AP Calculus — Name____________________Pd.__

Absolute Extrema — Day 1 Application of Derivatives

1-6: Find the absolute maximum and absolute minimum values of f on the given interval.

1. $f(x)=12+4x-x^2,\quad [0,5]$

2. $f(x)=2x^3-3x^2-12x+1,\quad [-2,3]$

3. $f(x)=x^3-6x^2+5,\quad [-3,5]$

4. $f(x)=(x^2-1)^3,\quad [-1,2]$

5. $f(x)=\dfrac{x}{x^2-x+1},\quad [0,3]$

6. $f(t)=\sqrt[3]{t}\,(8-t),\quad [0,8]$

distribute

$f(t)=8t^{1/3}-t^{4/3}$

$f'(t)=\frac{8}{3}t^{-2/3}-\frac{4}{3}t^{1/3}$

common denominator

$f'(t)=\dfrac{8}{3t^{2/3}}-\dfrac{4t^{1/3}\cdot t^{2/3}}{3t^{2/3}}$

$f'(t)=\dfrac{8-4t}{3t^{2/3}}$

$f'(t)=0$ — $f'(t)=ud$

$8-4t=0$ — $3t^{2/3}=0$

$4t=8$ — $t=0$

$t=2$

t	$f(t)$
0	0 Abs min
2	$6\sqrt[3]{2}$ Abs max
8	0 Abs min

AP Calculus Name__________________Pd.__
Linear Approximation Day 1 Application of Derivatives

7-10: Find the linearization L(x) of the function at a.

7. $f(x) = x^4 + 3x^2, \quad a = -1$

8. $f(x) = \sin x, \quad a = \frac{\pi}{6}$

Point $f(\frac{\pi}{6}) = \sin\frac{\pi}{6} = \frac{1}{2}$

Slope $f'(\frac{\pi}{6}) = \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$

$f(x) = \sin x$

$f'(x) = \cos x$

$y - \frac{1}{2} = \frac{\sqrt{3}}{2}(x - \frac{\pi}{6})$

$y = \frac{\sqrt{3}}{2}(x - \frac{\pi}{6}) + \frac{1}{2}$

9. $f(x) = \sqrt{x}, \quad a = 4$

10. $f(x) = x^{\frac{3}{4}}, \quad a = 16$

11. Find the linear approximation of the function $f(x) = \sqrt{1-x}$ at a=0 and use it to approximate the numbers $\sqrt{0.9}$ and $\sqrt{0.99}$.

Tangent line $a=0$

P: $f(0) = \sqrt{1-0} = \sqrt{1} = 1$

S: $f'(0) = \frac{-1}{2\sqrt{1-0}} = -\frac{1}{2}$

$f(x) = (1-x)^{1/2}$

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

$f'(x) = \frac{-1}{2\sqrt{1-x}}$

$y - 1 = -\frac{1}{2}(x-0)$

$y = -\frac{1}{2}(x-0) + 1$

$\boxed{\sqrt{.9}} = y(.1) = -\frac{1}{2}(.1) + 1$

$= -.5(.1) + 1$

$= -.05 + 1$

$= \boxed{.95}$

$\boxed{\sqrt{.99}} = y(.01) = -\frac{1}{2}(.01) + 1$

$= -.5(.01) + 1$

$= -.005 + 1$

$= \boxed{.995}$

$\sqrt{.9} = \sqrt{1-x}$

$.9 = 1-x$

$x - 1 = -.9$

$\boxed{x = .1}$

You have to solve for what x-gives you .9 when you plug in to composite function

$\sqrt{.99} = \sqrt{1-x}$

$.99 = 1-x$

$x - 1 = -.99$

$\boxed{x = .01}$

12-17: Use a linear approximation (or differentials) to estimate the given number.

12. $(1.999)^4$

13. $e^{-0.015}$

14. $\sqrt[3]{1001}$

15. $\frac{1}{4.002}$ $f(x)=\frac{1}{x}$ $a=4$ $y-\frac{1}{4}=-\frac{1}{16}(x-4)$

Point $f(4)=\frac{1}{4}$ $y=-\frac{1}{16}(x-4)+\frac{1}{4}$

Slope $f'(4)=-\frac{1}{16}$

$f(x)=x^{-1}$ $f'(x)=-1x^{-2}=\frac{-1}{x^2}$

$y(4.002)=-\frac{1}{16}(4.002-4)+\frac{1}{4}=-\frac{1}{16}(.002)+\frac{1\cdot 4}{4\cdot 4}$

$=\frac{-.002}{16}+\frac{4}{16}=\frac{3.998}{16}=\frac{3998}{16000}=\boxed{.249875}$

16. $\tan 44^\circ$ $f(x)=\tan x$ $a=\frac{\pi}{4}$

Point: $f(\frac{\pi}{4})=\tan\frac{\pi}{4}=1$

Slope: $f'(\frac{\pi}{4})=(\sec\frac{\pi}{4})^2=(\frac{2}{\sqrt{2}})^2=2$

Convert $44^\circ=\frac{\pi}{180^\circ}$ $\frac{44\pi}{180}$

$f(x)=\tan x$

$f'(x)=\sec^2 x$ $y-1=2(x-\frac{\pi}{4})$

$y=2(x-\frac{\pi}{4})+1$

$y(\frac{44\pi}{180})=2(\frac{44\pi}{180}-\frac{\pi}{4})+1$

$=\frac{44\pi}{90}-\frac{\pi}{2}+1=\boxed{.9650934}$

17. $\sqrt{99.8}$

Answers:

1. Abs Max=16 Abs Min=7
2. Abs Max=8 Abs Min=-19
3. Abs Min=-76 Abs Max=5 Relative Min=-27
4. Abs Min=-1 Abs Max=27
5. Abs Min=0 Abs Max=1
6. Abs Min=0 Abs Max=7.5595
7. $y=-10(x+1)+4$
8. $y=\frac{\sqrt{3}}{2}\left(x-\frac{\pi}{6}\right)+\frac{1}{2}$
9. $y=\frac{1}{4}(x-4)+2$
10. $y=\frac{3}{8}(x-16)+8$
11. $y(.1)=.95$ $y(.01)=.995$
12. 15.968
13. 1.985
14. 10.003
15. .249875
16. .965
17. 9.99