

Unjustified answers will receive little or no credit.

1. (26 pts) Find the volume of the solid generated by revolving the region between the line $y = x$ and the parabola $y = x^2$ about (a) the x -axis; (b) the line $x = 2$.

2. (12 pts each) Find the following limits:

$$(a) \lim_{x \rightarrow 0} \frac{x + \sin x}{e^x - 1} \quad (b) \lim_{x \rightarrow \infty} \frac{\sqrt{x^2 + x}}{x + 2} \quad (c) \lim_{x \rightarrow 0^+} x(\ln x)^2$$

3. (16 pts each) Evaluate the following integrals:

$$(a) \int_1^e \frac{(\ln x)^2}{x} dx \quad (b) \int 2x \arctan x dx \quad (c) \int \frac{dx}{\sqrt{1+x^2}}$$

4. (a) (15 pts) Find the standard equation of the ellipse with foci $(0, \pm 3)$ and vertices $(0, \pm 5)$, then sketch its graph.

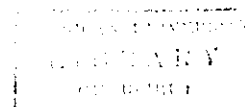
(b) (15 pts) Find the standard equation of the hyperbola with foci $(\pm 2, 0)$ and asymptotes $y = \frac{\pm 1}{\sqrt{3}}x$, then sketch its graph. Include the foci and asymptotes in your sketch.

5. Consider the three points

$$A(2, 2, 1) \quad B(7, -3, 6) \quad C(6, 6, 4)$$

and let

$$\mathbf{v} = \overrightarrow{AB} \quad \mathbf{w} = \overrightarrow{AC}$$



(a) (6 pts) Express \mathbf{v} and \mathbf{w} in the form $a\mathbf{i} + b\mathbf{j} + c\mathbf{k}$.

(b) (14 pts) Find an equation for the plane through A , B , and C .

(c) (20 pts) Express \mathbf{w} as the sum of a vector parallel to \mathbf{v} and a vector orthogonal to \mathbf{v} .

(d) (20 pts) Let L be the line through A and B . Find parametric equations for L . Also find the point on L closest to C .