

## A piece of Pi – An elicitation activity for Applications of Differential Calculus

International Pi Day – 14<sup>th</sup> March 2013

Hello everyone,

Pi day is the 14<sup>th</sup> March and to celebrate I have decided to put together this elicitation activity that gets you thinking about some of the fundamental rules you will be learning in the second topic “Applications of Differential Calculus”. While some questions probe more at your understanding of rates of change, the main emphasis here is on differentiating  $e^x$  and  $\ln x$ , as these values have real world applications.

The back-story behind (what I hope you will find) an exciting investigation is that Pi is having his friends  $e^x$  and  $\ln x$  over for a party to celebrate the annual Mathematical tradition. However, Pi needs your help as planning a party is not as easy as one would think. Only your mathematical talent and logic can help Pi ensure that the party is a success.

In this document, you should learn the following new rules that you can add to your already existing differential calculus knowledge.

$$f'(e^x) = e^x$$

$$f'(e^{-x}) = e^{-x} (-1)$$

$$f'(\ln x) = \frac{1}{x}$$

$$f'(e^{f(x)}) = e^{f(x)} (f'(x))$$

$$f'(\ln f(x)) = \frac{f'(x)}{f(x)}$$

$$f'(\ln kx) = \frac{k}{kx} = \frac{1}{x}$$

Where  $k$  is a constant

First off, which rules of the above do you already know? Consider which ones you don't? Hopefully by the end of this document you will have some familiarity with these ideas. Now this document goes hand in hand with the videos I have made for Mathematical Studies. You can access my YouTube channel here:

<http://www.youtube.com/user/davidmcafee42/videos?view=0&flow=grid> . These may help if you get stuck while helping Pi plan the party.

- Differentiating  $\ln x$  (Part 1 and 2)
- Differentiating  $e^x$  (Part 1 and 2)

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8. At the party, there is some dispute between functions, some believe that the  $dy/dx$  of  $\ln 7x$  would be  $7 \ln x$ , while others believe that the derivative of  $\ln 7x$  would be  $1/7$ . Which group is correct? Provide proof where  $k$  is a constant to ensure that no one disputes your claim.

9. At the party, Pi is responsible for picking the songs on the playlist. His jukebox is encoded with a program that relies on entering the derivative of a function to play the correct song. Find the derivative of the following functions based on the rules on the first page so Pi can play the correct songs.

\*NOTE, all those cool rules that you learnt from your last module – product, quotient and chain, can all be used here. Just add them and the new rules into the picture and you will be finding derivatives in no time\*

- $y = e^{4x}$
- $y = \ln 7x$
- $y = 5e^{6x}$
- $y = (e^x) / (2 \ln x)$
- $y = 15 e^x - \ln (9x^2 - 6x)$
- $y = (6e^x + 6) / (\ln (8x+1))$

