First, review the definitions of position and displacement, which were given in Lecture 1. Now, learn the following two definitions:

DEF The AVERAGE SPEED ($\bar{u}$) during some time interval (Δt) is the distance (d) traveled during that interval divided by the time elapsed.

In symbols,

$$\bar{u} \equiv \frac{d}{\Delta t}$$

Average speed is a scalar quantity. The units are m/s.

DEF The AVERAGE VELOCITY ($\bar{\mathbf{v}}$) during some time interval (Δt) is the displacement ($\Delta \mathbf{r}$) divided by the time elapsed.

In symbols,

$$\bar{\mathbf{v}} \equiv \frac{\Delta \mathbf{r}}{\Delta t}$$

Average velocity is a vector quantity. The units are m/s.

Now do Check Your Understanding (CYU) #1 on C&J p. 28. Once that is complete, learn the following four definitions:

DEF The INSTANTANEOUS VELOCITY ($\mathbf{v}(t)$ or just $\mathbf{v}$) is the velocity at a particular instant of time t. Velocity is a vector quantity. The units are m/s.

One way to calculate the instantaneous velocity is to calculate the average velocity $\bar{\mathbf{v}}$ during a very small Δt which surrounds the time t. If Δt is small enough, then there is no significant difference between $\bar{\mathbf{v}}$ during Δt and $\mathbf{v}(t)$.

DEF The INSTANTANEOUS SPEED ($v(t)$ or just v) is the magnitude of the instantaneous velocity. In symbols,

$$v \equiv |\mathbf{v}|$$

Speed is a scalar quantity. The units are m/s.

It takes considerable practice for beginning students to say or think "speed" when they read the symbol v without any vector sign or boldfacing. Try to say it correctly when you are working in your study groups. It is an acceptable common practice to drop the word "instantaneous" when referring to these quantitites. In other words, "velocity" used by itself always refers to instantaneous velocity, not average velocity.

DEF The AVERAGE ACCELERATION ($\bar{\mathbf{a}}$) during some time interval (Δt) is the change in velocity during that interval divided by the time elapsed.

In symbols,

$$\bar{\mathbf{a}} \equiv \frac{\Delta \mathbf{v}}{\Delta t} = \frac{\mathbf{v}_f - \mathbf{v}_i}{\Delta t}$$

Average acceleration is a vector quantity. The units are (m/s)/s or m/s^2.

DEF The INSTANTANEOUS ACCELERATION ($\mathbf{a}(t)$ or just $\mathbf{a}$) is the acceleration at a particular instant of time t. Acceleration is a vector quantity. The units are (m/s)/s or m/s^2.

One way to calculate the instantaneous acceleration is to calculate the average acceleration $\bar{\mathbf{a}}$ during a very small Δt which surrounds the time t. If Δt is small enough, then there is no significant difference between $\bar{\mathbf{a}}$ during Δt and $\mathbf{a}(t)$.

Now do CYU #2 on C&J p. 32. Finally do Self-Assessment Test 2.1 available from the "Student Companion Site" at

http://www.wiley.com/college/cutnell