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1 Simplify the following expressions.

a) $\frac{5x^2}{10x^3} =$

b) $\frac{8xy^3}{12x^2y^2} =$

c) $\frac{1}{x} \times \frac{x^2}{y} =$

d) $\frac{a}{x} \div \frac{a^2}{x^2} =$

e) $\frac{3abc}{2a^2} \times \frac{8a}{9b^2c} =$

f) $\frac{ab}{xy} \times \frac{y^2}{x^2} \div \frac{bc}{y} =$

2 Reduce each of the following fractions to its lowest terms.

a) $\frac{2x}{6x^2 - x} =$

b) $\frac{6x^2 + 6ax}{3a^2x} =$

c) $\frac{x^2 - 1}{x^2 + x} =$

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

e) $\frac{x^3 + 1}{x^3 - x} =$

f) $\frac{a^3 + 3a^2b - 4ab^2}{2a^2 - 4ab + 2b^2} =$

3 Simplify the following expressions.

a) $\frac{x}{x^2 - 1} \times \frac{x^2 - 3x + 2}{x^2 + 2x} =$

b) $\frac{2x + 4}{x^2 + x - 12} \times \frac{x - 3}{x^2 + 6x + 8} =$

c) $\frac{x - 4}{x - 2} \div \frac{x^2 - 5x + 4}{x^2 - 4} =$

d) $\frac{x^2 - 9}{x + 2} \div (x^2 - x - 6) =$

4 For each of the following pairs of polynomials, factor the polynomials and find the greatest common divisor (GCD) and the least common multiple (LCM).

a) $\begin{cases} x^2 - 4 = \\ x^2 + 4x + 4 = \end{cases} \begin{cases} \text{GCD} = \\ \text{LCM} = \end{cases}$

b) $\begin{cases} x^2 - x - 2 = \\ x^3 + 1 = \end{cases} \begin{cases} \text{GCD} = \\ \text{LCM} = \end{cases}$

c) $\begin{cases} x^2 - 1 = \\ x^3 + x^2 - x - 1 = \\ x^3 - x^2 - x + 1 = \end{cases} \begin{cases} \text{GCD} = \\ \text{LCM} = \end{cases}$

5 Simplify the following expressions.

a) $\frac{2x}{x + 5} - \frac{x - 5}{x + 5} =$

b) $\frac{x - 2}{2x} + \frac{x + 3}{3x} =$

c) $\frac{1}{x} - \frac{1}{x + 1} =$

d) $\frac{1}{a} + \frac{1}{a^2 - a} - \frac{2}{a^2 - 1} =$

e) $\frac{4x}{x^2 - 1} - \frac{x - 1}{x^2 + x} =$

6 a) Factor $x^2 + 2xy - 3y^2$. $x^2 + 2xy - 3y^2 =$

b) Using the above result, simplify the following.

$$\frac{x-y}{x^2+2xy-3y^2} - \frac{2}{x-y} - \frac{7}{x+3y} =$$

7 Simplify the following expressions.

a) $\frac{\frac{c}{ab}}{ab^2c} =$

b) $\frac{\frac{bc}{ad}}{\frac{b^2}{a}} =$

c) $\frac{1}{1 - \frac{1}{x+1}} =$

d) $\frac{1 - \frac{1}{x}}{x - \frac{1}{x}} =$

e) $\frac{x+3}{1 + \frac{1}{x+2}} + \frac{x-2}{1 - \frac{1}{x-1}} =$

8 Simplify the following expressions.

a) $\left(\frac{x^2}{y} - \frac{y^2}{x}\right) \div \left(\frac{1}{y} - \frac{1}{x}\right) =$

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

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

d) $\frac{1}{x} - \frac{y}{x(x+y)} - \frac{z}{(x+y)(x+y+z)} =$

e) $\frac{b-c}{(a+b)(a+c)} + \frac{c-a}{(b+c)(b+a)} + \frac{a-b}{(c+a)(c+b)}$
 $=$

9 Along a certain river, there are two points A and B separated by a km. The boat goes upstream from A to B, and then comes back downstream from B to A. Assuming that the speed of the boat is u km/h in calm waters, and the speed of the river flow is v km/h ($v < u$), Answer the following questions. [Hint: The speed of boat from A to B is $(u - v)$ km/h, and the speed from B to A is $(u + v)$ km/h]

a) Find the time it takes to make a round trip.

b) Find the average speed of the boat while making the round trip.

c) Which is faster, the average speed found in b), or the speed in calm waters?