## Station 1 *NO CALCULATOR*

**Differentiate each function below.**

1. $y = e^{5x-3} \cdot x^4$

*Write your answer in factored form.*

$y' = (e^{5x-3})(5)x^4 + 4x^3(e^{5x-3})$

$\boxed{= x^3 \cdot e^{5x-3}(5x+4)}$

2. $f(x) = \cos\left(\frac{1}{2}x\right) - \tan(2x)$

$f'(x) = -\sin\left(\frac{1}{2}x\right) \cdot \frac{1}{2} - \sec^2(2x) \cdot 2$

$\boxed{= -\frac{1}{2}\sin\left(\frac{1}{2}x\right) - 2\sec^2(2x)}$

3. $y = 13^{-2x}$

$\frac{dy}{dx} = 13^{-2x} \cdot \ln 13 \cdot -2$

$\boxed{= -2 \cdot 13^{-2x} \ln 13}$

4. $y = \sin^{-1}(2-x)$ $u = 2-x$

$y = \sin^{-1} u$

$y' = \frac{1}{\sqrt{1-(2-x)^2}} \cdot -1$

$\boxed{= \frac{-1}{\sqrt{1-(2-x)^2}}}$

## Station 2 *NO CALCULATOR*

1. LS $\lim_{x \to 2^-} x+2 = 4$ ✓ $(x+2)\cancel{(x-2)}$ / $\cancel{x-2}$

RS $\lim_{x \to 2^-} x+2 = 4$ ✓

$f(x) = \begin{cases} \frac{x^2-4}{x-2} & \text{if } x \neq 2 \\ 1 & \text{if } x = 2 \end{cases}$

Let $f$ be the function defined above. Which of the following statements about $f$ are true?

I. $f$ has a limit at $x = 2$. ✓

✗ II. $f$ is continuous at $x = 2$. $f(2) = 1 \neq 4$

✗ III. $f$ is differentiable at $x = 2$. Not continuous so not diff.

(A) I only
(B) II only
(C) III only
(D) I and II only
(E) I, II, and III

2. Differentiable functions $f$ and $g$ have the values in the table. *****Write your formula first!!!**

| $x$ | $f$ | $f'$ | $g$ | $g'$ |
|---|---|---|---|---|
| 0 | 2 | 1 | 5 | −4 |
| 1 | 3 | 2 | 3 | −3 |
| 2 | 5 | 3 | 1 | −2 |
| 3 | 10 | 4 | 0 | −1 |

a. If $M(x) = g(f(x))$, then $M'(1) =$

$M'(x) = g'(f(x)) \cdot f'(x)$

(A) −2 (B) −6 (C) 4 (D) 6 (E) 12

$M'(1) = g'(f(1)) \cdot f'(1)$

$= g'(3) \cdot f'(1) = -1 \cdot 2 = -2$

$f^{-1}$ $(3, 1)$

$f$ $(1, 3)$

b. If $S(x) = f^{-1}(x)$, then $S'(3) =$

(A) −2 (B) $-\frac{1}{25}$ (C) $\frac{1}{4}$ (D) $\frac{1}{2}$ (E) 2

$S'(3) = (f^{-1}(3))' = \left.\frac{df^{-1}}{dx}\right|_{x=3} = \frac{1}{\left.\frac{df}{dx}\right|_{x=1}} = \frac{1}{f'(1)} = \frac{1}{2}$

## Station 3 *NO CALCULATOR*

1. If $v(t) = \ln(t^2 + t + 1)$, then $v'(1) =$ ______

   A.) 1/3  B.) -2/3  C.) 1  D.) 4/3  E.) 3

   $v'(t) = \frac{1}{t^2+t+1} \cdot (2t+1)$  $v'(1) = \frac{1}{1+1+1} \cdot 3 = \frac{3}{3} = 1$

2. $f(x) = \frac{1}{2}(2x+5)^3$. $f'(x) =$ ______.

   A.) $\frac{3}{2}(2x+5)^2$  B.) $3(2x+5)^2$  C.) $3(2x+5)$  D.) $\frac{3}{2}(2x+5)$  E.) $6(2x+5)$

   $f'(x) = \frac{3}{\cancel{2}}(2x+5)^2 \cdot \cancel{2} = 3(2x+5)^2$

3. If $y = \ln(e^{x^2-1})$. Find the slope of the tangent line when $x = 1$.

   (A.) 0  (B.) $\frac{1}{2}$  (C.) 1  (D.) 2  (E.) undefined

   $y' = \frac{1}{\cancel{e^{x^2-1}}} \cdot \cancel{e^{x^2-1}} \cdot 2x = 2x$  $y'|_{x=1} = 2$

4. Evaluate $\lim_{x \to 1} \frac{\ln x}{\cos \frac{\pi x}{2}}$ $\frac{0}{0}$  A) -2  B) $-\pi/2$  C) $-2/\pi$  D) DNE

   L'Hopital

   $\lim_{x \to 1} \frac{\frac{1}{x}}{-\sin(\frac{\pi}{2}x) \cdot \frac{\pi}{2}} = \frac{1}{-\sin(\frac{\pi}{2}) \cdot \frac{\pi}{2}} = \frac{1}{-\frac{\pi}{2}} = -\frac{2}{\pi}$

## Station 4 *NO CALCULATOR*

1. If $x^4 - 3x^2y^2 + 4y^2 = 5$, then the value of $\frac{dy}{dx}$ at $(1, 2)$ is

   (A) -3  (B) -1  (C) 2  (D) 5  **(E) None of the above.**

   $4x^3 - [6xy^2 + 2y \cdot \frac{dy}{dx} \cdot 3x^2] + 8y \cdot \frac{dy}{dx} = 0$

   $4x^3 - 6xy^2 - 6x^2y\frac{dx}{dx} + 8y \cdot \frac{dy}{dx} = 0$

   $-6x^2y\frac{dy}{dx} + 8y\frac{dy}{dx} = -4x^3 + 6xy^2$

   $\frac{dy}{dx} = \frac{-4x^3 + 6xy^2}{-6x^2y + 8y}$

   $\frac{dy}{dx}\Big|_{(1,2)} = \frac{-4(1)^3 + 6(1)\cdot(2)^2}{-6(1)^2(2) + 8(2)} = \frac{-4+24}{-12+16} = \frac{-20}{4} = 5$

   Write the equation of the normal line at $(1, 2)$.

   $y - 2 = \frac{-1}{5}(x-1)$

2. If $x^2 + xy = 10$, then when $x = 2$, $\frac{dy}{dx} =$

   $2^2 + 2y = 10$  
   $2y = 6$  $y = 3$

   (A) $-\frac{7}{2}$  (B) $-2$  (C) $\frac{2}{7}$  (D) $\frac{3}{2}$  (E) $\frac{7}{2}$

   $2x + y + x\frac{dy}{dx} = 0$

   $x\frac{dy}{dx} = -y - 2x$

   $\frac{dy}{dx} = \frac{-y-2x}{x}$

   $\frac{dy}{dx}\Big|_{(2,3)} = \frac{-3-2(2)}{2} = -\frac{7}{2}$

## Station 5 *NO CALCULATOR*

Basics you must know!

1. *Math 2!!!!*

$x^{-1} = \frac{1}{x}$ $x^{\frac{1}{2}} = \sqrt{x}$ $x^{-\frac{1}{2}} = \frac{1}{\sqrt{x}}$ $\sqrt[3]{x} = x^{\frac{1}{3}}$ $\sqrt[4]{x^3} = x^{\frac{3}{4}}$

$\left(\frac{x^2}{2}\right)^2 = \frac{x^4}{4}$ $\frac{3}{\sqrt{x}} = 3x^{-\frac{1}{2}}$ $4^{\frac{-3}{2}} = \frac{1}{\sqrt{4^3}} = \frac{1}{\sqrt{64}} = \frac{1}{8}$ $\frac{x \cdot \sqrt{x}}{\frac{1}{\sqrt{x}} \cdot \sqrt{x}} = \boxed{x\sqrt{x}}$ $64^{\frac{1}{3}} = 4$

2. *Do not draw a unit circle!*

$\cos(\pi) = -1$ $\sin(2\pi) = 0$ $\tan(0) = 0$ $\sin\left(\frac{3\pi}{2}\right) = -1$

$\cos\left(\frac{\pi}{2}\right) = 0$ $\sin(\pi) = 0$ $\cos(0) = 1$ $\tan\left(\frac{\pi}{2}\right) = \emptyset$

3. *Do not touch your calculator!*

$e^1 = e$ $\ln 0 = \emptyset$ $e^0 = 1$ $\ln 1 = 0$

$\ln e = 1$ $e^{-1} = \frac{1}{e}$ $\ln e^x = x$ $e^{\ln x} = x$

$-1/2 - 1 = -\frac{3}{2}$ $-1 - 1 = -2$ $-1/3 - 1 = -\frac{4}{3}$ $-2/3 - 1 = -\frac{5}{3}$

$(x+3y)^2 = x^2 + 6xy + 9y^2$

Calculate the slope of the line going through the points (-3, -8) and (10, -4).

$$m = \frac{-4 - -8}{10 - -3} = \frac{-4+8}{10+3} = \frac{4}{13}$$