t) = \frac{df}{dt} = -\frac{1}{10} \sin \left( \frac{t}{10} \right) + \frac{21}{40} \cos \left( \frac{7t}{40} \right) \]

\[ a(23) = -\frac{1}{10} \sin \left( 2.3 \right) + \frac{21}{40} \cos \left( \frac{161}{40} \right) \approx -0.408 \text{ miles/min}^2. \]

Work for problem 3(d)

\[
\text{avg velocity} = \frac{1}{40} \int_0^{40} f(t) \, dt = \frac{1}{40} \int_0^{40} \left( 6 + \cos \left( \frac{t}{10} \right) + 3\sin \left( \frac{7t}{40} \right) \right) \, dt
\]

\[
= \frac{1}{40} \left[ 6t + 10\sin \left( \frac{t}{10} \right) - 3\cos \left( \frac{7t}{40} \right) \left( \frac{40}{7} \right) \right]_0^{40}
\]

\[
= \frac{1}{40} \left[ 6t + 10\sin \left( \frac{40}{10} \right) - \frac{120}{7} \cos \left( \frac{7\times40}{40} \right) \right]_0^{40}
\]

\[
= \frac{1}{40} \left[ 240 - 7.568 - 12.924 - \left( -\frac{120}{7} \right) \right]
\]

\[
= \frac{5.916}{\text{min}}
\]

END OF PART A OF SECTION II

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