

1. (25 pts) One Friday morning at 8:00 AM there were 3 inches of snow on the ground. A student with way too much free time noticed that at noon there were 5 inches of snow on the ground.

a) At what rate was the snow accumulating on the ground? You may use whatever units you like, as long as you specify the units.

Any rate of change is the amount of change divided by the length of time,

$$\text{rate} = \frac{\text{amount}}{\text{time}}$$

In this case, rather than distance change, it is snow depth change. The change in the depth of the snow is 5 inches - 3 inches = 2 inches. The time over which this change occurs is 4 hours. Thus the rate of change is

$$\text{rate} = \frac{\text{change}}{\text{time}} = \frac{2 \text{ inches}}{4 \text{ hours}} = 1/2 \text{ inch/hour}$$

b) Assuming the snow continues falling at this rate, by how much will the depth of the snow increase by 5:00 PM?

I left this question open as to the starting point, either 8:00 AM or 12:00 PM. In either case, the principle is the same. The amount of change is equal to the rate of change times the length of time over which the change occurs,

$$\text{change} = \text{rate} \times \text{time}$$

For an 8:00 AM starting point, we get

$$\text{change} = (1/2) \times (9 \text{ hours}) = 4.5 \text{ inches}$$

For a noon starting point, this gives

$$\text{change} = (1/2) \times (5 \text{ hours}) = 2.5 \text{ inches}$$

c) How deep will the snow be at 5:00 PM?

Again, the principle is the same here as with our study of motion. The final value of a quantity is equal to the initial value plus the amount of change,

$$\text{final} = \text{initial} + \text{change}$$

If you start counting from 8:00 AM with an initial 3 inches of snow, this gives

$$\text{final depth} = 3 \text{ inches} + 4.5 \text{ inches} = 7.5 \text{ inches}$$

On the other hand, if you start with the 5 inches at noon, we get

$$\text{final depth} = 5 \text{ inches} + 2.5 \text{ inches} = 7.5 \text{ inches}$$

Both approaches give the same *final* snow depth.

d) Is your answer to (a) the instantaneous or average rate of snow accumulation?

The answer to (a) is the *average* rate of snow accumulation during that 4 hour time interval.