Math 122 Practice Exam 1

Index card only portion

Find the derivatives of the following functions.

1. $f(x) = \exp(-2x)\sin(3x)$

$$f'(x) = e^{-2x}\cos(3x)3 + \sin(3x)e^{-2x}(-2)$$
$$= e^{-2x}\left(3\cos(3x) - 2\sin(3x)\right)$$

2. $f(t) = \exp(\sin(3t))$

$$f'(t) = e^{\sin(3t)}\cos(3t)3 = 3\cos(3t)\exp(\sin(3t))$$

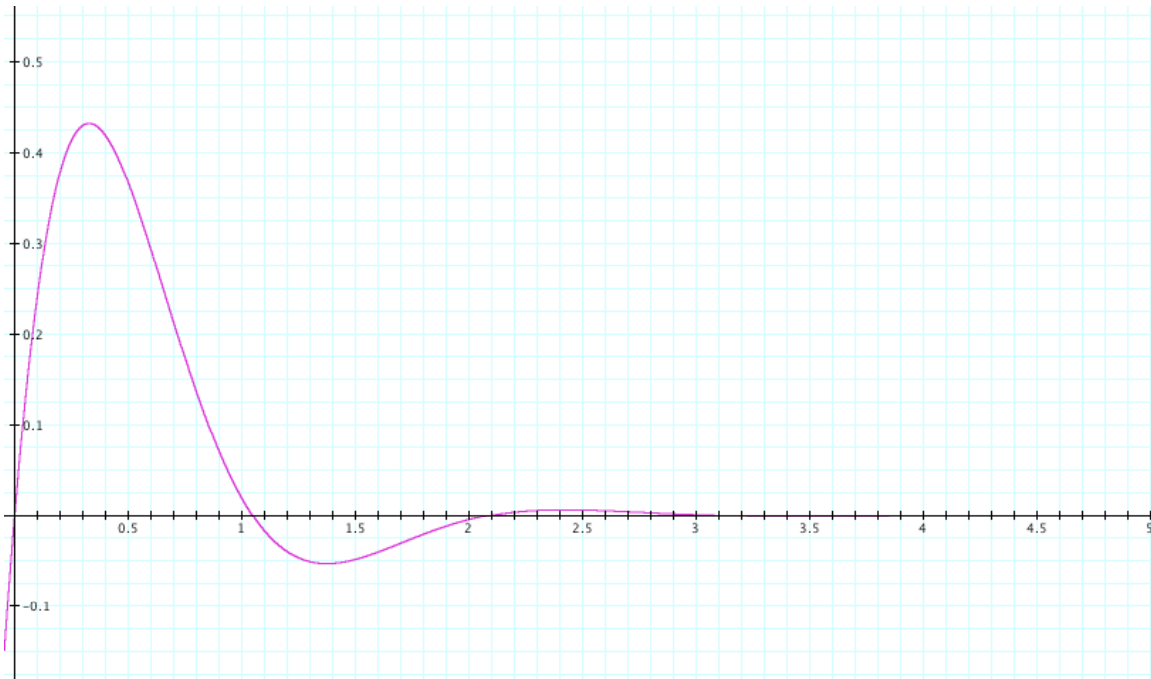To be turned in before obtaining your full computational aids and notes portion.

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Full computational aids and open notes portion

1. Sketch the function

$$f(t) = \exp(-2t)\sin(3t)$$

defined only for values of on x in the interval [0,5]. Find the absolute maximum and minimum correct to 4 figures and the t values where these extreme f values are taken on.

Absolute max at t=0.3276 and f(t) = 0.4321.
Absolute min at t=1.3748 and f(t) = -0.05321.

2. Find a function that repeats every time the variable (t=time) changes by 7 days, has a largest value of 9 when t=5, and oscillates between the maximum value of 9 and the minimum value of 3.

$$f(t) = 6 + 3\sin\left(\frac{2\pi}{7}t - \frac{13\pi}{14}\right)$$

$$= 6 + 3\cos\left(\frac{2\pi}{7}(t - 5)\right)$$

3. A certain bacterial population is undergoing Malthusian growth. If its initial mass is 60 grams and one hour later it weighs 120 grams, how much does it weigh 1.5 hours after the start of the experiment?

$$120\sqrt{2} \approx 169.7 \text{ grams}$$

4. How old is a wooden artefact whose C14 undergoes 11.3 disintegrations per minute per gram?
(Recall that living wood undergoes 15.3 disintegrations per gram per minute and the half life of C14 is 5730 years.)

2505.2 years old.

5. Find the values of the parameters alpha (α) and omega (ω) that make the fit between the following data

t	f(t)		t	f(t)
0	10			
0.1	7.8216336		2.6	0.002976486
0.2	5.5323901		2.7	-0.010999869
0.3	3.411467837		2.8	-0.019202587
0.4	1.628178345		2.9	-0.022665687
0.5	0.260227622		3	-0.022584661
0.6	-0.684319559		3.1	-0.020136525
0.7	-1.244935167		3.2	-0.016361153
0.8	-1.488772236		3.3	-0.012096272
0.9	-1.494421199		3.4	-0.007955313
1	-1.339809149		3.5	-0.004336335
1.1	-1.094158773		3.6	-0.00145084
1.2	-0.813520881		3.7	0.000637146
1.3	-0.539175898		3.8	0.001969231
1.4	-0.298127912		3.9	0.002653429
1.5	-0.104949049		4	0.002830815
1.6	0.035666514		4.1	0.002649673
1.7	0.126143532		4.2	0.002247402
1.8	0.17342172		4.3	0.001739542
1.9	0.186731693		4.4	0.001214734
2	0.175861322		4.5	0.00073419
2.1	0.14993457		4.6	0.000334253
2.2	0.116663285		4.7	3.07389E-05
2.3	0.081995347		4.8	-0.000175971
2.4	0.050065774		4.9	-0.000295881
2.5	0.023356104		5	-0.000344898

and the function

$$f(t) = 10\exp(-\alpha t)\cos(\omega t)$$

as small as possible in the least squares sense.

(The data in this problem is available at http://www-rohan.sdsu.edu/~psalamon/PracT1Data.txt)

$$\alpha = 2$$
$$\omega = 3$$