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**. *First four problems are worth 10 points, remaining are worth 15 points for a total of 100 points.*

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DO NOT BEGIN THIS TEST UNTIL INSTRUCTED TO START

Do not write in these boxes on the exam $\longrightarrow$

score

1. Find $\lim_{t \to 0} \dfrac{e^{2t} - 1 - 2t}{1 - \cos(3t)}$.

score

2. Find $\int_0^{\pi/4} \left(2 - \sec^2(\theta)\right)^{1/2} \sec^2(\theta)\, d\theta$. (Hint: recall that $\tan^2(\theta) + 1 = \sec^2(\theta)$.)

score

3. (a) Find the linearization to $f(x) = x^{1/5}$ at $x = 32$.

(b) Use the linearization from (a) to estimate $(34)^{1/5}$.

score

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

score

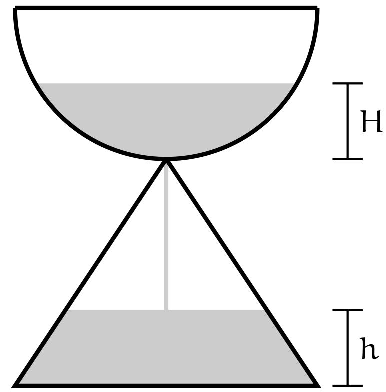
5. Determine the absolute max and min for $f(x) = x - |x^2 - 5x - 6|$ for $0 \leqslant x \leqslant 7$.

score

6. Suppose the weight of a cloud in tons after t hours, denoted $W(t)$, decreases proportionally to its surface area and that this process speeds up over time until the cloud is completely gone. We can approximate this behavior with the differential equation $W' = -\frac{5}{3}tW^{2/3}$. Given that the cloud initially weights 1000 tons, how many hours until the cloud is completely gone?

score

7. To help focus on studying for calculus you have recently purchased an hourglass as an aide to measure time with a device that does not also beep. When you open the box you are surprised to discover that the top and bottom of the hour glass are differently shaped. One side is a hemisphere with a radius of two inches, and the other side is a pyramid measuring four inches on each side of the base and with a height of three inches. (See the cross section to the right.)

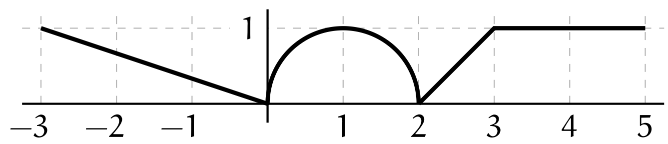


At a particular moment you notice that the sand in both the top and bottom of the hourglass have a height of one inch. If the height of the sand in the top is decreasing at a rate of 2/15 inches per minute, at what rate is the height of the sand in the bottom increasing?

Note: the volume in the top is $2\pi H^2 - \frac{1}{3}\pi H^3$; the volume in the bottom is $\frac{16}{27}h^3 - \frac{16}{3}h^2 + 16h$.

score

8. Given $f(x)$ is shown below, and $F(x) = \displaystyle\int_{3-x}^{2x^2} f(t)\,dt$, determine the following.



(a) Find $F(1)$.

(b) Find $F(-1)$.

(c) Find $F(0)$.

(d) Find $F'\big(-\sqrt{2}\big)$.

score