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Exam 2 - MAC 2311

Spring 2014

**Important Rules:**

1. Unless otherwise mentioned, to receive full credit you **MUST SHOW ALL YOUR WORK**. Answers which are not supported by work might receive no credit.
2. Please turn your cell phone off at the beginning of the exam and place it in your bag, **NOT** in your pocket.
3. No electronic devices (cell phones, calculators of any kind, etc.) should be used at any time during the examination. Notes, texts or formula sheets should **NOT** be used either. Concentrate on your own exam. Do not look at your neighbor's paper or try to communicate with your neighbor. Violations of any type of this rule will lead to a score of 0 on this exam.
4. Solutions should be concise and clearly written. Incomprehensible work is worthless.

1. (10 pts) The function  $h(x)$  is given by  $h(x) = \frac{x^2}{f(x)}$ . It is known that  $f(2) = 3$  and  $f'(2) = 2$ . Compute

(a) (3pts)  $h(2)$

(b) (7pts)  $h'(2)$

2. (10 pts) Show that  $y = x \sin x$  satisfies the equation  $y'' + y = 2 \cos x$ .

3. (36 pts) Find the derivative of each of the following functions. Simplify your answer when possible (6 pts each):

(a)  $y = 5x^4 - \frac{4}{\sqrt{x}} + \frac{e^3}{3}$

(b)  $y = x \arctan(x^2)$

(c)  $y = \ln(\sec x + \tan x)$

(d)  $y = \sqrt{1 + \sin^2(3x)}$

(e)  $y = e^{x^e}$

(f)  $y = \log_x 2$

5. (14 pts) A certain population of bacteria evolves according to the function  $P(t) = 500e^{0.3t}$ , where  $t$  is the time in hours since an initial moment  $t = 0$ .

(a) (6 pts) Show that the rate of change of the population is proportional to its size.

(b) (8 pts) Find the time when the population doubled compared to its initial size and find the rate of change of the population at this time. (Please give units to your answer. OK if the time is left as logarithm.)

5. (14 pts) (a) (8 pts) Use implicit differentiation to find  $dy/dx$  for the Folium of Descartes  $x^3 + y^3 = 3xy$ .

(b) (6 pts) At what point(s) in the first quadrant is the tangent line to the Folium of Descartes vertical?

6. (10 pts) Find, with proof, a formula for  $(\arccos x)'$ .

7. (10 pts) A 10-meter ladder is leaning against a wall. If the bottom of the ladder is pulled along the ground away from the wall at a constant rate of 2 m/s, how fast will the top of the ladder be moving down the wall when it is 8 m above the ground?

8. (10 pts) Find the tangent line at  $(2, 2)$  to the curve  $x^y + y^x = 8$ .