AP CALCULUS BC
Unit 3 Outline – Advanced Differentiation Techniques

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/6	**DERIVATIVES OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS**	Ex. 1 Evaluate $\frac{d}{dx}\left(e^x\right)$ using the limit definition of the derivative. Ex. 2 Differentiate $f\left(x\right)=e^{\sin(2x)}$. Ex. 3 Differentiate $y=\ln\square$. Ex. 4 Find the derivative of $f\left(x\right)=\ln\left(\sin x+e^x-x^3\right)$. Ex. 5 Differentiate $y=\log_b\square$ Ex. 6 Differentiate $f\left(x\right)=\log_7\left(3x+\tan 5x\right)$ Ex. 7 Differentiate $y=b^{\square}$ Ex. 8 Differentiate $f\left(x\right)=3^{\sin\left(x^2\right)}$

AP MULTIPLE CHOICE

What are the equations of the horizontal asymptotes of the graph of $y=\frac{2x}{\sqrt{x^2-1}}$?

(A) $y = 0$ only

(B) $y = 1$ only

(C) $y = 2$ only

(D) $y = -2$ and $y = 2$ only

(E) $y = -1$ and $y = 1$ only

Let f be the function defined by $f(x)=\begin{cases}x^2+2 & \text{for } x\le 3,\\ 6x+k & \text{for } x>3.\end{cases}$

If f is continuous at $x = 3$, what is the value of k?

(A) -7 (B) 2 (C) 3 (D) 7 (E) There is no such value of k.

HOMEWORK	Worksheet 14

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/9	**IMPLICIT DIFFERENTIATION**	Ex. 1 Find $\frac{dy}{dx}$ for $y^2 = x$. Ex. 2 Find $\frac{dy}{dx}$ for $2y = x^2 + \sin y$. Ex. 3 Find the equations of the tangent and normal line for $x^2 - xy + y^2 = 7$ at $(-1, 2)$ Ex. 4 Find $\frac{d^2y}{dx^2}$ for $x^2 - y^2 = 16$ in terms of x and y.

AP MULTIPLE CHOICE

What is the slope of the line tangent to the curve $y + 2 = \frac{x^2}{2} - 2\sin y$ at the point $(2, 0)$?

(A) -2 (B) 0 (C) $\frac{1}{2}$ (D) $\frac{2}{3}$ (E) 2

HOMEWORK	Worksheet 15

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/10	**IMPLICIT DIFFERENTIATION**	Ex. 1 Find $\frac{dy}{dx}$ for $x^3 + 5xy - y^3 = 11$. Ex. 2 If $e^y - e^{y^2} = x - x^3$, then the value of $\frac{dy}{dx}$ at the point $(0,1)$ is Ex. 3. Find the equation of the tangent and normal line to $x^2y^2 = 9$ at $(-1,3)$.

AP MULTIPLE CHOICE

Suppose $\ln x - \ln y = y - 4$, where y is a differentiable function of x and $y = 4$ when $x = 4$. What is the value of $\frac{dy}{dx}$ when $x = 4$?

(A) 0 (B) $\frac{1}{5}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$ (E) $\frac{17}{5}$

HOMEWORK	Worksheet 16

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/11	**DERIVATIVES OF INVERSE TRIG FUNCTIONS**	Ex. 1 Differentiate $y = \arcsin(3x+2)$ Ex. 2 Find y' for $y = \arccos(2x^3)$ Ex. 3 $\frac{d}{dx}\arccos(\tan x)$ Ex. 4 Find the derivative of $y = \tan^{-1}(3-5x)$.

AP MULTIPLE CHOICE

If $\arcsin x = \ln y$, then $\frac{dy}{dx} =$

(A) $\frac{y}{\sqrt{1-x^2}}$ (B) $\frac{xy}{\sqrt{1-x^2}}$ (C) $\frac{y}{1+x^2}$ (D) $e^{\arcsin x}$ (E) $\frac{e^{\arcsin x}}{1+x^2}$

HOMEWORK	Worksheet 17

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/12	**DERIVATIVES OF FUNCTIONS DEFINED AS INVERSES**	1. Let $f(x) = x^3 - 5x^2 - 8$ and let g be the inverse function of f. (a) Find $f(1)$ and $f'(1)$. (b) Find $g(-12)$ and $g'(-12)$.

AP MULTIPLE CHOICE

x	$f(x)$	$f'(x)$
0	1	1
1	3	4
2	11	13

The table above gives selected values for a differentiable and increasing function f and its derivative. If g is the inverse function of f, what is the value of $g'(3)$?

(A) $\frac{1}{13}$ (B) $\frac{1}{4}$ (C) 1 (D) 4 (E) 13

The function h is given by $h(x) = x^5 + 3x - 2$ and $h(1) = 2$. If h^{-1} is the inverse of h, what is the value of $\left(h^{-1}\right)'(2)$?

(A) $\frac{1}{83}$ (B) $\frac{1}{8}$ (C) $\frac{1}{2}$ (D) 1 (E) 8

HOMEWORK	Worksheet 18

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/13	**LOGARITHMIC DIFFERENTIATION**	**Ex. 1** Differentiate $f(x) = x^x$ **Ex. 2** Differentiate $f(x) = x^{\sin x}$

AP MULTIPLE CHOICE

If $\lim_{h \to 0} \dfrac{\arcsin(a+h) - \arcsin(a)}{h} = 2$, which of the following could be the value of a ?

(A) $\dfrac{\sqrt{2}}{2}$ (B) $\dfrac{\sqrt{3}}{2}$ (C) $\sqrt{3}$ (D) $\dfrac{1}{2}$ (E) 2

HOMEWORK	Worksheet 19

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/16	**REVIEW**	None

AP MULTIPLE CHOICE

If $f(x) = \sin x + 2x + 1$ and g is the inverse function of f, what is the value of $g'(1)$?

(A) $\dfrac{1}{3}$ (B) 1 (C) 3 (D) $\dfrac{1}{2 + \cos 1}$ (E) $2 + \cos 1$

If $y^2 - 2x^2y = 8$, then $\dfrac{dy}{dx} =$

(A) $\dfrac{4}{y - 2x}$ (B) $\dfrac{2xy}{y - x^2}$ (C) $\dfrac{4 + 2xy}{y - x^2}$ (D) $\dfrac{2xy}{y + x^2}$ (E) $\dfrac{2xy + x^2}{y}$

HOMEWORK	Worksheet 20

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/17	**FREE RESPONSE QUESTIONS**	None
HOMEWORK		Worksheet 21 – FRQ

DATE	CONCEPT	IN-CLASS SAMPLE PROBLEMS
9/18	**EXAM**	None
HOMEWORK		None