Motion is the displacement of an object from one place to another in time and space. The physical quantities involved in describing motion are:

1. Displacement
2. Velocity
3. Acceleration

**SCALARS AND VECTORS**
Scalars are quantities that are fully described by magnitude alone (e.g., length, area, energy, temperature).
Vectors are quantities that are fully described by both magnitude and direction (e.g., displacement, velocity, acceleration, momentum, force).

**DISPLACEMENT**
Displacement is defined as the change in position of an object.

Note: Displacement is not the same as distance.

It is a vector quantity given by:
\[ \Delta x = x_f - x_i \]  
in meters (m)

- \( x_f \) is the final position of the object, in m
- \( x_i \) is the initial position of the object, in m

**Example 1:** A person walks around a circle with radius 2m and returns to his or her initial position. Find the displacement and distance covered by the person.

![Circle Diagram]

**VELOCITY**
Velocity is defined as the rate and direction of change in position of an object.

Note: Speed is a scalar quantity; it is defined as the distance travelled per unit time. Velocity is a vector quantity; it is defined as the displacement per unit time.

It is a vector quantity given by:

Average velocity = \( \Delta x/\Delta t \)  
meters/second (m/s)

**ACCELERATION**
Acceleration is defined as the rate of change in velocity of an object.

Note: If an object’s velocity and acceleration are in the same direction, then the object’s speed increases. If an object’s velocity and acceleration are in opposite directions, then the object’s speed decreases (deceleration).
Physics: Motion in One Direction

It is a vector quantity given by:
Average acceleration = \( \Delta v/\Delta t \) meters/second \(^2\) (m/s\(^2\))

Example 2: An object starting from rest moves 100 meters in 50 seconds. Find the average velocity and average acceleration of the object.

ONE DIMENSIONAL MOTION WITH CONSTANT ACCELERATION
The equations used to describe the motion of an object with constant acceleration are:

1. \( v = v_0 + at \)
2. \( \Delta x = v_0 t + \frac{1}{2}at^2 \)
3. \( v^2 = v_0^2 + 2a\Delta x \)

\( v \) is the final velocity, in m/s  
\( v_0 \) is the initial velocity, in m/s  
\( a \) is the acceleration, in m/s\(^2\)  
\( t \) is the time, in s  
\( \Delta x \) is the displacement, in m

Example 3: A car starting from rest accelerates at a constant rate of 5.00 m/s\(^2\). What is the velocity of the car after it has travelled 10 m? How much time does the car take to travel this distance?

FREELY FALLING OBJECTS
Objects falling in the presence of earth’s gravitational force exhibit free fall acceleration (e.g., an object falling to the ground). The equations for freely falling objects are the same as the equations for motion of constant acceleration.

Note: The value of acceleration (\( a \)) for freely falling objects is 9.8 m/s\(^2\).

ANSWERS
Example 1:
1. The displacement of the person is zero because the initial and final positions of the person are the same.
2. The distance covered by the person is the circumference of the circle (2\( \pi r \)) = 12.56 m.

Example 2:
1. The average velocity is: \( 100/50 = 2 \) m/s
2. The average acceleration is: \( 2/50 = 0.04 \) m/s\(^2\)

Example 3:
The time taken by the car to travel 10 m is given by the equation: \( \Delta x = v_0 t + \frac{1}{2}at^2 \)
Using values:
\( \Delta x = 10 \) m  
\( v_0 = 0 \) m/s  
\( a = 5.00 \) m/s\(^2\)  
\( t = 2 \) s