

## Answers and Answer Explanations

Using the table below, score your test. Determine how many questions you answered correctly and how many you answered incorrectly. Additional information about scoring is at the end of the Practice Test.

1. C	2. E	3. D	4. A	5. C
6. B	7. E	8. D	9. D	10. A
11. E	12. A	13. C	14. C	15. E
16. A	17. E	18. B	19. A	20. E
21. B	22. A	23. E	24. A	25. C
26. C	27. B	28. D	29. A	30. B
31. D	32. D	33. D	34. B	35. D
36. C	37. E	38. B	39. E	40. A
41. D	42. E	43. C	44. A	45. D

### MULTIPLE-CHOICE QUESTIONS

1. **ANSWER: (C)** The domain for  $f(x) = \ln(x^2 - 1)$  is  $|x| > 1$ . With  $f'(x) = \frac{2x}{x^2 - 1} = 0 \Rightarrow x = 0$ , but  $x = 0$  is not in the domain of  $f(x)$ . The behavior of the curve is analyzed using the sign chart below.

$x$	$-\infty < x < -1$	$1 < x < \infty$
$f'(x)$	negative	positive
$f(x)$	decreasing	increasing

Therefore the curve is decreasing when  $x < -1$ .  
(Calculus 8th ed. pages 179–185 / 9th ed. pages 179–185)

2. **ANSWER: (E)**  $\lim_{x \rightarrow 0} \frac{\cos x}{|x|} = \frac{1}{0}$ , which does not exist. (The value of the limit from both the left and right side of 0 is  $\infty$ .)  
(Calculus 8th ed. pages 83–87 / 9th ed. pages 83–87)
3. **ANSWER: (D)** By substituting  $u = -x$  and  $du = -dx$ ,  

$$\int 3^{-x} + \frac{1}{x} dx = - \int 3^u du + \int \frac{1}{x} dx = -\frac{3^u}{\ln 3} + \ln |x| + C$$

$$= -\frac{3^{-x}}{\ln 3} + \ln |x| + C$$
(Calculus 8th ed. pages 360–365, 332–337 / 9th ed. pages 362–367, 334–339)

4. **ANSWER: (A)**  $\frac{d}{dx}[\cos(x+y)] = \frac{d}{dx}(x) \Rightarrow -\sin(x+y) \cdot \left(1 + \frac{dy}{dx}\right) = 1$

$$1 + \frac{dy}{dx} = \frac{1}{-\sin(x+y)} = -\csc(x+y)$$

$$\frac{dy}{dx} = -\csc(x+y) - 1$$

(Calculus 8th ed. pages 141–148 / 9th ed. pages 141–148)

5. **ANSWER: (C)**  $g(-1) = \int_0^{-1} f(t) dt = -\int_{-1}^0 f(t) dt = -\frac{1}{2}(1)(2) = -1$

$$g'(x) = f(x) \Rightarrow g'(-1) = f(-1) = 0$$

$$g''(x) = f'(x) \Rightarrow g''(-1) = f'(-1) = 2$$

$$g(-1) + g'(-1) + g''(-1) = -1 + 0 + 2 = 1$$

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–296)

6. **ANSWER: (B)** Solve the integral by adding up the geometric areas pictured.

$$\int_{-3}^5 f(t) dt = 1(-2) + \frac{1}{2}(1)(-2) + \frac{1}{2}(1)(2) + 2(2) + \left(2(2) - \frac{\pi}{2}\right) + \frac{1}{2}(1)(2)$$

$$= -2 - 1 + 1 + 4 + 4 - \frac{\pi}{2} + 1$$

$$= 7 - \frac{\pi}{2}$$

(Calculus 8th ed. pages 271–281 / 9th ed. pages 271–281)

7. **ANSWER: (E)** The function  $g(x)$  is increasing for  $x > 0$ , so the absolute maximum occurs at  $x = 5$ . The relative minimum occurs where  $g'(x)$  changes from negative to positive, so the relative minimum occurs at  $x = -1$ . A point of inflection occurs where the slope of  $f(x)$ ,  $f'(x) = g''(x)$ , changes from negative to positive, so a point of inflection occurs where  $x = 3$ . The roots of  $g(x)$  occur

where  $\int_0^x f(t) dt = 0$ , and this occurs when  $x = 0$  or  $x = -2$ .

Therefore the false statement is E, because  $g''(x) = f'(x)$  is greater than zero in the open interval  $-2 < x < -1$ , which indicates that the curve is concave up.

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–296)

8. **ANSWER: (D)** Speed  $= |v(t)| = |x'(t)|$ . Since  $x'(t) = 3 - 3t^2$ , then

$$|v(4)| = |3 - 3(4)^2| = 45$$

(Calculus 8th ed. pages 107–118 / 9th ed. pages 107–118)

9. **ANSWER: (D)** Using the disk method and integrating with respect to  $y$ :

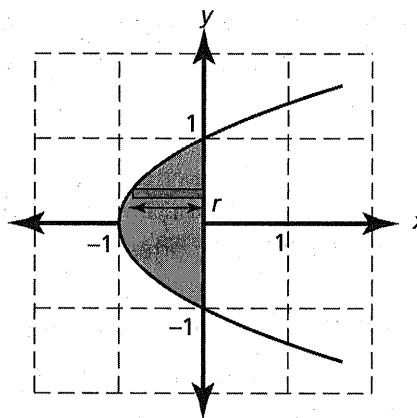
$$V = \pi \int_{-1}^1 x^2 dx = 2\pi \int_0^1 (y^2 - 1)^2 dy.$$

$$V = 2\pi \int_0^1 (y^4 - 2y^2 + 1) dy$$

$$= 2\pi \left( \frac{1}{5} y^5 - \frac{2}{3} y^3 + y \right) \Big|_0^1$$

$$= 2\pi \left( \frac{1}{5} - \frac{2}{3} + 1 \right) = \frac{16\pi}{15}$$

(Calculus 8th ed. pages 456–466 / 9th ed. pages 458–468)



10. **ANSWER: (A)** Case I:  $f'(x) = \frac{1}{3x^{\frac{2}{3}}}$  and is not defined at  $x = 0$ .

Therefore,  $f'(x)$  is always greater than zero, except at  $x = 0$ .  
(Therefore, the statement is true)

Case II: The function is not differentiable at  $x = 0$  and since the slope of the tangent line is undefined at  $x = 0$ , the tangent line is vertical. (So, the statement is false.)

Case III: The Mean Value Theorem is not applicable in the stated interval, because the function is not differentiable at  $x = 0$ . (Thus, the statement is false.)

(Calculus 8th ed. pages 164–197 / 9th ed. pages 164–197)

11. **ANSWER: (E)** Rewrite  $a(t)$  using long division:

$$\frac{t^2 + t}{t^2 + 1} \Rightarrow 1 + \frac{1-t}{t^2 + 1} \Rightarrow 1 + \frac{1}{t^2 + 1} - \frac{t}{t^2 + 1}$$

$$v(t) = \int a(t) dt = \int \left( 1 + \frac{1}{t^2 + 1} - \frac{t}{t^2 + 1} \right) dt = t + \tan^{-1} t - \frac{1}{2} \ln(t^2 + 1) + C.$$
 If

$$v(0) = 1, \text{ then } C = 1 \text{ and finally, } v(t) = t + \tan^{-1} t - \frac{1}{2} \ln(t^2 + 1) + 1.$$

(Calculus 8th ed. pages 332–337, 380–387 / 9th ed. pages 334–339, 382–389)

12. **ANSWER: (A)** For  $n = 3$  the width of each rectangle is 4. Since

$f_{\text{avg}} = \frac{1}{b-a} \int_a^b f(x) dx$  and  $\int_a^b f(x) dx$  is approximated by using a right Riemann sum, then

$$R_{\text{avg}} = \frac{1}{12} \int_0^{12} R(t) dt \approx \frac{1}{12} (4)(10 + 12 + 8) = 10 \text{ cm}^3/\text{min}$$

(Calculus 8th ed. pages 271–281 / 9th ed. pages 271–281)

13. **ANSWER: (C)**  $h(x)$  has a point of inflection where  $h''(x)$  changes sign. For  $h''(x) = e^{x-1}(2x-1)^2(x-3)^3(4x+5)$ , the factor  $e^{x-1}$  never equals zero.

$x$	$-\infty < x < -\frac{5}{4}$	$-\frac{5}{4} < x < \frac{1}{2}$	$\frac{1}{2} < x < 3$	$3 < x < \infty$
$h''(x)$	positive	negative	negative	positive

Therefore, there are two points of inflection, one at  $x = -\frac{5}{4}$  and the other at  $x = 3$ , where  $h''(x)$  changes from positive to negative or negative to positive.

(Calculus 8th ed. pages 190–197 / 9th ed. pages 190–197)

14. **ANSWER: (C)** Since  $\int_a^b f'(x) dx = f(b) - f(a)$ , then

$$\begin{aligned} f(2) - f(-1) &= \int_{-1}^2 f'(x) dx. \text{ Then } \int_{-1}^2 f'(x) dx \Rightarrow \\ \int_{-1}^1 f'(x) dx + \int_1^2 f'(x) dx &\Rightarrow \int_{-1}^1 f'(x) dx + k. \text{ Thus,} \\ f(2) - f(-1) &= \left[ 1(-1) + \frac{1}{2} \left( \frac{1}{3} \right) (-1) + \frac{1}{2} \left( \frac{2}{3} \right) (2) \right] + k \\ &= \left[ -1 - \frac{1}{6} + \frac{2}{3} \right] + k \\ &= k - \frac{1}{2} \end{aligned}$$

(Calculus 8th ed. pages 271–294 / 9th ed. pages 271–294)

15. **ANSWER: (E)** Since  $\int \frac{1}{a^2 + u^2} du = \frac{1}{a} \tan^{-1} \frac{u}{a} + C$ ,

$$\text{then } \int \frac{1}{16 + x^2} dx = \frac{1}{4} \tan^{-1} \frac{x}{4} + C$$

(Calculus 8th ed. pages 380–387 / 9th ed. pages 382–389)

16. **ANSWER: (A)** Acceleration has a relative maximum or minimum when  $a'(t) = 0$ . So,  $v(t) = -t^3 + \frac{9}{4}t^4 \Rightarrow a(t) = -3t^2 + 9t^3$  and finally,

$$a'(t) = -6t + 27t^2 = 0 \Rightarrow -3t(2 - 9t) \Rightarrow t = \frac{2}{9} \text{ or } 0$$

$t$	$0 < t < \frac{2}{9}$	$\frac{2}{9} < t < \infty$
$a'(t)$	negative	positive
$a(t)$	decreasing	increasing

Therefore  $a(t)$  is at a minimum when  $t = \frac{2}{9}$ , where  $a(t)$  changes from decreasing to increasing.

(Calculus 8th ed. pages 190–197 / 9th ed. pages 190–197)

17. **ANSWER: (E)**  $\lim_{h \rightarrow 0} \frac{\sin^{-1}(1+h) - \frac{\pi}{2}}{h}$  is in the form of the definition of the derivative,  $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h} = f'(x)$ , with the

function,  $f(x) = \sin^{-1}(x)$  and  $x = 1$ , because  $\sin^{-1}(1) = \frac{\pi}{2}$ . Then,

$$f'(x) = \frac{1}{\sqrt{1-x^2}} \text{ and } f'(1) = \frac{1}{\sqrt{1-1^2}} \text{ does not exist.}$$

(Calculus 8th ed. pages 96–106, 371–376 / 9th ed. pages 96–106, 373–378)

18. **ANSWER: (B)** For  $f(x) = e^{\sin x} + x$ ,  $f(0) = e^0 + 0 = 1$  and  $f'(x) = e^{\sin x} \cos x + 1$ , with  $f'(0) = e^0 \cos 0 + 1 = 2$ . Since  $f(0) = 1$  and  $f'(0) = m = 2$ , then the equation of the tangent is  $y - 1 = 2(x - 0) \Rightarrow y = 2x + 1$ .

(Calculus 8th ed. pages 350–359 / 9th ed. pages 352–361)

19. **ANSWER: (A)** Observe that the segments with slopes of zero occur where  $x$  and  $y$  are equal and that the segments with vertical slopes occur where  $y = 0$ . Thus the statement that matches the slope field is  $\frac{dy}{dx} = \frac{x-y}{2y}$ .

(Calculus 8th ed. pages 404–408 / 9th ed. pages 406–410)

20. **ANSWER: (E)** The Second Fundamental Theorem states that if

$$F(x) = \int_a^{g(x)} f(u) \, du, \text{ then } F'(x) = f[g(x)] \cdot g'(x). \text{ First, rewrite}$$

$$F(x) = \int_{3x-2}^2 f(2t) \, dt \Rightarrow F(x) = - \int_2^{3x-2} f(2t) \, dt, \text{ where } g(x) = 3x - 2. \text{ By}$$

substitution of  $u = 2t$  and  $du = 2 \, dt$ , change the limits of the integral (where  $t = 2$ , then  $u = 4$ , and where  $t = 3x - 2$ ,  $u = 6x - 4$ ) and the

integral becomes  $F(x) = -\frac{1}{2} \int_4^{6x-4} f(u) \, du$ . Finally,

$$F'(x) = -\frac{1}{2} [f(6x-4)] \cdot 6 = -3f(6x-4)$$

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–296)

21. **ANSWER: (B)** With  $h'(x) = \frac{15x^2 - 2}{2\sqrt{5x^3 - 2x + 1}}$ ,  $h'(1) = \frac{15 - 2}{2\sqrt{5 - 2 + 1}} = \frac{13}{4}$ . A normal line is perpendicular to the tangent at the point of tangency, so  $m_{\text{normal}} = -\frac{4}{13}$ .

(Calculus 8th ed. pages 130–140 / 9th ed. pages 130–140)

22. **ANSWER: (A)** The average rate of change of a function in a closed interval is given by  $\frac{f(b) - f(a)}{b - a}$ . Then the average rate of change of

$y$  in the closed interval  $0 \leq x \leq \frac{\pi}{2}$  is

$$\begin{aligned} \frac{y\left(\frac{\pi}{2}\right) - y(0)}{\left(\frac{\pi}{2}\right) - 0} &= \frac{2\left(\frac{\pi}{2}\right)\left[\sin 2\left(\frac{\pi}{2}\right) + \frac{\pi}{2}\cos 2\left(\frac{\pi}{2}\right)\right] - 2(0)(\sin 0 + 0 \cos 0)}{\frac{\pi}{2} - 0} \\ &= \frac{\pi\left[0 - \frac{\pi}{2}\right] - 0}{\frac{\pi}{2}} = -\pi \end{aligned}$$

(Calculus 8th ed. pages 96–106 / 9th ed. pages 96–106)

23. ANSWER: (E)  $f'(x) = 3x^2 - \frac{1}{x+k} \Rightarrow f'(1) = 3 - \frac{1}{k+1} = 0 \Rightarrow k = -\frac{2}{3}$

(Calculus 8th ed. pages 322–331 / 9th ed. pages 324–333)

24. ANSWER: (A)

$$\begin{aligned} C'(t) &= \frac{2(8100 + t^2) - 2t(2t)}{(8100 + t^2)^2} \\ &= \frac{16,200 - 2t^2}{(8100 + t^2)^2} = 0 \Rightarrow 16,200 - 2t^2 \\ &= 0 \Rightarrow t = \sqrt{8100} = 90 \text{ min} \end{aligned}$$

To be sure that this value of  $t$  occurs when  $C(t)$  is a relative maximum, use a sign chart.

$t$	$0 < t < 90$	$t > 90$
$C'(t)$	positive	negative
$C(t)$	increasing	decreasing

Since  $C(t)$  increases before  $t = 90$  and decreases after  $t = 90$ ,  $C(t)$  has a relative maximum at  $t = 90$ .

(Calculus 8th ed. pages 179–189 / 9th ed. pages 179–189)

25. ANSWER: (C) If  $\lim_{x \rightarrow \infty} \frac{ae^x}{2 + e^x} = 3$  and  $\lim_{x \rightarrow \infty} e^x = \infty$ , then

$$\lim_{x \rightarrow \infty} \frac{\frac{ae^x}{e^x}}{\frac{2 + e^x}{e^x}} = \lim_{x \rightarrow \infty} \frac{a}{\frac{2}{e^x} + 1} = \frac{a}{1} = 3. \text{ Thus, } a = 3.$$

Although l'Hôpital's Rule is not a topic for the AB exam, the solution for this problem can be found using l'Hôpital's Rule (if the student is familiar with it) as follows:  $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)} = \lim_{x \rightarrow \infty} \frac{f'(x)}{g'(x)}$  can also

be used to evaluate a limit when of the form  $\frac{\infty}{\infty}$  or  $\frac{0}{0}$ . Thus,

$$\lim_{x \rightarrow \infty} \frac{ae^x}{2+e^x} = \lim_{x \rightarrow \infty} \frac{ae^x}{e^x} \Rightarrow \lim_{x \rightarrow \infty} a = 3, \text{ and therefore, } a = 3.$$

(Calculus 8th ed. pages 198–208 / 9th ed. pages 198–208)

26. ANSWER: (C)

$$\begin{aligned} \frac{d}{dx} [f(g(x^2))] &= f'(g(x^2)) \cdot g'(x^2) \cdot 2x \Rightarrow f'(g(4)) \cdot g'(4) \cdot 4 \\ &= f'(1) \cdot \left(-\frac{1}{2}\right) \cdot 4 = \frac{2}{3}(-2) = -\frac{4}{3} \end{aligned}$$

(Calculus 8th ed. pages 130–140 / 9th ed. pages 130–140)

27. ANSWER: (B)  $V = 2x^2h = 8 \Rightarrow h = \frac{8}{2x^2} = \frac{4}{x^2}$

$$SA = 2(2x + x)h + 2x^2$$

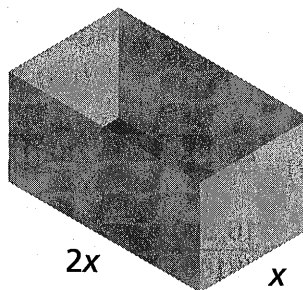
$$= 6x \left( \frac{4}{x^2} \right) + 2x^2$$

$$= 24x^{-1} + 2x^2$$

$$SA' = -24x^{-2} + 4x = 0 \Rightarrow 4 \left( x - \frac{6}{x^2} \right) = 0 \text{ and}$$

$x = \sqrt[3]{6}$  is the width of the base.  $SA'' = 48x^{-3} + 4 > 0$  for all  $x$ , and the function  $SA$  will be concave up, thus  $x = \sqrt[3]{6}$  occurs at a relative minimum.

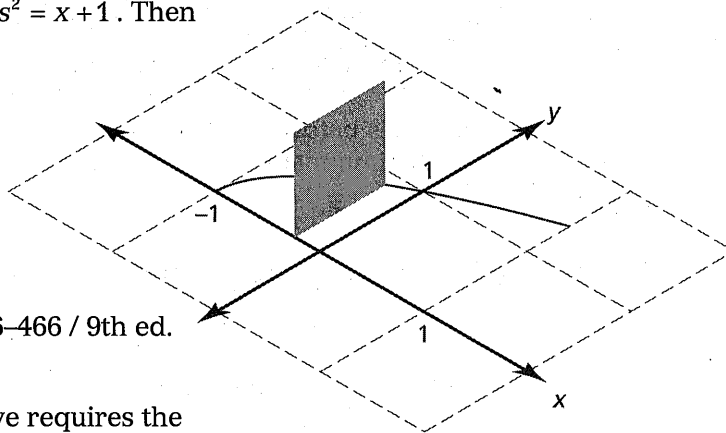
(Calculus 8th ed. pages 218–228 / 9th ed. pages 218–228)



28. ANSWER: (D) The length of the side of each square is  $s = \sqrt{x+1}$  and the area of each square is  $s^2 = x+1$ . Then

$$\begin{aligned} V &= \int_{-1}^1 s^2 dx \Rightarrow \int_{-1}^1 (x+1) dx \\ &= \left( \frac{x^2}{2} + x \right) \Big|_{-1}^1 \\ &= \left( \frac{1}{2} + 1 \right) - \left( \frac{1}{2} - 1 \right) \\ &= 2 \end{aligned}$$

(Calculus 8th ed. pages 456–466 / 9th ed. pages 458–468)



29. ANSWER: (A) Each derivative requires the use of the Chain Rule. For  $h = [g(x)]^{\frac{1}{2}}$ ,

$$h' = \frac{1}{2}[g(x)]^{-\frac{1}{2}} \cdot g'(x). \text{ And}$$

$$h'' = \left\{ -\frac{1}{4}[g(x)]^{-\frac{3}{2}} \cdot g'(x) \right\} g'(x) + g''(x) \left\{ \frac{1}{2}[g(x)]^{-\frac{1}{2}} \right\}.$$

$$\text{Finally, } h''(0) = \left[ -\frac{1}{4}(4)^{-\frac{3}{2}}(8) \right](8) + (-12) \left[ \frac{1}{2}(4)^{-\frac{1}{2}} \right] = -2 - 3 = -5.$$

(Calculus 8th ed. pages 130–140 / 9th ed. pages 130–140)

30. **ANSWER: (B)**  $g'(x) = \int_0^3 g''(x)dx + (-1) \approx 0.527 + (-1) = -0.473$

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–296)

31. **ANSWER: (D)** Let  $x$  = the distance from car A to point P,  $y$  = the distance from car B to point P, and  $z$  = the distance between the cars at time  $t$ .

$$\text{Then, } \frac{d}{dt}(x^2 + y^2 = z^2) = 2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 2z \frac{dz}{dt},$$

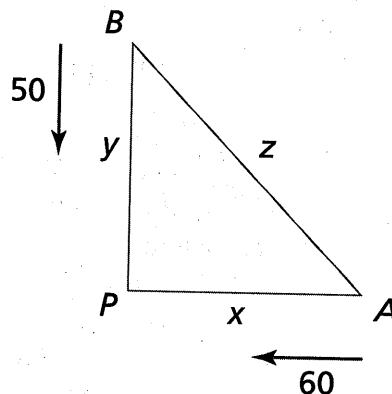
$$\text{which simplifies to } x \frac{dx}{dt} + y \frac{dy}{dt} = z \frac{dz}{dt}. \text{ By}$$

$$\text{substitution, } 12(-60) + 10(-50) =$$

$$\sqrt{12^2 + 10^2} \frac{dz}{dt} \Rightarrow \frac{dz}{dt} \approx -78.102 \text{ Therefore, the}$$

distance between the cars is decreasing at approximately 78.102 miles per hour.

(Calculus 8th ed. pages 149–157 / 9th ed. pages 149–157)



32. **ANSWER: (D)**  $f'(x) = 2^{-2x}(-2 \ln 2) = -1 \Rightarrow x \approx 0.2356$

$$f(0.2356) \approx 0.7213 \text{ and the tangent is } y - 0.7213 = -1(x - 0.2356)$$

with the  $x$ -intercept of  $x \approx 0.957$ .

(Calculus 8th ed. pages 350–355 / 9th ed. pages 352–357)

33. **ANSWER: (D)** Tangents are parallel when derivatives are equal;  $g'(x) = y' \Rightarrow \sec^2(x+2) = 2$ . There are five points in the open interval  $-4 < x < 5$  where the derivatives intersect. Therefore the tangents to  $g(x)$  are parallel to the given line five times in this interval.

(Calculus 8th ed. pages 119–125 / 9th ed. pages 119–125)

34. **ANSWER: (B)**

$$\begin{aligned} \int_1^{2k} \left( x - \frac{k}{x^2} \right) dx &= 15 \Rightarrow \left( \frac{x^2}{2} + \frac{k}{x} \right) \Big|_1^{2k} \\ &= \left( \frac{4k^2}{2} + \frac{k}{2k} \right) - \left( \frac{1}{2} + \frac{k}{1} \right) \Rightarrow 2k^2 + \frac{1}{2} - \frac{1}{2} - k \\ &= 15 \Rightarrow 2k^2 - k - 15 = 0 \end{aligned}$$

Factor the quadratic and solve for  $k$ .  $(2k+5)(k-3) = 0$ , and  $k = 3$

and  $-\frac{5}{2}$ . The sum of both  $k$  values is  $\frac{1}{2}$ .

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–296)



- 35.
- ANSWER: (D)**
- Use a sign chart to analyze the curve.

	$-\infty < x < -2$	$-2 < x < -1.5$	$-1.5 < x < 0$	$x > 0$
$f'(x)$	positive	negative	negative	positive
$f''(x)$	negative	negative	positive	positive
$f(x)$	increasing concave down	decreasing concave down	decreasing concave up	increasing concave up

Therefore, a correct graph of  $f(x)$  is D.

(Calculus 8th ed. pages 209–217 / 9th ed. pages 209–217)

- 36.
- ANSWER: (C)**
- By the Trapezoidal Rule,

$$\int_0^4 H(t) dt \approx \frac{b-a}{2n} [H(0) + 2H(1) + 2H(2) + 2H(3) + H(4)]$$

where  $\frac{b-a}{2n} = \frac{4-0}{2(4)} = \frac{1}{2}$ . If  $H_{avg} = \frac{1}{b-a} \int_a^b H(t) dt$  then  $H_{avg}$  is approximated by

$$H_{avg} = \frac{1}{4} \int_0^4 H(t) dt \Rightarrow \frac{1}{4} \left\{ \frac{1}{2} [0 + 2(1.3) + 2(1.5) + 2(2.1) + 2.6] \right\}.$$

(Calculus 8th ed. pages 309–315 / 9th ed. pages 311–317)

- 37.
- ANSWER: (E)**
- Distance traveled,
- $x(t) = \int_0^{1.5} |v(t)| dt \approx 31.669$
- cm.

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–294)

- 38.
- ANSWER: (B)**
- I. (False) The Mean Value Theorem is satisfied in the interval
- $0 < x < 2$
- , but not necessarily at
- $c = 1$
- . (The statement is true if
- $f(x) = 4 - x^2$
- but not true for a function such as

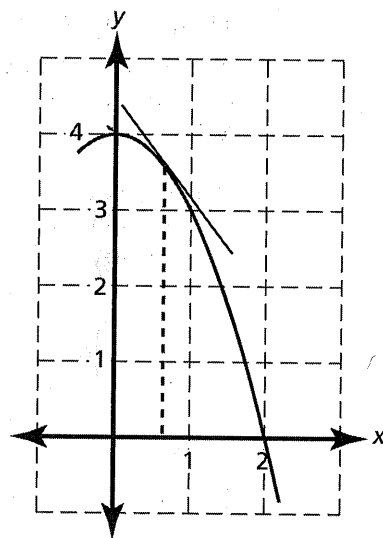
$$f(x) = 4 - \frac{1}{4}x^4, \text{ where}$$

$$f'(c) = -c^3 = \frac{f(2) - f(0)}{2 - 0} \Rightarrow -c^3 = \frac{0 - 4}{2} \Rightarrow c = \sqrt[3]{2}.)$$

- II. (True) Since  $f(x)$  is decreasing and concave down, the area from  $x = 0$  to  $x = 1$  is always greater than from  $x = 1$  to  $x = 2$ . Use right or left Riemann sums to visualize the statement.

- III. (False) The tangent will always be above the curve in this interval and will therefore overestimate the function value.

(Calculus 8th ed. pages 172–178, 271–282, 235–241 / 9th ed. pages 172–178, 271–282, 235–241)



- 39.
- ANSWER: (E)**
- $f(-2) = (-2)^2 + \int_{-2}^2 g(t) dt = 4 + 0 = 4$

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–294)

- 40.
- ANSWER: (A)**
- $f'(x) = 2x + g(x) \Rightarrow f'(-2) = 2(-2) + g(-2) = -4 - 2 = -6$

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–294)

- 41.
- ANSWER: (D)**
- $f''(x) = 2 + g'(x) \Rightarrow f''(2) = 2 + g'(2) = 2 + 0 = 2$
- .

(Calculus 8th ed. pages 282–294 / 9th ed. pages 282–294)

42. **ANSWER: (E)** The curves intersect at  $x \approx 1.781$  and the area between

the curves is found by  $\int_0^{1.781} (f - g) dx + \int_{1.781}^{\frac{\pi}{2}} (f - g) dx$

$\approx 1.1661 + 0.5953 \approx 1.761$ . (The area can also be computed by evaluating the absolute value of the difference of the functions as

the functions intersect in the interval  $0 \leq x \leq \frac{\pi}{2}$ :

$$\int_0^{\frac{\pi}{2}} |f(x) - g(x)| dx \approx 1.761.)$$

(Calculus 8th ed. pages 446–455 / 9th ed. pages 448–457)

43. **ANSWER: (C)**  $f(x)$  is decreasing and concave down when  $f'(x)$  and  $f''(x)$  are both less than 0.

$x$	$-8 < x < -6$	$-6 < x < 4.5$	$-4.5 < x < -2$	$-2 < x < 0$	$0 < x < 3$	$3 < x < 5$
$f'$	negative	positive	positive	negative	negative	negative
$f''$	positive	positive	negative	negative	positive	negative
$f$	decreasing	increasing	increasing	decreasing	decreasing	decreasing
	concave up	concave up	concave down	concave down	concave up	concave down

Therefore, the intervals are  $-2 < x < 0$  and  $3 < x < 5$ .

(Calculus 8th ed. pages 190–197 / 9th ed. pages 190–197)

44. **ANSWER: (A)** Since the rate of decay is proportional to the amount present, then  $y = Ce^{kt}$ . When  $t = 0$ ,  $C = 25$ . With a half-life of 276

days, solve for  $k$ .  $12.5 = 25e^{k(276)} \Rightarrow k \approx -0.0025$  and  $y = 25e^{-0.0025t}$ .

Then  $y'(t) = 25e^{-0.0025t}(-0.0025)$  and  $y'(120) = 25e^{-0.0025(120)}(-0.0025)$

$\approx -0.046$  grams per day.

(Calculus 8th ed. pages 413–420 / 9th ed. pages 415–422)

45. **ANSWER: (D)** When rotating about the line  $x = 2$ , the radius of rotation  $= 2 - x$ . Rewrite the function for  $x$  in terms of  $y$ . Then

$$\begin{aligned} y &= \sin^{-1}(x - 1) + \frac{\pi}{2} \Rightarrow y - \frac{\pi}{2} \\ &= \sin^{-1}(x - 1) \Rightarrow \sin\left(y - \frac{\pi}{2}\right) + 1 \\ &= x. \end{aligned}$$

$$\begin{aligned} \text{Finally, } r &= 2 - x \Rightarrow 2 - \left[\sin\left(y - \frac{\pi}{2}\right) + 1\right] \\ &= 1 - \sin\left(y - \frac{\pi}{2}\right). \end{aligned}$$

(Calculus 8th ed. pages 456–466 / 9th ed. pages 458–468)

