EMT111 - Practice Problems #4

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1. If a ball is thrown into the air with a velocity of 40 ft/s, its height (in feet) after t seconds is given by $y = 40t - 16t^2$.
   Find the velocity when $t = 2$.

2. If a cylindrical tank holds $100,000$ gallons of water, which can be drained from the bottom of the tank in an hour, then Torricelli's Law gives the volume V of water remaining in the tank after t minutes as

   $$V(t) = 100,000\left(1 - \frac{t}{60}\right)^2, 0 \leq t \leq 60$$

   Find the rate at which the water is flowing out of the tank as a function of t. For times $t = 0$, 10, 20, 30, 40,50, and 60 min, find the flow rate and the amount of water remaining in the tank.

3. Use the definition of the derivative as a limit of a difference quotient to compute the derivative of $y = x + \frac{1}{x}$ for all points $x > 0$.

4. Find all points on the graph of the function

   $$f(x) = 2\sin x + \sin^2 x$$

   at which the tangent line is horizontal.

5. For the function $f(x) = e^{-\frac{x^2}{2}}$,compute the first, second and third derivatives of $f(x)$.

6. For each of the following functions compute the derivative :

   (a) $y = 4\pi^2$

(b) $y = \sin x + 10 \tan x$

(c) $y = \frac{x}{\cos x}$

(d) $y = \sin(x \cos x)$

(e) $y = \tan(\sin x)$

(f) $f(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$

(g) $y = \sqrt{1 + x^{1234}}$

(h) $f(x) = x \ln x - x$