Q- A 500 kg satellite circles the earth ($5.97*10^{24}$ kg) along an orbit of radius $6.7*10^6$m. Find

(a) The force attracting the satellite toward the earth.

(b) the satellite's centripetal acceleration.

(c) The speed of the satellite along its orbit.

a) The force of attraction between the satellite and the Earth is the force of gravitation and is given according to Newton's law of gravitation as

$$F = \frac{Gm_E m_S}{R^2}$$

Where m_E is the mass of earth, m_s is the mass of the satellite and R is the distance between the earth and the satellite.

Substituting the values, we get

$$F = \frac{Gm_E m_S}{R^2} = \frac{6.67*10^{-11}*5.97*10^{24}*500}{(6.7*10^6)^2} = 4435.3\ N$$

b) As according to Newton's second law of motion F = m*a, the acceleration of a body will be

a = F/m

And hence the centripetal acceleration of the satellite is given by

$$a = \frac{F_{CP}}{m} = \frac{4435.3}{500} = 8.87\ m/s^2$$

c) if the speed of the satellite along the orbit is v than it is given by using equation of centripetal acceleration of a body in circular path of radius R as

$$a = \frac{v^2}{R}$$

The gravitational force on the satellite due to earth the centripetal acceleration and hence we can write

$$a = \frac{v^2}{R}$$

Or $v = \sqrt{a * R} = \sqrt{8.88 * 6.7 * 10^6} = 7709.3$ m/s

Hence the speed of the satellite along the orbit is 7709.3 m/s.