# Week 5 - some practice problems

**June 2016**

1. Find the following derivatives:
   (a) $\dfrac{da^x}{dx}$ where $a$ is a constant.
   (b) $\dfrac{dx^a}{dx}$ where $a$ is a constant.
   (c) $\dfrac{d}{dx}\left(\dfrac{x^e+\pi}{\sin(\pi x^2)}\right)$
   (d) $\dfrac{d}{dx}\left(\cos(x^2+1)\sin(x^2-1)\right)$
   (e) $\dfrac{d}{dx}\left(\sin(\tan(log(x^4+5)))\right)$

2. Fleas are amazing jumpers. These are wingless insects that are abour 2-3mm long. But a flea can jump vertically up to $180mm$. Assuming that once the flea jumps its vertical position is given by $s(t) = -5t^2 + V_0 t$, find the velocity at $t = 0$, i.e. $V_0$.

3. Find all the critical numbers of the function
$$f(x) = \begin{cases} 2x^3 - 3x^2 - 12x & x \leq 0 \\ e^{-11x}(1-x) - 1 & x > 0 \end{cases}$$

4. Sketch the graph of $f(x) = x^{2/3}e^x$.

5. Find all horizontal and vertical asymptotes of $y = \dfrac{(\sqrt{x^2+x+3}-3)(2x+1)}{x^2-4}$.

6. Assuming that $f(1) = 2$, $f'(1) = 3$, find the slope of the tangent line to $f^{-1}(x)$ at $x = 2$.