Quiz 2 (20 points in total)  
Section 201/202 (circle one)  
Name:  

1. [6 points] The average weight of a squirrel in Ann Arbor oscillates sinusoidally between a low of 5 pounds on January 1 and a high of 9 pounds on July 1, and a low of 5 pounds on January 1 next year again. Suppose that the function $P(t)$ gives the average weight in pounds of an Ann Arbor squirrel $t$ months after January 1.

a). What is the amplitude of $P(t)$?
$A = \frac{1}{2} (\max - \min) = \frac{1}{2} (9 - 5) = 2 \text{ lbs.}$

(Midline: $\frac{1}{2} (\min + \max) = \frac{1}{2} (9 + 5) = 7$)

b). What is the period of $P(t)$?
$\text{Per} = \text{time for 1 cycle (i.e. low} \rightarrow \text{high} \rightarrow \text{low}) = 12 \text{ months (Jan. 1} \rightarrow \text{Jan. 1)}$

c). Find a formula for $P(t)$.  
Need to specify period by $\frac{\text{Per}}{2\pi}$ (to make new period = 12)

$P(t) = -2 \cos \left( \frac{2\pi}{12} t \right) + 7$

2. [2 points] $f(x) = \sin(x)^2$, write down the limit definition of $f'(3)$. (You don’t need to calculate it, just write the definition.)

$$f'(3) = \lim_{h \to 0} \frac{f(3 + h) - f(3)}{h} = \lim_{h \to 0} \frac{\sin(3 + h)^2 - \sin(3)^2}{h}$$

3. [4 points] The cost, $C$ (in dollars) to produce $g$ gallons of ice cream can be expressed as $C = f(g)$. Assume $f$ is invertible. Interpret

(1) $f'(100) = 2.5$ If we increase our production from 100 gallons of ice cream to 101 gal, cost will increase by about $2.50

(2) $(f^{-1})'(100) = 2.5$ If we increase our spending (cost) from $100 up to $101, we will produce about 2.5 more gallons of ice cream.

Answers may vary. About is essential, as are correct units on all quantities.
4. [6 points] Consider a particle, whose position, $s$, is given by the table

<table>
<thead>
<tr>
<th>$t$ (seconds)</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
<th>0.8</th>
<th>1.0</th>
<th>1.2</th>
<th>1.4</th>
<th>1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S$ (feet)</td>
<td>0.5</td>
<td>1.4</td>
<td>3.8</td>
<td>6.5</td>
<td>9.6</td>
<td>9.2</td>
<td>8.7</td>
<td>6.1</td>
</tr>
</tbody>
</table>

(1) Estimate the velocity of the particle at $t = 0.2$. (Don't forget the unit)

$$v(t) \approx \frac{s(t) - s(0.2)}{0.4 - 0.2} = \frac{1.4 - 0.5}{0.2} = 4.5 \text{ ft/sec}$$

(2) Use (1) and the table to estimate the position of the particle at $t = 0.17$. (Don't forget the unit)

$$\text{Use line } \theta \ t = 0.2 : (s - 0.5) = 4.5 (t - 0.2), \text{ so } s = 0.5 + 4.5 (0.17 - 0.2) \approx 0.5 - 0.135 = 0.365 \text{ ft}$$

(3) For which $t$, does the velocity appear to be positive?

$t < \frac{1}{2} \text{ sec } (s(t) \text{ get bigger as } t \text{ get bigger UNTIL } t = 1/2\text{ sec})$

5. [2 points] See figure 1, which graph represents the position of an object that is speeding up and then slowing down?

Answer: C

Figure 1: Problem 5