Show all work for full credit. You may use a basic function calculator. No scientific or graphing calculators are allowed. No notes or books are allowed.

(5 pts) 1. State the definition of $f'(x)$.

2. Find the derivative of the following functions.

(6 pts) a. $y = xe^{2x}$

(6 pts) b. $y = 3\sqrt{x}$
(6 pts) c. $f(x) = \cos(\ln(3x + 4))$

(6 pts) d. $g(x) = \frac{(3 - 2x)^2}{\sqrt{x + 1}}$

(6 pts) e. $y = x^{\sin(x)}$
(15 pts) 3. Find the equation of the line tangent to the curve $y = e^{2x} + 1$ at $x = 0$.

(6 pts) 4. If $f(x) = 3\sqrt{x^3}$, find $f''(x)$. 
5. Find \( \frac{dy}{dx} \) using implicit differentiation.

(6 pts) a. \( 4 \cos x \sin y = 1 \)

(6 pts) b. \( x^2y + xy^2 = 3x \)
(12 pts) 6. The graph of \( f(x) \) is given.

![Graph of f(x)]

a. Find \( f'(2.5) \)

b. List one point where \( f'(x) = 0 \).

c. For what values of \( x \) does \( f'(x) \) fail to exist?
(10 pts) 7. The edge of a cube is 10 cm with a possible error in measurement of 0.1 cm. Use differentials to estimate the maximum possible error in computing

(5 pts) a. the volume of the cube, and

(5 pts) b. the surface area of the cube.
(10 pts) 8. At noon, ship A is 200 km west of ship B. Ship A is sailing east at 10 km/h and ship B is sailing north at 40 km/h. How fast is the distance between the ships changing at 5:00 PM?