

1. Use differentiation formulas to find the derivative of each of the following functions.

$$(a) y = \frac{x^3}{\cos x}$$

$$(b) y = \sqrt{x} + 1 + \frac{1}{\sqrt{x}}$$

2. If f is the focal length of a convex lens and an object is placed at a distance p from the lens, then its image will be at a distance q from the lens, where f , p and q are related by the *lens equation*

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

If the focal length of the lens is 5 cm, how fast is the distance of the image from the lens changing when the object is 30 cm from the lens?

3. Evaluate each limit, if it exists.

$$(a) \lim_{r \rightarrow 2} \frac{r^2 + 4}{r - 1}$$

$$(b) \lim_{t \rightarrow 0} \frac{\sqrt{2-t} - \sqrt{2}}{t}$$

4. Find the equations of all tangent lines to the curve $y = \frac{1}{3}x^3 - x^2 + 2$ that are parallel to the line $y = 3x - 4$.

5. Use the definition of the derivative to show that the derivative of $f(x) = \cos x$ is $f'(x) = -\sin x$. You will need the trigonometric identity of the form

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

and limit theorems from the text as well as limit laws.