Suppose the motion of the particle is described by the equation: x=a+bt2, where a=20cm and b=4cm.s-2. a) Find the displacement of the particle in the time interval between t1 =2s and t2 =5s. b) Find the average velocity in this time interval. C) Find the instantaneous velocity at time t1 =2s.

Solution: the equation of motion for a particle and the equation of motion in the general form:

$$x = a + bt^2, \qquad general:\ x = x_0 + V_0 t + \frac{At^2}{2}, where\ A - acceleration, V_0 - initial\ velocity$$

Comparing the two equations we can find the initial speed, position and the acceleration:

$$x_0 = a,\ \ V_0 = 0,\ \ A = 2b$$

A: Because the coordinate of the particle is increasing, we will find the position of a particle at point 1 and point 2 and subtract the values of the coordinates. The difference will be equal to the displacement of the particle.

$$x_{t1} = a + bt_1^2,\ \ x_{t2} = a + bt_2^2$$

$$\Delta S = x_{t2} - x_{t1} = a + bt_2^2 - a - bt_1^2 = b(t_2^2 - t_1^2) = 4\frac{cm}{s^2} * (5s * 5s - 2s * 2s) = 84\ cm$$

B: Average speed is equal to the length of way divided by the time in which the particle passes this way:

$$V_a = \frac{\Delta S}{\Delta t}$$

$$\Delta t = t_2 - t_1$$

$$V_a = \frac{\Delta S}{\Delta t} = \frac{84\ cm}{5s - 2s} = 28\frac{cm}{s}$$

C: The equation of motion for a particle:

$$V = V_0 + At, \qquad V_0 = 0, \qquad A = 2b = 8\ \frac{cm}{s^2}$$

Instantaneous velocity at time t =2s:

$$V_i = At = 8\ \frac{cm}{s^2} * 2s = 16\ \frac{cm}{s}$$

Answer: a) 84 cm b) $28\frac{cm}{s}$, c) $16\ \frac{cm}{s}$.