

- 36.49** The SR-71 Blackbird aircraft travels at 2193mph at an altitude of $70,000\text{ft}$ where the temperature is -70°F . What is the Mach number?
- A. 2.8
 - B. 3.3
 - C. 7.7
 - D. 18.9

The **Mach Number** is the ratio of velocity of the air to the speed of sound.

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

The **Speed of Sound**, c , is a function of the ratio of specific heats, k , the **Specific Gas Constant**, R , and the temperature, T , in absolute terms i.e. Rankine. The gravitational constant, g_c , also needs to be included to make the units work out, which must be inferred since it is not shown in the reference handbook.

Calculate the speed of sound in air at -70°F .

$$c = \sqrt{kRT}$$

$$c = \sqrt{(1.4) \left(53.3 \frac{\text{ft} \cdot \text{lb}_f}{\text{lb}_m \cdot \text{R}} \right) (390\text{R}) \left(32.2 \frac{\text{ft} \cdot \text{lb}_m}{\text{s}^2 \cdot \text{lb}_f} \right)} = 968 \frac{\text{ft}}{\text{s}}$$

Determine the Mach number. Convert mph to $\frac{\text{ft}}{\text{s}}$ such that the final result is unitless.

$$M = \frac{(2193\text{mph}) \left(88 \frac{\text{ft}}{\text{min} \cdot \text{mph}} \right) \left(\frac{1\text{min}}{60\text{s}} \right)}{968 \frac{\text{ft}}{\text{s}}} = 3.3$$

Answer B