WELCOME

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

For other educational tools created to prepare candidates for licensure, contact Aircraft Technical Book Company.

We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2013 12	Module Creation and Release
002	2016 11	Format Update and Appearance Update
003	2018 07	Refined content sequencing to Appendix 1.
003.1	2020 05	Clarified formulas for Buoyant Force – Sub-Module 02
003.2	2021 05	Corrected formulas for Pendular Movement and Vibration. Sub-Module 02, page 2.11

Version 003 - The following content was added for clarity:

Sub-Module 01	Elasticity
Sub-Module 02	Harmonics, Velocity Ratio, Inertia, Total Energy, Coefficient of Friction, Compressibility
Sub-Module 04	Reflection
Sub-Module 05	Wave Motion, Production of Sound

MODULE EDITIONS AND UPDATES

ATB EASA Modules are in a constant state of review for quality, regulatory updates, and new technologies. This book's edition is given in the revision log above. Update notices will be available Online at *www.actechbooks.com/revisions.html*
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For the formula above, mass would typically be converted to weight divided by gravity, velocity would be in feet per second, and the radius would be in feet.

Example: What would the centripetal force be if a 10 pound weight was moving in a 3ft radius circular path at a velocity of 500 fps?

$$\text{Centripetal Force} = \text{Mass (Velocity}^2) \div \text{Radius}$$

$$\text{Centripetal Force} = 10\ (500^2) \div 32.2\ (3) = 25\ 880 \text{ lb}$$

In the condition identified in the example, the object acts like it weighs 2 588 times more than it actually does. It can also be said that the object is experiencing 2 588 Gs (force of gravity). The fan blades in a large turbofan engine, when the engine is operating at maximum rpm, are experiencing many thousands of Gs for the same reason.

PERIODIC MOVEMENT

PENDULAR MOTION

Periodic motion is evident during pendular motion and vibration. A pendulum is a weight suspended from a fixed point so it can swing freely back and forth. The motion is characterized by a few important variables. The period is the time it takes for the weight to complete one cycle of motion. It is dependent on the length of the suspending rod or string. Specifically, the period varies directly with the square root of "L" which is the length of the suspending item (i.e. a string or rod). The period also varies inversely with the square root of the acceleration of gravity. The following equation expresses these relationships:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Where:

T = period in seconds (s)
L = length of the pendulum in feet or meters
g = acceleration of gravity (32.2 ft/s^2 or 9.82 m/s^2)

Pendulums are unique in that the period of a pendulum will remain the same as it swings to and fro even though it gradually displaces less and less with each ensuing swing. This regularity has resulted in pendulum motion to be the regulating motion in mechanical clocks.

THEORY OF VIBRATION, HARMONICS, RESONANCE

VIBRATION

Vibration is periodic motion caused by oscillation of the parts of a fluid or an elastic solid whose equilibrium has been disturbed. An electromagnetic wave also experiences vibration. Something that is vibrating has motion back and forth across a central point. While this can be harmless in an aircraft, vibration can also be destructive. Design engineers must design the aircraft to withstand or safely dissipate any vibration produced by the engine, components, or by the aircraft's movement through the atmosphere.

Vibratory motion is also known as harmonic motion. It is regular in nature. Vibration is characterized by having a period, which is the time it takes for a complete cycle of movement. It's frequency is the number of times per second a complete cycle occurs. The unit of measure for frequency is the hertz (Hz). One cycle per second is equal to one hertz. Vibration also has amplitude. Amplitude is measured from the midpoint of the motion to the point of maximum displacement. Unless there is a means to input energy into the vibrating object, the amplitude of vibration will steadily decrease as time goes on. However, the frequency of vibration will remain the same.

On a musical instrument, it is the frequency that sets the pitch of the tone created when the string is plucked. The amplitude is related to the loudness of the vibrating string.

The formula for computing the period of a vibrating or oscillating object is virtually the same as that of a pendulum. Instead of gravity supplying the force as with a pendulum, some other force must be applied to create vibration. But the uniqueness of a steady frequency is shared by vibrating objects and a pendulum. So the formula for vibration remains the same as for a pendulum, or a mass hanging on a string.

$$T = 2\pi\sqrt{\frac{M}{k}}$$

Where:

T = period in seconds (s)
M = mass in pounds or kilograms (kg)
k = force in pound/feet or Newton/meters (N/m)