Simplify the following.

1. $(3x + 1) - (2x - 5)$

2. $x^2 + 3x - 1 + 4x + 9$

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

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

5. $(x + 3)^2$

6. $(2x - 1)(2x + 1)$

7. $(x - 5)^2$

8. $(x - 3)^2 - 2(x - 3)$

9. $(x + 1)^2 - 4(x + 1) - 5$

Given the following functions $f(x) = x^2 - 4$, $g(x) = 3x - 1$ and $r(x) = 2x - 5$. Calculate the following.

a. $f(-3)$

b. $g(1)$

c. $r(-2)$

d. $f(x) - g(x)$

e. $g(-2) + r(0)$

f. $g(x)f(x)$

g. $\frac{f(-1)}{g(6)}$

Given the following functions $f(x) = 2x^2 - 3x + 1$, $g(x) = x^2 - 7x$ and $r(x) = -4x + 2$. Calculate the following.

a. $f(g(-2))$

b. $g(r(0))$

c. $f(f(0))$

d. $r(3) - g(-1)$

e. $\frac{f(-2)}{g(2)}$

f. $g(a+2)$

g. $r(2a - 1)$

h. $f(a - 1)$

i. $2g(x) + 3r(x)$

j. $-2r(x) + g(x)$

k. $f(x) - 2r(x)$

l. $r(g(1))$

Given the following functions $f(x) = 4x^2 + 3x - 1$, $g(x) = x^2 + 1$, $h(x) = 5x - 5$. Calculate the following.

a. $f(-1)$

b. $g(3) + h(7)$

c. $g(h(x))$

d. $\frac{f(2)}{h(1)}$

e. $h(h(x))$

f. $f(-1) + g(3) - h(0)$

g. $f(a + 4)$

h. $g(2)f(1)$

j. $g(x) - 2h(x)$

k. $3h(x) - g(x)$

If $f(x) = x^2 + 3$ and $g(x) = x^3 - 1$, calculate the following.

a. $2g(x) - f(x)$

b. $3f(x) + g(x)$

c. $f(g(2))$

d. $\frac{f(1)}{g(0)}$

Given f(g(x)) = x and g(f(x)) = x then f(x) and g(x) are inverse functions of each other.

a. Given f(g(x)) = x and f(x) $= \frac{3x-2}{5}$ then find g(x).

b. Given f(g(x)) = x and g(x) = $\sqrt[3]{x-1}$ then find f(x).

c. Given f(g(x)) = x and f(x) = e^{x+1} then find g(x).

d. Given f(g(x)) = x and f(x) = mx + b then find g(x).

Factoring

Factor the following equations.

1. $x^2 - 81$

2. $x^2 - x - 12$

3. $2x^2 - 10x$

4. $x^2 - 3x - 10$

5. $x^2 - 36$

6. $x^2 + 10x + 25$

7. $x^2 - 10x + 9$

8. $9x^2 + 27x$

Solve the following equations.

1. $x^2 + 3x - 18 = 0$

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

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

4. $x^2 - x - 12 = 0$

5. $x^2 - 1 = 0$

6. $x^2 + 6x + 8 = 0$

In each of the following problems express r in terms of t.

1. $r = 3s - 1$ $s = 4 - 2t$

2. $r = s + 4$ $s = 2t + 1$

3. $r = 2s - 5$ $s = 5t + 1$

4. $r = s - 6$ $s = -t - 4$

5. $r = 3s + 7$ $s = t + 2$

6. $r = -2s - 8$ $s = -3t - 5$

Complex Numbers

$\sqrt{-1} = i$ or $i^2 = -1$

Simplify the following complex numbers.

1. $(3i + 5) - (2 + 8i)$

2. $(-2i - 7) + (5 - 6i)$

3. $5(3 - i) + 4i$

4. $(-3i + 7) - (8i + 3)$

5. $(2i - 3)(4i + 5)$

6. $(5i + 3)(5i - 3)$

7. $(i + 9)(2i - 1)$

8. $(i - 1)^2$

9. $(4i - 2)^2$

10. $(2 + i)^2$

11. $\frac{1}{2i - 1}$

12. $\frac{1}{3i + 4}$

13. i^7

14. i^{10}

15. i^6

16. i^{-1}

Given $z = a + bi$ then the conjugate of z is $\bar{z}$ and $\bar{z} = a - bi$.

Find the conjugate, $\bar{z}$ of the following:

a. $z = 3 - 5i$

b. $z = -4 + 6i$

c. $z = 6 - 2i$

d. $z = 3 + 7i$

Find $z^2 \bar{z}$ for the following:

a. $z = 4 - 2i$

b. $z = -2 + 3i$

c. $z = 5 + i$

Exponential and Logarithmic Equations

Solve the following equations for x.

1. $4^x = 64$

   a. 1

   b. 3

   c. -2

   d. 0

2. $4^x = 2$

   a. -1

   b. $\frac{1}{2}$

   c. $\frac{1}{3}$

   d. 2

3. $\log x = 3$

   a. 1000

   b. 100

   c. $\frac{1}{1000}$

   d. $\frac{1}{3}$

4. $\log x = -1$

   a. 0

   b. 10

   c. -10

   d. $\frac{1}{10}$

5. $2^{x+2} = \frac{1}{2}$

   a. -3

   b. -2

   c. 0

   d. 1

6. $3^{1-x} = \frac{1}{9}$

   a. 4

   b. -2

   c. 2

   d. 3

7. $5^{3x+1} = \frac{1}{25}$

a. -2

b. 2

c. -1

d. $-\frac{1}{2}$

8. $\left(\frac{1}{4}\right)^{x} = 16$

a. 1

b. $\frac{1}{2}$

c. -2

d. 4

9. $5^{x} = 625$

a. 6

b. -3

c. 2

d. 4

10. $3^{x} = 81$

a. 2

b. 4

c. 3

d. 0

11. $2^{x} = 32$

a. 0

b. -3

c. 5

d. 2

12. $4^{x} = 256$

a. -1

b. -3

c. 2

d. 4

Find the domain and range of the following functions:

a. $f(x) = \sqrt{x^2 - 4}$

b. $r(x) = \log (x - 3)$

c. $p(x) = x^2 - 6x + 7$

d. $f(x) = \sqrt[3]{x}$

e. $g(x) = 5 \sin x$

Logarithm Rules

If M, N and P are real numbers and $M > 0$ and $N > 0$ then the following rules are true:

$\log MN = \log M + \log N$

$\log \frac{M}{N} = \log M - \log N$

$\log M^P = P \log M$

Write the following as a sum or difference of logarithms without products, quotients or exponents in the argument.

1. $\log(10x) =$

2. $\log\left(\frac{x}{100}\right) =$

3. $\log(x^3) =$

4. $\log\left(\frac{1000x^4}{y^2}\right) =$

Write the following as a single logarithm.

1. $\log(4) + \log(y) =$

2. $\log(y) - \log(7) =$

3. $3 \log(y) =$

4. $2 \log(x) - 8 \log(y) + 10 \log(z) =$

Simplify the following logarithms.

1. $\log\sqrt{\frac{x^2y}{100}}$

2. $\log\sqrt{\frac{400}{a^4b^2}}$

3. $\log\sqrt{10w^8z}$

3. $\ln(e^{14})$

5. $\ln(e^6x^3y^5z^6)$

6. $\ln\left(\frac{e^4x^7y^3}{e^{10}w^4z}\right)$

Geometric Sequences

A **geometric** sequence is a sequence of the form $a_0, a_0r, a_0r^2, a_0r^3, a_0r^3, a_0r^4, \ldots$

The **nth term** of a geometric sequence is given by $a_n = a_0r^{n-1}$

The first term $= a_0$

second term: $a_1 = a_0r$

third term: $a_2 = a_0r^2$

fourth term: $a_3 = a_0r^3$

$r = \frac{a_1}{a_0}$ $\qquad$ $a_{n+1} = r \cdot a_n$

Determine the next term in each geometric sequence.

1. 1, 2, 4, 8, ...

2. $1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \ldots$

3. 3, 6, 12, 24, ...

4. -1, 3, -9, 27, ...

5. $1, -\frac{1}{2}, \frac{1}{4}, -\frac{1}{8}, \ldots$

6. $3, -\frac{3}{2}, \frac{3}{4}, -\frac{3}{8}, \ldots$

Arithmetic Sequences

An **arithmetic** sequence is sequence of the form $a_0, a_1, a_2, a_3, a_n, \ldots$

Where $a_1 = a_0 + c$

$a_2 = a_1 + c$

$a_3 = a_2 + c$

$a_n = a_{n-1} + c$ c is a constant.

Find the missing term in each arithmetic sequence.

1. $1, 3, 5, \_\_\_, \ldots$

2. $1, \frac{7}{2}, \_\_\_, \frac{17}{2}, \ldots.$

3. $2, \frac{3}{4}, -\frac{1}{2}, \_\_\_, \ldots$

4. $-\frac{3}{2}, \_\_\_, \frac{1}{2}, \frac{3}{2}, \ldots$

5. $\frac{16}{3}, 3, \_\_\_, -\frac{5}{3}, \ldots$

6. $-2, -\frac{5}{2}, -3, \_\_\_, \ldots$