1

1. No, because the x-value of 3 has two different y-values

2. Yes, every x-value has exactly 1 y-value

3. No, if you draw a vertical line, it will cross the graph twice, meaning there are two different y-values for a given x-value.

4. Yes, if you draw a vertical line anywhere on the graph, it will only touch the graph once, meaning every x-value has exactly one y-value

5. $2y^2 - 5x = 10$

$2y^2 = 5x + 10$

$y^2 = \frac{5x+10}{2}$

$y = \pm\sqrt{\frac{5x+10}{2}}$

$\therefore$ No, for every x-value, there will be 2 y-values.

6. $2|y| + x^2 - 2 = 0$

$2|y| = -x^2 + 2$

$|y| = \frac{-x^2+2}{2}$

$y = -\left(\frac{-x^2+2}{2}\right)$ or $y = \frac{-x^2+2}{2}$

$\therefore$ No, for every x-value there will be 2 y-values

7. $x^3 = y^3$

$\sqrt[3]{x^3} = \sqrt[3]{y^3}$

$x = y$

$\therefore$ Yes, every x-value has exactly 1 y-value

8. $x^2y + xy = -2$

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

$y = \frac{-2}{x^2+x}$

$\therefore$ Yes, every x-value has exactly 1 y-value

1. $f(x) = \dfrac{\sqrt{x^2-9}}{2x-4}$

$x^2-9 \geq 0$

$(x+3)(x-3) \geq 0$

c.p. $x=-3$ $x=3$

int	#	$(x+3)$	$(x-3)$	$(x+3)(x-3)$	≥ 0
$(-\infty,-3]$	-10	$-$	$-$	$+$	✓
$[-3,3]$	0	$+$	$-$	$-$	×
$[3,\infty)$	10	$+$	$+$	$+$	✓

interval : $(-\infty,-3] \cup [3,\infty)$
set : $\{x \mid x \leq -3 \text{ or } x \geq 3\}$

$2x-4 \neq 0$

$2x \neq 4$

$x \neq 2$ ← extraneous

2. $f(x) = \sqrt{x^2-8x+12}$

$x^2-8x+12 \geq 0$

$(x-6)(x-2) \geq 0$

c.p. $x=6$ $x=2$

int	#	$(x-6)$	$(x-2)$	$(x-6)(x-2)$	≥ 0
$(-\infty,2]$	0	$-$	$-$	$+$	✓
$[2,6]$	4	$-$	$+$	$-$	×
$[6,\infty)$	10	$+$	$+$	$+$	✓

set: $\{x \mid x \leq 2 \text{ or } x \geq 6\}$
interval : $(-\infty,2] \cup [6,\infty)$

3. $f(x) = \dfrac{x^2-5x+10}{\sqrt{2x^2+4x}}$

$2x^2+4x > 0$

$2x(x+2) > 0$

$x=0$ $x=-2$

int	#	$2x$	$(x+2)$	$2x(x+2)$	>0
$(-\infty,-2)$	-10	$-$	$-$	$+$	✓
$(-2,0)$	-1	$-$	$+$	$-$	×
$(0,\infty)$	10	$+$	$+$	$+$	✓

set:
$\{x \mid x < -2 \text{ or } x > 0\}$
interval
$(-\infty,-2) \cup (0,\infty)$

4. $2x-7 > 4$

$2x > 11$

$\boxed{x > \frac{11}{2}}$

6. $3x^2-9x+6 \leq 6$

$3x^2-9x \leq 0$

$3x(x-3) \leq 0$

cp $x=0$ $x=3$

int	#	$3x$	$(x-3)$	$3x(x-3)$	≤ 0
$(-\infty,0]$	-10	$-$	$-$	$+$	×
$[0,3]$	1	$+$	$-$	$-$	✓
$[3,\infty)$	10	$+$	$+$	$+$	×

set:
$\{x \mid 0 \leq x \leq 3\}$
interval
$[0,3]$

5. $2x^2-7x > 4$

$2x^2-7x-4 > 0$

c.p. $x = \dfrac{7 \pm \sqrt{49+32}}{4} = \dfrac{7 \pm \sqrt{81}}{4} = \dfrac{7 \pm 9}{4}$

$x = \frac{16}{4} = 4$ $x = \frac{-2}{4} = -\frac{1}{2}$

int	#	$(x-4)$	$(x+\frac{1}{2})$	$(x-4)(x+\frac{1}{2})$	>0
$(-\infty,-\frac{1}{2})$	-10	$-$	$-$	$+$	✓
$(-\frac{1}{2},4)$	0	$-$	$+$	$-$	×
$(4,\infty)$	10	$+$	$+$	$+$	✓

set:
$\{x \mid x < -\frac{1}{2} \text{ or } x > 4\}$

interval:
$(-\infty,-\frac{1}{2}) \cup (4,\infty)$

1. $f(g(x)) = f(2x^2+8x+8) = \sqrt{2(2x^2+8x+8)} = \sqrt{4(x^2+4x+4)} = \sqrt{4(x+2)(x+2)}$

$= \boxed{2(x+2)}$

3

2. $f(g(x)) = f\left(\frac{1}{x+4}\right) = 2\left(\frac{1}{x+4}\right)^2 + 6\left(\frac{1}{x+4}\right) = \frac{2}{(x+4)^2} + \frac{6}{x+4} = \frac{2+6(x+4)}{(x+4)^2}$

$= \boxed{\frac{6x+26}{(x+4)^2}}$

3. $\boxed{\begin{array}{l} f(x) = \frac{x}{2x-1} \\ g(x) = x^2 \end{array}}$ $f(g(x)) = f(x^2) = \frac{x^2}{2x^2-1}$ ✓

4. $\boxed{\begin{array}{l} f(x) = \frac{2x+7}{3} \\ g(x) = \sqrt{x} \end{array}}$ $f(g(x)) = f(\sqrt{x}) = \frac{2\sqrt{x}+7}{3}$ ✓

5. $\boxed{\begin{array}{l} f(x) = x^9 \\ g(x) = 4+x \\ h(x) = \sqrt[3]{x} \end{array}}$ $f(g(h(x))) = f(g(\sqrt[3]{x})) = f(4+\sqrt[3]{x}) = (4+\sqrt[3]{x})^9$ ✓

6. $f(a+h) = \frac{2(a+h)^2 - 5(a+h)}{3} = \frac{2a^2+4ah+2h^2-5a-5h}{3}$

$f(a) = \frac{2a^2-5a}{3}$

$\frac{f(a+h)-f(a)}{h} = \frac{\frac{\cancel{2a^2}+4ah+2h^2\cancel{-5a}-5h\cancel{-2a^2}\cancel{+5a}}{3}}{h} = \frac{4ah+2h^2-5h}{3} \cdot \frac{1}{h}$

$= \frac{4a\cancel{h}+2h^{\cancel{2}}-5\cancel{h}}{3\cancel{h}}$

$= \boxed{\frac{4a+2h-5}{3}}$

1. walls: 4

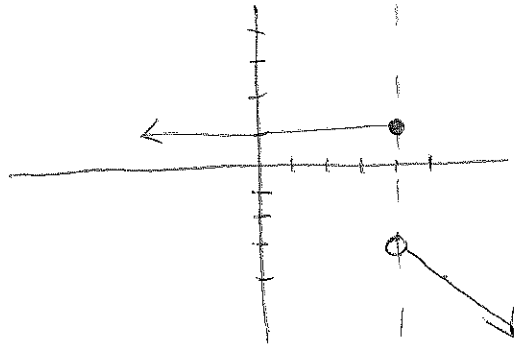
Shapes: * line, slope = -1

* line through 1

points:

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

$f(4) = 1$ $(4,1)$

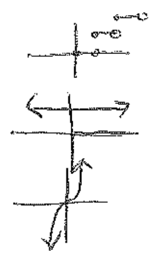


2. walls: 1, 3

Shapes: * greatest int., up 2

* line through 4

* x^3, left 2



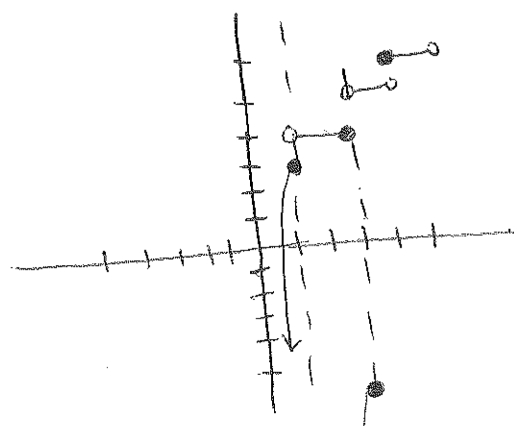
points:

$f(3) = [\![3]\!] + 2 = 5$ $(3,5)$

$f(3) = 4$ $(3,4)$

$f(1) = 4$ $(1,4)$

$f(1) = \ln 1 + 3 = 3$ $(1,3)$



3. Walls: 2, -1

Shapes: * line, slope = $-\frac{2}{1}$

* x^2, vert. stretch

* x^3, left 2

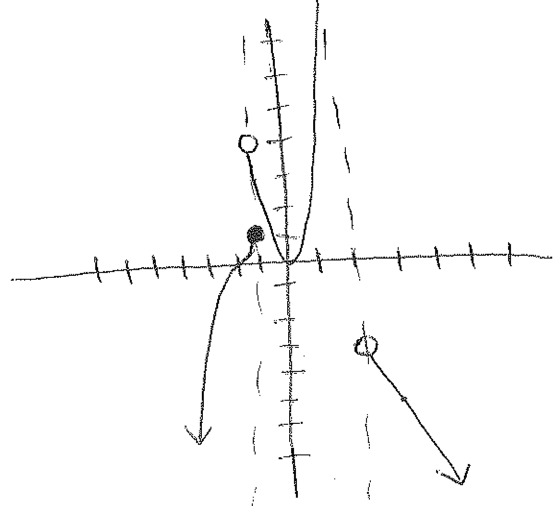
points:

$f(2) = -2(2)+1 = -3$ $(2,-3)$

$f(2) = 4(2)^2 = 16$ $(2,16)$

$f(-1) = 4(-1)^2 = 4$ $(-1,4)$

$f(-1) = (-1+2)^3 = 1$ $(-1,1)$



5

1. $f(x) = |3x-12| + 8$

when $3x-12 \geq 0$ $\quad$ $x \geq 4$ $\quad$ $3x-12+8$ $\quad$ $3x-4$

when $3x-12 < 0$ $\quad$ $x < 4$ $\quad$ $-(3x-12)+8$ $\quad$ $-3x+20$

$$\boxed{f(x) = \begin{cases} 3x-4 & x \geq 4 \\ -3x+20 & x < 4 \end{cases}}$$

2. $f(x) = |x+4| + |2x-3|$

$x=-4 \quad x = \frac{3}{2}$

$$f(x) = \begin{cases} \overset{\text{same}}{(x+4)} + \overset{\text{same}}{(2x-3)} & x \geq \frac{3}{2} \\ \overset{\text{same}}{(x+4)} + -\overset{\text{opp}}{(2x-3)} & -4 \leq x < \frac{3}{2} \\ -\overset{\text{opp}}{(x+4)} + -\overset{\text{opp}}{(2x-3)} & x < -4 \end{cases}$$

$$\boxed{f(x) = \begin{cases} 3x+1 & x \geq \frac{3}{2} \\ -x+7 & -4 \leq x < \frac{3}{2} \\ -3x-1 & x < -4 \end{cases}}$$

3. $f(x) = |4x-16| + |3x| + 1$

$4x-16=0 \quad x=0$

$x=4$

$$f(x) = \begin{cases} \overset{\text{same}}{(4x-16)} + \overset{\text{same}}{(3x)} + 1 & x \geq 4 \\ -\overset{\text{opp}}{(4x-16)} + \overset{\text{same}}{(3x)} + 1 & 0 \leq x < 4 \\ -\overset{\text{opp}}{(4x-16)} + -\overset{\text{opp}}{(3x)} + 1 & x < 0 \end{cases}$$

$$\boxed{f(x) = \begin{cases} 7x-15 & x \geq 4 \\ -x+17 & 0 \leq x < 4 \\ -7x+17 & x < 0 \end{cases}}$$

4. $f(x) = |2x+6| + |x-8| + 3$

$x=-3 \quad x=8$

$$f(x) = \begin{cases} \overset{\text{same}}{(2x+6)} + \overset{\text{same}}{(x-8)} + 3 & x \geq 8 \\ \overset{\text{same}}{(2x+6)} + -\overset{\text{opp}}{(x-8)} + 3 & -3 \leq x < 8 \\ -\overset{\text{opp}}{(2x+6)} + -\overset{\text{opp}}{(x-8)} + 3 & x < -3 \end{cases}$$

$$\boxed{f(x) = \begin{cases} 3x+1 & x \geq 8 \\ x+17 & -3 \leq x < 8 \\ -3x+5 & x < -3 \end{cases}}$$

(6)

① $|2x-1| \le 6$ L.A.

$-6 \le 2x-1 \le 6$

$-5 \le 2x \le 7$

$\boxed{\{x \mid -\frac{5}{2} \le x \le \frac{7}{2}\}}$

$\boxed{[-\frac{5}{2}, \frac{7}{2}]}$

② $2|x+7|-8>6$

$2|x+7|>14$ GO

$|x+7|>7$

$x+7<-7$ $x+7>7$

$\boxed{\{x \mid x<-14 \text{ or } x>0\}}$

$\boxed{(-\infty,-14)\cup(0,\infty)}$

③ $12 \le 6|x-9|$

$6|x-9| \ge 12$ GO

$|x-9| \ge 2$

$x-9 \le -2$ $x-9 \ge 2$

$\boxed{\{x \mid x \le 7 \text{ or } x \ge 11\}}$

$\boxed{(-\infty,7]\cup[11,\infty)}$

④ $|3x-2| \le 0$ L.A.

$0 \le 3x-2 \le 0$

$2 \le 3x \le 2$

$\frac{2}{3} \le x \le \frac{2}{3}$

$\boxed{\{x \mid x=\frac{2}{3}\}}$

5. $7|2x-1|+8 \le 1$

$7|2x-1| \le -7$

$|2x-1| \le -1$

a positive is <u>never</u> less than a negative

$\boxed{\varnothing}$

6. $|2x-1|>-3$

a positive is <u>always</u> greater than a negative

$\boxed{\mathbb{R}}$

7

1. odd, because if you reflect the graph across the x-axis, then the y-axis it is the same graph

2. even, because if you reflect the graph across the y-axis then it's the same graph

3. even, because if you reflect the graph across the y-axis then it's the same graph.

4. odd, because if you reflect the graph across the x-axis, then the y-axis

5. $f(x) = 2x^3 + \frac{3}{x}$

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

$-f(x) = -\left(2x^3 + \frac{3}{x}\right) = -2x^3 - \frac{3}{x}$

$\boxed{\therefore \text{odd}}$

6. $f(x) = |2x| + x$

$f(-x) = |2(-x)| + (-x)$

$|2x| - x$

$-f(x) = -(|2x| + x) = -|2x| - x$

$\boxed{\therefore \text{neither}}$

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

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

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

$\boxed{\therefore \text{odd}}$

8. $f(x) = 2x^3 - \sqrt[3]{2x}$

$f(-x) = 2(-x)^3 - \sqrt[3]{2(-x)} = -2x^3 + \sqrt[3]{2x}$

$-f(x) = -(2x^3 - \sqrt[3]{2x}) = -2x^3 + \sqrt[3]{2x}$

$\boxed{\therefore \text{odd}}$

8

1. a. $y^3 + xy^3 + x - 1 = 0$

$y^3(1+x) = -x+1$

$\sqrt[3]{y^3} = \sqrt[3]{\dfrac{-x+1}{1+x}}$

$y = \sqrt[3]{\dfrac{-x+1}{1+x}}$

yes.

b. $y + |x+5| - 19x = x^2$

$y = x^2 + 19x - |x+5|$

yes.

c. $2xy^2 + y^2 = 3$

$y^2(2x+1) = 3$

$\sqrt{y^2} = \sqrt{\dfrac{3}{2x+1}}$

$y = \pm\sqrt{\dfrac{3}{2x+1}}$

NO.

2. a. $f(x) = \dfrac{\sqrt{9-4x^2}}{2x+1}$

$x \neq -\frac{1}{2}$ $\quad 9 - 4x^2 \geq 0$

$(3-2x)(3+2x) \geq 0$

c.p. $x = \frac{3}{2}$, $x = -\frac{3}{2}$

	$(-\infty, -\frac{3}{2}]$	$[-\frac{3}{2}, \frac{3}{2}]$	$[\frac{3}{2}, \infty)$
tp	-100	0	100
$(3-2x)(3+2x)$	$+ \cdot - = -$	$+ \cdot + = +$	$- \cdot + = -$
positive?	No!	Yes!	No!

$\boxed{\{x \mid -\frac{3}{2} \leq x \leq \frac{3}{2} \text{ and } x \neq -\frac{1}{2}\}}$

$\boxed{[-\frac{3}{2}, -\frac{1}{2}) \cup (-\frac{1}{2}, \frac{3}{2}]}$

b. $f(x) = \dfrac{13x + 25}{\sqrt{x^2 - 9x - 10}}$

$x^2 - 9x - 10 > 0$

$(x-10)(x+1) > 0$

c.p. $x = 10$ $\quad x = -1$

	$(-\infty, -1)$	$(-1, 10)$	$(10, \infty)$
tp	-30	5	500
$(x-10)(x+1)$	$- \cdot - = +$	$- \cdot + = -$	$+ \cdot + = +$
>0?	✓	X	✓

$\boxed{(-\infty, -1) \cup (10, \infty)}$

$\boxed{\{x \mid x < -1 \text{ or } x > 10\}}$

c. $f(x) = \sqrt{\dfrac{x-5}{2x+4}}$

$\dfrac{x-5}{2x+4} \geq 0$ $\quad x \neq -2$

c.p. $x = 5$

$x = -2$

	$(-\infty, -2)$	$(-2, 5]$	$[5, \infty)$
tp.	-10	0	20
$\frac{x-5}{2x+4}$	$\frac{-}{-} = +$	$\frac{-}{+} = -$	$\frac{+}{+} = +$
≥ 0?	✓	X	✓

$\boxed{(-\infty, -2) \cup [5, \infty)}$

$\boxed{\{x \mid x < -2 \text{ or } x \geq 5\}}$

3. a. $f(x) = \dfrac{2x^2 - x}{x+1}$

$$\frac{\dfrac{2(a+h)^2 - (a+h)}{(a+h+1)} - \dfrac{2a^2 - a}{a+1}}{h} = \frac{\dfrac{(a+1)}{(a+1)}\dfrac{2a^2 + 4ah + 2h^2 - a - h}{a+h+1} - \dfrac{2a^2 - a}{a+1}\dfrac{(a+h+1)}{(a+h+1)}}{h} =$$

$$\frac{\cancel{2a^3} + 4a^2h + 2ah^2 - \cancel{a^2} - \cancel{ah} + \cancel{2a^2} + 4ah + 2h^2 - \cancel{a} - h - \cancel{2a^3} - 2a^2h - \cancel{2a^2} + \cancel{a^2} + \cancel{ah} + \cancel{a}}{h(a+1)(a+h+1)}$$

$$\frac{2a^2\cancel{h} + 2ah^{\cancel{2}} + 4a\cancel{h} + 2h^{\cancel{2}} - \cancel{h}}{\cancel{h}(a+1)(a+h+1)} = \boxed{\frac{2a^2 + 2ah + 4a + 2h - 1}{(a+1)(a+h+1)}}$$

b. $f(x) = \dfrac{\sqrt{1-2x}}{x}$

$$\frac{\dfrac{\sqrt{1-2(a+h)}}{a+h} - \dfrac{\sqrt{1-2a}}{a}}{h} = \boxed{\frac{a\sqrt{1-2a-2h} - a\sqrt{1-2a} - h\sqrt{1-2a}}{ha(a+h)}}$$

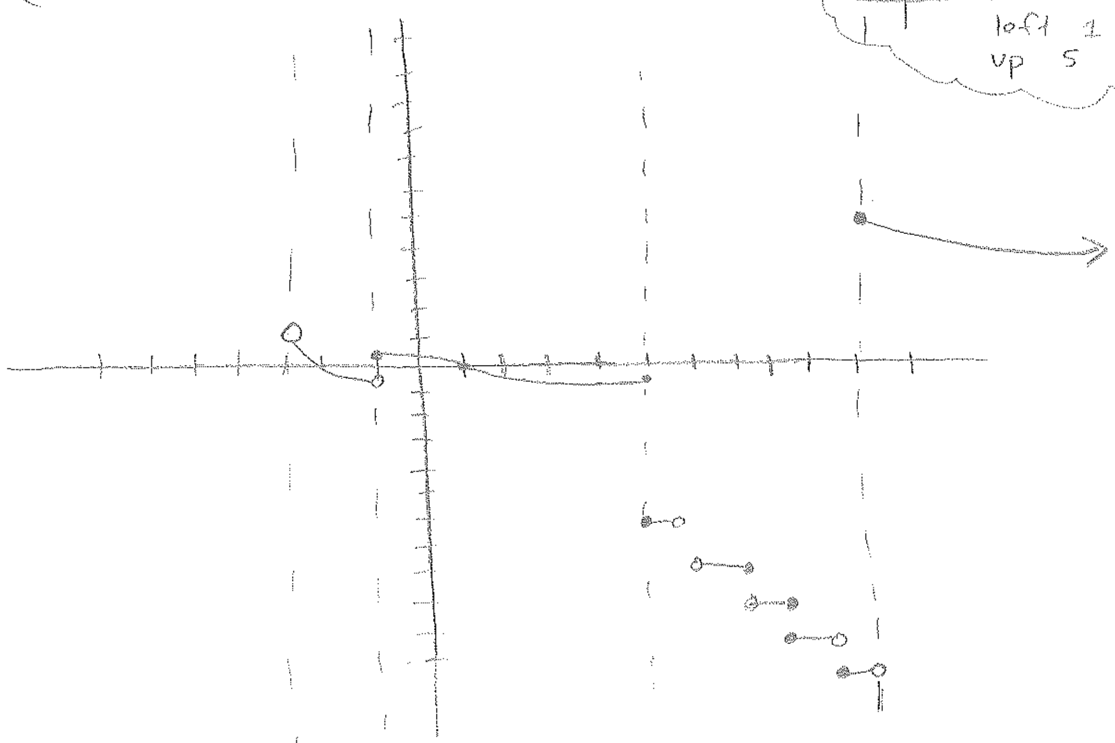
4. $f(x) = \begin{cases} 1-\ln(x+4) & -3<x<-1 & \circ(-3,1) \quad \circ(-1,-.1) \\ \sqrt[3]{-x+1} & -1\le x<5 & \bullet(-1,1.3) \quad \circ(5,-1.6) \\ -1-[x] & 5\le x<10 & \bullet(5,-6) \quad \circ(10,-11) \\ e^{-x+1}+5 & x\ge 10 & \bullet \quad (10,5) \end{cases}$

left 4
reflect across x
up 1

reflect across y
left 1

reflect across x
down 1

reflect across y
left 1
up 5



5. $f(x) = 1-|x+5| + |3x-1| - 2|x|$

$x=-5 \qquad x=\frac{1}{3} \qquad x=0$

$$f(x) = \begin{cases} 1-(x+5)+(3x-1)-2(x) & x\ge\frac{1}{3} \\ 1-(x+5)-(3x-1)-2(x) & 0\le x<\frac{1}{3} \\ 1-(x+5)-(3x-1)+2(x) & -5\le x<0 \\ 1+(x+5)-(3x-1)+2(x) & x<-5 \end{cases}$$

$$\boxed{f(x) = \begin{cases} -5 & x\ge\frac{1}{3} \\ -6x-3 & 0\le x<\frac{1}{3} \\ -2x-3 & -5\le x<0 \\ 7 & x<-5 \end{cases}}$$

6. a. $\left|\frac{10x-1}{2}\right| + 3 > 0$

$\left|\frac{10x-1}{2}\right| > -3$

$\boxed{\mathbb{R}}$

b. $\frac{|3x+7|}{2} - 10 \le 4$

$\frac{|3x+7|}{2} \le 14$

$|3x+7| \le 28$

$-28 \le 3x+7 \le 28$

$-21 \le 3x \le 35$

$-7 \le x \le \frac{35}{3}$

$\boxed{\left\{x \mid -7 \le x \le \frac{35}{3}\right\}}$

$\boxed{\left[-7, \frac{35}{3}\right]}$

7. a. $f(x) = \sqrt[5]{x+7} + x$

$f(-x) = \sqrt[5]{-x+7} + (-x)$

$= \sqrt[5]{-x+7} - x$ or $-\sqrt[5]{x-7} - x$

$-f(x) = -\left(\sqrt[5]{x+7} + x\right)$

$= -\sqrt[5]{x+7} - x$ $\quad \therefore \boxed{\text{Neither}}$

b. $f(x) = -x^{-3} - |x|$

or

$f(x) = -\frac{1}{x^3} - |x|$

$f(-x) = -\frac{1}{(-x)^3} - |-x| = \frac{1}{x^3} - |x|$

$-f(x) = -\left(-\frac{1}{x^3} - |x|\right) = \frac{1}{x^3} + |x|$

$\therefore \boxed{\text{Neither}}$