**MATH 221: Calculus and Analytic Geometry**
**Prof. Ram, Fall 2004**

## HOMEWORK 3: SELECTED ANSWERS

### Problem A. Vocabulary and basic identities.

(2) $e^x$ is the function such that $\dfrac{de^x}{dx} = e^x$ and $e^(x+y) = e^x e^y$.

(3) $\ln x$ is the inverse function to $e^x$.

### Problem B. Inverse trigonometric functions.

(1) $\sin^{-1} x$ is the inverse function to $\sin x$.

(2) $\cos^{-1} x$ is the inverse function to $\cos x$.

(3) $\tan^{-1} x$ is the inverse function to $\tan x$.

(4) $\cot^{-1} x$ is the inverse function to $\cot x$.

(5) $\sec^{-1} x$ is the inverse function to $\sec x$.

(6) $\csc^{-1} x$ is the inverse function to $\csc x$.

### Problem D. Derivatives with trigonometric functions.

(1) $\dfrac{dy}{dx} = 3\cos(3x+2)$.

(2) $\dfrac{dy}{dx} = 2x^3(\sin x^4)^{-1/2}\cos x^4$.

(3) $\dfrac{dy}{dx} = x^2\cos x + 2x\sin x$.

(4) $\dfrac{dy}{dx} = -x\sin x$.

(5) $\dfrac{dy}{dx} = -9\cos^2 3x \sin 3x$.

(6) $\dfrac{dy}{dx} = 4(x^2+\cos x)^3(2x - \sin x)$.

(7) $\dfrac{dy}{dx} = 2\sin x(3\cos^2 x - 1)$.

(8) $\dfrac{dy}{dx} = \dfrac{2x\cos 2x - 2\sin 2x}{x^3}$.

(9) $\dfrac{dy}{dx} = 2\sin 2x$.

(10) $\dfrac{dy}{dx} = 2x\cos x^2 - \left(\dfrac{(1+x^2)\sec^2 x - 2x\tan x}{(1+x^2)^2}\right)$.

(11) $\dfrac{dy}{dx} = -\left(\dfrac{2x\sin x + 4\sin x + 2\cos x + 2}{(x+2)^2}\right)$.

(12) $\dfrac{dy}{dx} = 2x + \dfrac{\sin x - x\cos x}{\sin^2 x}$.

(13) $\dfrac{dy}{dx} = 2\cos x$.

(14) $\dfrac{dy}{dx} = \dfrac{1}{6}\sec(x/3)\tan(x/3)$.

(15) $\dfrac{dy}{dx} = (\cos x - \sin x)\cos(\sin x + \cos x)$.

(16) $\dfrac{dy}{dx} = -2\csc 2x \cos 2x$.

(17) $\dfrac{dy}{dx} = 2x\left(\cot x + \dfrac{\tan x}{1+x^2}\right) + \dfrac{x^2-1}{(1+x^2)^2}((1+x^2)\sec^2 x - (1+x^2)^2\csc^2 x - 2x\tan x)$.

(18) $\dfrac{dy}{dx} = \dfrac{-\dfrac{d\theta}{dx}}{\sqrt{\cos 2\theta}(\cos\theta + \sin\theta)}$.

(19) $\dfrac{dy}{dx} = \dfrac{2\cos x}{(1-\sin x)^2}$.

(20) $\dfrac{dy}{dx} = \dfrac{1}{2}\sec^2(x/2)$.

(21) $\dfrac{dy}{dx} = x^3\tan(x/2)\sec^2(x/2) + 3x^2\tan^2(x/2)$.

(22) $\dfrac{\frac{dy}{dx} = -\sec^2(\cos(\sin\theta))\sin(\sin\theta)\cos\theta\cdot d\theta}{dx}$.

**Problem E. Derivatives with exponentials and logs.**

(1) $\dfrac{dy}{dx} = 2ex - \dfrac{3\pi}{x^4} + \dfrac{7}{2}x^{5/2}$.

(2) $\dfrac{dy}{dx} = a^{ax+b+1}\ln a$.

(3) $\dfrac{dy}{dx} = 3x^2 a^{x^3}\ln a$.

(4) $\dfrac{dy}{dx} = 2 \cdot 6^{2x} \ln 6.$

(5) $\dfrac{dy}{dx} = \dfrac{2ax}{ax^2 + b}.$

(6) $\dfrac{dy}{dx} = 3x^2.$

(7) $\dfrac{dy}{dx} = 2(e^{2x} + e^{-2x}).$

(8) $\dfrac{dy}{dx} = 2(x+1)e^{x^2+2x}.$

(9) $\dfrac{dy}{dx} = ax^{a-1}a^x + x^a a^x \ln a.$

(10) $\dfrac{dy}{dx} = (x+1)e^x.$

(11) $\dfrac{dy}{dx} = \dfrac{1}{\sqrt{x^2 + a^2}}.$

(12) $\dfrac{dy}{dx} = \dfrac{2e^x}{(1 - e^x)^2}.$

(13) $\dfrac{dy}{dx} = \dfrac{-2x(x+2)}{(x^2 + x + 1)(x^2 - x - 1)}.$

(14) $\dfrac{dy}{dx} = \dfrac{x^2 - 1}{x^2 - 4}.$

(15) $\dfrac{dy}{dx} = \dfrac{4}{\ln(\ln x^4)(\ln x^4)x}.$