The acronym "NOTA" stands for "None Of The Above". You may find Stirling's approximation useful: for when n becomes large, $n! \sim \sqrt{2\pi n}\left(\frac{n}{e}\right)^n$. Assume all derivatives are within the function's domain.

1. Find $\left.\frac{d}{dx}\right|_{x\to 2017}\left(2017!^{2017!} - \log\left(\left(10^{2017!}\right)^x\right) + \ln 2017 - e^{2017} + 1^x\right)$

   A. 0 B. 2017 C. 2017! D. $2017!^{2017}$ E. NOTA

2. Find $\lim_{x\to 0}\frac{\sin^{2017!}(2017x)}{x^{2017!}}$

   A. 0 B. 2017 C. 2017! D. $2017!^{2017}$ E. NOTA

3. Find the slope of the tangent line at (2017!, 1) of the graph $\frac{x-y^{2017!}}{2017!-1} = 1$

   A. 0 B. 2017 C. 2017! D. $\frac{1}{2017!}$ E. NOTA

4. Find $\lim_{x\to -\infty}\frac{2017!x^{2017!}+2016!x^{2016!}+2015!x^{2015!}+\cdots+1!x^{1!}}{2016!x^{2017!}+2015!x^{2016!}+2014!x^{2015!}+\cdots+0!x^{1!}}$

   A. 0 B. 2017 C. 2017! D. $2017!^{2017!}$ E. NOTA

5. Evaluate $\left.\frac{d^{2017}f(x)}{dx^{2017}}\right|_{x\to 2017!^{2017!}}$ if $f(x) = \sum_{n=0}^{2016} n!\,x^n$

   A. 0 B. 2017 C. 2017! D. $2017!^{2017!}$ E. NOTA

6. Evaluate the $\lim_{n\to\infty}\left[\sum_{i=1}^{2n}\frac{3}{n}\left(\frac{2i}{n}\right)^{\frac{2i}{n}}\left(\ln\left(\frac{2i}{n}\right)+1\right)\right]$

   A. $\frac{9}{2}$ B. 6 C. $\frac{765}{2}$ D. 384 E. NOTA

7. Mercy starts at objective B located at (30,40) and is traveling towards objective A located at (-10,70) at a rate of 40 units/s. Roadhog starts at (0,0) and travels towards a chokepoint located at (70,240) at a rate of 25 units/s. After 1 second what is the rate of change of the distance between Mercy and Roadhog, in units/s?

   A. $\frac{-351}{41}$ B. $\frac{351}{41}$ C. $\frac{-39}{\sqrt{65}}$ D. $\frac{39}{\sqrt{65}}$ E. NOTA

8. Let $A = \lim_{x\to -2} f(x)$, $B = \lim_{x\to 0} f(x)$, $C = \lim_{x\to 2^-} f(x)$, $D = \lim_{x\to 4^-} f(x)$ and

$$f(x) = \begin{cases} 2x-4, & if\ x < -2 \\ 6x+4, & if\ -2 \le x < 0 \\ 5, & if\ x = 0 \\ x^2, & if\ 0 < x < 2 \\ -x^2, & if\ x \ge 2 \end{cases}.$$

If the limit does not exist, instead let the value of the variable that equals the limit be equal to 1. Find A+B+C+D.

A. -19 B. -15 C. -13 D. -10 E. NOTA

9. Evaluate $\frac{d}{dx}\int_{-2x}^{x^2} 2e^{-t^2}\sin(t)dt$.

A. $-e^{-4x^2}\sin(2x) + 2e^{-x^4}\sin(x^2)$ B. $e^{-4x^2}\sin(2x) + 2e^{-x^4}\sin(x^2)$

C. $-4e^{-4x^2}\sin(2x) + 4xe^{-x^4}\sin(x^2)$ D. $4e^{-4x^2}\sin(2x) + 4xe^{-x^4}\sin(x^2)$ E. NOTA

10. Let n be an odd integer. There are n points evenly spaced out on a circle. Three distinct points are chosen on the circle. P(n) is the probability that the points form an obtuse triangle? What is $\lim_{n\to\infty} P(n)$?

A. $\frac{1}{8}$ B. $\frac{1}{2}$ C. $\frac{3}{4}$ D. $\frac{4}{5}$ E. NOTA

11. In higher levels of math, the formula for the "directional derivative in the direction of $\boldsymbol{u}$" of f at the point (x,y,z) is given by $D_u f(x,y,z) = \nabla f(x,y,z)\cdot \boldsymbol{u}$ where $\nabla f(x,y,z)$is a set vector and u is a unit vector. If $\nabla f(x,y,z) = \langle a,b,c\rangle$, which unit vector, $\boldsymbol{u}$, will always minimize $D_u f(x,y,z)$?

A. $-\frac{\langle a,b,c\rangle}{|\langle a,b,c\rangle|}$ B. $\frac{\langle a,b,c\rangle}{|\langle a,b,c\rangle|}$ C. $\frac{\langle -bc,-ac,2ab\rangle}{|\langle -bc,-ac,2ab\rangle|}$ D. $\frac{\langle bc,ac,-2ab\rangle}{|\langle bc,ac,-2ab\rangle|}$ E. NOTA

12. The drain current of a NFET, I, is represented by $I(V_T) = \frac{k}{2}\left(\frac{W}{L}\right)(V_{GS}-V_T)^2(1+\lambda V_{DS})$ where k, W, L, V_{GS}, V_{DS}, and λ are all constants. What is $\frac{dI}{d\sqrt{V_T}}$?

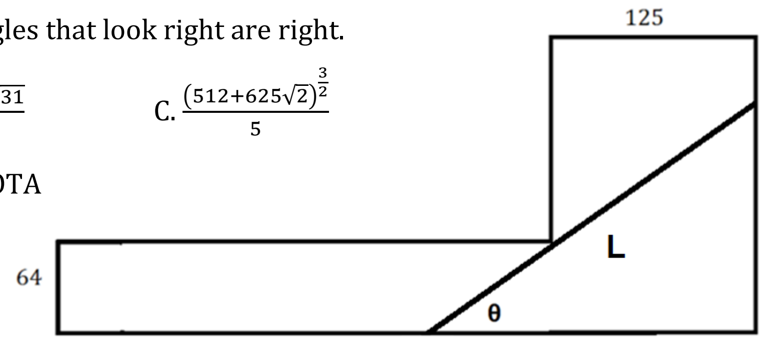
A. $\frac{-k\left(\frac{W}{L}\right)(V_{GS}-V_T)(1+\lambda V_{DS})}{2\sqrt{V_T}}$ B. $\frac{k\left(\frac{W}{L}\right)(V_{GS}-V_T)(1+\lambda V_{DS})}{2\sqrt{V_T}}$

C. $k\left(\frac{W}{L}\right)2\sqrt{V_T}(V_{GS}-V_T)(1+\lambda V_{DS})$ D. $-k\left(\frac{W}{L}\right)2\sqrt{V_T}(V_{GS}-V_T)(1+\lambda V_{DS})$ E. NOTA

13. A 90° bend in a hallway is shown below with dimensions. The **length** of the longest ladder that can fit through the bend in the hallway is "L" and the $\tan(\theta)$ the ladder makes with the bottom wall is given as "T". What is LT? Assume the ladder is always parallel to the ground and has negligible width. All angles that look right are right.

A. $\frac{205\sqrt{41}}{4}$ B. $\frac{31\sqrt{31}}{4}$ C. $\frac{(512+625\sqrt{2})^{\frac{3}{2}}}{5}$

D. $\frac{164\sqrt{41}}{5}$ E. NOTA



For questions 14-16 refer to the following function: $f(x) = \begin{cases} 0, & x \le 0 \\ e^{-\frac{1}{x}}, & x > 0 \end{cases}$

14. What is the $\lim_{x \to 0} f(x)$?

A. 0 B. 1 C. e D. Does not Exist E. NOTA

15. What is $f''(0)$?

A. 0 B. 1 C. e D. Does not Exist E. NOTA

16. What is $\lim_{n \to \infty} f^{(n)}(0)$?

A. 0 B. 1 C. e D. Does not Exist E. NOTA

17. Using the Delta-Epsilon definition of a limit for $\lim_{x \to 1} x^{\frac{1}{3}} - 4 = -3$. If $\varepsilon = 0.1$, what is the maximum value of δ that would satisfy the definition?

A. 0.729 B. 0.602 C. 0.331 D. 0.271 E. NOTA

18. Find $\lim_{x \to 2} \frac{\sqrt{2+x}-2}{2-x}$

A. 0 B. $\frac{1}{4}$ C. $\frac{1}{2}$ D. Does Not Exist E. NOTA

19. Find y' if $y = x^{x^{x^{\cdot^{\cdot^{\cdot}}}}}$.

A. $y \cdot x^{y-1}$ B. $\frac{y\ln(x^x)+y^2}{x}$ C. $\frac{y^2}{x(1-y\ln(x))}$ D. $\frac{y^2}{x(1+y\ln(x))}$ E. NOTA

For questions 20-21 refer to the following table:

x	F(x)	G(x)	H(x)	F'(x)	G'(x)	H'(x)
0	1	2	2	-2	1	4
1	2	-3	2	1	2	-1
2	0	1	2	1	0	-1
3	0	-1	1	-3	2	1

20. If $P(x) = F\big(G(H(x) - x)\big)$, what is $P'(2)$?

A. -4 B. -2 C. 2 D. 4 E. NOTA

21. If $Q(x) = \frac{F(x^2)G(x-1)}{H(x)}$, what is $Q'(1)$?

A. -4 B. -2 C. 2 D. 4 E. NOTA

22. Find $\frac{d^3y}{dx^3}$ if $y = \sin(t)$ and $x = e^t$

A. $-e^{-3t}\sin(t) - 3e^{-3t}\cos(t)$ B. $3e^{-3t}\sin(t) + e^{-3t}\cos(t)$

C. $-e^{-3t}\sin(t) + 3e^{-3t}\cos(t)$ D. $2e^{-t}\sin(t)$ E. NOTA

23. Evaluate $\lim_{x\to\infty} \sqrt[\frac{5}{2}]{2x^{\frac{5}{2}} + 5x^{\frac{3}{2}} + 1} - \sqrt[\frac{5}{2}]{2x^{\frac{5}{2}} - 2x^{\frac{3}{2}} + 3x}$

A. $\frac{7}{2\sqrt{2}}$ B. $\frac{7\cdot 2^{\frac{2}{5}}}{5}$ C. $\frac{7\cdot 2^{\frac{3}{5}}}{5}$ D. $\frac{7\cdot 2^{-\frac{3}{5}}}{5}$ E. NOTA

24. Find line perpendicular to the graph $xy + x^2y^3 = 10$ at the point (1,2).

A. $-23 - 13x + 18y = 0$ B. $-49 + 13x + 18y = 0$

C. $-44 + 18x + 13y = 0$ D. $-8 - 18x + 13y = 0$ E. NOTA

For questions 25-26 refer to the following description: Let α be a fixed positive integer and n be a non-negative integer. The n[th] derivative of $\frac{1}{x^{\alpha}-1}$ is written in the form $\frac{P_n(x)}{(x^{\alpha}-1)^{n+1}}$ where $P_n(x)$ is a polynomial.

25. Find $P_n(1)$.

A. $(-1)^n(a)^n 2^n$ B. $(-1)^n(a)^n n^n$ C. $(-1)^n a^n (n+1)!$ D. $(-1)^n a^n (n-1)!$ E. NOTA

26. Find the $\lim_{n\to\infty} \frac{P_{n+1}(1)}{(-a)^{n+2}(\frac{n^{n+1}}{e^{n+1}})\sqrt{2\pi(n+1)}}$

A. $\frac{e}{a}$ B. $-\frac{e}{a}$ C. $\frac{1}{a}$ D. $-\frac{1}{a}$ E. NOTA

27. Give the Maclaurin series of cosh(x).

A. $\sum_{k=0}^{\infty} \frac{(-1)^k x^{(2k)}}{(2k)!}$ B. $\sum_{k=0}^{\infty} \frac{(-1)^k x^{1+2k}}{(1+2k)!}$ C. $\sum_{k=0}^{\infty} \frac{x^{2k}}{(2k)!}$ D. $\sum_{k=0}^{\infty} \frac{x^{1+2k}}{(1+2k)!}$ E. NOTA

28. Find $\lim_{b\to\infty} \int_{-1}^{b} \left[\left(\frac{x^{1513}}{1+x^{2018}}\right)^2\right] dx$

A. $\frac{2+3\pi}{8072}$ B. $\frac{-2+3\pi}{8072}$ C. $\frac{1+3\pi}{8072}$ D. $\frac{-1+3\pi}{8072}$ E. NOTA

29. Find an implicit solution to the differential equation:

$$e^{-x}\sin(y) + y + (-e^{-x}\cos(y) + x + 1)y' = 0$$

A. $e^{-x}\sin(y) + \text{xy} = 1$ B. $-e^{-x}\cos(y) + \text{xy} + y = 3$
C. $-e^{-x}\sin(y) + \text{xy} + y = 10$ D. $e^{-x}\cos(y) + \text{xy} = -1$ E. NOTA

30. Find $\lim_{x\to 0} \sqrt{\arctan(x)}$

A. 0
B. π
C. $-\pi$
D. ∞
E. NOTA