36.53 Air exits a nozzle at $500\frac{ft}{s}$ into a $70°F$ room at atmospheric pressure. What is the Mach number?

A. 0.39

B. 0.44

C. 2.3

D. 2.5

The Mach Number is the velocity of the air divided by the speed of sound in air. The speed of sound in air can be determined in at least three ways. First, it can be memorized. $c \approx 1130\frac{ft}{s}$

Second, it can be looked up in the Properties of Air at Low Pressure table. Interpolate or estimate as necessary.

Third, it can be calculated using the equation below. However, the make the units work, the gravitational constant, g_c, must also be included for US customary units. Substitute the ratio of specific heats for air, the Specific Gas Constant for air, and the absolute temperature in degrees Rankine.

$$c = \sqrt{kRT}$$

$$c = \sqrt{kRTg_c}$$

$$c = \sqrt{(1.4)\left(53.35\frac{ft \cdot lb_f}{lb_m \cdot R}\right)(530R)\left(32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)} = 1128\frac{ft}{s}$$

Calculate the Mach number.

$$M = \frac{V}{c}$$

$$M = \frac{500\frac{ft}{s}}{1128\frac{ft}{s}} = 0.44$$

Answer B