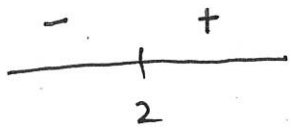
pg. 240
1-9 all

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

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

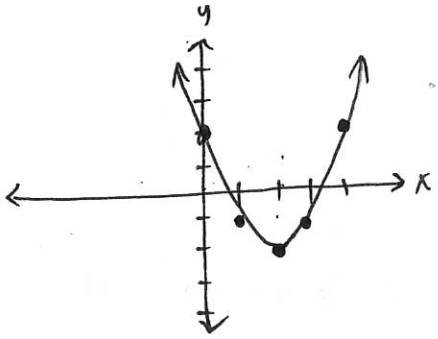
$= 2(x-2)$



a) $f(x)$ increases $(2, \infty)$
$f(x)$ decreases $(-\infty, 2)$

b) relative minimum @ $x = (2, 2)$

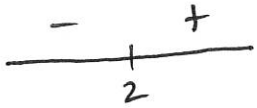
c)



(2.) $f(x) = 2x^2 - 8x + 10$

$f'(x) = 4x - 8$

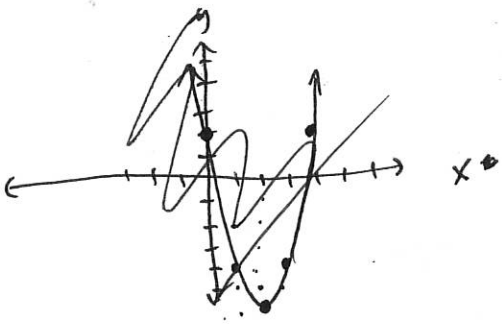
$= 4(x-2)$



a) $f(x)$ increases $(2, \infty)$
$f(x)$ decreases $(-\infty, 2)$

b) relative minimum @ $x = 2$

c)



$(2, 2)$

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

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

$= 2(2 - x)$

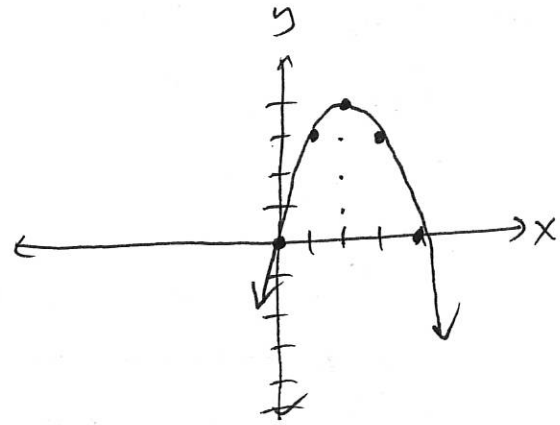
$+ \quad 2 \quad -$

a) $f(x)$ increasing $(-\infty, 2)$

$f(x)$ decreasing $(2, \infty)$

b) relative Maximum @ $x = (2, 4)$

c)



(4.) $f(x) = x^2 + 6x + 5$

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

$= 2(x + 3)$

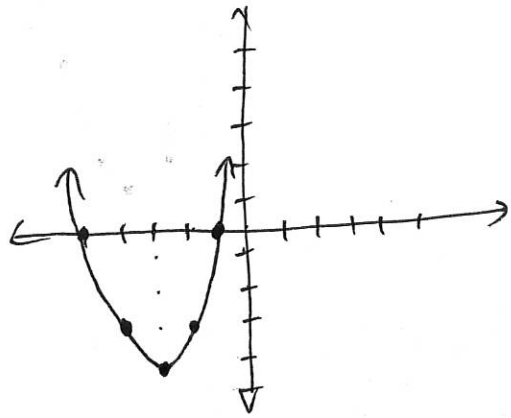
$- \quad -3 \quad +$

a) $f(x)$ increasing $(-3, \infty)$

$f(x)$ decreasing $(-\infty, -3)$

b) relative minimum @ $(-3, -4)$

c)



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

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

$= 3x(x - 2)$

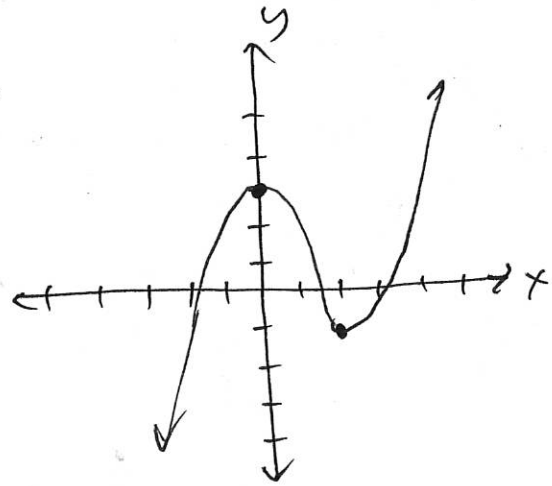
$+ \quad 0 \quad - \quad 2 \quad +$

a) $f(x)$ inc $(-\infty, 0)$ $(2, \infty)$

$f(x)$ dec $(0, 2)$

b) relative maximum @ $(0, 3)$

min @ $(2, -1)$



6. $f(x) = 3x - x^3$

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

$= 3(1 - x^2)$

$-$ $+$ $-$

-1 1

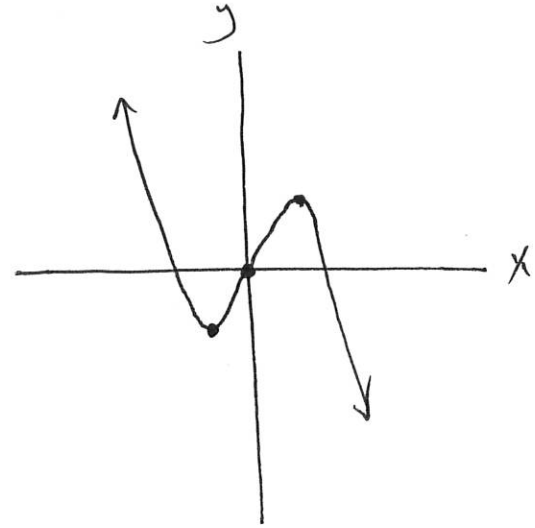
a) $f(x)$ increasing $(-1, 1)$

$f(x)$ decreasing $(-\infty, -1)$ and $(1, \infty)$

b) relative maximum @ $(1, 2)$

relative minimum @ $(-1, -2)$

c)



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

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

$= 3(4 - x^2)$

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

$-$ $+$ $-$

-2 2

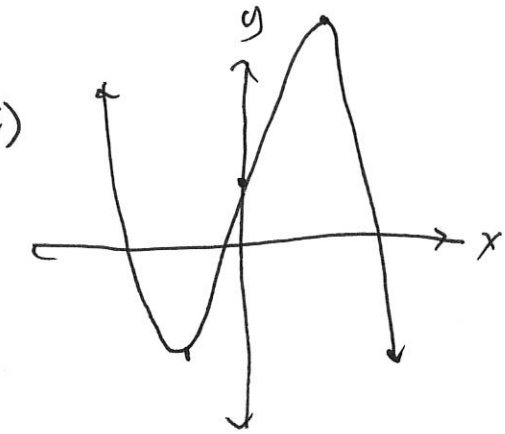
a) $f(x)$ increasing $(-2, 2)$

$f(x)$ decreasing $(-\infty, -2)$ and $(2, \infty)$

b) rel. Max $(2, 22)$

rel. Min $(-2, -10)$

c)



8. $f(x) = x^3 - 3x^2$

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

$= 3x(x - 2)$

$+$ $-$ $+$

0 2

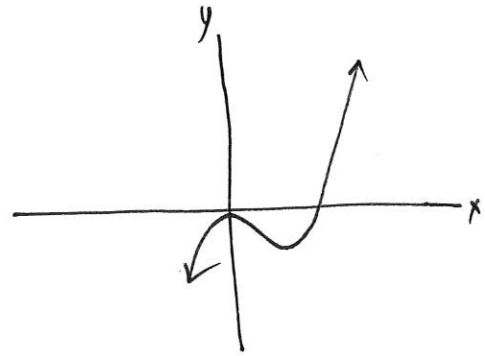
a) $f(x)$ increasing $(-\infty, 0)$ and $(2, \infty)$

$f(x)$ decreasing $(0, 2)$

b) rel max $(0, 0)$

rel min $(2, -4)$

c)



9. $f(x) = 8x^2 - x^4$

$f'(x) = 16x - 4x^3$

$= 4x(4 - x^2)$

$(2 + x)(2 - x)$

$+$ $-$ $+$ $-$

-2 0 2

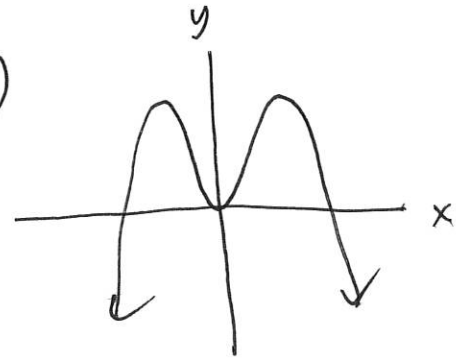
a) $f(x)$ increasing $(-\infty, -2)$ and $(0, 2)$

$f(x)$ decreasing $(-2, 0)$ and $(2, \infty)$

b) rel max $(-2, 16)$ $(2, 16)$

rel min $(0, 0)$

c)



3690

Pg. 244
1-14

1. $f(x) = x^3 - 6x^2 + 9x$

$f'(x) = 3x^2 - 12x + 9$

$f''(x) = 6x - 12$

$= 6(x-2)$

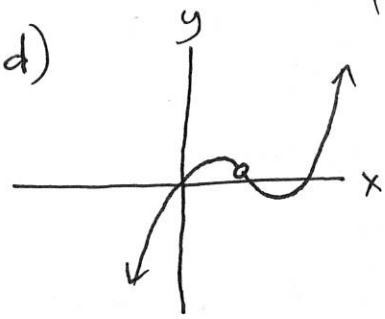
$-$ | $+$
2

a) concave down $(-\infty, 2)$

b) concave up $(2, \infty)$

c) $(2,2)$

d)



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

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

$f''(x) = -6x$

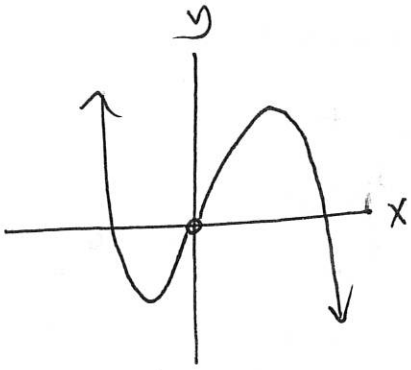
$+$ | $-$
0

a) concave up $(-\infty, 0)$

b) concave down $(0, \infty)$

c) $(0,0)$

d)



3. $f(x) = x^3 + 3x$

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

$f''(x) = 6x$

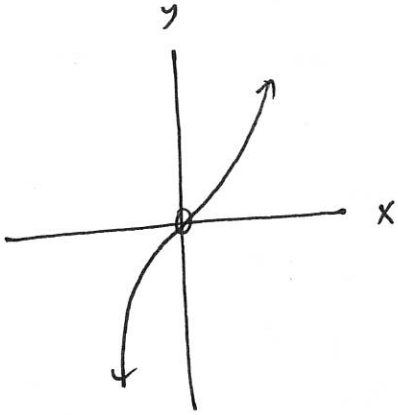
$-$ | $+$
0

a) concave up $(0, \infty)$

b) concave dow $(-\infty, 0)$

c) $(0,0)$

d)



4. $f(x) = x^3 - 3x^2 - 9x + 12$

$f'(x) = 3x^2 - 6x - 9$

$f''(x) = 6x - 6$

$= 6(x-1)$

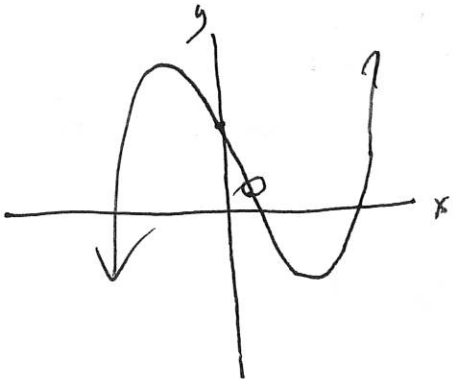
$-$ | $+$
1

a) concave up $(1, \infty)$

b) concave down $(-\infty, 1)$

c) $(1,1)$

d)



(5.) $f(x) = 6x^2 - x^4$

$f'(x) = 12x - 4x^3$

$f''(x) = 12 - 12x^2$

$= 12(1 - x^2)$

$12(1+x)(1-x)$

$-$ $+$ $-$

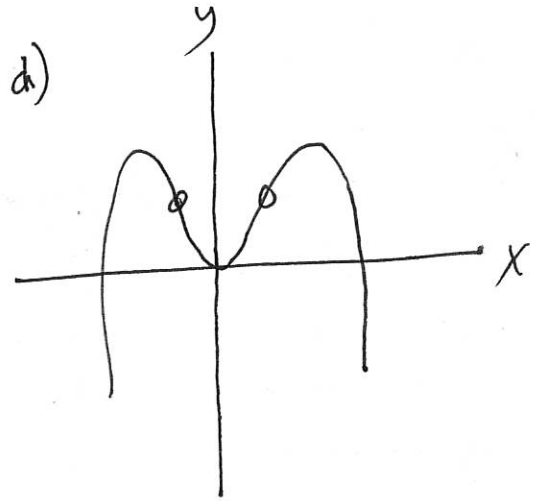
-1 1

a) concave up $(-1, 1)$

b) concave down $(-\infty, -1)$ and $(1, \infty)$

c) $(-1, 5)$ $(1, 5)$

d)



(6.) $f(x) = x^4 - 4x^3$

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

$f''(x) = 12x^2 - 24x$

$= 12x(x - 2)$

$+$ $-$ $+$

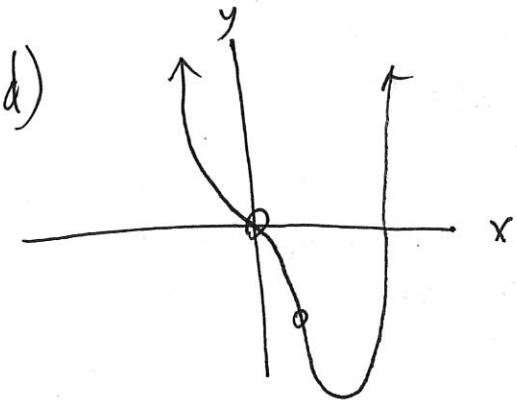
0 2

a) concave up $(-\infty, 0)$ and $(2, \infty)$

b) concave down $(0, 2)$

c) $(0, 0)$ $(2, -16)$

d)



(7.) $f(x) = x^4 - 6x^2 + 8x$

$f'(x) = 4x^3 - 12x + 8$

$f''(x) = 12x^2 - 12$

$= 12(x^2 - 1)$

$= 12(x+1)(x-1)$

$+$ $-$ $+$

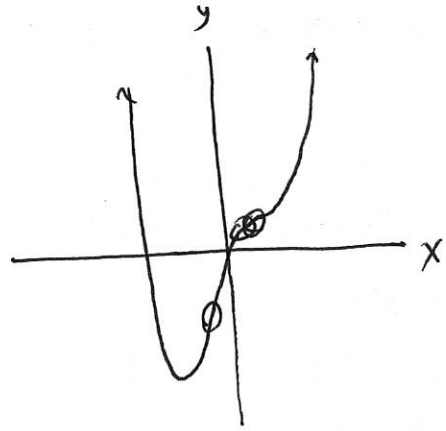
-1 1

a) concave up $(-\infty, -1)$ $(1, \infty)$

b) concave down $(-1, 1)$

c) $(-1, -13)$ $(1, 3)$

d)



(8.) $f(x) = 4x^3 - x^4 - 9$

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

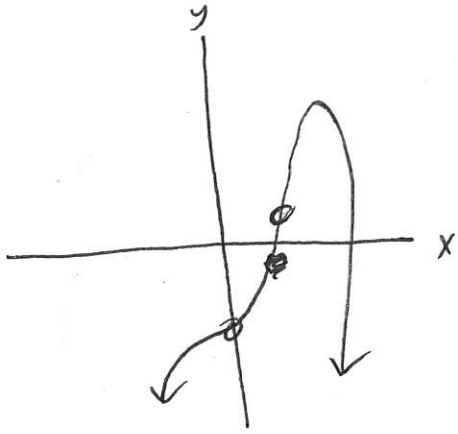
$f''(x) = 24x - 12x^2$

$= 12x(2 - x)$

$-$ $+$ $-$

0 2

d)



a) concave down $(-\infty, 0)$ and $(2, \infty)$

b) concave up $(0, 2)$

c) $(0, -9)$ $(2, 7)$

(9.) $f(x) = 3x^5 - 10x^3$

$f'(x) = 15x^4 - 30x^2$

$f''(x) = 60x^3 - 60x$

$= 60x(x^2 - 1)$

$(x+1)(x-1)$

$-$ $+$ $-$ $+$

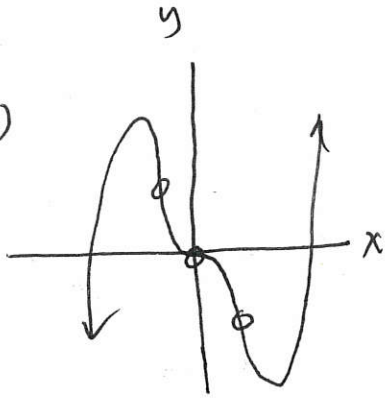
-1 0 1

a) concave up $(-1, 0)$ $(1, \infty)$

b) concave down $(-\infty, -1)$ and $(0, 1)$

c) $(-1, 7)$ $(0, 0)$ $(1, -7)$

d)



(10.) $f(x) = 2x^6 - 5x^4$

$f'(x) = 12x^5 - 20x^3$

$f''(x) = 60x^4 - 60x^2$

$= 60x^2(x^2 - 1)$

$(x+1)(x-1)$

$+$ $+$ $+$ $+$

-1 0 1

$-$ $+$ $+$ $+$

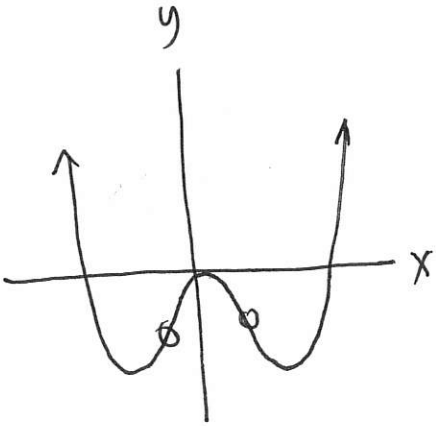
-1 0 1

$-$ $-$ $-$ $+$

$+$ $-$ $-$ $+$

-1 0 1

d)



a) concave up $(-\infty, -1)$ and $(1, \infty)$

b) concave down $(-1, 0)$ and $(0, 1)$

c) $(-1, -3)$ $(0, 0)$ $(1, -3)$

(11.) $g(x) = x + \frac{2}{\sqrt{x}}$

$= x + 2(x)^{-\frac{1}{2}}$

$\frac{1}{x^{\frac{3}{2}}} = \frac{1}{\sqrt{x^3}}$

$g'(x) = 1 - 1x^{-\frac{3}{2}} = 1 - x^{-\frac{3}{2}}$

$0 = 1 - x^{-\frac{3}{2}}$ $\quad x = 1$

$g''(x) = \frac{3}{2}x^{-5/2}$

$\boxed{\text{relative minimum @ } (1, 3)}$

(12.) $g(x) = x^2 - \frac{2}{x}$ $\quad -2x^{-1}$

$2x + 2x^{-2}$

$\frac{2x^3}{x^2} + \frac{2}{x^2} =$

$g'(x) = 2x + 2x^{-2}$

$\frac{2x^3}{x^2} + \frac{2}{x^2} = \frac{2x^3+2}{x^2} = 0$ $\quad x = -1$

$g''(x) = 2 - 4x^{-3}$

$\boxed{\text{relative } \cancel{\text{maximum}} \text{ minimum?} \text{ @ } (-1, 3)}$

(13.) $g(x) = \frac{x^3+4}{x^2} = (x^3+4)(x^{-2})$

$(x^3+4)(-2x^{-3}) + (x^{-2})(3x^2)$

$g'(x) =$

$-2 - 8x^{-3} + 3$ $\quad 1 = \frac{8}{x^3}$ $\quad x = 2$

$1 - 8x^{-3}$

$g''(x) = 24x^{-4}$

$\boxed{\text{relative minimum @ } (2, 3)}$

(14.) $g(x) = x^{\frac{1}{2}} + x^{-\frac{1}{2}}$

$g'(x) = \frac{1}{2}x^{-\frac{1}{2}} - \frac{1}{2}x^{-\frac{3}{2}} = \frac{1}{2\sqrt{x}} - \frac{1}{2x\sqrt{x}}$

$= \frac{x-1}{2x\sqrt{x}}$ $\quad x = 1$

$\boxed{\text{relative minimum @ } (1, 2)}$

$g''(x) = -\frac{1}{4}x^{-\frac{3}{2}} + \frac{3}{4}x^{-\frac{5}{2}} = \frac{2}{4}$