INSTRUCTIONS: Books, notes, and electronic devices are **not** permitted. Write (1) **your full name**, (2) **1340/Final**, (3) **lecture number/instructor name** and (4) **FALL 2019** on the front of your bluebook. Make a **grading table** for 5 problems and a total. Do all problems. **Start each problem on a new page.** **Box** **your answers.** A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. **Justify your answers, show all work.**

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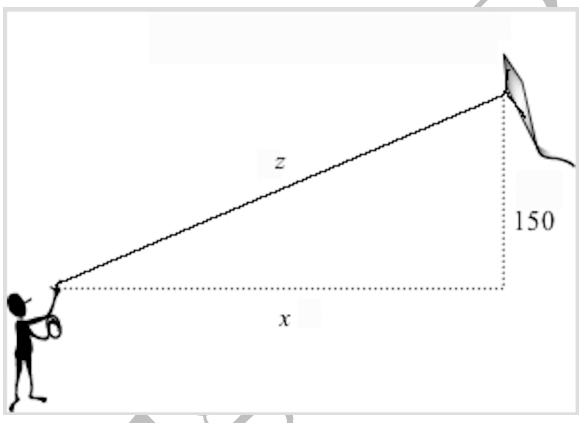
1. (35pts) The following problems are not related.

   (a)(16pts) Consider the following problem: *Ralphie flies a kite at a constant height of* 150 *ft above the ground with the wind carrying the kite horizontally away from Ralphie at a rate of 25 ft/sec. How fast must Ralphie let out the string when 250 ft of string is out?* **Now answer the following questions:** (*i*)(4pts) Write down the information that is given in this problem (use the notation established in the diagram below). (*ii*)(4pts) Write down what you are trying to find in this problem. (*iii*)(8pts) Solve the problem. Simplify your answer. (*Hint:* Recall that $3^2 + 4^2 = 5^2$)



Problem 1: Figure for problem 1(a). The kite is kept at a constant height of 150ft above the ground

   (b)(16pts) Find the *linearizaton* $L(x)$ of $f(x) = \sqrt[3]{1+x}$ at $x = 0$ and use it to approximate $\sqrt[3]{0.95}$

   (c)(3pts) Which choice below is the correct *derivative* of $f(x) = \dfrac{3x+2}{2x+3}$? (**No justification necessary** - *Choose only one answer, copy down the entire answer.*)

   (A) $f'(x) = -\dfrac{1}{(2x+3)^2}$ (B) $f'(x) = \dfrac{3}{2}$ (C) $f'(x) = \dfrac{13}{(2x+3)^2}$ (D) $f'(x) = -\dfrac{5}{(2x+3)^2}$ (E) $f'(x) = \dfrac{5}{(2x+3)^2}$

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2. (34pts) The following problems are not related.

   (a)(17pts) Suppose x represents the edge length of a metal cube. (*i*)(8pts) If $V(x) = x^3$ find dV, the *differential* of V. (*ii*)(9pts) Suppose the edge of the cube was originally found to be 10 cm in length but expands due to heat to 10.01 cm, use differentials to estimate the change in the volume, ΔV.

   (b)(17pts) Find the *absolute minimum* and *absolute maximum values* of $f(x) = x^3 + 6x^2 + 1$ on the interval $[-1, 1]$. Give your answer in the form (x, y). Show all work, justify your answers and clearly label your answers.

PROBLEMS #3, #4 & #5 ON THE OTHER SIDE

3. (34pts) The following problems are not related.

(a)(17pts) (*i*)(8pts) State the *Mean Value Theorem*. (*ii*)(9pts) Find all numbers c that satisfy the conclusion of the Mean Value Theorem for the function $g(x) = 1/x$ over the interval $[1, 3]$.

(b)(17pts) Suppose $y = f(x)$, use *implicit differentiation* to find y' if $\cos(xy) = 1 - \sin(y)$.

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4. (35pts) The following problems are not related.

(a)(16pts) Is the function $f(x) = \begin{cases} \dfrac{\sin(x)}{6x}, & \text{if } x < 0 \\ \dfrac{x^2 + x + 2}{6x^2 + 12}, & \text{if } x \geq 0 \end{cases}$ *continuous* at $x = 0$? Justify your answer with <u>limits</u>.

(b)(16pts) (*i*)(8pts) Write down the *piecewise* definition of the function $g(x) = |x^2 - 1|$.

(*ii*)(8pts) Find the derivative of $g(x) = |x^2 - 1|$.

(c)(3pts) The function $h(x) = \dfrac{3x + 1}{\sqrt{4x^2 + 5}}$ has a *horizontal asymptote* at which choice below? (**No justification necessary** - *Choose only <u>one</u> answer, copy down the entire answer.*)

(A) $y=0$ (B) $y=\dfrac{3}{2}$ (C) $y=0$ and $y=3/2$ (D) $y=-3/2$ and $y=1.5$ (E) None of these

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5. (12pts) Answer either **ALWAYS TRUE** or **FALSE**. You do <u>NOT</u> need to justify your answer. (*Don't just write down "A.T." or "F", completely write out the words "ALWAYS TRUE" or "FALSE" depending on your answer.*)

(a)(3pts) If $f(x)$ is *continuous* at $x = a$ then $f(x)$ is *differentiable* at $x = a$.

(b)(3pts) $\lim\limits_{h \to 0} \dfrac{\sec(x + h) - \sec(x)}{h} = \sec(x)\tan(x)$.

(c)(3pts) Suppose the position function of a particle (at time $t \geq 0$ in seconds) is given by $s(t) = t^2 - t$ meters, then the *total distance* traveled during the time period $0 \leq t \leq 1$ by the particle is 0.25 meters.

(d)(3pts) If $f(x) = \sqrt{2x + 3}$ and $g(x) = x^2 + 5$, then $(f \circ g)(x) = \sqrt{2x^2 + 13}$ for all real numbers x.

The list of Appm 1340 <u>Lecture Numbers</u> for the front of your blue book:

Lecture #	Instructor	Class Time	Class Location
150	Bhat	MWF 12-12:50	ECCR 135
160	Bhat	MWF 1-1:50	ECCR 135

— END —