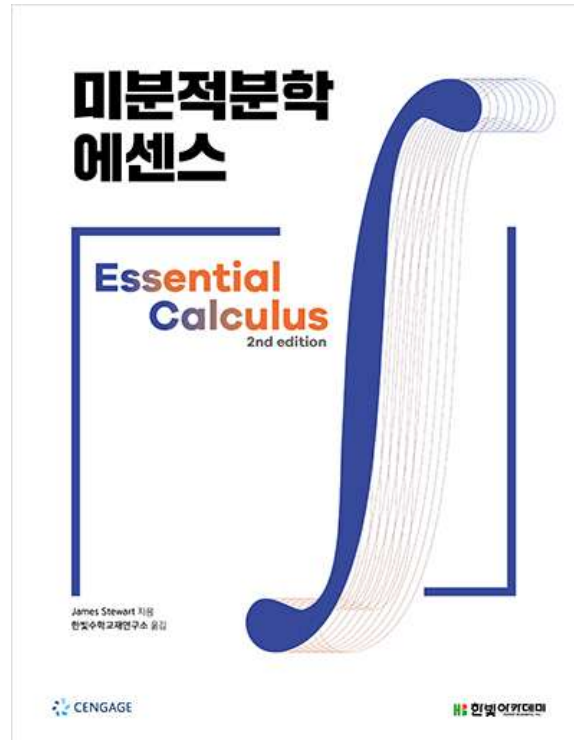




연습문제 해답

게시 일자 : 2018-03-09

Last Updated : 2026-02-27

1장

함수와 극한

1.1 함수의 정의와 표현 방법

01. 예

02. (a) -2 (b) 2.8 (c) $-3, 1$ (d) $-2.5, 0.3$ (e) $[-3, 3]$, $[-2, 3]$ (f) $[-1, 3]$

03. 그래프가 아니다.

04. 그래프이다. 정의역 : $[-3, 2]$, 치역 : $[-3, -2) \cup [-1, 3]$

05.

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

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

$$f(-2) = 3(-2)^2 - (-2) + 2 = 12 + 2 + 2 = 16.$$

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

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

$$f(a+1) = 3(a+1)^2 - (a+1) + 2 = 3(a^2 + 2a + 1) - a - 1 + 2 = 3a^2 + 6a + 3 - a + 1 = 3a^2 + 5a + 4.$$

$$2f(a) = 2 \cdot f(a) = 2(3a^2 - a + 2) = 6a^2 - 2a + 4.$$

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

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

$$\begin{aligned} [f(a)]^2 &= [3a^2 - a + 2]^2 = (3a^2 - a + 2)(3a^2 - a + 2) \\ &= 9a^4 - 3a^3 + 6a^2 - 3a^3 + a^2 - 2a + 6a^2 - 2a + 4 = 9a^4 - 6a^3 + 13a^2 - 4a + 4. \end{aligned}$$

$$f(a+h) = 3(a+h)^2 - (a+h) + 2 = 3(a^2 + 2ah + h^2) - a - h + 2 = 3a^2 + 6ah + 3h^2 - a - h + 2.$$

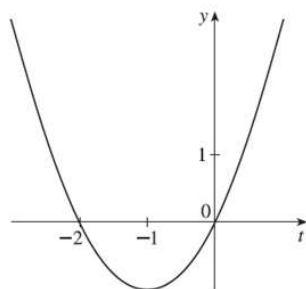
06.

$$\frac{f(3+h) - f(3)}{h} = \frac{(4 - 3h - h^2) - 4}{h} = \frac{h(-3 - h)}{h} = -3 - h.$$

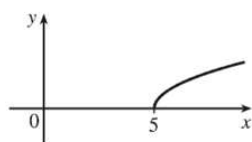
07. $(-\infty, -3) \cup (-3, 3) \cup (3, \infty)$

08. $[0, 4]$

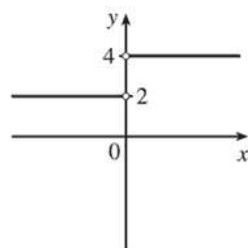
09. $(-\infty, \infty)$



10. $[5, \infty)$



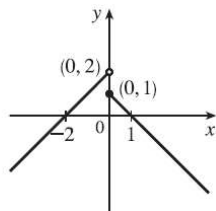
11. $(-\infty, 0) \cup (0, \infty)$



12.

$$f(x) = \begin{cases} x + 2 & \text{if } x < 0 \\ 1 - x & \text{if } x \geq 0 \end{cases}$$

The domain is $\mathbb{R}$.



13. $f(x) = \frac{5}{2}x - \frac{11}{2}, 1 \leq x \leq 5$

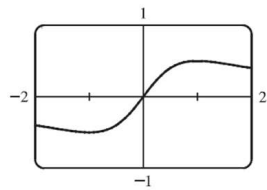
14. $f(x) = 1 - \sqrt{-x}$

15. $A(L) = L(10 - L) = 10L - L^2, \quad 0 < L < 10$

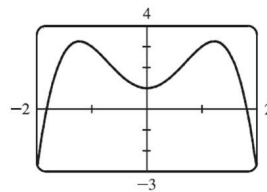
16. $A(x) = \frac{1}{2}(x)\left(\frac{\sqrt{3}}{2}x\right) = \frac{\sqrt{3}}{4}x^2$, with domain $x > 0$

17. (a) $(-5, 3)$ (b) $(-5, -3)$

18. 기함수



19. 우함수



20.

(i) $f + g$ 는 우함수

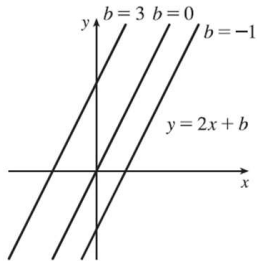
(ii) $f + g$ 는 기함수

(iii) 아무것도 아니다 ($f = 0$ or $g = 0$ 이 아닌 경우).

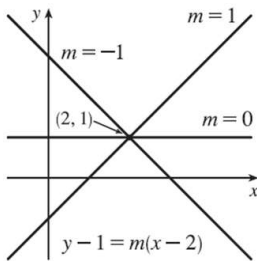
1.2 꼭 필요한 함수 목록

01.

(a) $y = f(x) = 2x + b$, 여기서 b 는 y 절편이다.

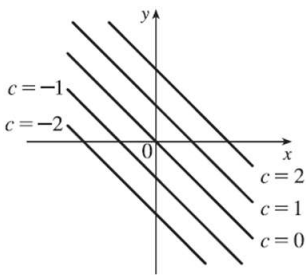


(b) $y = mx + (1 - 2m)$, 여기서 m 은 기울기이다.



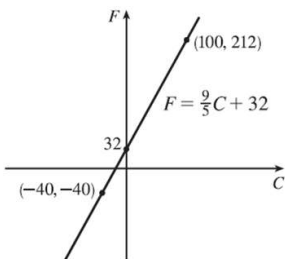
(c) $y = 2x - 3$

02. 이 그래프들은 기울기 -1 을 갖는다.



03. $f(x) = -3x(x+1)(x-2)$

04.



(a)

(b) $\frac{9}{5}$, 1°C 당 온도에 대한 $^\circ\text{F}$ 의 변화; 32 , 0°C 에 대응하는 화씨온도

05.

(a) $y = f(x) + 3$

(b) $y = f(x) - 3$

(c) $y = f(x - 3)$

(d) $y = f(x + 3)$

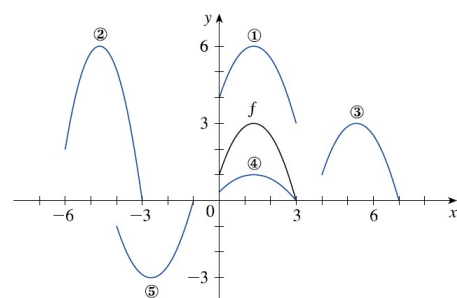
(e) $y = -f(x)$

(f) $y = f(-x)$

(g) $y = 3f(x)$

(h) $y = \frac{1}{3}f(x)$

06.



(a) (graph 3) The graph of f is shifted 4 units to the right and has equation $y = f(x - 4)$.

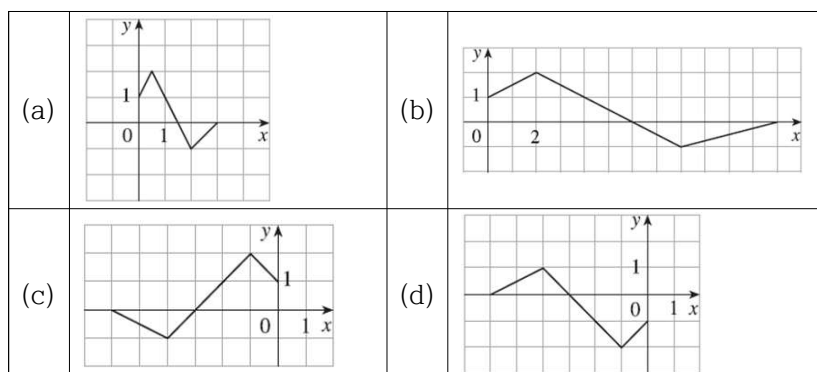
(b) (graph 1) The graph of f is shifted 3 units upward and has equation $y = f(x) + 3$.

(c) (graph 4) The graph of f is shrunk vertically by a factor of 3 and has equation $y = \frac{1}{3}f(x)$.

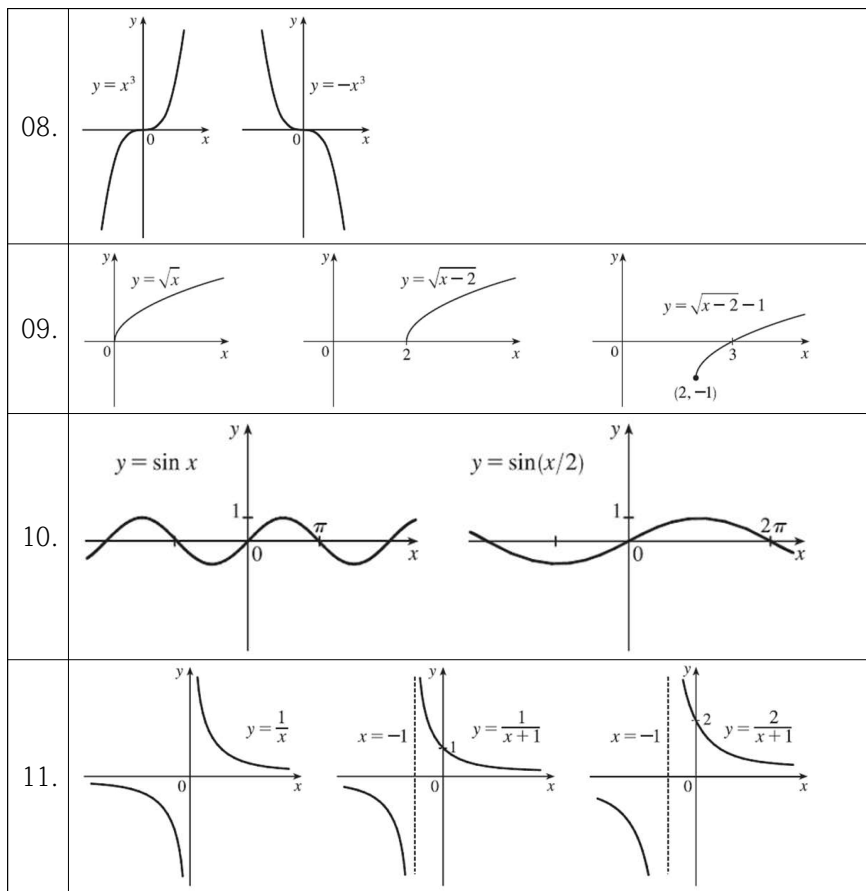
(d) (graph 5) The graph of f is shifted 4 units to the left and reflected about the x -axis. Its equation is $y = -f(x + 4)$.

(e) (graph 2) The graph of f is shifted 6 units to the left and stretched vertically by a factor of 2. Its equation is $y = 2f(x + 6)$.

07.



08. ~ 11.



12.

- (a) $(f+g)(x) = \sqrt{1+x} + \sqrt{1-x}$, $[-1, 1]$
 (b) $(f-g)(x) = \sqrt{1+x} - \sqrt{1-x}$, $[-1, 1]$
 (c) $(fg)(x) = \sqrt{1+x} \cdot \sqrt{1-x} = \sqrt{1-x^2}$, $[-1, 1]$
 (d) $(f/g)(x) = \frac{\sqrt{1+x}}{\sqrt{1-x}}$, $[-1, 1)$

13.

- (a) $(f \circ g)(x) = 4x^2 + 4x$, $(-\infty, \infty)$
 (b) $(g \circ f)(x) = 2x^2 - 1$, $(-\infty, \infty)$
 (c) $(f \circ f)(x) = x^4 - 2x^2$, $(-\infty, \infty)$
 (d) $(g \circ g)(x) = 4x + 3$, $(-\infty, \infty)$

14.

$$(f \circ g \circ h)(x) = \sqrt{x^6 + 4x^3 + 1}$$

15.

(a) $g(2) = 5$, because the point $(2, 5)$ is on the graph of g . Thus, $f(g(2)) = f(5) = 4$, because the point $(5, 4)$ is on the graph of f .

(b) $g(f(0)) = g(0) = 3$

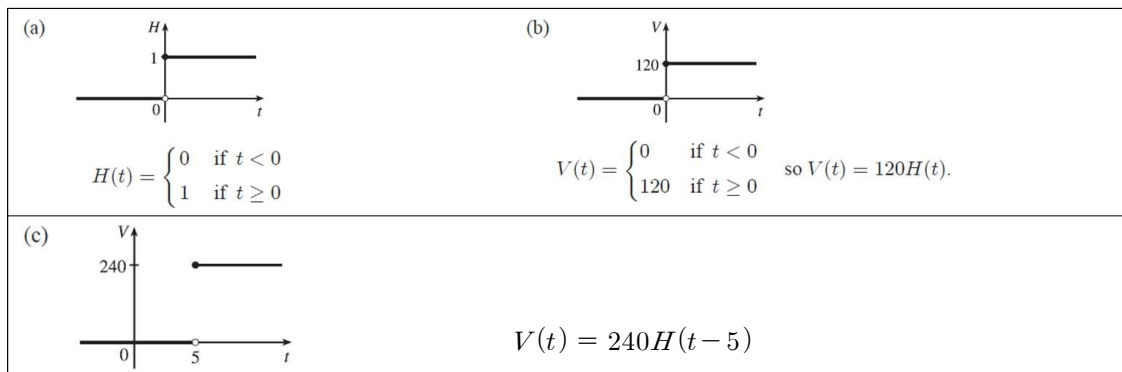
(c) $(f \circ g)(0) = f(g(0)) = f(3) = 0$

(d) $(g \circ f)(6) = g(f(6)) = g(6)$. This value is not defined, because there is no point on the graph of g that has x -coordinate 6.

(e) $(g \circ g)(-2) = g(g(-2)) = g(1) = 4$

(f) $(f \circ f)(4) = f(f(4)) = f(2) = -2$

16.



17. 그렇다.

1.3 함수의 극한

01.

(a)

(i) $[1.5, 2]: h = 0.5, v_{\text{ave}} = -7.15 \text{ m/s}$

(ii) $[1.5, 1.6]: h = 0.1, v_{\text{ave}} = -5.19 \text{ m/s}$

(iii) $[1.5, 1.55]: h = 0.05, v_{\text{ave}} = -4.945 \text{ m/s}$

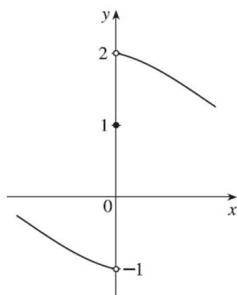
(iv) $[1.5, 1.51]: h = 0.01, v_{\text{ave}} = -4.749 \text{ m/s}$

(b) -4.7 m/s

02.

(a) 2 (b) 1 (c) 4 (d) 존재하지 않는다. (e) 3

03.

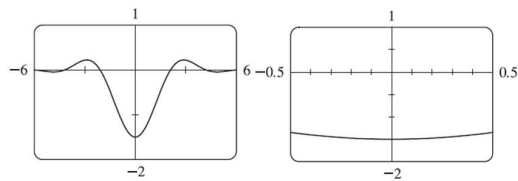


04. $\frac{2}{3}$

05. $\frac{1}{4}$

06. $\frac{3}{5}$

07.



(a) -1.5

(b)

x	$f(x)$
± 0.1	-1.493759
± 0.01	-1.499938
± 0.001	-1.499999
± 0.0001	-1.500000

08.

(a) 0

x	$f(x)$
1	0.998000
0.8	0.638259
0.6	0.358484
0.4	0.158680
0.2	0.038851
0.1	0.008928
0.05	0.001465

(b) -0.001

x	$f(x)$
0.04	0.000572
0.02	-0.000614
0.01	-0.000907
0.005	-0.000978
0.003	-0.000993
0.001	-0.001000

1.4 극한 계산

01.

(a) -6 (b) -8 (c) 2 (d) -6 (e) 존재하지 않는다. (f) 0

02. $\frac{7}{8}$

03. $\frac{\pi}{2}$

04. 4

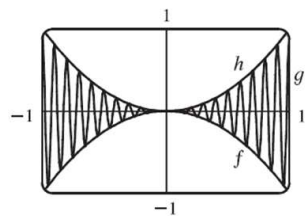
05. $\frac{6}{5}$

06. -10

07. $3x^2$

08. (a) $\approx \frac{2}{3}$ (b) $\frac{2}{3}$ (c) 생략

09. 0



10. 생략

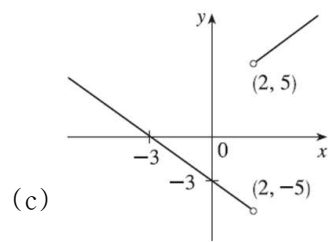
11. 6

12. -4

13.

(a) (i) 5 (ii) -5

(b) 존재하지 않는다.



14.

(a)

(i) -2 (ii) 존재하지 않는다. (iii) -3

(b)

(i) $n-1$ (ii) n

(c) a 는 정수가 아닐 때 존재한다.

15. 생략

16. $\frac{2}{3}$

17. 9

18. 15

19. 0

20. ~ 23. 생략

1.5 연속성

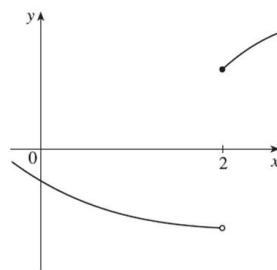
01. $\lim_{x \rightarrow 4} f(x) = f(4)$

02.

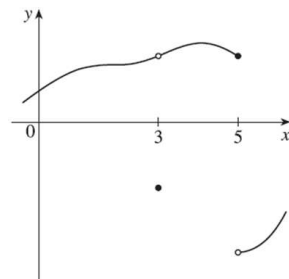
(a) f is discontinuous at -4 since $f(-4)$ is not defined and at -2 , 2 , and 4 since the limit does not exist (the left and right limits are not the same).

(b) f is continuous from the left at -2 since $\lim_{x \rightarrow -2^-} f(x) = f(-2)$. f is continuous from the right at 2 and 4 since $\lim_{x \rightarrow 2^+} f(x) = f(2)$ and $\lim_{x \rightarrow 4^+} f(x) = f(4)$. It is continuous from neither side at -4 since $f(-4)$ is undefined.

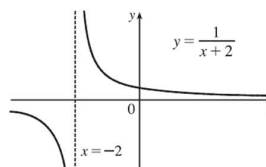
03.



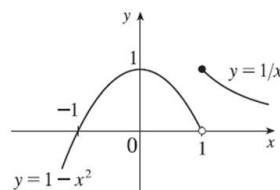
04.



05. 4



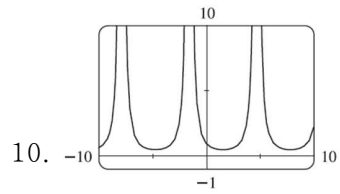
06. $f(-2)$ 가 정의되지 않았다.



07. $\lim_{x \rightarrow 1} f(x)$ 가 존재하지 않는다.

08. $(-\infty, \infty)$

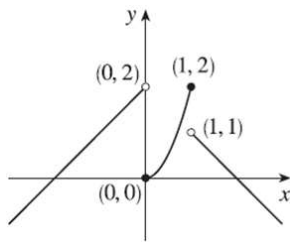
09. $(-\infty, -1] \cup (0, \infty)$



$x = -\frac{\pi}{2} + 2\pi n, n$ 은 정수

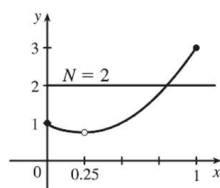
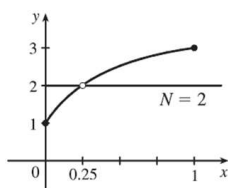
11. $\frac{7}{3}$

12. 0, 오른쪽으로부터 연속
1, 왼쪽으로부터 연속



13. $\frac{2}{3}$

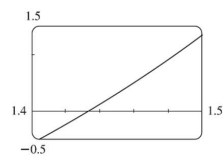
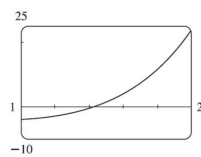
14.



15. ~ 16. 생략

17. (a) 생략

(b) $x \approx 1.434$



18. 생략

1.6 연속성

01.

(a) $\lim_{x \rightarrow \infty} f(x) = -2$

(b) $\lim_{x \rightarrow -\infty} f(x) = 2$

(c) $\lim_{x \rightarrow 1} f(x) = \infty$

(d) $\lim_{x \rightarrow 3} f(x) = -\infty$

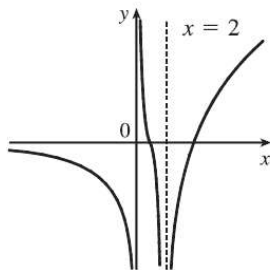
(e) Vertical: $x = 1, x = 3$; horizontal: $y = -2, y = 2$

02.

$\lim_{x \rightarrow 2} f(x) = -\infty, \quad \lim_{x \rightarrow \infty} f(x) = \infty,$

$\lim_{x \rightarrow -\infty} f(x) = 0, \quad \lim_{x \rightarrow 0^+} f(x) = \infty,$

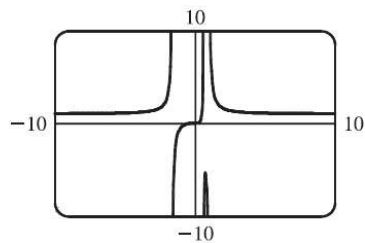
$\lim_{x \rightarrow 0^-} f(x) = -\infty$



03.

Vertical: $x \approx -1.62, x \approx 0.62, x = 1$;

Horizontal: $y = 1$



04. $-\infty$

05. ∞

06. $-\infty$

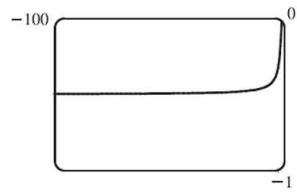
07. $\frac{1}{2}$

08. 4

09. ∞

10.

(a) -0.5



x	$f(x)$
-10,000	-0.4999625
-100,000	-0.4999962
-1,000,000	-0.4999996

(b)

(c) 생략

11. (a) $\frac{5}{4}$

(b) 5

12. (a) 0

(b) $\pm \infty$

13. 4

14.

(a) 생략

(b) 탱크 안으로 들어온 소금물의 농도로 접근한다.

15. 생략

1장 복습문제

연습문제

01.

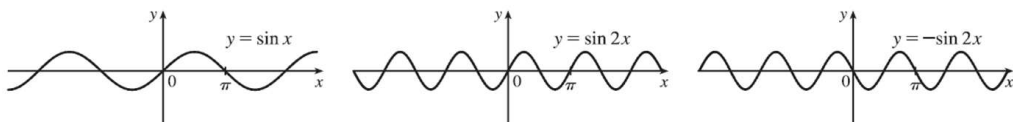
- (a) $f(2) \approx 2.7$
- (b) $x \approx 2.3, 5.6$
- (c) $[-6, 6]$
- (d) $[-4, 4]$
- (e) $[-4, 4]$
- (f) 기함수, 이 그래프는 원점에 대해 대칭이다.

02. $\left(-\infty, \frac{1}{3}\right) \cup \left(\frac{1}{3}, \infty\right), (-\infty, 0) \cup (0, \infty)$

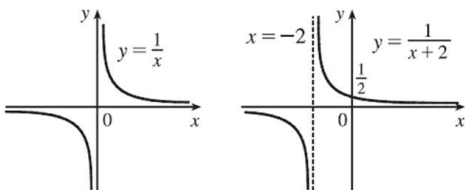
03.

- (a) 그래프를 위쪽으로 8단위만큼 이동
- (b) 그래프를 왼쪽으로 8단위만큼 이동
- (c) 그래프를 수직으로 2배로 늘리고 위쪽으로 1단위만큼 이동
- (d) 그래프를 오른쪽으로 2단위만큼 이동하고 아래쪽으로 2단위만큼 이동
- (e) 그래프를 x 축에 대해 대칭이동
- (f) 그래프를 x 축에 대해 대칭이동하고 위쪽으로 3단위만큼 이동

04.



05.



06.

- (a) 아무것도 아니다.
- (b) 기함수
- (c) 우함수
- (d) 아무것도 아니다.

07.

- (a) $(f \circ g)(x) = \sqrt{\sin x}$, $\{x \mid x \in [2n\pi, \pi + 2n\pi], n \text{은 정수}\}$
(b) $(g \circ f)(x) = \sin \sqrt{x}$, $[0, \infty)$
(c) $(f \circ f)(x) = \sqrt[4]{x}$, $[0, \infty)$
(d) $(g \circ g)(x) = \sin(\sin x)$, $\mathbb{R}$

08.

- (a) (i) 3 (ii) 0 (iii) 존재하지 않는다. (iv) 2 (v) ∞ (vi) $-\infty$
(vii) 4 (viii) -1
(b) $y = 4$, $y = -1$ (c) $x = 0$, $x = 2$ (d) -3, 0, 2, 4

09. 1

10. 0

11. $-\frac{1}{8}$

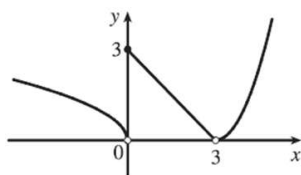
12. 2

13. 1

14. ~ 15. 생략

16.

- (a) (i) 3 (ii) 0 (iii) 존재하지 않는다. (iv) 0 (v) 0 (vi) 0
(b) 0과 3에서
(c)



17. 생략