No book, notes or calculators are alllowed. Show all your work.

(20)   1. Evaluate the following limits.

(a) $\displaystyle\lim_{x\to 0} \frac{\sin^2 x}{x^2}$

(b) $\displaystyle\lim_{x\to 0} \frac{x}{\sqrt{1+x}-\sqrt{1-x}}$

(20)   2. Write an equation of the tangent line to the curve $f(x) = (\frac{x}{x-3})^{\frac{3}{2}}$ at the point $(4, 8)$. Is function $f(x)$ increasing or decreasing at this point?

(20)   3. Find all points on the graph of the function $f(x) = x\sqrt{2 - x}$ where the tangent line is either vertical or horizontal. What is the domain of this function? Where is it continous? Where is it differentiable?

(20)   4. Differentiate the following functions. You do not need to simplify.

(a) $\sin^2 t \cos t^3$

(b) $\tan(\sin x)$

(20)   5. A ball is thrown up in the air with the initial velocity of 40ft/s, its height (in feet) after t seconds is given by $y = 40t - 16t^2$. Find the velocity of the ball at the moment when it hits the ground.