

Date: _____ **UNIT 1: ALGEBRAIC & NUMERICAL EXPRESSIONS****1.1 Adding, Subtracting, and Multiplying Polynomials****1. Simplify.**

a) $(1 - 3x + 2x^3) + (x^2 - 2x - 2)$

b) $(9x^2 - 4xy - y^2) - (6y^2 + 3xy + 10x^2)$

c) $-4x - \sqrt{36x^4} - 9x^2 + \sqrt{64x^2}$

d) $\sqrt{x^6 y^4} - \sqrt{16y^4 x^6} - \sqrt{9(y-2x)^2} + \sqrt{25(2x+3y)^2}$

e) $-2mn(m^2 - 4n) - 4mn(m^2 + 5n)$

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

g) $-3[5 - 4(y+7)]$

h) $2t[3(4-3t) + 5(t-3)]$

2. Expand and simplify.

a) $(x+1)(x+2)$

b) $(2x-3)(x-4)$

c) $(x^3 - 4)(x^3 + 1)$

d) $(3x^2 - 2)(5x^2 + 6)$

e) $(1-2y)(1+2y)$

f) $(5t-6)^2$

g) $(7x+2y)(8x-7y)$

h) $(3x+4y)^2$

i) $(8x+5y)(8x-5y)$

j) $5(1-x^2y^3)(1+x^2y^3)$

k) $-4x(2x-1)(3x+1)$

l) $y^2 \left(y - \frac{2}{y} \right) \left(y + \frac{3}{y} \right)$

3. Simplify.

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

b) $(2x-1)(x+2) + (x-4)(x+3)$

c) $2(m-3)(m-4) - 3(m+5)^2$

d) $4(5x-y)^2 - 5(4x-y)^2$

e) $(3x-5)[3 + (2x+4)(x-1)]$

f) $4x(x-3y) - (x+y)^2 - 2(x-y)(x+y) + 5$

g) $(3y+2)(2y^2+3y-4)$

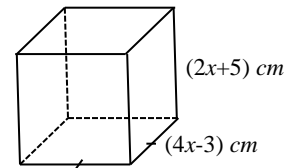
h) $(2x-1)(2x+5)(2x-5)$

i) $(3x-2y)^3$

j) $(x^2 - 4x + 1)^2$

4. The perimeter of a triangle is $5x - 2y + 3z$. If the two sides have lengths $3y + z$ and $4x - y + z$, what is the length of the third side?

5. Given the open-topped storage box as shown, determine simplified expressions for each of the following:

a) **Surface Area**b) **Volume****1.1 Answers**

1. a) $2x^3 + x^2 - 5x - 1$ b) $-x^2 - 7xy - 7y^2$ c) $-15x^2 + 4x$ d) $-3x^3y^2 + 16x + 12y$ e) $-6m^3n - 12mn^2$ f) $2x^2 + 14x$ g) $12y + 69$ h) $-8t^2 - 6t$
 2. a) $x^2 + 3x + 2$ b) $2x^2 - 11x + 12$ c) $x^6 - 3x^3 - 4$ d) $15x^4 + 8x^2 - 12$ e) $1 - 4y^2$ f) $25t^2 - 60t + 36$ g) $56x^2 - 33xy - 14y^2$
 h) $9x^2 + 24xy + 16y^2$ i) $64x^2 - 25y^2$ j) $5 - 5x^4y^6$ k) $-24x^3 + 4x^2 + 4x$ l) $y^4 + y^2 - 6$
 3. a) $5x^2 - x + 2$ b) $3x^2 + 2x - 14$ c) $-m^2 - 44m - 51$ d) $20x^2 - y^2$ e) $6x^3 - 4x^2 - 13x + 5$ f) $x^2 - 14xy + y^2 + 5$
 g) $6y^3 + 13y^2 - 6y - 8$ h) $8x^3 - 4x^2 - 50x + 25$ i) $27x^3 - 54x^2y + 36xy^2 - 8y^3$ j) $x^4 - 8x^3 + 18x^2 - 8x + 1$
 4. $x - 4y + z$ units
 5. a) $(48x^2 + 32x - 51) \text{ cm}^2$ b) $(32x^3 + 32x^2 - 102x + 45) \text{ cm}^3$

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1.2 Review of Factoring Techniques**“When factoring always look for the *greatest common factor* first.”****1. Factor completely.**

- a) $x^2 + x$ b) $-2x + 8$ c) $wxy - xyz$ d) $-m^6 - m^2$
 e) $9a^3 - 12a$ f) $5a^2b + ab^2$ g) $-4a^3b^4 - 6a^2b^2 + 2a^2b$ h) $\pi r^2 + \pi rh$

2. Factor completely.

- a) $y^2 - 1$ b) $m^2 - 16$ c) $4 - a^2$ d) $x^2y^2 - 9$ e) $25 - t^4$
 f) $x^6 - 49$ g) $81x^2 - 64y^2$ h) $100 - 4y^2$ i) $\pi R^2 - \pi r^2$ j) $x^5y - xy^5$

3. Factor completely.

- a) $x^2 - 3x + 2$ b) $y^2 + 6y + 5$ c) $x^2 - 5x - 6$ d) $-3t^2 - 21t - 36$
 e) $2x^2 - 22x + 36$ f) $x^2 + 11x - 42$ g) $x^2 + 15x + 54$ h) $y^3 - 21y^2 + 54y$
 i) $x^2 - 16xy + 64y^2$ j) $m^2 - 16mn - 80n^2$ k) $a^4 + 6a^2b^2 - 7b^4$ l) $x^4 - 18x^2 + 81$

4. Factor completely.

- a) $2x^2 + 7x + 3$ b) $2x^2 - 3x + 1$ c) $3t^2 - 11t - 20$ d) $-2y^2 + 7y - 5$
 e) $6x^2 - 23x - 18$ f) $12x^2 - 5x - 2$ g) $4x^2 + 17xy + 4y^2$ h) $9m^2 - 30mn + 25n^2$
 i) $4x^4 - 3x^2 - 1$ j) $-2x^3y + 3x^2y - xy$ k) $4x^4 - 13x^2 + 9$ l) $8y^4 - 31y^2 - 4$
 m) $15t^2 - 29t - 14$ n) $21x^2 - 29x + 10$ o) $22x^2 + 43x - 2$ p) $18a^2 - 21ab - 9b^2$

5. Factor completely.

- a) $x^2 - 13x + 22$ b) $-3x^2y^3 + 9xy^2$ c) $6a^2 + 11a - 7$ d) $10x^3 - 21x^2 + 8x$
 e) $25x^2 - 49y^2$ f) $4x^2 + 20xy + 25y^2$ g) $5t^2 - 30t + 45$ h) $4y^2 + 19y - 5$
 i) $100a^2b^4 - 36c^6$ j) $4x^6 - 28x^4 + 49x^2$ k) $-12x^2 - 16x + 60$ l) $48p^5q - 56p^3q^3 - 40pq^5$

6. Without using a calculator use difference of squares to evaluate each of the following.

- a) $51^2 - 49^2$ b) $27^2 - 23^2$ c) $121^2 - 111^2$ d) $10000^2 - 9999^2$

7. Factor only the leading rational numerical coefficient for each of the following.

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

1.2 Answers

1. a) $x(x+1)$ b) $-2(x-4)$ c) $xy(w-z)$ d) $-m^2(m^4+1)$ e) $3a(3a^2-4)$ f) $ab(5a+b)$ g) $-2a^2b(2ab^3+3b-1)$ h) $\pi r(r+h)$
 2. a) $(y-1)(y+1)$ b) $(m-4)(m+4)$ c) $(2-a)(2+a)$ d) $(xy-3)(xy+3)$ e) $(5-t^2)(5+t^2)$ f) $(x^3-7)(x^3+7)$ g) $(9x-8y)(9x+8y)$
 h) $4(5-y)(5+y)$ i) $\pi(R-r)(R+r)$ j) $xy(x-y)(x+y)(x^2+y^2)$
 3. a) $(x-2)(x-1)$ b) $(y+5)(y+1)$ c) $(x-6)(x+1)$ d) $-3(t+4)(t+3)$ e) $2(x-2)(x-9)$ f) $(x+14)(x-3)$ g) $(x+9)(x+6)$
 h) $y(y-3)(y-18)$ i) $(x-8y)^2$ j) $(m-20n)(m+4n)$ k) $(a-b)(a+b)(a^2+7b^2)$ l) $(x-3)^2(x+3)^2$
 4. a) $(2x+1)(x+3)$ b) $(2x-1)(x-1)$ c) $(3t+4)(t-5)$ d) $-(2y-5)(y-1)$ e) $(3x+2)(2x-9)$ f) $(3x-2)(4x+1)$ g) $(4x+y)(x+4y)$
 h) $(3m-5n)^2$ i) $(4x^2+1)(x-1)(x+1)$ j) $-xy(2x-1)(x-1)$ k) $(2x-3)(2x+3)(x-1)(x+1)$ l) $(8y^2+1)(y-2)(y+2)$
 m) $(5t+2)(3t-7)$ n) $(7x-5)(3x-2)$ o) $(22x-1)(x+2)$ p) $3(3a+b)(2a-3b)$
 5. a) $(x-11)(x-2)$ b) $-3xy^2(xy-3)$ c) $(3a+7)(2a-1)$ d) $x(5x-8)(2x-1)$ e) $(5x-7y)(5x+7y)$ f) $(2x+5y)^2$ g) $5(t-3)^2$
 h) $(4y-1)(y+5)$ i) $4(5ab^2-3c^3)(5ab^2+3c^3)$ j) $x^2(2x^2-7)^2$ k) $-4(3x-5)(x+3)$ l) $8pq(3p^2-5q^2)(2p^2+q^2)$
 6. a) 200 b) 200 c) 2320 d) 19999 7. a) $\frac{1}{4}(x-8)$ b) $-\frac{1}{3}(x+3)$ c) $-\frac{1}{2}(x^2-6x)$ d) $\frac{2}{3}(x^2+9x)$

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1.3 Factoring by Substitution and Grouping1. Factor completely using the method of *substitution*. Do not expand before factoring.

- a) $x(2x-1) + 2(2x-1)$ b) $(x+3)^2 - 3(x+3)$ c) $3y(2y+5) - 6(2y+5)$
 d) $3t(t^2-9) + (t^2-9)$ e) $15(3m)^2 - 14(3m) - 8$ f) $(6x-1)^2 + 7(6x-1) + 12$
 g) $6(a+b)^2 + 17(a+b) + 5$ h) $(x^2+3x)^2 - 2(x^2+3x) - 8$ i) $(2a^2+5a)^2 - 10(2a^2+5a) - 24$
 j) $(5x-2)^2 - 64$ k) $(5m+2)^2 - (3m-8)^2$ l) $9(3x+5y)^2 - 49(x-y)^2$

2. Factor completely by *grouping*.

- a) $x^3 - 4x^2 + 3x - 12$ b) $4x^3 + 8x^2 - x - 2$ c) $x^3 - x^2y - xy^2 + y^3$
 d) $90n^3 - 27n^2 + 10n - 3$ e) $2x^3 - 6x^2 + 10x - 30$ f) $x^2 - 8x + 16 - 4y^2$
 g) $9a^4 - 12a^2 + 4 - 49b^4$ h) $25 - m^2 - 12m - 36$ i) $16x^2 - y^2 + 14yz - 49z^2$
 j) $x^2y + x^2 - 4xy - 4x - 5y - 5$ k) $x^4 + 4x^2y^2 + 4y^4 - x^2 - 6xy - 9y^2$

1.3 Answers

1. a) $(2x-1)(x+2)$ b) $x(x+3)$ c) $3(2y+5)(y-2)$ d) $(t-3)(t+3)(3t+1)$ e) $(9m-4)(15m+2)$ f) $6(3x+1)(2x+1)$
 g) $(3a+3b+1)(2a+2b+5)$ h) $(x+4)(x-1)(x+1)(x+2)$ i) $(2a+1)(a+2)(2a-3)(a+4)$ j) $5(x-2)(5x+6)$ k) $4(4m-3)(m+5)$
 l) $16(x+11y)(2x+y)$
 2. a) $(x-4)(x^2+3)$ b) $(x+2)(2x-1)(2x+1)$ c) $(x-y)^2(x+y)$ d) $(10n-3)(9n^2+1)$ e) $2(x-3)(x^2+5)$ f) $(x-4-2y)(x-4+2y)$
 g) $(3a^2-2-7b^2)(3a^2-2+7b^2)$ h) $-(m+1)(m+11)$ i) $(4x-y+7z)(4x+y-7z)$ j) $(y+1)(x-5)(x+1)$
 k) $(x^2+2y^2-x-3y)(x^2+2y^2+x+3y)$

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1.4 Solving Quadratic Equations by Factoring**Recall:** Every quadratic equation of the form $ax^2 + bx + c = 0$ is of the 2nd degree and has 2 roots.1. Solve each of the following for x by factoring.

- a) $x^2 - x - 6 = 0$ b) $x^2 - 4y^2 = 0$ c) $-2x^2 + 12x = 0$
 d) $2x^2 + 5x - 3 = 0$ e) $9x^2 - 6x + 1 = 0$ f) $0 = 10x^2 + 16x + 6$
 g) $2x^2 + 11x + 15 = 0$ h) $12x^2 - 17x - 7 = 0$ i) $6x^2 - 13xy + 6y^2 = 0$
 j) $3x = 2x^2$ k) $16 - 9x^2 = 0$ l) $16 + 12x + 2x^2 = 0$
 m) $x^2 - 15y^2 = 2xy$ n) $20 - 6x^2 = 7x$ o) $0 = 6xy + 12x^2$

2. Solve.

- a) $t^2 - 10t = 2t - 36$ b) $8x - 24 = 3x - x^2$
 c) $3x^2 + 4 - 8x = 9x + 9x^2 - 10$ d) $2m(m+3) = 5(3+m)$
 e) $5x(x-2) = x^2 - 3(2x-1)$ f) $3y(y+2) = 2(y^2+8) + 6y$
 g) $3x(x-3) = x(x-2) + 15$ h) $2(a-14) - a(a-9) = 0$
 i) $(2x-1)(x-3) = (x+1)(x-2)$ j) $6a(a-2) - 3 = 2(a-2)(a+2) - 4$
 k) $(2p-1)^2 - (p-2)(p-1) = 3$ l) $2(x-3)(x-4) = 3x^2 + (3x-4)(x-6)$

1.4 Answers

1. a) $-2, 3$ b) $-2y, 2y$ c) $0, 6$ d) $-3, \frac{1}{2}$ e) $\frac{1}{3}, \frac{1}{3}$ f) $-1, -\frac{3}{5}$ g) $-3, -\frac{5}{2}$ h) $-\frac{1}{3}, \frac{7}{4}$ i) $\frac{2y}{3}, \frac{3y}{2}$ j) $0, \frac{3}{2}$ k) $-\frac{4}{3}, \frac{4}{3}$
 l) $-4, -2$ m) $-3y, 5y$ n) $-\frac{5}{2}, \frac{4}{3}$ o) $-\frac{y}{2}, 0$
 2. a) $6, 6$ b) $-8, 3$ c) $-\frac{7}{2}, \frac{2}{3}$ d) $-3, \frac{5}{2}$ e) $-\frac{1}{2}, \frac{3}{2}$ f) $-4, 4$ g) $-\frac{3}{2}, 5$ h) $4, 7$ i) $1, 5$ j) $\frac{3}{2}, \frac{3}{2}$ k) $-1, \frac{4}{3}$ l) $0, 2$

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Review Part I: 1.1 to 1.4**1. Simplify.**

- a) $-2y^2 - \sqrt{9x^4y^6} + \sqrt{16y^4} - \sqrt{25y^6x^4}$ b) $\sqrt{4(x-2y)^2} - \sqrt{(4x-3y)^2}$
 c) $3x(x-2) + 2x(3x+4) - 4x(2x-3)$ d) $2x[2-x(x-1)] + [3-x(x+20)]$
 e) $-3x^2(3x-1)^2$ f) $(4x^2+3y^2)(5y^2-2x^2)$
 g) $(x+6)^2 - (x+4)(x-7)$ h) $3(4y+1)^2 + 2(3y-4)(2y-3)$
 i) $2(3x-2y)(x+3y) - 2(2x-y)^2$ j) $(2t+1)(3t+2)(2t-1)$
 k) $(3z^2-2z+1)(2z^2+2z-3)$ l) $3(2x+3)^2 - (x-5)^2 - (3x-4)(x-5)$

2. Factor completely.

- a) $y^2 + 3y - 10$ b) $n^3 - 5n^2 - 36n$ c) $-x^2 + 11x - 30$ d) $x^2 + 12xy + 32y^2$
 e) $3x^2 - 2x - 8$ f) $6 - 11m + 4m^2$ g) $12n^2 + 4n - 8$ h) $16a^2 - 24ab + 9b^2$
 i) $4x^4y - 36x^3y - 80x^2y$ j) $-8m^8n^3 + 18m^2n^9$ k) $5x^4 - x^2y^2 - 4y^4$ l) $1 - 81t^4$

3. Factor completely using the most appropriate technique. Do not expand before factoring.

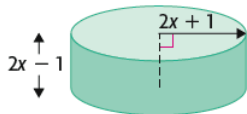
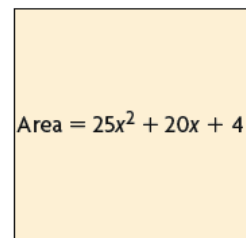
- a) $7x^2(x-1) - x(x-1) - 6(x-1)$ b) $2(t+3) - (t+3)^2$ c) $(a^2 - 13a)^2 - 900$
 d) $2(4x)^2 + 9(4x) + 4$ e) $25(2x+5y)^2 - 16(3x-2y)^2$ f) $4y^2 + 8xy + 3y + 6x$
 g) $x^3 - 2x^2 - x + 2$ h) $2x^4 - 4x^3 - 8x^2 + 16x$ i) $x^2 - 4x + 4 - 36y^2$
 j) $9x^2 - 25y^2 + 10y - 1$ k) $a^2 - 2a + 1 - b^2 - 2bc - c^2$ l) $(x-3)^4 - 16$

4. Solve the following quadratic equations for x by factoring.

- a) $28x^2 + 63x = 0$ b) $9x^2 - 25 = 0$ c) $x^2 - 4xy - 32y^2 = 0$
 d) $-2x^2 - 16x - 30 = 0$ e) $6x^2 = 3 + 7x$ f) $48 - 3x^2 = 0$
 g) $2x^2 + x + 15 = 7x^2 - 3$ h) $9x^2 + 18y^2 = 33xy$ i) $6x(x+3) + 5 = 2(x^2 - x - 10)$
 j) $(x+8)(x-5) + 48 = (2x+1)(2x-3) + 5$ k) $3(x-1)^2 - (x-4)(x+1) = 9$

5. Given the cylinder pictured below, write simplified expressions for its

- a) surface area, where $SA = 2\pi r^2 + 2\pi rh$
 b) volume, where $V = \pi r^2 h$

**6. Determine a simplified expression for the perimeter of the square pictured below.****Part I Review 1.1-1.4**

1. a) $2y^2 - 8x^2y^3$ b) $-2x - y$ c) $x^2 + 14x$ d) $-2x^3 + x^2 - 16x + 3$ e) $-27x^4 + 18x^3 - 3x^2$ f) $-8x^4 + 14x^2y^2 + 15y^4$ g) $15x + 64$
 h) $60y^2 - 10y + 27$ i) $-2x^2 + 22xy - 14y^2$ j) $12t^3 + 8t^2 - 3t - 2$ k) $6z^4 + 2z^3 - 11z^2 + 8z - 3$ l) $8x^2 + 65x - 18$
 2. a) $(y+5)(y-2)$ b) $n(n-9)(n+4)$ c) $-(x-5)(x-6)$ d) $(x+8y)(x+4y)$ e) $(3x+4)(x-2)$ f) $(4m-3)(m-2)$ g) $4(3n-2)(n+1)$
 h) $(4a-3b)^2$ i) $4x^2y(x^2-9x-20)$ j) $-2m^2n^3(2m^3-3n^3)(2m^3+3n^3)$ k) $(5x^2+4y^2)(x-y)(x+y)$ l) $(1-3t)(1+3t)(1+9t^2)$
 3. a) $(x-1)^2(7x+6)$ b) $-(t+3)(t+1)$ c) $(a-10)(a-3)(a+2)(a-15)$ d) $4(8x+1)(x+1)$ e) $-(2x-33y)(22x+17y)$
 f) $(y+2x)(4y+3)$ g) $(x-2)(x-1)(x+1)$ h) $2x(x+2)(x-2)^2$ i) $(x-2-6y)(x-2+6y)$ j) $(3x-5y+1)(3x+5y-1)$
 k) $(a-b-c-1)(a+b+c-1)$ l) $(x-5)(x-1)(x^2-6x+13)$
 4. a) $-\frac{9}{4}, 0$ b) $-\frac{5}{3}, \frac{5}{3}$ c) $-4y, 8y$ d) $-5, -3$ e) $-\frac{1}{3}, \frac{3}{2}$ f) $-4, 4$ g) $-\frac{9}{5}, 2$ h) $\frac{2y}{3}, 3y$ i) $-\frac{5}{2}, -\frac{5}{2}$ j) $-\frac{2}{3}, 3$ k) $-\frac{1}{2}, 2$
 5. a) $(16\pi x^2 + 8\pi x) \text{ units}^2$ b) $(8\pi x^3 + 4\pi x^2 - 2\pi x - \pi) \text{ units}^3$ 6. $(20x+8) \text{ units}$

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1.5 Simplifying Rational Expressions**1. Simplify and state any restrictions on the variables.***Remember to factor, restrict and reduce.*

$$\begin{array}{llll} \text{a) } \frac{-3m^2n^2}{6m^2n} & \text{b) } \frac{16abc^4}{4a^3b^2c} & \text{c) } \frac{-4x^4y^2z}{20x^3y^3z} & \text{d) } \frac{14x(2x-3y)}{21x^2(2x-3y)} \\ \text{e) } \frac{4y(3y-4)}{(3y-4)(3y+4)} & \text{f) } \frac{(x-1)(3x+5)}{(x-1)^2} & \text{g) } \frac{(2m+2)(m+2)}{m+1} & \text{h) } \frac{(5-2x)}{(2x-5)(x+3)} \end{array}$$

2. Simplify and state any restrictions on the variables.*Remember to factor, restrict and reduce.*

$$\begin{array}{llll} \text{a) } \frac{24x^3+18x^2+6x}{6x} & \text{b) } \frac{-6a^2+9a}{12a^2} & \text{c) } \frac{8x}{4x^2-12x} & \text{d) } \frac{3xy}{6x^2y-12xy^2} \\ \text{e) } \frac{10-5x}{3x-6} & \text{f) } \frac{8x^2+4x}{16x^3+8x^2} & \text{g) } \frac{6y-10x}{15x-9y} & \text{h) } \frac{-5xy+10x}{4y-2y^2} \end{array}$$

3. Simplify and state any restrictions on the variables.*Remember to factor, restrict and reduce.*

$$\begin{array}{llll} \text{a) } \frac{x^2-4}{x^2-5x+6} & \text{b) } \frac{a^2-a-20}{a^2+11a+28} & \text{c) } \frac{4-9m^2}{9m^2-3m-2} & \text{d) } \frac{m^2-10mn+25n^2}{m^2-25n^2} \\ \text{e) } \frac{3t^2-8t+4}{4t-6t^2} & \text{f) } \frac{6p^2+30p+36}{3p^2-3p-18} & \text{g) } \frac{5x^2y+3xy^2-2y^3}{3x^2y+3xy^2} & \text{h) } \frac{6x^2+6-13x}{8x^2-9-6x} \\ \text{i) } \frac{2-7z+3z^2}{9z^2-6z+1} & \text{j) } \frac{-18x^2+6x+40}{9x^2-9x-10} & \text{k) } \frac{x^3-4x}{x^3+4x^2-4x-16} & \text{l) } \frac{4x^4+3x^2-1}{2x^3-x^2+2x-1} \end{array}$$

1.5 Answers

$$\begin{array}{l} \text{1. a) } -\frac{n}{2}, m, n \neq 0 \quad \text{b) } \frac{4c^3}{a^2b}, a, b, c \neq 0 \quad \text{c) } -\frac{x}{5y}, x, y, z \neq 0 \quad \text{d) } \frac{2}{3x}, x \neq 0, \frac{3y}{2} \quad \text{e) } \frac{4y}{3y+4}, y \neq -\frac{4}{3}, \frac{4}{3} \quad \text{f) } \frac{3x+5}{x-1}, x \neq 1 \\ \text{g) } 2(m+2), m \neq -1 \quad \text{h) } -\frac{1}{x+3}, x \neq -3, \frac{5}{2} \\ \text{2. a) } 4x^2+3x+1, x \neq 0 \quad \text{b) } \frac{-(2a-3)}{4a} \text{ or } -\frac{2a-3}{4a} \text{ or } \frac{3-2a}{4a}, a \neq 0 \quad \text{c) } \frac{2}{x-3}, x \neq 0, 3 \quad \text{d) } \frac{1}{2(x-2y)}, x \neq 0, 2y, y \neq 0 \\ \text{e) } -\frac{5}{3}, x \neq 2 \quad \text{f) } \frac{1}{2x}, x \neq -\frac{1}{2}, 0 \quad \text{g) } -\frac{2}{3}, x \neq \frac{3y}{5} \quad \text{h) } \frac{5x}{2y}, y \neq 0, 2 \\ \text{3. a) } \frac{x+2}{x-3}, x \neq 2, 3 \quad \text{b) } \frac{a-5}{a+7}, a \neq -7, -4 \quad \text{c) } \frac{-(3m+2)}{3m+1} \text{ or } -\frac{3m+2}{3m+1} \text{ or } \frac{-3m-2}{3m+1}, m \neq -\frac{1}{3}, \frac{2}{3} \quad \text{d) } \frac{m-5n}{m+5n}, m \neq -5n, 5n \\ \text{e) } \frac{-(t-2)}{2t} \text{ or } -\frac{t-2}{2t} \text{ or } \frac{2-t}{2t}, t \neq 0, \frac{2}{3} \quad \text{f) } \frac{2(p+3)}{p-3}, p \neq -2, 3 \quad \text{g) } \frac{5x-2y}{3x}, x \neq -y, 0, y \neq 0 \quad \text{h) } \frac{3x-2}{4x+3}, x \neq -\frac{3}{4}, \frac{3}{2} \\ \text{i) } \frac{z-2}{3z-1}, z \neq \frac{1}{3} \quad \text{j) } \frac{-2(3x+4)}{3x+2}, x \neq -\frac{2}{3}, \frac{5}{3} \quad \text{k) } \frac{x}{x+4}, x \neq -4, -2, 2 \quad \text{l) } 2x+1, x \neq \frac{1}{2} \end{array}$$

Date: _____

1.6 Multiplying and Dividing Rational Expressions

1. Simplify and state any restrictions on the variables.

a) $\frac{3x}{8} \times \frac{2y}{9}$

b) $\frac{6}{a} \times \frac{5a^2}{3b}$

c) $\frac{8a}{9} \div \frac{2b}{3}$

d) $\frac{3m^2}{n} \div 6m^3 \div \frac{2m}{n}$

e) $\frac{9x^2y}{4y} \cdot \frac{12xy}{3x^2y}$

f) $\frac{14pq}{5q^2} \div \frac{21pq^2}{10q^2}$

g) $\frac{-56a^2b^2}{24a^3b} \div \frac{16ab^3}{18b}$

h) $\frac{36pqr^2}{-26p^3qr} \cdot \frac{-39pr}{24pq^2r}$

i) $\frac{3x}{x-2} \cdot \frac{4(x-2)}{6x}$

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

k) $\frac{10x}{x+2} \div \frac{5}{2(x+2)}$

l) $\frac{3s+1}{2s-1} \div \frac{3s(s+1)}{2s-1}$

2. Simplify and state any restrictions on the variables. *Remember to factor, restrict and reduce.*

a) $\frac{4x+4}{3x-3} \times \frac{6x-6}{5x+5}$

b) $\frac{6m^4}{m+3} \times \frac{5m+15}{8m^3}$

c) $\frac{x^2-4}{x+3} \div \frac{6x-12}{3x+9}$

d) $\frac{25-m^2}{2m^2-32} \div \frac{2m-10}{4m+16}$

e) $\frac{a^2+7a+12}{a^2+4a+4} \cdot \frac{a^2-a-6}{a^2-9}$

f) $\frac{21p-3p^2}{16p^2+4p^3} \div \frac{14-9p+p^2}{12+7p+p^2}$

g) $\frac{x^2-y^2}{4} \div (x-y)$

h) $\frac{2x^2-5x-3}{2x^2-11x+15} \cdot \frac{4x^2-8x-5}{4x^2+4x+1}$

i) $(4x^2-9y^2) \div \frac{3xy+2x^2}{2}$

3. Simplify and state any restrictions on the variables.

a) $\frac{x+7}{x^2-5x-36} \div \frac{x^2-2x-63}{x^2+4x} \times \frac{x^2-15x+54}{x^3-36x}$

b) $\frac{x^2-9y^2}{6x^2+5xy-4y^2} \cdot \frac{10x-5y}{x^2+2xy-3y^2} \cdot \frac{6x^2+2xy-8y^2}{20x-10y}$

4. Simplify and state any restrictions on the variables.

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

b) $\frac{m^2+2m+1}{\frac{m+1}{m}}$

c) $\frac{4-x}{\frac{x}{x^2-16}}$

1.6 Answers

1. a) $\frac{xy}{12}$ b) $\frac{10a}{b}, a, b \neq 0$ c) $\frac{4a}{3b}, b \neq 0$ d) $\frac{1}{4m^2}, m, n \neq 0$ e) $9x, x, y \neq 0$ f) $\frac{4}{3q}, p, q \neq 0$ g) $\frac{-21}{8a^2b}, a, b \neq 0$ h) $\frac{9r}{4p^2q^2}, p, q, r \neq 0$

i) $2, x \neq 0, 2$ j) $\frac{5}{4y(y-5)}, y \neq -3, 0, 5$ k) $4x, x \neq -2$ l) $\frac{3s+1}{3s(s+1)}, s \neq -1, 0, \frac{1}{2}$

2. a) $\frac{8}{5}, x \neq -1, 1$ b) $\frac{15m}{4}, m \neq -3, 0$ c) $\frac{x+2}{2}, x \neq -3, 2$ d) $\frac{-(m+5)}{m-4}$ or $-\frac{m+5}{m-4}$ or $\frac{-m-5}{m-4}, m \neq -4, 4, 5$ e) $\frac{a+4}{a+2}, a \neq -3, -2, 3$

f) $\frac{3(3+p)}{4p(2-p)}$ or $\frac{-3(p+3)}{4p(p-2)}, p \neq -4, -3, 0, 2, 7$ g) $\frac{x+y}{4}, x \neq y$ h) $1, x \neq -\frac{1}{2}, \frac{5}{2}, 3$ i) $\frac{2(2x-3y)}{x}, x \neq -\frac{3y}{2}, 0$

3. a) $\frac{1}{(x-9)(x+6)}, x \neq -7, -6, -4, 0, 6, 9$ b) $\frac{x-3y}{2x-y}, x \neq -3y, -\frac{4y}{3}, \frac{y}{2}, y$

4. a) $\frac{2(x-2)}{x}, x \neq -2, 0$ b) $m(m+1), m \neq -1, 0$ c) $\frac{-1}{x(x+4)}, x \neq -4, 0, 4$

Date: _____

1.7 Adding and Subtracting Rational Expressions

1. Simplify and state any restrictions on the variables.

a) $\frac{7}{5x} - \frac{2}{3x} - \frac{9}{10x}$

b) $\frac{y-5}{6} - \frac{2y-3}{4} + 1$

c) $\frac{4t-1}{6} + \frac{3t+2}{2} - \frac{2t+1}{3}$

d) $\frac{a}{bc} + \frac{b}{ac}$

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

f) $\frac{3a+b^2}{4b^2} - \frac{7}{5ab} - 1$

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

h) $\frac{5x}{(x+4)^2} - \frac{1}{2(x+4)} - \frac{1}{2}$

i) $\frac{2}{x+3} + \frac{3}{x+1}$

j) $\frac{t}{2t+3} - \frac{t+3}{2t-3}$

k) $\frac{1}{x-y} - \frac{1}{y-x}$

l) $\frac{5x-5}{x^2-9} + \frac{4x-2}{9-x^2}$

2. Simplify and state any restrictions on the variables.

a) $\frac{a^2}{a-2b} + \frac{4b^2}{2b-a}$

b) $\frac{x^2-5x+6}{2x^2-11x+15} - \frac{6x^2+7x-20}{4x^2-25}$

c) $\frac{2}{2m+2} + \frac{5}{3m+3}$

d) $\frac{4}{2x^2+3x+1} + \frac{2}{2x+1}$

e) $\frac{6}{2n-1} - \frac{3}{6n^2-5n+1}$

f) $\frac{7a}{a^2-a-12} - \frac{4a}{a^2+2a-3}$

g) $\frac{3x-4}{x^2+5x+4} + \frac{2x-3}{x^2+2x-8}$

h) $\frac{2y-1}{4y^2-25} - \frac{2y+5}{4y^2-8y-5}$

i) $\frac{2x-1}{x^2-6x+9} + \frac{2x}{3x-x^2}$

j) $\frac{3x-y}{x-4y} - \frac{x^2+4xy-12y^2}{x^2-6xy+8y^2}$

k) $\frac{3t+1}{6t^2-7t-3} - \frac{2t-1}{2t^2+9t-5} - \frac{5}{2t^2+7t-15}$

3. Simplify and state any restrictions on the variables.

a) $\frac{x-1}{x+3} \div \frac{x^2-3x+2}{x^2+5x+6} - \frac{6}{x+3}$

b) $\left(\frac{3x-2}{2x^2-5x-3} - \frac{x+2}{x^2-9} \right) \div \frac{2x-3}{2x^2+7x+3}$

4. Simplify and state any restrictions on the variables.

a) $\frac{1}{x} \left(\frac{1}{2+x} - \frac{1}{2} \right)$

b) $\frac{1}{\frac{1}{3} + \frac{1}{x}}$

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

1.7 Answers

1. a) $-\frac{1}{6x}, x \neq 0$ b) $\frac{-4y+11}{12}$ c) $\frac{3t+1}{2}$ d) $\frac{a^2+b^2}{abc}, a, b, c \neq 0$ e) $\frac{-30x^2-10x+1}{15x^2}, x \neq 0$ f) $\frac{15a^2-15ab^2-28b}{20ab^2}, a, b \neq 0$

g) $\frac{9x}{(3x-1)^2}, x \neq \frac{1}{3}$ h) $\frac{-x^2+x-20}{2(x+4)^2}, x \neq -4$ i) $\frac{5x+11}{(x+3)(x+1)}, x \neq -3, -1$ j) $\frac{-12t-9}{(2t-3)(2t+3)}, t \neq -\frac{3}{2}, \frac{3}{2}$ k) $\frac{2}{x-y}, x \neq y$ l) $\frac{1}{x+3}, x \neq -3, 3$

2. a) $a+2b, a \neq 2b$ b) $\frac{-2x+2}{2x-5}, x \neq -\frac{5}{2}, \frac{5}{2}, 3$ c) $\frac{8}{3(m+1)}, m \neq -1$ d) $\frac{2x+6}{(2x+1)(x+1)}, x \neq -1, -\frac{1}{2}$ e) $\frac{9}{3n-1}, n \neq \frac{1}{3}, \frac{1}{2}$

f) $\frac{3a}{(a-4)(a-1)}, a \neq -3, 1, 4$ g) $\frac{5x^2-11x+5}{(x+4)(x+1)(x-2)}, x \neq -4, -1, 2$ h) $\frac{-20y-26}{(2y-5)(2y+5)(2y+1)}, y \neq -\frac{5}{2}, -\frac{1}{2}, \frac{5}{2}$ i) $\frac{5}{(x-3)^2}, x \neq 0, 3$

j) $\frac{2x-7y}{x-4y}, x \neq 2y, 4y$ k) $\frac{-t+3}{(2t-3)(t+5)}, t \neq -5, -\frac{1}{3}, \frac{1}{2}, \frac{3}{2}$

3. a) $\frac{x^2-x+18}{(x-2)(x+3)}, x \neq -3, -2, 1, 2$ b) $\frac{x^2+2x-8}{(x-3)(2x-3)}, x \neq -3, -\frac{1}{2}, \frac{3}{2}, 3$

4. a) $\frac{-1}{2(2+x)}, x \neq -2, 0$ b) $\frac{3x}{x+3}, x \neq -3, 0$ c) $\frac{-x^2-1}{2x}, x \neq -1, 0, 1$

Date: _____

1.8 Working With Radicals, I

1. Simplify.

a) $\sqrt{12}$

b) $\sqrt{45}$

c) $\sqrt{24}$

d) $\sqrt{200}$

e) $\sqrt{44}$

f) $\sqrt{18}$

g) $\sqrt{128}$

h) $-\sqrt{125}$

i) $4\sqrt{8}$

j) $-2\sqrt{60}$

k) $-\frac{1}{2}\sqrt{36}$

l) $\frac{2}{3}\sqrt{90}$

2. Simplify.

a) $\frac{\sqrt{14}}{\sqrt{7}}$

b) $\frac{\sqrt{60}}{\sqrt{3}}$

c) $\frac{\sqrt{96}}{\sqrt{3}}$

d) $\frac{3\sqrt{24}}{\sqrt{2}}$

e) $\frac{27\sqrt{35}}{3\sqrt{5}}$

f) $\frac{-12\sqrt{75}}{4\sqrt{3}}$

g) $\frac{4\sqrt{2}}{\sqrt{8}}$

h) $\frac{3\sqrt{20}}{6\sqrt{9}}$

3. Simplify.

a) $\sqrt{2} \times \sqrt{10}$

b) $\sqrt{15} \times \sqrt{5}$

c) $-4\sqrt{3} \times \sqrt{7}$

d) $-2\sqrt{2}(-3\sqrt{6})$

e) $3\sqrt{3}(4\sqrt{15})$

f) $\frac{1}{2}\sqrt{6} \times \frac{2}{3}\sqrt{3} \times \sqrt{2}$

g) $(3\sqrt{5})^2$

h) $-(2\sqrt{7})^2 \times \frac{1}{8}\sqrt{1}$

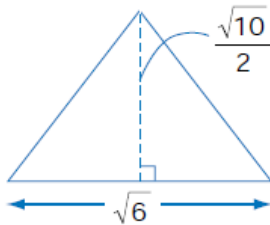
4. Simplify.

a) $\frac{7-21\sqrt{7}}{14}$

b) $\frac{6+\sqrt{8}}{2}$

c) $\frac{-4+3\sqrt{48}}{-4}$

5. Express the exact area of the triangle in simplest radical form.

6. A square has an area of 675 cm^2 . Express the side length in simplest radical form.

7. Solve. Express each answer in simplest radical form.

a) $\sqrt{5} \cdot x = \sqrt{40}$

b) $5x + \sqrt{50} = 0$

c) $\frac{x}{\sqrt{3}} = 2\sqrt{6}$

8. If $\sqrt{4^2 + 4^2 + \dots + 4^2} = 16$, how many 4^2 's are under the radical?**1.8 Answers**

1. a) $2\sqrt{3}$ b) $3\sqrt{5}$ c) $2\sqrt{6}$ d) $10\sqrt{2}$ e) $2\sqrt{11}$ f) $3\sqrt{2}$ g) $8\sqrt{2}$ h) $-5\sqrt{5}$ i) $8\sqrt{2}$ j) $-4\sqrt{15}$ k) -3 l) $2\sqrt{10}$

2. a) $\sqrt{2}$ b) $2\sqrt{5}$ c) $4\sqrt{2}$ d) $6\sqrt{3}$ e) $9\sqrt{7}$ f) -15 g) 2 h) $\frac{\sqrt{5}}{3}$

3. a) $2\sqrt{5}$ b) $5\sqrt{3}$ c) $-4\sqrt{21}$ d) $12\sqrt{3}$ e) $36\sqrt{5}$ f) 2 g) 45 h) $-\frac{7}{2}$ 4. a) $\frac{1-3\sqrt{7}}{2}$ b) $3+\sqrt{2}$ c) $1-3\sqrt{3}$

5. $\frac{\sqrt{15}}{2} \text{ units}^2$ 6. $15\sqrt{3} \text{ cm}$ 7. a) $2\sqrt{2}$ b) $-\sqrt{2}$ c) $6\sqrt{2}$ 8. 16

Date: _____

1.9 Working With Radicals, II**1. Simplify.**

a) $8\sqrt{10} - 2\sqrt{10} - 7\sqrt{10}$

b) $\sqrt{2} - 3\sqrt{2} - 9\sqrt{2} + 11\sqrt{2}$

c) $\sqrt{5} + \sqrt{5} + \sqrt{5} + \sqrt{5}$

d) $9\sqrt{3} - \sqrt{3} + 6\sqrt{6} - 3\sqrt{6} - 2\sqrt{3}$

e) $12\sqrt{7} + 9 - 3\sqrt{7} + 4$

f) $8 + 7\sqrt{11} - 9 - 9\sqrt{11}$

g) $\sqrt{75} + \sqrt{48} + \sqrt{27}$

h) $\sqrt{18} - \sqrt{8} - \sqrt{72}$

i) $\sqrt{28} - 2\sqrt{27} + 3\sqrt{63} + \sqrt{300}$

j) $\sqrt{5} + 2\sqrt{45} - 3\sqrt{20}$

k) $-\sqrt{49} - 6\sqrt{7} + 2\sqrt{28} - 2\sqrt{9}$

l) $3\sqrt{48} - 4\sqrt{8} + 4\sqrt{27} - 2\sqrt{72}$

m) $(2\sqrt{6})^2 - \sqrt{6} - 3\sqrt{24} - \sqrt{144}$

n) $\frac{2}{5}\sqrt{125} - \frac{2}{3}\sqrt{243} - \frac{1}{3}\sqrt{45} + \frac{1}{2}\sqrt{48}$

2. Expand and simplify.

a) $\sqrt{3}(\sqrt{6} - 1)$

b) $2\sqrt{2}(3\sqrt{6} - \sqrt{3})$

c) $3\sqrt{5}(2\sqrt{15} + \sqrt{10})$

d) $(2\sqrt{3} - 1)(3\sqrt{3} + 2)$

e) $(\sqrt{5} + \sqrt{6})(\sqrt{5} - 3\sqrt{6})$

f) $(3\sqrt{3} + 1)^2$

g) $(2 - \sqrt{5})(2 + \sqrt{5})$

h) $(3\sqrt{10} - 5\sqrt{2})^2$

i) $(2\sqrt{7} + 3\sqrt{5})(2\sqrt{7} - 3\sqrt{5})$

3. Simplify by rationalizing the denominator.

a) $\frac{2}{\sqrt{7}}$

b) $\frac{3\sqrt{5}}{2\sqrt{3}}$

c) $\frac{4\sqrt{7}}{2\sqrt{14}}$

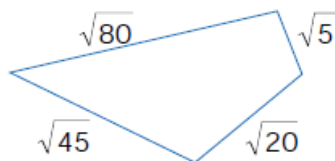
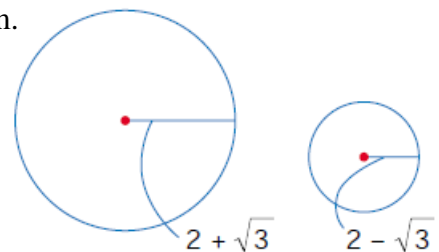
d) $\frac{2\sqrt{5}}{5\sqrt{2}}$

e) $\frac{3}{\sqrt{5} - \sqrt{2}}$

f) $\frac{\sqrt{6} - 3}{\sqrt{6} + 3}$

g) $\frac{3\sqrt{3}}{2\sqrt{6} - 3\sqrt{2}}$

h) $\frac{2\sqrt{7} + \sqrt{5}}{3\sqrt{7} + 2\sqrt{5}}$

4. Express the perimeter of the quadrilateral in simplest radical form.**5. Express the ratio of the area of the larger circle to the area of the smaller circle in simplest radical form.****6. If $\sqrt{128} = \sqrt{2} + \sqrt{x}$, what is the value of x ?****1.9 Answers**

1. a) $-\sqrt{10}$ b) 0 c) $4\sqrt{5}$ d) $6\sqrt{3} + 3\sqrt{6}$ e) $9\sqrt{7} + 13$ f) $-1 - 2\sqrt{11}$ g) $12\sqrt{3}$ h) $-5\sqrt{2}$ i) $11\sqrt{7} + 4\sqrt{3}$ j) $\sqrt{5}$ k) $-13 - 2\sqrt{7}$

l) $24\sqrt{3} - 20\sqrt{2}$ m) $12 - 7\sqrt{6}$ n) $\sqrt{5} - 4\sqrt{3}$

2. a) $3\sqrt{2} - \sqrt{3}$ b) $12\sqrt{3} - 2\sqrt{6}$ c) $30\sqrt{3} + 15\sqrt{2}$ d) $16 + \sqrt{3}$ e) $-13 - 2\sqrt{30}$ f) $28 + 6\sqrt{3}$ g) -1 h) $140 - 60\sqrt{5}$ i) -17

3. a) $\frac{2\sqrt{7}}{7}$ b) $\frac{\sqrt{15}}{2}$ c) $\sqrt{2}$ d) $\frac{\sqrt{10}}{5}$ e) $\sqrt{5} + \sqrt{2}$ f) $-5 + 2\sqrt{6}$ g) $\frac{6\sqrt{2} + 3\sqrt{6}}{2}$ h) $\frac{32 - \sqrt{35}}{43}$

4. $10\sqrt{5}$ units 5. $97 + 56\sqrt{3}$ 6. 98

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1.10 Working With Complex Numbers

Recall: A complex number is of the form $a + bi$, where a and b are real numbers and i , the imaginary unit is equal to $\sqrt{-1}$, ie. $i = \sqrt{-1}$ and $i^2 = -1$.

1. Simplify.

a) $\sqrt{-9}$

b) $\sqrt{-13}$

c) $-\sqrt{-81}$

d) $\sqrt{-12}$

e) $-\sqrt{-54}$

f) $4 + \sqrt{-20}$

g) $-8 + \sqrt{-16}$

h) $-10 - \sqrt{-75}$

i) $\frac{4 - \sqrt{-4}}{4}$

j) $\frac{-12 + \sqrt{-27}}{3}$

k) $\frac{-8 + \sqrt{-32}}{-4}$

l) $\frac{-5 - \sqrt{-150}}{10}$

2. Simplify.

a) $(-8 + i) + (-3 - 4i)$

b) $(3i + 11) - (13 - 6i)$

c) $2(1 - 7i) + 3(4 - i)$

d) $(-3i)^2$

e) $-\frac{1}{2}i(-3i)(6i)$

f) $(2i\sqrt{5})^2$

g) $-4i(3 - 7i)$

h) $2i(3i^2 - 4i + 2)$

i) $(3i - 1)(4i - 5)$

j) $(3 - 4i)(3 + 4i)$

k) $(5i - 2)^2$

l) $(3 - 2i)^2 - (4 + 3i)^2$

m) $(\sqrt{6} + 2i\sqrt{3})^2$

n) $(-4 - 3i\sqrt{2})(-4 + 3i\sqrt{2})$

o) $(3 + i)(2 + i)(-1 + i)$

3. Simplify.

a) $-\frac{4}{3i}$

b) $\frac{2 - 2i}{i}$

c) $\frac{5 + 2i}{2i}$

d) $\frac{i}{4 + 3i}$

e) $\frac{5}{1 + 2i}$

f) $\frac{2 - 2i}{3 + i}$

g) $\frac{2 + 3i}{2 - 3i}$

h) $\frac{-4 - 3i}{-2 + 2i}$

4. Expand and simplify each of the following expressions to the form $ax^2 + bx + c$.

a) $(2x - 3 - 2i)(2x - 3 + 2i)$ b) $(x + 1 + 3i\sqrt{5})(x + 1 - 3i\sqrt{5})$ c) $(2x - 3)^2 - (2i)^2$ d) $(x + 1)^2 - (3i\sqrt{5})^2$

1.10 Answers

1. a) $3i$ b) $i\sqrt{13}$ c) $-9i$ d) $2i\sqrt{3}$ e) $-3i\sqrt{6}$ f) $4 + 2i\sqrt{5}$ g) $-8 + 4i$ h) $-10 - 5i\sqrt{3}$ i) $\frac{2-i}{2}$ j) $-4 + i\sqrt{3}$

k) $2 - i\sqrt{2}$ l) $\frac{-1 - i\sqrt{6}}{2}$

2. a) $-11 - 3i$ b) $-2 + 9i$ c) $14 - 17i$ d) -9 e) $-9i$ f) -20 g) $-28 - 12i$ h) $8 - 2i$ i) $-7 - 19i$ j) 25 k) $-21 - 20i$

l) $-2 - 36i$ m) $-6 + 12i\sqrt{2}$ n) 34 o) -10

3. a) $\frac{4i}{3}$ b) $-2 - 2i$ c) $\frac{2 - 5i}{2}$ d) $\frac{3 + 4i}{25}$ e) $1 - 2i$ f) $\frac{2 - 4i}{5}$ g) $\frac{-5 + 12i}{13}$ h) $\frac{1 + 7i}{4}$

4. a) $4x^2 - 12x + 13$ b) $x^2 + 2x + 46$ c) $4x^2 - 12x + 13$ d) $x^2 + 2x + 46$

Date: _____

Review Part II: 1.5 to 1.10**A: Working With Rational Expressions**

1. Simplify and state any restrictions on the variables.

a) $\frac{3x^5y^2z^3}{-15x^7y^2z}$

b) $\frac{-3w}{-3w^2+12w}$

c) $\frac{8y^2-10xy}{4xy}$

d) $\frac{6x-10y}{5y-3x}$

e) $\frac{6n^2-7n-3}{12n^2+7n+1}$

f) $\frac{-4a^2+14a+30}{2a-10}$

g) $\frac{4x^3+x^2-16x-4}{x^4-3x^2-4}$

h) $\frac{-15ab^2}{75a^2b} \times \frac{50a^3b}{ab^4}$

i) $\frac{4m^2+12m}{2m^2-10m+8} \times \frac{m^2-7m+12}{m^3-9m}$

j) $\frac{x^2-x-6}{2x^2+3x-2} \div \frac{2x^2-5x-3}{2x^2-5x+2}$

k) $\frac{2}{3m} + \frac{4}{9m^2} - \frac{5}{6m}$

l) $\frac{x^2+5}{x^2-4} + \frac{x^2-2}{4-x^2}$

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

n) $\frac{1}{2x-6} - \frac{x}{x^2-9}$

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

p) $\frac{3}{x^2-xy} - \frac{4}{y^2-xy}$

q) $\frac{2}{t^2+3t+2} - \frac{1}{t^2+t-2}$

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

2. Simplify and state any restrictions on the variables.

a) $\frac{7a^3c}{63a^2b} \div \frac{21ab^2c^2}{27a^2b^2c^3} \times 7ab$

b) $\frac{x^2-y^2}{y^2-4x^2} \times \frac{4x^2+8xy+3y^2}{x+y} \div \frac{2x+3y}{2x-y}$

c) $\frac{a^2-25}{a^2-6a} \div \frac{a^2+2a-15}{a^2-12a+36} \div \frac{a^2-11a+30}{a^2+4a-21}$

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

e) $\frac{a-2}{6a^2-7a-5} \div \frac{2a}{3a^2-5a} - \frac{3a+2}{2a^2+11a+5}$

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

3. Consider a cylinder of height h , and radius, r .

a) Determine the simplified ratio of the volume of the cylinder to its surface area.

b) What restrictions are there on r and h ?**Part II-A Review 1.5-1.7**

1. a) $-\frac{z^2}{5x^2}, x, y, z \neq 0$ b) $\frac{1}{w-4}, w \neq 0, 4$ c) $\frac{4y-5x}{2x}, x, y \neq 0$ d) $-2, x \neq \frac{5y}{3}$ e) $\frac{2n-3}{4n+1}, n \neq -\frac{1}{3}, -\frac{1}{4}$ f) $-2a-3, a \neq 5$

g) $\frac{4x+1}{x^2+1}, x \neq -2, 2$ h) $\frac{-10a}{b^2}, a, b \neq 0$ i) $\frac{2}{m-1}, m \neq -3, 0, 1, 3, 4$ j) $\frac{x-2}{2x+1}, x \neq -2, -\frac{1}{2}, \frac{1}{2}, 2, 3$ k) $\frac{-3m+8}{18m^2}, m \neq 0$

l) $\frac{3}{x^2-4}, x \neq -2, 2$ m) $\frac{11x+8}{(2x+1)(3x+2)}, x \neq -\frac{2}{3}, -\frac{1}{2}$ n) $\frac{-1}{2(x+3)}, x \neq -3, 3$ o) $\frac{a^2-a-2}{2(a-1)^2}, a \neq 1$ p) $\frac{4x+3y}{xy(x-y)}, x \neq 0, y; y \neq 0$

q) $\frac{t-3}{(t+2)(t+1)(t-1)}, t \neq -2, -1, 1$ r) $\frac{3(x-1)}{(3x+1)(x-2)}, x \neq -1, -\frac{1}{3}, 2$

2. a) $a^3c^2, a, b, c \neq 0$ b) $-x+y, x \neq -y, -\frac{3y}{2}, -\frac{y}{2}, \frac{y}{2}$ c) $\frac{a+7}{a}, a \neq -7, -5, 0, 3, 5, 6$ d) $\frac{3}{(x+1)(x-2)}, x \neq -3, -1, 2$

e) $\frac{a^2-3a-14}{2(2a+1)(a+5)}, a \neq -5, -\frac{1}{2}, 0, \frac{5}{3}$ f) $\frac{1}{(x+3)(3x+5)}, x \neq -3, -\frac{5}{3}, 1$

3. a) $\frac{rh}{2(r+h)}$ b) $r > 0, h > 0$

B: Working With Radicals and Complex Numbers

1. Simplify.

a) $\sqrt{18}$ b) $-\sqrt{32}$ c) $\frac{2}{5}\sqrt{150}$ d) $\frac{\sqrt{120}}{\sqrt{10}}$
e) $\frac{\sqrt{2}}{\sqrt{200}}$ f) $\frac{6\sqrt{30}}{2\sqrt{5}}$ g) $-\sqrt{10} \times \sqrt{6}$ h) $-3\sqrt{5}(-2\sqrt{10})$
i) $(3\sqrt{7})^2$ j) $\frac{6+9\sqrt{3}}{12}$ k) $\frac{-4-\sqrt{20}}{2}$ l) $\frac{8-\sqrt{8}}{8}$

2. Simplify.

a) $\sqrt{-49}$ b) $-\sqrt{-7}$ c) $\sqrt{-80}$ d) $2\sqrt{-48}$
e) $5i \times 6i$ f) $9i(-4i)$ g) $(-4i)^2$ h) $(2i\sqrt{5})^2$
i) $5-\sqrt{-36}$ j) $\frac{3-\sqrt{-3}}{3}$ k) $\frac{-12-\sqrt{-40}}{2}$ l) $\frac{18+\sqrt{-27}}{6}$

3. Simplify.

a) $7\sqrt{3}-2\sqrt{6}+\sqrt{6}-3\sqrt{3}$ b) $\frac{1}{3}\sqrt{45}-\frac{3}{2}\sqrt{80}$ c) $\sqrt{48}-\sqrt{27}+2\sqrt{12}$
d) $5\sqrt{18}-\sqrt{40}-2\sqrt{128}+\sqrt{90}-2\sqrt{3}$ e) $-\sqrt{3}(\sqrt{2}+5)$ f) $2\sqrt{2}(\sqrt{10}-2\sqrt{2})$
g) $(4\sqrt{2}+\sqrt{5})(\sqrt{2}-3\sqrt{5})$ h) $(2\sqrt{3}+\sqrt{6})^2$ i) $(3\sqrt{6}+5\sqrt{2})(3\sqrt{6}-5\sqrt{2})$
j) $\frac{6\sqrt{2}}{\sqrt{3}}$ k) $-\frac{\sqrt{3}}{4\sqrt{10}}$ l) $\frac{3\sqrt{3}}{\sqrt{2}-\sqrt{5}}$ m) $\frac{2\sqrt{7}-\sqrt{3}}{3\sqrt{7}+2\sqrt{3}}$

4. Simplify.

a) $(7+3i)+(5-6i)$ b) $(9-2i)-(11+4i)$ c) $(-3+5i)(5+2i)$ d) $(2-3i)^2$
e) $\frac{-2}{i}$ f) $\frac{5-2i}{3i}$ g) $\frac{4}{-3+2i}$ h) $\frac{1+2i}{1-4i}$

5. a) A rectangular prism has a length of $(5\sqrt{2}+2\sqrt{3})$ units, a width of $(\sqrt{15}-\sqrt{2})$ units and height of $(5\sqrt{2}-2\sqrt{3})$ units. Express the volume of this prism in simplest radical form.

b) If $a > 0$ and $b > 0$, determine how much larger is $(\sqrt{a}+\sqrt{b})^2$ than $\sqrt{a^2}+\sqrt{b^2}$.

c) Without using a calculator, arrange the following expressions in order from least to greatest.

$\sqrt{3}(\sqrt{3}+1)$, $(\sqrt{3}+1)(\sqrt{3}-1)$, $(1-\sqrt{3})^2$, $(\sqrt{3}+1)^2$

6. Expand and simplify the following expressions to the form ax^2+bx+c .

a) $(2x-1-2i\sqrt{3})(2x-1+2i\sqrt{3})$ b) $(2x-1)^2-(2i\sqrt{3})^2$

Part II-A Review 1.8-1.10

1. a) $3\sqrt{2}$ b) $-4\sqrt{2}$ c) $2\sqrt{6}$ d) $2\sqrt{3}$ e) $\frac{1}{10}$ f) $3\sqrt{6}$ g) $-2\sqrt{15}$ h) $30\sqrt{2}$ i) 63 j) $\frac{2+3\sqrt{3}}{4}$ k) $-2-\sqrt{5}$ l) $\frac{4-\sqrt{2}}{4}$
2. a) $7i$ b) $-i\sqrt{7}$ c) $4i\sqrt{5}$ d) $8i\sqrt{3}$ e) -30 f) 36 g) -16 h) -20 i) $5-6i$ j) $\frac{3-i\sqrt{3}}{3}$ k) $-6-i\sqrt{10}$ l) $\frac{6+i\sqrt{3}}{2}$
3. a) $4\sqrt{3}-\sqrt{6}$ b) $-5\sqrt{5}$ c) $5\sqrt{3}$ d) $-\sqrt{2}+\sqrt{10}-2\sqrt{3}$ e) $-\sqrt{6}-5\sqrt{3}$ f) $4\sqrt{5}-8$ g) $-7-11\sqrt{10}$ h) $18+12\sqrt{2}$ i) 4
j) $2\sqrt{6}$ k) $-\frac{\sqrt{30}}{40}$ l) $-\sqrt{6}-\sqrt{15}$ m) $\frac{48-7\sqrt{21}}{51}$ 4. a) $12-3i$ b) $-2-6i$ c) $-25+19i$ d) $-5-12i$ e) $2i$
f) $\frac{-2-5i}{3}$ g) $\frac{-12-8i}{13}$ h) $\frac{-7+6i}{17}$ 5. a) $(38\sqrt{15}-38\sqrt{2})$ units³ b) $2\sqrt{ab}$ c) $(1-\sqrt{3})^2$, $(\sqrt{3}+1)(\sqrt{3}-1)$, $\sqrt{3}(\sqrt{3}+1)$, $(\sqrt{3}+1)^2$ or $4-2\sqrt{3}$, 2 , $3+\sqrt{3}$, $4+2\sqrt{3}$ 6. a) $4x^2-4x+13$ b) $4x^2-4x+13$