

MATH 110 Problem Set 2.4

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The following problems based on Section 2.4 of the textbook will help you study. *You do not need to hand in solutions to these problems.*

1. (Based on 2.4.1–16) Differentiate the following functions.

(a) $f(x) = 2x^3 + \cos x$

(b) $G(t) = t^2 \cos t$

(c) $\frac{1 - \sin \theta}{\tan \theta + \cos \theta}$

2. (Based on 2.4.21–24) Find an equation for the tangent line to the curve $y = x \cos x$ at the point $(\pi, -\pi)$ on the curve.

3. (Based on 2.4.29–30) Find $\frac{d^2y}{dx^2}$ for $y = x \cos x$

4. For what values of x does $f(x) = x + \cos x$ have a horizontal tangent?

5. (Based on 2.4.39–50) Find the following limits.

(a) $\lim_{x \rightarrow 0} \frac{\sin 2x}{x}$

(b) $\lim_{x \rightarrow 0} \frac{\sin 2x}{\sin 3x}$

(c) $\lim_{t \rightarrow 0} \frac{\sin^3 2t}{t^3}$

(d) $\lim_{\theta \rightarrow 0} \frac{\cos \theta - 1}{\tan \theta}$

6. (Based on 2.4.17–19) Use the quotient rule and the derivatives of $\cos x$ and $\sin x$ to show that $\frac{d}{dx} \sec x = \sec x \tan x$

7. (Based on 2.4.20) Use the definition of derivative and the basic trig limits to show that $\frac{d}{dx} \cos x = -\sin x$

8. (Based on 2.4.38) An object with weight W is dragged along a floor by a force acting along a rope attached to the object. If the rope makes an angle θ with the floor, then the magnitude of the total force acting on the object is

$$F(\theta) = \frac{\mu W}{\mu \sin \theta + \cos \theta}$$

where μ is a number known as the *coefficient of friction* between the object and the floor.

- (a) Find the derivative of F with respect to θ .
(b) For what value(s) of θ is $dF/d\theta = 0$?

You may find the following additional exercises from Section 2.4 helpful.

2.4 C-level: 1–16, 21–24, 25–26, 27–30, 33–34, 39–50;

B-level: 17–20, 31, 32, 35–38;

A-level: 51–52, 53–58