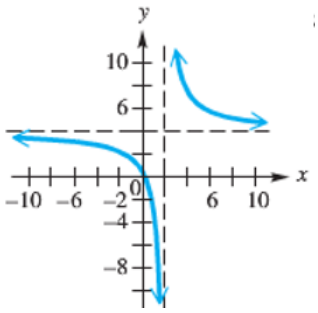
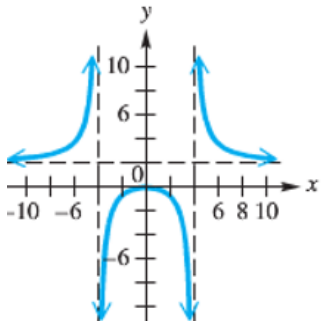
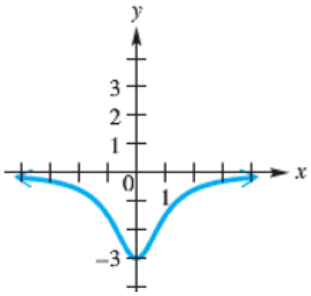
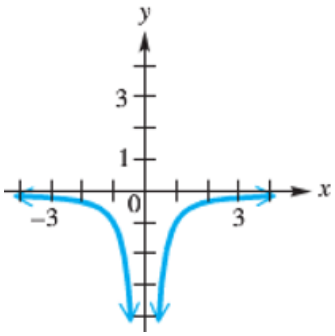
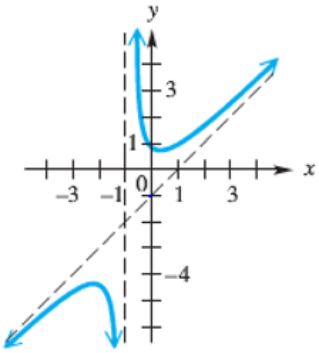
1. Analyse each graph. State the domain, range, types and equations of asymptotes, and parity of the function if applicable.

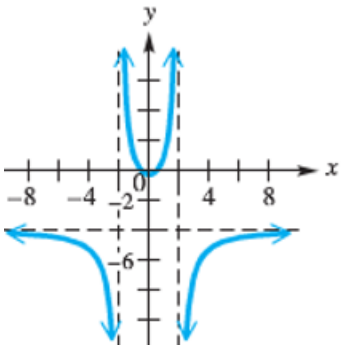
a) 

b) 

c) 

d) 

e) 

f) 

2. If the rational function $y = r(x)$ has the vertical asymptote $x = 2$, then as $x \to 2^+$, either $y \to$ _____ or $y \to$ _____.

   If the rational function $y = r(x)$ has the horizontal asymptote $y = 2$, then $y \to$ _____ as $x \to \pm\infty$.

3. Let $r(x) = \frac{(x+1)(x-2)}{(x+2)(x-3)}$.

   a) The function r has x-intercepts _____ and _____ .

   b) The function r has y-intercept _____ .

   c) The function r has vertical asymptotes _____ and _____ .

   d) The function r has horizontal asymptote _____ .

4. Explain how the graph of each function can be obtained from the graph of $y = \frac{1}{x}$ or $y = \frac{1}{x^2}$. Then graph the function and give its domain and range as well as intervals on which the function is increasing and decreasing.

a) $f(x) = \frac{1}{x} - 2$ b) $f(x) = \frac{1}{(x-3)^2}$ c) $f(x) = \frac{-1}{(x+3)^2} - 3$

5. Give equations of vertical and horizontal (or slant) asymptotes of the graph of

   a) $y = \frac{1}{x-3} + 2$ b) $y = \frac{1}{(x+2)^2} - 4$ c) $y = 2x + \frac{1}{x-1}$

6. Match the function from column I with the property listed in column II.

I	II
$f(x) = \frac{x+7}{x+1}$	**A.** The x-intercept is -3.
$f(x) = \frac{x+10}{x+2}$	**B.** The y-intercept is 5.
$f(x) = \frac{1}{x+4}$	**C.** The horizontal asymptote is $y = 4$.
$f(x) = \frac{-3}{x^2}$	**D.** The vertical asymptote is $x = -1$.
$f(x) = \frac{x^2-16}{x+4}$	**E.** There is a "hole" in its graph at $x = -4$.
$f(x) = \frac{4x+3}{x-7}$	**F.** The graph has an oblique asymptote.
$f(x) = \frac{x^2+3x+4}{x-5}$	**G.** The x-axis is its horizontal asymptote, and the y-axis is not its vertical asymptote.
$f(x) = \frac{x+3}{x-6}$	**H.** The x-axis is its horizontal asymptote, and the y-axis is its vertical asymptote.

7. ***Concept Check*** After the numerator is divided by the denominator,

$$f(x) = \frac{x^5+x^4+x^2+1}{x^4+1} \quad \text{becomes} \quad f(x) = x + 1 + \frac{x^2-x}{x^4+1}.$$

(a) What is the oblique asymptote of the graph of the function?
(b) Where does the graph of the function intersect its asymptote?
(c) As $x \to \infty$, does the graph of the function approach its asymptote from above or below?

8. ***Concept Check*** Which function has a graph that does not have a vertical asymptote?

A. $f(x) = \frac{1}{x^2+2}$ **B.** $f(x) = \frac{1}{x^2-2}$ **C.** $f(x) = \frac{3}{x^2}$ **D.** $f(x) = \frac{2x+1}{x-8}$

9. ***Concept Check*** Which function has a graph that does not have a horizontal asymptote?

A. $f(x) = \frac{2x-7}{x+3}$ **B.** $f(x) = \frac{3x}{x^2-9}$

C. $f(x) = \frac{x^2-9}{x+3}$ **D.** $f(x) = \frac{x+5}{(x+2)(x-3)}$

10. Sketch the graph of each rational function.

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

c) $f(x) = \frac{2x^2+3}{x-4}$ d) $f(x) = \frac{x^2-16}{x+4}$

11. **Drug Concentration** A drug is administered to a patient, and the concentration of the drug in the bloodstream is monitored. At time $t \geq 0$ (in hours since giving the drug), the concentration (in mg/L) is given by

$$c(t) = \frac{5t}{t^2 + 1}$$

Graph the function c with a graphing device.

(a) What is the highest concentration of drug that is reached in the patient's bloodstream?

(b) What happens to the drug concentration after a long period of time?

(c) How long does it take for the concentration to drop below 0.3 mg/L?