Math 165   Student name: _____

Practice Final Exam   Instructor & Section: _____

This test is closed book and closed notes. A (graphing) calculator is allowed for this test but cannot also be a communication device (e.g., your cellphones or tablets are not calculators). Answer each question completely using **exact values***. You do not need to simplify your answers unless otherwise indicated. Show your work (legibly);* **answers without work and/or justifications will not receive credit***. Each problem is worth 10 points for a total of 80 points.*

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DO NOT BEGIN THIS TEST UNTIL INSTRUCTED TO START

Do not write
in these boxes ⟶
on the exam

score

1. Find $\dfrac{d}{dx}\left(\dfrac{x^{\sin(x)}\cos(x)}{e^{3x}+5}\right).$

score

2. Find $\displaystyle\int_{1}^{3\sqrt{3}} \frac{dy}{y^{2/3}(y^{2/3} + 1)}$.

3. Find $\displaystyle \lim_{t \to 0} \frac{t^2 + 2\ln(\cos t)}{t^4}$.

score

4. Consider the function $h(x) = \dfrac{e^x}{4x^2 + 3}$.

(a) Determine the (maximal) intervals where the function is increasing and, similarly, where the function is decreasing.

(b) Find and classify the x-coordinates of the critical point(s) of $h(x)$.

score

5. Find and verify the value of $a > 0$ so that the *average value* of $f(x) = 30x - 4x^3$ on the interval $0 \leqslant x \leqslant a$ is maximal.

score

6. Rewrite the following as a *single* integral, i.e., of the form $\int_a^b f(u)\,du$:

$$\int_0^{\ln(3)} e^x f(e^x)\,dx + \int_3^6 \sin(2\pi x)f\big(\sin(\pi x)\big)\,dx + \int_6^{10} \tfrac{1}{2}f\big(8 - \tfrac{1}{2}x\big)\,dx.$$

score

7. In this problem use Newton's method to approximate a root to $f(x) = x^3 + 7x - 3$.

(a) Give the recurrence for x_{n+1} as a function of x_n. (The answer should not use "f".)

$$x_{n+1} = x_n - \frac{x_n^3 + 7x_n - 3}{3x_n^2 + 7} = \frac{2x_n^3 + 3}{3x_n^2 + 7}$$

(b) Starting with $x_0 = 2$, give the *exact* value of x_3.

$x_1 = 1, \quad x_2 = \tfrac{1}{2}, \quad x_3 = \tfrac{13}{31}$

8. Given that $y' = (y + 1)e^x$ and that $y(0) = e - 1$, find an expression for $y(x)$.