1. If $f(x) = \dfrac{xe^x}{x+1}$, then $f'(0)$ is:

   a) 1
   b) 0
   c) -1
   d) 2
   e) -2

2. $\lim\limits_{x \to \frac{\pi}{4}} \dfrac{\cot x - 1}{x - \frac{\pi}{4}}$ is:

   a) -2
   b) 2
   c) 0
   d) Undefined
   e) $+\infty$

3. If $f(x) = x \sec x$, then $f''(x)$ is equal to:

a) $2 \sec x \tan x + 2x \sec^3 x - x \sec x$
b) $2 \sec x \tan x + 2x \sec^3 x + x \sec x$
c) $2 \sec x \tan x - 2x \sec^3 x + x \sec x$
d) $2 \sec x \tan x - 3x \sec^3 x - x \sec x$
e) $2 \sec x \tan x + 3x \sec^3 x - x \sec x$

4. Let $f(x) = x^3 \sin \dfrac{1}{x}$ if $x \neq 0$ and $f(0) = 0 = f'(0)$. Then f' is:

a) Continuous at $x_0 = 0$
b) Continuous at $x_0 = 0$ but f is not.
c) Has a removable discontinuity at $x_0 = 0$
d) Has a jump discontinuity at $x_0 = 0$
e) Has an infinite discontinuity at $x_0 = 0$

5. If $f(x) = x^3 \ln\left(\frac{1}{x}\right)$, then $f'(2)$ is :

a) $-12 \ln 2 - 4$
b) $12 \ln 2 - 4$
c) $12 \ln(1/2) + 4$
d) $-12 \ln(1/2) + 4$
e) $-12 \ln 2 + 4$

6. A particle moving with a position function $s(t) = t^3 - t^2 + t + 1$. At which time its velocity $v(t)$ is equal to 9?

a) $t = 2$
b) $t = 1$
c) $t = \frac{4}{3}$
d) $t = \frac{3}{4}$
e) $t = \frac{1}{4}$

7. A particle is moving along the curve $y = x^2$. If x is increasing at the rate of $\sqrt{2}$, how fast is the distance D from the point $(2, 0)$ to the particle is changing when the particle passes through $(1, 1)$?

   a) 1
   b) $\dfrac{1}{\sqrt{2}}$
   c) $\sqrt{2}$
   d) $\dfrac{-1}{\sqrt{2}}$
   e) -1

8. If $\lim\limits_{x\to 2}\left(\dfrac{x^2+x-6}{\sin(x-2)}+\dfrac{\tan(\pi\, x/8)}{x}\right)=\dfrac{a}{b}$ where a and b are positive integers and $\dfrac{a}{b}$ is in its lowest term, then $a + b =$

   a) 13
   b) 9
   c) 22
   d) 18
   e) 27

9. The slope the tangent line to the graph of $y = x^2 \tan\left(\frac{1}{x}\right)$ at the point $x = \frac{1}{\pi}$, equals

a) -1
b) 1
c) 0
d) $\frac{2}{\pi}$
e) 2π

10. The slope the **<u>normal</u>** line to the circle $(x-2)^2 + y^2 = 25$ at the point $(-1, 4)$ is equal to

a) $-\frac{4}{3}$
b) $-\frac{3}{4}$
c) $\frac{3}{4}$
d) 3
e) $\frac{4}{3}$

11. If $f(x) = \dfrac{(x-4)(x^2+1)^3}{(x-1)\cos x}$ then $f'(0) =$

a) 3
b) -5
c) 0
d) 4
e) -4

12. If $y = (x^{-2} + x^{-1})^{-1}$ then $y'(1) =$

a) $\dfrac{3}{4}$
b) $-\dfrac{4}{3}$
c) $\dfrac{4}{3}$
d) $-\dfrac{3}{4}$
e) 12

13. The slope of the **normal** line to the curve $\sqrt{xy}+\dfrac{x}{y^2}=6$ at the point $(4,1)$ is equal to:

a) $\dfrac{-28}{5}$
b) 3
c) -3
d) $\dfrac{11}{5}$
e) $-\dfrac{5}{2}$

14. Let $y=(x+2\cos x)^{x+1}$. Then $y'(0)=$

a) $1+2\ln 2$
b) $2\ln 2$
c) 0
d) 1
e) $-1+\ln 2$

15. A stone is thrown vertically upward so that its equation of motion is $s = 64t - 16\,t^2$ where s is in ft and t is in seconds. The highest altitude reached by the stone and its velocity when it hits the ground are respectively

a) $s = 64\,ft$ and $v = -64\,ft/s$
b) $s = 32\,ft$ and $v = 64\,ft/s$
c) $s = 64\,ft$ and $v = 64\,ft/s$
d) $s = 32\,ft$ and $v = -64\,ft/s$
e) $s = 64\,ft$ and $v = -32\,ft/s$

16. A ladder $5m$ long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 1 m/s, how fast is the angle, between the ladder and the ground, changing when the bottom of the ladder is $3m$ from the wall?

a) $-\frac{1}{4}$ rad/s
b) $\frac{3}{20}$ rad/s
c) $-\frac{5}{4}$ rad/s
d) -3 deg/s
e) 22 deg/s

17. Let $f(x) = \begin{cases} x^2, & x \leq -1 \\ mx + b, & x > -1 \end{cases}$
If the constants m and b make the function f differentiable everywhere, then $m - b$ is equal to

a) -1
b) 5
c) 1
d) -5
e) 0

18. A particle is moving with a position function $s(t) = \frac{t^3}{3} - \frac{5}{2}t^2 + 6t - 1$. The distance traveled by the particle on the interval $[0, 4]$ is equal to

a) $\frac{17}{3}$
b) $\frac{34}{3}$
c) $\frac{34}{9}$
d) $\frac{19}{3}$
e) $\frac{19}{32}$

19. $\lim_{t\to 0} \dfrac{3\,\tan 2t - 5\,\tan 3t}{7t\,\cos t + 4\,\sin 5t} =$

a) $-\dfrac{1}{3}$

b) $\dfrac{1}{27}$

c) $-\dfrac{1}{9}$

d) $\dfrac{5}{27}$

e) $-\dfrac{8}{9}$

20. $\dfrac{d}{dx}\left(\dfrac{2x-1}{3x+2}\right)^8 =$

a) $\dfrac{56(2x-1)^7}{(3x+2)^9}$

b) $\dfrac{48(2x-1)^7}{(3x+2)^8}$

c) $\dfrac{56(2x-1)^7}{(3x+2)^8}$

d) $\dfrac{72(2x-1)^7}{(3x+2)^9}$

e) $\dfrac{24(2x-1)^7}{(3x+2)^9}$