At 2 am one morning a person runs 250 m along the infinite corridor at MIT from Mass Ave to the end of Building 8, turns right at the end of the corridor and runs 178 m to the end of Building 2, and then turns right and runs 30 m down the hall. What is the direction and magnitude of the straight line between start and finish?

**Solution** The figure below shows the vector diagram with a convenient choice of unit vectors for your motion with the overall displacement vector denoted by $\Delta \vec{r}$.

b) Your three separate displacements are given by the vectors $\Delta \vec{r}_1 = 250 \text{ m } \hat{j}$, $\Delta \vec{r}_2 = 178 \text{ m } \hat{i}$, and $\Delta \vec{r}_3 = -30 \text{ m } \hat{j}$. The displacement vector for your entire run is given by

$$\Delta \vec{r} = \Delta \vec{r}_1 + \Delta \vec{r}_2 + \Delta \vec{r}_3 = 250 \text{ m } \hat{j} + 178 \text{ m } \hat{i} + -30 \text{ m } \hat{j} = 178 \text{ m } \hat{i} + 220 \text{ m } \hat{j}.$$  

The magnitude of the your displacement from start to finish is

$$|\Delta \vec{r}| = \left( (178 \text{ m})^2 + (220 \text{ m})^2 \right)^{1/2} = 283 \text{ m}.$$  

The direction with respect to the $+\hat{i}$ - direction is given by the angle

$$\theta = \tan^{-1} \left[ \frac{220 \text{ m}}{178 \text{ m}} \right] = 51.0^\circ.$$