1. How many of the following rational expressions do *not* have any restrictions on the variable?

$$\frac{x^4-1}{9} \qquad \frac{x^2+3x+2}{x^3+1} \qquad \frac{x^2+1}{x^2} \qquad \frac{x^2-16}{x^4+125} \qquad \frac{x+5}{x^2-36}$$

a) 1   b) 2   c) 3   d) 4   e) 5

2 For what values of x is the following expression undefined?

$$\frac{x-7}{x+2}$$

a) -7 only   b) -2 only   c) -7 and 2 d) 7 and -2 e) 7 only

3 For what values of x is the following expression undefined?

$$\frac{5x-3y}{2x+7y}$$

a) $-3y$ and $7y$ b) $-\frac{3}{5}y$ and $\frac{7}{2}y$ c) $-\frac{7}{2}y$ only   d) $3y$ only   e) $\frac{3}{5}y$ only

4. For what values of x is the following expression undefined?

$$\frac{x^2-10x+24}{x^2+5x-36}$$

a) -4 and 9 b) -9 only   c) 4 only   d) 4 and -9 only   e) -9, 4 and 6

5. Simplify: $\dfrac{4x^2-25x+6}{6x^2-35x-6}$

a) $\dfrac{2}{3}$ b) $\dfrac{x+4}{x-6}$ c) $\dfrac{4x+1}{6x-1}$ d) $\dfrac{4x-1}{6x-1}$ e) $\dfrac{4x-1}{6x+1}$

6. When simplified, $\dfrac{3x^2-5x-12}{x-3}=Ax+B$. What is the value of $A+B$?

a) -7 b) -1 c) 6 d) 7 e) 14

7. Simplify completely: $\dfrac{x+\dfrac{x}{9}}{x+\dfrac{x}{8}}$

a) $\dfrac{8}{9}$ b) $\dfrac{80}{81}$ c) $\dfrac{81}{80}$ d) $\dfrac{9}{8}$ e) $\dfrac{5}{4}$

8 Simplify: $\dfrac{(-3x^2)^3(x-7)^2}{(3x)^2(7-x)}$

a) $-3x^4(x-7)$ b) $3x^3(x-7)$ c) $-3x^3(x-7)$ d) $3x^4(x-7)$ e) $9x^4(x-7)$

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Simplify: $\dfrac{3x}{4} + \dfrac{7x+1}{5}$

a) $\dfrac{43x+4}{20}$ b) $\dfrac{10x+1}{9}$ c) $\dfrac{43x+1}{20}$ d) $7x+4$ e) $\dfrac{43x+1}{5}$

10. Simplify and determine the NPV.

a) $\dfrac{-35a^2b^3c^4}{40abc^7}$	b) $\dfrac{\dfrac{2}{x} - \dfrac{5}{x+3}}{\dfrac{-4}{x} + x}$
c) $\dfrac{\dfrac{6}{x+2} - \dfrac{7}{x-3}}{\dfrac{2}{x^2-4} - 7}$	d) $\dfrac{m^2 + 2mn - 3n^2}{3m^2 + 9mn}$
e) $\dfrac{a^2 + 10ab + 24b^2}{a^2 - 36b^2}$	f) $\dfrac{2x^3 - 28x^2 - 102x}{18x - 2x^3}$

11. Simplify and determine the NPV.

a) $\dfrac{(2m)^2}{5n} \times \dfrac{10m}{8n} \div \dfrac{15m}{(4n)^2}$	b) $\dfrac{2x^2 - 3x - 20}{2x^2 + 5x - 12} \times \dfrac{2x^2 - 15x + 18}{2x^2 - 7x - 30}$

c) $\dfrac{2x-1+\dfrac{3x}{x+1}}{3x-\dfrac{x}{x+1}}$

d) $\dfrac{2y-5+\dfrac{3y^2-3y}{y+1}}{3y-1-\dfrac{2y+1}{y+1}}$

e) $\dfrac{9a^2+42ab+49b^2}{2a^2-13ab+20b^2} \times \dfrac{4a^2-25b^2}{9a^2-49b^2} \div \dfrac{2a+5b}{3a^2-19ab+28b^2}$

f) $\dfrac{2x^2+5xy+2y^2}{3x^2-8xy-3y^2} \times \dfrac{x^2-9y^2}{x^2-4y^2} \div \dfrac{3x^2+11xy+6y^2}{2x^2-3xy-2y^2}$

12. Simplify and state all NPVs.

a) $\dfrac{6x-11y}{9x}+\dfrac{3x-16y}{6y}$

b) $\dfrac{2x+3y^2}{8xy}-3-\dfrac{5x^2-2y}{6x^2}$

c) $\dfrac{7x}{x^2-x-12} - \dfrac{4x}{x^2+2x-3}$	d) $\dfrac{3a+2}{a^2+10a+21} + \dfrac{5a-4}{15+2a-a^2}$
e) $\dfrac{5m+25}{2m^2+13m+15} - \dfrac{2m-5}{m^2-4}$	f) $\dfrac{3x+y}{2x^2-11xy-21y^2} + \dfrac{x-2y}{2x^2+11xy+12y^2} - \dfrac{2x+y}{x^2-3xy-28y^2}$

13. Solve.

a) $\dfrac{x+15}{5} = \dfrac{2}{x} + \dfrac{x+1}{5}$	b) $\dfrac{2x+1}{3x-2} = \dfrac{4x+3}{6x-5}$
c) $\dfrac{1}{x+2} + \dfrac{4}{2x-1} = 1$	d) $\dfrac{9x^2}{x^2-25} = \dfrac{4x}{x-5} + \dfrac{x}{x+5}$

e) $x - \dfrac{1}{x+4} = -4$	f) $\dfrac{3x+2}{2x+1} = \dfrac{3x+1}{x-1} - \dfrac{1}{3}$

14	A tank can be filled by one pipe in 20 minutes and by another in 30 minutes. How long will it take both pipes together to fill the tank?
15	Tim can finish painting his barn in 10 hours. It takes his wife JoAnn only 8 hours to do the same job. If they work together, how long will it take them to complete the job?
16	Adan can do a piece of work in 3 days, Bernie in 4 days, and Cynthia in 6 days each working alone. How long will it take them to do it working together?
17	A carpenter and his assistant can do a piece of work in 3 days. If the carpenter himself could do the work alone in 5 days, how long would the assistant take to do the work alone?
18	A sink can be filled from the faucet in 5 minutes. It takes only 3 minutes to empty the sink when the drain is open. If the sink is full and both the faucet and the drain are open, how long will it take to empty the sink?
19	Of two inlet pipes, the smaller pipe takes 5 hours longer than the larger pipe to fill a pool. When both pipes are open, the pool is filled in 6 hours. If only the larger pipe is open, how many hours are required to fill the pool?
20	It takes John 16 minutes longer than Sally to mow the lawn. If they work together they can mow the lawn in 15 minutes. How long will it take each to mow the lawn if they work alone?
21	Bill's father can paint a room in 3 hours less than Bill can paint it. Working together they can complete the job in 2 hours. How much time would each require working alone?
22	Two workers, a trainer and a trainee, working together can do a job in 3 hours. The trainer is 3 times faster than the trainee to complete the same job. How long will it take the trainee to finish the same job?
23	The faucet alone can fill the sink in 6 minutes, while it takes 8 minutes to empty it with the drain. How long will it take to fill the sink?

24	It takes Roberto 8 hours longer than Paula to repair a transmission. If it takes them 3 hours to do the job if they work together, how long will it take each of them working alone?
25	A water tank is being filled by two inlet pipes. Pipe A can fill the tank in 4 hours, while both pipes together can fill the tank in 2 hours. How long does it take to fill the tank using only Pipe B?
26	Cheng takes 10 hours longer to pave a driveway than Sammy to do a job. Working together they can do the job in 12 hours. How long does it take each working alone?

1. Simplify and determine the NPV.

g)	$\dfrac{-35a^2b^3c^4}{40abc^7} = \dfrac{-7ab^2}{8c^3}$ $NPV : a \neq 0, b \neq 0, c \neq 0$	h)	$\dfrac{12-3m}{20-5m} = \dfrac{3}{5}$ $NPV : m \neq 4$
i)	$\dfrac{6x^2-8x}{4x} = \dfrac{3x-4}{2}$ $NPV : x \neq 0$	j)	$\dfrac{m^2+2mn-3n^2}{3m^2+9mn} = \dfrac{(m-n)}{3m}$ $NPV : m \neq 0, m \neq 3n$
k)	$\dfrac{a^2+10ab+24b^2}{a^2-36b^2} = \dfrac{(a+4b)}{(a-6b)}$ $NPV : a \neq \pm 6b$	l)	$\dfrac{2x^3-28x^2-102x}{18x-2x^3} = \dfrac{(x-17)}{-(x-3)}$ $NPV : x \neq 0, -3, 3$

2. Simplify and determine the NPV.

a)	$\dfrac{(2m)^2}{5n} \times \dfrac{10m}{8n} \div \dfrac{15m}{(4n)^2} = \dfrac{16m^2}{15}$ $NPV : m \neq 0, n \neq 0$	b)	$= \dfrac{(x-4)}{(x+4)}$ $NPV : x \neq -4, \dfrac{-5}{2}, \dfrac{3}{2}, 6$
c)	$= \dfrac{2x^2+4x-1}{x(3x+2)}$	d)	$= \dfrac{-5}{3y^2-2}$
e)	$\dfrac{9a^2+42ab+49b^2}{2a^2-13ab+20b^2} \times \dfrac{4a^2-25b^2}{9a^2-49b^2} \div \dfrac{2a+5b}{3a^2-19ab+28b^2}$ $= 3a+7b$ $NPV : a \neq \pm\dfrac{5b}{2}, a \neq \pm\dfrac{7b}{3}, a \neq 4b$		
f)	$\dfrac{2x^2+5xy+2y^2}{3x^2-8xy-3y^2} \times \dfrac{x^2-9y^2}{x^2-4y^2} \div \dfrac{3x^2+11xy+6y^2}{2x^2-3xy-2y^2} = \dfrac{(x+2y)(2x+y)}{(x+3y)(3x+2y)}$ $NPV : x \neq \pm 3y, x \neq \pm 2y, x \neq -\dfrac{2y}{3}, x \neq -\dfrac{y}{2}, x \neq -\dfrac{y}{3}$		

3. Simplify and state all NPVs.

g)	$\dfrac{6x-11y}{9x} + \dfrac{3x-16y}{6y} = \dfrac{9x^2-36xy-22y^2}{18xy}$	h)	$\dfrac{2x+3y^2}{8xy} - 3 - \dfrac{5x^2-2y}{6x^2} = \dfrac{6x^2-92x^2y+9xy^2+8y^2}{24x^2y}$
i)	$\dfrac{7x}{x^2-x-12} - \dfrac{4x}{x^2+2x-3} = \dfrac{3x}{(x-4)(x-1)}$	j)	$\dfrac{3a+2}{a^2+10a+21} + \dfrac{5a-4}{15+2a-a^2} = \dfrac{2(a^2+22a-9)}{(a+7)(a+3)(5-a)}$
k)	$= \dfrac{m^2+4m-5}{(m+2)(m-2)(2m+3)}$	l)	$= \dfrac{-x^2-4xy+15y^2}{(x-7y)(2x+3y)(x+4y)}$

4. Solve.

g)	$\dfrac{x+15}{5} = \dfrac{2}{x} + \dfrac{x+1}{5}$ $x = \dfrac{5}{7}$	h)	$\dfrac{2x+1}{3x-2} = \dfrac{4x+3}{6x-5}$ $x = \dfrac{1}{5}$
i)	$\dfrac{1}{x+2} + \dfrac{4}{2x-1} = 1$ $x = \dfrac{-3}{2}, 3$	j)	$\dfrac{9x^2}{x^2-25} = \dfrac{4x}{x-5} + \dfrac{x}{x+5}$ $x = 0, \dfrac{15}{4}$
k)	$x - \dfrac{1}{x+4} = -4$ $x = -5, -3$	l)	$\dfrac{3x+2}{2x+1} = \dfrac{3x+1}{x-1} - \dfrac{1}{3}$ $x = -2, \dfrac{-5}{7}$

5. The average speed of an airplane is five times as fast as the average speed of a passenger train. To travel 2000km, ……… $Train : 80\,\dfrac{km}{h}$; $Plane : 400\,\dfrac{km}{h}$

6. The average speed of an express train is 40 km/h faster than the average speed of a bus. To travel 1200km, the bus requires ……. $Bus : 80\,\dfrac{km}{h}$; $Train : 120\,\dfrac{km}{h}$

7. Each week, Angela flies her small plane 500 km from Lethbridge to Moose Jaw. After a brief stopover, she returns to…….. $time : 5\dfrac{5}{8}\ hours$