100. (a) The time available before the train arrives at the impact spot is

$$t_{\text{train}} = \frac{40\,\text{m}}{30\,\text{m/s}} = 1.33\ \text{s}$$

(the train does not reduce its speed). We interpret the phrase "distance between the car and the center of the crossing" to refer to the distance from the front bumper of the car to that point. In which case, the car needs to travel a total distance of $\Delta x = 40 + 5 + 1.5 = 46.5$ m in order for its rear bumper and the edge of the train not to collide (the distance from the center of the train to either edge of the train is 1.5 m). With a starting velocity of $v_0 = 30$ m/s and an acceleration of $a = 1.5$ m/s^2, Eq. 2-15 leads to

$$\Delta x = v_0 t + \frac{1}{2}at^2 \implies t = \frac{-v_0 \pm \sqrt{v_0^2 + 2a\Delta x}}{a}$$

which yields (upon taking the positive root) a time $t_{\text{car}} = 1.49$ s needed for the car to make it. Recalling our result for t_{train} we see the car doesn't have enough time available to make it across.

(b) The difference is $t_{\text{car}} - t_{\text{train}} = 0.16$ s. We note that at $t = t_{\text{train}}$ the front bumper of the car is $v_0 t + \frac{1}{2}at^2 = 41.33$ m from where it started, which means it is 1.33 m past the center of the track (but the edge of the track is 1.5 m from the center). If the car was coming from the south, then the point P on the car impacted by the southern-most corner of the front of the train is 2.83 m behind the front bumper (or 2.17 m in front of the rear bumper). The motion of P is what is plotted below (the top graph – looking like a line instead of a parabola because the final speed of the car is not much different than its initial speed). Since the position of the train is on an entirely different axis than that of the car, we plot the distance (in meters) from P to "south" rail of the tracks (the top curve shown), and the distance of the "south" front corner of the train to the line-of-motion of the car (the bottom line shown).