Instructions: Please self-score your work out of 35 using the answers and point values below. We recommend that

- Students who score a total above 24 use their Calculus I credit;
- Students who scored a total of 10-24 enroll in Math 111L Calculus I to strengthen their understanding of Calculus I material;
- Students who scored a total below 10 take the Precalculus Self-Assessment at [https://math.duke.edu/courses/self-assessments](https://math.duke.edu/courses/self-assessments) and consider enrolling in Math 105L Calculus I to strengthen their understanding of both Precalculus and Calculus I material.

To discuss placement further, we encourage you to reach out the Math 111L Calculus I coordinator, Prof. Shira Viel, at shira.viel@duke.edu.

1. (a) 2, (b) $\frac{4}{9}$, (c) 0, (d) $\frac{1}{8}$, (e) $\frac{\pi}{4}$
   - 5 points: 1 point per part
   - Topic: Evaluating limits, including L'Hopital’s Rule and Riemann Sums

2. $a = e, b = 2$.
   - 2 points: 1 point per constant
   - Topics: Continuity and Differentiability

3. (a) $y = -5$, (b) $x = -1, x = 1$, (c) none, (d) local minimum at $x = 0$
   - 5 points: 1 point per (a),(b),(c), 2 points for (d)- 1 for crit pt, 1 for classification.
   - Topics: Rational functions, Critical points

4. (a.i) $\frac{3}{2}$, (a.ii) $\frac{11}{2\sqrt{2}}$, (a.iii) $\frac{11}{16}$, (a.iv) $\frac{1}{4}$,
   (b.i) 3, (b.ii) $8 \ln(2)$, (c) 2.3, (d) Overestimate.
   - 8 points: 1 point per part
   - Topics: Definition of the derivative, Rules for differentiation, Linear approximation

5. (a) $\frac{4y - 8x}{8y - 4x}$, (b) $\left(1, \frac{1}{2}\right)$ and $\left(-1, -\frac{1}{2}\right)$
   - 3 points: 1 point part (a), 2 points part (b)
   - Topic: Implicit Differentiation and Linear Approximation

6. $h = \frac{400}{\pi}$ meters and $w = 0$ meters. Global max by either 1st or 2nd Derivative Test.
   - 3 points: 1 point per dimension, 1 point for justification
   - Topic: Optimization
7. 0.5 m/sec
   • 2 points
   • Topic: Related Rates

8. (a) $54 \cos(18)$, (b) $\frac{11}{3}$, (c) $\frac{1}{2}e^2 - \frac{13}{6}$
   • 3 points: 1 point per part
   • Topic: Fundamental Theorem of Calculus

9. (a) $\frac{dF}{dt} = 60 - kF, F(0) = 0$, (b) 0.2, (c) $F(t) = -300e^{-0.2t} + 300$
   • 4 points: 1 point per parts (a),(b), 2 points for (c)- general solution + coefficient
   • Topic: Separable Differential Equations and Modeling