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.

(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 north along the first road, and car B is driving east along the second road. At a particular time car A is 10 kilometers to the north of P and traveling at 80km/hr, while car B is 15 kilometers to the east of P and traveling at 10 km/hr. How fast is the distance between the two cars changing at that time?

3. (15 pts.) Find where the curve \( y = \cot(x) + 2x \) has a horizontal tangent in the interval \((0, \pi)\).

4. (15 pts.) The graph of the equation \( x^2 - xy + y^2 = 9 \) 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 \( f(x) = \sin(2x) \). Find \( dy \) if \( a = \pi \) and \( dx = \frac{\pi}{100} \).

6. (5 pts.) Given \( f(0) = 3 \), and \( f'(0) = 4 \) find the derivative of \( g(x) = \frac{\sin^{-1}(x) + 2x}{f(x)} \) at \( x = 0 \).
7. (5 pts. each) Find $y'$. Show your work and only do obvious simplifications.
   
   (a) $y = (x^2 + 5x)^4$
   (b) $y = xe^{\sin(x)}$
   (c) $y = (\ln(\sqrt{x}))^3$

8. (5 pts. each) Find $\frac{dy}{dx}$ in each of the following equations.
   
   (a) $\ln(xy) + y^3 = 4x$
   (b) $y = (\sin(x))^{\cos(x)}$

9. (5 points) Let $f(x) = \log_4(x^2)$. Find $f''(x)$.

10. (10 points) Consider $y = (x^2 - 3)^{4x}$.
    
    (a) Explain why $y' \neq 4x(x^2 - 3)^{4x-1}(2x)$.
    (b) Find $y'$