2.7 - The Particle Problem

A particle moves along a line so that its position at any time $t \geq 0$ is given by $s(t) = t^3 - 12t^2 + 36t$, where t is measured in seconds and s in meters.

1. What is the displacement during the first two seconds?

$s(2) - s(0) = 32 - 0 = 32$ m

32 m

2. Average velocity during the first four seconds?

$\frac{s(4) - s(0)}{4 - 0} = \frac{4^3 - 12(4)^2 + 36(4) - 0}{4} = 4$ m/s

4 m/s

3. Instantaneous velocity when t = 4?

$3t^2 - 24t + 36$

$3(4)^2 - 24(4) + 36 = -12$ m/s

-12 m/s

4. When does the particle not move?

$3t^2 - 24t + 36 = 0$

$t^2 - 8t + 12 = 0$

$(t-2)(t-6) = 0$

$t = 2, 6$

5. When does the particle move in the positive direction?

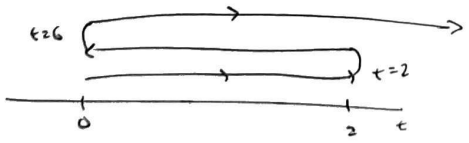
$s'(t) > 0$

$[0, 2) \cup (6, \infty)$

6. When does the particle move in the opposite direction?

(2, 6)

7. Draw a diagram that represents the motion of the particle.



8. How long does it take for the particle to get back to the starting position?

$t^3 - 12t^2 + 36t = 0$

$t(t^2 - 12t + 36) = 0$

$t(t-6)^2 = 0$

6 seconds

9. Find the total distance traveled in the first five seconds.

$|s(7) - s(6)| + |s(6) - s(2)| + |s(2) - s(0)| = 7$ 1