Differentiate and simplify where appropriate:

1. (7pts) $\dfrac{d}{dx}\left((x^3 + 4x^2)e^x\right) =$

2. (8pts) $\dfrac{d}{dx}\dfrac{x^2 + 5x - 4}{3x - 5} =$

3. (7pts) $\dfrac{d}{dt}\dfrac{1}{\sqrt{t^4 + 4t^2 + 1}} =$

4. (8pts) $\dfrac{d}{d\theta}\dfrac{e^{-2\theta}}{\sin(5\theta)} =$

5. (8pts) $\dfrac{d}{dx}\tan\left(\sqrt{x^7 - \sqrt[3]{x}}\right) =$

6. (10pts) Find the equation of the tangent line to the curve $y = \sin^2 x$ at the point $x = \frac{\pi}{3}$.

7. (14pts) A golf ball is shot upward with inital velocity 30 meters per second.
a) Write the formula for the position of the ball at time t (you may assume $g \approx 10$).
b) Write the formula for the velocity of the ball at time t.
c) When does the ball have upward velocity $10\frac{m}{s}$? At what height is it at that moment?

8. (14pts) The body surface area A (in meters squared) of a person 196cm tall is given by the formula $A = \frac{7\sqrt{w}}{30}$, where w is the weight of the person in kilograms.

a) Find the body surface area of a person weighing 81kg.

b) Find the ROC of the body surface area with respect to weight when $w = 81$ (units?).

c) Use b) estimate the change in body surface area if weight changes by 2kg.

d) Use c) to estimate the body surface area of a person weighing 83kg .

9. (12pts) Find $g''\left(\frac{\pi}{4}\right)$, if $g(x) = \dfrac{\sin x}{\sin x + \cos x}$.

10. (12pts) Let $f(x) = x^{-\frac{3}{2}}$.

a) Find the first four derivatives of f.

b) Find the general formula for $f^{(n)}(x)$.

Bonus. (10pts) Use the product rule to establish the quotient rule. To do this, let $h = \frac{f}{g}$, so $hg = f$. Take the derivative of both sides of the last equation, and solve for h', expressing the solution only in terms of f and g.