

- [20] 1. Find the following limits. If there is no finite limit, determine whether the limit is ∞ or $-\infty$.

a) $\lim_{x \rightarrow 4} \frac{\sqrt{x+5} - 3}{x-4}$

b) $\lim_{x \rightarrow 2^-} \frac{x^2 + 4}{x - 2}$

c) $\lim_{x \rightarrow \infty} \frac{9x - 5}{\sqrt{9x^2 + 4}}$

d) $\lim_{\theta \rightarrow 0} \frac{\sin^2 3\theta}{\theta^2}$

[35] 2. Find the derivative of each function. Do not simplify your answers.

a) $f(x) = e^{3x} + 3 \ln x + x \ln 3$

b) $g(x) = \sec^2(3x) + 4 \tan(2x)$

c) $p(x) = (\sqrt{x} + 1)^3(x^4 - 2)^5$

$$\text{d) } q(x) = \frac{2x^2 + 5x}{(x + 1)^2}$$

$$\text{e) } F(x) = \int_0^{x^3} \sqrt{t^3 + 8} dt$$

[7] 3. Use logarithmic differentiation to find the derivative of $h(x) = (1 - x)^{1/x}$.

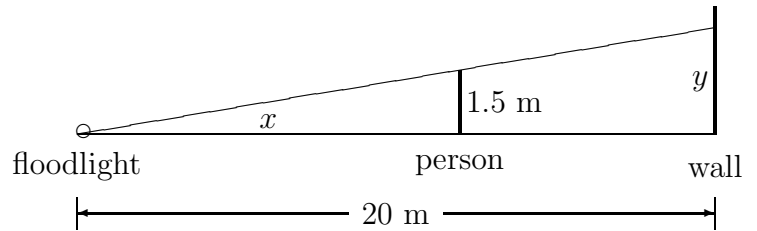
[8] 4. Use the definition of the derivative to find $f'(x)$ if $f(x) = \frac{x+2}{x}$.

[10] 5. Find an equation of the line tangent to the curve $y = 2 + \sin(\pi x)$ at $x = 1$.

[10] 6. Use implicit differentiation to find dy/dx if $\cos(xy) + x^2y^3 = y$.

- [10] 7. A floodlight at ground level shines on a wall 20 m away. A 1.5 m tall person starts at the floodlight and walks directly towards the wall.

If the person walks at a rate of 0.4 m/s, how fast is the length of the person's shadow on the wall changing when the person is 18 m from the floodlight?



- [8] 8. Let $f(x) = 2 - \frac{1}{x^2}$. Then $f'(x) < 0$ for $x < 0$ and $f'(x) > 0$ for $x > 0$.
- a) Find all vertical and horizontal asymptotes for the graph of $y = f(x)$.

b) Sketch the graph of the function.

[12] 9. Let $f(x) = x^3 - 3x^2 - 9x + 24$.

a) Find the open intervals on which $f(x)$ is increasing and those on which $f(x)$ is decreasing.

b) Find all points on the graph of the function (x and y values) where $f(x)$ has local maxima or minima.

c) Find the open intervals on which the graph of $y = f(x)$ is concave up and those on which it is concave down.

d) Find all inflection points (x and y values) on the graph of $y = f(x)$.

- [10] 10. Find the absolute maximum and absolute minimum values of the function $f(x) = xe^{-2x}$ on the interval $[0, 3]$.
- [10] 11. A farmer wants to fence in a rectangular enclosure with area 21,600 square feet and then divide the enclosure in two with a fence parallel to one of the sides of the rectangle. What are the dimensions of the enclosure that use the minimum amount of fencing material? Be sure to justify why your answer gives a minimum.

[28] 12. Evaluate the following indefinite integrals:

a) $\int \frac{2x^5 + 5x^2 - 7\sqrt{x}}{x^2} dx$

b) $\int \frac{\cos x}{3 + \sin x} dx$

c) $\int (\sec^2 3x + e^{4x}) dx$

$$d) \int \frac{\cos(1/x)}{x^2} dx$$

[14] 13. Evaluate the following definite integrals:

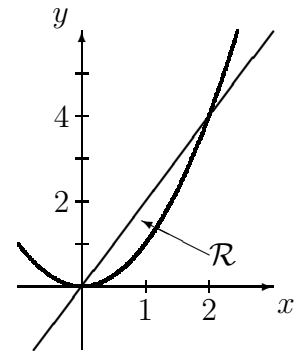
$$a) \int_0^4 x\sqrt{2x+1} dx$$

$$b) \int_0^1 \left(\frac{x}{x^2+1} + \frac{1}{x^2+1} \right) dx$$

- [8] 14. Find the area of the region bounded by $y = \frac{x^3}{2}$ and $y = x^2$.

- [10] 15. Let \mathcal{R} be the region bounded by $y = 2x$ and $y = x^2$ shown at right.

- a) Set up, but do not evaluate, an integral that represents the volume of the solid generated by revolving the region \mathcal{R} about the x -axis.



- b) Set up, but do not evaluate, an integral that represents the volume of the solid generated by revolving the region \mathcal{R} about the line $x = 2$.