Instructions
1. Write your Name, PID, and Section on the front of your Blue Book.
2. No calculators or other electronic devices are allowed during this exam.
3. You may use one page of notes, but no books or other assistance during this exam.
4. Read each question carefully, and answer each question completely.
5. Write your solutions clearly in your Blue Book
   (a) Carefully indicate the number and letter of each question.
   (b) Present your answers in the same order they appear in the exam.
   (c) Start each question on a new page.
6. Show all of your work; no credit will be given for unsupported answers.

1. (10 points) The graph below is the graph of \( y = f'(x) \), the derivative of the function \( f \).

   ![Graph of f'(x)](image)

   The area of region \( A \) is 6, the area of region \( B \) is 4, and the area of region \( C \) is 1.
   (a) If \( f(1) = 3 \), what is \( f(6) \)?
   (b) Find the absolute maximum value of \( f(x) \) on the interval \([1, 6]\) and indicate at which \( x \) value it occurs.

2. Compute the following indefinite integrals:
   (a) (10 points) \( \int x^2 e^x \, dx \)
   (b) (10 points) \( \int \frac{1}{(4 + z^2)^{3/2}} \, dz \)
   (c) (10 points) \( \int \frac{3x + 1}{x(x^2 - 1)} \, dz \)

(Please turn over.)
3. (10 points) Find the area of the region bounded by 
\[ y = \frac{1}{\sqrt{x-1}}, \quad x = 1, \quad x = 2, \] and the x-axis.

\[ y \]
\[ x \]

4. (10 points) For the improper integral, state whether or not it converges. Justify your answer:

\[ \int_{1}^{\infty} \frac{2z}{4 + z^3} \, dz \]

5. (10 points) The figure below shows the curve of 
\[ y = \sqrt{\sin^2 x \cos x} \] over the interval \([0, \pi/2]\) and the region under the curve. Calculate the volume of the solid obtained by rotating the shaded region about the x-axis.

\[ y \]
\[ x \]
\[ \frac{\pi}{2} \]

6. (10 points) An object is heated to a temperature of 100° F and then placed in a room held at a constant temperature of 60° F. Let \( H(t) \) be the temperature of the object \( t \) minutes after being placed in the room. According to Newton’s Law of Cooling, the rate of change in \( H \) over time is given by the differential equation:

\[ \frac{dH}{dt} = k(H - 60), \]

where \( k \) is a constant.

(a) Solve the differential equation subject to the initial conditions given in the statement of the problem. (Your answer will have a \( k \) in it.)

(b) Ten minutes after the object was placed in the room, it had a temperature of 80° F. Find the exact value of the constant \( k \). (Your answer will include a logarithm. This is as it should be.)

(c) Find \( \lim_{t \to \infty} H(t) \). (Justify your answer.)

(This exam is worth 80 points.)