1. Integrate:
   
   a) \( \int_0^{\pi/2} \cos^3 \theta \, d\theta \)  
   b) \( \int_1^e (\ln x)^2 \, dx \)  
   c) \( \int \frac{x}{x^2 - 5x + 6} \, dx \)  
   d) \( \int \sqrt{4 - x^2} \, dx \)

2. a) Set up an integral corresponding to the area of the region bounded by the curves: \( y = \sqrt{1 + x^3} \), \( y = 1 - x \), and \( x = 2 \). b) Find a numerical estimate for this integral using a Reimann sum with 4 subdivisions.

3. Compute the volume of a sphere of radius \( r \).

4. Suppose that, on a certain day, from noon to 3 pm the average temperature was 60\(^\circ\)F, from 3 to 4 pm the average temperature was 48\(^\circ\)F, and from 4 to 6 pm the average temperature was 30\(^\circ\)F. Use integrals to find the average temperature from noon until 6 pm.

5. A circular swimming pool has diameter 24 ft, the sides are 5 ft high, and the depth of the water is 4 ft. How much work is required to pump all of the water over the side? (Suppose, for convenience, that water weighs 1 lb/ft\(^3\), and also that the gravitational constant \( g = 1 \).)

The first problem is worth 40 points (10 points for each part), and the rest are 15 points each.