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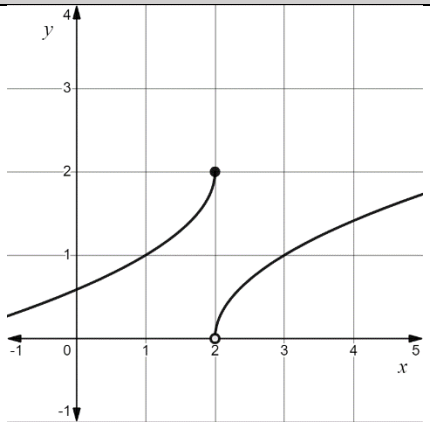
Chapter 2 Review
Limits and Derivatives

For each type of question, the achievement level is indicated. Showing work is an important strategy in communicating your knowledge and ideas so please be thorough.

Learning Goal 2.1	Finite limits and continuity.

1. Find the following limits.

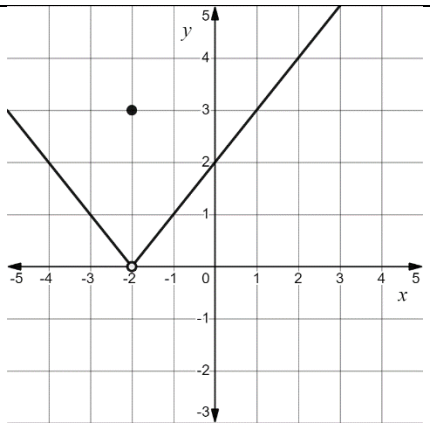
Developing



a. $\lim_{x\to 2^-} f(x) = 2$

b. $\lim_{x\to 2^+} f(x) = 0$

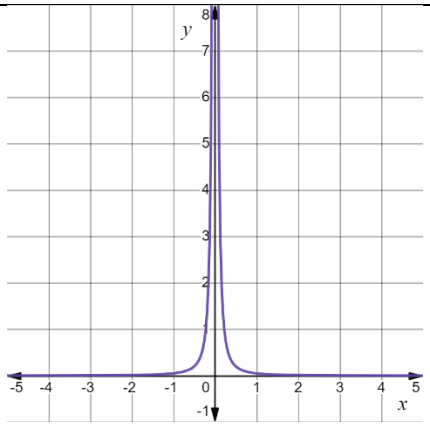
c. $\lim_{x\to 2} f(x) = \text{DNE}$



d. $\lim_{x\to -2^-} f(x) = 0$

e. $\lim_{x\to -2^+} f(x) = 0$

f. $\lim_{x\to -2} f(x) = 0$



g. $\lim_{x\to 0^-} f(x) = \infty$

h. $\lim_{x\to 0^+} f(x) = \infty$

i. $\lim_{x\to 0} f(x) = \infty$

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j. $\lim_{x\to -2} x^3+6x^2-16$ $=0$	k. $\lim_{x\to 4}\frac{x^2+9}{x^2-1}$ $=\frac{5}{3}$	l. $\lim_{x\to 4}\frac{x^2-16}{x^2+x-20}$ $=\frac{8}{9}$
m. $\lim_{x\to 0}\frac{x^2+2x}{x-2x^2}$ $=2$	n. $\lim_{x\to 1}\frac{1-x^2}{x^2+5x-6}$ $=-\frac{2}{7}$	o. $\lim_{x\to 1}\frac{x^2+x-2}{x^2-4x+3}$ $=-\frac{3}{2}$
p. $\lim_{x\to 3}\frac{x^3-27}{x-3}$ $=27$	q. $\lim_{x\to 1}\frac{x^3-3x^2+2x}{x-1}$ $=-1$	r. $\lim_{x\to 2}\frac{x^3-4x}{x^3-2x^2}$ $=2$
s. $\lim_{x\to a}\frac{1/x-1/a}{x-a}$ $=-\frac{1}{a^2}$	t. $\lim_{x\to 0}\frac{1/(3+x)-1/3}{x}$ $=-\frac{1}{9}$	u. $\lim_{x\to -a}\frac{x^3+a}{x+a}$ $=3a^2$
v. $\lim_{x\to 3}\frac{x-3}{x^3-27}$ $=\frac{1}{27}$	w. $\lim_{x\to 2}\frac{1-4/x^2}{1-2/x}$ $=2$	x. $\lim_{x\to 4^-}\frac{x-4}{\lvert x-4\rvert}$ $=-1$
y. $\lim_{x\to 1}\frac{x-1}{\lvert x-1\rvert}$ $=\text{DNE}$	z. $\lim_{x\to 1}\begin{cases}\frac{1}{x+2}, & x<1\\ 1-2x, & x>1\end{cases}$ $=\text{DNE}$	aa. $\lim_{x\to 3}\begin{cases}x^2-1, & x<3\\ (x-1)^3, & x>3\end{cases}$ $=8$
bb. $\lim_{x\to 3}\frac{4x^2-36}{2x-6}$ $=12$	cc. $\lim_{x\to -1}\frac{x^3+1}{x^4-1}$ $=-\frac{3}{4}$	dd. $\lim_{x\to 2}\frac{2x^2-x-6}{3x^2-7x+2}$ $=\frac{7}{5}$

Proficient		
a. $\lim_{x\to 0}\frac{\sqrt{x+1}-1}{x}$ $=\frac{1}{2}$	b. $\lim_{x\to 25}\frac{5-\sqrt{x}}{25-x}$ $=\frac{1}{10}$	c. $\lim_{x\to 9}\frac{9-x}{\sqrt{x}-3}$ $=-6$
d. $\lim_{x\to 0}\frac{(x+3)^3-27}{x}$ $=27$	e. $\lim_{x\to 0}\frac{x^2}{\sqrt{x^2+12}-\sqrt{12}}$ $=4\sqrt{3}$	f. $\lim_{x\to 3}\left(\frac{1}{x-3}-\frac{6}{x^2-9}\right)$ $=\frac{1}{6}$
g. $\lim_{x\to 5}\frac{x-5}{\sqrt{x-1}-2}$	h. $\lim_{x\to 0}\frac{x^2}{\sqrt{x^2+12}-\sqrt{12}}$	i. $\lim_{x\to 3}\left(\frac{1}{x-3}-\frac{6}{x^2-9}\right)$

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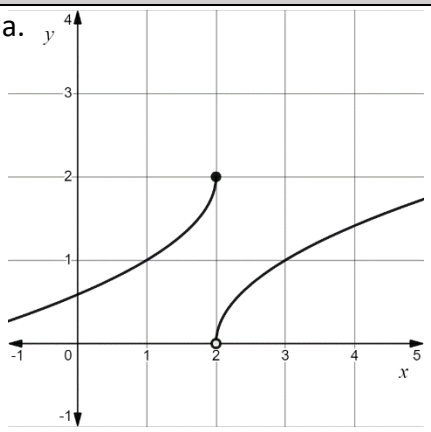
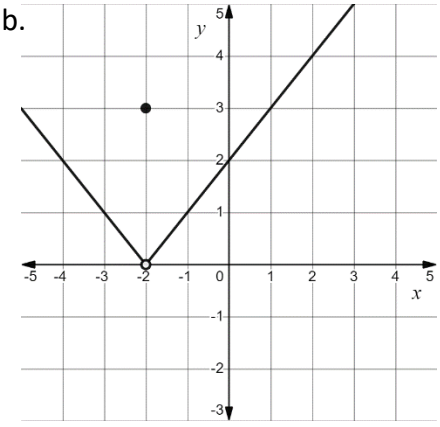
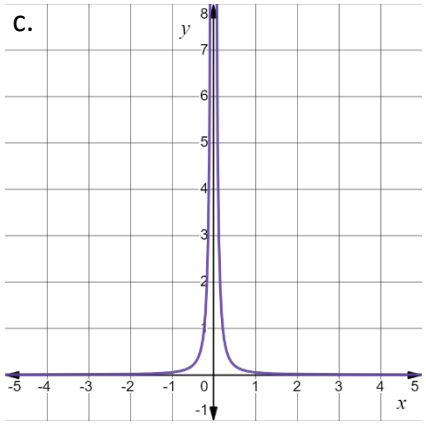
$= 4$	$= 4\sqrt{3}$	$= \frac{1}{6}$
j. $\lim_{x\to 2} \frac{x^2 - x - 2}{\lvert x-2\rvert}$ $= \text{DNE}$	k. $\lim_{x\to 0} \frac{\sqrt{x+1}-1}{x}$ $= \frac{1}{2}$	l. $\lim_{x\to 0} \frac{2-\sqrt{4+x}}{x}$ $= -\frac{1}{4}$

Extending		
a. $\lim_{x\to 0} \frac{\sin 2x}{4x}$ $= \frac{1}{2}$	b. $\lim_{x\to 0} \frac{\sin x}{x^2 - 3x}$ $= -3$	c. $\lim_{x\to 0} \frac{\sin x + 3x + 1}{x}$ $= \text{DNE}$
d. $\lim_{x\to 0} \frac{x \sin x}{\lvert x\rvert}$ $= 0$	e. $\lim_{x\to 0} \frac{(x+8)^{1/3} - 2}{x}$ $= 4$	f. $\lim_{x\to 0} \frac{\sqrt{x+1}-\sqrt{2x+1}}{\sqrt{3x+4}-\sqrt{2x+4}}$ $= -2$
g. $\lim_{x\to 1} \frac{x^{1/6} - 1}{x-1}$ $= \frac{1}{6}$	h. $\lim_{x\to 5/2} \frac{\lvert 2x-5\rvert(x+1)}{2x-5}$ $= \text{DNE}$	i. $\lim_{x\to 1} \frac{x^2 + \lvert x-1\rvert - 1}{\lvert x-1\rvert}$ $= \text{DNE}$
j. $\lim_{x\to 27} \frac{27-x}{x^{1/3} - 3}$ $= -27$	k. $\lim_{x\to 4} \frac{\sqrt{x}-2}{\sqrt{x^3}-8}$ $= \frac{1}{12}$	l. $\lim_{x\to 8} \frac{\sqrt[3]{x}-2}{x-8}$ $= \frac{1}{12}$

2. Find the point(s) and the associated type(s) of discontinuity.

Developing		
a.  $x = 2$ jump	b.  $x = -2$ point	c.  $x = 0$ vertical asymptote

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d. $f(x) = \dfrac{x-1}{x^2+2x-8}$ $x = -4, 2$ vertical asymptotes	e. $f(x) = \dfrac{x^2-16}{x^2+x-20}$ $x = -5$ vertical asymptote $x = 4$ removable	f. $f(x) = \dfrac{x^2+2x}{x-2x^2}$ $x = 0$ removable $x = \dfrac{1}{2}$ vertical asymptote
g. $f(x) = \dfrac{1-x^2}{x^2+5x-6}$ $x = 1$ removable $x = -6$ vertical asymptote	h. $f(x) = \dfrac{x^2+x-2}{x^2-4x+3}$ $x = 3$ vertical asymptote $x = 1$ removable	i. $f(x) = \dfrac{x^3-4x}{x^3-2x^2}$ $x = 2$ removable $x = 0$ vertical asymptote
j. $f(x) = \dfrac{2x^2+5x+20}{x^2+4x}$ $x = -4, 0$ vertical asymptote	k. $f(x) = \dfrac{x^3+1}{x^4-1}$ $x = 1$ vertical asymptote $x = -1$ removable	l. $f(x) = \dfrac{2x^2-x-6}{3x^2-7x+2}$ $x = 2$ removable $x = \dfrac{1}{3}$ vertical asymptote
Proficient		
a. $f(x) = \dfrac{x-4}{\lvert x-4\rvert}$ $x = 4$ jump	b. $f(x) = \begin{cases} \dfrac{2}{x-1}, & x < 2 \\ x^3 - 2x + 1, & x \geq 2 \end{cases}$ $x = 1$ vertical asymptote $x = 2$ jump	c. $f(x) = \dfrac{9-x}{\sqrt{x}-3}$ $x = 9$ removable
Extending		
a. $f(x) = \dfrac{x-3}{x^3-27}$ $x = 3$ removable	b. $f(x) = \dfrac{x^3-3x-10}{x^3-5x^2-4x+20}$ $x = 2$ vertical asymptote $x = -2, 5$ removable	c.

3. Determine constants a and b such that $f(x)$ is continuous for all values of x.

$$f(x) = \begin{cases} ax + 3, & x > 5 \\ 8, & x = 5 \\ x^2 + bx + a, & x < 5 \end{cases}$$

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$a = 1, b = -\frac{18}{5}$