

Rationals Practice Test

Name: _____

Part A: Indicate which value(s) must not be substituted into the following expressions:

a) $\frac{x-2}{x^2+4x}$ $x(x+4)$ $x \neq 0, -4$	b) $\frac{x+2}{x-4} \div \frac{x+3}{x-3}$ $x \neq 4, 3, -3$	c) $\frac{2x^2+3}{x^2-49}$ $x \neq \pm 7$
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Part B: Simplify.

1.	$\frac{48x^3+24x^2-12x}{4x} = \frac{12x(4x^2+2x-1)}{4x} = 3(4x^2+2x-1)$
2.	$\frac{a+2b}{5a+10b} = \frac{\cancel{a+2b}}{5(\cancel{a+2b})} = \frac{1}{5}$
3.	$\frac{x^3+2x^2}{x+2} = \frac{x^2(\cancel{x+2})}{\cancel{x+2}} = x^2$
4.	$\frac{x^2+3x-18}{x+6} = \frac{(\cancel{x+6})(x-3)}{\cancel{x+6}} = x-3$
5.	$\frac{x+5}{x^2-25} = \frac{\cancel{x+5}}{(x-5)(\cancel{x+5})} = \frac{1}{x-5}$
6.	$\frac{12-4x}{3x-9} = \frac{-4(\cancel{3-x})}{3(\cancel{x-3})} = -\frac{4}{3}$
7.	$\frac{y^2+5y-36}{y^2+11y+18} = \frac{(\cancel{y+9})(y-4)}{(\cancel{y+9})(y+2)} = \frac{y-4}{y+2}$
8.	$\frac{x^2+2xy-3y^2}{2x^2-xy-y^2} = \frac{(x+3y)(\cancel{x-y})}{(2x+y)(\cancel{x-y})} = \frac{x+3y}{2x+y}$
9.	$\frac{6-x-2x^2}{12+7x-10x^2} = \frac{(\cancel{3-2x})(2+x)}{(4+5x)(\cancel{3-2x})} = \frac{2+x}{4+5x}$

$\begin{array}{r} 2 \overline{) 11} \\ 1 \overline{) -1} \end{array}$
 $\begin{array}{r} 3 \overline{) -2x} \\ 2 \overline{) +1x} \\ 4 \quad 3 \end{array}$
 $\begin{array}{r} 4 \overline{) +5x} \\ 3 \overline{) -2x} \\ 15 \quad 8 \end{array}$

Part C: Simplify (Multiplying & Dividing Questions).

1.	$\frac{r^2-25}{8(r+5)} \times \frac{16a^4}{a^2(r-5)} = \frac{16a^4 \cancel{(r-5)} \cancel{(r+5)}}{8a^2 \cancel{(r+5)} \cancel{(r-5)}} = 2a^2$
2.	$\frac{(x^2+9x+20)}{(x^2-16)} \left(\frac{x-3}{x^2+2x-15} \right) = \frac{\cancel{(x+5)} \cancel{(x+4)} \cancel{(x-3)}}{\cancel{(x+4)} \cancel{(x-4)} \cancel{(x+5)} \cancel{(x-3)}} = \frac{1}{x-4}$
3.	$\frac{5-2x}{6x-15} \div \left(\frac{5-2x}{25-10x} \right) = -\frac{\cancel{(5-2x)}}{3 \cancel{(2x-5)}} \cdot \frac{5 \cancel{(5-2x)}}{\cancel{5-2x}} = -\frac{5}{3}$
4.	$\frac{(x^2-4)}{(x^2+5x+6)} \left(\frac{x^2+7x+10}{x^2-3x-10} \right) = \frac{\cancel{(x-2)} \cancel{(x+2)} \cancel{(x+5)} \cancel{(x+2)}}{\cancel{(x+2)} \cancel{(x+3)} \cancel{(x-5)} \cancel{(x+2)}} = \frac{(x-2)(x+5)}{(x+3)(x-5)}$
5.	$\frac{3x^2+9x}{3x-6} \left(\frac{4x-8}{x^2+3x} \right) = \frac{\cancel{3x} \cancel{(x+3)}}{\cancel{3} \cancel{(x-2)}} \cdot \frac{4 \cancel{(x-2)}}{x \cancel{(x+3)}} = 4$
6.	$\frac{a^2-a-72}{a^2+5a-24} \div \frac{a^2-4a-45}{a^2+2a-15} = \frac{\cancel{(a-9)} \cancel{(a+8)} \cancel{(a+5)} \cancel{(a-3)}}{\cancel{(a+8)} \cancel{(a-3)} \cancel{(a-9)} \cancel{(a+5)}} = 1$
7.	$\frac{6x^2+xy-2y^2}{4x^2-8xy+3y^2} \cdot \frac{x-y}{3x+2y} \cdot \frac{8x-12y}{2y-2x} = -\frac{\cancel{(2x-y)} \cancel{(3x+2y)} \cancel{(x-y)} 4 \cancel{(2x-3y)}}{\cancel{(2x-3y)} \cancel{(2x-y)} \cancel{(3x+2y)} 2 \cancel{(y-x)}} = -2$
8.	$\frac{x+5}{x+10} \div \left(\frac{10x}{x^2+10x} \cdot \frac{x^2+10x+25}{x^2+15x+50} \right) = \frac{x+5}{x+10} \div \left(\frac{10x \cancel{(x+5)} \cancel{(x+5)}}{x \cancel{(x+10)} \cancel{(x+5)} \cancel{(x+10)}} \right)$ $= \frac{\cancel{x+5}}{\cancel{x+10}} \cdot \frac{\cancel{(x+10)} \cancel{(x+10)}}{10 \cancel{(x+5)}} = \frac{x+10}{10}$

$$\begin{array}{r} 2 \overline{) -1} \\ 3 \overline{) +2} \end{array}$$

$$\begin{array}{r} 2 \overline{) -3} \\ 2 \overline{) -1} \end{array}$$

Part D: Simplify (Addition and Subtraction Questions)

1.	$\frac{25}{3a} - \frac{5}{2a} + \frac{5}{6a} = \frac{10 - 15 + 5}{6a} = 0$
2.	$\frac{2a+7}{6} - \frac{5-6a}{5} = \frac{10a+35}{30} - \frac{30-36a}{30} = \frac{46a+5}{30}$
3.	$\frac{2a+1}{4a} - \frac{3-2a}{3} = \frac{3(2a+1)}{12a} - \frac{4a(3-2a)}{12a} = \frac{6a+3-12a+8a^2}{12a} = \frac{8a^2-6a+3}{12a}$
4.	$\frac{3}{2a^2} + \frac{5}{4a} - \frac{7}{5} = \frac{30}{20a^2} + \frac{25a}{20a^2} - \frac{28a^2}{20a^2} = \frac{30+25a-28a^2}{20a^2}$
5.	$\frac{2x^2-3x}{x-5} - \frac{x^2+10}{x-5} = \frac{x^2-3x-10}{x-5} = \frac{\cancel{(x-5)}(x+2)}{\cancel{x-5}} = x+2$
6.	$\frac{4}{b+3} - \frac{5}{b^2-9} - \frac{3}{b-3} = \frac{4(b-3) - 5 - 3(b+3)}{(b+3)(b-3)} = \frac{4b-12-5-3b-9}{b^2-9} = \frac{b-26}{(b+3)(b-3)}$
7.	$\frac{4}{x+2} - \frac{5}{x+3} - \frac{3}{(x+2)(x+3)} = \frac{4(x+3) - 5(x+2) - 3}{(x+2)(x+3)} = \frac{4x+12-5x-10-3}{(x+2)(x+3)} = \frac{-x-1}{(x+2)(x+3)}$
8.	$\frac{x+3}{x+5} + \frac{x-3}{x} = \frac{x(x+3) + (x-3)(x+5)}{x(x+5)} = \frac{x^2+3x+x^2+2x-15}{x(x+5)} = \frac{2x^2+5x-15}{x(x+5)}$
9.	$\frac{5x}{x^2-2x} - \frac{8}{x-2} - \frac{2}{x} = \frac{5x}{x(x-2)} - \frac{8}{x-2} - \frac{2}{x} = \frac{5x-8x-2(x-2)}{x(x-2)} = \frac{4-5x}{x(x-2)}$

10.	$\frac{x^2+4x}{x^2+7x+12} + \frac{x+5}{x^2+5x+6} = \frac{x(\cancel{x+4})}{(x+3)(\cancel{x+4})} + \frac{x+5}{(x+2)(x+3)} = \frac{x(x+2)}{(x+3)(x+2)} + \frac{x+5}{(x+2)(x+3)}$ $= \frac{x^2+3x+5}{(x+3)(x+2)}$
11.	$\frac{5}{2x^3} - \frac{3x-9}{x^2-6x+9} + \frac{12x}{4x^2-12x} = \frac{5}{2x^3} - \frac{3(\cancel{x-3})}{(x-3)(\cancel{x-3})} + \frac{\overset{3}{\cancel{12x}}}{\cancel{4x}(x-3)} = \frac{5}{2x^3}$ <p style="text-align: center;">↑ ↑ same</p>
12.	$\frac{x}{2x^2+x-1} + \frac{3}{3x^2+2x-1} = \frac{x}{(2x-1)(x+1)} + \frac{3}{(3x-1)(x+1)}$ $= \frac{x(3x-1) + 3(2x-1)}{(2x-1)(x+1)(3x-1)} = \frac{3x^2+5x-3}{(2x-1)(x+1)(3x-1)}$

$\begin{array}{r} 2 \cancel{1} \\ 1 \cancel{1} \end{array}$
 $\begin{array}{r} 3 \cancel{1} \\ 1 \cancel{1} \end{array}$

Part E: Combined Operations

1.	$\frac{x+5}{x+6} + \frac{1}{x+4} \div \frac{x+6}{x^2-x-20} = \frac{x+5}{x+6} + \frac{1}{\cancel{x+4}} \cdot \frac{(x-5)(\cancel{x+4})}{x+6}$ $= \frac{\cancel{x+5} + x - 5}{x+6}$ $= \frac{2x}{x+6}$
2.	$\frac{2x^2}{x-1} - \frac{2x^2-7x+3}{x-3} \cdot \frac{x+2}{x-1} = \frac{2x^2}{x-1} - \frac{(2x-1)(\cancel{x-3})(x+2)}{(\cancel{x-3})(x-1)}$ $= \frac{2x^2 - (2x-1)(x+2)}{x-1}$ $= \frac{2-3x}{x-1}$

$\begin{array}{r} 2 \cancel{1} \\ 1 \cancel{1} \end{array}$

3.	$\frac{\left(\frac{1}{x} - 2\right)x}{\left(\frac{5}{x} + 1\right)x} = \frac{1-2x}{5+x}$
4.	$\frac{\left(\frac{2}{5x} - \frac{3}{x^2}\right)20x^2}{\left(\frac{7}{2x} + \frac{3}{4x^2}\right)20x^2} = \frac{8x-60}{70x+15} = \frac{4(2x-15)}{5(35x+3)}$

Part F: Solving Rational Equations

1) $\frac{2x}{3} + \frac{5}{6x} = \frac{3}{2} \quad x \neq 0$

$\frac{1}{4} \cdot \frac{1}{-5}$

$4x^2 + 5 = 9x$

$4x^2 - 9x + 5 = 0$

$(x-1)(4x-5) = 0$

$x = 1, \frac{5}{4}$

2) $x + \frac{4x}{x+6} = 3 \quad x \neq -6$

$x(x+6) + 4x = 3(x+6)$

$x^2 + 6x + 4x = 3x + 18$

$x^2 + 7x - 18 = 0$

$(x+9)(x-2) = 0$

$x = -9, 2$

3) $\frac{x-5}{3x-1} = \frac{x+5}{x-4} \quad x \neq \frac{1}{3}, 4$

$(x-5)(x-4) = (x+5)(3x-1)$

$x^2 - 9x + 20 = 3x^2 + 14x - 5$

$\frac{2}{1} \cdot \frac{25}{-1}$

$0 = 2x^2 + 23x - 25$

$0 = (2x+25)(x-1)$

$x = -25/2, 1$

4) $\frac{2}{2x-1} + \frac{1}{2x-1} = -3 \quad x \neq \frac{1}{2}$

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

$3 = -6x + 3$

$0 = -6x$

$0 = x$

$$5) 11 - \frac{6}{x} = 13$$

$$x \neq 0$$

$$11x - 6 = 13x$$

$$-6 = 2x$$

$$-3 = x$$

$$6) \frac{2}{x+2} = \frac{5}{x+3}$$

$$x \neq -2, -3$$

$$2x + 6 = 5x + 10$$

$$-4 = 3x$$

$$-\frac{4}{3} = x$$

$$7) x - \frac{6}{x-2} = 7$$

$$x \neq 2$$

$$x(x-2) - 6 = 7(x-2)$$

$$x^2 - 2x - 6 = 7x - 14$$

$$x^2 - 9x + 8 = 0$$

$$(x-8)(x-1) = 0$$

$$x = 8, 1$$

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

$$x \neq \pm 2$$

$$6(x+2) = 21 + x^2 - 4$$

$$6x + 12 = 21 + x^2 - 4$$

$$0 = x^2 - 6x + 5$$

$$0 = (x-5)(x-1)$$

$$x = 5, 1$$

$$9) \frac{2x}{x-4} = \frac{8}{x-4} + 1$$

$$x \neq 4$$

$$2x = 8 + x - 4$$

~~$$x = 4$$~~

No Solution

$$10) \frac{x}{x-5} - \frac{3}{x+1} = \frac{30}{x^2-4x-5}$$

$$x \neq 5, -1$$

$$\frac{x}{x-5} - \frac{3}{x+1} = \frac{30}{(x-5)(x+1)}$$

$$x(x+1) - 3(x-5) = 30$$

$$x^2 + x - 3x + 15 = 30$$

$$x^2 - 2x - 15 = 0$$

$$(x-5)(x+3) = 0$$

~~$$x = -3$$~~

11. Students sent flowers costing \$20 to a sick classmate. There were 4 fewer students contributing than was planned, requiring each of the others to pay 25 cents more than their original share. How many contributed to the flowers?

$$\frac{20}{x-4} = \frac{20}{x} + \frac{1}{4}$$

$$80x = 80(x-4) + x(x-4)$$

$$\cancel{80x} = \cancel{80x} - 320 + x^2 - 4x$$

$$0 = x^2 - 4x - 320$$

$$0 = (x-20)(x+16)$$

$$x = 20, -16$$

16 contributed

12. A group of business leaders pledged a total of \$1000 per year for the upkeep of a pedestrian mall. When 2 of them went out of business, the share of each remaining member went up by \$25. How many were in the original group?

$$\frac{1000}{x-2} = \frac{1000}{x} + 25$$

$$1000x = 1000(x-2) + 25x(x-2)$$

$$\cancel{1000x} = \cancel{1000x} - 2000 + 25x^2 - 50x$$

$$0 = 25x^2 - 50x - 2000$$

$$0 = x^2 - 2x - 80$$

$$0 = (x-10)(x+8)$$

$$x = 10, -8$$

10 business leaders

13. Chris drove 235 km from Quebec City to Montreal in the same length of time as Benton took to drive 205 km from Ottawa to Montreal. Chris drove 12 km/h faster than Benton. At what speed did Benton drive in km/h?

	D	R	T
Chris	235	$x+12$	$\frac{235}{x+12}$
Benton	205	x	$\frac{205}{x}$

$$\frac{235}{x+12} = \frac{205}{x}$$

$$235x = 205x + 2460$$

$$30x = 2460$$

$$x = 82$$

Benton drove 82 km/h

14. Emily and Sharu drove their scooters over a distance of 100 km. Emily's scooter's average speed is 5 km/h less than that of Sharu's scooter. If Emily's trip took an extra hour, find the average speed of both Emily's and Sharu's scooters.

	D	R	T
Emily	100	$x-5$	$\frac{100}{x-5}$
Sharu	100	x	$\frac{100}{x}$

$$\frac{100}{x-5} - \frac{100}{x} = 1$$

$$100x - 100(x-5) = x^2 - 5x$$

$$100x - 100x + 500 = x^2 - 5x$$

$$0 = x^2 - 5x + 500$$

$$0 = (x-25)(x+20)$$

$$x = 25, -20$$

Emily 20 km/h
Sharu 25 km/h

15. Gagan can take inventory at the store in 30 minutes. Jason can take inventory in 20 minutes. If they work together, how long will inventory take?

$$\frac{t}{30} + \frac{t}{20} = 1$$

$$2t + 3t = 60$$

$$5t = 60$$

$$t = 12$$

Together in 12 minutes

16. It takes Natalie 9 hours longer than Michelle to paint a house. Working together they can do the job in 20 hours. How long would it take each person, working alone, to paint the house?

x = # of hrs Michelle needs

$x+9$ = # of hrs Natalie needs

Michelle does $\frac{20}{x}$ of the job
Natalie does $\frac{20}{x+9}$ of the job.

$$\frac{20}{x} + \frac{20}{x+9} = 1$$

$$20(x+9) + 20x = x(x+9)$$

$$20x + 180 + 20x = x^2 + 9x$$

$$0 = x^2 - 31x - 180$$

$$0 = (x-36)(x+5)$$

$$x = 36, -5$$

Michelle takes 36 hours.
Natalie takes 45 hrs

17. A number added to the product of 6 and the reciprocal of the number is -5. Find the number.

$$x + \frac{6}{x} = -5 \quad x \neq 0$$

$$x^2 + 6 = -5x$$

$$x^2 + 5x + 6 = 0$$

$$(x+2)(x+3) = 0$$

$x = -2, -3$