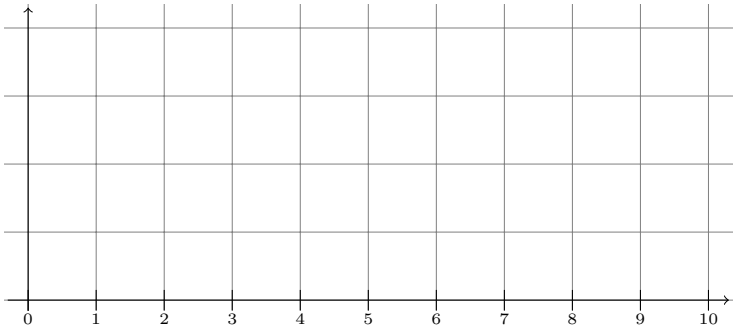
Name: _____

Directions: Show all work. No credit for answers without work.

1. [**10 points**] Draw a single graph that has each of the following three properties:

   - a global maximum at $x = 2$,
   - a critical point which is neither a local minimum nor a local maximum at $x = 5$, and
   - a local minimum which is not a global minimum at $x = 7$.



2. [**10 points**] Find the exact global maximum and global minimum values of $f(x) = xe^{-2x}$ over the closed interval $[-1, 1]$. (Decimal approximations with appropriate work are worth partial credit.)

3. [**2 parts, 4 points each**] Mike owns a small business that produces desks. His total cost $C(q)$ (in dollars) to produce q desks is given by $C(q) = q^2 + 200q + 400$.

   (a) Find the marginal cost function and the average cost function.

   (b) Find the production level that minimizes Mike's average cost. What is the minimum possible average cost?

4. [**4 points**] Fill in the blanks: on the graph of the cost function $C(q)$, the average cost at production level q is represented by the slope of the line joining _____ and _____.

5. [**2 parts, 4 points each**] A company that produces books has cost function $C(q)$ (in dollars) and revenue function $R(q)$ (in dollars). Currently, the production level is $q = 70$ books, and $C'(70) = 23$ and $R'(70) = 21$.

   (a) Estimate the change in profit that results from producing the 71st book.

   (b) Should the company increase production, decrease production, or leave production unchanged?

6. [**6 points**] Give the Right Hand Sum approximation to $\int_{-3}^{3} x(x+1)\,dx$ with $n = 3$.

7. [**6 points**] Express the area bounded by the curves $y = 2x^2 - 5x - 6$ and $y = x^2 + 8$ as a definite integral. You do not need to solve this integral; your final answer is the integral.

8. [**2 parts, 4 points each**] A printer is able to produce pages faster as it warms up. After t minutes have elapsed since starting a print job, the printer produces pages at a rate of $4t$ pages per minute.

   (a) Express the number of pages printed during the first 5 minutes as a definite integral.

   (b) Use the graphical interpretation of the definite integral to determine the number of pages printed during the first 5 minutes exactly. (Your answer must demonstrate that you understand the graphical interpretation of the definite integral.)

9. [**10 parts, 2 points each**] Evaluate the following.

(a) $\int 2\,dx$

(b) $\int 0\,dz$

(c) $\int 2t^3 - 6t^2\,dt$

(d) $\int e^{-2x}\,dx$

(e) $\int r^{-1}\,dr$

(f) $\int \frac{1}{\sqrt{y}}\,dy$

(g) $\int x^{\ln(2)}\,dx$

(h) $\int t(5t^4 + 3)\,dt$

(i) $\int \frac{3s^2 + 7}{s}\,ds$

(j) $\int (e^{3z} + 2)^2\,dz$

10. [**4 parts, 5 points each**] Evaluate the following.

(a) $\int (6t+5)(3t^2+5t)^{14}\,dt$

(b) $\int \dfrac{(\ln z)^5 + (\ln z)^2}{z}\,dz$

(c) $\int \dfrac{x}{x^2+1}\,dx$

(d) $\int \dfrac{e^{\sqrt{y}}}{\sqrt{y}}\,dy$