1. If $f(x) = 3\pi e^x - 2ex^\pi + 5\sin^{-1}\left(\frac{2}{\pi}\right)$, then $f'(1) =$

(a) πe

(b) $5\pi e$

(c) $7\pi e$

(d) $4\pi e$

(e) $2e$

2. An equation of the tangent line to the curve of $y = \dfrac{\sqrt{x} - 2x}{x}$ at $x = 4$ is

(a) $y = -\dfrac{x}{16} - \dfrac{5}{4}$

(b) $y = \dfrac{x}{16} - \dfrac{7}{4}$

(c) $y = \dfrac{x}{32} - \dfrac{13}{8}$

(d) $y = -\dfrac{5x}{16} - \dfrac{5}{4}$

(e) $y = -x + \dfrac{5}{2}$

3. If $y = 3u^4 + 1$ and $u = \sqrt{x}$, then $\left.\dfrac{dy}{dx}\right|_{x=1} =$

(a) 6
(b) 10
(c) 12
(d) 8
(e) 14

4. Let $f(x) = \dfrac{3\csc(3x)}{1 + 2\cot(3x)}$, then the slope of the tangent line to the curve of f at $x = \dfrac{\pi}{6}$ is

(a) 18
(b) 24
(c) 9
(d) 12
(e) 22

5. $\lim_{x \to 0} \dfrac{\tan(x) - \tan(x)\cos^2(2x)}{x^3} =$

(a) 4

(b) 9

(c) 7

(d) 8

(e) ∞

6. If $g(x) = \sqrt{1 + 3f(x)}$, where $f(2) = 5,\ f'(2) = 16$, then the slope of the normal line to the curve of g at $x = 2$ is

(a) $-\dfrac{1}{6}$

(b) $-\dfrac{1}{8}$

(c) $-\dfrac{1}{3}$

(d) $-\dfrac{1}{4}$

(e) $-\dfrac{1}{16}$

7. The slope of the tangent line to the curve $xy - \dfrac{x}{2y} = 2$ at the point $(4, 1)$ is

(a) $-\dfrac{1}{12}$

(b) $\dfrac{2}{15}$

(c) $-\dfrac{1}{6}$

(d) $\dfrac{1}{4}$

(e) $-\dfrac{1}{2}$

8. If $f(x) = 3x^2 - 4$, $x \leq -1$, then $\left(f^{-1}\right)'(2) =$

(a) $-\dfrac{\sqrt{2}}{12}$

(b) $-\dfrac{\sqrt{2}}{8}$

(c) $\dfrac{\sqrt{2}}{8}$

(d) $\sqrt{2}$

(e) $\dfrac{\sqrt{2}}{12}$

9. An equation of the tangent line to the curve $y = (1 + \sin(4x))^{x+1}$ at $x = 0$ is

(a) $y = 4x + 1$

(b) $y = x + 1$

(c) $y = 4x - 1$

(d) $y = -8x - 1$

(e) $y = 1 - 4x$

10. $\dfrac{d}{dx}\left(\arctan\left(\dfrac{x}{1-x}\right)\right) =$

(a) $\dfrac{1}{2x^2 - 2x + 1}$

(b) $\dfrac{x}{x^2 - x + 1}$

(c) $\dfrac{1}{x^2}$

(d) $\dfrac{1}{x^2 - x + 1}$

(e) $\dfrac{1 - 2x - 2x^2}{2x^2 - 2x + 1}$

11. A particle moves according to a law of motion

$$s = \frac{25}{t^2} - \frac{5}{t}, \quad 1 \leq t \leq 20,$$

where t is measured in seconds and s in meters. The particle is **speeding up** when

(a) $10 < t < 15$

(b) $1 < t < 15$

(c) $1 < t < 10$

(d) $5 < t < 20$

(e) $5 < t < 15$

12. If the position of a particle is given by $s = t^2 - 4t + 10$, where t is measured in seconds and s in meters, the total distance traveled, in meters, during the time interval $[0, 3]$ is

(a) 5

(b) 11

(c) 12

(d) 8

(e) 7

13. The radius of a sphere is increasing at a rate of 0.01 cm/s. At the time when the diameter is 20 cm, the volume is increasing at the rate

(a) 4π cm^3/s

(b) 8π cm^3/s

(c) π cm^3/s

(d) 36π cm^3/s

(e) 2π cm^3/s

14. Suppose f and g are differentiable functions such that $f(g(x)) = \log_3 x$ and $f'(x) = 1 + [f(x)]^2$. Then $g'(9) =$

(a) $\dfrac{1}{45 \ln 3}$

(b) $\dfrac{1}{36 \ln 3}$

(c) $\dfrac{1}{25 \ln 3}$

(d) $\dfrac{1}{9 \ln 3}$

(e) $\dfrac{1}{20 \ln 3}$

15. If $f(x) = \dfrac{x}{e^x}$, then $f^{(101)}(6) =$

(a) $95\, e^{-6}$

(b) $-95\, e^{-6}$

(c) $96\, e^{-6}$

(d) $-96\, e^{-6}$

(e) $101\, e^{-6}$

1. If $f(x) = 6\pi e^x - 2ex^\pi + 5\sin^{-1}\left(\frac{2}{\pi}\right)$, then $f'(1) =$

(a) $4\pi e$

(b) $5\pi e$

(c) $7\pi e$

(d) πe

(e) $2e$

2. An equation of the tangent line to the curve of $y = \frac{\sqrt{x} - 4x}{x}$ at $x = 4$ is

(a) $y = -\frac{x}{16} - \frac{13}{4}$

(b) $y = \frac{x}{16} - \frac{15}{4}$

(c) $y = \frac{x}{32} - \frac{29}{8}$

(d) $y = -\frac{5x}{16} + \frac{3}{4}$

(e) $y = -\frac{x}{4} - \frac{5}{2}$

3. If $y = 5u^4 + 1$ and $u = \sqrt{x}$, then $\left.\dfrac{dy}{dx}\right|_{x\,=\,1} =$

(a) 10
(b) 6
(c) 12
(d) 8
(e) 14

4. Let $f(x) = \dfrac{4\csc(2x)}{1 + 3\cot(2x)}$, then the slope of the tangent line to the curve of f at $x = \dfrac{\pi}{4}$ is

(a) 24
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5. $\lim_{x \to 0} \dfrac{\tan(x) - \tan(x)\cos^2(3x)}{x^3} =$

(a) 9

(b) 4

(c) 7

(d) 8

(e) ∞

6. If $g(x) = \sqrt{1 + 4f(x)}$, where $f(2) = 2$, $f'(2) = 12$, then the slope of the normal line to the curve of g at $x = 2$ is

(a) $-\dfrac{1}{8}$

(b) $-\dfrac{1}{6}$

(c) $-\dfrac{1}{3}$

(d) $-\dfrac{1}{4}$

(e) $-\dfrac{1}{12}$

7. The slope of the tangent line to the curve $xy - \frac{x}{2y} = 2$ at the point $(4, 1)$ is

(a) $-\frac{1}{12}$

(b) $\frac{2}{15}$

(c) $-\frac{1}{6}$

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

(e) $-\frac{1}{2}$

8. If $f(x) = 2x^2 - 2$, $x \leq -1$, then $\left(f^{-1}\right)'(2) =$

(a) $-\frac{\sqrt{2}}{8}$

(b) $-\frac{\sqrt{2}}{16}$

(c) $\frac{\sqrt{2}}{8}$

(d) $\sqrt{2}$

(e) $\frac{\sqrt{2}}{16}$

9. An equation of the tangent line to the curve $y = (1 + \sin(5x))^{x-1}$ at $x = 0$ is

(a) $y = 1 - 5x$

(b) $y = 5x + 1$

(c) $y = x + 1$

(d) $y = -8x - 1$

(e) $y = 5x - 1$

10. $\dfrac{d}{dx}\left(\arctan\left(\dfrac{x}{1-x}\right)\right) =$

(a) $\dfrac{1}{2x^2 - 2x + 1}$

(b) $\dfrac{x}{x^2 - x + 1}$

(c) $\dfrac{1}{x^2}$

(d) $\dfrac{1}{x^2 - x + 1}$

(e) $\dfrac{1 - 2x - 2x^2}{2x^2 - 2x + 1}$

11. A particle moves according to a law of motion

$$s = \frac{15}{t^2} - \frac{5}{t}, \quad 1 \le t \le 15,$$

where t is measured in seconds and s in meters. The particle is <u>**speeding up**</u> when

(a) $6 < t < 9$
(b) $1 < t < 9$
(c) $1 < t < 6$
(d) $5 < t < 15$
(e) $10 < t < 15$

12. If the position of a particle is given by $s = t^2 - 4t + 10$, where t is measured in seconds and s in meters, the total distance traveled, in meters, during the time interval $[0, 4]$ is

(a) 8
(b) 11
(c) 12
(d) 5
(e) 7

13. The radius of a sphere is increasing at a rate of 0.01 cm/s. At the time when the diameter is 10 cm, the volume is increasing at the rate

(a) π cm^3/s

(b) 8π cm^3/s

(c) 16π cm^3/s

(d) 36π cm^3/s

(e) 2π cm^3/s

14. Suppose f and g are differentiable functions such that $f(g(x)) = \log_2 x$ and $f'(x) = 1 + [f(x)]^2$. Then $g'(4) =$

(a) $\dfrac{1}{20 \ln 2}$

(b) $\dfrac{1}{36 \ln 2}$

(c) $\dfrac{1}{25 \ln 2}$

(d) $\dfrac{1}{16 \ln 2}$

(e) $\dfrac{1}{45 \ln 2}$

15. If $f(x) = \dfrac{x}{e^x}$, then $f^{(103)}(5) =$

(a) $98\,e^{-5}$

(b) $-98\,e^{-5}$

(c) $97\,e^{-5}$

(d) $-97\,e^{-5}$

(e) $103\,e^{-5}$