1. (i) Calculate the approximations MID(4) and TRAP(4) to $\int_1^3 (1-x^2)\,\mathrm{d}x$.

   (ii) Without evaluating the integral, determine if the approximation is an under-estimate or an over-estimate.

2. Calculate the integrals if they converge.

   (i) $\displaystyle\int_{-\infty}^{\infty} \frac{1}{x^2+25}\,\mathrm{d}x$ (ii) $\displaystyle\int_{\pi/4}^{\pi/2} \frac{\sin x}{\sqrt{\cos x}}\,\mathrm{d}x$ (iii) $\displaystyle\int_3^6 \frac{1}{(4-x)^2}\,\mathrm{d}x$

3. Decide whether the improper integrals converge or diverge.

   (i) $\displaystyle\int_2^{\infty} \frac{1}{\sqrt{1+x^3}}\,\mathrm{d}x$ (ii) $\displaystyle\int_0^{\pi} \frac{2-\sin x}{x^2}\,\mathrm{d}x$ (iii) $\displaystyle\int_0^{\infty} \frac{1}{e^x+2^x}\,\mathrm{d}x$

4. Find, by slicing, a formula for the volume of a cone of height h and base radius r.

5. Find the volume of the solid obtained by rotating the region bounded by $y=\sqrt{x}, x=1$, and $y=0$ about the axis $x=2$.

6. Find the volume of the solid whose base is the region bounded by $y=2e^x$, $x=1$, and the lines $x=0$ and $x=1$ and whose cross-sections perpendicular to the x-axis are equilateral triangles.

7. Find the arc length of the parametric curve $x=\cos 3t, y=\sin 5t$ for $0\le t\le 2\pi$.

8. Sketch the polar curve $r=\cos 2\theta$.

9. Find the area of the region that lies inside the cardioid $r=1-\sin\theta$ and outside the circle $r=1/2$.

10. For what values of θ on the polar curve $r=\theta$, with $0\le\theta\le 2\pi$, are the tangent lines horizontal? Vertical?

11. Find the arc length of the polar curve $r=1/\theta$ for $\pi\le\theta\le 2\pi$.

12. The density of oil in a circular oil slick on the surface of the ocean at a distance r meters from the center of the slick is given by $\delta(r)=50/(1+r)$ kg / m^2.

    (i) If the slick extends from $r=0$ to $r=10,000$ m, find a Riemann sum approximating the total mass of oil in the slick.

    (ii) Find the exact value of the mass of oil in the slick.

    (iii) Within what distance r is half the oil of the slick contained?

13. A metal plate, with constant density 5 gm / cm^2, has a shape bounded by the curve $y=\sqrt{x}$ and the x-axis, with $0\le x\le 1$ and x,y in cm.

    (i) Find the total mass of the plate.

    (ii) Find $\overline{x}$ and $\overline{y}$.