APPM 1345

Exam 1

Spring 2024

1. (29 pts) Parts (a) and (b) are unrelated.

   (a) Find the most general form of $u(x)$ such that $u''(x) = \sin x + x^{3=4} + 1$.

   (b) Consider a particle that is moving along a linear path. Let t represent the time in seconds, let $s(t)$ represent the position in meters, let $v(t)$ represent the velocity in m=s, and let $a(t)$ represent the acceleration in m=s^2. Suppose the particle is accelerating at a constant rate of $a = 4$ m=s^2, its initial velocity is $v(0) = 2$ m=s, and its initial position is $s(0) = 6$ meters. How many seconds would it take for the particle to move from a position of $s = 6$ meters to a position of $s = 30$ meters? Show the full derivation of your results (do not simply use a formula from a different course).

3. (23 pts) Suppose Newton's Method is used to estimate the value of a root of $y = p(x) = 0{:}05(2x^3 \quad 3x^2 \quad 12x + 5)$.

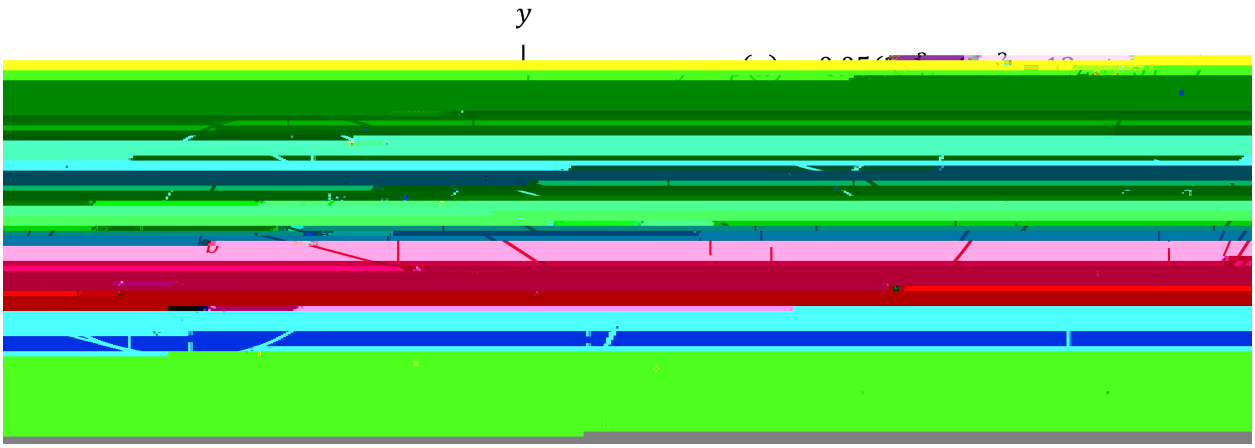
   (a) Write the expression for Newton's Method for the specified function $p(x)$. Your answer should be an expression for x_{n+1} in terms of x_n.

   (b) Use the result from part (a) with a value of $x_0 = 1$ to determine the corresponding value of x_1.

   (c) The following graph of $y = p(x)$ labels four particular x values as constants a through d. The line tangent to $y = p(x)$ at each of those four x values is also shown.

      i. Determine the actual numerical values of the constants b and d, which correspond to horizontal tangent lines.

      ii. Consider using each of the four labeled x values (a through d) as the value of x_0 in Newton's Method. For which of those choices would Newton's Method fail to converge? List all that apply, and in each case, briefly explain why it would not converge.



(Extra workspace for problem 3, if needed)

4. (26 pts) Let $f(x) = (x \quad 1)\sin x + \cos x$ on the interval $[0; \quad]$. Answer the following for the specified interval.

   (a) Identify all critical numbers of $f(x)$.

   (b) For which values of x is $f(x)$ increasing and for which values of x is $f(x)$ decreasing? Express your answers using interval notation.

   (c) Identify the x-coordinate of each local maximum and minimum value of $f(x)$ (if any). Use the First Derivative Test to classify each one.

END OF EXAM

Your Initials _____

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If you write a solution here, please clearly indicate the problem number.