

A roadrunner is running along a north-south highway in the American West. At noon it crosses the Arizona-Utah state line. Its position (in miles north or south) relative to the state line t hours after noon is given by the function $s(t) = t^3 - 9t^2 + 15t + 10$, where a positive value of $s(t)$ represents miles north of the state line and a negative value of $s(t)$ represents miles south of the state line.

1. Find a formula for the velocity of the roadrunner at time t .

$$v(t) = s'(t) = 3t^2 - 18t + 15$$

2. What is the roadrunner's velocity at 3 p.m.?

$$v(3) = 3(3)^2 - 18(3) + 15 = -12$$

\Rightarrow 12 mph south

3. When is the roadrunner not running?

$$0 = v(t) = 3t^2 - 18t + 15$$

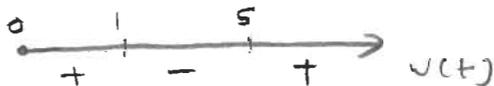
$$0 = 3(t^2 - 6t + 5)$$

$$0 = 3(t-1)(t-5)$$

$$\Rightarrow t = 1, 5$$

1 p.m. & 5 p.m.

4. When is the roadrunner running north?



running north when $v(t) > 0$

\Rightarrow 12-1 p.m. and after 5 p.m.

5. Find the net displacement of the roadrunner as of 8 p.m.

$$s(8) - s(0) = 66 - 10 = 56 \text{ miles north}$$

6. Find the total distance travelled by the roadrunner as of 8 p.m.

$$|s(1) - s(0)| + |s(5) - s(1)| + |s(8) - s(5)|$$

$$= |17 - 10| + |-15 + 17| + |66 - (-15)|$$

$$= 7 + 2 + 81 = 120 \text{ mi}$$

7. Draw a diagram that illustrates the path of the roadrunner.

