Introduction to Physics : Notes/W.S.-20

If the velocity of an object changes, we say that the object is accelerating. The acceleration equals the change in velocity divided by the time.
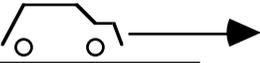
$$\texttt{acceleration} = \frac{v_f - v_i}{time}$$

This equation can be written as:

$$v_f = v_i + a \cdot t$$

The acceleration may be positive or negative. The units are m/s^2.

example: A car accelerates to the right.

t = 0 sec   t = 3 sec
V_i = +4.0 m/s V_f = +10 m/s

a = (10 - 4.0)/3 = +2.0 m/s^2

In this example, the acceleration of the car is +2.0 m/s^2. This means that the velocity increases at a rate of +2.0 m/s, every second. So the velocity increases by +6.0 m/s in 3.0 seconds.

example: A falling ball will accelerate downwards. Near the Earth's surface, the velocity of a ball that is dropped, will be -9.8 m/s after a time of 1 second. After 2 seconds, the velocity will be 2x(-9.8) = -19.6 m/s. Downward velocities are negative.

t = 0 sec
V_i = 0.0 m/s   ○

t = 1 sec   ○
V_f = -9.8 m/s   ↓

_____
Earth
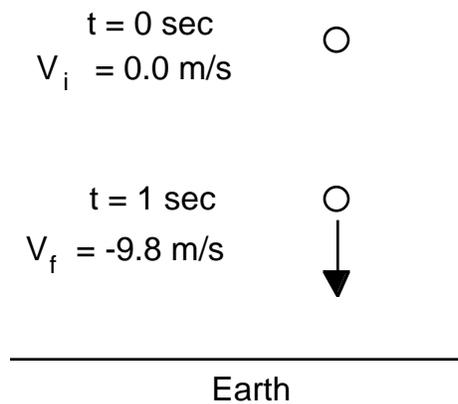
The acceleration is -9.8 m/s². This is the acceleration due to gravity on Earth. It means that the velocity of a falling object increases by -9.8 m/s every second. On the Moon, the acceleration due to gravity is -1.6 m/s².

Problems:

1)a) The acceleration due to gravity near the Earth's surface is _____ . If a ball is dropped, the velocity at 1 second is _____ . The velocity at 2 seconds is _____ . The velocity at 3 seconds is _____ .

b) If the same ball is dropped (at t = 0.0 seconds) near the Moon's surface, the acceleration will be _____ . The velocity at 4 seconds will be _____ . The time when the ball moves with a velocity of -10 m/s will be _____ .

2)a) The initial velocity of a car is 0.0 m/s. The car starts to accelerate at a constant rate. It reaches a velocity of 12 m/s in 4.0 s. The acceleration is _____ .

b) If the car continues to accelerate at this rate for another 4.0 seconds, the velocity will then be _____ .

3)a) A car moves with a velocity of -15 m/s. Its velocity increases to -22 m/s in 4.0 seconds. The acceleration is _____ .

b) The car then slows down from -22 m/s to -8.0 m/s in 5.0 s. The acceleration is _____ .

4)a) A car moves to the right as shown below.

t = 0 sec

V_i = +18 m/s

t = 4.0 sec

V_f = +8.0 m/s
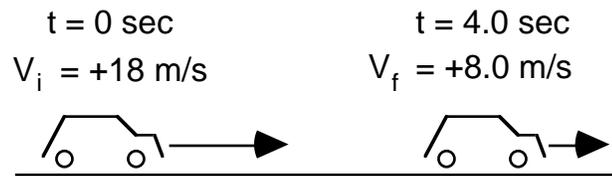
The acceleration of the car is _____ .

b) If the acceleration is constant, the velocity at t = 2.0 seconds is
_____ . The velocity at t = 6.0 seconds will be _____ .

Answers: 1)a) -9.8 m/s^2, -9.8 m/s, -19.6 m/s, -29.4 m/s, b) -1.6
m/s^2, -6.4 m/s, 6.25 s, 2)a) 3.0 m/s^2, b) 24 m/s, 3)a) -1.75 m/s^2, b)
+2.8 m/s^2, 4)a) -2.5 m/s^2, b) +13 m/s, +3.0 m/s.