

1) Simplify each of the following and state the excluded values

a)  $\frac{4x^2 - 12x}{12x}$

b)  $\frac{3x^2 - 42x + 144}{x^2 - 14x + 48}$

c)  $\frac{9x^2 + 12x - 45}{21x^3 + 42x^2 - 63x}$

d)  $\frac{6x^2 + 29x + 20}{7x^2 - 70x}$

2) Simplify each expression.

a)  $\frac{x+4}{x^2+6x+8} \div \frac{1}{7x-21}$

b)  $\frac{x^2-6x+9}{5x+3} \cdot \frac{10x^2+11x+3}{18x^2+9x}$

c)  $\frac{14x^2-39x+27}{21x^2-27x} \div \frac{15-10x}{12x+28}$

d)  $\frac{6x^2+7x-24}{2x-3} \cdot \frac{5x^2+x-6}{15x^2+58x+48}$

3) Simplify each expression.

a)  $\frac{4}{x-6} + \frac{5x}{x+8}$

b)  $\frac{2}{x-2} - \frac{5}{x-5}$

c)  $\frac{x+6}{12x^3-36x^2+24x} - \frac{6x}{2}$

d)  $\frac{3x}{x-3} - \frac{7}{2x^2+12x}$

4) Solve each equation. Check for extraneous solutions.

a)  $\frac{6}{5x} = 1 + \frac{1}{5x}$

b)  $\frac{x+6}{x} = 1 + \frac{2}{x^2+12x}$

c)  $\frac{1}{x} - \frac{6}{x^3-16x^2+55x} = \frac{1}{x^3-16x^2+55x}$

d)  $\frac{x^2+x-20}{x^2-7x} - \frac{3}{x^2-7x} = \frac{x-10}{x}$

5) State the domain, equation of any vertical, horizontal or oblique asymptotes if any.

a)  $y = \frac{4x}{x^2-4}$

b)  $y = \frac{5x^2}{x^2-1}$

c)  $y = \frac{x^2+x-6}{x-2}$

d)  $y = \frac{x}{4x^3+7}$

e)  $y = \frac{x-4}{x^2-2x-8}$

f)  $y = \frac{x^3-5x^2+2x-10}{x^2-3x-10}$

6) Create sketches for each of the following by following the algorithm below.

- Simplify the function and state the restrictions on the domain.
- Determine if there are any holes in the graph
- Determine the asymptotes
- Determine the behaviour of  $f(x)$  near the asymptotes
- Determine if the graph crosses over its horizontal or oblique asymptote
- Determine the intercepts

a)  $y = \frac{3x-1}{x+1}$

b)  $y = \frac{4x^2}{2x^2-1}$

c)  $y = \frac{x}{x^2-4}$

d)  $y = \frac{2x^2+x-3}{x^2-4}$

e)  $y = \frac{x^2}{x+2}$

f)  $y = \frac{-5x^2+30x+3}{x-5}$

7) Solve the following rational inequalities i) algebraically; ii) graphically

a)  $\frac{6}{x-3} \leq 0$

b)  $\frac{2x^2+x-3}{x^2-4} > 2$

c)  $\frac{x-3}{x+4} \geq \frac{x+2}{x-5}$

8) Find the rate of change to the relation  $y = \frac{-1}{3x}$  at  $x = 3$ .

9) May and Richard are throwing Frisbee at the beach. When May throws to Richard, the height, in metres, of the Frisbee above the sand after  $t$  seconds is described by the function  $h(t) = \frac{t^3-8}{t^2-4}$ .

(Hint: Simplify function before finding velocity)

- Find the average upward velocity of the Frisbee for the time period from  $t = 1$ , lasting for 2s.
- What is the instantaneous velocity of the Frisbee when  $t = 2$ ?

10) The height, in metres, of a toy rocket launched at an initial upward velocity of 30 m/s, from a height of 1 m, is approximately given by  $s = \frac{5t^2-3t-2}{3t^2-7t+4}$ , where  $t$  is measured in seconds. Find the instantaneous velocity of the rocket after 1 s.

**Answers**

1a)  $\frac{x-3}{3}; \{0\}$     b)  $3; \{6,8\}$     c)  $\frac{3x-5}{7x(x-1)}; \{0, -3, 1\}$     d)  $\frac{(6x+5)(x+4)}{7x(x-10)}; \{0, 10\}$

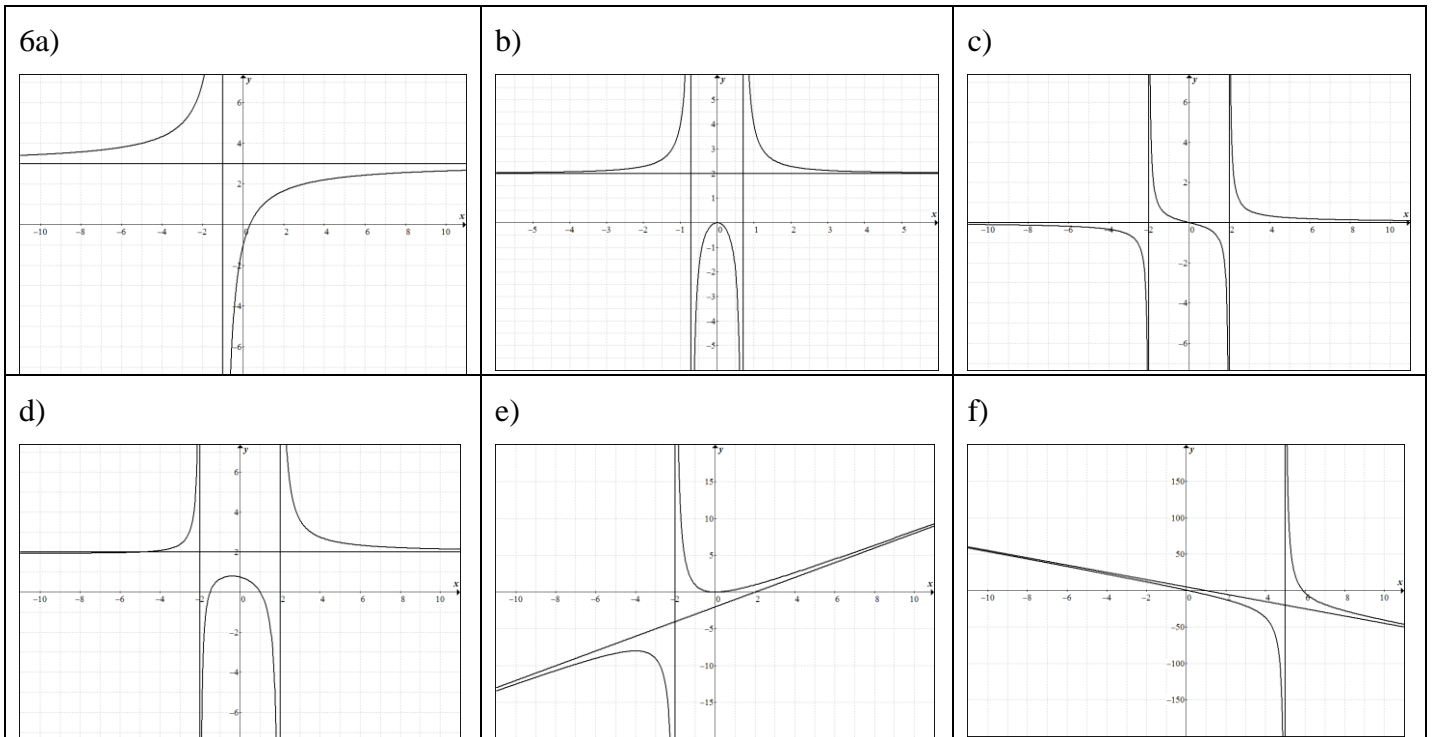
2a)  $\frac{7(x-3)}{x+2}$     b)  $\frac{(x-3)^2}{9x}$     c)  $\frac{-4(3x+7)}{15x}$     d)  $x-1$     3a)  $\frac{(5x-16)(x-2)}{(x+8)(x-6)}$     b)  $\frac{-3x}{(x-2)(x-5)}$

c)  $\frac{-36x^4 + 108x^3 - 72x^2 + x + 6}{12x(x-1)(x-2)}$     d)  $\frac{6x^3 + 36x^2 - 7x + 21}{2x(x+6)(x-3)}$     4a) 1    b)  $-\frac{35}{3}$     c) 4, 12    d)  $\frac{31}{6}$

5a)  $x \neq \pm 2$ ; V:  $x = \pm 2$ ; H:  $y = 0$     b)  $x \neq \pm 1$ ; V:  $x = \pm 1$ ; H:  $y = 5$     c)  $x \in \mathbb{R}$ ; O:  $y = x + 3$

d)  $x \neq \sqrt[3]{-7/4}$ ; V:  $x = \sqrt[3]{-7/4}$ ; H:  $y = 0$     e)  $x \neq 4, -2$ ; V:  $x = -2$ ; H:  $y = 0$

f)  $x \neq 5, -2$ ; V:  $x = -2$ ; O:  $y = x - 2$



7a)  $(-\infty, 3)$     b)  $(-5, -2) \& (2, \infty)$     c)  $(-\infty, -4) \& [\frac{1}{2}, 5)$     8)  $\frac{1}{27}$     9a) 0.73 m/s    b) 0.75 m/s    10) -26 m/s