

# Honors Math 3: Operations w/ Rational Expressions

$$\textcircled{1} \frac{r^2+3r}{21r^2} \cdot \frac{14}{2r+6} \quad \frac{\cancel{r}(r+3)}{3 \cancel{21}r^{\cancel{2}}} \cdot \frac{14^{\cancel{2}}}{\cancel{2}(r+3)} \quad \boxed{\frac{1}{3r}}$$

$$\textcircled{2} \frac{2a+6}{6a-18} \cdot \frac{3a-9}{7a+21} \quad \frac{\cancel{2}(a+3)}{\cancel{6}(a-3)} \cdot \frac{\cancel{3}(a-3)}{7(a+3)} \quad \boxed{\frac{1}{7}}$$

$$\textcircled{3} \frac{12x^2y}{3x-6y} \cdot \frac{(x-2y)^2}{2xy^3} \quad \frac{\cancel{2}12x^{\cancel{2}}y}{3(x-2y)} \cdot \frac{(x-2y)^{\cancel{2}}}{\cancel{2}xy^{\cancel{3}2}} \quad \text{or} \quad \frac{2x(x-2y)}{y^2}$$

$$\frac{2x-4y}{y^2}$$

$$\textcircled{4} \frac{3w+9}{3w^2} \cdot \frac{w^2+3w}{(w+3)^3} \quad \frac{\cancel{3}(w+3)}{\cancel{3}w^{\cancel{2}}} \cdot \frac{\cancel{w}(w+3)}{(w+3)^{\cancel{3}2}} \quad \frac{1}{w(w+3)} \quad \text{or} \quad \frac{1}{w^2+3w}$$

$$\textcircled{5} \frac{2a+8}{a^2-b^2} \cdot \frac{2a-2b}{a^2-16} \quad \frac{\cancel{2}(a+4)}{(a+b)(\cancel{a-b})} \cdot \frac{\cancel{2}(a-b)}{(\cancel{a+4})(a-4)} \quad \frac{4}{(a+b)(a-4)}$$

$$\text{or} \quad \frac{4}{a^2-4a+ab-4b}$$

$$\textcircled{6} \frac{xy^2+x^2y}{y^2+3y} \cdot \frac{xy^2-9x}{xy^2-x^3} \quad \frac{xy(y+x)}{y(y+3)} \cdot \frac{x(y^2-9)}{x(y^2-x^2)}$$

$$\frac{\cancel{xy}(y+x)}{y(\cancel{y+3})} \cdot \frac{x(y-3)(\cancel{y+3})}{\cancel{x}(y-x)(y+x)}$$

$$\boxed{\frac{x(y-3)}{y-x} \quad \text{or} \quad \frac{xy-3x}{y-x}}$$

$$\frac{y^2-9}{5y+10} \cdot \frac{y+2}{y^2+7y+12}$$

$$\frac{(y-3)(y+3)}{5(y+2)} \cdot \frac{(y+2)}{(y+3)(y+4)}$$

$$\frac{y-3}{5(y+4)} \text{ or } \frac{y-3}{5y+20}$$

$$\textcircled{8} \frac{w^2+w-6}{3w-6} \cdot \frac{w^2-2w}{2w+6}$$

$$\frac{(w+3)(w-2)}{3(w-2)} \cdot \frac{w(w-2)}{2(w+3)}$$

$$\frac{w(w-2)}{6} \text{ or } \frac{w^2-2w}{6}$$

$$\textcircled{9} \frac{c^2-2c-8}{c^2+3c+2} \cdot \frac{4c+4}{c^2-c-12}$$

$$\frac{(c-4)(c+2)}{(c+2)(c+1)} \cdot \frac{4(c+1)}{(c-4)(c+3)}$$

$$\frac{4}{c+3}$$

$$\textcircled{10} \frac{2w^2+5w+2}{w^2-4} \cdot \frac{w^2+w-6}{2w^2+w}$$

$$\frac{(2w^2+4w)+(w+2)}{(w-2)(w+2)} \cdot \frac{(w+3)(w-2)}{w(2w+1)}$$

$$\frac{2w(w+2)+1(w+2)}{(w-2)(w+2)} \cdot \frac{(w+3)(w-2)}{w(2w+1)}$$

$$\frac{(2w+1)(w+2)}{(w-2)(w+2)} \cdot \frac{(w+3)(w-2)}{w(2w+1)}$$

$$\frac{w+3}{w}$$

$$\frac{y^2 + 7y + 10}{3y^2 - 6y} \cdot \frac{y^3 - 4y}{y^2 + 4y + 4}$$

$$\frac{(y+5)(y+2)}{3y(y-2)} \cdot \frac{y(y^2-4)}{(y+2)(y+2)}$$

$$\frac{y+5}{3}$$

$$\frac{(y+5)(y+2)}{3y(y-2)} \cdot \frac{\cancel{y}(y-2)(y+2)}{\cancel{(y+2)}(y+2)}$$

$$\textcircled{12} \frac{2w^2 + 3w - 20}{6w^2 - 18w} \cdot \frac{2w^2 - 6w}{2w^2 + w - 15}$$

$$\frac{(2w-5)(w+4)}{3(2w-5)(w+3)} \cdot \frac{2w(w-3)}{(2w-5)(w+3)}$$

$$\frac{w+4}{3(w+3)} \text{ or } \frac{w+4}{3w+9}$$

$$\textcircled{13} \frac{18r^2 + 3r - 36}{9r^2 - 16} \cdot \frac{6r^2 - r - 12}{8r^2 + 20r - 48}$$

$$\frac{3(6r^2 + r - 12)}{(3r-4)(3r+4)} \cdot \frac{(6r^2 + 9r - 8r - 12)}{4(2r^2 + 5r - 12)}$$

$$\frac{3(2x+3)(3x-4)}{(3r-4)(3r+4)} \cdot \frac{(2x-3)(3x+4)}{4(2x-3)(x+4)}$$

$$\frac{3(2x+3)}{4(x+4)}$$

$$\frac{3x^2 + 6x - 9}{x^2 + x - 2} \cdot \frac{x^2 - 9x}{4x^2 - 24x - 108}$$

$$\frac{3(x^2 + 2x - 3)}{(x+2)(x-1)} \cdot \frac{x(x-9)}{4(x^2 - 6x - 27)}$$

$$\frac{3(x+3)(x-1)}{(x+2)(x-1)} \cdot \frac{x(x-9)}{4(x-9)(x+3)}$$

$$\frac{3x}{4(x+2)} \text{ or } \frac{3x}{4x+8}$$

$$\textcircled{15} \frac{6y^2 - 32y - 24}{3y^4 - 12y^3 - 36y^2} \cdot \frac{2y^3 - 8y}{12y^2 - 16y - 16}$$

$$\frac{2(3y^2 - 16y - 12)}{3y^2(y^2 - 4y - 12)} \cdot \frac{2y(y^2 - 4)}{4(3y^2 - 4y - 4)}$$

$$\frac{2(3y+2)(y-6)}{3y^2(y-6)(y+2)} \cdot \frac{2y(y-2)(y+2)}{4(3y+2)(y-2)}$$

$$\frac{1}{3y}$$

$$\textcircled{16} \frac{9}{x^2 - 16} \cdot \frac{4-x}{21}$$

$$\frac{3 \cancel{x}}{(x-4)(x+4)} \cdot \frac{-1(x-4)}{\cancel{21} 7}$$

$$\frac{-3}{7(x+4)} \text{ or } \frac{-3}{7x+28}$$

$$\textcircled{17} \frac{9r^2 - 1}{r^2 - 4} \cdot \frac{2-r}{3r+1}$$

$$\frac{(3r-1)(3r+1)}{(r-2)(r+2)} \cdot \frac{-1(r-2)}{3r+1}$$

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

$$\frac{0 - x - x^2}{x^2 - 16}$$

$$\cdot \frac{(x+4)^2}{x^2 - 5x + 6}$$

$$\frac{-x^2 - x + 6}{(x-4)(x+4)}$$

$$\cdot \frac{(x+4)^2}{(x-2)(x-3)}$$

$$\frac{-(x^2 + x - 6)}{(x-4)(x+4)}$$

$$\cdot \frac{(x+4)^2}{(x-2)(x-3)}$$

$$\frac{-(x+3)(x-2)}{(x-4)(x+4)}$$

$$\cdot \frac{(x+4)^2}{(x-2)(x-3)}$$

$$\boxed{\frac{-(x+3)(x+4)}{(x-4)(x-3)}}$$

$$\textcircled{19} \frac{y^2 + 7y + 10}{2y^2 + 13y + 15}$$

$$\cdot \frac{6 + y - 2y^2}{2y^3 - 8y}$$

$$\frac{(y+5)(y+2)}{(2y+3)(y+5)} \cdot \frac{-(2y^2 - y - 6)}{2y^2(y^2 - 4)}$$

$$\frac{\cancel{(y+5)}\cancel{(y+2)}}{\cancel{(2y+3)}\cancel{(y+5)}} \cdot \frac{-(2y+3)\cancel{(y-2)}}{2y\cancel{(y-2)}\cancel{(y+2)}}$$

$$\boxed{\frac{-1}{2y}}$$

$$\textcircled{20} \frac{10a + 8 - 3a^2}{a^2 - a - 12}$$

$$\cdot \frac{9a^3 - 8}{3a^2 - 7a - 6}$$

$$\frac{-(3a^2 - 10a - 8)}{(a-4)(a+3)} \cdot \frac{9a(a^2 - 9)}{(3a+2)(a-3)}$$

$$\frac{-(3a+2)\cancel{(a-4)}}{\cancel{(a-4)}(a+3)} \cdot \frac{9a\cancel{(a-3)}\cancel{(a+3)}}{(3a+2)\cancel{(a-3)}}$$

$$\boxed{-9a}$$

$$\frac{5m-12}{2m+8} \div \frac{6m-24}{4m+16}$$

$$\frac{3m-12}{2m+8} \cdot \frac{4m+16}{6m-24}$$

$$\frac{3(m-4)}{2(m+4)} \cdot \frac{4(m+4)}{3(m-4)}$$

$$(22) \frac{2x-6y}{12x+4y} \div \frac{6x-18y}{9x+3y}$$

$$\frac{2x-6y}{12x+4y} \cdot \frac{9x+3y}{6x-18y}$$

$$\boxed{1}$$

$$\frac{2(x-3y)}{4(3x+y)} \cdot \frac{3(3x+y)}{2(x+3y)}$$

$$\boxed{\frac{1}{4}}$$

$$(23) \frac{x^2-16y^2}{4xy^2} \div \frac{x^2+4xy}{2y}$$

$$\frac{x^2-16y^2}{4xy^2} \cdot \frac{2y}{x^2+4xy}$$

$$\frac{(x-4y)(x+4y)}{2xy^2} \cdot \frac{2y}{x(x+4y)}$$

$$\frac{x-4y}{2xy}$$

$$\boxed{\frac{x-4y}{2xy}}$$

$$(24) \frac{a^2-ac}{3a+9c} \div \frac{a^2-c^2}{2a+6c}$$

$$\frac{a^2-ac}{3a+9c} \cdot \frac{2a+6c}{a^2-c^2}$$

$$\frac{a(a-c)}{3(a+3c)} \cdot \frac{2(a+3c)}{(a-c)(a+c)}$$

$$\boxed{\frac{2a}{3(a+c)} \text{ or } \frac{2a}{3a+3c}}$$

$$(25) \frac{r^2-r-30}{r+4} \div (r^2-2r-24)$$

$$\frac{r^2-r-30}{r+4} \cdot \frac{1}{r^2-2r-24}$$

$$\frac{(r-6)(r+5)}{r+4} \cdot \frac{1}{(r-6)(r+4)}$$

$$\boxed{\frac{r+5}{(r+4)^2}}$$

$$\frac{k^2-9}{k^2+3k-18} \div \frac{4k^2+12k}{k^2+10k+24} \quad \frac{k^2-9}{k^2+3k-18} \cdot \frac{k^2+10k+24}{4k^2+12k}$$

$$\frac{(k+3)(k-3)}{(k+6)(k-3)} \cdot \frac{(k+4)(k+6)}{4k(k+3)}$$

$$\frac{k+4}{4k}$$

$$\textcircled{27} \frac{n-n^2}{10n+8} \div \frac{(n-1)^2}{5n^2+4n} \quad \frac{n-n^2}{10n+8} \cdot \frac{5n^2+4n}{(n-1)^2}$$

$$\frac{n(1-n)}{2(5n+4)} \cdot \frac{n(5n+4)}{(n-1)^2}$$

$$\frac{n(1-n)}{2(5n+4)} \cdot \frac{n(5n+4)}{(n-1)(n-1)}$$

$$\frac{n \cdot -1(n-1)}{2(5n+4)} \cdot \frac{n(5n+4)}{(n-1)(n-1)}$$

$$\frac{-n^2}{2(n-1)}$$

$$\frac{-n^2}{2n-2} \quad \frac{n^2}{-2n+2}$$

$$\textcircled{28} \frac{2w^2+9w+4}{16-w^2} \div \frac{2w^2+w}{w^2-w-12} \quad \frac{2w^2+9w+4}{16-w^2} \cdot \frac{w^2-w-12}{2w^2+w}$$

$$\frac{(2w+1)(w+4)}{(4-w)(4+w)} \cdot \frac{(w-4)(w+3)}{w(2w+1)}$$

$$\frac{(2w+1)(w+4)}{-1(w-4)(w+4)} \cdot \frac{(w-4)(w+3)}{w(2w+1)}$$

$$\frac{w+3}{-w}$$

$$\frac{x+1}{3x-x^2} \div \frac{x^2-5x-2}{x^3-4x}$$

$$\frac{6x^2+17x+5}{3x-x^2} \cdot \frac{x^3-4x}{3x^2-5x-2}$$

$$\frac{(6x^2+2x+15x+5)}{3x-x^2} \cdot \frac{x(x^2-4)}{(3x+1)(x-2)}$$

$$\frac{2x(3x+1)+5(3x+1)}{x(3-x)} \cdot \frac{x(x-2)(x+2)}{(3x+1)(x-2)}$$

$$\frac{(3x+1)(2x+5)}{x(3-x)} \cdot \frac{x(x-2)(x+2)}{(3x+1)(x-2)}$$

$$\frac{(2x+5)(x+2)}{3-x}$$

or

$$\frac{(2x+5)(x+2)}{-1(x-3)}$$

$$(36) \frac{a^2+3a-10}{2a^2-a-6} \div \frac{25-a^2}{2a^2-7a-15}$$

$$\frac{a^2+3a-10}{2a^2-a-6} \cdot \frac{2a^2-7a-15}{25-a^2}$$

$$\frac{(a+5)(a-2)}{(2a+3)(a-2)} \cdot \frac{(2a+3)(a-5)}{(5-a)(5+a)}$$

$$\frac{(a+5)(a-2)}{(2a+3)(a-2)} \cdot \frac{(2a+3)(a-5)}{-1(a-5)(a+5)}$$

$$-1$$



$$\frac{3}{x^2y} + \frac{4}{xy^4} \quad \underline{\text{CD}}: x^2y^4$$

$$\frac{3y^3}{x^2y^4} + \frac{4x}{x^2y^4}$$

$$\frac{3y^3+4x}{x^2y^4}$$

$$(32) \quad \frac{2}{a} - \frac{2}{b} + \frac{2}{c} \quad \underline{\text{CD}}: abc \quad \frac{2bc}{abc} - \frac{2ac}{abc} + \frac{2ab}{abc}$$

$$\frac{2bc-2ac+2ab}{abc}$$

$$(33) \quad \frac{a+2b}{2} - \frac{2a+b}{5} \quad \underline{\text{CD}}: 10 \quad \frac{5a+10b}{10} - \frac{4a+2b}{10} \quad \frac{5a+10b-(4a+2b)}{10}$$

$$\frac{a+8b}{10}$$

$$(34) \quad \frac{m-3n}{mn} + \frac{n-2p}{pm} \quad \underline{\text{CD}}: pmn \quad \frac{pm-3pn}{pmn} + \frac{n^2-2pn}{pmn}$$

$$\frac{pm-5pn+n^2}{pmn}$$

$$(35) \quad \frac{5}{x+2} - \frac{8}{x+5} \quad \underline{\text{CD}}: (x+2)(x+5) \quad \frac{5x+25}{(x+2)(x+5)} - \frac{8x+16}{(x+2)(x+5)}$$

$$\frac{5x+25-8x-16}{(x+2)(x+5)}$$

$$\frac{-3x+9}{(x+2)(x+5)}$$

$$(36) \quad \frac{k}{k-1} - \frac{k}{k+3} \quad \underline{\text{CD}}: (k-1)(k+3) \quad \frac{k^2+3k}{(k-1)(k+3)} - \frac{k^2-k}{(k-1)(k+3)}$$

$$\frac{k^2+3k-k^2+k}{(k-1)(k+3)}$$

$$\frac{4k}{(k-1)(k+3)}$$

$$\frac{x-y}{x+y} + \frac{x+y}{x-y} \quad \text{CD: } (x+y)(x-y)$$

$$\frac{(x-y)(x+y)}{(x+y)(x-y)} + \frac{(x+y)(x+y)}{(x+y)(x-y)}$$

$$\frac{x^2+y^2}{(x+y)(x-y)} + \frac{x^2+y^2}{(x+y)(x-y)}$$

$$\frac{2x^2+2y^2}{(x+y)(x-y)} \quad \text{or} \quad \frac{2x^2+2y^2}{x^2-y^2}$$

$$\textcircled{38} \quad \frac{10x}{4(x-1)} - \frac{3}{x-1} \quad \text{CD: } 4(x-1)$$

$$\frac{10x}{4(x-1)} - \frac{12}{4(x-1)} \quad \frac{10x-12}{4(x-1)} \quad \frac{2(5x-6)}{4(x-1)}$$

$$\frac{5x-6}{2(x-1)} \quad \text{or} \quad \frac{5x-6}{2x-2}$$

$$\textcircled{39} \quad \frac{r}{2r-4} - \frac{5r}{12r-24} \quad \frac{r}{2(r-2)} - \frac{5r}{12(r-2)} \quad \text{CD: } 12(r-2)$$

$$\frac{6r}{12(r-2)} - \frac{5r}{12(r-2)}$$

$$\frac{r}{12(r-2)} \quad \text{or} \quad \frac{r}{12r-24}$$

$$\frac{2}{2y+6} + \frac{3y-2}{4y^2+12y}$$

$$\frac{2}{2(y+3)} + \frac{3y-2}{4y(y+3)}$$

$$\underline{CD: 4y(y+3)}$$

$$\frac{4y}{4y(y+3)} + \frac{3y-2}{4y(y+3)}$$

$$\frac{7y-2}{4y(y+3)} \quad \text{or} \quad \frac{7y-2}{4y^2+12y}$$

$$\textcircled{4} \quad \frac{4-3m}{16-m^2} + \frac{3}{m-4}$$

$$\frac{4-3m}{-1(m^2-16)} + \frac{3}{m-4}$$

$$\frac{-4+3m}{(m-4)(m+4)} + \frac{3}{m-4}$$

$$\underline{CD: (m-4)(m+4)}$$

$$\frac{-4+3m}{(m-4)(m+4)} + \frac{3(m+4)}{(m-4)(m+4)}$$

$$\frac{-4+3m+3m+12}{(m-4)(m+4)}$$

$$\frac{6m+8}{(m-4)(m+4)}$$

$$\frac{3a}{(a^2-a-6)} - \frac{4}{a-3} \quad \frac{3a}{(a-3)(a+2)} - \frac{4}{(a-3)} \quad \text{CD: } (a-3)(a+2)$$

$$\frac{3a}{(a-3)(a+2)} - \frac{4(a+2)}{(a-3)(a+2)} = \frac{3a-4a-8}{(a-3)(a+2)}$$

$$\frac{-a-8}{(a-3)(a+2)}$$

$$\frac{-1(a+8)}{(a-3)(a+2)}$$

$$\textcircled{43} \quad \frac{8}{3y-18} - \frac{y+1}{y^2-5y-6} \quad \frac{8}{3(y-6)} - \frac{y+1}{(y-6)(y+1)} \quad \text{CD: } 3(y-6)(y+1)$$

$$\frac{8(y+1)}{3(y-6)(y+1)} - \frac{3(y+1)}{3(y-6)(y+1)} = \frac{8y+8-3y-3}{3(y-6)(y+1)} = \frac{5y+5}{3(y-6)(y+1)}$$

$$\frac{5(y+1)}{3(y-6)(y+1)}$$

$$\frac{5}{3(y-6)}$$

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$$4) \frac{3}{p^2-4p-12} + \frac{4}{p^2-4}$$

$$\frac{3}{(p-6)(p+2)} + \frac{4}{(p-2)(p+2)}$$

CD:  $(p-6)(p+2)(p-2)$

$$\frac{3(p-2)}{(p-6)(p+2)(p-2)} + \frac{4(p-6)}{(p-6)(p+2)(p-2)}$$

$$\frac{3p-6+4p-24}{(p-6)(p+2)(p-2)}$$

$$\frac{7p-30}{(p-6)(p+2)(p-2)}$$

$$45) \frac{a^2+8}{a^2-4} - \frac{a+1}{a-2}$$

$$\frac{a^2+8}{(a-2)(a+2)} - \frac{a+1}{a-2} \quad \text{CD: } (a-2)(a+2)$$

$$\frac{a^2+8}{(a-2)(a+2)} - \frac{(a+1)(a+2)}{(a-2)(a+2)}$$

$$\frac{a^2+8 - (a^2+3a+2)}{(a-2)(a+2)}$$

$$\frac{a^2+8-a^2-3a-2}{(a+2)(a+2)}$$

$$\frac{-3a+6}{(a-2)(a+2)}$$

$$\frac{-3(a-2)}{(a-2)(a+2)}$$

$$\frac{-3}{a+2}$$

$$\textcircled{46} \frac{c+5}{c^2-5c-36} + \frac{c-6}{c^2-11c+18}$$

$$\frac{c+5}{(c-9)(c+4)} + \frac{c-6}{(c-9)(c-2)}$$

$$\text{CD} = (c-9)(c+4)(c-2)$$

$$\frac{(c+5)(c-2)}{(c-9)(c+4)(c-2)} + \frac{(c-6)(c+4)}{(c-9)(c+4)(c-2)}$$

$$\frac{c^2+3c-10 + c^2-2c-24}{(c-9)(c+4)(c-2)}$$

$$\frac{2c^2+c-34}{(c-9)(c+4)(c-2)}$$

$$\textcircled{47} \frac{n}{a-5} - \frac{2n}{5-a}$$

$$\frac{n}{a-5} - \frac{2n}{-1(a-5)}$$

$$\frac{n}{a-5} + \frac{2n}{a-5}$$

$$\frac{3n}{a-5}$$

$$\textcircled{48} \frac{7}{2-x} + \frac{5}{x^2-4}$$

$$\frac{-7}{x-2} + \frac{5}{(x-2)(x+2)}$$

$$\text{CD} = (x-2)(x+2)$$

$$\frac{-7(x+2)}{(x-2)(x+2)} + \frac{5}{(x-2)(x+2)}$$

$$\frac{-7x-9}{(x-2)(x+2)}$$

$$\frac{7x+9}{-(x+2)(x-2)}$$