Problem 330A

An automobile tire bursts sending a shock wave (assume a normal shock wave) propagating into the ambient air whose pressure is denoted by p_1, sonic speed by c_1 and ratio of specific heats by γ. If the pressure behind the shock is p_2 (roughly the inflated tire pressure) show that the speed of propagation of the shock, u_s, is given by

$$u_s = c_1 \left\{ \frac{\gamma - 1}{2\gamma} + \frac{p_2}{p_1} \frac{(\gamma + 1)}{2\gamma} \right\}^{\frac{1}{2}}$$

Calculate this speed if the temperature of the ambient air is $30°C$ and the pressure ratio, p_2/p_1, is 3.0.