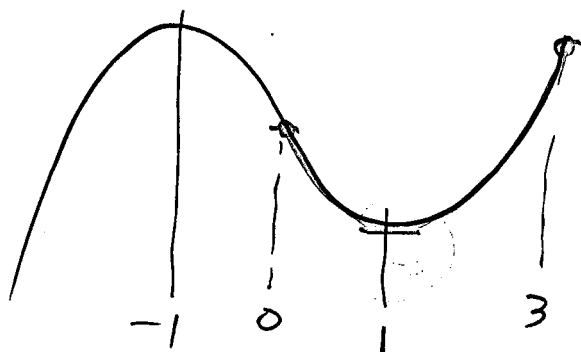
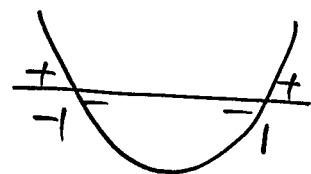


P191

EX) $f(x) = x^3 - 3x + 2 \quad (0 \leq x \leq 3)$

$f'(x) = 3(x^2 - 1) = 3(x+1)(x-1)$



$f(0) = 2$

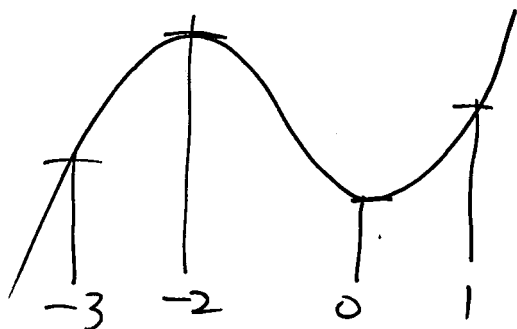
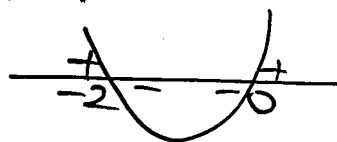
$M = f(3) = 27 - 9 + 2 = 20, \quad m = f(1) = 1 - 3 + 2 = 0$

P193

II

$f(x) = x^3 + 3x^2 \quad (-3 \leq x \leq 1)$

$f'(x) = 3x^2 + 6x = 3x(x+2)$



$f(-2) = -8 + 12 = 4$

$f(1) = 1 + 3 = 4$

$M = 4$

$f(0) = 0$

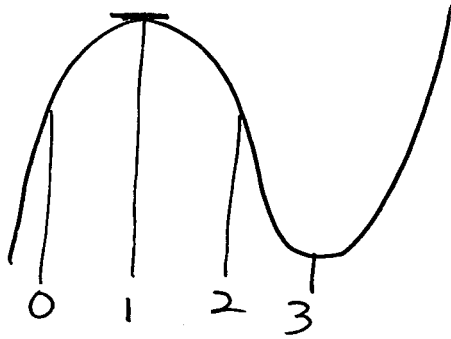
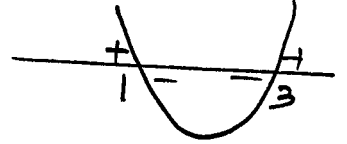
$f(-3) = -27 + 27 = 0$

$m = 0$

21

$$f(x) = x^3 - 6x^2 + 9x \quad (0 \leq x \leq 2)$$

$$f'(x) = 3(x^2 - 4x + 3) = 3(x-1)(x-3)$$

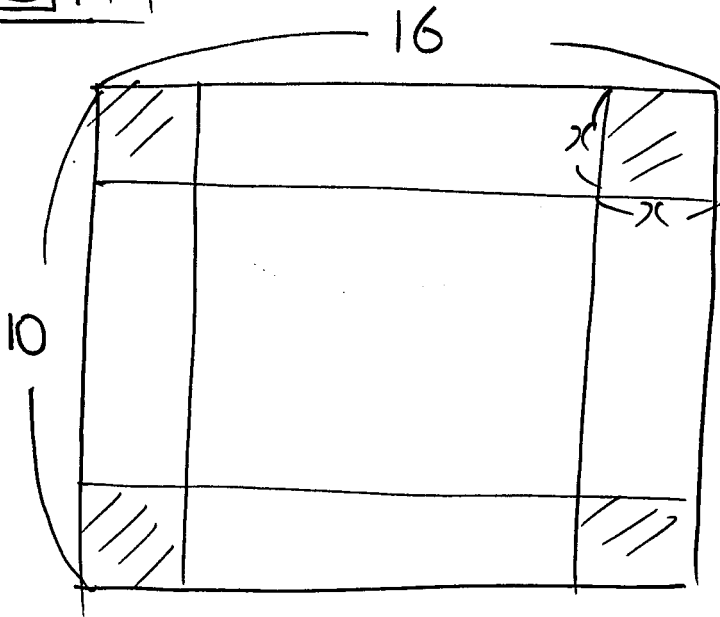


$$M = f(1) = 1 - 6 + 9 = 4$$

$$m = f(0) = 0$$

$$f(2) = 8 - 24 + 18 = 2$$

3144



$$(\text{가로}) = 16 - 2x > 0$$

$$(\text{세로}) = 10 - 2x > 0$$

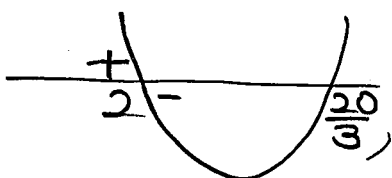
$$(\text{높이}) = x > 0$$

$$V(x) = (16-2x)(10-2x) \cdot x \quad (0 < x < 5)$$

$$= 4x(8-x)(5-x)$$

$$= 4(x^3 - 13x^2 + 40x)$$

$$V'(x) = 4(3x^2 - 26x + 40) = 4(x-2)(3x-20)$$



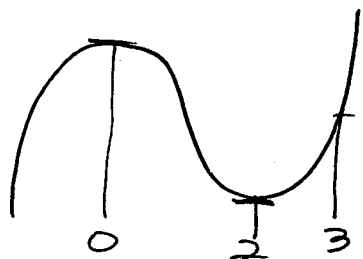
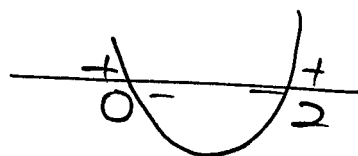
$x = 2$ 일때 최댓값

$$V(2) = 12 \cdot 6 \cdot 2 = 144$$

1-1

(1) $f(x) = x^3 - 3x^2 + 2 \quad (0 \leq x \leq 3)$

$f'(x) = 3x^2 - 6x = 3x(x-2)$



$f(0) = 2$

$M = 2$

$f(3) = 27 - 27 + 2 = 2$

$m = f(2) = 8 - 12 + 2 = -2$

(2) $f(x) = -x^3 + 3x^2 + 9x - 7 \quad (0 \leq x \leq 4)$

$f'(x) = -3(x^2 - 2x - 3) = -3(x+1)(x-3)$



$M = f(3) = -27 + 27 + 27 - 7 = 20$

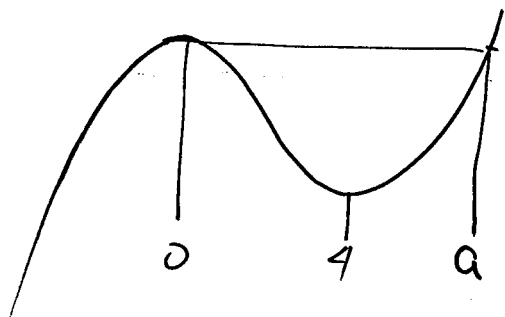
$m = f(0) = -7$

$f(4) = -64 + 48 + 36 - 7 = 13$

1-2 6

$f(x) = x^3 - 6x^2 + 1 \quad (0 \leq x \leq a)$

$f'(x) = 3(x^2 - 4x) = 3x(x-4)$



$f(0) = 1$

$f(a) = a^3 - 6a^2 + 1$

$a^3 - 6a^2 + 1 \leq 1$

$a^2(a-6) \leq 0$

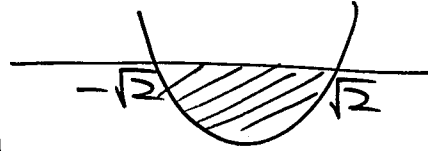
$a \leq 6 \quad \therefore 0 < a \leq 6$

1-3

$$x^2 = 4 - 2y^2 \geq 0$$

$$y^2 - 2 \leq 0$$

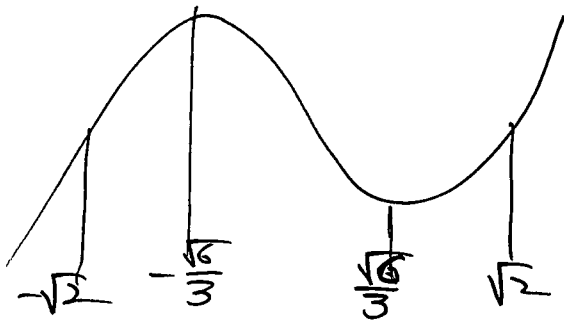
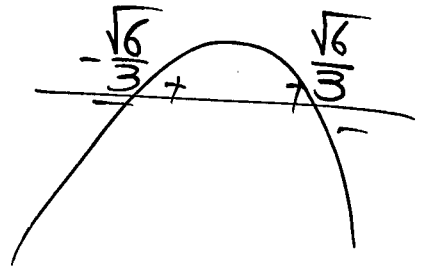
$$\boxed{-\sqrt{2} \leq y \leq \sqrt{2}}$$



$$x^2 y = (4 - 2y^2) \cdot y = f(y)$$

$$f(y) = -2y^3 + 4y$$

$$f'(y) = -6y^2 + 4 = -6(y^2 - \frac{2}{3})$$



$$f(-\sqrt{2}) = 0, \quad f(\sqrt{2}) = 0$$

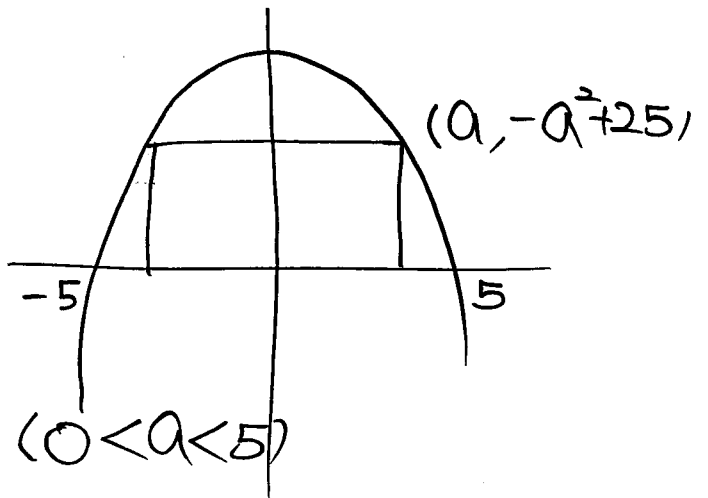
$$m = f(-\frac{\sqrt{6}}{3}) = (4 - \frac{4}{3})(-\frac{\sqrt{6}}{3}) = -\frac{8\sqrt{6}}{9}$$

$$M = f(\frac{\sqrt{6}}{3}) = (4 - \frac{4}{3})(\frac{\sqrt{6}}{3}) = \frac{8\sqrt{6}}{9}$$

2-11 $\frac{500\sqrt{3}}{9}$

$$y = -(x-3)^2 + 25$$

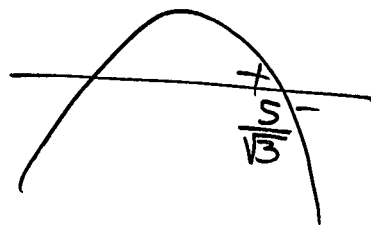
$$\text{令 } x = -3, \quad y = -x^2 + 25$$



$$S(a) = 2a \cdot (-a^2 + 25) \quad (0 < a < 5)$$

$$S(a) = 2(-a^3 + 25a)$$

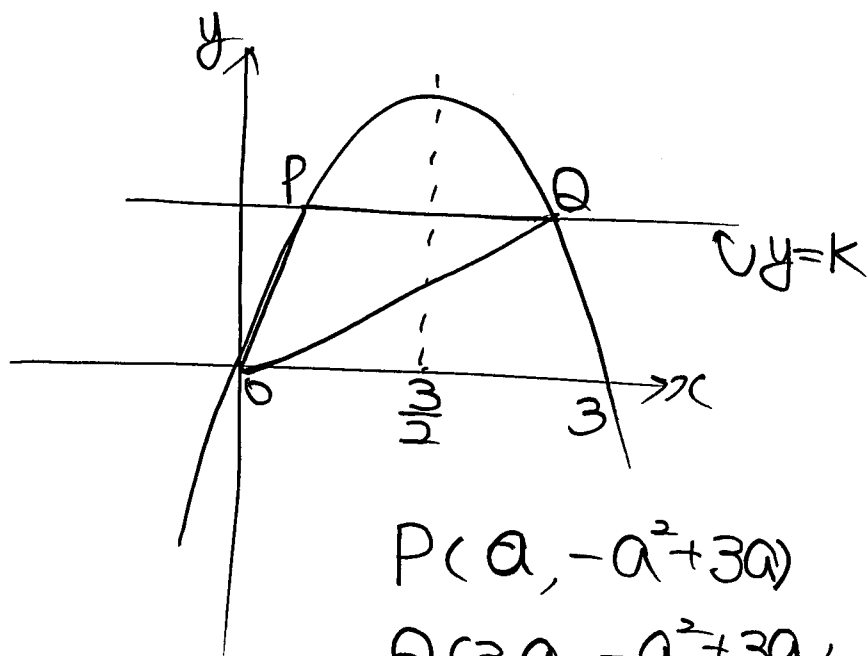
$$S'(a) = 2(-3a^2 + 25)$$



$$a = \frac{5}{\sqrt{3}} \text{ 일 때 최댓값}$$

$$S\left(\frac{5}{\sqrt{3}}\right) = \frac{10}{\sqrt{3}} \left(-\frac{25}{3} + 25\right) = \frac{10}{\sqrt{3}} \cdot \frac{50}{3} = \frac{500\sqrt{3}}{9}$$

$$\frac{2-2\sqrt{3}}{2}$$



$$P(a, -a^2 + 3a)$$

$$-a^2 + 3a = k$$

$$Q(3-a, -a^2 + 3a)$$

$$0 < a < \frac{3}{2}$$

$$f(a) = \frac{1}{2} \cdot (3-2a) \cdot (-a^2 + 3a)$$

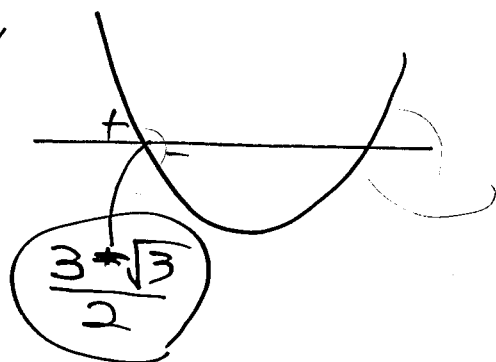
$$= \frac{1}{2} (2a^3 - 9a^2 + 9a)$$

$$f'(a) = \frac{1}{2} (6a^2 - 18a + 9)$$

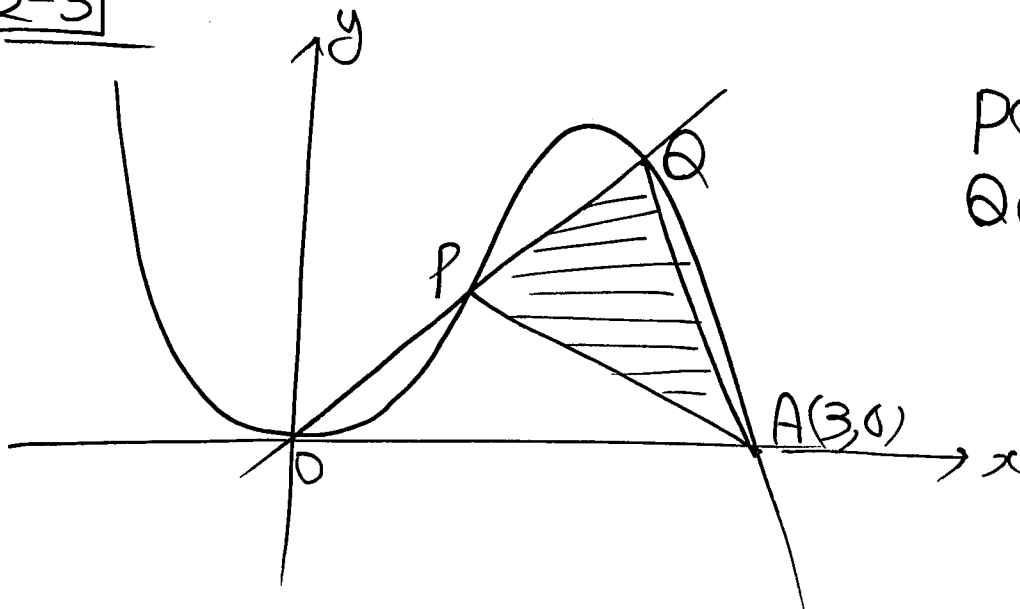
$$= \frac{3}{2} (2a^2 - 6a + 3)$$

$$2a^2 - 6a + 3 = 0$$

$$k = \frac{3}{2}$$



2-3



$P(\alpha, m\alpha)$

$Q(\beta, m\beta)$

$\alpha < \beta$

$$x^2(3-x) = mx$$

$$x^3 - 3x^2 + mx = 0$$

$$x(x^2 - 3x + m) = 0$$

$$x^2 - 3x + m = 0 \Rightarrow \alpha, \beta$$

$$\alpha + \beta = 3$$

$$\alpha\beta = m$$

$$S = \frac{1}{2} \cdot 3 \cdot m\beta - \frac{1}{2} \cdot 3 \cdot m\alpha$$

$$= \frac{3m(\beta - \alpha)}{2}$$

$$= \frac{3m\sqrt{9-4m}}{2}$$

$$= \frac{3\sqrt{9m^2-4m^3}}{2}$$

$$(\beta - \alpha)^2 = (\alpha + \beta)^2 - 4\alpha\beta$$

$$= 9 - 4m$$

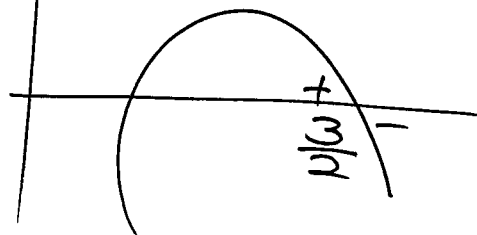
$$\beta - \alpha = \sqrt{9-4m}$$

$$\sqrt{m^2} = m \quad (m > 0)$$

$$f(m) = 9m^2 - 4m^3$$

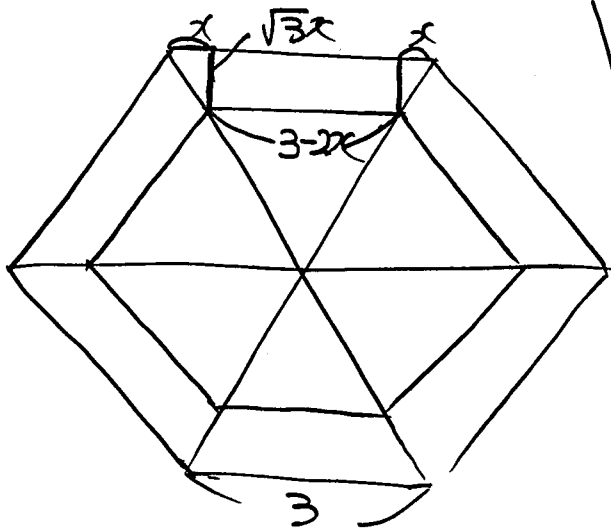
$$f'(m) = 18m - 12m^2$$

$$= 6m(3-2m)$$



$$m = \frac{3}{2} \text{ 일 때 최댓값 : } S = \frac{3 \cdot \frac{3}{2} \cdot \sqrt{3}}{2} = \frac{9\sqrt{3}}{4}$$

3-119



$$V = \frac{\sqrt{3}}{4} (3-2x)^2 \cdot 6 \cdot \sqrt{3}x \quad (0 < x < \frac{3}{2})$$

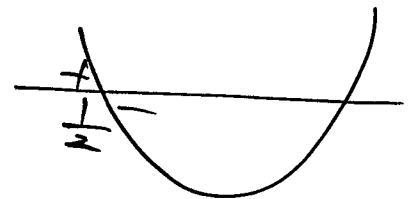
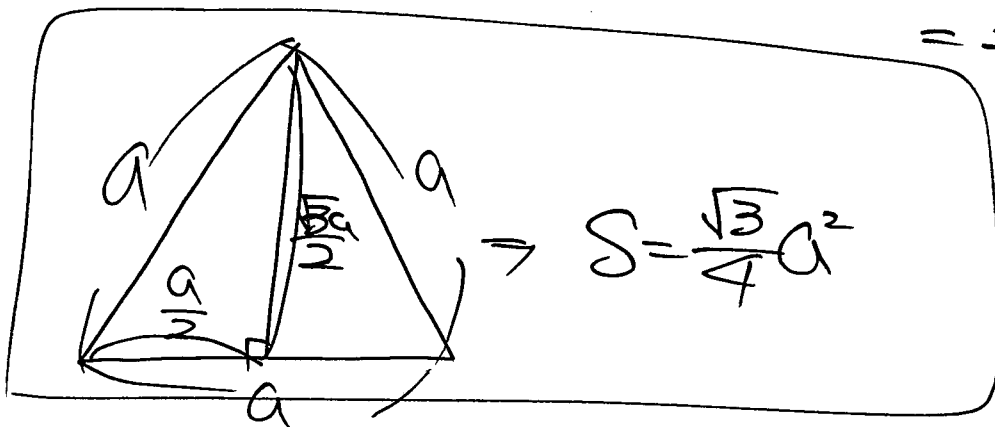
$$= \frac{9}{2} x (4x^2 - 12x + 9)$$

$$= \frac{9}{2} (4x^3 - 12x^2 + 9x) = f(x)$$

$$f'(x) = \frac{9}{2} (12x^2 - 24x + 9)$$

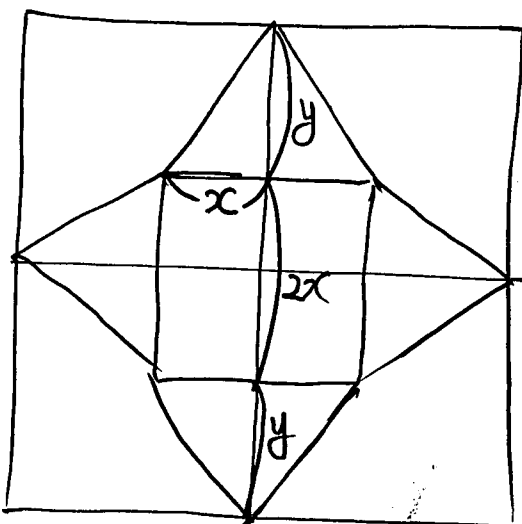
$$= \frac{9}{2} (3) (4x^2 - 8x + 3)$$

$$= \frac{27}{2} (2x - 1) (2x - 3)$$



$$f(\frac{1}{2}) = \frac{9}{2} \cdot \frac{1}{2} \cdot 4 = 9$$

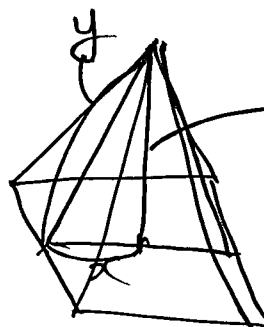
3-21



$$2x + 2y = 4$$

$$\parallel 2x = ?$$

$$x + y = 2$$



$$\sqrt{y^2 - x^2}$$

$$= \sqrt{(2-x)^2 - x^2}$$

$$= \sqrt{4 - 4x}$$

$$V = \frac{1}{3} \cdot 4x^2 \cdot \sqrt{4-4x} \quad (0 < x < 1)$$

$$= \frac{4}{3} \sqrt{4x^4 - 4x^5} = \frac{8}{3} \sqrt{x^4 - x^5}$$

$$f(x) = x^4 - x^5$$

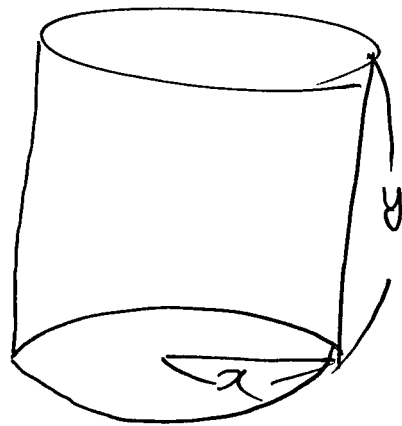
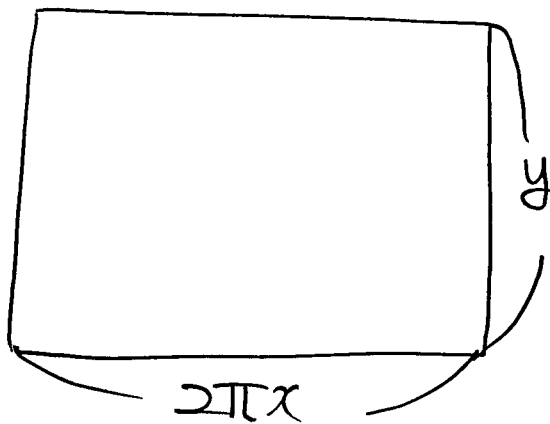
$$f'(x) = 4x^3 - 5x^4 = x^3(4 - 5x)$$

$$\frac{x}{5/4}$$

$$\underline{x = \frac{4}{5}}$$

$$\boxed{\text{한변의 길이: } \frac{8}{5}}$$

3-3

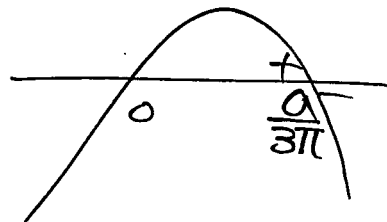


$$2y + 4\pi x = (\text{일정}) = 2a$$

$$\boxed{y + 2\pi x = a} \Rightarrow y = a - 2\pi x$$

$$V = \pi x^2 y = \pi x^2 (a - 2\pi x) = \pi (ax^2 - 2\pi x^3) = f(x)$$

$$f'(x) = \pi (2ax - 6\pi x^2)$$



$$x = \frac{a}{3\pi}$$

$$y + \frac{2a}{3} = a$$

$$y = \frac{a}{3}$$

$$2\pi x : y = \frac{2a}{3} : \frac{a}{3} = 2 : 1$$

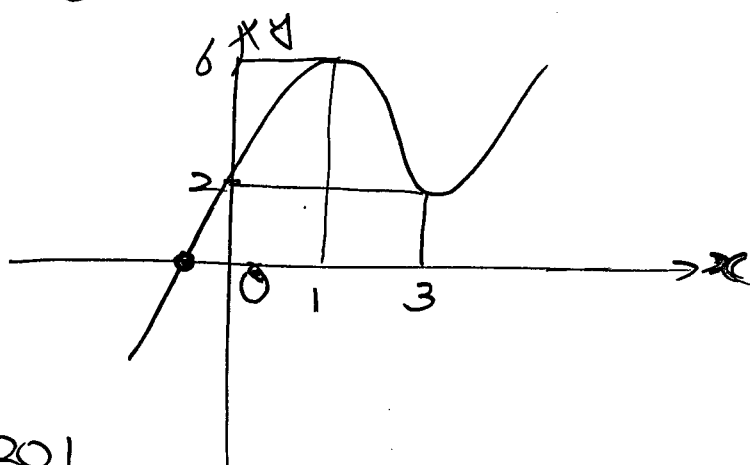
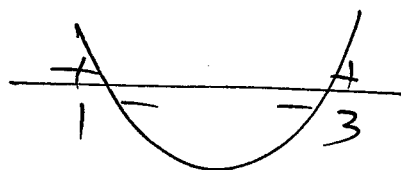
P200

EX, $f(x) = x^3 - 6x^2 + 9x + 2$

$f'(x) = 3(x^2 - 4x + 3)$

$f(1) = 1 - 6 + 9 + 2 = 6$

$f(3) = 27 - 54 + 27 + 2 = 2$



174

P201

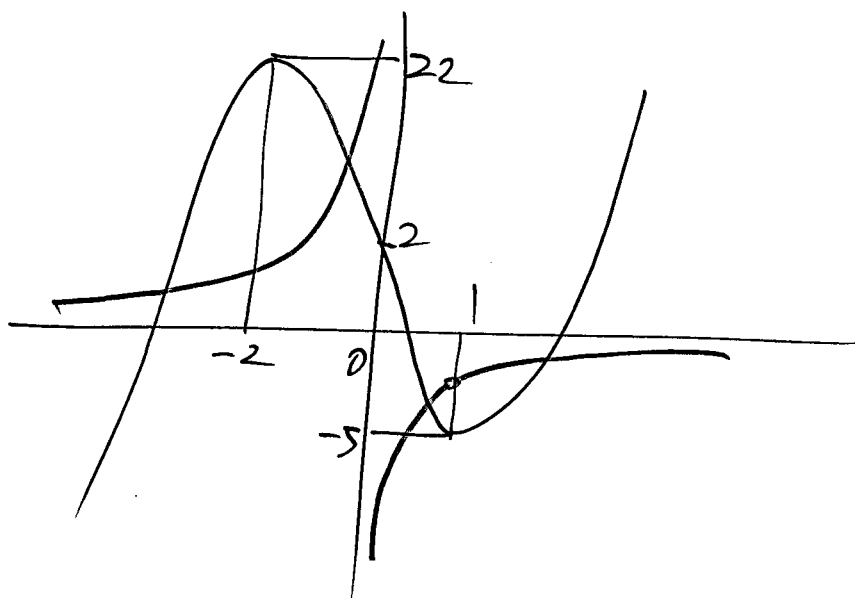
EX, $f(x) = 2x^3 + 3x^2 - 12x + 2$, $g(x) = -\frac{1}{x}$

$f'(x) = 6(x^2 + x - 2)$



$f(-2) = -16 + 12 + 24 + 2 = 22$

$f(1) = 2 + 3 - 12 + 2 = -5$

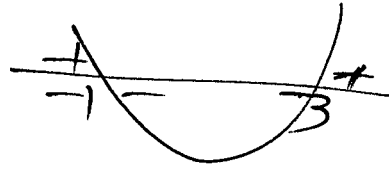


424

P202

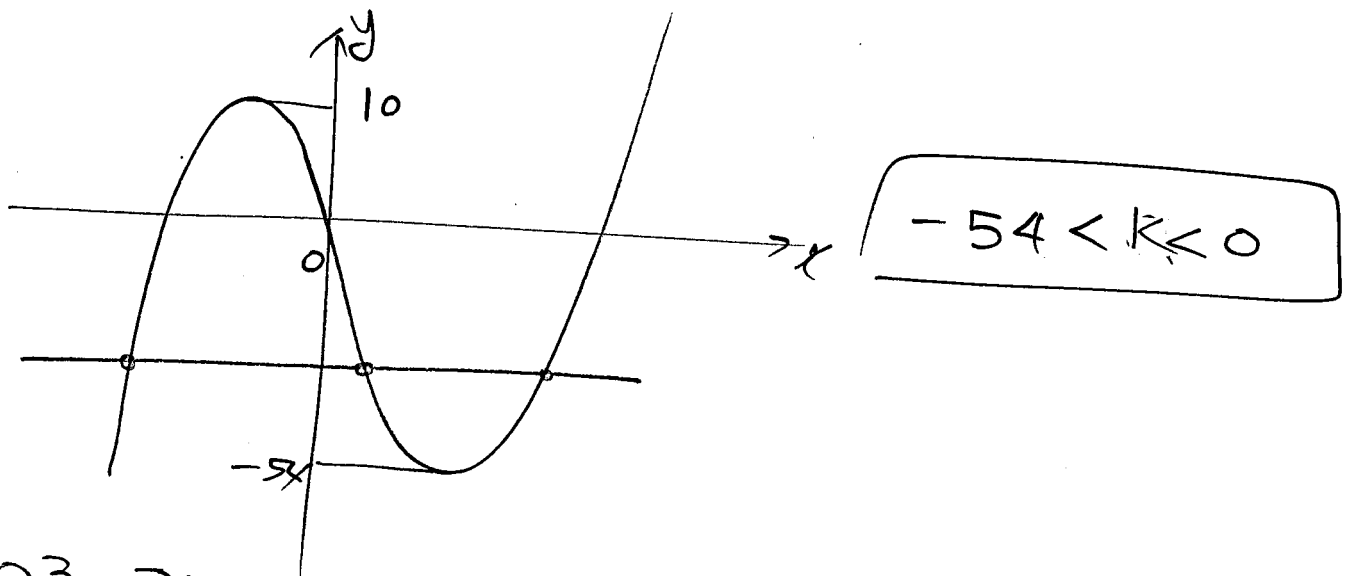
Ex, $f(x) = 2x^3 - 6x^2 - 18x$
 $y = k$

$f'(x) = 6(x^2 - 2x - 3)$



$f(-1) = -2 - 6 + 18 = 10$

$f(3) = 54 - 54 - 54 = -54$

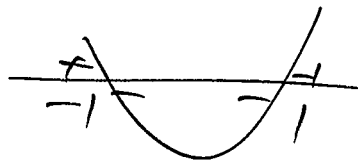


P203 Ex,

$2x^3 - 6x = a$

$y = a$
 $f'(x) = 2x^2 - 6$

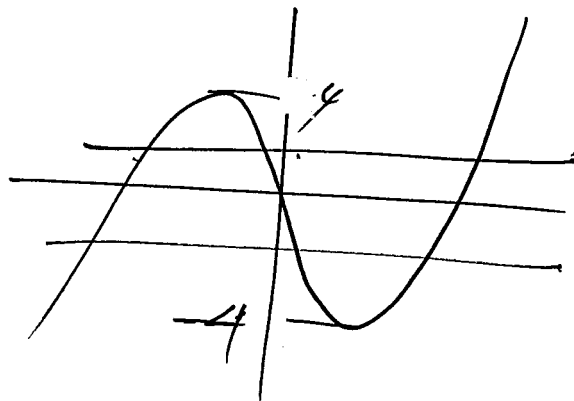
$f'(x) = 6(x^2 - 1)$



$f(-1) = -2 + 6 = 4$

$f(1) = 2 - 6 = -4$

$-4 < a < 4$

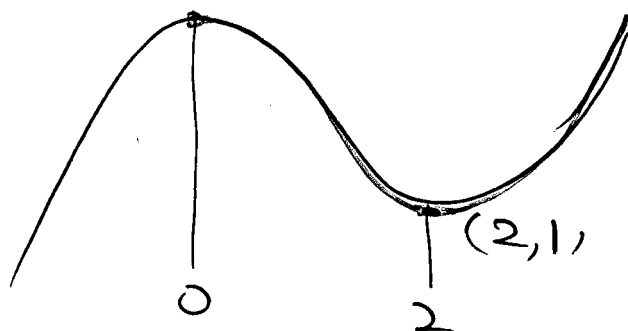
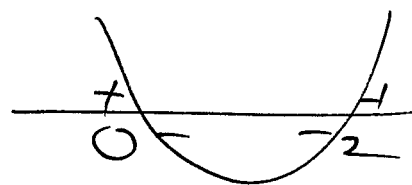


P204

EX, $x \geq 0$

$$f(x) = x^3 - 3x^2 + 5$$

$$f'(x) = 3x^2 - 6x = 3x(x-2)$$



$$f(2) = 8 - 12 + 5 = 1$$

$$x^3 - 3x^2 + 5 > 0$$

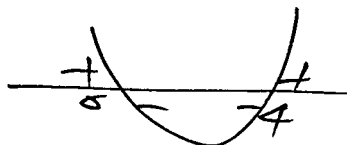
$$x^3 > 3x^2 - 5$$

P205

11

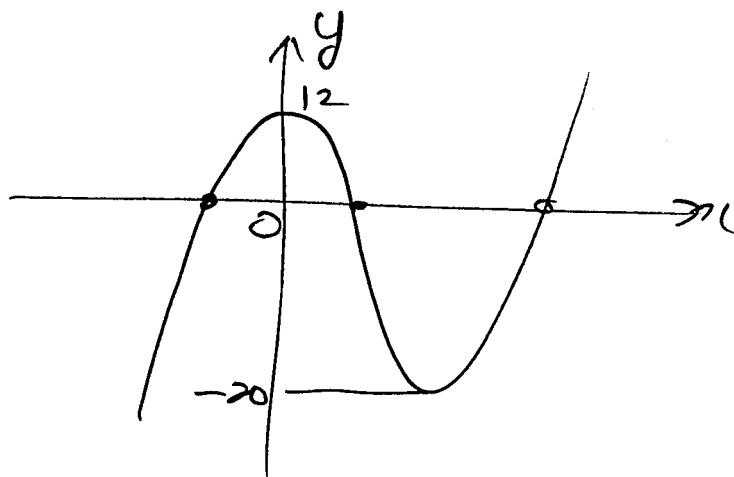
$$f(x) = x^3 - 6x^2 + 12$$

$$f'(x) = 3(x^2 - 4x)$$



$$f(0) = 12$$

$$f(4) = 64 - 96 + 12 = -20$$



$$3x^4$$

2)

$$x \geq 0 \quad x^3 \geq 3x^2 - 4$$

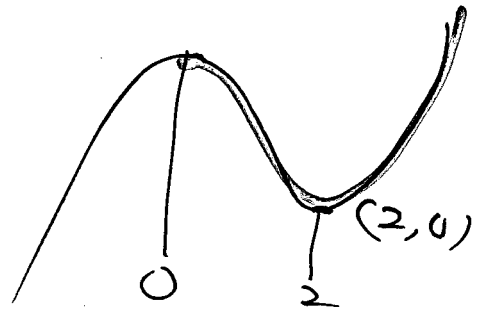
$$f(x) = x^3 - 3x^2 + 4$$

$$f'(x) = 3(x^2 - 2x) \quad \begin{array}{c} \text{+} \\ \text{---} \end{array} \quad \begin{array}{c} \text{+} \\ \text{---} \end{array}$$

$$f(0) = 4$$

$$f(2) = 8 - 12 + 4 = 0$$

$$f(x) \geq 0$$



$$\boxed{\therefore x^3 \geq 3x^2 - 4}$$

4-1)

$$2x^3 - 3x^2 - 12x = k$$

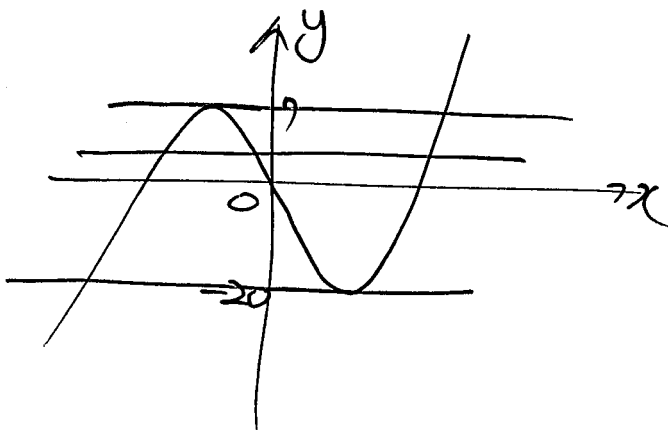
$$y = k$$

$$y = f(x) = 2x^3 - 3x^2 - 12x$$

$$f'(x) = 6(x^2 - x - 2) \quad \begin{array}{c} \text{+} \\ \text{---} \end{array} \quad \begin{array}{c} \text{+} \\ \text{---} \end{array}$$

$$f(-1) = -2 - 3 + 12 = 7$$

$$f(2) = 16 - 12 - 24 = -20$$



$$1) \quad k = -20 \text{ or } k = 7$$

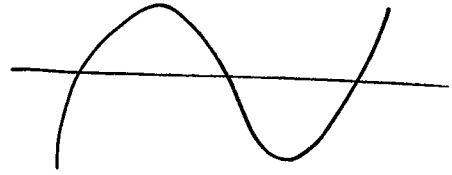
$$2) \quad -20 < k < 7$$

$$3) \quad 0 < k < 7$$

4-2)

$$f(x) = x^3 - 3ax + 2$$

$$f'(x) = 3(x^2 - a)$$



$$D > 0$$

$$a > 0$$

$$f(-\sqrt{a}) = -a\sqrt{a} + 3a\sqrt{a} + 2 = 2a\sqrt{a} + 2 > 0$$

$$f(\sqrt{a}) = a\sqrt{a} - 3a\sqrt{a} + 2 = -2a\sqrt{a} + 2 < 0$$

$$a\sqrt{a} > 1$$

$$a^{\frac{3}{2}} > 1$$

$$\boxed{a > 1}$$

$$\underline{4-31-\frac{45}{4}}$$

$$x^3 - 3x^2 - 9x - p = 0 \text{ 서로다른 세 실근 } \alpha, \beta, r$$

$$\alpha + \beta + r = 3 \quad \dots \textcircled{7}$$

$$(\alpha < \beta < r)$$

$$\alpha\beta + \beta r + r\alpha = -9 \quad \dots \textcircled{8}$$

$$\alpha\beta r = p$$

$$\textcircled{7}, \textcircled{8} \text{ 가 곱해서 } \beta(\alpha + r) + r\alpha = -9$$

$$r\alpha = -\beta(\alpha + r) - 9$$

$$= -\beta(3 - \beta) - 9$$

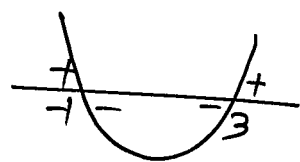
$$= \beta^2 - 3\beta - 9 = \left(\beta - \frac{3}{2}\right)^2 - 9 - \frac{9}{4}$$

$$\therefore \beta = \frac{3}{2} \text{ 일때 최솟값 } \boxed{-\frac{45}{4}}$$

$$x^3 - 3x^2 - 9x = p$$

$$\begin{cases} f(x) = x^3 - 3x^2 - 9x \\ y = p \end{cases}$$

$$f'(x) = 3(x^2 - 2x - 3) = 3(x-3)(x+1)$$

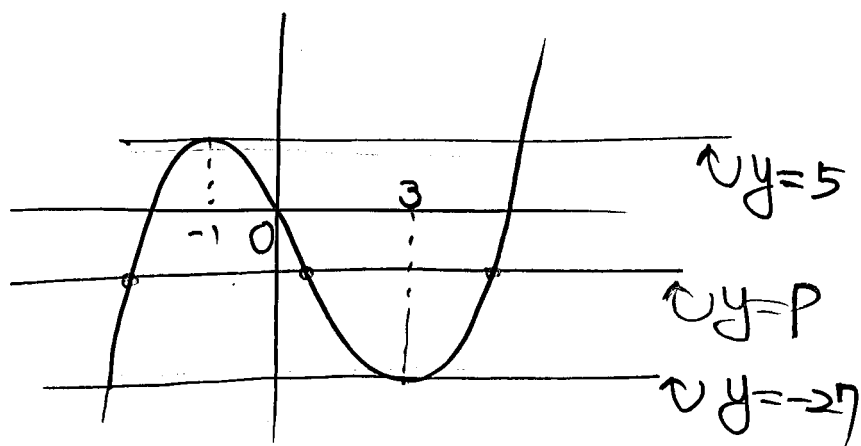


$$f(-1) = -1 - 3 + 9 = 5$$

$$f(3) = 27 - 27 - 27 = -27$$

$$-27 < p < 5$$

$$-1 < \beta < 3$$



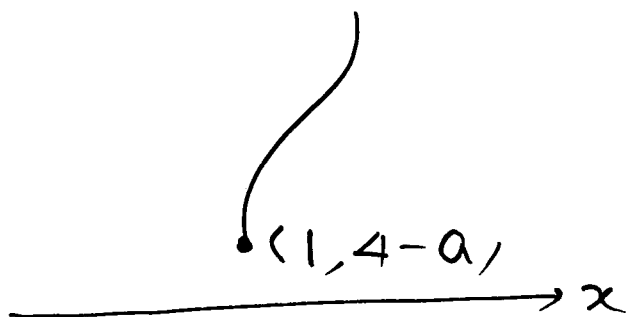
5-11

(1) $x \geq 1$

$$f(x) = x^3 + x^2 + 2x - a$$

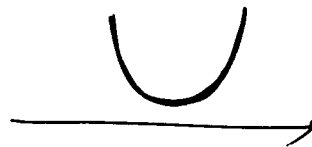
$$f'(x) = 3x^2 + 2x + 2 > 0$$

이므로 $f(x)$: 증가함수



$$f(x) > 0$$

$$D = 1 - 6 = -5 < 0$$



$$f(1) = 1 + 1 + 2 - a = 4 - a$$

$$f(1) = 4 - a > 0$$

$$\boxed{a < 4}$$

$$(2) f(x) = x^4 - 4a^3x + 12$$

$$f'(x) = 4x^3 - 4a^3$$

$$= 4(x - a)(x^2 + ax + a^2)$$

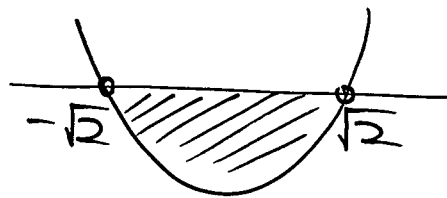
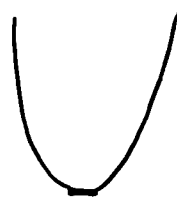
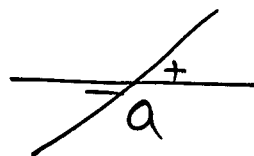
$$f(a) = a^4 - 4a^4 + 12 > 0$$

$$a^4 - 4 < 0$$

$$\underbrace{(a^2 + 2)(a^2 - 2)}_{> 0} < 0$$

$$\boxed{-\sqrt{2} < a < \sqrt{2}}$$

$$f(x) > 0$$



5-216

$$h(x) = f(x) - g(x)$$

$$= x^4 + 3x^2 - 10x + a$$

$$h'(x) = 4x^3 + 6x - 10$$

$$= 2(2x^3 + 3x - 5)$$

$$= 2(x-1) / (2x^2 + 2x + 5)$$

$$\hookrightarrow D_{\frac{1}{4}} = 1 - 10 < 0$$

$$| h(x) \geq 0$$

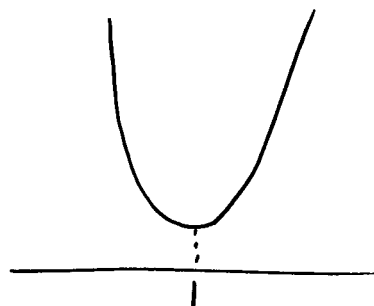
$$1 \mid \begin{array}{rrrr} 2 & 0 & 3 & -5 \\ & 2 & 2 & 5 \\ \hline 2 & 2 & 5 & 10 \end{array}$$



$$h(1) \geq 0$$

$$h(1) = 1 + 3 - 10 + a = a - 6 \geq 0$$

$$a \geq 6$$



5-311

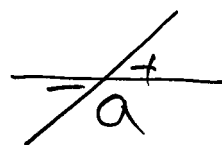
$$y^4 \leq 4 \frac{x}{y} ; \quad 3\left(\frac{x}{y}\right)^4 + 1 \geq 4a\left(\frac{x}{y}\right)^3$$

$$\frac{x}{y} = t \quad (t > 0)$$

$$3t^4 - 4at^3 + 1 \geq 0$$

$$f(t) = 3t^4 - 4at^3 + 1 \quad (a > 0)$$

$$f'(t) = 12t^3 - 12at^2 = 12t^2(t - a)$$



$$f(a) \geq 0$$

$$f(a) = 3a^4 - 4a^4 + 1 = -a^4 + 1 \geq 0$$

$$a^4 - 1 = (a^2 + 1)(a + 1)(a - 1) \leq 0 \quad a - 1 \leq 0$$

$$\therefore 0 < a \leq 1$$

P211

EX) $x = t^3 - 4t - 5$

$t = 1;$

$v = \frac{dx}{dt} = 3t^2 - 4$

$v = 3 - 4 = -1$

$a = \frac{dv}{dt} = 6t$

$a = 6$

P212

EX) $r = 1 + 3t$

$S = \pi r^2$

$\frac{dS}{dt} = 2\pi r \cdot \frac{dr}{dt}$

$r = 10, \frac{dr}{dt} = 3$
 $t = 3$

$\frac{dS}{dt} = 2\pi \cdot 10 \cdot 3 = 60\pi \text{ (cm}^2/\text{s)}$

P213

II

$x = 2t^3 - 12t^2 + 18t$

$v = \frac{dx}{dt} = 6(t^2 - 4t + 3)$

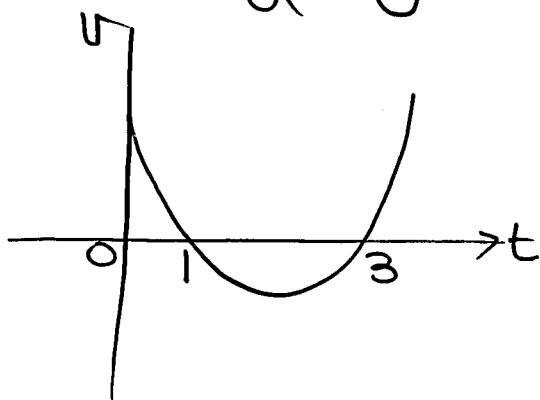
$a = \frac{dv}{dt} = 6(2t - 4)$

1) $t = 2; x = 16 - 48 + 36 = 4$

$v = 6(4 - 8 + 3) = -6$

$a = 0$

(2,



$t = 1$ et $t = 3$

21

$$x = 25t - 5t^2$$

$$v = \frac{dx}{dt} = 25 - 10t$$

$$(1) \quad t = 1; \quad v = 15 \text{ (m/s)}$$

$$t = 3; \quad v = -5 \text{ (m/s)}$$

$$(2) \quad v = 0; \quad 25 - 10t = 0 \quad t = \frac{5}{2}$$

$$x = \frac{125}{2} - \frac{125}{4} = \frac{125}{4} \text{ (m)}$$

6-11

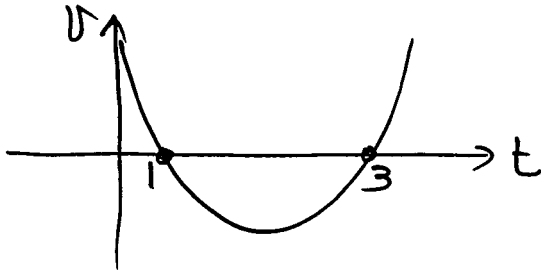
$$x = t^3 - 6t^2 + 9t$$

$$\frac{dx}{dt} = v = 3t^2 - 12t + 9 = 3(t-1)(t-3)$$

$$\frac{dv}{dt} = a = 6t - 12$$

$$(1) \quad t = 1; \quad v = 0, \quad a = -6$$

$$(2) \quad t = 3$$

6-21

$$x_p = t^3 + 3t$$

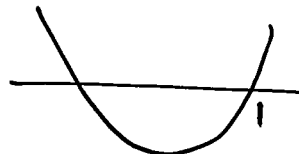
$$x_a = -t^2 - 4t$$

$$v_p = \frac{dx_p}{dt} = 3t^2 + 3$$

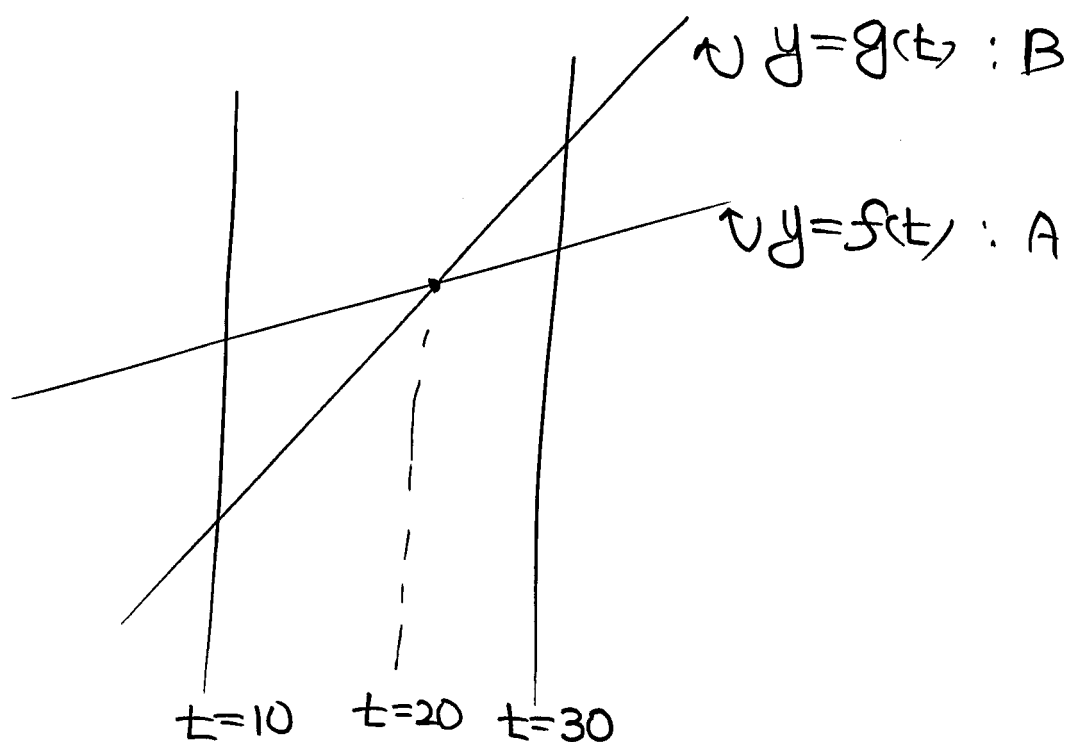
$$v_a = \frac{dx_a}{dt} = -2t - 4$$

$$(1) \quad x = \frac{t^3 - t^2 - t}{2} \quad v = \frac{dx}{dt} = \frac{3t^2 - 2t - 1}{2}$$

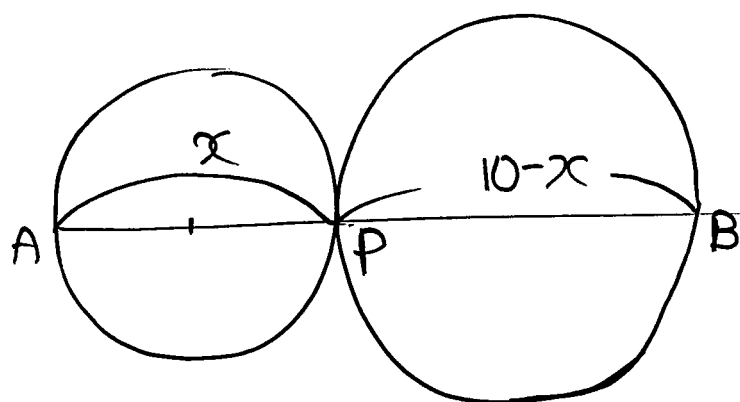
$$(2) \quad v = \frac{(3t+1)(t-1)}{2} \quad t=1; \quad v_p=6, \quad v_a=-6$$



6-31(4)



7-11 $\pi(\text{cm}^2/\text{s})$



$$x=t \quad \frac{dx}{dt}=1$$

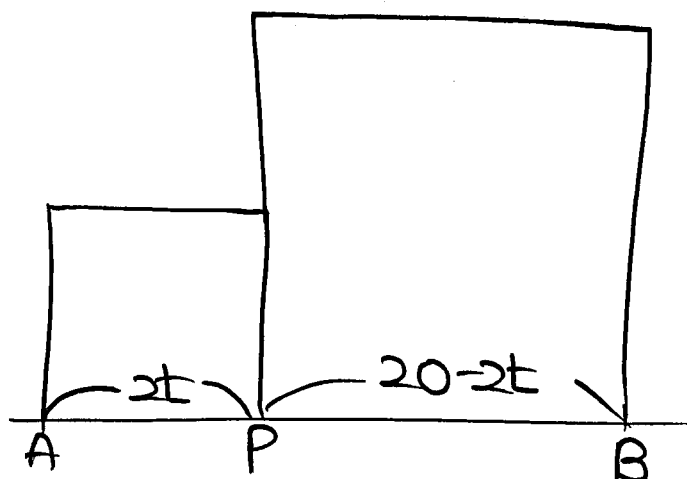
$$S = \frac{x^2}{4}\pi + \frac{(10-x)^2}{4}\pi$$

$$= \frac{(2t^2 - 20t + 100)}{4}\pi$$

$$\frac{dS}{dt} = \left(\frac{4t-20}{4}\right)\pi$$

$$t=6 \quad ; \quad \frac{dS}{dt} = \pi \text{ (cm}^2/\text{s)}$$

7-2 $48 \text{ (cm}^2/\text{s)}$

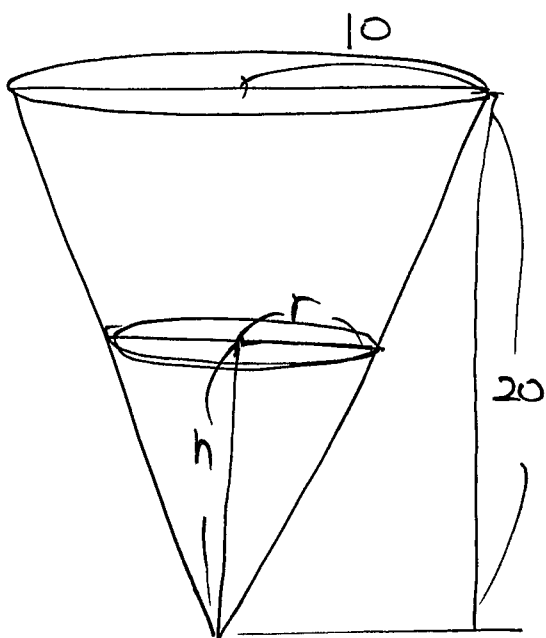


$$S = 4t^2 + (20-2t)^2 = 8t^2 - 80t + 400$$

$$\frac{dS}{dt} = 16t - 80$$

$$t = 8; \frac{dS}{dt} = 128 - 80 = 48 \text{ (cm}^2/\text{s)}$$

7-3 $36\pi \text{ (cm}^3/\text{s)}$



$$r:h = 1:2$$

$$h = 2r$$

$$V = \frac{1}{3} \cdot \pi r^2 \cdot h$$

$$= \frac{2\pi}{3} r^3$$

$$\frac{dV}{dt} = 2\pi r^2 \cdot \frac{dr}{dt}$$

$$\frac{dV}{dt} = 2\pi \cdot 36 \cdot \frac{1}{2} = 36\pi \text{ (cm}^3/\text{s)}$$

$$\frac{dr}{dt} = \frac{1}{2}$$

$$r = 6$$