Name: _____

1. **[2 parts, 2 points each]** Convert the following functions to the form $R\cos(\omega_0 t - \delta)$.

   (a) $4\cos(2t) - 3\sin(2t)$

   (b) $-7\cos(t) + 2\sin(t)$

2. **[1 point]** An object of mass m (kg) is attached to a spring with spring constant k (kg/s^2). The system is damped with damping constant γ (kg/s). The system is critically damped if and only if m, γ, and k satisfy a certain equation. What is this equation? (Hint: if you do not have this memorized, derive it directly from the differential equation that models spring/mass systems.)

3. A mass of 250 grams stretches a spring 8 cm. The system is undamped. Initially, the mass is pushed up a distance of 2 cm from its equilibrium position and released with a downward velocity of 10 cm/s.

   (a) **[3 points]** Find the position $u(t)$ of the spring at time t. Express u in cm and t in s.

   (b) **[2 points]** Determine the maximum distance of the mass from its equilibrium position and the time when it first reaches this position. Hint: first express $u(t)$ in the form $u(t) = R\cos(\omega_0 t - \delta)$.