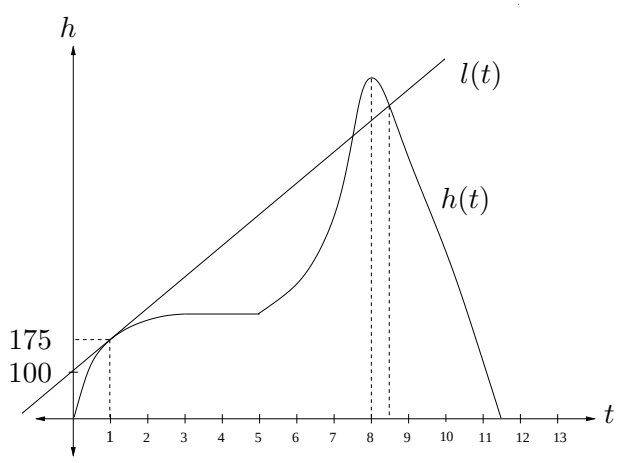
7. (12 points) The graph below gives a rock climber's height as a function of time as he climbs a small mountain. The height is measured in feet and the time is measured in hours. The line $l(t)$ gives the tangent line to $h(t)$ at time $t = 1$.



(a) For which time(s), if any, is the climber stopped?

The climber is stopped between the 3rd and 5th hour, and then again at the 8th hour.

(b) Does the climber speed up or slow down over the first three hours?

The climber slows down over the first hour, as can be seen by the fact that the graph is concave down on this interval. So he is climbing up at a decreasing rate.

(c) What is the climber's rate of ascent 1 hour into the climb?

The climber's rate of ascent is the derivative of the function $h(t)$, which happens to be the slope of the tangent line $l(t)$. To find the slope of $l(t)$, we use the points $(0, 100)$ and $(1, 175)$.

$$\begin{aligned} \text{slope of } l(t) &= \frac{175 - 100}{1 - 0} \\ &= 75\,\text{ft/hour} \end{aligned}$$

(d) What is the climber's height after 8.5 hours?

Note that the line $l(t)$ intersects $h(t)$ at $t = 8.5$. The equation for $l(t)$ is given by

$$l(t) = 75t + 100$$

. Putting in $t = 8.5$, we have that $h(8.5) = 737.5$ feet.

(e) If the maximum height the climber reaches is 800 feet, what is his average rate of ascent over the last 3.5 hours of his trip (i.e., for $8 < t < 11.5$)?

The average ascent is given by

$$\begin{aligned} \text{avg. ascent} &= \frac{800 - 0}{8 - 11.5} \\ &= -228.57\,\text{ft/hour} \end{aligned}$$

Note that the climber is climbing down, hence the negative rate of ascent.