90 Minutes—No Calculator

Note: In this examination, ln x denotes the natural logarithm of x (that is, logarithm to the base e).

1. $\int \left(x^3 - 3x\right) dx =$

(A) $3x^2 - 3 + C$ (B) $4x^4 - 6x^2 + C$ (C) $\frac{x^4}{3} - 3x^2 + C$

(D) $\frac{x^4}{4} - 3x + C$ (E) $\frac{x^4}{4} - \frac{3x^2}{2} + C$

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2. If $f(x) = x^3 + 3x^2 + 4x + 5$ and $g(x) = 5$, then $g\left(f(x)\right) =$

(A) $5x^2 + 15x + 25$ (B) $5x^3 + 15x^2 + 20x + 25$ (C) 1125

(D) 225 (E) 5

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3. The slope of the line tangent to the graph of $y = \ln\left(x^2\right)$ at $x = e^2$ is

(A) $\frac{1}{e^2}$ (B) $\frac{2}{e^2}$ (C) $\frac{4}{e^2}$ (D) $\frac{1}{e^4}$ (E) $\frac{4}{e^4}$

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4. If $f(x) = x + \sin x$, then $f'(x) =$

(A) $1 + \cos x$ (B) $1 - \cos x$ (C) $\cos x$

(D) $\sin x - x\cos x$ (E) $\sin x + x\cos x$

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5. If $f(x) = e^x$, which of the following lines is an asymptote to the graph of f?

(A) $y = 0$ (B) $x = 0$ (C) $y = x$ (D) $y = -x$ (E) $y = 1$

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6. If $f(x) = \frac{x-1}{x+1}$ for all $x \neq -1$, then $f'(1) =$

(A) -1 (B) $-\frac{1}{2}$ (C) 0 (D) $\frac{1}{2}$ (E) 1

7. Which of the following equations has a graph that is symmetric with respect to the origin?

(A) $y = \frac{x+1}{x}$ (B) $y = -x^5 + 3x$ (C) $y = x^4 - 2x^2 + 6$

(D) $y = (x-1)^3 + 1$ (E) $y = \left(x^2+1\right)^2 - 1$

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8. A particle moves in a straight line with velocity $v(t) = t^2$. How far does the particle move between times $t = 1$ and $t = 2$?

(A) $\frac{1}{3}$ (B) $\frac{7}{3}$ (C) 3 (D) 7 (E) 8

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9. If $y = \cos^2 3x$, then $\frac{dy}{dx} =$

(A) $-6\sin 3x \cos 3x$ (B) $-2\cos 3x$ (C) $2\cos 3x$

(D) $6\cos 3x$ (E) $2\sin 3x \cos 3x$

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10. The *derivative* of $f(x) = \frac{x^4}{3} - \frac{x^5}{5}$ attains its maximum value at $x =$

(A) -1 (B) 0 (C) 1 (D) $\frac{4}{3}$ (E) $\frac{5}{3}$

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11. If the line $3x - 4y = 0$ is tangent in the first quadrant to the curve $y = x^3 + k$, then k is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) 0 (D) $-\frac{1}{8}$ (E) $-\frac{1}{2}$

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12. If $f(x) = 2x^3 + Ax^2 + Bx - 5$ and if $f(2) = 3$ and $f(-2) = -37$, what is the value of $A + B$?

(A) -6 (B) -3 (C) -1 (D) 2

(E) It cannot be determined from the information given.

13. The acceleration α of a body moving in a straight line is given in terms of time t by $\alpha = 8 - 6t$. If the velocity of the body is 25 at $t = 1$ and if $s(t)$ is the distance of the body from the origin at time t, what is $s(4) - s(2)$?

(A) 20 (B) 24 (C) 28 (D) 32 (E) 42

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14. If $f(x) = x^{\frac{1}{3}}(x-2)^{\frac{2}{3}}$ for all x, then the domain of f' is

(A) $\{x \mid x \neq 0\}$ (B) $\{x \mid x > 0\}$ (C) $\{x \mid 0 \leq x \leq 2\}$

(D) $\{x \mid x \neq 0 \text{ and } x \neq 2\}$ (E) $\{x \mid x \text{ is a real number}\}$

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15. The area of the region bounded by the lines $x = 0$, $x = 2$, and $y = 0$ and the curve $y = e^{\frac{x}{2}}$ is

(A) $\dfrac{e-1}{2}$ (B) $e-1$ (C) $2(e-1)$ (D) $2e-1$ (E) $2e$

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16. The number of bacteria in a culture is growing at a rate of $3000e^{\frac{2t}{5}}$ per unit of time t. At $t = 0$, the number of bacteria present was 7,500. Find the number present at $t = 5$.

(A) $1{,}200e^2$ (B) $3{,}000e^2$ (C) $7{,}500e^2$ (D) $7{,}500e^5$ (E) $\dfrac{15{,}000}{7}e^7$

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17. What is the area of the region completely bounded by the curve $y = -x^2 + x + 6$ and the line $y = 4$?

(A) $\dfrac{3}{2}$ (B) $\dfrac{7}{3}$ (C) $\dfrac{9}{2}$ (D) $\dfrac{31}{6}$ (E) $\dfrac{33}{2}$

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18. $\dfrac{d}{dx}(\arcsin 2x) =$

(A) $\dfrac{-1}{2\sqrt{1-4x^2}}$ (B) $\dfrac{-2}{\sqrt{4x^2-1}}$ (C) $\dfrac{1}{2\sqrt{1-4x^2}}$

(D) $\dfrac{2}{\sqrt{1-4x^2}}$ (E) $\dfrac{2}{\sqrt{4x^2-1}}$

19. Suppose that f is a function that is defined for all real numbers. Which of the following conditions assures that f has an inverse function?

(A) The function f is periodic.
(B) The graph of f is symmetric with respect to the y-axis.
(C) The graph of f is concave up.
(D) The function f is a strictly increasing function.
(E) The function f is continuous.

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20. If F and f are continuous functions such that $F'(x) = f(x)$ for all x, then $\int_a^b f(x)\,dx$ is

(A) $F'(a) - F'(b)$
(B) $F'(b) - F'(a)$
(C) $F(a) - F(b)$
(D) $F(b) - F(a)$
(E) none of the above

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21. $\int_0^1 (x+1)e^{x^2+2x}\,dx =$

(A) $\frac{e^3}{2}$ (B) $\frac{e^3-1}{2}$ (C) $\frac{e^4-e}{2}$ (D) e^3-1 (E) e^4-e

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22. Given the function defined by $f(x) = 3x^5 - 20x^3$, find all values of x for which the graph of f is concave up.

(A) $x > 0$
(B) $-\sqrt{2} < x < 0$ or $x > \sqrt{2}$
(C) $-2 < x < 0$ or $x > 2$
(D) $x > \sqrt{2}$
(E) $-2 < x < 2$

23. $\lim_{h\to 0} \frac{1}{h}\ln\left(\frac{2+h}{2}\right)$ is

(A) e^2 (B) 1 (C) $\frac{1}{2}$ (D) 0 (E) nonexistent

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24. Let $f(x) = \cos(\arctan x)$. What is the range of f?

(A) $\left\{x \,\middle|\, -\frac{\pi}{2} < x < \frac{\pi}{2}\right\}$ (B) $\{x \mid 0 < x \le 1\}$ (C) $\{x \mid 0 \le x \le 1\}$

(D) $\{x \mid -1 < x < 1\}$ (E) $\{x \mid -1 \le x \le 1\}$

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25. $\int_0^{\pi/4} \tan^2 x\, dx =$

(A) $\frac{\pi}{4} - 1$ (B) $1 - \frac{\pi}{4}$ (C) $\frac{1}{3}$ (D) $\sqrt{2} - 1$ (E) $\frac{\pi}{4} + 1$

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26. The radius r of a sphere is increasing at the uniform rate of 0.3 inches per second. At the instant when the surface area S becomes 100π square inches, what is the rate of increase, in cubic inches per second, in the volume V? $\left(S = 4\pi r^2 \text{ and } V = \frac{4}{3}\pi r^3\right)$

(A) 10π (B) 12π (C) 22.5π (D) 25π (E) 30π

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27. $\int_0^{1/2} \frac{2x}{\sqrt{1-x^2}}\, dx =$

(A) $1 - \frac{\sqrt{3}}{2}$ (B) $\frac{1}{2}\ln\frac{3}{4}$ (C) $\frac{\pi}{6}$ (D) $\frac{\pi}{6} - 1$ (E) $2 - \sqrt{3}$

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28. A point moves in a straight line so that its distance at time t from a fixed point of the line is $8t - 3t^2$. What is the *total* distance covered by the point between $t = 1$ and $t = 2$?

(A) 1 (B) $\frac{4}{3}$ (C) $\frac{5}{3}$ (D) 2 (E) 5

29. Let $f(x)=\left|\sin x-\frac{1}{2}\right|$. The maximum value attained by f is

(A) $\frac{1}{2}$ (B) 1 (C) $\frac{3}{2}$ (D) $\frac{\pi}{2}$ (E) $\frac{3\pi}{2}$

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30. $\int_1^2 \frac{x-4}{x^2}\,dx =$

(A) $-\frac{1}{2}$ (B) $\ln 2-2$ (C) $\ln 2$ (D) 2 (E) $\ln 2+2$

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31. If $\log_a\left(2^a\right)=\frac{a}{4}$, then $a=$

(A) 2 (B) 4 (C) 8 (D) 16 (E) 32

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32. $\int \frac{5}{1+x^2}\,dx =$

(A) $\frac{-10x}{\left(1+x^2\right)^2}+C$ (B) $\frac{5}{2x}\ln\left(1+x^2\right)+C$ (C) $5x-\frac{5}{x}+C$

(D) $5\arctan x+C$ (E) $5\ln\left(1+x^2\right)+C$

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33. Suppose that f is an odd function; i.e., $f(-x)=-f(x)$ for all x. Suppose that $f'\left(x_0\right)$ exists. Which of the following must necessarily be equal to $f'\left(-x_0\right)$?

(A) $f'\left(x_0\right)$

(B) $-f'\left(x_0\right)$

(C) $\frac{1}{f'\left(x_0\right)}$

(D) $\frac{-1}{f'\left(x_0\right)}$

(E) None of the above

34. The average value of $\sqrt{x}$ over the interval $0 \le x \le 2$ is

(A) $\frac{1}{3}\sqrt{2}$ (B) $\frac{1}{2}\sqrt{2}$ (C) $\frac{2}{3}\sqrt{2}$ (D) 1 (E) $\frac{4}{3}\sqrt{2}$

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35. The region in the first quadrant bounded by the graph of $y = \sec x$, $x = \frac{\pi}{4}$, and the axes is rotated about the x-axis. What is the volume of the solid generated?

(A) $\frac{\pi^2}{4}$ (B) $\pi - 1$ (C) π (D) 2π (E) $\frac{8\pi}{3}$

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36. If $y = e^{nx}$, then $\frac{d^n y}{dx^n} =$

(A) $n^n e^{nx}$ (B) $n!e^{nx}$ (C) $n e^{nx}$ (D) $n^n e^x$ (E) $n!e^x$

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37. If $\frac{dy}{dx} = 4y$ and if $y = 4$ when $x = 0$, then $y =$

(A) $4e^{4x}$ (B) e^{4x} (C) $3 + e^{4x}$ (D) $4 + e^{4x}$ (E) $2x^2 + 4$

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38. If $\int_1^2 f(x - c)\,dx = 5$ where c is a constant, then $\int_{1-c}^{2-c} f(x)\,dx =$

(A) $5 + c$ (B) 5 (C) $5 - c$ (D) $c - 5$ (E) –5

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39. The point on the curve $2y = x^2$ nearest to $(4,1)$ is

(A) $(0,0)$ (B) $(2,2)$ (C) $(\sqrt{2},1)$ (D) $(2\sqrt{2},4)$ (E) $(4,8)$

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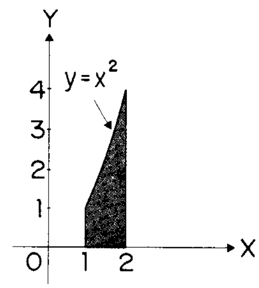
40. If $\tan(xy) = x$, then $\frac{dy}{dx} =$

(A) $\frac{1 - y\tan(xy)\sec(xy)}{x\tan(xy)\sec(xy)}$ (B) $\frac{\sec^2(xy) - y}{x}$ (C) $\cos^2(xy)$

(D) $\frac{\cos^2(xy)}{x}$ (E) $\frac{\cos^2(xy) - y}{x}$

41. Given $f(x)=\begin{cases} x+1 & \text{for } x<0, \\ \cos \pi x & \text{for } x \geq 0, \end{cases}$ $\int_{-1}^{1} f(x)\,dx =$

(A) $\frac{1}{2}+\frac{1}{\pi}$ (B) $-\frac{1}{2}$ (C) $\frac{1}{2}-\frac{1}{\pi}$ (D) $\frac{1}{2}$ (E) $-\frac{1}{2}+\pi$



42. Calculate the approximate area of the shaded region in the figure by the trapezoidal rule, using divisions at $x=\frac{4}{3}$ and $x=\frac{5}{3}$.

(A) $\frac{50}{27}$ (B) $\frac{251}{108}$ (C) $\frac{7}{3}$ (D) $\frac{127}{54}$ (E) $\frac{77}{27}$

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43. If the solutions of $f(x)=0$ are -1 and 2, then the solutions of $f\left(\frac{x}{2}\right)=0$ are

(A) -1 and 2 (B) $-\frac{1}{2}$ and $\frac{5}{2}$ (C) $-\frac{3}{2}$ and $\frac{3}{2}$

(D) $-\frac{1}{2}$ and 1 (E) -2 and 4

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44. For small values of h, the function $\sqrt[4]{16+h}$ is best approximated by which of the following?

(A) $4+\frac{h}{32}$ (B) $2+\frac{h}{32}$ (C) $\frac{h}{32}$

(D) $4-\frac{h}{32}$ (E) $2-\frac{h}{32}$

45. If f is a continuous function on $[a,b]$, which of the following is necessarily true?

(A) f' exists on (a,b).

(B) If $f(x_0)$ is a maximum of f, then $f'(x_0)=0$.

(C) $\lim_{x\to x_0} f(x) = f\left(\lim_{x\to x_0} x\right)$ for $x_0 \in (a,b)$

(D) $f'(x)=0$ for some $x \in [a,b]$

(E) The graph of f' is a straight line.

1. E $\int (x^3 - 3x)\,dx = \frac{1}{4}x^4 - \frac{3}{2}x^2 + C$

2. E $g(x) = 5 \Rightarrow g\left(f(x)\right) = 5$

3. B $y = \ln x^2$; $y' = \frac{2x}{x^2} = \frac{2}{x}$. At $x = e^2$, $y' = \frac{2}{e^2}$.

4. A $f(x) = x + \sin x$; $f'(x) = 1 - \cos x$

5. A $\lim_{x \to -\infty} e^x = 0 \Rightarrow y = 0$ is a horizontal asymptote

6. D $f'(x) = \frac{(1)(x+1) - (x-1)(1)}{(x+1)^2}$, $f'(1) = \frac{2}{4} = \frac{1}{2}$

7. B Replace x with $(-x)$ and see if the result is the opposite of the original. This is true for B.
$-(-x)^5 + 3(-x) = x^5 - 3x = -(-x^5 + 3x)$.

8. B Distance $= \int_1^2 \left| t^2 \right| dx = \int_1^2 t^2\,dt = \frac{1}{3}t^3 \Big|_1^2 = \frac{1}{3}(2^3 - 1^3) = \frac{7}{3}$

9. A $y' = 2\cos 3x \cdot \frac{d}{dx}(\cos 3x) = 2\cos 3x \cdot (-\sin 3x) \cdot \frac{d}{dx}(3x) = 2\cos 3x \cdot (-\sin 3x) \cdot (3)$
$y' = -6\sin 3x \cos 3x$

10. C $f(x) = \frac{x^4}{3} - \frac{x^5}{5}$; $f'(x) = \frac{4x^3}{3} - x^4$; $f''(x) = 4x^2 - 4x^3 = 4x^2(1-x)$
$f'' > 0$ for $x < 1$ and $f'' < 0$ for $x > 1 \Rightarrow f'$ has its maximum at $x = 1$.

11. B Curve and line have the same slope when $3x^2 = \frac{3}{4} \Rightarrow x = \frac{1}{2}$. Using the line, the point of tangency is $\left(\frac{1}{2}, \frac{3}{8}\right)$. Since the point is also on the curve, $\frac{3}{8} = \left(\frac{1}{2}\right)^3 + k \Rightarrow k = \frac{1}{4}$.

12. C Substitute the points into the equation and solve the resulting linear system.
$3 = 16 + 4A + 2B - 5$ and $-37 = -16 + 4A - 2B - 5$; $A = -3$, $B = 2 \Rightarrow A + B = -1$.

13. D $v(t)=8t-3t^2+C$ and $v(1)=25 \Rightarrow C=20$ so $v(t)=8t-3t^2+20$.

$s(4)-s(2)=\int_2^4 v(t)\,dt=(4t^2-t^3+20t)\Big|_2^4=32$

14. D $f(x)=x^{1/3}(x-2)^{2/3}$

$f'(x)=x^{1/3}\cdot\frac{2}{3}(x-2)^{-1/3}+(x-2)^{2/3}\cdot\frac{1}{3}x^{-2/3}=\frac{1}{3}x^{-2/3}(x-2)^{-1/3}(3x-2)$

f' is not defined at $x=0$ and at $x=2$.

15. C Area $=\int_0^2 e^{\frac{x}{2}}\,dx=2e^{\frac{x}{2}}\Big|_0^2=2(e-1)$

16. C $\frac{dN}{dt}=3000e^{\frac{2}{5}t}$, $N=7500e^{\frac{2}{5}t}+C$ and $N(0)=7500\Rightarrow C=0$

$N=7500e^{\frac{2}{5}t}$, $N(5)=7500e^2$

17. C Determine where the curves intersect. $-x^2+x+6=4\Rightarrow x^2-x-2=0$

$(x-2)(x+1)=0\Rightarrow x=-1,\ x=2$. Between these two x values the parabola lies above the line $y=4$.

Area $=\int_{-1}^2\left((-x^2+x+6)-4\right)dx=\left(-\frac{1}{3}x^3+\frac{1}{2}x^2+2x\right)\Big|_{-1}^2=\frac{9}{2}$

18. D $\frac{d}{dx}(\arcsin 2x)=\frac{1}{\sqrt{1-(2x)^2}}\cdot\frac{d}{dx}(2x)=\frac{2}{\sqrt{1-(2x)^2}}=\frac{2}{\sqrt{1-4x^2}}$

19. D If f is strictly increasing then it must be one to one and therefore have an inverse.

20. D By the Fundamental Theorem of Calculus, $\int_a^b f(x)\,dx=F(b)-F(a)$ where $F'(x)=f(x)$.

21. B $\int_0^1(x+1)e^{x^2+2x}\,dx=\frac{1}{2}\int_0^1 e^{x^2+2x}\left((2x+2)\,dx\right)=\frac{1}{2}\left(e^{x^2+2x}\right)\Big|_0^1=\frac{1}{2}\left(e^3-e^0\right)=\frac{e^3-1}{2}$

22. B $f(x)=3x^5-20x^3$; $f'(x)=15x^4-60x^2$; $f''(x)=60x^3-120x=60x\left(x^2-2\right)$

The graph of f is concave up where $f''>0$: $f''>0$ for $x>\sqrt{2}$ and for $-\sqrt{2}<x<0$.

23. C $\lim\limits_{h \to 0} \frac{\ln(2+h) - \ln 2}{h} = f'(2)$ where $f(x) = \ln x$; $f'(x) = \frac{1}{x} \Rightarrow f'(2) = \frac{1}{2}$

24. B $f(x) = \cos(\arctan x)$; $-\frac{\pi}{2} < \arctan x < \frac{\pi}{2}$ and the cosine in this domain takes on all values in the interval $(0,1]$.

25. B $\int_0^{\frac{\pi}{4}} \tan^2 x\, dx = \int_0^{\frac{\pi}{4}} (\sec^2 x - 1)\, dx = (\tan x - x)\Big|_0^{\pi/4} = 1 - \frac{\pi}{4}$

26. E $\frac{dV}{dt} = 4\pi r^2 \cdot \frac{dr}{dt} = S \cdot \frac{dr}{dt} = 100\pi(0.3) = 30\pi$

27. E $\int_0^{1/2} \frac{2x}{\sqrt{1-x^2}}\, dx = -\int_0^{1/2} \left(1-x^2\right)^{-\frac{1}{2}} (-2x\, dx) = -2\left(1-x^2\right)^{\frac{1}{2}}\Big|_0^{\frac{1}{2}} = 2 - \sqrt{3}$

28. C $v(t) = 8 - 6t$ changes sign at $t = \frac{4}{3}$. Distance $= \left| x(1) - x\left(\frac{4}{3}\right) \right| + \left| x(2) - x\left(\frac{4}{3}\right) \right| = \frac{5}{3}$.

Alternative Solution: Distance $= \int_1^2 \left| v(t) \right| dt = \int_1^2 \left| 8 - 6t \right| dt = \frac{5}{3}$

29. C $-1 \le \sin x \le 1 \Rightarrow -\frac{3}{2} \le \sin x - \frac{1}{2} \le \frac{1}{2}$; The maximum for $\left| \sin x - \frac{1}{2} \right|$ is $\frac{3}{2}$.

30. B $\int_1^2 \frac{x-4}{x^2}\, dx = \int_1^2 \left(\frac{1}{x} - 4x^{-2} \right) dx = \left(\ln x + \frac{4}{x} \right)\Big|_1^2 = (\ln 2 + 2) - (\ln 1 + 4) = \ln 2 - 2$

31. D $\log_a\left(2^a\right) = \frac{a}{4} \Rightarrow \log_a 2 = \frac{1}{4} \Rightarrow 2 = a^{\frac{1}{4}}$; $a = 16$

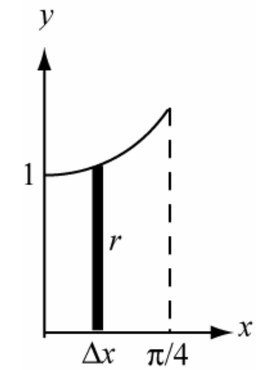
32. D $\int \frac{5}{1+x^2}\, dx = 5\int \frac{1}{1+x^2}\, dx = 5\tan^{-1}(x) + C$

33. A $f(-x) = -f(x) \Rightarrow f'(-x)\cdot(-1) = -f'(x) \Rightarrow f'(-x) = -f'(x)$ thus $f'(-x_0) = -f'(x_0)$.

34. C $\frac{1}{2}\int_0^2 \sqrt{x}\,dx = \frac{1}{2}\cdot\frac{2}{3}x^{\frac{3}{2}}\Big|_0^2 = \frac{1}{3}\cdot 2^{\frac{3}{2}} = \frac{2}{3}\sqrt{2}$

35. C Washers: $\sum \pi r^2 \Delta x$ where $r = y = \sec x$.

Volume $= \pi\int_0^{\frac{\pi}{4}} \sec^2 x\,dx = \pi \tan x\Big|_0^{\pi/4} = \pi(\tan\frac{\pi}{4} - \tan 0) = \pi$



36. A $y = e^{nx}$, $y' = ne^{nx}$, $y'' = n^2 e^{nx}, \cdots, y^{(n)} = n^n e^{nx}$

37. A $\frac{dy}{dx} = 4y$, $y(0) = 4$. This is exponential growth. The general solution is $y = Ce^{4x}$. Since $y(0) = 4$, $C = 4$ and so the solution is $y = 4e^{4x}$.

38. B Let $z = x - c$. Then $5 = \int_1^2 f\left(x-c\right)dx = \int_{1-c}^{2-c} f\left(z\right)dz$

39. B Use the distance formula to determine the distance, L, from any point $(x,y) = (x, \frac{1}{2}x^2)$ on the curve to the point $(4,1)$. The distance L satisfies the equation $L^2 = \left(x-4\right)^2 + \left(\frac{1}{2}x^2 - 1\right)$. Determine where L is a maximum by examining critical points. Differentiating with respect to x, $2L\cdot\frac{dL}{dx} = 2(x-4) + 2\left(\frac{1}{2}x^2 - 1\right)x = x^3 - 8$. $\frac{dL}{dx}$ changes sign from positive to negative at $x = 2$ only. The point on the curve has coordinates $(2,2)$.

40. E $\sec^2(xy)\cdot(xy' + y) = 1$, $xy'\sec^2(xy) + y\sec^2(xy) = 1$, $y' = \frac{1 - y\sec^2(xy)}{x\sec^2(xy)} = \frac{\cos^2(xy) - y}{x}$

41. D $\int_{-1}^{1} f(x)\,dx = \int_{-1}^{0}(x+1)\,dx + \int_0^1 \cos(\pi x)\,dx = \frac{1}{2}(x+1)^2\Big|_{-1}^{0} + \frac{1}{\pi}\sin(\pi x)\Big|_0^1$

$$= \frac{1}{2} + \frac{1}{\pi}\left(\sin\pi - \sin 0\right) = \frac{1}{2}$$

42. D $\Delta x = \frac{1}{3};\ T = \frac{1}{2}\cdot\frac{1}{3}\left(1^2 + 2\left(\frac{4}{3}\right)^2 + 2\left(\frac{5}{3}\right)^2 + 2^2\right) = \frac{127}{54}$

43. E Solve $\frac{x}{2} = -1$ and $\frac{x}{2} = 2;\ x = -2,\ 4$

44. B Use the linearization of $f(x) = \sqrt[4]{x}$ at $x = 16$. $f'(x) = \frac{1}{4}x^{-\frac{3}{4}}$, $f'(16) = \frac{1}{32}$

$L(x) = 2 + \frac{1}{32}(x - 16);\ f(16 + h) \approx L(16 + h) = 2 + \frac{h}{32}$

45. C This uses the definition of continuity of f at $x = x_0$.