5. (10 points) The *trebuchet*, a medieval catapult driven by a falling, hinged counterweight, can be simulated with the use of mathematical models. The range of the projectile flung from the catapult at an angle θ is given by

$$R = \frac{2{v_0}^2 \sin\theta\cos\theta}{g},$$

where g is the constant acceleration due to gravity and v_0 is the constant representing the initial velocity of the projectile.

(a) Find the exact value of θ on the interval $0 \leq \theta \leq \pi/2$ that maximizes the range of the projectile.

(b) What is the maximum range?