## Math 229 Calculus Computer Lab Spring 15 Midterm 3a

**Name:** Solutions

- I will count your best 5 of the following 6 questions.
- You may only use `julia` during this exam. No calculators or cell phones or notes.

| | | |
|---|---|---|
| 1 | 10 | |
| 2 | 10 | |
| 3 | 10 | |
| 4 | 10 | |
| 5 | 10 | |
| 6 | 10 | |
| | 50 | |

| | |
|---|---|
| Midterm 3 | |
| Overall | |

(1) Convert the following `julia` expressions to standard mathematical expressions. Use parentheses to clearly indicate the order of operations:

(a) `a+b/2c-b/2`

$$a + \frac{b}{2c} - \frac{b}{2}$$

(b) `sin(1/2*x^2)*1/2x^2`

$$\frac{\sin\left(\frac{x^2}{2}\right)}{2x^2}$$

(c) `x/y/z-y/2*3`

$$\frac{x}{yz} - \frac{3y}{2}$$

(2) Consider the function $f(x) = e^{x/2} - x - x^2$. Use `julia` to find all the critical points; write both the `julia` commands and your answers.

```
f(x) = e^(x/2) - x - x^2
plot(f, -5, 10)
fzero(D(f), 0) : -0.282984...
fzero(D(f), 6) : 6.728709...
```

(3) Consider a function $f(x)$ for that $f'(x) = 10\cos(x) - x^2$. Use `julia` to find all the critical points; write both the `julia` commands and your answers.

```
fp(x) = 10 cos(x) - x^2
plot(fp, -10, 10)
fzero(fp, 2) : 1.379364...
fzero(fp, -2) : -1.379364....
```

(4) Consider the function $f(x) = e^x - e^{-x} - 10x^2$. Where is the function concave up and concave down?

f(x) = e^x - e^(-x) - 10*x^2

plot(f, -5, 7)

fzero(D(f,2), 0) : 2.998222...

concave down on $(-\infty, 2.998222\ldots)$

concave up on $(2.998222\ldots, \infty)$

(5) Use the built in Newton's method `newton(f, fp, x)` to find all zeros of $f(x) = x/2 - 2\sin(x)$, where `fp(x) = D(f)(x)`.

f(x) = x/2 - 2*sin(x)

plot(f, -10, 10)

newton(f, D(f), 2) : 2.474576...

newton(f, D(f), 0) : 0

newton(f, D(f), -2) : -2.474576...

(6) Use the built in Newton's method `newton(f, fp, x)` to find all zeros of $f(x) = 2/\sin(x) - 3/\cos(x)$, where `fp(x) = D(f)(x)`.

$f(x) = 2/\sin(x) - 3/\cos(x)$

plot(f, 0, 2pi - 0.1)

newton(f, D(f), 1) : 0.588002 ....

newton(f, D(f), 4) : 3.729595 ....