s(t) – meters
v(t) – m/sec
a(t) – m/sec²

p. 137 (19) A particle moves ~~along a line~~ so that its position at any time $t \geq 0$ is given by the function $s(t) = t^2 - 3t + 2$ where s is measured in meters and t is measured in seconds.

a) Find the displacement during the first 5 seconds.

Final – Initial

displacement = $\Delta s = 12 - 2$
$= 10$ meters

change in position (s(t))

$s(0) = 2$
$s(5) = 12$

b) Find the average velocity during the first 5 seconds.

avg v(t) → slope of s(t)

$s(0) = 2$
$s(5) = 12$

$\text{avg}_{v(t)} = \frac{12-2}{5-0} = \frac{10}{5} = 2$ m/sec

c) Find the instantaneous velocity when t = 4.

instantaneous v(t)
derivative of s(t)

$v(t) = 2t - 3$ m/sec
$v(4) = 2(4) - 3 = 5$ m/sec

d) Find the acceleration of the particle when t = 4.

$a(t) = 2$ m/sec²
$a(4) = 2$ m/sec²

e) At what values of t does the particle change direction?

$v(t) = 0$

$2t - 3 = 0$
$+3 \quad +3$
$\frac{2t}{2} = \frac{3}{2}$

$t = 1.5$ sec

f) Describe the particles motion

$v(t) = 2t - 3$

$v(1) = -1 < 0$

$v(2) = 1 > 0$

$(0, 1.5)$ particle moving left

$(1.5, \infty)$ particle moving right

a) Find the body's velocity, speed, and acceleration at time t.

b) Find the the body's velocity, speed, and acceleration at time $t = \frac{\pi}{4}$

15. $s(t) = 2\sin t + 3\cos t$

$v(t) = 2\cos t - 3\sin t$ $\quad v\left(\frac{\pi}{4}\right) = \frac{2\sqrt{2}}{2} - \frac{3\sqrt{2}}{2} = -\frac{\sqrt{2}}{2}$

How fast ← speed $= |v(t)| = |2\cos t - 3\sin t|$ $\quad \left|v\left(\frac{\pi}{4}\right)\right| = \frac{\sqrt{2}}{2}$

$a(t) = -2\sin t - 3\cos t$ $\quad a\left(\frac{\pi}{4}\right) = -\frac{2\sqrt{2}}{2} - \frac{3\sqrt{2}}{2} = -\frac{5\sqrt{2}}{2}$

Displacement

Average Velocity

Average Acceleration : slope of $\frac{\text{velocity}}{\text{time}}$

Instantaneous Velocity

Acceleration

Change Direction

Describe Motion

Particle at Rest