

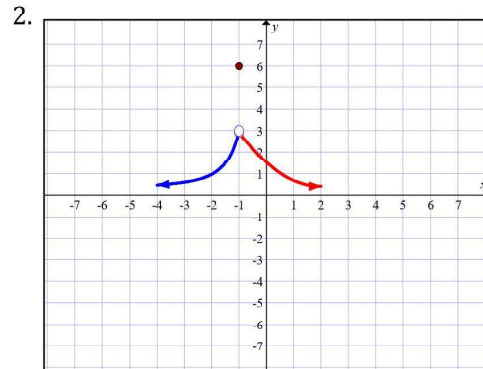
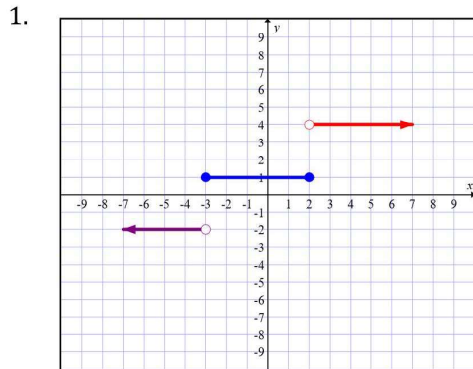
Name _____

Date _____

Calc I H - 1.4 day 1 - Continuity

Period _____

- For #1 -- #6, for each graph shown, find:
- I. Identify the location of **each** point of discontinuity (x-values)
 - II. **Each** type of discontinuity (Removable or non-removable? Hole, Jump, Infinite?)
 - III. The condition of continuity that is not satisfied for **each** point of discontinuity
 ($f(c)$ is undefined, $\lim_{x \rightarrow c} f(x)$ does not exist, $f(c) \neq \lim_{x \rightarrow c} f(x)$)



Type: a) Remov hole b) Non-remov jump c) Non-remov infinite **Reason:** d) $f(c)$ und e) $\lim_{x \rightarrow c} f(x)$ DNE f) $f(c) \neq \lim_{x \rightarrow c} f(x)$

Discontinuity at $x = -3$, Type: b, Reason: e

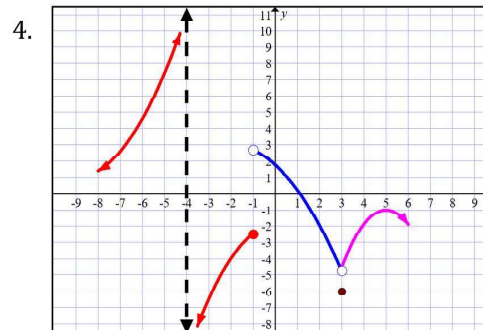
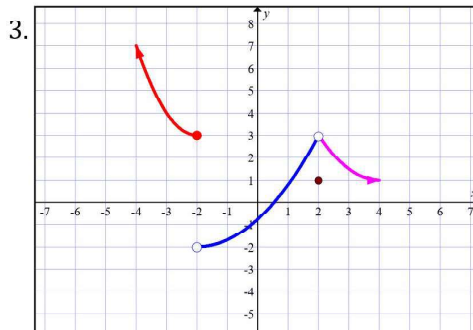
Discontinuity at $x = -1$, Type: a, Reason: f

Discontinuity at $x = 2$, Type: b, Reason: e

Discontinuity at $x = \underline{\hspace{1cm}}$, Type: , Reason:

Discontinuity at $x = \underline{\hspace{1cm}}$, Type: , Reason:

Discontinuity at $x = \underline{\hspace{1cm}}$, Type: , Reason:



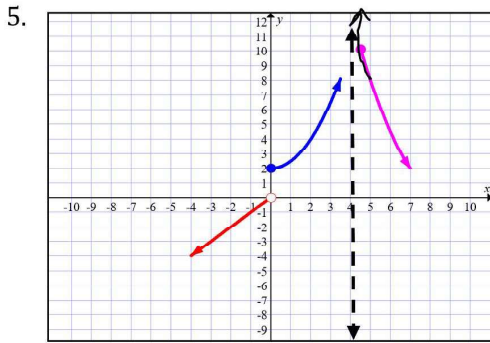
at $x = -2$, Non-removable, Jump Disc
 $\lim_{x \rightarrow -2^-} f(x) = 3 \neq \lim_{x \rightarrow -2^+} f(x) = -2 \} \lim_{x \rightarrow -2} f(x) \text{ DNE}$

at $x = -4$, Nonremovable, Infinite Disc
 $\lim_{x \rightarrow -4^-} f(x) = \infty \neq \lim_{x \rightarrow -4^+} f(x) = -\infty \} \lim_{x \rightarrow -4} f(x) \text{ DNE}$

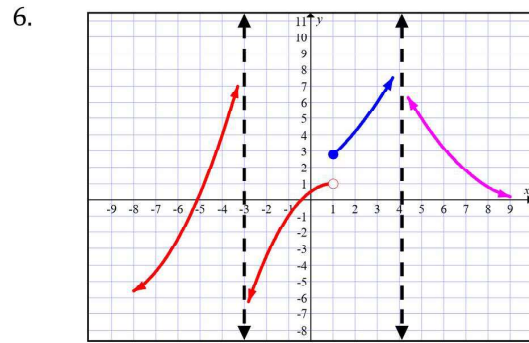
at $x = 2$, Removable, hole disc
 $\lim_{x \rightarrow 2} f(x) = 3 \neq f(2) = 1$

at $x = -1$, Nonremovable Jump Disc
 $\lim_{x \rightarrow -1^-} f(x) \neq \lim_{x \rightarrow -1^+} f(x) \} \lim_{x \rightarrow -1} f(x) \text{ DNE}$

at $x = 3$, Removable, Hole Disc
 $\lim_{x \rightarrow 3} f(x) = -5 \neq f(3) = -6$



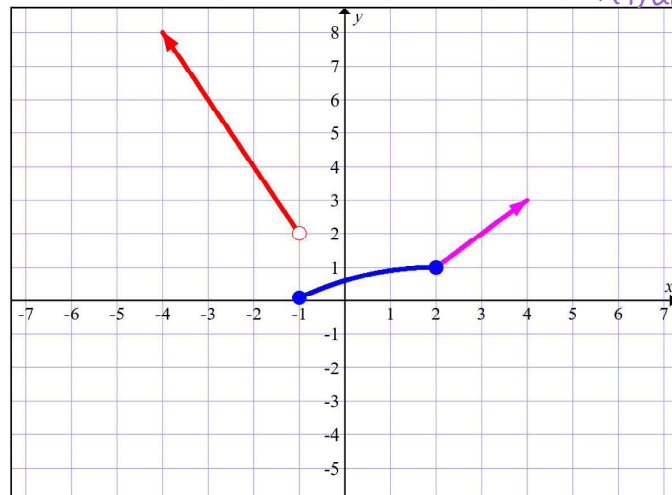
at $x=0$, Nonremovable Jump Disc
 $\lim_{x \rightarrow 0^-} f(x) = 0 \neq \lim_{x \rightarrow 0^+} f(x) = 2 \} \lim_{x \rightarrow 0} f(x) \text{ DNE}$
 at $x=4$, Nonremovable Inf Disc
 $\lim_{x \rightarrow 4^-} f(x) = \infty, \lim_{x \rightarrow 4^+} f(x) = -\infty \} \lim_{x \rightarrow 4} f(x) = \infty$
 $f(4)$ und



at $x=-3$, Nonremovable Inf Disc
 $\lim_{x \rightarrow -3^-} f(x) = \infty \neq \lim_{x \rightarrow -3^+} f(x) = -\infty$
 $f(-3)$ und
 at $x=1$, Nonremovable Jump Dis
 $\lim_{x \rightarrow 1^-} f(x) = 1 \neq \lim_{x \rightarrow 1^+} f(x) = 3$
 $\lim_{x \rightarrow 1} f(x) \text{ DNE}$
 at $x=4$, Nonremovable Infinite Disc
 $\lim_{x \rightarrow 4^-} f(x) = \infty, \lim_{x \rightarrow 4^+} f(x) = -\infty$
 $\lim_{x \rightarrow 4} f(x) \text{ DNE}$
 $f(4)$ und

7. For the graph shown at the right, find the indicated limits.

- a. $\lim_{x \rightarrow -1^+} f(x) = 2$
 b. $\lim_{x \rightarrow -1^-} f(x) = 0$
 c. $\lim_{x \rightarrow -1} f(x) = \text{DNE}$
 d. $\lim_{x \rightarrow 2^-} f(x) = 1$
 e. $\lim_{x \rightarrow 2^+} f(x) = 1$
 f. $\lim_{x \rightarrow 2} f(x) = 1$



8. For the function $f(x)$ defined below, find the indicated limits **algebraically**.

$$f(x) = \begin{cases} 3-x & \text{if } x < 1 \\ 2 & \text{if } x = 1 \\ x+1 & \text{if } x > 1 \end{cases}$$

- a. $\lim_{x \rightarrow 1^+} f(x) = 2$
 $1+1$
 b. $\lim_{x \rightarrow 1^-} f(x) = 2$
 $3-1$
 c. $\lim_{x \rightarrow 1} f(x) = 2$
 $3-0$
 d. $\lim_{x \rightarrow 0} f(x) = 3$
 $2+1$
 e. $\lim_{x \rightarrow 2} f(x) = 3$

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

For #9 -- #11, find each limit algebraically.

9. $\lim_{x \rightarrow 0} \frac{(1-x)^3 - 1}{x}$ "0/0"

$$\lim_{x \rightarrow 0} \frac{-x^3 + 3x^2 - 3x + 1 - 1}{x}$$

$$\lim_{x \rightarrow 0} \frac{-x(x^2 - 3x + 3)}{x}$$

$$\lim_{x \rightarrow 0} -(x^2 - 3x + 3) = \boxed{-3}$$

10. $\lim_{x \rightarrow 1} \frac{3x^2 + 1}{5x^2 - 2}$

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

11. $\lim_{x \rightarrow 2} \frac{2x^2 - 5x + 2}{x^2 - 4}$ "0/0"

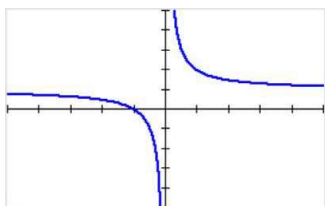
$$\lim_{x \rightarrow 2} \frac{(2x-1)(x-2)}{(x+2)(x-2)}$$

$$\lim_{x \rightarrow 2} \frac{2x-1}{x+2} = \frac{2(2)-1}{2+2} = \boxed{\frac{3}{4}}$$

For each of the following functions:

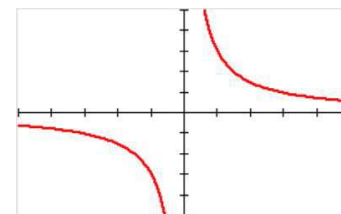
- graph the function (calculator use is okay)
- determine the location of **each** point(s) of discontinuity (x-coordinate)
- state the type (removable, or non-removable & jump, infinite, hole) of **each** discontinuity
- state the conditions of continuity that are not satisfied for **each** discontinuity

12. $f(x) = \frac{x+1}{x}$



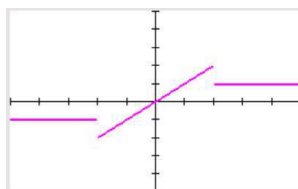
at $x=0$, Nonremovable, infinite discontinuity
 $\lim_{x \rightarrow 0^-} f(x) = -\infty \neq \lim_{x \rightarrow 0^+} f(x) = \infty$
 $f(0)$ und $\therefore \lim_{x \rightarrow 0} f(x)$ DNE

13. $k(x) = \frac{3x+9}{x^2+3x}$



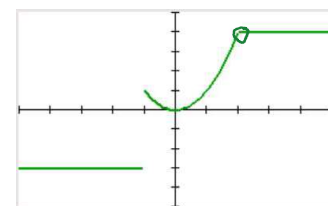
at $x=0$, Nonremovable, infinite discontinuity
 $\lim_{x \rightarrow 0^-} k(x) = -\infty \neq \lim_{x \rightarrow 0^+} k(x) = \infty$
 $k(0)$ und $\therefore \lim_{x \rightarrow 0} k(x)$ DNE

14. $q(x) = \begin{cases} -1 & \text{if } x < -2 \\ x & \text{if } -2 \leq x < 2 \\ 1 & \text{if } x > 2 \end{cases}$



at $x=-2$, Nonremovable jump discontinuity
 $\lim_{x \rightarrow -2^-} q(x) = -1 \neq \lim_{x \rightarrow -2^+} q(x) = -2$
 $\therefore \lim_{x \rightarrow -2} q(x)$ DNE
 at $x=2$, Nonremovable jump discontinuity
 $\lim_{x \rightarrow 2^-} q(x) = 2 \neq \lim_{x \rightarrow 2^+} q(x) = 1$
 $\therefore \lim_{x \rightarrow 2} q(x)$ DNE

15. $r(x) = \begin{cases} -3 & \text{if } x \leq -1 \\ x^2 & \text{if } -1 < x < 2 \\ 4 & \text{if } x > 2 \end{cases}$



at $x=-1$, Nonremovable jump discontinuity
 $\lim_{x \rightarrow -1^-} r(x) = 3 \neq \lim_{x \rightarrow -1^+} r(x) = 1$
 $\therefore \lim_{x \rightarrow -1} r(x)$ DNE
 at $x=2$, Removable Hole Disc.
 $f(2)$ und $\lim_{x \rightarrow 2} f(x) = 4$