

Multiple Choice Questions

Part A. No Calculator.

- 1. What is the instantaneous rate of change at x=2 of the function f given by $f(x)=\frac{x^2-2}{x-1}$?
 - (A) -2
- (B) $\frac{1}{6}$
- (C) $\frac{1}{2}$
- (D) 2
- (E) 6

Part B. Graphing Calculator Allowed.

- 2. Let f be a function given by $f(x) = 3e^{2x}$ and let g be the function given by $g(x) = 6x^3$. At what value of x do the graphs of f and g have parallel tangent lines?
 - (A) -0.701
 - (B) -0.567
 - (C) -0.391
 - (D) -0.302
 - (E) -0.258
- 3. Let f be the function defined by $f(x) = x + \ln x$. What is the value of c for which the instantaneous rate of change of f at x = c is the same as the average rate of change of f over [1,4]?
 - (A) 0.456
- (B) 1.244
- (C) 2.164
- (D) 2.342
- (E) 2.452
- 4. Let f be a function given by $f(x) = 2e^{4x^2}$. For what value of x is the slope of the line tangent to the graph of f at (x, f(x)) equal to 3?
 - (A) 0.168
- (B) 0.276
- (C) 0.318
- (D) 0.342
- (E) 0.551
- 5. Let $f(x) = \sqrt{x}$. If the rate of change of f at x = c is twice its rate of change at x = 1, then c = c
 - (A) $\frac{1}{4}$
- (B) 1
- (C) 4
- (D) $\frac{1}{\sqrt{2}}$
- (E) $\frac{1}{2\sqrt{2}}$

Student Handout

Free Response Questions

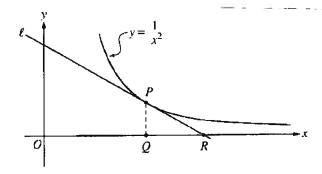
2007 AB 3 Form B

The wind chill is the temperature, in degrees Fahrenheit (°F), a human feels based on the air temperature, in degrees Fahrenheit, and the wind velocity v, in miles per hour (mph). If the air temperature is 32°F, then the wind chill is given by $W(v) = 55.6 - 22.1v^{0.16}$ and is valid for $5 \le v \le 60$.

- (a) Find W'(20). Using correct units, explain the meaning of W'(20) in terms of the wind chill.
- (b) Find the average rate of change of W over the interval $5 \le v \le 60$. Find the value of v at which the instantaneous rate of change of W is equal to the average rate of change of W over the interval $5 \le v \le 60$.
- (c) Over the time interval $0 \le t \le 4$ hours, the air temperature is a constant 32°F. At time t = 0, the wind velocity is v = 20 mph. If the wind velocity increases at a constant rate of 5 mph per hour, what is the rate of change of the wind chill with respect to time at t = 3 hours? Indicate units of measure.

1999 AB 6

Average and Instantaneous Rates of Change



In the figure above, line ℓ is tangent to the graph of $y = \frac{1}{x^2}$ at point P, with coordinates $\left(w, \frac{1}{w^2}\right)$, where w > 0. Point Q has coordinates (w, 0). Line ℓ crosses the x-axis at point R, with coordinates (k, 0).

- (a) Find the value of k when w = 3.
- (b) For all w > 0, find k in terms of w.
- (c) Suppose that w is increasing at the constant rate of 7 units per second. When w = 5, what is the rate of change of k with respect to time?
- (d) Suppose that w is increasing at the constant rate of 7 units per second. When w = 5, what is the rate of change of the area of ΔPQR with respect to time? Determine whether the area is increasing or decreasing at this instant.



2004 AB 2 Form B

For $0 \le t \le 31$, the rate of change of the number of mosquitoes on Tropical Island at time t days is modeled by $R(t) = 5\sqrt{t}\cos\left(\frac{t}{5}\right)$ mosquitoes per day. There are 1000 mosquitoes on Tropical Island at time t = 0.

- (a) Show that the number of mosquitoes is increasing at time t=6.
- (b) At time t = 6, is the number of mosquitoes increasing at an increasing rate, or is the number of mosquitoes increasing at a decreasing rate? Give a reason for your answer.
- (c) According to the model, how many mosquitoes will be on the island at time t=31? Round your answer to the nearest whole number.
- (d) To the nearest whole number, what is the maximum number of mosquitoes for $0 \le t \le 31$? Show the analysis that leads to your conclusion.

Student Handout

Average and Instantaneous Rates of Change

2004 AB 1

Traffic flow is defined as the rate at which cars pass through an intersection, measured in cars per minute. The traffic flow at a particular intersection is modeled by the function F defined by

$$F(t) = 82 + 4\sin\left(\frac{t}{2}\right) \text{ for } 0 \le t \le 30.$$

- (a) To the nearest whole number, how many cars pass through the intersection over the 30-minute period?
- (b) Is the traffic flow increasing or decreasing at t=7? Give a reason for your answer.
- (c) What is the average value of the traffic flow over the time interval $10 \le t \le 15$? Indicate units of measure.
- (d) What is the average rate of change of the traffic flow over the time interval $10 \le t \le 15$? Indicate units of measure.