Applied Calculus

Homework 2

Due in class, September 22, 2015

1. The radioactive gas Radon-222 has a half life of 3.8 days. Initially, there are $2 \cdot 10^9$ atoms in a sample. How many atoms remain after 10 days?

2. (Partially from MLS, p. 277–278.) Compute the following limits, if they exist.

   (a) $\lim\limits_{x\to 1} \dfrac{x^2-1}{x-1}$

   (b) $\lim\limits_{x\to -3} \dfrac{x^2-x+12}{x+3}$

   (c) $\lim\limits_{x\to -3} \dfrac{x^2-x-12}{x+3}$

   (d) $\lim\limits_{h\to 0} \dfrac{(3+h)^2-9}{h}$

   (e) $\lim\limits_{t\to 0} \dfrac{\sqrt{2-t}-\sqrt{2}}{t}$

   (f) $\lim\limits_{x\to 1} \left(\dfrac{2}{1-x^2}+\dfrac{1}{x-1}\right)$

   (g) $\lim\limits_{s\to 0} \left(\dfrac{1}{s\sqrt{s+1}}-\dfrac{1}{s}\right)$

   (h) $\lim\limits_{x\to \infty} \dfrac{3x-2}{x+1}$

   (i) $\lim\limits_{x\to \infty} \dfrac{x+\ln x}{x}$

   (j) $\lim\limits_{s\to -\infty} s^{100}\,\mathrm{e}^s$

   (2 Points each)

3. (Partially from MLS, p. 295.) Determine where $f(x)$ is continuous. If $f(x)$ has a discontinuity, state the type of discontinuity (removable discontinuity, jump discontinuity, vertical asymptote, or other).

(a) $f(x) = x^2 - x - 6$

(b) $f(x) = \dfrac{x^2 - x - 6}{x + 2}$

(c) $f(x) = \dfrac{3^x}{x}$

(d) $f(x) = \begin{cases} x & \text{for } x \leq 1 \\ x + 2 & \text{for } x > 1 \end{cases}$

(e) $f(x) = \begin{cases} \frac{x^2-1}{x-1} & \text{for } x < 1 \\ 2x^2 & \text{for } x \geq 1 \end{cases}$

(2 Points each)

4. (From MLS, p. 296.) To be continuous or not: that is the question.

   (a) When a patient receives an injection, the amount of the injected substance in the body immediately goes up. Comment on whether the function that describes the amount of the drug with respect to time is a continuous function. Justify your reasoning.

   (b) When a person takes a pill, the amount of the drug contained in the pill is immediately inside the body. Comment on whether the function that describes the amount of the drug in the blood stream with respect to time is a continuous function.

5. *Note:* The following two problems problem require the use of *Scientific Python*. An Ipython noteboook from the class session September 3 is available on my web page, it already contains the solution for part (a) below.

   (From MLS, p. 45.) Use the data from the example shown in class.

   (a) Find the equation for the least-squares fit of the y data in terms of the x data.

   (b) Find the equation for the least-squares fit of the x data in terms of the y data.

   (c) Solve the equation in (b) for y in terms of x. Is this the same equation that you obtained in (a)? Explain why you think the answers were the same or different.

   (d) Compute the ρ^2 value in each case and interpret the results.

6. (MLS, Problem 4.14) See attached scan with data.