1. (8 points) Calculate the following integrals:
   
   (a) (4 points) \( \int_{0}^{\pi/2} (\sin \theta \cos^3 \theta) d\theta. \)

   (b) (4 points) \( \int 5e^{3t} + 2dt. \)

2. (8 points) Calculate the area in the region between \( y = \frac{2x}{\pi} \) and \( y = \sin x \) shown below:
3. **(8 points)** Calculate the volume of the solid produced by rotating the region bounded by the \( y \)-axis, \( y = \frac{12}{x} \), \( y = 2 \), and \( y = 3 \) **around the \( y \)-axis.**

![Diagram of the region](image)

4. **(2 point bonus)** Calculate the volume of the solid produced by rotating the region shown in the above problem around the \( x \)-axis.