

Show sufficient work to justify all answers.

1. The temperature, T (in degrees), of a hot object put in the refrigerator is given by

$$T = f(t) = 195 - \frac{3t}{50},$$

where t is the time in seconds since the object was put in to refrigerator.

- (a) Find a formula for the inverse function $f^{-1}(T)$.

$$f^{-1}(T) = \underline{\hspace{10cm}} \quad [3]$$

- (b) Evaluate and give the practical meaning $f^{-1}(32)$.

$$f^{-1}(32) = \underline{\hspace{2cm}} \quad []$$

$f^{-1}(32)$ means: _____ [3]

2. Give a formula for a rational function which has x -intercepts at $x = 2$ and $x = -3$ and a vertical asymptote at $x = 1$.

$$y = \underline{\hspace{10cm}} [4]$$

3. Suppose that after 5 years, 60% of a radioactive substance is left.

- (a) Assuming the substance decays at a continuous rate, fill in the following table, where P is the percentage of the original amount left after t years.

t (years)	0	5	10	15
P (percent)	100	60		

[2]

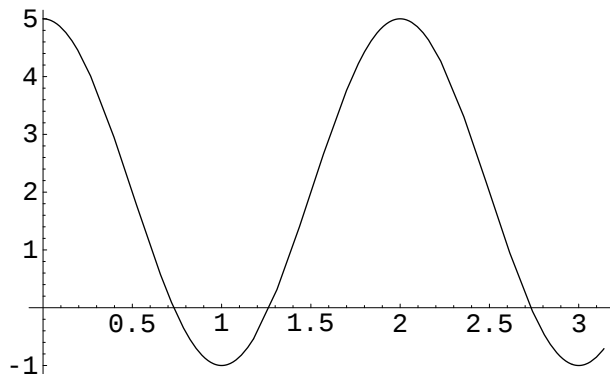
- (b) Find a possible formula for $P(t)$.

$$P(t) = \underline{\hspace{2cm}} \quad [4]$$

- (c) Use your formula to find the half-life of the substance.

$$\text{Half-Life} = \underline{\hspace{2cm}} \quad [4]$$

4. Find a possible formula for the graph of the sinusoidal function shown below:



$$y = \underline{\hspace{2cm}} \quad [4]$$

5. The table gives the population $P = f(t)$, in millions, in some country in the year t .

t	1950	1960	1970	1980	1990
P (Population in millions)	40	52.8	74.2	111.8	144.1

- (a) Does $f'(t)$ appear to be positive or negative during the years between 1950 and 1990?
(Show work to support your answer)

$f'(t)$ is _____ [3]

- (b) Does $f''(t)$ appear to be positive or negative during the years between 1950 and 1990?
(Show work to support your answer)

$f''(t)$ is _____ [3]

- (c) Estimate $f'(1975)$. (Include units)

$f'(1975) =$ _____ [3]

6. At a time t seconds after it is thrown in the air, a tomato is at a height of $h(t) = -4.9t^2 + 25t + 3$ meters.

- (a) What is the average velocity of the tomato during the first 2 seconds? (Include units)

Average Velocity = _____ [4]

- (b) Find the exact instantaneous velocity of the tomato at $t = 2$ seconds. (Include units)

Instantaneous Velocity = _____ [4]

- (c) What is the acceleration at $t = 2$ seconds? (Include units)

Acceleration = _____ [4]

7. Let $f(x) = x^2 + 3x + 2$. Find $f'(1)$ algebraically using the limit definition of the derivative.

$$f'(1) = \text{_____} [6]$$

8. An economist is interested in how the price of a certain commodity affects its sales. Suppose that at a price of p dollars, a quantity q of the commodity is sold.

- (a) If $q = f(p)$, explain in economic terms the meaning of the statements $f(10) = 240,000$ and $f'(10) = -29000$.

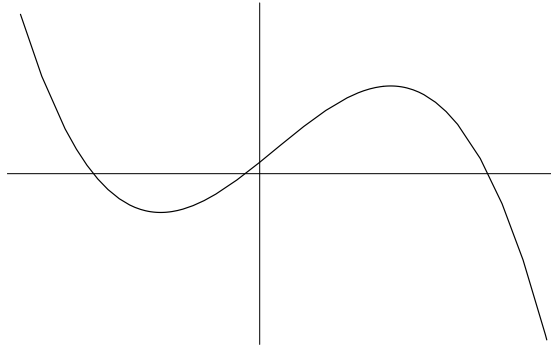
$$f(10) = 240,000 \text{ means } \text{_____} [4]$$

$$f'(10) = -29000 \text{ means } \text{_____} [4]$$

- (b) Using this information, estimate $f(12)$.

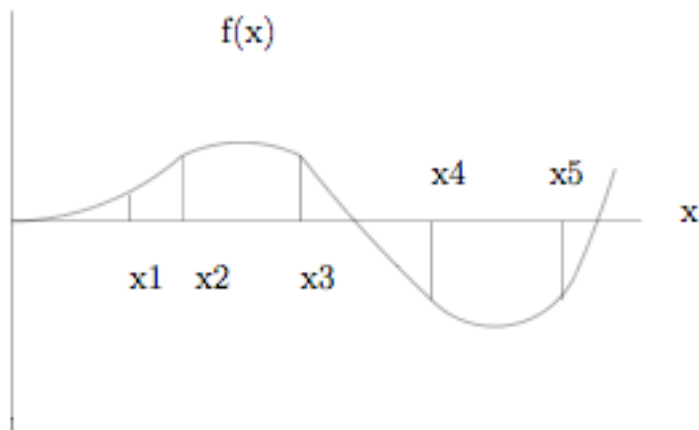
$$f(12) = \text{_____} [4]$$

9. The graph of $f(x)$ is shown below. Sketch a possible graph of $f'(x)$ on the same set of axes.



[5]

10. At which of the marked x -values in the figure can the following statements be true?.



(a) $f(x) < 0$

(a) _____ [2]

(b) $f'(x) < 0$

(b) _____ [2]

(c) $f(x)$ is decreasing

(c) _____ [2]

(d) $f'(x)$ is decreasing

(d) _____ [2]

(e) Slope of $f(x)$ is positive

(e) _____ [2]

(f) Slope of $f(x)$ is increasing

(f) _____ [2]

[12]