VCE Mathematics Methods: Practice problems and solutions: Functions, Algebra, Differential Calculus

Contents

1. Introduction

1.1 Motivation

My year 9 daughter kept asking me to write her new math problems, apart from those in the text book, so she can do more practice. I'd take a piece of paper and write problems, but it's a tedious process. So I thought: how about I **generate tons** of them?

1.2 Problem generation method

The problems and solutions have all been generated using the python programming language, and relied on a number of open source python packages, especially the SymPy package. Therefore, you can trust the accuracy of the solutions.

1.3 Structure

This document includes hundreds of mathematics problems that have been designed for year 11 students enrolled in VCE Mathematics Methods.

Most of the problems require the student to perform a single task, such as calculating the derivative of a function or finding the prime numbers within a range of integers. In addition, a number of questions have been designed based on the Mathematics Methods exam questions, which require the student to perform two or more tasks.

I hope you find them useful.

2. Functions

2.1 Problems

Exercise 2.1 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(1,6)$ and $(0,7)$. Find the values of a and b.

Exercise 2.2 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(-7,-5)$ and $(4,8)$. Find the values of a and b.

Exercise 2.3 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(4,9)$ and $(5,7)$. Find the values of a and b.

Exercise 2.4 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(-3,10)$ and $(7,-7)$. Find the values of a and b.

Exercise 2.5 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(3,-10)$ and $(-7,0)$. Find the values of a and b.

Exercise 2.6 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(4,5)$ and $(2,9)$. Find the values of a and b.

Exercise 2.7 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(5,-10)$ and $(10,0)$. Find the values of a and b.

Exercise 2.8 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(7,5)$ and $(6,-4)$. Find the values of a and b.

Exercise 2.9 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(8,2)$ and $(-6,6)$. Find the values of a and b.

Exercise 2.10 The line defined by the function

$$f(x) = ax + b$$

passes through the points $(-2,-1)$ and $(5,-9)$. Find the values of a and b.

Exercise 2.11 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-4,25)$ and $(-8,121)$. Find the values of a and b.

Exercise 2.12 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-1,3)$ and $(-6,-32)$. Find the values of a and b.

Exercise 2.13 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(5,-109)$ and $(-6,-153)$. Find the values of a and b.

Exercise 2.14 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-5,-22)$ and $(-4,-13)$. Find the values of a and b.

Exercise 2.15 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-3,36)$ and $(9,396)$. Find the values of a and b.

Exercise 2.16 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-5,106)$ and $(-3,42)$. Find the values of a and b.

Exercise 2.17 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(5,60)$ and $(-10,210)$. Find the values of a and b.

Exercise 2.18 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(0,6)$ and $(5,-94)$. Find the values of a and b.

Exercise 2.19 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-3, 16)$ and $(-10, 198)$. Find the values of a and b.

Exercise 2.20 The graph defined by the function

$$f(x) = ax^2 + b$$

passes through the points $(-5, 110)$ and $(0, 10)$. Find the values of a and b.

Exercise 2.21 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(2, 24)$ and $(-4, -30)$. Find the values of a and b.

Exercise 2.22 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(-1, -17)$ and $(-3, -35)$. Find the values of a and b.

Exercise 2.23 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(1, 31)$ and $(-9, -219)$. Find the values of a and b.

Exercise 2.24 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(2, 56)$ and $(-10, -244)$. Find the values of a and b.

Exercise 2.25 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(2, 56)$ and $(-10, -244)$. Find the values of a and b.

Exercise 2.26 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(-5, -40)$ and $(0, 5)$. Find the values of a and b.

Exercise 2.27 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(4, 101)$ and $(3, 76)$. Find the values of a and b.

Exercise 2.28 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(-4, -14)$ and $(-7, -17)$. Find the values of a and b.

Exercise 2.29 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(2, 21)$ and $(-8, -69)$. Find the values of a and b.

Exercise 2.30 The graph defined by the function

$$f(x) = a^2x + b$$

passes through the points $(-4,-27)$ and $(-1,0)$. Find the values of a and b.

Exercise 2.31 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(4,0)$ and $(-8,-12)$. Find the values of a and b.

Exercise 2.32 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(4,90)$ and $(5,115)$. Find the values of a and b.

Exercise 2.33 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(0,5)$ and $(-2,-13)$. Find the values of a and b.

Exercise 2.34 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(-5,-42)$ and $(-9,-78)$. Find the values of a and b.

Exercise 2.35 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(1,2)$ and $(-1,-6)$. Find the values of a and b.

Exercise 2.36 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(1,17)$ and $(-9,-73)$. Find the values of a and b.

Exercise 2.37 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(-4,-54)$ and $(4,74)$. Find the values of a and b.

Exercise 2.38 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(-5,-87)$ and $(7,105)$. Find the values of a and b.

Exercise 2.39 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(-3,-49)$ and $(10,159)$. Find the values of a and b.

Exercise 2.40 The graph defined by the function

$$f(x) = a^2x + ab$$

passes through the points $(1,-8)$ and $(0,-9)$. Find the values of a and b.

Exercise 2.41 The function

$$f(x) = m + 16x^2 - 16x + 5$$

is greater than -4 for all values of x for a certain value of k. Find the value of k.

Exercise 2.42 The function

$$f(x) = m + x^2 - 14x + 37$$

is greater than -2 for all values of x for a certain value of k. Find the value of k.

Exercise 2.43 The function

$$f(x) = m + 64x^2 - 128x + 59$$

is greater than -4 for all values of x for a certain value of k. Find the value of k.

Exercise 2.44 The function

$$f(x) = m + 100x^2 - 100x + 28$$

is greater than 2 for all values of x for a certain value of k. Find the value of k.

Exercise 2.45 The function

$$f(x) = m + 9x^2 - 18x + 18$$

is greater than 3 for all values of x for a certain value of k. Find the value of k.

Exercise 2.46 The function

$$f(x) = m + 81x^2 - 126x + 52$$

is greater than 9 for all values of x for a certain value of k. Find the value of k.

Exercise 2.47 The function

$$f(x) = m + 36x^2 - 84x + 50$$

is greater than 7 for all values of x for a certain value of k. Find the value of k.

Exercise 2.48 The function

$$f(x) = m + 81x^2 + 90x + 15$$

is greater than -1 for all values of x for a certain value of k. Find the value of k.

Exercise 2.49 The function

$$f(x) = m + 36x^2 + 24x + 14$$

is greater than 3 for all values of x for a certain value of k. Find the value of k.

Exercise 2.50 The function

$$f(x) = m + 16x^2 + 80x + 91$$

is greater than -2 for all values of x for a certain value of k. Find the value of k.

Exercise 2.51 A line is parallel to the graph

$$16x + 8y + 3 = 0$$

and passes through the point $(-7, 9)$. What is the equation of that line?

Exercise 2.52 A line is parallel to the graph

$$3x+y+1=0$$

and passes through the point $(18,-44)$. What is the equation of that line?

Exercise 2.53 A line is parallel to the graph

$$-50x-5y+7=0$$

and passes through the point $(-8,76)$. What is the equation of that line?

Exercise 2.54 A line is parallel to the graph

$$-70x-10y+2=0$$

and passes through the point $(11,-71)$. What is the equation of that line?

Exercise 2.55 A line is parallel to the graph

$$90x-10y+3=0$$

and passes through the point $(2,23)$. What is the equation of that line?

Exercise 2.56 A line is parallel to the graph

$$-12x+6y-8=0$$

and passes through the point $(-5,-12)$. What is the equation of that line?

Exercise 2.57 A line is parallel to the graph

$$56x+7y-7=0$$

and passes through the point $(17,-144)$. What is the equation of that line?

Exercise 2.58 A line is parallel to the graph

$$-40x+10y-5=0$$

and passes through the point $(8,41)$. What is the equation of that line?

Exercise 2.59 A line is parallel to the graph

$$-8x-4y+7=0$$

and passes through the point $(9,-23)$. What is the equation of that line?

Exercise 2.60 A line is parallel to the graph

$$4x-2y-7=0$$

and passes through the point $(6,22)$. What is the equation of that line?

Exercise 2.61 A line is perpendicular to the graph

$$-10x-60y-10=0$$

and passes through the point $(19,-118)$. What is the equation of that line?

Exercise 2.62 A line is perpendicular to the graph

$$-10x-70y+8=0$$

and passes through the point $(-14,97)$. What is the equation of that line?

Exercise 2.63 A line is perpendicular to the graph

$$2x+2y+10=0$$

and passes through the point $(-6,13)$. What is the equation of that line?

Exercise 2.64 A line is perpendicular to the graph

$$10x-80y+2=0$$

and passes through the point $(12,92)$. What is the equation of that line?

Exercise 2.65 A line is perpendicular to the graph

$$-7x+49y+9=0$$

and passes through the point $(18,127)$. What is the equation of that line?

Exercise 2.66 A line is perpendicular to the graph

$$4x+28y+4=0$$

and passes through the point $(8,-64)$. What is the equation of that line?

Exercise 2.67 A line is perpendicular to the graph

$$5x-10y+1=0$$

and passes through the point $(-16,-36)$. What is the equation of that line?

Exercise 2.68 A line is perpendicular to the graph

$$-x-y-8=0$$

and passes through the point $(18,-9)$. What is the equation of that line?

Exercise 2.69 A line is perpendicular to the graph

$$8x+80y-8=0$$

and passes through the point $(20,-203)$. What is the equation of that line?

Exercise 2.70 A line is perpendicular to the graph

$$6x+42y-2=0$$

and passes through the point $(-12,83)$. What is the equation of that line?

Exercise 2.71 Find the value of x at which the graphs of the following functions intersect:

$$f(x)=-5a-4x$$

and

$$g(x)=-a-5x$$

Exercise 2.72 Find the value of x at which the graphs of the following functions intersect:

$$f(x)=5a-4x$$

and

$$g(x)=2a-2x$$

Exercise 2.73 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = 4a + 2x$$

and

$$g(x) = 2a - 3x$$

Exercise 2.74 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -a + 5x$$

and

$$g(x) = -2a - 3x$$

Exercise 2.75 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -a + x$$

and

$$g(x) = 2a + 4x$$

Exercise 2.76 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -2x - 3$$

and

$$g(x) = -a - 5x$$

Exercise 2.77 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = 2x + 1$$

and

$$g(x) = -2a + 5x$$

Exercise 2.78 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = 5a - 2x$$

and

$$g(x) = -a + x$$

Exercise 2.79 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = 4x - 2$$

and

$$g(x) = -4a + 5x$$

Exercise 2.80 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -4a + 5x$$

and

$$g(x) = -a + x$$

Exercise 2.81 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -ax^2 - 3a + 3x$$

and

$$g(x) = a(2x - 5)$$

Exercise 2.82 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -4ax^2 + 3a + x$$

and

$$g(x) = a(2 - x)$$

Exercise 2.83 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -2ax^2 - 2a - 3x$$

and

$$g(x) = 2a(1 - 2x)$$

Exercise 2.84 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = ax^2 - 3a + 3x$$

and

$$g(x) = a(x + 3)$$

Exercise 2.85 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = 4ax^2 - 2a + 2x$$

and

$$g(x) = a(-5x - 4)$$

Exercise 2.86 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -4ax^2 + 2a + 3x$$

and

$$g(x) = a(5x - 2)$$

Exercise 2.87 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = ax^2 + 2a + x$$

and

$$g(x) = a(x - 2)$$

Exercise 2.88 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -3ax^2 + 5a + 5x$$

and

$$g(x) = a(x + 1)$$

Exercise 2.89 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -3ax^2 - 2a + 3x$$

and

$$g(x) = a(x + 1)$$

Exercise 2.90 Find the value of x at which the graphs of the following functions intersect:

$$f(x) = -ax^2 + a - 5x$$

and

$$g(x) = a(-x - 1)$$

Exercise 2.91 If $f(x)$ is defined as

$$f(x) = 4 - x$$

and $g(x)$ is defined as

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

simplify $g(f(x))$.

Exercise 2.92 If $f(x)$ is defined as

$$f(x) = -3x - 3$$

and $g(x)$ is defined as

$$g(x) = -2x^2 - x - 3$$

simplify $g(f(x))$.

Exercise 2.93 If $f(x)$ is defined as

$$f(x) = x - 2$$

and $g(x)$ is defined as

$$g(x) = -x^2 - 2x - 2$$

simplify $g(f(x))$.

Exercise 2.94 If $f(x)$ is defined as

$$f(x) = 2x - 2$$

and $g(x)$ is defined as

$$g(x) = 5x^2 - x - 3$$

simplify $g(f(x))$.

Exercise 2.95 If $f(x)$ is defined as

$$f(x) = 3x - 1$$

and $g(x)$ is defined as

$$g(x) = -3x^2 - x + 2$$

simplify $g(f(x))$.

Exercise 2.96 If $f(x)$ is defined as

$$f(x) = x - 5$$

and $g(x)$ is defined as

$$g(x) = -4x^2 + 3x - 5$$

simplify $g(f(x))$.

Exercise 2.97 If $f(x)$ is defined as

$$f(x) = x + 5$$

and $g(x)$ is defined as

$$g(x) = 4x^2 + 2x + 3$$

simplify $g(f(x))$.

Exercise 2.98 If $f(x)$ is defined as

$$f(x) = -4x - 4$$

and $g(x)$ is defined as

$$g(x) = 4x^2 - 2x + 3$$

simplify $g(f(x))$.

Exercise 2.99 If $f(x)$ is defined as

$$f(x) = 4 - 4x$$

and $g(x)$ is defined as

$$g(x) = -4x^2 + 2x + 5$$

simplify $g(f(x))$.

Exercise 2.100 If $f(x)$ is defined as

$$f(x) = 4x+2$$

and $g(x)$ is defined as

$$g(x) = -5x^2 - 5x + 2$$

simplify $g(f(x))$.

Exercise 2.101 If $f(x)$ is defined as

$$f(x) = -4ax - 3x^2$$

and $g(x)$ is defined as

$$g(x) = 2 - 4x$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.102 If $f(x)$ is defined as

$$f(x) = -2ax + 2x^2$$

and $g(x)$ is defined as

$$g(x) = -4x - 3$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.103 If $f(x)$ is defined as

$$f(x) = -3ax - 2x^2$$

and $g(x)$ is defined as

$$g(x) = 5 - 5x$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.104 If $f(x)$ is defined as

$$f(x) = -3ax - 2x^2$$

and $g(x)$ is defined as

$$g(x) = -3x - 2$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.105 If $f(x)$ is defined as

$$f(x) = -2ax - 3x^2$$

and $g(x)$ is defined as

$$g(x) = 2x + 1$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.106 If $f(x)$ is defined as

$$f(x) = -2ax - 2x^2$$

and $g(x)$ is defined as

$$g(x) = -4x - 4$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.107 If $f(x)$ is defined as

$$f(x) = 4ax + 5x^2$$

and $g(x)$ is defined as

$$g(x) = 2 - 4x$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.108 If $f(x)$ is defined as

$$f(x) = 4ax + 2x^2$$

and $g(x)$ is defined as

$$g(x) = 2x - 4$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.109 If $f(x)$ is defined as

$$f(x) = ax - 5x^2$$

and $g(x)$ is defined as

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

solve the equation

$$g(f(x)) = 0$$

Exercise 2.110 If $f(x)$ is defined as

$$f(x) = -4ax - 3x^2$$

and $g(x)$ is defined as

$$g(x) = 2x - 3$$

solve the equation

$$g(f(x)) = 0$$

Exercise 2.111 If $f(x)$ is defined as

$$f(x) = \frac{3-x}{-5x-3}$$

find $f^{-1}(x)$.

Exercise 2.112 If $f(x)$ is defined as

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

find $f^{-1}(x)$.

Exercise 2.113 If $f(x)$ is defined as

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

find $f^{-1}(x)$.

Exercise 2.114 If $f(x)$ is defined as

$$f(x) = \frac{-2x-3}{-5x-4}$$

find $f^{-1}(x)$.

Exercise 2.115 If $f(x)$ is defined as

$$f(x) = \frac{2x+4}{1-x}$$

find $f^{-1}(x)$.

Exercise 2.116 If $f(x)$ is defined as

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

find $f^{-1}(x)$.

Exercise 2.117 If $f(x)$ is defined as

$$f(x) = \frac{4x-5}{5x-1}$$

find $f^{-1}(x)$.

Exercise 2.118 If $f(x)$ is defined as

$$f(x) = \frac{4-4x}{4x+5}$$

find $f^{-1}(x)$.

Exercise 2.119 If $f(x)$ is defined as

$$f(x) = \frac{-5x-4}{4x-3}$$

find $f^{-1}(x)$.

Exercise 2.120 If $f(x)$ is defined as

$$f(x) = \frac{5-5x}{4x+2}$$

find $f^{-1}(x)$.

Exercise 2.121 If $f(x)$ is defined as

$$f(x) = \frac{-4ax-3a}{-2a-x}$$

find the value of a if $f^{-1}(1) = 4$.

Exercise 2.122 If $f(x)$ is defined as

$$f(x) = \frac{3ax-2a}{3a+x}$$

find the value of a if $f^{-1}(7) = 5$.

Exercise 2.123 If $f(x)$ is defined as

$$f(x) = \frac{-4ax+3a}{-3a-x}$$

find the value of a if $f^{-1}(7) = 2$.

Exercise 2.124 If $f(x)$ is defined as

$$f(x) = \frac{ax-a}{-5a-x}$$

find the value of a if $f^{-1}(3) = 6$.

Exercise 2.125 If $f(x)$ is defined as

$$f(x) = \frac{-ax+4a}{-2a-2x}$$

find the value of a if $f^{-1}(9) = 10$.

Exercise 2.126 If $f(x)$ is defined as

$$f(x) = \frac{-4ax+a}{-2a+2x}$$

find the value of a if $f^{-1}(7) = 3$.

Exercise 2.127 If $f(x)$ is defined as

$$f(x) = \frac{5ax - 3a}{a + x}$$

find the value of a if $f^{-1}(7) = 8$.

Exercise 2.128 If $f(x)$ is defined as

$$f(x) = \frac{-2ax + a}{4a - x}$$

find the value of a if $f^{-1}(3) = 9$.

Exercise 2.129 If $f(x)$ is defined as

$$f(x) = \frac{-5ax - 2a}{a - 2x}$$

find the value of a if $f^{-1}(4) = 4$.

Exercise 2.130 If $f(x)$ is defined as

$$f(x) = \frac{2ax + a}{3a + 2x}$$

find the value of a if $f^{-1}(6) = 2$.

Exercise 2.131 If $f(x)$ is defined as

$$f(x) = \frac{3x - 5}{4x - 5}$$

what is the domain and range of $f(x)$?

Exercise 2.132 If $f(x)$ is defined as

$$f(x) = \frac{3 - x}{4 - x}$$

what is the domain and range of $f(x)$?

Exercise 2.133 If $f(x)$ is defined as

$$f(x) = \frac{-3x - 5}{x - 3}$$

what is the domain and range of $f(x)$?

Exercise 2.134 If $f(x)$ is defined as

$$f(x) = \frac{1 - 5x}{4x - 4}$$

what is the domain and range of $f(x)$?

Exercise 2.135 If $f(x)$ is defined as

$$f(x) = \frac{-5x - 3}{-2x - 4}$$

what is the domain and range of $f(x)$?

Exercise 2.136 If $f(x)$ is defined as

$$f(x) = \frac{x - 5}{4x - 4}$$

what is the domain and range of $f(x)$?

Exercise 2.137 If $f(x)$ is defined as

$$f(x) = \frac{x-5}{x-3}$$

what is the domain and range of $f(x)$?

Exercise 2.138 If $f(x)$ is defined as

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

what is the domain and range of $f(x)$?

Exercise 2.139 If $f(x)$ is defined as

$$f(x) = \frac{2-x}{2x-4}$$

what is the domain and range of $f(x)$?

Exercise 2.140 If $f(x)$ is defined as

$$f(x) = \frac{-3x-2}{1-4x}$$

what is the domain and range of $f(x)$?

Exercise 2.141 A tranformation is defined by the matrix

$$\begin{bmatrix} 4 & 0 \\ 0 & 3 \end{bmatrix}$$

Find the expression for the graph

$$y = -4x - 2$$

after applying the transformation.

Exercise 2.142 A tranformation is defined by the matrix

$$\begin{bmatrix} -3 & 0 \\ 0 & -5 \end{bmatrix}$$

Find the expression for the graph

$$y = 2 - 2x$$

after applying the transformation.

Exercise 2.143 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & -2 \\ -3 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = -5x - 4$$

after applying the transformation.

Exercise 2.144 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & 2 \\ 5 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = 4 - 3x$$

after applying the transformation.

Exercise 2.145 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & 3 \\ -3 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = 4x + 2$$

after applying the transformation.

Exercise 2.146 A tranformation is defined by the matrix

$$\begin{bmatrix} 5 & 0 \\ 0 & -3 \end{bmatrix}$$

Find the expression for the graph

$$y = -3x - 5$$

after applying the transformation.

Exercise 2.147 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & -3 \\ 4 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = -x - 4$$

after applying the transformation.

Exercise 2.148 A tranformation is defined by the matrix

$$\begin{bmatrix} 5 & 0 \\ 0 & 1 \end{bmatrix}$$

Find the expression for the graph

$$y = 5x - 3$$

after applying the transformation.

Exercise 2.149 A tranformation is defined by the matrix

$$\begin{bmatrix} -5 & 0 \\ 0 & 2 \end{bmatrix}$$

Find the expression for the graph

$$y = 3 - 5x$$

after applying the transformation.

Exercise 2.150 A tranformation is defined by the matrix

$$\begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$$

Find the expression for the graph

$$y = 3 - x$$

after applying the transformation.

Exercise 2.151 A tranformation is defined by the matrix

$$\begin{bmatrix} 4 & 0 \\ 0 & -3 \end{bmatrix}$$

Find the expression for the graph

$$y = -2x^2 + 3x + 1$$

after applying the transformation.

Exercise 2.152 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & 3 \\ -3 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = -3x^2 + 5x - 1$$

after applying the transformation.

Exercise 2.153 A tranformation is defined by the matrix

$$\begin{bmatrix} 5 & 0 \\ 0 & -5 \end{bmatrix}$$

Find the expression for the graph

$$y = 3x^2 - x - 2$$

after applying the transformation.

Exercise 2.154 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & 3 \\ 3 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = 5x^2 + x + 4$$

after applying the transformation.

Exercise 2.155 A tranformation is defined by the matrix

$$\begin{bmatrix} -3 & 0 \\ 0 & -4 \end{bmatrix}$$

Find the expression for the graph

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

after applying the transformation.

Exercise 2.156 A tranformation is defined by the matrix

$$\begin{bmatrix} -5 & 0 \\ 0 & 5 \end{bmatrix}$$

Find the expression for the graph

$$y = x^2 - x - 1$$

after applying the transformation.

Exercise 2.157 A tranformation is defined by the matrix

$$\begin{bmatrix} 2 & 0 \\ 0 & -3 \end{bmatrix}$$

Find the expression for the graph

$$y = -4x^2 + 4x - 3$$

after applying the transformation.

Exercise 2.158 A tranformation is defined by the matrix

$$\begin{bmatrix} 0 & -4 \\ -3 & 0 \end{bmatrix}$$

Find the expression for the graph

$$y = -4x^2 + x + 3$$

after applying the transformation.

Exercise 2.159 A tranformation is defined by the matrix

$$\begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix}$$

Find the expression for the graph

$$y = -2x^2 + 3x + 3$$

after applying the transformation.

Exercise 2.160 A tranformation is defined by the matrix

$$\begin{bmatrix} -4 & 0 \\ 0 & -1 \end{bmatrix}$$

Find the expression for the graph

$$y = -3x^2 + 4x + 4$$

after applying the transformation.

2.2 Solutions

1. $\{a : -1,\ b : 7\}$

2. $\left\{a : \frac{13}{11},\ b : \frac{36}{11}\right\}$

3. $\{a : -2,\ b : 17\}$

4. $\left\{a : -\frac{17}{10},\ b : \frac{49}{10}\right\}$

5. $\{a : -1,\ b : -7\}$

6. $\{a : -2,\ b : 13\}$

7. $\{a : 2,\ b : -20\}$

8. $\{a : 9,\ b : -58\}$

9. $\left\{a : -\frac{2}{7},\ b : \frac{30}{7}\right\}$

10. $\left\{a : -\frac{8}{7},\ b : -\frac{23}{7}\right\}$

11. $\{a : -2,\ b : -7\}$

12. $\{a : 1,\ b : 4\}$

13. $\left\{a : \frac{44}{61},\ b : -\frac{7749}{61}\right\}$

14.

$$\{a : 1,\ b : 3\}$$

15.

$$\{a : 4,\ b : 72\}$$

16.

$$\{a : -4,\ b : 6\}$$

17.

$$\left\{a : -\frac{6}{5},\ b : 90\right\}$$

18.

$$\{a : -4,\ b : 6\}$$

19.

$$\{a : -2,\ b : -2\}$$

20.

$$\{a : -4,\ b : 10\}$$

21.

$$[(-3,\ 6),\ (3,\ 6)]$$

22.

$$[(-3,\ -8),\ (3,\ -8)]$$

23.

$$[(-5,\ 6),\ (5,\ 6)]$$

24.

$$[(-5,\ 6),\ (5,\ 6)]$$

25.

$$[(-5,\ 6),\ (5,\ 6)]$$

26.

$$[(-3,\ 5),\ (3,\ 5)]$$

27.

$$[(-5,\ 1),\ (5,\ 1)]$$

28.

$$[(-1, -10), (1, -10)]$$

29.

$$[(-3, 3), (3, 3)]$$

30.

$$[(-3, 9), (3, 9)]$$

31.

$$[(-1, 4), (1, -4)]$$

32.

$$[(-5, 2), (5, -2)]$$

33.

$$\left[\left(-3, -\frac{5}{3}\right), \left(3, \frac{5}{3}\right)\right]$$

34.

$$[(-3, -1), (3, 1)]$$

35.

$$[(-2, 1), (2, -1)]$$

36.

$$\left[\left(-3, -\frac{8}{3}\right), \left(3, \frac{8}{3}\right)\right]$$

37.

$$\left[\left(-4, -\frac{5}{2}\right), \left(4, \frac{5}{2}\right)\right]$$

38.

$$\left[\left(-4, \frac{7}{4}\right), \left(4, -\frac{7}{4}\right)\right]$$

39.

$$\left[\left(-4, \frac{1}{4}\right), \left(4, -\frac{1}{4}\right)\right]$$

40.

$$[(-1, 9), (1, -9)]$$

41. -5

42. 10
43. 1
44. -1
45. -6
46. 6
47. 6
48. 9
49. -7
50. 7
51. $y = -2x - 5$
52. $y = 10 - 3x$
53. $y = -10x - 4$
54. $y = 6 - 7x$
55. $y = 9x + 5$
56. $y = 2x - 2$
57. $y = -8x - 8$
58. $y = 4x + 9$
59. $y = -2x - 5$
60. $y = 2x + 10$
61. $y = -6x - 4$
62. $y = -7x - 1$

63.

$$y = 7 - x$$

64.

$$y = 8x - 4$$

65.

$$y = 7x + 1$$

66.

$$y = -7x - 8$$

67.

$$y = 2x - 4$$

68.

$$y = 9 - x$$

69.

$$y = -10x - 3$$

70.

$$y = -7x - 1$$

71.

$$\{4a\}$$

72.

$$\left\{\frac{3a}{2}\right\}$$

73.

$$\left\{-\frac{2a}{5}\right\}$$

74.

$$\left\{-\frac{a}{8}\right\}$$

75.

$$\{-a\}$$

76.

$$\left\{1 - \frac{a}{3}\right\}$$

77.

$$\left\{\frac{2a}{3}+\frac{1}{3}\right\}$$

78.

$$\{2a\}$$

79.

$$\{4a-2\}$$

80.

$$\left\{\frac{3a}{4}\right\}$$

81.

$$\left\{-\frac{2a-3}{2a}-\frac{\sqrt{3}\sqrt{4a^2-4a+3}}{2a},-\frac{2a-3}{2a}+\frac{\sqrt{3}\sqrt{4a^2-4a+3}}{2a}\right\}$$

82.

$$\left\{\frac{a+1}{8a}-\frac{\sqrt{17a^2+2a+1}}{8a},\frac{a+1}{8a}+\frac{\sqrt{17a^2+2a+1}}{8a}\right\}$$

83.

$$\left\{\frac{4a-3}{4a}-\frac{\sqrt{-16a^2-24a+9}}{4a},\frac{4a-3}{4a}+\frac{\sqrt{-16a^2-24a+9}}{4a}\right\}$$

84.

$$\left\{\frac{a-3}{2a}-\frac{\sqrt{25a^2-6a+9}}{2a},\frac{a-3}{2a}+\frac{\sqrt{25a^2-6a+9}}{2a}\right\}$$

85.

$$\left\{-\frac{5a+2}{8a}-\frac{\sqrt{-7a^2+20a+4}}{8a},-\frac{5a+2}{8a}+\frac{\sqrt{-7a^2+20a+4}}{8a}\right\}$$

86.

$$\left\{-\frac{5a-3}{8a}-\frac{\sqrt{89a^2-30a+9}}{8a},-\frac{5a-3}{8a}+\frac{\sqrt{89a^2-30a+9}}{8a}\right\}$$

87.

$$\left\{-\frac{\sqrt{-(3a+1)(5a-1)}}{2a}+\frac{a-1}{2a},\frac{\sqrt{-(3a+1)(5a-1)}}{2a}+\frac{a-1}{2a}\right\}$$

88.

$$\left\{-\frac{a-5}{6a}-\frac{\sqrt{49a^2-10a+25}}{6a},-\frac{a-5}{6a}+\frac{\sqrt{49a^2-10a+25}}{6a}\right\}$$

89.

$$\left\{-\frac{\sqrt{-(5a+3)(7a-3)}}{6a}-\frac{a-3}{6a},\frac{\sqrt{-(5a+3)(7a-3)}}{6a}-\frac{a-3}{6a}\right\}$$

90.

$$\left\{\frac{a-5}{2a}-\frac{\sqrt{9a^2-10a+25}}{2a},\frac{a-5}{2a}+\frac{\sqrt{9a^2-10a+25}}{2a}\right\}$$

91.

$$5x^2-35x+55$$

92.

$$-18x^2-33x-18$$

93.

$$-x^2+2x-2$$

94.

$$20x^2-42x+19$$

95.

$$-27x^2+15x$$

96.

$$-4x^2+43x-120$$

97.

$$4x^2+42x+113$$

98.

$$64x^2+136x+75$$

99.

$$-64x^2+120x-51$$

100.

$$-80x^2-100x-28$$

101.

$$\left\{-\frac{2a}{3}-\frac{\sqrt{2}\sqrt{8a^2-3}}{6},-\frac{2a}{3}+\frac{\sqrt{2}\sqrt{8a^2-3}}{6}\right\}$$

102.

$$\left\{\frac{a}{2}-\frac{\sqrt{2}\sqrt{2a^2-3}}{4},\frac{a}{2}+\frac{\sqrt{2}\sqrt{2a^2-3}}{4}\right\}$$

103.

$$\left\{-\frac{3a}{4}-\frac{\sqrt{9a^2-8}}{4},-\frac{3a}{4}+\frac{\sqrt{9a^2-8}}{4}\right\}$$

104.

$$\left\{-\frac{3a}{4}-\frac{\sqrt{3}\sqrt{27a^2+16}}{12},-\frac{3a}{4}+\frac{\sqrt{3}\sqrt{27a^2+16}}{12}\right\}$$

105.

$$\left\{-\frac{a}{3}-\frac{\sqrt{2}\sqrt{2a^2+3}}{6},-\frac{a}{3}+\frac{\sqrt{2}\sqrt{2a^2+3}}{6}\right\}$$

106.

$$\left\{-\frac{a}{2}-\frac{\sqrt{a^2+2}}{2},-\frac{a}{2}+\frac{\sqrt{a^2+2}}{2}\right\}$$

107.

$$\left\{-\frac{2a}{5}-\frac{\sqrt{2}\sqrt{8a^2+5}}{10},-\frac{2a}{5}+\frac{\sqrt{2}\sqrt{8a^2+5}}{10}\right\}$$

108.

$$\left\{-a-\sqrt{a^2+1},-a+\sqrt{a^2+1}\right\}$$

109.

$$\left\{\frac{a}{10}-\frac{\sqrt{3}\sqrt{3a^2+40}}{30},\frac{a}{10}+\frac{\sqrt{3}\sqrt{3a^2+40}}{30}\right\}$$

110.

$$\left\{-\frac{2a}{3}-\frac{\sqrt{2}\sqrt{8a^2-9}}{6},-\frac{2a}{3}+\frac{\sqrt{2}\sqrt{8a^2-9}}{6}\right\}$$

111.

$$\left\{-\frac{3\,(y+1)}{5y-1}\right\}$$

112.

$$\left\{-\frac{2\,(y+2)}{3y+1}\right\}$$

113.

$$\left\{\frac{3y+1}{5y+1}\right\}$$

114.

$$\left\{-\frac{4y-3}{5y-2}\right\}$$

115.

$$\left\{\frac{y-4}{y+2}\right\}$$

116.

$$\left\{-\frac{2y-3}{5(y-1)}\right\}$$

117.

$$\left\{\frac{y-5}{5y-4}\right\}$$

118.

$$\left\{-\frac{5y-4}{4(y+1)}\right\}$$

119.

$$\left\{\frac{3y-4}{4y+5}\right\}$$

120.

$$\left\{-\frac{2y-5}{4y+5}\right\}$$

121.

$$0.235$$

122.

$$-4.375$$

123.

$$-0.875$$

124.

$$-0.9$$

125.

$$-15.0$$

126.

14.0

127.

1.867

128.

0.931

129.

1.231

130.

-1.846

131. Domain:

$$\left(-\infty, \frac{5}{4}\right) \cup \left(\frac{5}{4}, \infty\right)$$

Range:

$$\left(-\infty, \frac{3}{4}\right) \cup \left(\frac{3}{4}, \infty\right)$$

132. Domain:

$$(-\infty, 4) \cup (4, \infty)$$

Range:

$$(-\infty, 1) \cup (1, \infty)$$

133. Domain:

$$(-\infty, 3) \cup (3, \infty)$$

Range:

$$(-\infty, -3) \cup (-3, \infty)$$

134. Domain:

$$(-\infty, 1) \cup (1, \infty)$$

Range:

$$\left(-\infty, -\frac{5}{4}\right) \cup \left(-\frac{5}{4}, \infty\right)$$

135. Domain:

$$(-\infty,-2)\cup(-2,\infty)$$

Range:

$$\left(-\infty,\frac{5}{2}\right)\cup\left(\frac{5}{2},\infty\right)$$

136. Domain:

$$(-\infty,1)\cup(1,\infty)$$

Range:

$$\left(-\infty,\frac{1}{4}\right)\cup\left(\frac{1}{4},\infty\right)$$

137. Domain:

$$(-\infty,3)\cup(3,\infty)$$

Range:

$$(-\infty,1)\cup(1,\infty)$$

138. Domain:

$$\left(-\infty,-\frac{1}{2}\right)\cup\left(-\frac{1}{2},\infty\right)$$

Range:

$$\left(-\infty,-\frac{3}{4}\right)\cup\left(-\frac{3}{4},\infty\right)$$

139. Domain:

$$(-\infty,2)\cup(2,\infty)$$

Range:

$$\left\{-\frac{x}{2x-4}+\frac{2}{2x-4}\right\}$$

140. Domain:

$$\left(-\infty,\frac{1}{4}\right)\cup\left(\frac{1}{4},\infty\right)$$

Range:

$$\left(-\infty,\frac{3}{4}\right)\cup\left(\frac{3}{4},\infty\right)$$

141.

$$y=-\frac{16x}{3}-\frac{2}{3}$$

142.

$$y = -\frac{6x}{5} - \frac{2}{5}$$

143.

$$y = \frac{2}{5} - \frac{3x}{10}$$

144.

$$y = \frac{2}{3} - \frac{5x}{6}$$

145.

$$y = -\frac{x}{4} - \frac{1}{6}$$

146.

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

147.

$$y = \frac{4x}{3} + \frac{4}{3}$$

148.

$$y = 25x - 3$$

149.

$$y = \frac{25x}{2} + \frac{3}{2}$$

150.

$$y = -x - 1$$

151.

$$y = \frac{32x^2}{3} - 4x - \frac{1}{3}$$

152.

$$y = \frac{5}{18} - \frac{\sqrt{36x+13}}{18}$$

153.

$$y = -15x^2 + x + \frac{2}{5}$$

154.

$$y = -\frac{\sqrt{60x-79}}{30} - \frac{1}{30}$$

155.

$$y = \frac{9x^2}{4} - \frac{15x}{4} - \frac{5}{4}$$

156.

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

157.

$$y = \frac{16x^2}{3} - \frac{8x}{3} + 1$$

158.

$$y = -\frac{\sqrt{48x+49}}{32} - \frac{1}{32}$$

159.

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

160.

$$y = 48x^2 + 16x - 4$$

3. Algebra

3.1 Problems

Exercise 3.1 Express the fraction

$$\frac{20mn+6}{5mn+1}$$

in the form

$$\frac{A}{5mn+1}+B$$

Exercise 3.2 Express the fraction

$$\frac{16uv-4}{-2uv-5}$$

in the form

$$\frac{A}{-2uv-5}+B$$

Exercise 3.3 Express the fraction

$$\frac{-4uw+6}{2uw-4}$$

in the form

$$\frac{A}{2uw-4}+B$$

Exercise 3.4 Express the fraction

$$\frac{25z-14}{-5z-4}$$

in the form

$$\frac{A}{-5z-4}+B$$

Exercise 3.5 Express the fraction

$$\frac{4-35p}{-5p-2}$$

in the form

$$\frac{A}{-5p-2}+B$$

Exercise 3.6 Express the fraction

$$\frac{45ln+6}{-5ln-4}$$

in the form

$$\frac{A}{-5ln-4}+B$$

Exercise 3.7 Express the fraction

$$\frac{1-8q}{4q+3}$$

in the form

$$\frac{A}{4q+3}+B$$

Exercise 3.8 Express the fraction

$$\frac{24pqr+1}{3pqr-1}$$

in the form

$$\frac{A}{3pqr-1}+B$$

Exercise 3.9 Express the fraction

$$\frac{30pq+5}{-5pq-4}$$

in the form

$$\frac{A}{-5pq-4}+B$$

Exercise 3.10 Express the fraction

$$\frac{-40rst+2}{-5rst-2}$$

in the form

$$\frac{A}{-5rst-2}+B$$

Exercise 3.11 Simplify

$$\frac{-2a^5b^2 - 3a^4}{a^3}$$

Exercise 3.12 Simplify

$$\frac{-5r^3s^6 - 2r^3s^5}{(-1)\,r^3s^2}$$

Exercise 3.13 Simplify

$$\frac{-16p^3q^7r^4 - 12q^6}{4q^3}$$

Exercise 3.14 Simplify

$$\frac{6a^3b^6cd^3 + 15ab^5c}{(-1)\,3ab^3c}$$

Exercise 3.15 Simplify

$$\frac{-6p^4q^4r^5 - 12q^2r^4}{3q^2r^4}$$

Exercise 3.16 Simplify

$$\frac{2m^7n^5 + 5m^3n^5}{m^3n^3}$$

Exercise 3.17 Simplify

$$\frac{4q^4r^5 - 16r^7}{(-1)\,4r^4}$$

Exercise 3.18 Simplify

$$\frac{12a^4bc^2 - 9a^2}{3a}$$

Exercise 3.19 Simplify

$$\frac{6r^4s^2 + 12r^4}{3r}$$

Exercise 3.20 Simplify

$$\frac{-3u^7v^3w^6 + 2u^3v^3w^6}{(-1)\,u^3v^3w^4}$$

Exercise 3.21 Simplify

$$\frac{3p^4q^4r}{9p^5q^8r^4 - 15p^4q^4r^3}$$

Exercise 3.22 Simplify

$$\frac{(-1)\,s^2}{5r^4s^5 - rs^5}$$

Exercise 3.23 Simplify

$$\frac{2r^2s^4}{-2r^4s^4+10r^2s^7}$$

Exercise 3.24 Simplify

$$\frac{5b^2c^3}{25a^4b^3c^4-10b^2c^5}$$

Exercise 3.25 Simplify

$$\frac{4a^2b^4c^4}{-16a^2b^4c^5-20a^2b^4c^4}$$

Exercise 3.26 Simplify

$$\frac{(-1)\,2t}{6s^3t^2+2t^3}$$

Exercise 3.27 Simplify

$$\frac{5vw^4}{-10v^3w^4+20v^2w^6}$$

Exercise 3.28 Simplify

$$\frac{c^2}{-5b^4c^5-c^2}$$

Exercise 3.29 Simplify

$$\frac{4r^3}{16r^6-8r^3}$$

Exercise 3.30 Simplify

$$\frac{4v^4}{-8u^4v^8+8u^4v^4}$$

Exercise 3.31 Simplify

$$\frac{-12p^2q^4-6p^2q-16q^4-8q}{-3p^2q-4q}$$

Exercise 3.32 Simplify

$$\frac{-9r^4s^6+9r^4s^5-9s^4+9s^3}{3s^3-3s^2}$$

Exercise 3.33 Simplify

$$\frac{-12l^4m^6+6l^4m^5+20l^2m^2-10l^2m}{-4m^2+2m}$$

Exercise 3.34 Simplify

$$\frac{4p^5q^2r^3+5p^3q^2r^7-16p^2q-20qr^4}{p^3q^2r^3-4q}$$

Exercise 3.35 Simplify

$$\frac{-r^8t^4+4r^7s^4t^7-r^6s^3+4r^5s^7t^3}{-r^4t^4-r^2s^3}$$

Exercise 3.36 Simplify

$$\frac{15rs^4+9rs-10s^6-6s^3}{-3r+2s^2}$$

Exercise 3.37 Simplify

$$\frac{-3r^4s^7-r^4s^4+12rs^6+4rs^3}{-3s^4-s}$$

Exercise 3.38 Simplify

$$\frac{-2r^6st^3-r^4st^7-6r^2-3t^4}{2r^2+t^4}$$

Exercise 3.39 Simplify

$$\frac{20a^4d^4-10a^3c^3+8a^3d^4-4a^2c^3}{4ad^4-2c^3}$$

Exercise 3.40 Simplify

$$\frac{2pq^8r^2-4pq^6r^2+4q^6r^3-8q^4r^3}{2pq^4r^2+4q^2r^3}$$

Exercise 3.41 Simplify

$$\frac{m^4n-m^2n^4}{-m^8n^3+m^6n^6+m^5n-m^3n^4}$$

Exercise 3.42 Simplify

$$\frac{5p^4q^4-4p^4q^3r}{-5p^6q^4r^4+4p^6q^3r^5-10p^5q^4r^4+8p^5q^3r^5}$$

Exercise 3.43 Simplify

$$\frac{r^2s-2s^4}{-2r^6s^3+4r^4s^6-2r^4s^2+4r^2s^5}$$

Exercise 3.44 Simplify

$$\frac{3p^4q^4-3p}{-9p^8q^8r^2+3p^6q^4+9p^5q^4r^2-3p^3}$$

Exercise 3.45 Simplify

$$\frac{-3p^3q^3-4p}{-12p^3q^4-16pq}$$

Exercise 3.46 Simplify

$$\frac{-4p^4+3p^3r}{-12p^8q^3+9p^7q^3r+8p^6q^3r^4-6p^5q^3r^5}$$

Exercise 3.47 Simplify

$$\frac{5p^4r^3 - 2q^3}{-25p^6q^3r^6 + 20p^4r^3 + 10p^2q^6r^3 - 8q^3}$$

Exercise 3.48 Simplify

$$\frac{-3pr^3 - 2q^3r^4}{12p^3r^7 + 8p^2q^3r^8 + 3pr^3 + 2q^3r^4}$$

Exercise 3.49 Simplify

$$\frac{-r^4 + 5r^2}{-3r^8 + 5r^6s^3 + 15r^6 - 25r^4s^3}$$

Exercise 3.50 Simplify

$$\frac{8r^3}{-24r^6s^4 - 24r^3s}$$

Exercise 3.51 If we divide the polynomial

$$-16l^3 + 40l^2 - 3lv - 17l + v - 10$$

by

$$4l - 5$$

the remainder is 5. What is the value of v?

Exercise 3.52 If we divide the polynomial

$$2vz - 3v + 4z^3 + 8z^2 - 28z + 16$$

by

$$4 - 4z$$

the remainder is 6. What is the value of v?

Exercise 3.53 If we divide the polynomial

$$-12n^3 + 32n^2 + nu - 8n + 3u - 20$$

by

$$5 - 3n$$

the remainder is 10. What is the value of u?

Exercise 3.54 If we divide the polynomial

$$-4sy - 2s - 12y^3 - 19y^2 + 8y + 16$$

by

$$3y + 4$$

the remainder is 7. What is the value of s?

Exercise 3.55 If we divide the polynomial

$$20n^3 + 3n^2 - 2nx - 5n - x + 3$$

by

$$-4n - 3$$

the remainder is 7. What is the value of x?

Exercise 3.56 If we divide the polynomial

$$-3cu - 5c + 10u^3 - 24u^2 + 33u - 10$$

by

$$2 - 5u$$

the remainder is 3. What is the value of c?

Exercise 3.57 If we divide the polynomial

$$10p^3 - 12p^2 - 3pu - 18p + 4u + 4$$

by

$$2p - 4$$

the remainder is 6. What is the value of u?

Exercise 3.58 If we divide the polynomial

$$-5c^3 + 17c^2 - 5cl - c + 2l - 2$$

by

$$5c - 2$$

the remainder is 1. What is the value of l?

Exercise 3.59 If we divide the polynomial

$$-8w^3 - 6w^2 + 5wz + 15w - 4z + 4$$

by

$$4w + 1$$

the remainder is 2. What is the value of z?

Exercise 3.60 If we divide the polynomial

$$-4sz + 4s + 10z^3 + 17z^2 - 30z + 8$$

by

$$4 - 5z$$

the remainder is 6. What is the value of s?

Exercise 3.61 Expand

$$(1-4t)\left(2r^4s-5r^2s^4t^3-2t^3\right)$$

Exercise 3.62 Expand

$$\left(3r^4s^2+4r^3s^3\right)\left(4rs^4+5r+5\right)$$

Exercise 3.63 Expand

$$\left(-a^3b^3c^4d^2-5a^2b^4c\right)\left(2a^4b^4d-3ac^2-2b^3d^4\right)$$

Exercise 3.64 Expand

$$\left(-u^3v^3+2\right)\left(2u^3w^4+5uv^4w^4+uw\right)$$

Exercise 3.65 Expand

$$\left(r^3s^4t^3+5rs^4t\right)\left(2r^3s^4t^2-3r^2s^4t^2+3r^2t^4\right)$$

Exercise 3.66 Expand

$$\left(5p^3-5q\right)\left(4p^2q^4+5q^3+5\right)$$

Exercise 3.67 Expand

$$\left(a^3b+ab^2c\right)\left(2a^3b+a^2c^3-3a^2\right)$$

Exercise 3.68 Expand

$$\left(-5u^2v^4+3u^2v^3w^3\right)\left(u^3vw^3+v^3-1\right)$$

Exercise 3.69 Expand

$$\left(3p^2-1\right)\left(3p^3q^4+5p^2q^4\right)$$

Exercise 3.70 Expand

$$\left(3mn^3+5n^4\right)\left(-4m^4n^2+2m^3n^4+n\right)$$

Exercise 3.71 Expand

$$\left(-u^4-5v^2\right)^2\cdot\left(4u^2w^3+5u\right)$$

Exercise 3.72 Expand

$$\left(5l^3n^4-3m^3\right)\left(-3l^4m^4n^2-5l^3\right)^2$$

Exercise 3.73 Expand

$$\left(s^4-2s^3\right)^2\cdot\left(5r^3s^2-r^3\right)$$

Exercise 3.74 Expand

$$(5-5x)^2\left(xy^4z-2y^3z\right)$$

Exercise 3.75 Expand

$$\left(2p+r^2\right)\left(2q^4-q^3\right)^2$$

Exercise 3.76 Expand

$$\left(4r^2s^3+2rs^3\right)\left(2r^3s+2\right)^2$$

Exercise 3.77 Expand

$$\left(5r+2\right)\left(-s^4-4s^3\right)^2$$

Exercise 3.78 Expand

$$\left(-2r^3+3s^3\right)^2\left(-4r^3s+2r^2\right)$$

Exercise 3.79 Expand

$$\left(-2mn^2+3n^3\right)\left(m^4n^2+5m^2\right)^2$$

Exercise 3.80 Expand

$$\left(2lm^3n-2n^2\right)\left(-4l^2m^3n^4-3l^2n^2\right)^2$$

Exercise 3.81 Expand

$$\left(p^4qr^3-p+5q^2r^2\right)^2$$

Exercise 3.82 Expand

$$\left(-2xy^3-2z^3+4\right)^2$$

Exercise 3.83 Expand

$$\left(2p^3qr^2+3p^3r+5q^4r^2\right)^2$$

Exercise 3.84 Expand

$$\left(-m^3n^3-m^3+1\right)^2$$

Exercise 3.85 Expand

$$\left(-5r^3s^4t^3+5r^3s^3t^4+2r^3st^4\right)^2$$

Exercise 3.86 Expand

$$\left(2l^2m^3n^2-3m^4+4\right)^2$$

Exercise 3.87 Expand

$$\left(5p^2q^3r^3-5p-2q^3r\right)^2$$

Exercise 3.88 Expand

$$\left(3q+5\right)^2$$

Exercise 3.89 Expand

$$(-2c+3d+5)^2$$

Exercise 3.90 Expand

$$\left(4ab^3c^2d+2ad+2\right)^2$$

Exercise 3.91 Expand

$$(-5uw+1)\left(-2u^4v^2-4u^3w\right)\left(-2u^4w+3u^2\right)$$

Exercise 3.92 Expand

$$\left(2l^3+5lm^2n^4\right)\left(-mn^3+4\right)\left(5l^4m^4n-5l^3\right)$$

Exercise 3.93 Expand

$$\left(2r^3-4s^3\right)\left(4r^4+s^2\right)\left(2s^2-3s\right)$$

Exercise 3.94 Expand

$$\left(rt^2-1\right)\left(3r^4t^4-rs^2t\right)\left(2s^2t^2+2\right)$$

Exercise 3.95 Expand

$$\left(-xz^4-5y^4\right)\left(4x^3y^4+4xz\right)\left(3x^3y^2z^2-2xz\right)$$

Exercise 3.96 Expand

$$\left(-2m^3+4n^3\right)\left(2m^4+2n^2\right)\left(-5mn^3-3n^4\right)$$

Exercise 3.97 Expand

$$\left(-4ln^2+m^2\right)\left(-3l^2n-ln\right)\left(-5m^2n^3+5n^3\right)$$

Exercise 3.98 Expand

$$\left(4l^4+2l^3m\right)\left(3l^4m^2-3m^2\right)\left(-5l^3m^4n^4+3m^3n\right)$$

Exercise 3.99 Expand

$$\left(5lm^4-4l\right)\left(ln^3+2\right)\left(3l^3mn^3+4n^3\right)$$

Exercise 3.100 Expand

$$(-2t-2)\left(3r^2t+4r^2\right)\left(-2s^3t^4+2\right)$$

Exercise 3.101 Expand and simplify

$$\left(2q^4-2\right)\left(p^3q^4-5q^4\right)^2$$

Exercise 3.102 Expand and simplify

$$100b^6\cdot\left(5a+3b^2\right)$$

Exercise 3.103 Expand and simplify

$$\left(3acd^4 - 3b^3c^3\right)^2 \left(-5ac^2d - 3c^4\right)$$

Exercise 3.104 Expand and simplify

$$\left(5p^2r^4 + 3\right)^2 \left(p^3q^4r - p^2q^2r^2\right)$$

Exercise 3.105 Expand and simplify

$$\left(5a^4 - a^2b^3c^2\right) \left(3a^2c + 4c^3\right)^2$$

Exercise 3.106 Expand and simplify

$$\left(-x - 3y^3\right)^2 \cdot \left(2x^4 + 4x^2y^2\right)$$

Exercise 3.107 Expand and simplify

$$\left(-2m^3n^3 + 4n^3\right)^2 \left(m^4n^4 - 5n^3\right)$$

Exercise 3.108 Expand and simplify

$$\left(-5l^4n^4 - 1\right)^2 \left(l^2mn + lm^3\right)$$

Exercise 3.109 Expand and simplify

$$\left(p^4 + 5q^2\right) \left(4p^2q + q^2\right)^2$$

Exercise 3.110 Expand and simplify

$$\left(-v^2w^2 - 2\right)^2 \left(-3u^4vw^4 - 5w^2\right)$$

Exercise 3.111 Expand

$$\left(-4p^4q^3 - \frac{1}{3p^4}\right)^2$$

Exercise 3.112 Expand

$$\left(2b^3d^4 + \frac{1}{4a^2}\right)^2$$

Exercise 3.113 Expand

$$\left(4p^3q - \frac{1}{p^2}\right)^2$$

Exercise 3.114 Expand

$$\left(4x^3yz + \frac{1}{y^3z^4}\right)^2$$

Exercise 3.115 Expand

$$\left(u^2vw - \frac{1}{2u^4vw^4}\right)^2$$

Exercise 3.116 Expand

$$\left(-5a^4bc^2+\frac{1}{a^4b^2c^3}\right)^2$$

Exercise 3.117 Expand

$$\left(-3+\frac{1}{mn^4}\right)^2$$

Exercise 3.118 Expand

$$\left(3r^4s^2-\frac{1}{r^4s^4}\right)^2$$

Exercise 3.119 Expand

$$\left(-p^3+\frac{1}{5p^2q^2}\right)^2$$

Exercise 3.120 Expand

$$\left(-3-\frac{1}{5u^4v^2}\right)^2$$

Exercise 3.121 If $a=5b^4+2c^4$, show that

$$(a-x)^2+(a+x)^2=50b^8+40b^4c^4+8c^8+2x^2$$

Exercise 3.122 If $a=5r^2t^2-r^2$, show that

$$(a-x)^2+(a+x)^2=50r^4t^4-20r^4t^2+2r^4+2x^2$$

Exercise 3.123 If $a=4d^2+2$, show that

$$(a-x)^2+(a+x)^2=32d^4+32d^2+2x^2+8$$

Exercise 3.124 If $a=-x^2y^2-xyz^3$, show that

$$(a-x)^2+(a+x)^2=x^2\left(\left(xy^2+yz^3-1\right)^2+\left(xy^2+yz^3+1\right)^2\right)$$

Exercise 3.125 If $a=-5p^4+2q^4$, show that

$$(a-x)^2+(a+x)^2=50p^8-40p^4q^4+8q^8+2x^2$$

Exercise 3.126 If $a=4x^3y^3-y^4$, show that

$$(a-x)^2+(a+x)^2=32x^6y^6-16x^3y^7+2x^2+2y^8$$

Exercise 3.127 If $a=7r^3$, show that

$$(a-x)^2+(a+x)^2=98r^6+2x^2$$

Exercise 3.128 If $a=-5u^4w^4+4$, show that

$$(a-x)^2+(a+x)^2=50u^8w^8-80u^4w^4+2x^2+32$$

Exercise 3.129 If $a = -4b^4c + 2bc^2$, show that

$$(a-x)^2 + (a+x)^2 = 32b^8c^2 - 32b^5c^3 + 8b^2c^4 + 2x^2$$

Exercise 3.130 If $a = x^3yz^4 - 5z$, show that

$$(a-x)^2 + (a+x)^2 = \left(-x^3yz^4 + x + 5z\right)^2 + \left(x^3yz^4 + x - 5z\right)^2$$

Exercise 3.131 If $a = -4m - 4$, show that

$$-(a-x)^3 + (a+x)^3 = -(4m - x + 4)^3 - (4m + x + 4)^3$$

Exercise 3.132 If $a = 3r^4s^3 - 3r^2$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(-3r^4s^3 + 3r^2 + x\right)^3 + \left(3r^4s^3 - 3r^2 + x\right)^3$$

Exercise 3.133 If $a = -2b^4c + b^4$, show that

$$-(a-x)^3 + (a+x)^3 = \left(-2b^4c + b^4 + x\right)^3 - \left(2b^4c - b^4 + x\right)^3$$

Exercise 3.134 If $a = -3b^3c^2 + 2b^2c^3$, show that

$$-(a-x)^3 + (a+x)^3 = \left(-3b^3c^2 + 2b^2c^3 + x\right)^3 - \left(3b^3c^2 - 2b^2c^3 + x\right)^3$$

Exercise 3.135 If $a = -4p^4q - 3$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(4p^4q - x + 3\right)^3 - \left(4p^4q + x + 3\right)^3$$

Exercise 3.136 If $a = 2l^2n^4 - 5m^3$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(-2l^2n^4 + 5m^3 + x\right)^3 + \left(2l^2n^4 - 5m^3 + x\right)^3$$

Exercise 3.137 If $a = -2r^2s^4 - 2r^2s$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(2r^2s^4 + 2r^2s - x\right)^3 - \left(2r^2s^4 + 2r^2s + x\right)^3$$

Exercise 3.138 If $a = -3qr^3 - 2$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(3qr^3 - x + 2\right)^3 - \left(3qr^3 + x + 2\right)^3$$

Exercise 3.139 If $a = -5m^2n - 1$, show that

$$-(a-x)^3 + (a+x)^3 = -\left(5m^2n - x + 1\right)^3 - \left(5m^2n + x + 1\right)^3$$

Exercise 3.140 If $a = -5rs^2 + 1$, show that

$$-(a-x)^3 + (a+x)^3 = \left(-5rs^2 + x + 1\right)^3 - \left(5rs^2 + x - 1\right)^3$$

Exercise 3.141 Solve the equation in x:

$$-4a^2x^2 - 5x^2 - 8x = 0$$

Exercise 3.142 Solve the equation in x:

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

Exercise 3.143 Solve the equation in x:

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

Exercise 3.144 Solve the equation in x:

$$-4ax^2-5ax-4x=0$$

Exercise 3.145 Solve the equation in x:

$$-7a-1=0$$

Exercise 3.146 Solve the equation in x:

$$-5ax^2-a+5x^2+2=0$$

Exercise 3.147 Solve the equation in x:

$$5a^2-5ax+2x=0$$

Exercise 3.148 Solve the equation in x:

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

Exercise 3.149 Solve the equation in x:

$$-6ax-3x^2-2=0$$

Exercise 3.150 Solve the equation in x:

$$5x-4=0$$

Exercise 3.151 Solve the equation in x:

$$2a-7x+5=0$$

Exercise 3.152 Solve the equation in x:

$$-ax-6a-3x=0$$

Exercise 3.153 Solve the equation in x:

$$6ax-7a=0$$

Exercise 3.154 Solve the equation in x:

$$7ax+3=0$$

Exercise 3.155 Solve the equation in x:

$$2a+4x+1=0$$

Exercise 3.156 Solve the equation in x:

$$-5ax-2a+x+8=0$$

Exercise 3.157 Solve the equation in x:

$$6a = 0$$

Exercise 3.158 Solve the equation in x:

$$-2ax + 1 = 0$$

Exercise 3.159 Solve the equation in x:

$$-2ax + 3a - 8x = 0$$

Exercise 3.160 Solve the equation in x:

$$5a + x - 1 = 0$$

Exercise 3.161 Solve the following simultaneous equations for x and y:

$$3x + 4y + 4 = 0$$

$$-5x + 3y + 6 = 0$$

Exercise 3.162 Solve the following simultaneous equations for x and y:

$$x - 3y + 3 = 0$$

$$-5x + 3y + 2 = 0$$

Exercise 3.163 Solve the following simultaneous equations for x and y:

$$x + y = 0$$

$$-5x - 4y - 6 = 0$$

Exercise 3.164 Solve the following simultaneous equations for x and y:

$$3x + 2y = 0$$

$$-4x - 3y - 3 = 0$$

Exercise 3.165 Solve the following simultaneous equations for x and y:

$$-5x - 4y + 1 = 0$$

$$-3x - 4y + 8 = 0$$

Exercise 3.166 Solve the following simultaneous equations for x and y:

$$4x + 3y + 8 = 0$$

$$x - 5y - 2 = 0$$

Exercise 3.167 Solve the following simultaneous equations for x and y:

$$4x - 2y - 6 = 0$$

$$x - y - 6 = 0$$

Exercise 3.168 Solve the following simultaneous equations for x and y:

$$-2x+5y-7=0$$

$$-4x+y+9=0$$

Exercise 3.169 Solve the following simultaneous equations for x and y:

$$2x+y-3=0$$

$$-3x-2y+8=0$$

Exercise 3.170 Solve the following simultaneous equations for x and y:

$$4x+2y-10=0$$

$$-2x-2y=0$$

Exercise 3.171 Solve the following simultaneous equations for x and y:

$$4ax+6y+2=0$$

$$-12ay-12x+5=0$$

Exercise 3.172 Solve the following simultaneous equations for x and y:

$$-5a-3x+12y=0$$

$$4ax-3a+20y=0$$

Exercise 3.173 Solve the following simultaneous equations for x and y:

$$-2ax-25ay-3a=0$$

$$8x-y-4=0$$

Exercise 3.174 Solve the following simultaneous equations for x and y:

$$3ay-3a+16x=0$$

$$-3ax+12y+4=0$$

Exercise 3.175 Solve the following simultaneous equations for x and y:

$$-6ay-9x+3=0$$

$$2ay+2x+2=0$$

Exercise 3.176 Solve the following simultaneous equations for x and y:

$$-5ax+20y-4=0$$

$$8ax-4a-25y=0$$

Exercise 3.177 Solve the following simultaneous equations for x and y:

$$5a+5x+10y=0$$

$$-4ax-5a-10y=0$$

Exercise 3.178 Solve the following simultaneous equations for x and y:

$$-10ay+3a+2x=0$$

$$2ay-4a-25x=0$$

Exercise 3.179 Solve the following simultaneous equations for x and y:

$$15ay-5x-1=0$$

$$10ax+5y-2=0$$

Exercise 3.180 Solve the following simultaneous equations for x and y:

$$-15ax-5a+20y=0$$

$$-5a-20x-20y=0$$

Exercise 3.181 Simplify

$$-\frac{6c}{4c+1}+\frac{4c-5}{3c}$$

Exercise 3.182 Simplify

$$\frac{-5n-1}{2n+5}+\frac{6}{4n+1}$$

Exercise 3.183 Simplify

$$\frac{2-4m}{-3m-5}-\frac{5}{2-2m}$$

Exercise 3.184 Simplify

$$-\frac{5q}{7}+\frac{2-q}{3q+4}$$

Exercise 3.185 Simplify

$$\frac{3u}{2}-\frac{1}{6}$$

Exercise 3.186 Simplify

$$-\frac{b+5}{-4b-2}+\frac{5}{2-5b}$$

Exercise 3.187 Simplify

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

Exercise 3.188 Simplify

$$-\frac{2u+5}{3u+4}-\frac{-5u-3}{2u}$$

Exercise 3.189 Simplify

$$\frac{1-q}{2q+1}+\frac{5q-2}{-3q-4}$$

Exercise 3.190 Simplify

$$\frac{a+5}{6a}-\frac{4a-5}{5a}$$

Exercise 3.191 Simplify

$$\frac{2p-1}{5u-3}+\frac{-3u-5}{4p+5}-\frac{-p-5u}{4p}$$

Exercise 3.192 Simplify

$$-\frac{qy}{-2q-y}+\frac{-3q-4}{3qy+2q}+6$$

Exercise 3.193 Simplify

$$\frac{-5nx-2n}{nx-5n}-\frac{-4nx-2n}{4n+2x}+\frac{5nx-x}{2n}$$

Exercise 3.194 Simplify

$$\frac{9}{7}+\frac{2ps-5s}{-4ps-5s}-\frac{-ps-5p}{4p}$$

Exercise 3.195 Simplify

$$-\frac{4dm}{5}+\frac{d}{2}+\frac{17m}{20}-1$$

Exercise 3.196 Simplify

$$-\frac{-3sx+2}{-3sx+x}+\frac{4x+3}{s+5}-\frac{-s-2x}{3-5x}$$

Exercise 3.197 Simplify

$$-\frac{2x}{7}+\frac{8x}{p-x}-\frac{4x-4}{-3p-1}$$

Exercise 3.198 Simplify

$$\frac{3n}{5}+\frac{-3m-2}{3mn-5n}+\frac{mn+n}{2m-2}$$

Exercise 3.199 Simplify

$$\frac{5v-4}{5v-3}-\frac{6}{4-2p}+\frac{-5pv+5}{2-p}$$

Exercise 3.200 Simplify

$$\frac{-5w-4}{4w+1}+\frac{5w+2}{-5w-3}-\frac{5}{2m}$$

Exercise 3.201 Simplify

$$\frac{\frac{4n}{5}+\frac{4}{3n+4}}{-\frac{n}{2n+3}+2}$$

Exercise 3.202 Simplify

$$\frac{\frac{v}{5}+\frac{9}{2}}{\frac{2v-2}{3v+5}-\frac{5-5v}{7v}}$$

Exercise 3.203 Simplify

$$\frac{-\frac{p}{8}+\frac{-2p-3}{-2p-2}+\frac{1}{8}}{-\frac{p}{3-3p}-\frac{5p+1}{-4p-1}}$$

Exercise 3.204 Simplify

$$\frac{-\frac{5c}{3}+\frac{3c-5}{4c-5}-\frac{1}{3}}{-\frac{4-5c}{5c}+\frac{5c-5}{5c}}$$

Exercise 3.205 Simplify

$$\frac{-1-\frac{-t-4}{7t}}{\frac{t}{-3t-5}-\frac{2-4t}{2t+1}}$$

Exercise 3.206 Simplify

$$\frac{\frac{3m-5}{m}+\frac{3}{2m}}{-\frac{5}{3-m}-\frac{4}{m}}$$

Exercise 3.207 Simplify

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

Exercise 3.208 Simplify

$$\frac{\frac{8x}{5x-3}+\frac{-3x-4}{4-x}}{-\frac{4x}{4x-2}+\frac{-2x-4}{4x+1}}$$

Exercise 3.209 Simplify

$$\frac{-a+\frac{8}{3a}}{\frac{2-2a}{-2a-1}+\frac{2}{4a+5}}$$

Exercise 3.210 Simplify

$$\frac{-\frac{q}{5}+\frac{2q+3}{7q}}{\frac{6}{-3q-5}-\frac{-3q-2}{2-5q}}$$

Exercise 3.211 Divide the polynomial

$$3x^2 - 3x - 3$$

by

$$4 - x$$

Exercise 3.212 Divide the polynomial

$$2x^2 - 4x + 1$$

by

$$2x - 3$$

Exercise 3.213 Divide the polynomial

$$4x^2 + 2x - 1$$

by

$$-x - 2$$

Exercise 3.214 Divide the polynomial

$$5x^2 - 3x + 5$$

by

$$-3x - 1$$

Exercise 3.215 Divide the polynomial

$$x^2 + 2x + 4$$

by

$$3x + 1$$

Exercise 3.216 Divide the polynomial

$$5x^2 + x - 4$$

by

$$-x - 3$$

Exercise 3.217 Divide the polynomial

$$-4x^2 - x - 2$$

by

$$5 - x$$

Exercise 3.218 Divide the polynomial

$$3x^2+4x+5$$

by

$$-4x-3$$

Exercise 3.219 Divide the polynomial

$$-4x^2+x-3$$

by

$$2-5x$$

Exercise 3.220 Divide the polynomial

$$x^2+2x-4$$

by

$$3x+3$$

Exercise 3.221 Divide the polynomial

$$x^3+4x^2-2x+2$$

by

$$3-x$$

Exercise 3.222 Divide the polynomial

$$-2x^3+x^2-x+2$$

by

$$-4x-3$$

Exercise 3.223 Divide the polynomial

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

by

$$3x+1$$

Exercise 3.224 Divide the polynomial

$$2x^3+x^2+5x+3$$

by

$$2-x$$

Exercise 3.225 Divide the polynomial

$$4x^3 - 2x^2 - 2x - 1$$

by

$$-2x - 3$$

Exercise 3.226 Divide the polynomial

$$-4x^3 - x^2 + 5x + 4$$

by

$$5x - 3$$

Exercise 3.227 Divide the polynomial

$$-2x^3 + 2x^2 + 4x - 5$$

by

$$5 - x$$

Exercise 3.228 Divide the polynomial

$$3x^3 - 2x^2 + 3x - 2$$

by

$$3x + 5$$

Exercise 3.229 Divide the polynomial

$$-5x^3 + x^2 + 2x + 5$$

by

$$2x - 3$$

Exercise 3.230 Divide the polynomial

$$2x^3 + 5x^2 - 3x + 2$$

by

$$-4x - 4$$

Exercise 3.231 Divide the polynomial

$$-3x^3 - 5x^2 - 5x + 3$$

by

$$5x^2 - 2x - 3$$

Exercise 3.232 Divide the polynomial

$$2x^3 - 4x^2 + 2x - 3$$

by

$$-5x^2 - 4x + 1$$

Exercise 3.233 Divide the polynomial

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

by

$$-3x^2 - 5x - 2$$

Exercise 3.234 Divide the polynomial

$$-4x^3 + 5x^2 + 5x - 2$$

by

$$-2x^2 - x + 2$$

Exercise 3.235 Divide the polynomial

$$5x^3 - 3x^2 + x + 4$$

by

$$4x^2 - 3x + 2$$

Exercise 3.236 Divide the polynomial

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

by

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

Exercise 3.237 Divide the polynomial

$$2x^3 + x^2 + 3x + 2$$

by

$$-2x^2 + 4x - 5$$

Exercise 3.238 Divide the polynomial

$$-5x^3 - 2x^2 + 3x + 4$$

by

$$5x^2 - 3x - 5$$

Exercise 3.239 Divide the polynomial

$$-x^3 - x^2 - 4x - 3$$

by

$$-5x^2 + 4x + 5$$

Exercise 3.240 Divide the polynomial

$$3x^3 + x^2 + 3x - 3$$

by

$$5x^2 + 2x + 1$$

Exercise 3.241 Divide the polynomial

$$-x^2 + x + 2$$

by

$$2x^2 + 4x + 3$$

Exercise 3.242 Divide the polynomial

$$-5x^2 + x - 5$$

by

$$-3x^2 - 3x + 1$$

Exercise 3.243 Divide the polynomial

$$-4x^2 - x + 2$$

by

$$5x^2 + x - 5$$

Exercise 3.244 Divide the polynomial

$$-4x^2 + x + 1$$

by

$$5x^2 + 3x + 3$$

Exercise 3.245 Divide the polynomial

$$4x^2 - 4x + 1$$

by

$$-2x^2 + 2x + 5$$

Exercise 3.246 Divide the polynomial

$$3x^2+4x+5$$

by

$$4x^2-x-1$$

Exercise 3.247 Divide the polynomial

$$-x^2-x+1$$

by

$$-5x^2+4x-5$$

Exercise 3.248 Divide the polynomial

$$-4x^2+3x-2$$

by

$$x^2-x-2$$

Exercise 3.249 Divide the polynomial

$$-2x^2-4x-2$$

by

$$-2x^2-2x+1$$

Exercise 3.250 Divide the polynomial

$$3x^2-3x-2$$

by

$$-5x^2+5x+4$$

Exercise 3.251 Factorize the polynomial

$$5x^2+22x-15$$

Exercise 3.252 Factorize the polynomial

$$4x^2+14x+10$$

Exercise 3.253 Factorize the polynomial

$$15x^2-14x-8$$

Exercise 3.254 Factorize the polynomial

$$-5x^2+17x+12$$

Exercise 3.255 Factorize the polynomial

$$-10x^2 - 6x + 4$$

Exercise 3.256 Factorize the polynomial

$$2x^2 + 10x + 12$$

Exercise 3.257 Factorize the polynomial

$$-20x^2 - 3x + 9$$

Exercise 3.258 Factorize the polynomial

$$10x^2 - 23x - 5$$

Exercise 3.259 Factorize the polynomial

$$15x^2 - 15$$

Exercise 3.260 Factorize the polynomial

$$x^2 + x - 2$$

Exercise 3.261 Factorize the polynomial

$$25x^3 + 15x^2 + 16x + 16$$

Exercise 3.262 Factorize the polynomial

$$20x^3 + 16x^2 - 24x + 4$$

Exercise 3.263 Factorize the polynomial

$$-3x^3 - 10x^2 + 9$$

Exercise 3.264 Factorize the polynomial

$$20x^3 - 21x^2 + 16x - 3$$

Exercise 3.265 Factorize the polynomial

$$-10x^3 + 17x^2 + 35x + 12$$

Exercise 3.266 Factorize the polynomial

$$9x^3 + 24x^2 + 30x + 15$$

Exercise 3.267 Factorize the polynomial

$$-8x^3 + 14x^2 + 27x + 9$$

Exercise 3.268 Factorize the polynomial

$$2x^3 + 13x^2 + 14x - 5$$

Exercise 3.269 Factorize the polynomial

$$20x^3 - 19x^2 - 22x + 5$$

Exercise 3.270 Factorize the polynomial

$$-2x^3 - 3x^2 + 7x + 5$$

Exercise 3.271 Factorize the polynomial

$$3x^4 - 15x^3 + 11x^2 + x + 12$$

Exercise 3.272 Factorize the polynomial

$$-16x^4 - 16x^3 + 17x^2 - 7x - 3$$

Exercise 3.273 Factorize the polynomial

$$-9x^4 + 3x^3 + 5x^2 - 5x - 2$$

Exercise 3.274 Factorize the polynomial

$$-4x^4 + 9x^3 - 21x^2 + 28x - 10$$

Exercise 3.275 Factorize the polynomial

$$5x^4 + 23x^3 + 2x^2 - 16x - 6$$

Exercise 3.276 Factorize the polynomial

$$-9x^4 + 3x^3 + 3x^2 + 24x - 16$$

Exercise 3.277 Factorize the polynomial

$$8x^4 - 24x^3 + 30x^2 - 18x + 4$$

Exercise 3.278 Factorize the polynomial

$$-15x^4 + 13x^3 - 22x^2 + 24x - 4$$

Exercise 3.279 Factorize the polynomial

$$-4x^4 + 18x^3 - 18x^2 - x - 10$$

Exercise 3.280 Factorize the polynomial

$$8x^4 + 6x^3 - 12x^2 - 6x + 4$$

Exercise 3.281 Factorize the polynomial

$$-45u^3 + 168u^2 - 185u + 50$$

Exercise 3.282 Factorize the polynomial

$$-18w^3 - 24w^2 + 70w + 100$$

Exercise 3.283 Factorize the polynomial

$$18q^3 - 30q^2 - 16q + 32$$

Exercise 3.284 Factorize the polynomial

$$64s^3 - 80s^2 + 28s - 3$$

Exercise 3.285 Factorize the polynomial

$$4l^3 - 19l^2 + 6l + 45$$

Exercise 3.286 Factorize the polynomial

$$-25q^3 - 5q^2 + 16q - 4$$

Exercise 3.287 Factorize the polynomial

$$-25v^3 + 115v^2 - 136v + 48$$

Exercise 3.288 Factorize the polynomial

$$2c^3 + 11c^2 + 12c - 9$$

Exercise 3.289 Factorize the polynomial

$$16l^3 - 56l^2 + 57l - 18$$

Exercise 3.290 Factorize the polynomial

$$80r^3 - 48r^2 - 12r + 8$$

Exercise 3.291 Solve the following equation

$$x^3 - 5x^2 + 3x + 9 = 0$$

Exercise 3.292 Solve the following equation

$$x^3 + 8x^2 + 5x - 50 = 0$$

Exercise 3.293 Solve the following equation

$$x^3 - 12x^2 + 45x - 50 = 0$$

Exercise 3.294 Solve the following equation

$$x^3 + 10x^2 + 32x + 32 = 0$$

Exercise 3.295 Solve the following equation

$$x^3 - 7x^2 + 15x - 9 = 0$$

Exercise 3.296 Solve the following equation

$$x^3 - 5x^2 + 3x + 9 = 0$$

Exercise 3.297 Solve the following equation

$$x^3+9x^2+15x-25=0$$

Exercise 3.298 Solve the following equation

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

Exercise 3.299 Solve the following equation

$$x^3+5x^2+8x+4=0$$

Exercise 3.300 Solve the following equation

$$x^3+9x^2+24x+16=0$$

Exercise 3.301 Solve the following equation

$$x^3-7x^2+7x+15=0$$

Exercise 3.302 Solve the following equation

$$x^3-4x^2-11x+30=0$$

Exercise 3.303 Solve the following equation

$$x^3-x^2-8x+12=0$$

Exercise 3.304 Solve the following equation

$$x^3+3x^2-9x+5=0$$

Exercise 3.305 Solve the following equation

$$x^3-3x+2=0$$

Exercise 3.306 Solve the following equation

$$x^3-2x^2-4x+8=0$$

Exercise 3.307 Solve the following equation

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

Exercise 3.308 Solve the following equation

$$x^3+x^2-17x+15=0$$

Exercise 3.309 Solve the following equation

$$x^3-12x+16=0$$

Exercise 3.310 Solve the following equation

$$x^3-9x^2+26x-24=0$$

Exercise 3.311 Complete the square for the following expression and then solve the equation:

$$-10m^2 - 7m$$

Exercise 3.312 Complete the square for the following expression and then solve the equation:

$$-9x^2 - 15x$$

Exercise 3.313 Complete the square for the following expression and then solve the equation:

$$16l^2 - 4l$$

Exercise 3.314 Complete the square for the following expression and then solve the equation:

$$5n^2 - 21n$$

Exercise 3.315 Complete the square for the following expression and then solve the equation:

$$-3q^2 - 7q$$

Exercise 3.316 Complete the square for the following expression and then solve the equation:

$$4a^2 + 8a$$

Exercise 3.317 Complete the square for the following expression and then solve the equation:

$$20q^2 + 13q$$

Exercise 3.318 Complete the square for the following expression and then solve the equation:

$$-20x^2 + 21x$$

Exercise 3.319 Complete the square for the following expression and then solve the equation:

$$20n^2 - 17n$$

Exercise 3.320 Complete the square for the following expression and then solve the equation:

$$10y^2 + 8y$$

Exercise 3.321 Solve the following inequality

$$3c + 2 \leq 4$$

Exercise 3.322 Solve the following inequality

$$2 - 4w > -1$$

Exercise 3.323 Solve the following inequality

$$4y - 1 < -2$$

Exercise 3.324 Solve the following inequality

$$n + 5 \geq -1$$

Exercise 3.325 Solve the following inequality

$$3 - 3v \geq 3$$

Exercise 3.326 Solve the following inequality

$$4 - 3l < 2$$

Exercise 3.327 Solve the following inequality

$$-2l - 5 \leq -1$$

Exercise 3.328 Solve the following inequality

$$5n - 4 \leq -1$$

Exercise 3.329 Solve the following inequality

$$-4m - 1 > 4$$

Exercise 3.330 Solve the following inequality

$$p + 3 < -2$$

Exercise 3.331 Solve the following inequality for u

$$u - 4y^2 > 3u + 5$$

Exercise 3.332 Solve the following inequality for q

$$2q + 2y < -4q - 3y^2$$

Exercise 3.333 Solve the following inequality for a

$$4a + n < -2a - 3n^2$$

Exercise 3.334 Solve the following inequality for n

$$-n + 2z < 5n - z$$

Exercise 3.335 Solve the following inequality for q

$$-q + 2t^2 \leq 3q - 2$$

Exercise 3.336 Solve the following inequality for y

$$-2c + 2y \geq 3y - 1$$

Exercise 3.337 Solve the following inequality for w

$$4t - 4w \geq -5t + w$$

Exercise 3.338 Solve the following inequality for u

$$-4u + 3x \geq u - 1$$

Exercise 3.339 Solve the following inequality for s

$$3l^2 - 5s \leq -3l + 4s$$

Exercise 3.340 Solve the following inequality for x

$$-5b^2 + 4x \leq -4b + 3x$$

3.2 Solutions

1. $$4+\frac{5}{5mn+1}$$

2. $$-8+\frac{1}{-2uv-5}$$

3. $$-2+\frac{10}{2uw-4}$$

4. $$-5-\frac{10}{-5z-4}$$

5. $$7+\frac{6}{-5p-2}$$

6. $$-9+\frac{10}{-5ln-4}$$

7. $$-2-\frac{2}{4q+3}$$

8. $$8+\frac{2}{3pqr-1}$$

9. $$-6+\frac{9}{-5pq-4}$$

10. $$8+\frac{4}{-5rst-2}$$

11. $$a\left(-2ab^2-3\right)$$

12. $$s^3\cdot(5s+2)$$

13. $$q^3\left(-4p^3qr^4-3\right)$$

14.

$$b^2\left(-2a^2bd^3-5\right)$$

15.

$$-2p^4q^2r-4$$

16.

$$n^2\cdot\left(2m^4+5\right)$$

17.

$$r\left(-q^4+4r^2\right)$$

18.

$$a\left(4a^2bc^2-3\right)$$

19.

$$2r^3\left(s^2+2\right)$$

20.

$$w^2\cdot\left(3u^4-2\right)$$

21.

$$\frac{1}{r^2\cdot(3pq^4r-5)}$$

22.

$$-\frac{1}{rs^3\cdot(5r^3-1)}$$

23.

$$-\frac{1}{r^2-5s^3}$$

24.

$$\frac{1}{c\,(5a^4b-2c)}$$

25.

$$-\frac{1}{4c+5}$$

26.

$$-\frac{1}{t\,(3s^3+t)}$$

27.

$$-\frac{1}{2v\left(v-2w^2\right)}$$

28.

$$-\frac{1}{5b^4c^3+1}$$

29.

$$\frac{1}{2\cdot\left(2r^3-1\right)}$$

30.

$$-\frac{1}{2u^4\left(v^4-1\right)}$$

31.

$$4q^3+2$$

32.

$$3s\left(-r^4s^2-1\right)$$

33.

$$l^2\cdot\left(3l^2m^4-5\right)$$

34.

$$4p^2+5r^4$$

35.

$$r^3\left(r-4s^4t^3\right)$$

36.

$$s\left(-5s^3-3\right)$$

37.

$$rs^2\left(r^3s-4\right)$$

38.

$$-r^4st^3-3$$

39.

$$a^2\cdot\left(5a+2\right)$$

40.

$$q^2\left(q^2-2\right)$$

41.

$$-\frac{1}{m^4n^2-m}$$

42.

$$-\frac{1}{pr^4\left(p+2\right)}$$

43.

$$-\frac{1}{2r^2s\left(r^2s+1\right)}$$

44.

$$-\frac{1}{3p^4q^4r^2-p^2}$$

45.

$$\frac{1}{4q}$$

46.

$$\frac{1}{p^2q^3\cdot\left(3p^2-2r^4\right)}$$

47.

$$-\frac{1}{5p^2q^3r^3-4}$$

48.

$$-\frac{1}{4p^2r^4+1}$$

49.

$$\frac{1}{r^2\cdot\left(3r^2-5s^3\right)}$$

50.

$$-\frac{1}{3s\left(r^3s^3+1\right)}$$

51.

$$\left\{-\frac{5}{3l-1}\right\}$$

52.

$$\left\{\frac{6}{2z-3}\right\}$$

53.

$$\left\{\frac{10}{n+3}\right\}$$

54.

$$\left\{-\frac{7}{2\cdot(2y+1)}\right\}$$

55.

$$\left\{-\frac{7}{2n+1}\right\}$$

56.

$$\left\{-\frac{3}{3u+5}\right\}$$

57.

$$\left\{-\frac{6}{3p-4}\right\}$$

58.

$$\left\{-\frac{1}{5c-2}\right\}$$

59.

$$\left\{\frac{2}{5w-4}\right\}$$

60.

$$\left\{-\frac{3}{2(z-1)}\right\}$$

61.

$$-8r^4st+2r^4s+20r^2s^4t^4-5r^2s^4t^3+8t^4-2t^3$$

62.

$$12r^5s^6+15r^5s^2+16r^4s^7+20r^4s^3+15r^4s^2+20r^3s^3$$

63.

$$-2a^7b^7c^4d^3-10a^6b^8cd+3a^4b^3c^6d^2+2a^3b^6c^4d^6+15a^3b^4c^3+10a^2b^7cd^4$$

64.

$$-2u^6v^3w^4-5u^4v^7w^4-u^4v^3w+4u^3w^4+10uv^4w^4+2uw$$

65.

$$2r^6s^8t^5-3r^5s^8t^5+3r^5s^4t^7+10r^4s^8t^3-15r^3s^8t^3+15r^3s^4t^5$$

66.

$$20p^5q^4 + 25p^3q^3 + 25p^3 - 20p^2q^5 - 25q^4 - 25q$$

67.

$$2a^6b^2 + a^5bc^3 - 3a^5b + 2a^4b^3c + a^3b^2c^4 - 3a^3b^2c$$

68.

$$-5u^5v^5w^3 + 3u^5v^4w^6 - 5u^2v^7 + 3u^2v^6w^3 + 5u^2v^4 - 3u^2v^3w^3$$

69.

$$9p^5q^4 + 15p^4q^4 - 3p^3q^4 - 5p^2q^4$$

70.

$$-12m^5n^5 + 6m^4n^7 - 20m^4n^6 + 10m^3n^8 + 3mn^4 + 5n^5$$

71.

$$4u^{10}w^3 + 5u^9 + 40u^6v^2w^3 + 50u^5v^2 + 100u^2v^4w^3 + 125uv^4$$

72.

$$45l^{11}m^8n^8 + 150l^{10}m^4n^6 + 125l^9n^4 - 27l^8m^{11}n^4 - 90l^7m^7n^2 - 75l^6m^3$$

73.

$$5r^3s^{10} - 20r^3s^9 + 19r^3s^8 + 4r^3s^7 - 4r^3s^6$$

74.

$$25x^3y^4z - 50x^2y^4z - 50x^2y^3z + 25xy^4z + 100xy^3z - 50y^3z$$

75.

$$8pq^8 - 8pq^7 + 2pq^6 + 4q^8r^2 - 4q^7r^2 + q^6r^2$$

76.

$$16r^8s^5 + 8r^7s^5 + 32r^5s^4 + 16r^4s^4 + 16r^2s^3 + 8rs^3$$

77.

$$5rs^8 + 40rs^7 + 80rs^6 + 2s^8 + 16s^7 + 32s^6$$

78.

$$-16r^9s + 8r^8 + 48r^6s^4 - 24r^5s^3 - 36r^3s^7 + 18r^2s^6$$

79.

$$-2m^9n^6 + 3m^8n^7 - 20m^7n^4 + 30m^6n^5 - 50m^5n^2 + 75m^4n^3$$

80.

$$32l^5m^9n^9 + 48l^5m^6n^7 + 18l^5m^3n^5 - 32l^4m^6n^{10} - 48l^4m^3n^8 - 18l^4n^6$$

81.

$$p^8q^2r^6 - 2p^5qr^3 + 10p^4q^3r^5 + p^2 - 10pq^2r^2 + 25q^4r^4$$

82.

$$4x^2y^6 + 8xy^3z^3 - 16xy^3 + 4z^6 - 16z^3 + 16$$

83.

$$4p^6q^2r^4 + 12p^6qr^3 + 9p^6r^2 + 20p^3q^5r^4 + 30p^3q^4r^3 + 25q^8r^4$$

84.

$$m^6n^6 + 2m^6n^3 + m^6 - 2m^3n^3 - 2m^3 + 1$$

85.

$$25r^6s^8t^6 - 50r^6s^7t^7 + 25r^6s^6t^8 - 20r^6s^5t^7 + 20r^6s^4t^8 + 4r^6s^2t^8$$

86.

$$4l^4m^6n^4 - 12l^2m^7n^2 + 16l^2m^3n^2 + 9m^8 - 24m^4 + 16$$

87.

$$25p^4q^6r^6 - 50p^3q^3r^3 - 20p^2q^6r^4 + 25p^2 + 20pq^3r + 4q^6r^2$$

88.

$$9q^2 + 30q + 25$$

89.

$$4c^2 - 12cd - 20c + 9d^2 + 30d + 25$$

90.

$$16a^2b^6c^4d^2 + 16a^2b^3c^2d^2 + 4a^2d^2 + 16ab^3c^2d + 8ad + 4$$

91.

$$-20u^9v^2w^2 + 4u^8v^2w - 40u^8w^3 + 30u^7v^2w + 8u^7w^2 - 6u^6v^2 + 60u^6w^2 - 12u^5w$$

92.

$$-10l^7m^5n^4 + 40l^7m^4n + 10l^6mn^3 - 40l^6 - 25l^5m^7n^8 + 100l^5m^6n^5 + 25l^4m^3n^7 - 100l^4m^2n^4$$

93.

$$16r^7s^2 - 24r^7s - 32r^4s^5 + 48r^4s^4 + 4r^3s^4 - 6r^3s^3 - 8s^7 + 12s^6$$

94.

$$6r^5s^2t^8 + 6r^5t^6 - 6r^4s^2t^6 - 6r^4t^4 - 2r^2s^4t^5 - 2r^2s^2t^3 + 2rs^4t^3 + 2rs^2t$$

95.

$$-12x^7y^6z^6 - 60x^6y^{10}z^2 + 8x^5y^4z^5 - 12x^5y^2z^7 + 40x^4y^8z - 60x^4y^6z^3 + 8x^3z^6 + 40x^2y^4z^2$$

96.

$$20m^8n^3 + 12m^7n^4 - 40m^5n^6 - 24m^4n^7 + 20m^4n^5 + 12m^3n^6 - 40mn^8 - 24n^9$$

97.

$$-60l^3m^2n^6 + 60l^3n^6 + 15l^2m^4n^4 - 20l^2m^2n^6 - 15l^2m^2n^4 + 20l^2n^6 + 5lm^4n^4 - 5lm^2n^4$$

98.

$$-60l^{11}m^6n^4 - 30l^{10}m^7n^4 + 36l^8m^5n + 60l^7m^6n^4 + 18l^7m^6n + 30l^6m^7n^4 - 36l^4m^5n - 18l^3m^6n$$

99.

$$15l^5m^5n^6 - 12l^5mn^6 + 30l^4m^5n^3 - 24l^4mn^3 + 20l^2m^4n^6 - 16l^2n^6 + 40lm^4n^3 - 32ln^3$$

100.

$$12r^2s^3t^6 + 28r^2s^3t^5 + 16r^2s^3t^4 - 12r^2t^2 - 28r^2t - 16r^2$$

101.

$$2q^8\left(p^6q^4 - p^6 - 10p^3q^4 + 10p^3 + 25q^4 - 25\right)$$

102.

$$b^6 \cdot \left(500a + 300b^2\right)$$

103.

$$c^4\left(-45a^3d^9 + 90a^2b^3c^2d^5 - 27a^2c^2d^8 - 45ab^6c^4d + 54ab^3c^4d^4 - 27b^6c^6\right)$$

104.

$$p^2q^2r\left(25p^5q^2r^8 - 25p^4r^9 + 30p^3q^2r^4 - 30p^2r^5 + 9pq^2 - 9r\right)$$

105.

$$a^2c^2 \cdot \left(45a^6 - 9a^4b^3c^2 + 120a^4c^2 - 24a^2b^3c^4 + 80a^2c^4 - 16b^3c^6\right)$$

106.

$$2x^2\left(x^4 + 6x^3y^3 + 9x^2y^6 + 2x^2y^2 + 12xy^5 + 18y^8\right)$$

107.

$$4n^9\left(m^{10}n - 4m^7n - 5m^6 + 4m^4n + 20m^3 - 20\right)$$

108.

$$lm\left(25l^9n^9+25l^8m^2n^8+10l^5n^5+10l^4m^2n^4+ln+m^2\right)$$

109.

$$q^2\cdot\left(16p^8+8p^6q+81p^4q^2+40p^2q^3+5q^4\right)$$

110.

$$w^2\left(-3u^4v^5w^6-12u^4v^3w^4-12u^4vw^2-5v^4w^4-20v^2w^2-20\right)$$

111.

$$16p^8q^6+\frac{8q^3}{3}+\frac{1}{9p^8}$$

112.

$$4b^6d^8+\frac{b^3d^4}{a^2}+\frac{1}{16a^4}$$

113.

$$16p^6q^2-8pq+\frac{1}{p^4}$$

114.

$$16x^6y^2z^2+\frac{8x^3}{y^2z^3}+\frac{1}{y^6z^8}$$

115.

$$u^4v^2w^2-\frac{1}{u^2w^3}+\frac{1}{4u^8v^2w^8}$$

116.

$$25a^8b^2c^4-\frac{10}{bc}+\frac{1}{a^8b^4c^6}$$

117.

$$9-\frac{6}{mn^4}+\frac{1}{m^2n^8}$$

118.

$$9r^8s^4-\frac{6}{s^2}+\frac{1}{r^8s^8}$$

119.

$$p^6-\frac{2p}{5q^2}+\frac{1}{25p^4q^4}$$

120.

$$9+\frac{6}{5u^4v^2}+\frac{1}{25u^8v^4}$$

121. Provided in problem statement
122. Provided in problem statement
123. Provided in problem statement
124. Provided in problem statement
125. Provided in problem statement
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137. Provided in problem statement
138. Provided in problem statement
139. Provided in problem statement
140. Provided in problem statement
141.

$$\left\{0, -\frac{8}{4a^2+5}\right\}$$

142.

$$\left\{\frac{5a}{4a^2+1}\right\}$$

143.

$$\left\{0, \frac{2(a+1)}{5}\right\}$$

144.

$$\left\{0, -\frac{5a+4}{4a}\right\}$$

145.

$$\emptyset$$

146.

$$\left\{-\frac{\sqrt{5}\sqrt{-\frac{a-2}{a-1}}}{5}, \frac{\sqrt{5}\sqrt{-\frac{a-2}{a-1}}}{5}\right\}$$

147.

$$\left\{\frac{5a^2}{5a-2}\right\}$$

148.

$$\left\{-\frac{5a^2}{8}-\frac{\sqrt{a\left(25a^3+80a-32\right)}}{8},-\frac{5a^2}{8}+\frac{\sqrt{a\left(25a^3+80a-32\right)}}{8}\right\}$$

149.

$$\left\{-a-\frac{\sqrt{3}\sqrt{3a^2-2}}{3},-a+\frac{\sqrt{3}\sqrt{3a^2-2}}{3}\right\}$$

150.

$$\left\{\frac{4}{5}\right\}$$

151.

$$\left\{\frac{2a}{7}+\frac{5}{7}\right\}$$

152.

$$\left\{-\frac{6a}{a+3}\right\}$$

153.

$$\left\{\frac{7}{6}\right\}$$

154.

$$\left\{-\frac{3}{7a}\right\}$$

155.

$$\left\{-\frac{a}{2}-\frac{1}{4}\right\}$$

156.

$$\left\{-\frac{2\left(a-4\right)}{5a-1}\right\}$$

157.

$$\emptyset$$

158.

$$\left\{\frac{1}{2a}\right\}$$

159.

$$\left\{\frac{3a}{2\left(a+4\right)}\right\}$$

160.

$$\{1-5a\}$$

161.

$$\left\{x:\frac{12}{29},\ y:-\frac{38}{29}\right\}$$

162.

$$\left\{x:\frac{5}{4},\ y:\frac{17}{12}\right\}$$

163.

$$\{x:-6,\ y:6\}$$

164.

$$\{x:6,\ y:-9\}$$

165.

$$\left\{x:-\frac{7}{2},\ y:\frac{37}{8}\right\}$$

166.

$$\left\{x:-\frac{34}{23},\ y:-\frac{16}{23}\right\}$$

167.

$$\{x:-3,\ y:-9\}$$

168.

$$\left\{x:\frac{26}{9},\ y:\frac{23}{9}\right\}$$

169.

$$\{x:-2,\ y:7\}$$

170.

$$\{x:5,\ y:-5\}$$

171.

$$\left\{x:\frac{-4a-5}{8a^2-12},\ y:\frac{5a+6}{12a^2-18}\right\}$$

172.

$$\left\{x:-\frac{16a}{12a+15},\ y:\frac{20a^2+9a}{48a+60}\right\}$$

173.

$$\left\{x : \frac{97}{202},\ y : -\frac{16}{101}\right\}$$

174.

$$\left\{x : \frac{16a}{3a^2+64},\ y : \frac{9a^2-64}{9a^2+192}\right\}$$

175.

$$\left\{x : 3,\ y : -\frac{4}{a}\right\}$$

176.

$$\left\{x : \frac{16a+20}{7a},\ y : \frac{4a}{7}+\frac{32}{35}\right\}$$

177.

$$\left\{x : 0,\ y : -\frac{a}{2}\right\}$$

178.

$$\left\{x : -\frac{17a}{123},\ y : \frac{67}{246}\right\}$$

179.

$$\left\{x : \frac{6a-1}{30a^2+5},\ y : \frac{2a+2}{30a^2+5}\right\}$$

180.

$$\left\{x : -\frac{2a}{3a+4},\ y : \frac{-3a^2+4a}{12a+16}\right\}$$

181.

$$\frac{-2c^2-16c-5}{12c^2+3c}$$

182.

$$\frac{-20n^2+3n+29}{8n^2+22n+5}$$

183.

$$\frac{8m^2+3m+29}{6m^2+4m-10}$$

184.

$$\frac{-15q^2-27q+14}{21q+28}$$

185.

$$\frac{3u}{2} - \frac{1}{6}$$

186.

$$\frac{5b^2 + 3b - 20}{20b^2 + 2b - 4}$$

187.

$$\frac{18y^2 - 6y + 6}{15y^2 + 17y - 4}$$

188.

$$\frac{11u^2 + 19u + 12}{6u^2 + 8u}$$

189.

$$\frac{-13q^2 - 2q + 6}{6q^2 + 11q + 4}$$

190.

$$\frac{55 - 19a}{30a}$$

191.

$$\frac{32p^3 + 20p^2u + 12p^2 + 40pu^2 - 99pu + 25p + 125u^2 - 75u}{80p^2u - 48p^2 + 100pu - 60p}$$

192.

$$\frac{3q^2y^2 + 38q^2y + 18q^2 + 18qy^2 + 9qy - 8q - 4y}{6q^2y + 4q^2 + 3qy^2 + 2qy}$$

193.

$$\frac{14n^2x^2 - 88n^2x - 18n^2 + 5nx^3 - 37nx^2 + 6nx - x^3 + 5x^2}{4n^2x - 20n^2 + 2nx^2 - 10nx}$$

194.

$$\frac{28ps + 228p + 35s + 495}{112p + 140}$$

195.

$$-\frac{4dm}{5} + \frac{d}{2} + \frac{17m}{20} - 1$$

196.

$$\frac{-3s^3x - 21s^2x^2 - 5s^2x + 60sx^3 - 94sx^2 + 33sx - 6s - 20x^3 + 7x^2 + 59x - 30}{15s^2x^2 - 9s^2x + 70sx^2 - 42sx - 25x^2 + 15x}$$

197.

$$\frac{6p^2x - 6px^2 - 194px + 28p + 26x^2 - 84x}{-21p^2 + 21px - 7p + 7x}$$

198.

$$\frac{33m^2n^2 - 30m^2 - 58mn^2 + 10m + 5n^2 + 20}{30m^2n - 80mn + 50n}$$

199.

$$\frac{25pv^2 - 10pv - 4p - 20v + 14}{5pv - 3p - 10v + 6}$$

200.

$$\frac{-90mw^2 - 96mw - 28m - 100w^2 - 85w - 15}{40mw^2 + 34mw + 6m}$$

201.

$$\frac{24n^3 + 68n^2 + 88n + 60}{45n^2 + 150n + 120}$$

202.

$$\frac{42v^3 + 1015v^2 + 1575v}{290v^2 - 40v - 250}$$

203.

$$\frac{-12p^4 + 105p^3 + 87p^2 - 141p - 39}{152p^3 + 64p^2 - 112p - 24}$$

204.

$$\frac{-100c^3 + 150c^2 - 50c}{120c^2 - 258c + 135}$$

205.

$$\frac{-36t^3 - 54t^2 + 22t + 20}{70t^3 + 91t^2 - 70t}$$

206.

$$\frac{6m^2 - 25m + 21}{2m + 24}$$

207.

$$\frac{42b^4 + 4b^3 - 170b^2 - 52b + 80}{21b^4 + 78b^3 + 63b^2 - 18b}$$

208.

$$\frac{-184x^4 + 214x^3 + 77x^2 - 45x - 12}{60x^4 - 236x^3 - 60x^2 + 188x - 48}$$

209.

$$\frac{-24a^4-42a^3+49a^2+112a+40}{24a^3+18a^2-24a}$$

210.

$$\frac{105q^4-17q^3-485q^2-185q+150}{315q^3+1785q^2-70q}$$

211.
$$\begin{array}{r|l} & -3x\ -9 \\ \hline -x+4 & 3x^2\ -3x\ -3 \\ & \underline{-3x^2+12x\ \ \ } \\ & \quad 9x\ -3 \\ & \quad \underline{-9x+36} \\ & \quad\ \ 33 \end{array}$$

212.
$$\begin{array}{r|l} & x-\frac{1}{2} \\ \hline 2x-3 & 2x^2-4x+1 \\ & \underline{-2x^2+3x\ \ \ } \\ & \quad -x+1 \\ & \quad \underline{x-\frac{3}{2}} \\ & \quad\ -\frac{1}{2} \end{array}$$

213.
$$\begin{array}{r|l} & -4x\ +6 \\ \hline -x-2 & 4x^2+2x\ -1 \\ & \underline{-4x^2-8x\ \ \ } \\ & \quad -6x\ -1 \\ & \quad \underline{6x+12} \\ & \quad\ \ 11 \end{array}$$

214.
$$\begin{array}{r|l} & -\frac{5}{3}x+\frac{14}{9} \\ \hline -3x-1 & 5x^2\ -3x\ +5 \\ & \underline{-5x^2\ -\frac{5}{3}x\ \ \ } \\ & \quad -\frac{14}{3}x\ +5 \\ & \quad \underline{\frac{14}{3}x+\frac{14}{9}} \\ & \quad\ \ \frac{59}{9} \end{array}$$

215.
$$\begin{array}{r|l} & \frac{1}{3}x+\frac{5}{9} \\ \hline 3x+1 & x^2+2x+4 \\ & \underline{-x^2-\frac{1}{3}x\ \ \ } \\ & \quad \frac{5}{3}x+4 \\ & \quad \underline{-\frac{5}{3}x-\frac{5}{9}} \\ & \quad\ \ \frac{31}{9} \end{array}$$

216.
$$\begin{array}{r|l} & -5x+14 \\ \hline -x-3 & 5x^2\ +x\ -4 \\ & \underline{-5x^2-15x\ \ \ } \\ & \quad -14x\ -4 \\ & \quad \underline{14x+42} \\ & \quad\ \ 38 \end{array}$$

217.
$$\begin{array}{r|l} & 4x+21 \\ \hline -x+5 & -4x^2-x-2 \\ & \underline{4x^2-20x} \\ & -21x-2 \\ & \underline{21x-105} \\ & -107 \end{array}$$

218.
$$\begin{array}{r|l} & -\frac{3}{4}x-\frac{7}{16} \\ \hline -4x-3 & 3x^2+4x+5 \\ & \underline{-3x^2-\frac{9}{4}x} \\ & \frac{7}{4}x+5 \\ & \underline{-\frac{7}{4}x-\frac{21}{16}} \\ & \frac{59}{16} \end{array}$$

219.
$$\begin{array}{r|l} & \frac{4}{5}x+\frac{3}{25} \\ \hline -5x+2 & -4x^2+x-3 \\ & \underline{4x^2-\frac{8}{5}x} \\ & -\frac{3}{5}x-3 \\ & \underline{\frac{3}{5}x-\frac{6}{25}} \\ & -\frac{81}{25} \end{array}$$

220.
$$\begin{array}{r|l} & \frac{1}{3}x+\frac{1}{3} \\ \hline 3x+3 & x^2+2x-4 \\ & \underline{-x^2-x} \\ & x-4 \\ & \underline{-x-1} \\ & -5 \end{array}$$

221.
$$\begin{array}{r|l} & -x^2-7x-19 \\ \hline -x+3 & x^3+4x^2-2x+2 \\ & \underline{-x^3+3x^2} \\ & 7x^2-2x \\ & \underline{-7x^2+21x} \\ & 19x+2 \\ & \underline{-19x+57} \\ & 59 \end{array}$$

222.
$$\begin{array}{r|l} & \frac{1}{2}x^2-\frac{5}{8}x+\frac{23}{32} \\ \hline -4x-3 & -2x^3+x^2-x+2 \\ & \underline{2x^3+\frac{3}{2}x^2} \\ & \frac{5}{2}x^2-x \\ & \underline{-\frac{5}{2}x^2-\frac{15}{8}x} \\ & -\frac{23}{8}x+2 \\ & \underline{\frac{23}{8}x+\frac{69}{32}} \\ & \frac{133}{32} \end{array}$$

223.
$$\begin{array}{r} -\frac{1}{3}x^2 - \frac{5}{9}x + \frac{41}{27} \\ 3x+1\,\overline{)\,-x^3 - 2x^2 + 4x - 1} \\ \underline{\;\;x^3 + \frac{1}{3}x^2\;\;\;\;\;\;\;\;} \\ -\frac{5}{3}x^2 + 4x \\ \underline{\;\;\frac{5}{3}x^2 + \frac{5}{9}x\;\;} \\ \frac{41}{9}x - 1 \\ \underline{-\frac{41}{9}x - \frac{41}{27}} \\ -\frac{68}{27} \end{array}$$

224.
$$\begin{array}{r} -2x^2 - 5x - 15 \\ -x+2\,\overline{)\;\;2x^3 + x^2 + 5x + 3} \\ \underline{-2x^3 + 4x^2\;\;\;\;\;\;} \\ 5x^2 + 5x \\ \underline{-5x^2 + 10x\;\;} \\ 15x + 3 \\ \underline{-15x + 30} \\ 33 \end{array}$$

225.
$$\begin{array}{r} -2x^2 + 4x - 5 \\ -2x-3\,\overline{)\;\;4x^3 - 2x^2 - 2x - 1} \\ \underline{-4x^3 - 6x^2\;\;\;\;\;\;} \\ -8x^2 - 2x \\ \underline{\;\;8x^2 + 12x\;\;} \\ 10x - 1 \\ \underline{-10x - 15} \\ -16 \end{array}$$

226.
$$\begin{array}{r} -\frac{4}{5}x^2 - \frac{17}{25}x + \frac{74}{125} \\ 5x-3\,\overline{)\,-4x^3 - x^2 + 5x + 4} \\ \underline{\;\;4x^3 - \frac{12}{5}x^2\;\;\;\;\;\;} \\ -\frac{17}{5}x^2 + 5x \\ \underline{\;\;\frac{17}{5}x^2 - \frac{51}{25}x\;\;} \\ \frac{74}{25}x + 4 \\ \underline{-\frac{74}{25}x + \frac{222}{125}} \\ \frac{722}{125} \end{array}$$

227.
$$\begin{array}{r} 2x^2 + 8x + 36 \\ -x+5\,\overline{)\,-2x^3 + 2x^2 + 4x - 5} \\ \underline{\;\;2x^3 - 10x^2\;\;\;\;\;\;} \\ -8x^2 + 4x \\ \underline{\;\;8x^2 - 40x\;\;} \\ -36x - 5 \\ \underline{36x - 180} \\ -185 \end{array}$$

228.
$$\begin{array}{r|l} & x^2 - \frac{7}{3}x + \frac{44}{9} \\ \hline 3x+5 & 3x^3 - 2x^2 + 3x - 2 \\ & -3x^3 - 5x^2 \\ \hline & \quad -7x^2 + 3x \\ & \quad 7x^2 + \frac{35}{3}x \\ \hline & \quad \frac{44}{3}x - 2 \\ & \quad -\frac{44}{3}x - \frac{220}{9} \\ \hline & \quad -\frac{238}{9} \end{array}$$

229.
$$\begin{array}{r|l} & -\frac{5}{2}x^2 - \frac{13}{4}x - \frac{31}{8} \\ \hline 2x-3 & -5x^3 + x^2 + 2x + 5 \\ & 5x^3 - \frac{15}{2}x^2 \\ \hline & \quad -\frac{13}{2}x^2 + 2x \\ & \quad \frac{13}{2}x^2 - \frac{39}{4}x \\ \hline & \quad -\frac{31}{4}x + 5 \\ & \quad \frac{31}{4}x - \frac{93}{8} \\ \hline & \quad -\frac{53}{8} \end{array}$$

230.
$$\begin{array}{r|l} & -\frac{1}{2}x^2 - \frac{3}{4}x + \frac{3}{2} \\ \hline -4x-4 & 2x^3 + 5x^2 - 3x + 2 \\ & -2x^3 - 2x^2 \\ \hline & \quad 3x^2 - 3x \\ & \quad -3x^2 - 3x \\ \hline & \quad -6x + 2 \\ & \quad 6x + 6 \\ \hline & \quad 8 \end{array}$$

231.
$$\begin{array}{r|l} & -\frac{3}{5}x - \frac{31}{25} \\ \hline 5x^2-2x-3 & -3x^3 - 5x^2 - 5x + 3 \\ & 3x^3 - \frac{6}{5}x^2 - \frac{9}{5}x \\ \hline & \quad -\frac{31}{5}x^2 - \frac{34}{5}x + 3 \\ & \quad \frac{31}{5}x^2 - \frac{62}{25}x - \frac{93}{25} \\ \hline & \quad -\frac{232}{25}x - \frac{18}{25} \end{array}$$

232.
$$\begin{array}{r|l} & -\frac{2}{5}x + \frac{28}{25} \\ \hline -5x^2-4x+1 & 2x^3 - 4x^2 + 2x - 3 \\ & -2x^3 - \frac{8}{5}x^2 + \frac{2}{5}x \\ \hline & \quad -\frac{28}{5}x^2 + \frac{12}{5}x - 3 \\ & \quad \frac{28}{5}x^2 + \frac{112}{25}x - \frac{28}{25} \\ \hline & \quad \frac{172}{25}x - \frac{103}{25} \end{array}$$

233.
$$\begin{array}{r|l} & \frac{1}{3}x - \frac{2}{9} \\ \hline -3x^2-5x-2 & -x^3 - x^2 + 4x - 1 \\ & x^3 + \frac{5}{3}x^2 + \frac{2}{3}x \\ \hline & \quad \frac{2}{3}x^2 + \frac{14}{3}x - 1 \\ & \quad -\frac{2}{3}x^2 - \frac{10}{9}x - \frac{4}{9} \\ \hline & \quad \frac{32}{9}x - \frac{13}{9} \end{array}$$

234.
$$\begin{array}{r} 2x-\frac{7}{2} \\ -2x^2-x+2\big)\overline{-4x^3+5x^2+5x-2} \\ \underline{4x^3+2x^2-4x} \\ 7x^2+x-2 \\ \underline{-7x^2-\frac{7}{2}x+7} \\ -\frac{5}{2}x+5 \end{array}$$

235.
$$\begin{array}{r} \frac{5}{4}x+\frac{3}{16} \\ 4x^2-3x+2\big)\overline{5x^3-3x^2+x+4} \\ \underline{-5x^3+\frac{15}{4}x^2-\frac{5}{2}x} \\ \frac{3}{4}x^2-\frac{3}{2}x+4 \\ \underline{-\frac{3}{4}x^2+\frac{9}{16}x-\frac{3}{8}} \\ -\frac{15}{16}x+\frac{29}{8} \end{array}$$

236.
$$\begin{array}{r} \frac{1}{3}x-\frac{2}{9} \\ -3x^2+4x+1\big)\overline{-x^3+2x^2-4x-1} \\ \underline{x^3-\frac{4}{3}x^2-\frac{1}{3}x} \\ \frac{2}{3}x^2-\frac{13}{3}x-1 \\ \underline{-\frac{2}{3}x^2+\frac{8}{9}x+\frac{2}{9}} \\ -\frac{31}{9}x-\frac{7}{9} \end{array}$$

237.
$$\begin{array}{r} -x-\frac{5}{2} \\ -2x^2+4x-5\big)\overline{2x^3+x^2+3x+2} \\ \underline{-2x^3+4x^2-5x} \\ 5x^2-2x+2 \\ \underline{-5x^2+10x-\frac{25}{2}} \\ 8x-\frac{21}{2} \end{array}$$

238.
$$\begin{array}{r} -x-1 \\ 5x^2-3x-5\big)\overline{-5x^3-2x^2+3x+4} \\ \underline{5x^3-3x^2-5x} \\ -5x^2-2x+4 \\ \underline{5x^2-3x-5} \\ -5x-1 \end{array}$$

239.
$$\begin{array}{r} \frac{1}{5}x+\frac{9}{25} \\ -5x^2+4x+5\big)\overline{-x^3-x^2-4x-3} \\ \underline{x^3-\frac{4}{5}x^2-x} \\ -\frac{9}{5}x^2-5x-3 \\ \underline{\frac{9}{5}x^2-\frac{36}{25}x-\frac{9}{5}} \\ -\frac{161}{25}x-\frac{24}{5} \end{array}$$

240.
$$\begin{array}{r} \frac{3}{5}x-\frac{1}{25} \\ 5x^2+2x+1\big)\overline{3x^3+x^2+3x-3} \\ \underline{-3x^3-\frac{6}{5}x^2-\frac{3}{5}x} \\ -\frac{1}{5}x^2+\frac{12}{5}x-3 \\ \underline{\frac{1}{5}x^2+\frac{2}{25}x+\frac{1}{25}} \\ \frac{62}{25}x-\frac{74}{25} \end{array}$$

241.
$$\begin{array}{r} -\frac{1}{2} \\ 2x^2+4x+3\big)\overline{-x^2\ +x+2} \\ \underline{x^2+2x+\frac{3}{2}} \\ 3x+\frac{7}{2} \end{array}$$

242.
$$\begin{array}{r} \frac{5}{3} \\ -3x^2-3x+1\big)\overline{-5x^2\ +x\ -5} \\ \underline{5x^2+5x\ -\frac{5}{3}} \\ 6x-\frac{20}{3} \end{array}$$

243.
$$\begin{array}{r} -\frac{4}{5} \\ 5x^2+x-5\big)\overline{-4x^2\ -x+2} \\ \underline{4x^2+\frac{4}{5}x-4} \\ -\frac{1}{5}x-2 \end{array}$$

244.
$$\begin{array}{r} -\frac{4}{5} \\ 5x^2+3x+3\big)\overline{-4x^2\ +x\ +1} \\ \underline{4x^2+\frac{12}{5}x+\frac{12}{5}} \\ \frac{17}{5}x+\frac{17}{5} \end{array}$$

245.
$$\begin{array}{r} -2 \\ -2x^2+2x+5\big)\overline{\ 4x^2-4x\ +1} \\ \underline{-4x^2+4x+10} \\ 0x+11 \end{array}$$

246.
$$\begin{array}{r} \frac{3}{4} \\ 4x^2-x-1\big)\overline{\ 3x^2+4x\ +5} \\ \underline{-3x^2+\frac{3}{4}x\ +\frac{3}{4}} \\ \frac{19}{4}x+\frac{23}{4} \end{array}$$

247.
$$\begin{array}{r} \frac{1}{5} \\ -5x^2+4x-5\big)\overline{-x^2\ -x+1} \\ \underline{x^2-\frac{4}{5}x+1} \\ -\frac{9}{5}x+2 \end{array}$$

248.
$$\begin{array}{r} -4 \\ x^2-x-2\big)\overline{-4x^2+3x\ -2} \\ \underline{4x^2-4x\ -8} \\ -x-10 \end{array}$$

249.
$$\begin{array}{r} 1 \\ -2x^2-2x+1\big)\overline{-2x^2-4x-2} \\ \underline{2x^2+2x-1} \\ -2x-3 \end{array}$$

250.
$$\begin{array}{r} -\frac{3}{5} \\ -5x^2+5x+4\big)\overline{\ 3x^2-3x\ -2} \\ \underline{-3x^2+3x+\frac{12}{5}} \\ 0x\ +\frac{2}{5} \end{array}$$

251.

$$3-5x$$

and

$$-x-5$$

252.

$$-2x-5$$

and

$$-2x-2$$

253.

$$5x+2$$

and

$$3x-4$$

254.

$$5x+3$$

and

$$4-x$$

255.

$$-2x-2$$

and

$$5x-2$$

256.

$$x+3$$

and

$$2x+4$$

257.

$$5x-3$$

and

$$-4x-3$$

258.

$$2x-5$$

and

$$5x+1$$

259.

$$3x+3$$

and

$$5x-5$$

260.

$$x+2$$

and

$$x-1$$

261.

$$5x+4$$

and

$$5x^2-x+4$$

262.

$$1-5x$$

and

$$-4x^2-4x+4$$

263.

$$x+3$$

and

$$-3x^2-x+3$$

264.

$$1-4x$$

and

$$-5x^2+4x-3$$

265.

$$5x+4$$

and

$$-2x^2+5x+3$$

266.

$$-3x-3$$

and

$$-3x^2-5x-5$$

267.

$$-4x-3$$

and

$$2x^2-5x-3$$

268.

$$-x-5$$

and

$$-2x^2-3x+1$$

269.

$$5x-1$$

and

$$4x^2-3x-5$$

270.

$$2x+5$$

and

$$-x^2+x+1$$

271.

$$x-4$$

and

$$3x^3-3x^2-x-3$$

272.

$$-4x-1$$

and

$$4x^3+3x^2-5x+3$$

273.

$$-3x-1$$

and

$$3x^3-2x^2-x+2$$

274.

$$5-4x$$

and

$$x^3-x^2+4x-2$$

275.

$$-5x-3$$

and

$$-x^3-4x^2+2x+2$$

276.

$$3x-4$$

and

$$-3x^3-3x^2-3x+4$$

277.

$$4x-2$$

and

$$2x^3-5x^2+5x-2$$

278.

$$1-5x$$

and

$$3x^3-2x^2+4x-4$$

279.

$$5-2x$$

and

$$2x^3-4x^2-x-2$$

280.

$$2x+2$$

and

$$4x^3-x^2-5x+2$$

281.

$$5-3u$$

and

$$5-3u$$

and

$$2-5u$$

282.

$$3w+5$$

and

$$3w+5$$

and

$$4-2w$$

283.

$$3q-4$$

and

$$3q-4$$

and

$$2q+2$$

284.

$$1-4s$$

and

$$1-4s$$

and

$$4s-3$$

285.

$$3-l$$

and

$$3-l$$

and

$$4l+5$$

286.

$$5q-2$$

and

$$5q-2$$

and

$$-q-1$$

287.

$$4-5v$$

and

$$4-5v$$

and

$$3-v$$

288.

$$-c-3$$

and

$$-c-3$$

and

$$2c-1$$

289.

$$3-4l$$

and

$$3-4l$$

and

$$l-2$$

290.

$$4r-2$$

and

$$4r-2$$

and

$$5r+2$$

291. 3, 3 and -1
292. -5, -5 and 2
293. 5, 5 and 2
294. -4, -4 and -2
295. 3, 3 and 1
296. 3, 3 and -1
297. -5, -5 and 1
298. 1, 1 and 1
299. -2, -2 and -1
300. -4, -4 and -1
301. -1, 5 and 3
302. 2, 5 and -3
303. 2, -3 and 2
304. 1, 1 and -5
305. 1, -2 and 1
306. -2, 2 and 2
307. 1, -1 and -1
308. 1, -5 and 3
309. 2, -4 and 2
310. 2, 3 and 4
311. Add the following term to it:

$$-1$$

The solution of the equation becomes:

$$\left[-\frac{1}{2}, -\frac{1}{5}\right]$$

312. Add the following term to it:

$$-4$$

The solution of the equation becomes:

$$\left[-\frac{4}{3}, -\frac{1}{3}\right]$$

313. Add the following term to it:

$$-12$$

The solution of the equation becomes:

$$\left[-\frac{3}{4}, 1\right]$$

314. Add the following term to it:

$$4$$

The solution of the equation becomes:

$$\left[\frac{1}{5}, 4\right]$$

315. Add the following term to it:

$$-4$$

The solution of the equation becomes:

$$\left[-\frac{4}{3}, -1\right]$$

316. Add the following term to it:

$$3$$

The solution of the equation becomes:

$$\left[-\frac{3}{2}, -\frac{1}{2}\right]$$

317. Add the following term to it:

$$-15$$

The solution of the equation becomes:

$$\left[-\frac{5}{4}, \frac{3}{5}\right]$$

318. Add the following term to it:

$$-4$$

The solution of the equation becomes:

$$\left[\frac{1}{4}, \frac{4}{5}\right]$$

319. Add the following term to it:

$$-10$$

The solution of the equation becomes:

$$\left[-\frac{2}{5}, \frac{5}{4}\right]$$

320. Add the following term to it:

$$-2$$

The solution of the equation becomes:

$$\left[-1, \frac{1}{5}\right]$$

321.

$$c \leq \frac{2}{3}$$

322.

$$w < \frac{3}{4}$$

323.

$$y < -\frac{1}{4}$$

324.

$$-6 \leq n$$

325.

$$v \leq 0$$

326.

$$\frac{2}{3} < l$$

327.

$$-2 \leq l$$

328.

$$n \leq \frac{3}{5}$$

329.

$$m < -\frac{5}{4}$$

330.

$$p < -5$$

331.

$$u < \frac{1}{4} - \frac{5y}{4}$$

332.

$$q < \frac{y^2}{5}$$

333.

$$a > \frac{4n}{9}$$

334.

$$n < \frac{5z}{4} - \frac{5}{4}$$

335.

True

336.

$$y \geq -\frac{2c^2}{5} + c$$

337.

$$w \leq \frac{t^2}{4} - \frac{3t}{4}$$

338.

$$u \geq \frac{4x}{3} - \frac{1}{3}$$

339.

$$s \geq -5l^2 - 5l$$

340.

$$x \leq \frac{3b^2}{2}$$

4. Differential Calculus

4.1 Problems

Exercise 4.1 Differentiate the polynomial with respect to w

$$-2w^2+5w-3$$

Exercise 4.2 Differentiate the polynomial with respect to m

$$-m^2+4m-3$$

Exercise 4.3 Differentiate the polynomial with respect to y

$$5y^2-3y+4$$

Exercise 4.4 Differentiate the polynomial with respect to x

$$2x^2-2x+2$$

Exercise 4.5 Differentiate the polynomial with respect to z

$$-5z^2-z-3$$

Exercise 4.6 Differentiate the polynomial with respect to n

$$5n^2+2n-1$$

Exercise 4.7 Differentiate the polynomial with respect to v

$$v^2+4v+3$$

Exercise 4.8 Differentiate the polynomial with respect to d

$$d^2-2d+3$$

Exercise 4.9 Differentiate the polynomial with respect to b

$$2b^2+2b-3$$

Exercise 4.10 Differentiate the polynomial with respect to c

$$-c^2 - 3c + 3$$

Exercise 4.11 Differentiate the following expression with respect to p

$$3p^{\frac{2}{5}} + 5p^{\frac{2}{3}} - \sqrt[3]{p} - 2$$

Exercise 4.12 Differentiate the following expression with respect to d

$$-4d^{\frac{5}{4}} - 3d^5 - 1$$

Exercise 4.13 Differentiate the following expression with respect to s

$$4s^{\frac{5}{3}} + s^{\frac{5}{2}} - s^3 - s^2$$

Exercise 4.14 Differentiate the following expression with respect to u

$$-2u^{\frac{5}{4}} - 2u^{\frac{4}{3}} + 4\sqrt[3]{u} - u$$

Exercise 4.15 Differentiate the following expression with respect to q

$$5q^{\frac{6}{5}} + 7q^4$$

Exercise 4.16 Differentiate the following expression with respect to q

$$5q^{\frac{5}{3}} + 5q^4 + 10q$$

Exercise 4.17 Differentiate the following expression with respect to l

$$-\sqrt[6]{l} - 2l^4 + 2l^2 + 4$$

Exercise 4.18 Differentiate the following expression with respect to y

$$5y^{\frac{5}{2}} + 2y + 2$$

Exercise 4.19 Differentiate the following expression with respect to r

$$5r^{\frac{2}{3}} + 4\sqrt{r} - 10r$$

Exercise 4.20 Differentiate the following expression with respect to u

$$\sqrt[5]{u} + 4u^{\frac{4}{3}} + 3u^{\frac{2}{3}} - u^3$$

Exercise 4.21 Differentiate the following expression with respect to b

$$4\tan\left(4v^2\right)$$

Exercise 4.22 Differentiate the following expression with respect to n

$$3\csc\left(4nv^2\right)$$

Exercise 4.23 Differentiate the following expression with respect to l

$$3\cot^2\left(3c^2l\right)$$

Exercise 4.24 Differentiate the following expression with respect to t

$$5\sec(4t)$$

Exercise 4.25 Differentiate the following expression with respect to m

$$-\cot\left(4c^2m\right)$$

Exercise 4.26 Differentiate the following expression with respect to c

$$-4\tan(2x)$$

Exercise 4.27 Differentiate the following expression with respect to c

$$5\sec^2(s)$$

Exercise 4.28 Differentiate the following expression with respect to x

$$-2\sin^2\left(4v^2\right)$$

Exercise 4.29 Differentiate the following expression with respect to t

$$\tan\left(4t^2\right)$$

Exercise 4.30 Differentiate the following expression with respect to v

$$4\tan(5bv)$$

Exercise 4.31 Differentiate the following expression with respect to a

$$-\cos\left(5u^2\right)-\tan^2\left(3a^2u^2\right)$$

Exercise 4.32 Differentiate the following expression with respect to y

$$2\cos^2(2y)-3\csc^2\left(5v^2y\right)$$

Exercise 4.33 Differentiate the following expression with respect to q

$$-4\sin^2\left(2aq^2\right)+4\sec^2(2q)$$

Exercise 4.34 Differentiate the following expression with respect to z

$$4\cos^2(5uz)+4\cot^2\left(4u^2\right)$$

Exercise 4.35 Differentiate the following expression with respect to a

$$-2\sin^2\left(2a^2\right)-4\tan(5b)$$

Exercise 4.36 Differentiate the following expression with respect to c

$$\cot\left(2r^2\right)+5\cot(5cr)$$

Exercise 4.37 Differentiate the following expression with respect to x

$$-4\sin\left(5m^2x\right)-\frac{1}{\tan^2(5m)}$$

Exercise 4.38 Differentiate the following expression with respect to r

$$-2\cos\left(2pr\right)-4\csc\left(4p^2r\right)$$

Exercise 4.39 Differentiate the following expression with respect to a

$$4\cot\left(a^2\right)-3\cot^2\left(5a^2y^2\right)$$

Exercise 4.40 Differentiate the following expression with respect to s

$$-3\cos^2\left(3s^2\right)-3\cot\left(4a\right)$$

Exercise 4.41 Differentiate the following expression with respect to w

$$-12e^{6w^2}\tan\left(w^2\right)$$

Exercise 4.42 Differentiate the following expression with respect to q

$$12e^{q^2s^2}\cot\left(4q^2s\right)$$

Exercise 4.43 Differentiate the following expression with respect to p

$$-2e^{np^2}\cos\left(p^2\right)$$

Exercise 4.44 Differentiate the following expression with respect to t

$$15e^{3rt}\cos^2\left(3r^2\right)$$

Exercise 4.45 Differentiate the following expression with respect to r

$$-16e^{10b^2}\sin^2\left(2br\right)$$

Exercise 4.46 Differentiate the following expression with respect to w

$$-4e^{5tw^2}\cot^2\left(3t\right)$$

Exercise 4.47 Differentiate the following expression with respect to c

$$-10e^{7w^2}\cot\left(3w^2\right)$$

Exercise 4.48 Differentiate the following expression with respect to a

$$4e^{x}\cos^2\left(a^2\right)$$

Exercise 4.49 Differentiate the following expression with respect to d

$$12e^{9r}\csc^2\left(5d^2r\right)$$

Exercise 4.50 Differentiate the following expression with respect to q

$$-10e^{6n^2}\csc\left(2n^2\right)$$

Exercise 4.51 Differentiate the following expression with respect to x

$$12e^{3nx}\cos\left(2nx^2\right)+\cos^2\left(3nx^2\right)$$

Exercise 4.52 Differentiate the following expression with respect to a

$$15e^{a}\cos^{2}\left(a^{2}m\right)+3\sec^{2}\left(4m^{2}\right)$$

Exercise 4.53 Differentiate the following expression with respect to v

$$-4e^{10c^{2}}\sin^{2}\left(2v\right)+3\csc^{2}\left(3c^{2}\right)$$

Exercise 4.54 Differentiate the following expression with respect to p

$$-12e^{5p}\cot^{2}\left(4np^{2}\right)+2\tan\left(4p\right)$$

Exercise 4.55 Differentiate the following expression with respect to l

$$8e^{4l}\csc\left(3l^{2}t^{2}\right)-2\cot^{2}\left(4lt^{2}\right)$$

Exercise 4.56 Differentiate the following expression with respect to n

$$6e^{10nt^{2}}\sec\left(5n^{2}\right)+2\cos\left(5n^{2}t^{2}\right)$$

Exercise 4.57 Differentiate the following expression with respect to d

$$-16e^{6d^{2}z}\tan\left(2d\right)+2\sec\left(3z\right)$$

Exercise 4.58 Differentiate the following expression with respect to s

$$-2e^{3n^{2}}\tan^{2}\left(2n^{2}s\right)-5\cos^{2}\left(3s^{2}\right)$$

Exercise 4.59 Differentiate the following expression with respect to w

$$-12e^{7w}\cos\left(3w^{2}\right)+2\sec\left(4c^{2}w\right)$$

Exercise 4.60 Differentiate the following expression with respect to r

$$3e^{5r^{2}}\cos^{2}\left(2pr^{2}\right)+3\sec\left(3pr^{2}\right)$$

Exercise 4.61 Let

$$f^{'}\left(x\right)=10x-2$$

If $f(1)=5$, find $f(x)$.

Exercise 4.62 Let

$$f^{'}\left(x\right)=10x-2$$

If $f(10)=482$, find $f(x)$.

Exercise 4.63 Let

$$f^{'}\left(x\right)=2x-3$$

If $f(1)=-1$, find $f(x)$.

Exercise 4.64 Let

$$f^{'}\left(x\right)=4-2x$$

If $f(6)=-15$, find $f(x)$.

Exercise 4.65 Let

$$f'(x) = 4x + 5$$

If $f(2) = 22$, find $f(x)$.

Exercise 4.66 Let

$$f'(x) = -10x - 1$$

If $f(7) = -247$, find $f(x)$.

Exercise 4.67 Let

$$f'(x) = 5 - 6x$$

If $f(9) = -201$, find $f(x)$.

Exercise 4.68 Let

$$f'(x) = 4x - 4$$

If $f(0) = 5$, find $f(x)$.

Exercise 4.69 Let

$$f'(x) = 1 - 2x$$

If $f(2) = -7$, find $f(x)$.

Exercise 4.70 Let

$$f'(x) = -6x - 5$$

If $f(0) = 3$, find $f(x)$.

Exercise 4.71 Let

$$f'(x) = -9x^2 - 6x + 1$$

If $f(9) = -2423$, find $f(x)$.

Exercise 4.72 Let

$$f'(x) = 6x^2 - 4x - 4$$

If $f(4) = 76$, find $f(x)$.

Exercise 4.73 Let

$$f'(x) = 15x^2 + 10x - 1$$

If $f(0) = -2$, find $f(x)$.

Exercise 4.74 Let

$$f'(x) = -9x^2 - 4x - 3$$

If $f(3) = -112$, find $f(x)$.

Exercise 4.75 Let

$$f'(x) = -6x^2 + 6x - 1$$

If $f(7) = -551$, find $f(x)$.

Exercise 4.76 Let

$$f'(x) = 6x^2 + 8x - 2$$

If $f(5) = 342$, find $f(x)$.

Exercise 4.77 Let

$$f'(x) = 9x^2 + 10x + 1$$

If $f(2) = 51$, find $f(x)$.

Exercise 4.78 Let

$$f'(x) = -9x^2 - 6x + 5$$

If $f(2) = -24$, find $f(x)$.

Exercise 4.79 Let

$$f'(x) = -9x^2 + 10x + 3$$

If $f(8) = -1196$, find $f(x)$.

Exercise 4.80 Let

$$f'(x) = 15x^2 - 4x - 3$$

If $f(4) = 277$, find $f(x)$.

Exercise 4.81 Let

$$f'(x) = x - 5$$

If $(5, -14.5)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.82 Let

$$f'(x) = x - 7$$

If $(7, -29.5)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.83 Let

$$f'(x) = 20 - 5x$$

If $(4, 38.0)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.84 Let

$$f'(x) = 4x - 36$$

If $(9, -164)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.85 Let

$$f'(x) = 15 - 5x$$

If $(3, 23.5)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.86 Let

$$f'(x) = 4x - 4$$

If $(1, -6)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.87 Let

$$f'(x) = 2x - 12$$

If $(6, -38)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.88 Let

$$f'(x) = x - 4$$

If $(4, -3.0)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.89 Let

$$f'(x) = 2x - 2$$

If $(1, -4)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.90 Let

$$f'(x) = 18 - 2x$$

If $(9, 84)$ is a stationary point: find the expression of $f(x)$, and determine the nature of the stationary point.

Exercise 4.91 If $f(x)$ is defined as

$$f(x) = k - x^3 - 9x^2 - 27x - 34$$

for what value of k will $f(x)$ be invertible?

Exercise 4.92 If $f(x)$ is defined as

$$f(x) = k - 64x^3 - 96x^2 - 48x - 7$$

for what value of k will $f(x)$ be invertible?

Exercise 4.93 If $f(x)$ is defined as

$$f(x) = k - 125x^3 - 75x^2 - 15x - 9$$

for what value of k will $f(x)$ be invertible?

Exercise 4.94 If $f(x)$ is defined as

$$f(x) = k - 27x^3 + 108x^2 - 144x + 74$$

for what value of k will $f(x)$ be invertible?

Exercise 4.95 If $f(x)$ is defined as

$$f(x) = k - 8x^3 + 24x^2 - 24x + 4$$

for what value of k will $f(x)$ be invertible?

Exercise 4.96 If $f(x)$ is defined as

$$f(x) = k + 8x^3 - 48x^2 + 96x - 69$$

for what value of k will $f(x)$ be invertible?

Exercise 4.97 If $f(x)$ is defined as

$$f(x) = k - 8x^3 - 36x^2 - 54x - 20$$

for what value of k will $f(x)$ be invertible?

Exercise 4.98 If $f(x)$ is defined as

$$f(x) = k + x^3 + 3x^2 + 3x - 1$$

for what value of k will $f(x)$ be invertible?

Exercise 4.99 If $f(x)$ is defined as

$$f(x) = k - 125x^3 + 150x^2 - 60x + 16$$

for what value of k will $f(x)$ be invertible?

Exercise 4.100 If $f(x)$ is defined as

$$f(x) = k - x^3 - 9x^2 - 27x - 19$$

for what value of k will $f(x)$ be invertible?

Exercise 4.101 For the function

$$f(x) = \frac{x^3}{3} + 2x^2 - 2$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(5,5)$ and $(9,25)$.

Exercise 4.102 For the function

$$f(x) = \frac{x^3}{3} + \frac{5x^2}{2} + 4x + 5$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-2,4)$ and $(2,-4)$.

Exercise 4.103 For the function

$$f(x) = \frac{x^3}{3} - x^2 - 6x + 1$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-5,-4)$ and $(-1,4)$.

Exercise 4.104 For the function

$$f(x) = \frac{x^3}{3} - x^2 + 2x - 3$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-2,4)$ and $(2,24)$.

Exercise 4.105 For the function

$$f(x) = \frac{x^3}{3} - x^2 - 4$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(4,1)$ and $(8,13)$.

Exercise 4.106 For the function

$$f(x) = \frac{x^3}{3} - \frac{x^2}{2} - 5x - 4$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-1,-1)$ and $(3,-13)$.

Exercise 4.107 For the function

$$f(x) = \frac{x^3}{3} - 3x^2 + 14x + 3$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-1,-5)$ and $(3,15)$.

Exercise 4.108 For the function

$$f(x) = \frac{x^3}{3} - \frac{3x^2}{2} + 2$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(3,2)$ and $(7,-6)$.

Exercise 4.109 For the function

$$f(x) = \frac{x^3}{3} + \frac{3x^2}{2} - 7x - 3$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(-3,-1)$ and $(1,11)$.

Exercise 4.110 For the function

$$f(x) = \frac{x^3}{3} + x^2 + x + 5$$

find the two points at which the tangents of the graph of $f(x)$ are parallel to the line connecting the two points $(5,2)$ and $(9,18)$.

Exercise 4.111 For the function

$$f(x) = \frac{x^3}{3} - x^2 - 13x - 2$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(5,-1)$ and $(9,-1/5)$.

Exercise 4.112 For the function

$$f(x) = \frac{x^3}{3} - 2x^2 + 7x - 4$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-2,1)$ and $(2,0)$.

Exercise 4.113 For the function

$$f(x) = \frac{x^3}{3} + \frac{7x^2}{2} + 9x + 3$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-1,-4)$ and $(3,-8/3)$.

Exercise 4.114 For the function

$$f(x) = \frac{x^3}{3} - 2x + 2$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-2,1)$ and $(2,5)$.

Exercise 4.115 For the function

$$f(x) = \frac{x^3}{3} - 9x + 3$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-2,2)$ and $(2,14/5)$.

Exercise 4.116 For the function

$$f(x) = \frac{x^3}{3} - \frac{x^2}{2} - 7x - 2$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-1,2)$ and $(3,6/5)$.

Exercise 4.117 For the function

$$f(x) = \frac{x^3}{3} + \frac{7x^2}{2} + 14x - 3$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(1,1)$ and $(5,-1)$.

Exercise 4.118 For the function

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

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(3,-2)$ and $(7,-14/5)$.

Exercise 4.119 For the function

$$f(x) = \frac{x^3}{3} - \frac{3x^2}{2} - 13x - 1$$

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(-1,2)$ and $(3,10/3)$.

Exercise 4.120 For the function

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

find the two points at which the tangents of the graph of $f(x)$ are perpendicular to the line connecting the two points $(1,4)$ and $(5,24/5)$.

4.2 Solutions

1. $5 - 4w$

2. $4 - 2m$

3. $10y - 3$

4. $4x - 2$

5. $-10z - 1$

6. $10n + 2$

7. $2v + 4$

8. $2d - 2$

9. $4b + 2$

10. $-2c - 3$

11. $\dfrac{50p^{\frac{19}{15}} - 5p^{\frac{14}{15}} + 18p}{15p^{\frac{8}{5}}}$

12. $-5\sqrt[4]{d} - 15d^4$

13. $\dfrac{20s^{\frac{2}{3}}}{3} + \dfrac{5s^{\frac{3}{2}}}{2} - 3s^2 - 2s$

14.

$$\frac{-15u^{\frac{11}{12}} - 6u^{\frac{2}{3}} - 16u + 8}{6u^{\frac{2}{3}}}$$

15.

$$6\sqrt[5]{q} + 28q^3$$

16.

$$\frac{25q^{\frac{2}{3}}}{3} + 20q^3 + 10$$

17.

$$-8l^3 + 4l - \frac{1}{6l^{\frac{5}{6}}}$$

18.

$$\frac{25y^{\frac{3}{2}}}{2} + 2$$

19.

$$-10 + \frac{2}{\sqrt{r}} + \frac{10}{3\sqrt[3]{r}}$$

20.

$$\frac{16\sqrt[3]{u}}{3} - 3u^2 + \frac{2}{\sqrt[3]{u}} + \frac{1}{5u^{\frac{4}{5}}}$$

21.

$$0$$

22.

$$-12v^2 \cot\left(4nv^2\right) \csc\left(4nv^2\right)$$

23.

$$-\frac{18c^2 \cot\left(3c^2 l\right)}{\sin^2\left(3c^2 l\right)}$$

24.

$$20 \tan\left(4t\right) \sec\left(4t\right)$$

25.

$$\frac{4c^2}{\sin^2\left(4c^2 m\right)}$$

26.

$$0$$

27.

$$0$$

28.

$$0$$

29.

$$\frac{8t}{\cos^2\left(4t^2\right)}$$

30.

$$\frac{20b}{\cos^2\left(5bv\right)}$$

31.

$$-\frac{12au^2\tan\left(3a^2u^2\right)}{\cos^2\left(3a^2u^2\right)}$$

32.

$$30v^2\cot\left(5v^2y\right)\csc^2\left(5v^2y\right)-4\sin\left(4y\right)$$

33.

$$-16aq\sin\left(4aq^2\right)+16\tan\left(2q\right)\sec^2\left(2q\right)$$

34.

$$-20u\sin\left(10uz\right)$$

35.

$$-8a\sin\left(4a^2\right)$$

36.

$$-\frac{25r}{\sin^2\left(5cr\right)}$$

37.

$$-20m^2\cos\left(5m^2x\right)$$

38.

$$4p\left(4p\cot\left(4p^2r\right)\csc\left(4p^2r\right)+\sin\left(2pr\right)\right)$$

39.

$$4a\left(\frac{15y^2\cos\left(5a^2y^2\right)}{\sin^3\left(5a^2y^2\right)}-\frac{2}{\sin^2\left(a^2\right)}\right)$$

40.

$$18s\sin\left(6s^2\right)$$

41.

$$-24e^{6w^2}w\left(6\log\left(e\right)\tan\left(w^2\right)+\frac{1}{\cos^2\left(w^2\right)}\right)$$

42.

$$24e^{q^2s^2}qs\left(\frac{s\log\left(e\right)}{\tan\left(4q^2s\right)}-\frac{4}{\sin^2\left(4q^2s\right)}\right)$$

43.

$$4e^{np^2}p\left(-n\log\left(e\right)\cos\left(p^2\right)+\sin\left(p^2\right)\right)$$

44.

$$45e^{3rt}r\log\left(e\right)\cos^2\left(3r^2\right)$$

45.

$$-32be^{10b^2}\sin\left(4br\right)$$

46.

$$-40e^{5tw^2}tw\log\left(e\right)\cot^2\left(3t\right)$$

47.

$$0$$

48.

$$-8ae^x\sin\left(2a^2\right)$$

49.

$$-240de^{9r}r\cot\left(5d^2r\right)\csc^2\left(5d^2r\right)$$

50.

$$0$$

51.

$$12n\left(-4e^{3nx}x\sin\left(2nx^2\right)+3e^{3nx}\log\left(e\right)\cos\left(2nx^2\right)-\frac{x\sin\left(6nx^2\right)}{2}\right)$$

52.

$$15e^a\left(-2am\sin\left(2a^2m\right)+\frac{\log\left(e\right)\cos\left(2a^2m\right)}{2}+\frac{\log\left(e\right)}{2}\right)$$

53.

$$-8e^{10c^2}\sin\left(4v\right)$$

54.

$$\frac{192e^{5p}np\cot\left(4np^2\right)}{\sin^2\left(4np^2\right)}-60e^{5p}\log\left(e\right)\cot^2\left(4np^2\right)+8\tan^2\left(4p\right)+8$$

55.

$$-48e^{4l}lt^2\cot\left(3l^2t^2\right)\csc\left(3l^2t^2\right)+32e^{4l}\log\left(e\right)\csc\left(3l^2t^2\right)+\frac{16t^2\cot\left(4lt^2\right)}{\sin^2\left(4lt^2\right)}$$

56.

$$60e^{10nt^2}n\tan\left(5n^2\right)\sec\left(5n^2\right)+60e^{10nt^2}t^2\log\left(e\right)\sec\left(5n^2\right)-20nt^2\sin\left(5n^2t^2\right)$$

57.

$$e^{6d^2z}\left(-192dz\log\left(e\right)\tan\left(2d\right)-\frac{32}{\cos^2\left(2d\right)}\right)$$

58.

$$-\frac{8e^{3n^2}n^2\tan\left(2n^2s\right)}{\cos^2\left(2n^2s\right)}+30s\sin\left(6s^2\right)$$

59.

$$8c^2\tan\left(4c^2w\right)\sec\left(4c^2w\right)+72e^{7w}w\sin\left(3w^2\right)-84e^{7w}\log\left(e\right)\cos\left(3w^2\right)$$

60.

$$6r\left(-2e^{5r^2}p\sin\left(4pr^2\right)+5e^{5r^2}\log\left(e\right)\cos^2\left(2pr^2\right)+3p\tan\left(3pr^2\right)\sec\left(3pr^2\right)\right)$$

61.

$$f(x)=5x^2-2x+2$$

62.

$$f(x)=5x^2-2x+2$$

63.

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

64.

$$f(x)=-x^2+4x-3$$

65.

$$f(x)=2x^2+5x+4$$

66.

$$f(x) = -5x^2 - x + 5$$

67.

$$f(x) = -3x^2 + 5x - 3$$

68.

$$f(x) = 2x^2 - 4x + 5$$

69.

$$f(x) = -x^2 + x - 5$$

70.

$$f(x) = -3x^2 - 5x + 3$$

71.

$$f(x) = -3x^3 - 3x^2 + x - 2$$

72.

$$f(x) = 2x^3 - 2x^2 - 4x - 4$$

73.

$$f(x) = 5x^3 + 5x^2 - x - 2$$

74.

$$f(x) = -3x^3 - 2x^2 - 3x - 4$$

75.

$$f(x) = -2x^3 + 3x^2 - x - 5$$

76.

$$f(x) = 2x^3 + 4x^2 - 2x + 2$$

77.

$$f(x) = 3x^3 + 5x^2 + x + 5$$

78.

$$f(x) = -3x^3 - 3x^2 + 5x + 2$$

79.

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

80.

$$f(x) = 5x^3 - 2x^2 - 3x + 1$$

81.

$$f(x) = \frac{x^2}{2} - 5x - 2$$

and the stationary point is a minimum

82.

$$f(x) = \frac{x^2}{2} - 7x - 5$$

and the stationary point is a minimum

83.

$$f(x) = -\frac{5x^2}{2} + 20x - 2$$

and the stationary point is a maximum

84.

$$f(x) = 2x^2 - 36x - 2$$

and the stationary point is a minimum

85.

$$f(x) = -\frac{5x^2}{2} + 15x + 1$$

and the stationary point is a maximum

86.

$$f(x) = 2x^2 - 4x - 4$$

and the stationary point is a minimum

87.

$$f(x) = x^2 - 12x - 2$$

and the stationary point is a minimum

88.

$$f(x) = \frac{x^2}{2} - 4x + 5$$

and the stationary point is a minimum

89.

$$f(x) = x^2 - 2x - 3$$

and the stationary point is a minimum

90.

$$f(x) = -x^2 + 18x + 3$$

and the stationary point is a maximum

91. 7
92. -1
93. 8
94. -10
95. 4
96. 5
97. -7
98. 2
99. -8
100. -8
101. -5 and 1
102. -3 and -2
103. 4 and -2
104. 3 and -1
105. -1 and 3
106. -1 and 2
107. 3 and 3
108. 1 and 2
109. 2 and -5
110. 1 and -3
111. 4 and -2
112. 3 and 1
113. -4 and -3
114. 1 and -1
115. 2 and -2
116. 4 and -3
117. -4 and -3
118. 2 and -3
119. 5 and -2
120. 1 and -4