Sample Midterm 1 MTH 228*

October 11, 2017

Name:

This is a closed book exam and the use of formula sheets or calculators is not permitted.

The first 6 problems are multiple choice problems, each worth 5 points. Please circle the right answer (there is exactly one for each problem). The last 2 problems require that you show all work, and will receive partial credit. They are worth 15 points each.

1. The derivative of the function $e^{\cos x}$ is

- $e^{-\sin x}$,
- $-\sin x e^{\cos x}$
- $\cos x e^{\cos x}$
- $-\sin x e^{-\sin x}$

2. The derivative of the function $^{1}\tan x$, where $x \neq \frac{\pi}{2} + k\pi$ and $k$ is any integer, is

- $\cot x$
- $-\cot x$
- $\frac{\sin^2 x - \cos^2 x}{\cos^2 x}$
- $\frac{1}{\cos^2 x}$

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1Recall that $\tan x = \frac{\sin x}{\cos x}$ and $\cot x = \frac{\cos x}{\sin x}$.
3. The derivative of the function $e^{2x} \cos(3x)$ is

- $e^{2x} (2 \cos(3x) - 3 \sin(3x))$
- $-6 e^{2x} \sin(3x)$
- $e^{2x} (2 \cos(3x) + 3 \sin(3x))$
- $e^{2x} (\cos(3x) - \sin(3x))$

4. The function $f(x) = \frac{1}{3}x^3 - x$, $-2 \leq x \leq 2$

- has a local minimum at $x = 1$ and a local minimum at $x = -1$.
- has a local maximum at $x = 1$ and a local maximum at $x = -1$.
- has a local minimum at $x = 1$ and a local maximum at $x = -1$.
- has a local maximum at $x = 1$ and a local minimum at $x = -1$.

5. The function $f(x) = \frac{1}{3}x^3 - x$, $-2 \leq x \leq 2$

- has a unique global maximum at $x = -1$ and a unique global minimum at $x = 1$.
- has two global maxima at $x = -1$ and at $x = 2$, and two global minima at $x = -2$ and at $x = 1$.
- has no global maxima or global minima.
- has a unique global maximum at $x = 2$ and a unique global minimum at $x = -2$.

6. The function $f(x) = \cos x$, $0 \leq x \leq \pi$,

- has no inflection points.
- has an inflection point at $x = \frac{\pi}{4}$.
- has an inflection point at $x = \frac{\pi}{2}$.
- has two inflection points at $x = 0$ and at $x = \pi$.

7. Show that the following logistic “growth” curve:

$$N(t) = \frac{2}{2 - e^{-t}}, \quad t \geq 0$$

is always decreasing.

8. An ornithologist wants to determine the optimal clutch size of an exotic bird, knowing that clutch fitness, as a function of the number of eggs $N$ is given by:

$$F(N) = N e^{-N/4}$$

Help her determine the optimal clutch size.