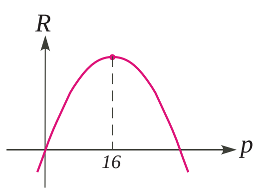
30 Multiple Choice Questions (5 Points Each)

1. When the total quantity of coffee beans available in the world market is 144 million bags[1] then its price is \$0.50 per pound. When the quantity of coffee beans available is 134 million bags then its price is \$0.60 per pound. Express the price p (in dollars per pound) as a function of the quantity q (in millions of bags), assuming that this function is **linear**.

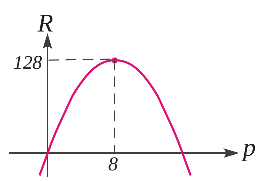
   (**a**) $p = -0.01q$ (**b**) $p = -0.01q + 0.6$ (**c**) $p = -0.01q + 0.5$

   (**d**) $p = 0.01q + 1.94$ (**e**) $p = -0.01q + 1.94$

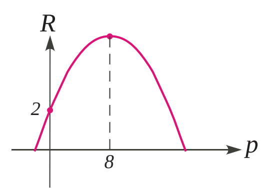
2. The demand for an item is given by $q = -2p + 32$, where q is in millions of units and p in dollars. Which of the following is the graph of the **revenue** function $R(p)$?



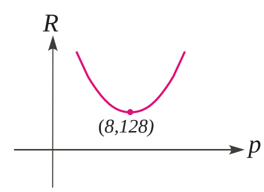
(**a**)



(**b**)



(**c**)



(**d**)

   (**e**) None of the above graphs.

3. A bank account earns interest at a rate of 6% compounded **continuously**. How many years will it take for the balance to be **triple** the principal?

   (**a**) $\dfrac{\ln 3}{0.06}$ (**b**) $\dfrac{\ln 3}{\ln(1.06)}$ (**c**) $\dfrac{\ln 3}{6}$ (**d**) $\ln 3 - 0.06$ (**e**) $\dfrac{\ln 3}{12\ln(1.005)}$

[1] A bag is 60 Kilograms or 132.276 pounds

4. Let $f(x)$ be a function whose graph is shown Figure 1. Which of the following statements is **NOT** true?

(**a**) $\lim_{x\to\infty} f(x)$ is finite.

(**b**) $\lim_{x\to 0^+} f(x)$ and $\lim_{x\to 0^-} f(x)$ both exist.

(**c**) $f(x)$ is continuous at $x = 4$.

(**d**) $f(x)$ is **not** continuous at $x = 2$.

(**e**) $\lim_{x\to 3^-} f(x) = 2$.

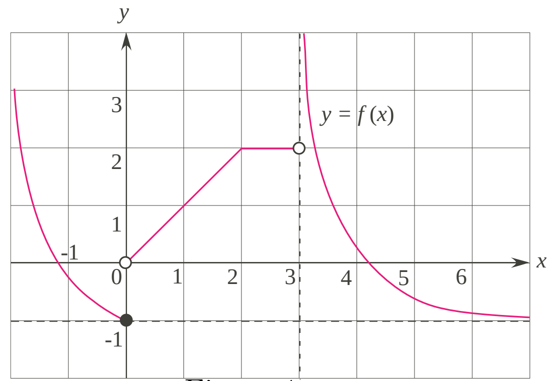


Figure 1

5. Denote by $w(t)$ the population, in thousands, of the gray whales in the North Pacific t years after 2000. Assume that $w(t)$ is modeled by

$$w(t) = \frac{500}{25 - 5e^{-0.03t}}.$$

Which of the following statements is **NOT** true?

(**a**) There were 25 thousand gray whales in 2000.

(**b**) Gray whales are headed for extinction in the future.

(**c**) Gray whales cannot exceed 25 thousand.

(**d**) The number of gray whales cannot be less than 20 thousand.

(**e**) The number of gray whales will approach 20 thousand as time goes on.

6. Evaluate: $\lim_{h\to 0} \dfrac{(8+h)^{2/3} - 8^{2/3}}{h}$. (Hint: Think derivative)

(**a**) 0 (**b**) ∞ (**c**) 1/3 (**d**) 1/2 (**e**) 1/4

7. Find the number x at which the tangent line to the graph of $f(x) = xe^{-x}$ is **horizontal**.

(**a**) $x = 0$ (**b**) $x = 1$ (**c**) $x = 3$ (**d**) $x = 2$ (**e**) $x = \sqrt{3}$

8. For the function $f(t)$ whose graph is given in Figure 2, compute its instantaneous rate of change at $t = 1$.

(**a**) 0

(**b**) $\frac{2}{3}$

(**c**) ∞

(**d**) $-\frac{2}{3}$

(**e**) $\frac{3}{2}$

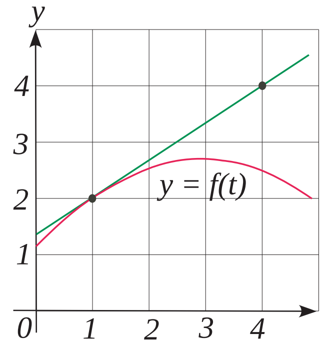


Figure 2

9. Let $f(t)$ be the function whose graph is given in Figure 2. Use **linear approximation** to estimate $f(1.03)$.

(**a**) 2.02 (**b**) 2.03 (**c**) 1.97 (**d**) 2.06 (**e**) None of the above.

10. Let $g(x)$ be the function whose graph is given in Figure 3. Find the derivative of the function $\ln(g(x))$ at $x = 3$.

(**a**) 4

(**b**) $\frac{2}{3}$

(**c**) -1

(**d**) $-\frac{1}{4}$

(**e**) $\frac{1}{4}$

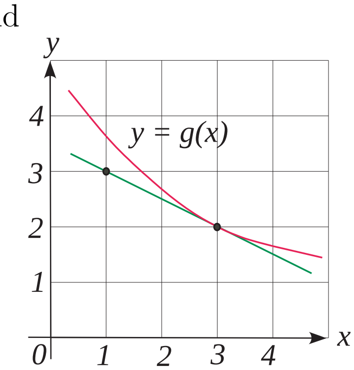


Figure 3

11. Let $g(x)$ be the function whose graph is given in Figure 3. Find the derivative of the function $e^{g(x)}$ at $x = 3$.

(**a**) e^3 (**b**) $\frac{1}{2}e^2$ (**c**) $-2e^2$ (**d**) e^{-2} (**e**) $-\frac{1}{2}e^2$

12. A company finds that if it produces and sells x boxes of assorted chocolates per week, its profit in dollars is $P(x) = -0.025x^2 + 15x - 500$. What is its marginal profit at the production level of 200 boxes per week?

(a) \$25 per box **(b)** \$20 per box **(c)** \$15 per box **(d)** \$10 per box **(e)** \$5 per box

13. Using implicit differentiation, find y' if $\frac{1}{3}y^3 + e^y = 8 - e^{-4x}$.

(a) $y' = \dfrac{e^{-4x}}{y^2 + e^y}$ **(b)** $y' = \dfrac{4e^{-4x}}{y^2 + e^y}$ **(c)** $y' = \dfrac{4e^{-4x}}{y^2 - e^y}$ **(d)** $y' = \dfrac{-4e^{-4x}}{y^2 + e^y}$ **(e)** $y' = \dfrac{e^{-4x}}{y^2 - e^y}$

14. The revenue function from selling x units of a certain item is $R(x) = -0.02x^2 + 18x$ and the cost function is $C(x) = 2x + 1000$, where both $R(x)$ and $C(x)$ represent dollar amounts. Find the maximum profit when production is in the interval [100, 600].

(a) \$2200 **(b)** \$600 **(c)** \$2000 **(d)** \$1500 **(e)** \$1600

15. The manufacturer of a line of private planes estimates that the demand for a particular plane is given by $p = \dfrac{100}{q+2}$, where p is the price in millions of dollars for each plane and q is the number of planes. Suppose each plane costs the manufacturer 2 million dollars to make. Find the quantity of planes that maximizes the profit.

(**a**) 4 (**b**) 6 (**c**) 8 (**d**) 10 (**e**) 12

16. The population, $P(t)$, of a certain town has been increasing over the years, but each year the rate of increase is steadily becoming smaller (is decreasing). Which of the following is true?

(a) $P'(t)$ is constant.

(b) $P'(t) > 0$ and $P''(t) > 0$.

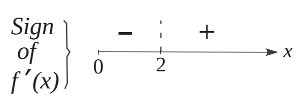
(c) $P'(t) < 0$ and $P''(t) > 0$.

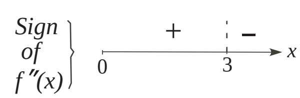
(d) $P'(t) < 0$ and $P''(t) < 0$.

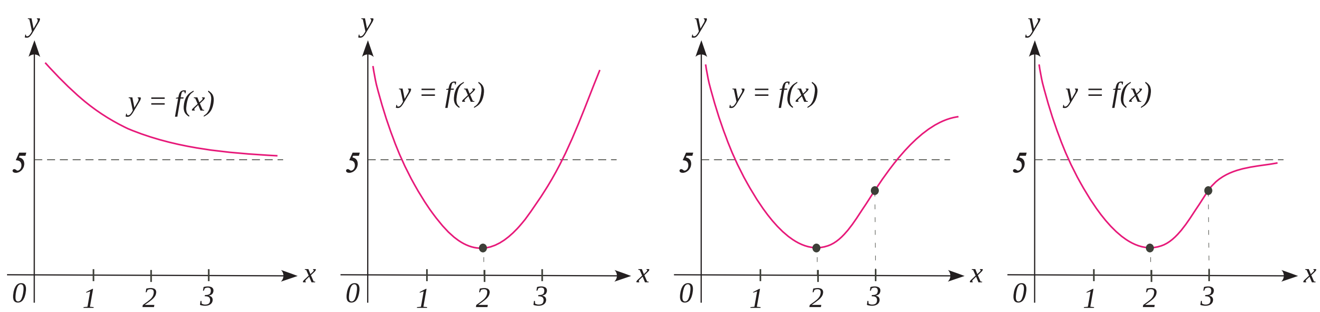
(e) $P'(t) > 0$ and $P''(t) < 0$.

17. Which one of the following graphs is the graph of a function $f(x)$ defined for $x > 0$ and such that:

$\lim_{x\to 0^+} f(x) = \infty$, $\lim_{x\to\infty} f(x) = 5$, and







(a) (b) (c) (d)

(e) None of the above graphs.

18. A city council decides to build a new park. It will be rectangular in shape, with a sidewalk going all around the perimeter and a grassy rectangular area in the interior (see Figure 4). The east and west sidewalks are to be 2 yards wide, and the north and south sidewalks are to be 1 yard wide. The total area allowed for the park (including sidewalks) is 7200 square yards. To find the dimensions of the park (including sidewalks) that maximizes the area of the grassy part, you must maximize the following function:

(**a**) $A(x) = (x+4)(\frac{7200}{x} + 2)$

(**b**) $A(x) = (x-4)(\frac{7200}{x} + 2)$

(**c**) $A(x) = (x-4)(\frac{7200}{x} - 2)$

(**d**) $A(x) = (x+4)(\frac{7200}{x} - 2)$

(**e**) None of the above

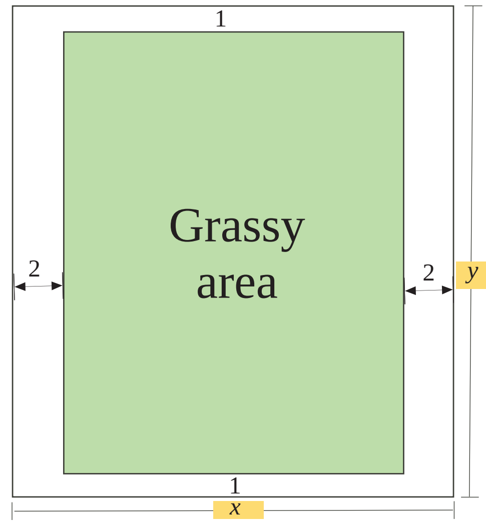


Figure 4

19. A medical research team is studying the human body's ability to metabolize a new drug used to prepare a patient for surgery. By injecting specified dosages into its volunteers and taking blood samples every 30 minutes for analysis, the team concludes that the concentration of the drug in the bloodstream t hours after injection is given by

$$C(t) = \frac{3t}{t^2 + 4}.$$

The drug will be of the most help to patients if it is at its maximum concentration when the surgery begins. How many hours before surgery should the injection be given?

(**a**) 1 hours (**b**) 2 hour (**c**) 3 hours (**d**) 4 hours (**e**) 5 hours

20. Applying substitution in the integral $\int \sqrt{x^2 - 16} \cdot x dx$ with $u = x^2 - 16$ gives:

(**a**) $\frac{1}{2} \int u^{1/2} du$ (**b**) $\int u^{1/2} du$ (**c**) $\frac{1}{3} \int u^{1/2} du$ (**d**) $\frac{1}{4} \int u^{1/2} du$ (**e**) $\frac{1}{2} \int u du$

21. Applying integration by parts to the integral $\int(\ln x)^2 \cdot 4x^3dx$ with $u = (\ln x)^2$ and $dv = 4x^3dx$ gives:

(**a**) $x^4(\ln x)^2 - \displaystyle\int (\ln x) \cdot x^3dx$

(**b**) $x^4(\ln x)^2 - 2\displaystyle\int (\ln x) \cdot x^3dx$

(**c**) $x^4(\ln x)^2 - 3\displaystyle\int (\ln x) \cdot x^3dx$

(**d**) $x^4(\ln x)^2 - 4\displaystyle\int (\ln x) \cdot x^3dx$

(**e**) $x^4(\ln x)^2 - 5\displaystyle\int (\ln x) \cdot x^3dx$

22. A car is traveling along a straight road at 120 feet per second when the driver steps on the brakes. At that point the car starts decelerating at the constant rate of 20 feet per second squared. How long does it take the car to slow down to the speed of 40 feet per second?

(**a**) 2 seconds (**b**) 3 seconds (**c**) 4 seconds (**d**) 5 seconds (**e**) 6 seconds

23. The rate of production of a certain item, in millions of units per month, is given by $P'(t) = 8te^{-t^2}$. Find the production function $P(t)$ if $P(0) = 3$.

(**a**) $P(t) = 3e^{-t^2}$ (**b**) $P(t) = 2e^{-t^2} + 1$ (**c**) $P(t) = 3e^{t^2}$ (**d**) $P(t) = -4e^{-t^2} + 7$ (**e**) $P(t) = e^{t^2} + 2$

24. Let $f(x)$ be the function whose graph is given in Figure 5. Estimate the integral $\int_0^2 f(x)dx$ by using the Riemann sum corresponding to $n = 4$ and midpoints.

(**a**) 4

(**b**) 2

(**c**) -2

(**d**) 0

(**e**) -10

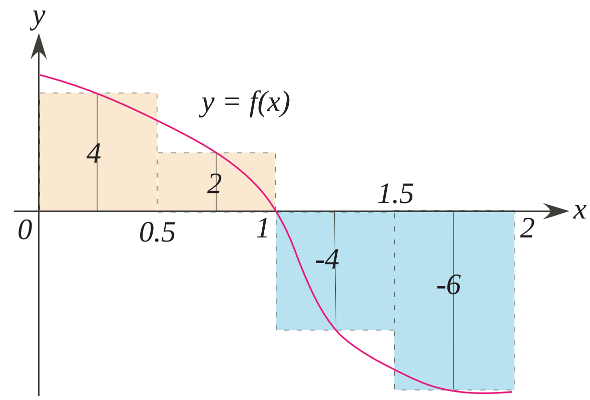


Figure 5

25. Applying substitution in the integral $\displaystyle\int_4^5 \sqrt{x^2 - 16} \cdot x dx$ with $u = x^2 - 16$ gives:

(**a**) $\displaystyle\frac{1}{2}\int_0^9 u du$ (**b**) $\displaystyle\int_0^9 u^{1/2} du$ (**c**) $\displaystyle\frac{1}{2}\int_4^5 u^{1/2} du$ (**d**) $\displaystyle\frac{1}{2}\int_4^9 u^{1/2} du$ (**e**) $\displaystyle\frac{1}{2}\int_0^9 u^{1/2} du$

26. A company finds that its marginal profit from producing and selling x boxes of assorted chocolates per week, in dollars per box, is $MP(x) = -0.05x + 15$. Compute the total change in profit if production changes from 200 boxes per week to 300 boxes per week.

(**a**) \$0 (**b**) \$50 (**c**) \$150 (**d**) \$250 (**e**) \$350

27. The average of a continuous quantity $Q(t)$ over the time interval $[1, 5]$ is equal 20. Find $\int_1^5 Q(t)dt$.

(**a**) 20 (**b**) 40 (**c**) 60 (**d**) 80 (**e**) 100

28. Find the area of the region between the curves $y = x^2$ and $y = x$.

(**a**) 1/6 (**b**) $-1/6$ (**c**) 1/3 (**d**) 1/2 (**e**) 0

29. The marginal revenue $MR = R'(x)$ from the sales of a certain item is shown in Figure 6. Here, x is in thousands of units and R is in thousands of dollars. Using the mid-point rule with $n = 5$, approximate the total revenue from the sales of the first thousand units.

(**a**) 5 thousand dollars

(**b**) 10 thousand dollars

(**c**) 15 thousand dollars

(**d**) 20 thousand dollars

(**e**) 25 thousand dollars

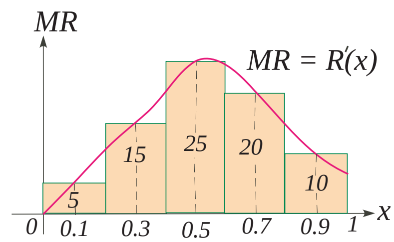


Figure 6

30. The velocity $v = v(t)$, in feet per second, of an object in the time interval between 0 and 20 seconds is shown in Figure 7. Using trapezoidal rule with $n = 4$ approximate the distance this object travels during this time interval.

(**a**) 1550 feet

(**b**) 1450 feet

(**c**) 1350 feet

(**d**) 1250 feet

(**e**) 1150 feet

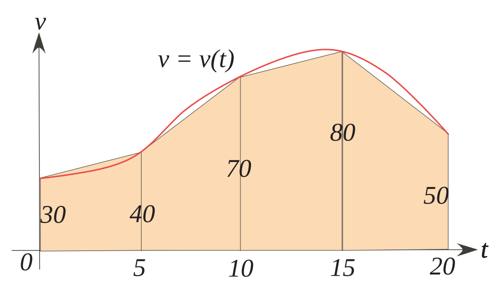


Figure 7