*COMP.5202 NZ Certificate in IT Level 5*

**COMP.5202 Fundamentals of Programming and Problem Solving**

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**Mathematics Algebra**

**Algebra Part Two - Quadratic Equations**

**Overview**

The document will cover:

• Factorising Quadratic Equations

• Solving Quadratic Equations

NOTE: Algebraic expressions are made up of letters, symbols and arithmetic

symbols, eg. + - / \* etc.

**What is a Quadratic Equation?**

A quadratic equation:

• Is one in which the highest power of x is x2.

• Looks like “ax2 + bx + c” where a, b and c are just numbers.

**Examples of Quadratic Equations**

• 2x2 + 5x − 12 (a = 2, b = 5, c = −12)

• 4x2 + 16 (a = 4, b = 0, c = 16)

• 3x2 + 8x (a = 3, b = 8, c = 0)

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**Factorising SIMPLE Quadratic Equations**

To factor a simple quadratic equation, “ax2 + bx + c” where the value of a is not greater

than 1, we need to find 2 factors of c that add together to get b.

Example 1: x2 + 5x + 6 = (x + ?) (x + ?)

In this example, we need to find factors of 6, that add together to give us 5.

Factors of 6 are: 1 and 6, 2 and 3 (also -1 and -6, -2 and -3)

The factors that would add up to give us 5 are 2 and 3.

We can then put these factors in two sets of brackets with an x on the left of each.

So x2 + 5x + 6 = (x + 2) ( x + 3)

CHECK:

We can expand (x + 2) (x + 3) to see if we end up with the original quadratic expression.

Simplifying (by removing the brackets) can be done by using one of the techniques previous

covered, eg. by using the first, lasts, inners and outers technique.

Expanding (x + 2) (x + 3) should end up with the original expression x2 + 5x + 6.

Example 2: x2 – 6x + 8 = (x + ?) (x + ?)

In this example, we need to find factors of 8, that add together to give us -6.

Factors of 8 are: 1 and 8, 2 and 4, -1 and -8, -2 and -4

The factors that would add up to give us -6 are -2 and -4.

We can then put these factors in two sets of brackets with an x on the left of each.

So x2 - 6x + 8 = (x - 2) ( x - 4)

CHECK:

We can expand (x - 2) (x - 4) to see if we end up with the original quadratic expression.

Simplifying (by removing the brackets) can be done by using one of the techniques previous

covered, eg. by using the first, lasts, inners and outers technique.

Expanding (x - 2) (x - 3) should end up with the original expression x2 - 6x + 8.

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**Factorising Quadratics - Exercises**

*Try factorising the following simple quadratic equations:*

1. x2 + 7x + 10

2. x2 + 2x – 8

3. x2 – 7x + 12

4. x2 + 6x + 9

5. x2 + 6x – 7

6. x2 + 10x + 25

7. x2 + 4x – 45

8. x2 – 9

9. x2 - 9x + 20

10. x2 - x – 12

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**Factorising Quadratics – Exercises: Sample Answers:**

You could use an online “Factoring Calculator” to find the answers to the exercise questions. https://www.mathpapa.com/factoring-calculator/

1. x2 + 7x + 10 = (x + 2) (x + 5)

2. x2 + 2x – 8 = (x - 2) (x + 4)

3. x2 – 7x + 12 = (x − 3) (x − 4)

4. x2 + 6x + 9 = (x + 3)(x + 3)

5. x2 + 6x – 7 = (x - 1)(x + 7)

6. x2 + 10x + 25 = (x + 5) (x + 5)

7. x2 + 4x – 45 = (x - 5) (x + 9)

8. x2 – 9 = (x + 3) (x - 3)

9. x2 - 9x + 20 = (x - 4) (x - 5)

10. x2 - x – 12 = (x + 3) (x - 4)

Note: Check by expanding the brackets.

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**Factorising and Solving Quadratics**

**Solving Quadratics - Overview**

We have looked at simplifying and factorising. Now we will look at solving quadratic

equations. That basically means finding the value of “x” (ie. the roots of the quadratic

equation).

So we are solving for “x” in the expression ax2 + bx + c = 0

In a quadratic we will have two answers for “x”, ie. two roots.

Another way of looking at it:

In the equation y = ax2 + bx + c, we want to find the values of “x” when “y = 0”. These

values of “x” are the “roots” of the equation.

**Solving Quadratics - Steps**

The steps for solving a quadratic equation by factorising are as follows:

1. Collect all terms on the left so the quadratic equation is in the following format:

ax2 + bx + c = 0

2. Factor the quadratic equation

3. Set each factor to zero

4. Solve the resulting linear equations (these numbers are called the roots of the quadratic

equation)

5. Check the solutions in the original equation

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**Solving Quadratics - Example**

x2 - x = 20 < find the roots

x2 - x – 20 = 0 Step 1

(x + 4) (x – 5) = 0 Step 2

x + 4 = 0 x – 5 = 0 Step 3

x = -4 x = 5 Step 4

The roots of this quadratic equation are x = -4 and x = 5.

Step 5:

We can check them in the original equation by substitution (substituting the each root value

in place of x)

Substitute x = -4 in the equation x2 - x – 20 = 0

(-4)2 - (-4) – 20 = 0

16 + 4 – 20 = 0

0 = 0

Substitute x = 5 in the equation x2 - x – 20 = 0

(5)2 - (5) – 20 = 0

25 - 5 – 20 = 0

0 = 0

Both roots satisfy the original equation.

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**Solving Quadratics - Exercises**

Solve the following quadratic equations:

1. x2 + x – 6 = 0

2. x2 - 4 = 0

3. x2 + 30 = 11x

4. x2 = 36

5. x2 – 7x + 12 = 0

6. x2 + 6x + 9 = 0

7. x2 + 6x = 7

8. x2 + 25 = -10x

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Solving Quadratics – Exercises: Sample Answers You could use an online “Quadratic Equations Solver” to find the answers to the exercise questions. https://www.mathgoodies.com/calculators/quadratic\_equations

1. x2 + x – 6 = 0

(x - 2) (x + 3) = 0 x = 2 and x = -3

2. x2 - 4 = 0

(x + 2) (x – 2) = 0 x = -2 and x = 2

3. x2 + 30 = 11x

x2 -11x + 30 = 0 (x - 5) (x – 6) = 0 x = 5 and x = 6

4. x2 = 36

x2 - 36 = 0 (x + 6) (x – 6) = 0 x = -6 and x = 6

5. x2 – 7x + 12 = 0

(x – 3) (x – 4) = 0 x = 3 and x = 4

6. x2 + 6x + 9 = 0

(x + 3) (x + 3) = 0 x = -3 and x = -3

7. x2 + 6x = 7

x2 + 6x – 7 = 0 (x – 1) (x + 7) = 0 x = 1 and x = -7

8. x2 + 25 = -10x

x2 + 10x + 25 = 0 (x + 5) (x + 5) = 0 x = -5 and x = -5

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**Additional Info: Graphing Quadratic Equations**

For students who are interested ....

Use the online graphing tool to plot a graph of the following quadratic equations.

https://www.desmos.com/calculator

**y = x2 + 6x - 7**

The graph intersects the x axis (y = 0) at x = -7 and x = 1.

This implies that the roots of the quadratic equation are x = -7 and x = 1.

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**y = x2 + 6x + 9**

The graph touches the x axis (y = 0) at x = -3.

This implies that the roots of the quadratic equation are x = -3 and x = -3.

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**y = x2 - 36**

The graph intersects the x axis (y = 0) at x = -6 and x = 6.

This implies that the roots of the quadratic equation are x = -6 and x = 6.

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