Problem 1. Section 3.5 #176

For the following exercises, find $\frac{dy}{dx}$ *for the given functions.*

Here $y = 3\csc(x) + \frac{5}{x}$.

We have $\boxed{\frac{dy}{dx} = -3\csc(x)\cot(x) - \frac{5}{x^2}}$.

Problem 2. Section 3.5 #180

For the following exercises, find $\frac{dy}{dx}$ *for the given functions.*

Here $y = \sin(x)\tan(x)$.

We have $\boxed{\frac{dy}{dx} = \cos(x)\tan(x) + \sin(x)\sec^2(x) = \sin(x)(1 + \sec^2(x))}$.

Problem 3. Section 3.5 #182

For the following exercises, find $\frac{dy}{dx}$ *for the given functions.*

Here $y = \frac{\tan(x)}{1-\sec(x)} = \frac{\sin(x)}{\cos(x)-1}$.

We have $\boxed{\frac{dy}{dx} = \frac{\cos(x)(\cos(x)-1)+\sin^2(x)}{(1-\cos(x))^2} = \frac{1}{1-\cos(x)}}$.

Problem 4. Section 3.5 #196

For the following exercises, find $\frac{d^2y}{dx^2}$ *for the given functions.*

Here $y = \sec^2(x)$. Therefore, $\boxed{\frac{dy}{dx} = 2\sec^2(x)\tan(x)}$.

Further we have $\boxed{\frac{d^2y}{dx^2} = 2(2\sec^2(x)\tan^2(x) + \sec^4(x)) = 2\sec^2(x)(2\tan^2(x) + \sec^2(x))}$.

Problem 5. Section 3.5 #198

Find all x *values on the graph of* $f(x) = x - 2\cos(x)$ *for* $0 < x < 2\pi$ *where the tangent line has slope* 2.

Given that $f(x) = x - 2\cos(x)$, we immediately have $\boxed{f'(x) = 1 + 2\sin(x)}$.

Solve the equation $f'(x) = 2$ for x, where $0 < x < 2\pi$. We get $\boxed{x = \frac{\pi}{6} \text{ or } x = \frac{5\pi}{6}}$.

Problem 6. Section 3.5 #204

The amount of rainfall per month in Phoenix, Arizona, can be approximated by $y(t) = 0.5 + 0.3\cos(t)$*, where* t *is months since January. Find* y' *and determine the intervals where the amount of rain falling is decreasing.*

As $y(t) = 0.5 + 0.3\cos(t)$, we get $\boxed{y' = -0.3\sin(t)}$. We need to find when $y' < 0$. That is to say, we need to find when $\sin(t) > 0$ as t varies from 1 to 12.

After some calculating, we obtain the intervals, which are $\boxed{[1,3] \text{ and } [7,9]}$, that is, $\boxed{\text{from January to March and from July to September}}$.

Problem 7. Section 3.5 #206

For the following exercises, use the quotient rule to derive the given equations.

We need to show that $\frac{d}{dx}(\sec(x)) = \sec(x)\tan(x)$.

Rewrite $\boxed{\sec(x) = \frac{1}{\cos(x)}}$. Then we have $\frac{d}{dx}(\sec(x)) = \frac{d}{dx}\frac{1}{cos(x)}$.

Using the quotient rule, we get $\boxed{\frac{d}{dx}\frac{1}{cos(x)} = \frac{\sin(x)}{\cos^2(x)} = \sec(x)\tan(x)}$.

Problem 8. Section 3.5 #210

For the following exercises, find the requested higher-order derivative for the given functions.

Here we have $y = 3\sin(x) + x^2\cos(x)$.

Therefore, we get $\frac{dy}{dx} = 3\cos(x) + 2x\cos(x) - x^2\sin(x)$.

Further we obtain $\frac{d^y}{dx^2} = -3\sin(x) + 2\cos(x) - 2x\sin(x) - 2x\sin(x) - x^2\cos(x)$. That is to say, $\boxed{\frac{d^2y}{dx^2} = -(4x+3)\sin(x) - (x^2-2)\cos(x)}$.