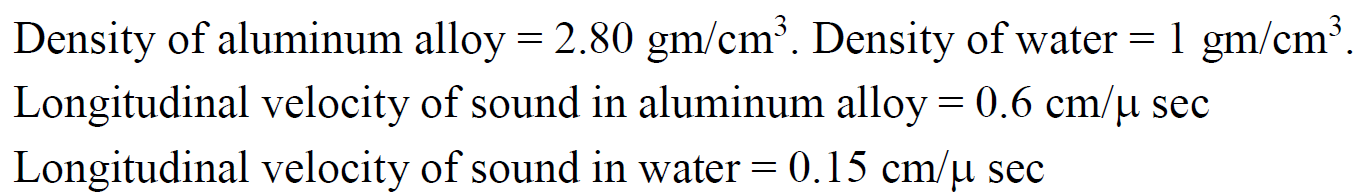
**TQME 2: Maintainability Engineering**

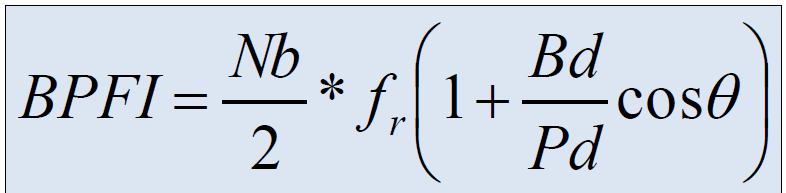
1. An ultrasonic beam travels through a 4-inch thick aluminum alloy plate and strikes a body of water. The following data for aluminum alloy and water are given.



1. Calculate the acoustic impedances of aluminum alloy and water. Indicate units
2. Calculate the percent of ultrasonic wave energy reflected
3. Calculate the percent of ultrasonic wave energy transmitted
4. The rotational speed of a turbine shaft is 3600 RPM
5. Calculate the rotational speed in Hz.
6. Give an example of a non-synchronous frequency of shaft speed (Hz)
7. Give an example of a sub-synchronous frequency of shaft speed (Hz)
8. Give an example of a harmonic frequency of shaft speed (Hz)
9. The drive gear in a gearbox has 32 teeth. It drives a pinion with 16 teeth. The drive

gear shaft speed is 180 RPM. Calculate the following.

1. Drive gear shaft speed in Hz
2. Tooth mesh frequency (Hz)
3. Rotational speed of the pinion (Hz)
4. The ball pass frequency of the inner race (BPFI) in a ball bearing is given by



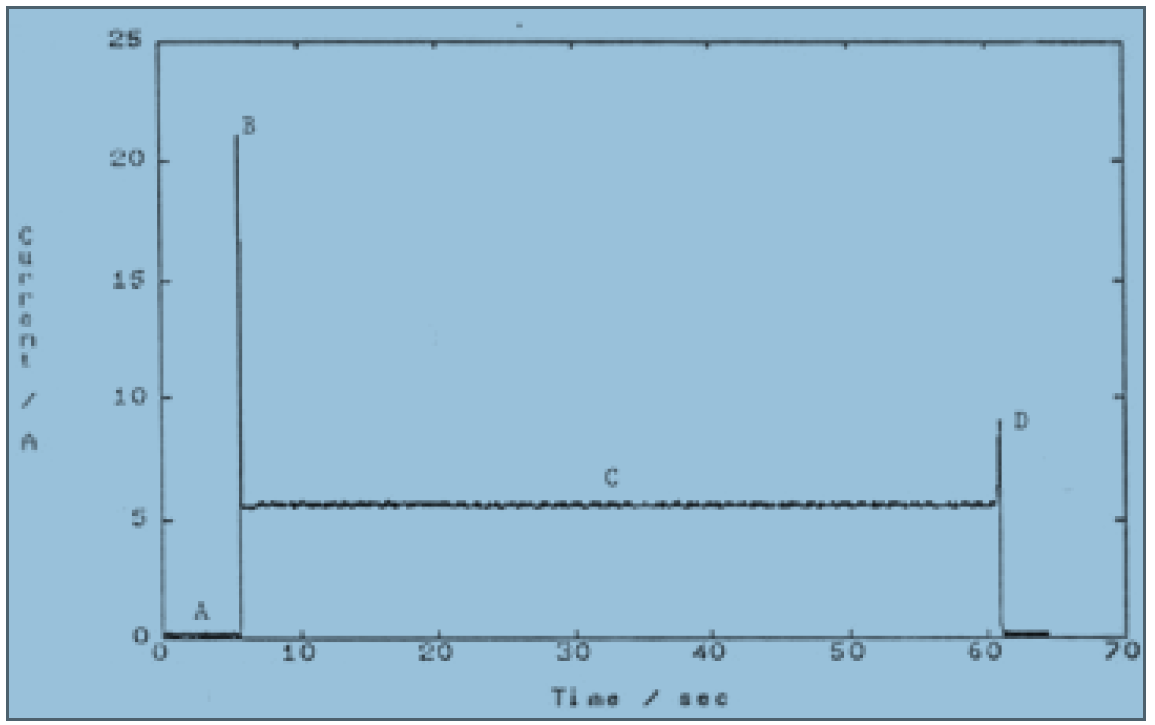
The following parameters are given: Bd = 8 mm, Pd = 40 mm, θ = 0°.

(a) Define (in words) ball pass frequency of the inner race (BPFI)

(b) Simplify the expression for BPFO in terms of Nb and fr using the above data

(c) If Nb = 9 and fr = 30 Hz, calculate the BPFI (in Hz) for this bearing.

1. The figure below shows the motor current pattern during the open-to-close stroke of a motor-operated valve. Match the letters B, C, and D in the figure with the statements below.



(a)\_\_\_\_\_ Valve seating current at the end of the stroke.

(b) \_\_\_\_\_ Motor inrush current upon starting.

(c) \_\_\_\_\_ The normal running current