19 Motion Part 1
#1-6

Stew Dent
date Per

1. $x(t) = 24t^2 - t^3 + 10$

A) ave vel $= \frac{\Delta x}{\Delta t} = \frac{x(3) - x(0)}{3-0} = \frac{199 - 10}{3} = 63$ in/sec

B) $x(3) = 199$ in away from the origin traveling 117 m/s

$v(t) = x'(t) = 48t - 3t^2$

$x'(3) = 117$ m/s

C) $x(20) = 1610$

$x'(20) = -240$

the particle is at $x = 1610$ traveling left 240 in/sec.

D) $x'(t) = 0$

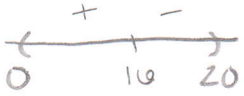
$48t - 3t^2 = 0$

$3t(16 - t) = 0$

$t = 0, 16$

$x(0) = 10 \quad x(16) = 2058$

The velocity is 0 at $t = 0$s, 16s; the particles position at those respective times are 10 in and 2058 in

E) $v(t)$ 

- from $t = 0$ to 16s the particle is moving to the right since $v(t) > 0$
- from $t = 16$ to 20s the particle is moving to the left since $v(t) < 0$

F) $a(t) = v'(t) = x''(t) = 48 - 6t$

$a(3) = 30$ in/sec^2 $\quad a(5) = 18$ in/sec^2

$a(10) = -12$ in/sec^2 $\quad a(15) = -42$ in/sec^2

G) at $t = 3$ $\quad v(3) = 117 > 0$

$a(3) = 30 > 0$

the particle is speeding up since v + a are going the same direction.

2. $h(t) = -16t^2 + 256t$

A) ave vel $\frac{\Delta h}{\Delta t} = \frac{h(5) - h(0)}{5-0} = \frac{880 - 0}{5} = 176$ ft/sec

B) $v(t) = h'(t) = -32t + 256$

$v(6) = 64$ ft/sec

$h(6) = 960$ ft

after 6 seconds the projectile is 960 ft above the ground traveling 64 ft/sec. upward.

C) $v(10) = -64$ ft/sec

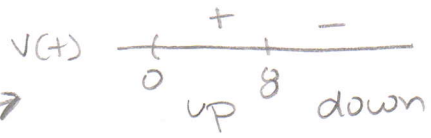
$h(10) = 960$ ft

after 10 sec the projectile is 960 ft above the ground traveling 64 ft/sec downward

D) max height $v(t) = 0$

$-32t + 256 = 0$

$t = 8$ s



$h(8) = 1024$ ft

the max height is 1024 ft, reached at $t = 8$s.

E) $h(t) = 0 = -16t(t - 16)$

$t = 0, 16$

starts, stops

$v(16) = -256$ ft/sec

at $t = 16$s the projectile hits the ground going 256 ft/sec down.

F) from $t = 0$ to 8s the projectile is going up, from $t = 8$ to 16s the particle is returning to the ground.

3. $v(2) = f'(x) = 2$ C

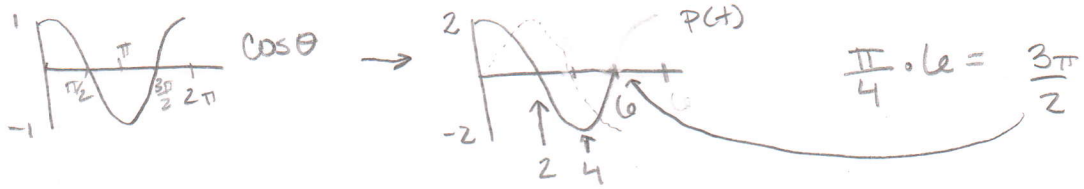
4. $v(t) = s'(t) = 3t^2 - 12t + 9 = 0$

$3(t^2 - 4t + 3) = 3(t-3)(t-1) = 0 \rightarrow t = 1, 3$ B

5. $v(t) = s'(t) = 6t^2 - 8t + 2$

$a(t) = v'(t) = 12t - 8$

$a(10) = 12(10) - 8 = 112 \text{ m/s}^2$ **A**

6. 

a) R moving right means $r'(t) > 0$

$r'(t) = 3t^2 - 12t + 9 = 0$

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

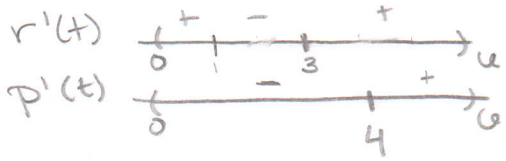
Particle R is moving right during $0 < t < 1$ and $3 < t < 6$ since $r'(t) > 0$

b) $p'(t) = -2\sin\left(\frac{\pi}{4}t\right) \cdot \frac{\pi}{4} = -\frac{\pi}{2}\sin\left(\frac{\pi}{4}t\right) = 0$

$\sin\theta = 0$ when $\theta = 0, \pi$

$\frac{\pi}{4}t = 0$; $t = 0$

$\frac{\pi}{4}t = \pi$; $t = 4$



traveling different directions $(0,1)$; $(3,4)$

c) $p''(t) = -\frac{\pi}{2}\cos\left(\frac{\pi}{4}t\right) \cdot \frac{\pi}{4} = -\frac{\pi^2}{8}\cos\left(\frac{\pi}{4}t\right)$

velocity: $p'(3) = \underbrace{-\frac{\pi}{2}}_{-} \underbrace{\sin\left(\frac{3\pi}{4}\right)}_{QII \to +} < 0$

accel: $p''(3) = \underbrace{-\frac{\pi^2}{8}}_{-} \underbrace{\cos\left(\frac{3\pi}{4}\right)}_{QII \to -} > 0$

at $t = 3$ particle P is since velocity + acceleration are going different directions