1. (10 pts.) The graph below shows the velocity, \( v = f(t) \), of a particle moving along a coordinate line. Explain your reasoning for each question below.

![Graph showing velocity over time](image)

(a) When does the particle move forward? Backward?
(b) When does the particle speed up? Slow down?
(c) When does the particle move at its greatest speed?
(d) When does the particle stand still for more than an instant?

2. (10 pts.) A road running north to south crosses a road going east to west at the point P. Car A is driving south along the first road, and car B is driving east along the second road. At a particular time car A is 10 miles to the south of P and traveling at 60 miles/hr, while car B is 15 miles to the east of P and traveling at 10 miles/hr. How fast is the distance between the two cars changing at that time?

3. (15 pts.) Find where the curve \( y = \tan(x) + 2x \) has a horizontal tangent in the interval \((\frac{-\pi}{2}, \frac{\pi}{2})\).

4. (15 pts.) The graph of the equation \( x^2 - xy + y^2 = 16 \) is an ellipse. Find the lines tangent to this curve at the two points where it intersects the x-axis. Show that these lines are parallel.

5. (5 pts.) Let \( f(x) = \cos(3x) \). Find \( dy \) if \( a = \frac{\pi}{2} \) and \( dx = \frac{\pi}{100} \).

6. (5 pts.) Given \( f(0) = 5 \), and \( f'(0) = 2 \) find the derivative of 
\[
g(x) = \frac{\sin^{-1}(x) + 3x}{f(x)} \text{ at } x = 0.
\]
7. (5 pts. each) Find $y'$. Show your work and only do obvious simplifications.

(a) $y = (x^3 + 4x)^5$
(b) $y = (\ln(\sqrt{x}))^4$
(c) $y = xe^{\cos(x)}$

8. (5 pts. each) Find $\frac{dy}{dx}$ in each of the following equations.

(a) $\ln(xy) + y^2 = 3x$
(b) $y = (\cos(x))^{\sin(x)}$

9. (5 points) Let $f(x) = \log_5(x^3)$. Find $f''(x)$.

10. (10 points) Consider $y = (x^2 + 1)^{3x}$.

(a) Explain why $y' \neq 3x(x^2 + 1)^{3x-1}(2x)$.
(b) Find $y'$