Circle your Instructor:
Faudree, Williams, Zirbes

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Math 251 Fall 2017 **Derivative Proficiency, October 25th**

Name: Solutions

This is a 30 minute quiz. There are 15 problems. Books, notes, calculators or any other aids are prohibited. Calculators and notes are not allowed. **Your answers should be simplified unless otherwise stated.** They should begin $y' =$ or $f'(x) =$ or $dy/dx =$, etc. There is no partial credit. If you have any questions, please raise your hand.

Circle your final answer.

For each function below, find the derivative.

Just constants

1. $f(x) = \frac{5}{x^2} - \sqrt{2}x^2 - e^2$ $= 5x^{-2} - \sqrt{2}x^2 - e^2$

$\boxed{f'(x) = -10x^{-3} - 2\sqrt{2}x}$

2. $g(x) = 5^x + \csc(2x)$

$\boxed{g'(x) = (\ln 5)5^x - 2\csc(2x)\cot(2x)}$

3. $y = \frac{1}{3x} + \frac{7}{2-x}$ $= \frac{1}{3}x^{-1} + 7(2-x)^{-1}$

$y' = -\frac{1}{3}x^{-2} - 7(2-x)^{-2}(-1)$

$\boxed{y' = -\frac{1}{3}x^{-2} + 7(2-x)^{-2}}$

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4. $y = \frac{t^5 - 5t^3 - 2}{\sqrt[3]{t}} = t^{14/3} - 5t^{8/3} - 2t^{-1/3}$

aside: $5 = \frac{15}{3}$

$3 = \frac{9}{3}$

$$\boxed{y' = \frac{14}{3}t^{11/3} - \frac{40}{3}t^{5/3} + \frac{2}{3}t^{-4/3}}$$

5. $h(x) = \frac{x^2 - x + 4}{\sin 3x}$ [You do not need to simplify.]

$$\boxed{h'(x) = \frac{(\sin 3x)(2x-1) - (x^2 - x + 4)(\cos 3x)(3)}{(\sin 3x)^2}}$$

6. $y = \sqrt{\ln x + e^x} = (\ln x + e^x)^{1/2}$

$y' = \frac{1}{2}(\ln x + e^x)^{-1/2}\left(\frac{1}{x} + e^x\right)$

$e^x = \frac{xe^x}{x}$

$$\boxed{y' = \frac{1 + xe^x}{2x\sqrt{\ln x + e^x}}}$$

7. $F(\theta) = (\tan(\pi\theta))e^{2\theta}$

$F'(\theta) = \tan(\pi\theta) \cdot 2e^{2\theta} + \pi \sec^2(\pi\theta) \cdot e^{2\theta}$

$= e^{2\theta}\left(2\tan(\pi\theta) + \pi\sec^2(\pi\theta)\right)$

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8. $z = 4\sqrt{t}(t^3 + 9t)$ $= 4\left(t^{7/2} + 9t^{3/2}\right)$

$$\boxed{z' = 4\left[\frac{7}{2}t^{5/2} + \frac{27}{2}t^{1/2}\right] = 14t^{5/2} + 54t^{1/2}}$$

9. $y = x \arctan(3x^2 + 1)$

$$y' = \arctan(3x^2+1) + x \cdot \frac{1}{1+(3x^2+1)^2} \cdot (6x)$$

$$\boxed{y' = \arctan(3x^2+1) + \frac{6x^2}{9x^4+6x^2+2}}$$

10. $G(x) = \ln(x^2\sqrt{x^2 + 16})$ $= \ln x^2 + \ln\sqrt{x^2+16} = 2\ln x + \frac{1}{2}\ln(x^2+16)$

$$G'(x) = \frac{2}{x} + \frac{1}{2} \cdot \frac{1}{x^2+16} \cdot 2x$$

$$\boxed{G'(x) = \frac{2}{x} + \frac{x}{x^2+16}}$$

11. $h(x) = \sqrt[3]{x^2} + 4\sqrt[5]{x}$ $= x^{2/3} + 4x^{1/5}$

$$\boxed{h'(x) = \frac{2}{3}x^{-1/3} + \frac{4}{5}x^{-4/5}}$$

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12. $H(x) = x(\cos x)e^x$

$\frac{d}{dx}[\cos x \cdot e^x]$

$H'(x) = 1 \cdot (\cos x)e^x + x\left[(\cos x)e^x + (-\sin x)e^x\right]$

$\boxed{H'(x) = e^x(\cos x + x\cos x - x\sin x)}$

13. $f(x) = \arccos(e^{5x})$

$f'(x) = \frac{-1}{\sqrt{1-(e^{5x})^2}} \cdot e^{5x} \cdot 5$

$\boxed{f'(x) = \frac{-5e^{5x}}{\sqrt{1-e^{10x}}}}$

14. $g(x) = (2x + \sin(x^2))^3$

$g'(x) = 3(2x + \sin(x^2))^2\left[2 + 2x\cos(x^2)\right]$

$\boxed{g'(x) = 6(2x+\sin(x^2))^2(1+x\cos(x^2))}$

15. Find ds/dt for $s = C\ln(at - b)$ where a, b, and C are fixed constants.

$\frac{ds}{dt} = C \cdot \frac{1}{at-b} \cdot a$

$\boxed{\frac{ds}{dt} = \frac{Ca}{at-b}}$