This homework assignment is about finding antiderivatives. Remember that you can always check if your antiderivative is correct by taking the derivative.

**Problem 1:** Assume \( f' \) is given by the graph below. Suppose \( f \) is continuous and that \( f(0) = 0 \).

(a) Find \( f(3) \) and \( f(7) \).

(b) Find all \( x \) with \( f(x) = 0 \).

(c) Sketch a graph of \( f \) over the interval \( 0 \leq x \leq 7 \).

**Problem 2:** Which of (I) - (V) are antiderivatives of \( 1/x \) for \( x > 0 \)?

(I) \( \ln x \) \hspace{1cm} (II) \( -1/x^2 \) \hspace{1cm} (III) \( \ln x + \ln 3 \) \hspace{1cm} (IV) \( \ln(2x) \) \hspace{1cm} (V) \( \ln(x+1) \)

**Problem 3:** Compute the following indefinite integrals. Remember the constant of integration!

(a) \( \int (z + e^z) \, dz \) \hspace{1cm} (b) \( \int (2 + \cos t) \, dt \) \hspace{1cm} (c) \( \int \left( \frac{3}{x^2} - \frac{2}{x^3} \right) \, dx \)

**Problem 4:** Compute the following indefinite integrals. Remember the constant of integration!

(a) \( \int (y^2 + 3)^2 \, dy \) \hspace{1cm} (b) \( \int \left( \frac{x+1}{x} \right) \, dx \) \hspace{1cm} (c) \( \int t^3(t^2 + 1) \, dt \)

**Problem 5:** Determine if the following statements are True or False. Be sure to show your work.

(a) \( \int \left( 3\sqrt{x} + \frac{5}{x^2} \right) \, dx = 2x^{3/2} + \frac{5}{x} + C \) \hspace{1cm} (c) \( \int x \cos x \, dx = \frac{x^2}{2} \sin x + C \)

(b) \( \int e^{2x} \, dx = 2e^{2x} + C \)

*Hint: trying to integrate the left hand side might not be the most efficient way to solve this problem.*
Problem 6: Evaluate the following definite integrals exactly.

(a) \[ \int_0^{\pi/4} (\sin t + \cos t) \, dt \]  
(b) \[ \int_1^3 \frac{1}{x} \, dx \]

Problem 7: Compute the following derivatives.

(a) \[ \frac{d}{dt} \int_\pi^0 4 \sin(\sqrt{x}) \, dx \]  
(b) \[ \frac{d}{dx} \int_1^t \ln(t^2 + 1) \, dt \]

Problem 8: Consider the function \( F(x) = \int_0^x e^{-t^2} \, dt \).

(a) Find the intervals where \( F(x) \) is increasing and decreasing.
(b) Find the intervals where \( F(x) \) is concave up and concave down.

Problem 9: Evaluate the following indefinite integrals.

(a) \[ \int (2x - 7)^3 \, dx \]  
(b) \[ \int \sin(3t)\sqrt{\cos(3t)} \, dt \]  
(c) \[ \int \frac{e^{\sqrt{y}}}{\sqrt{y}} \, dy \]

Problem 10: Evaluate the following definite integrals exactly.

(a) \[ \int_0^{\pi/2} \cos(\pi x) \, dx \]  
(b) \[ \int_0^2 \frac{y}{(1 + y^2)^2} \, dy \]

Problem 11: Evaluate the following indefinite integrals.

(a) \[ \int z(z + 1)^{1/3} \, dz \]  
(b) \[ \int \frac{3x - 2}{\sqrt{2x + 1}} \, dx \]

Problem 12: Suppose \( \int_0^1 f(t) \, dt = 3 \). Calculate the following:

(a) \[ \int_0^{0.5} f(2t) \, dt \]  
(b) \[ \int_0^1 f(1 - t) \, dt \]  
(c) \[ \int_1^{1.5} f(3 - 2t) \, dt \]

Note: you do have enough information to exactly calculate each of these integrals.