Name:_____
School:_____

Mu A Individual 2017

Benjamin Franklin Tournament

1. What is $f'(0)$ if $f(x) = \begin{cases} e^x, & x \leq 0 \\ e^{-x}, & x > 0 \end{cases}$?

2. Mariza is a professional stunt driver, and is filming for a scene where she drives on a straight track. She drives in reverse for the first five minutes of filming. Her position is represented by the function: $S(t) = -0.005t^3$ where t is minutes after filming begins, and S is her position in meters. What is Mariza's speed after 2 minutes of filming?

3. After driving in reverse for 5 minutes, Mariza decided to accelerate forward at 0.03 meters/min^2 for 5 minutes. Is the function for her position differentiable on the interval between 1 minute and 10 minutes of filming?

4. Find $\mathrm{d}^6/\,\mathrm{d}x^6 f(x)$ if $f(x) = xe^x$.

5. The absolute value of $f'(x)$ is $12x^3$. What are two of the possible functions of $f(x)$ if the y-intercept of $f(x)$ is 2?

6. Find
$$\lim_{h \to 0} \frac{\cos(\frac{\pi}{3} + h) - \frac{1}{2}}{h}$$

7. Find the derivative of the following polynomial: $e^5 + 7$.

8. Find the limit:
$$\lim_{x \to 1} \frac{x}{\ln(x)}$$

9. Find the equation of the line tangent to $y = -3x^2 + 2$ at $(2, -10)$

10. Find

$$\frac{\mathrm{d}}{\mathrm{d}x}\sin^{-1}(3x)$$

11. Find $\lim_{h\to 0}\ \dfrac{f(x+h)-f(x)}{h}$ for $f(x)=\pi^x,\ \ x>0$

12. For what values of x on the interval $[0,2\pi]$ is the line tangent to $f(x)=x-2\cos(x)$ horizontal?

13. Find the second derivative of $f(x)=2e^{-6x}$

14. Calculate $\frac{\mathrm{d}}{\mathrm{d}x}\sqrt{5x^2+1}$ when $x=1$

15. Find the tangent line at $(1,1)$ of $x^2+xy+y^2=3$.

16. Find

$$\lim_{x\to\pi}\ \frac{\cos(x)+\sin(x)}{\cos(-x)}$$

17. Find $\frac{\mathrm{d}^2y}{\mathrm{d}y^2}$ of $y=4\sin(3x)$

18. $\lim_{x\to\infty}\ \dfrac{1-x}{\cos(x)}$

Answers

1. DNE
2. 0.060 m/min
3. Yes
4. $e^x(x+6)$
5. $y = 3x^4 + 2$ and $y = -3x^4 + 2$
6. $-\frac{\sqrt{3}}{2}$
7. 0
8. DNE
9. $y = -12x + 14$
10. $\frac{3}{\sqrt{1-9x^2}}$
11. $\ln(\pi) \cdot \pi^x$
12. $\frac{7\pi}{6}$ and $\frac{11\pi}{6}$
13. $f'' = 72e^{-6x}$
14. $\frac{5\sqrt{6}}{6}$
15. $y = -x + 2$
16. 1
17. $y'' = -36\sin(3x)$
18. DNE