(1) (6 points each) Differentiate the function.
   (a) \( f(x) = \frac{4}{\sqrt{x}} - \ln(7x + 1) + 4e^{-x} + \sin^{-1}(x) \)

   (b) \( f(x) = 6\tan(x^2) - 8\sec(2x) \)

   (c) \( f(x) = 12 - x + \cos^2(3x + 2) \)

(2) (8 points each) Differentiate the function.
   (a) \( f(x) = \frac{x^3 - 4x + 5}{1 + x^2} \)

   (b) \( f(x) = 12e^{10 - 3x} \sin(4x + 1) \)
(3) (8 points each) Differentiate the function.
\( f(x) = \ln \left( \frac{(x^2 - 4)^3}{\sqrt{1 + x}} \right) \)

(b) \( f(x) = (\cos x)^{3x} \)

(4) (10 points) Use implicit differentiation to find \( y' \):
\[ \sin(x + y) = x^2 - y^2 \]
(5) (20 points) An object is moving along a line. Its position at time $t$ is given by the equation of motion $s(t) = t(t - 9)^2$, $0 \leq t \leq 12$, where $s$ is in meters and $t$ is in seconds.

(a) Find the average velocity for the first 12 seconds.
(b) Find the velocity function $v(t)$ and the acceleration function $a(t)$.
(c) When is the velocity equal to zero?
(d) When is the object moving in the positive direction?
(e) When is the velocity increasing?
(f) Find the total distance traveled.
(g) Sketch the graph of $s(t)$. 
(6) (20 points) A light is used to illuminate a wall. The light is located at ground level, a distance 12 m from the bottom of the wall. A person of height 1.8 m is walking from the light on a line perpendicular to the wall, and the light casts a shadow of the person on the wall.

(a) Draw a sketch, name the important variables and identify the important constants.

(b) If the person is walking at the speed 1.2 m/s, find the rate of change of the height of the shadow on the wall at the instant when the person is 9 m from the light.

(c) Is the height of the shadow increasing or decreasing?