Question 1 [10 points]: Use the definition of the derivative to determine $f'(x)$ if $f(x) = \frac{5}{x+7}$. (No credit will be given if $f'(x)$ is found using derivative rules, though you may check your answer using the rules.)

Question 2: Differentiate the following functions. It is not necessary to simplify final answers, but marks will be deducted for improper use of notation.

(a)[3 points] $f(x) = 3\sqrt{x} - \dfrac{2}{3x} + \pi^2$

(b)[3 points] $y = (t^3 - 3\cos t)(t-1)^4$

(c)[4 points] $g(r) = \dfrac{r^2 - \sqrt[3]{r}}{\tan r}$

Question 3: Differentiate the following functions. It is not necessary to simplify final answers, but marks will be deducted for improper use of notation.

(a)[3 points] $f(x) = \sin(x \cos x)$

(b)[3 points] $y = \sqrt{\pi^2 + \sec(2t)}$

(c)[4 points] $g(\theta) = \tan(\theta - \sin(\sqrt{\theta}))$

Question 4:

(a)[5 points] Determine the equation of the tangent line to the curve

$$y^3(x^2 + y^2) = 1 + x^4 y$$

at the point $(1, 1)$.

(b)[5 points] The position of a particle along a straight line at time t is given by

$$s(t) = \frac{t^3}{3} + qt(t + 1)$$

where q is a constant. At time $t = 1$ the velocity and acceleration are the same. Determine the value of the constant q.

Question 5:

(a)[5 points] Bart and Milhouse begin walking from the same point at the same time. Bart walks north at 2 m/s, while Milhouse walks east at 1 m/s. At what rate is the distance between Bart and Milhouse increasing 5 seconds after they begin walking?

(b)[5 points] At what values of x in the interval $[0, 2\pi]$ are tangent lines to the curve $y = \sin x + \cos x$ horizontal?