1. Demonstrate how to evaluate $\int \cos^2(\theta)\, d\theta$ using integration by parts.

2. **Particle, the Dog:**
   My dog, Particle, and I like to walk on the Cartesian plan. Like most dogs, Particle walks further than I do, even though we start and end in the same places. Unlike most dogs, Particle walks along a path described by a sine curve.

   As I walk along the x-axis, Particle moves along the curve $y = \sin x$, so that her x is the same as mine. For now, your goal is to develop distance function, $P(x)$, that takes a value of x and gives the "distance" Particle has walked along the sine curve from her starting point at the origin.

   (a) Develop a *distance element*, dP, for computing Particle's distance. Use this to come up with a method to obtain how far Particle has walked from the origin when I am at any point x. Be sure your dP is ready to be integrated. (Discuss what does this means.)

   (b) Use your dP and an integral to define our function, $P(x)$. (You need not try to express $P(x)$ without an integral.)

   (c) If I am walking along the x-axis at a rate of one unit per minute, what is Particle's speed along the curve as a function of t?

   (d) What are Particle's maximum and minimum speeds, and where do they occur?