## Contents

1 Introduction to Algebra ..... 1
1.1 Basics of Algebra ..... 1
1.2 Basics of Operations in Algebra ..... 2
Chapter Review ..... 7
2 Addition and Subtraction of Quadratic Expressions ..... 8
2.1 Introduction to Quadratic Terms and Expressions ..... 8
2.2 Like and Unlike Quadratic Terms ..... 9
2.3 Negative of Quadratic Expressions ..... 10
2.4 Addition and Subtraction of Quadratic Expressions ..... 12
2.5 Addition and Subtraction of Quadratic Expressions Involving Fractions ..... 13
2.6 Spot the Mistakes! ..... 15
Chapter Review ..... 16
3 Expansion of Algebraic Expressions ..... 17
3.1 Basic Expansion and Simplification of Algebraic Expressions ..... 18
3.2 Further Expansion and Simplification of Algebraic Expressions ..... 19
3.3 More Complex Expansion and Simplification of Algebraic Expressions ..... 22
3.4 Expansion Using Special Algebraic Identities ..... 25
3.5 Spot the Mistakes! ..... 29
Chapter Review ..... 30
4 Factorisation of Quadratic Expressions ..... 31
4.1 Factorisation of Quadratic Expressions Using Multiplication Frame ..... 32
4.2 Further Factorisation of Quadratic Expressions ..... 37
4.3 Further Factorisation Involving 2 or More Variables ..... 44
4.4 Factorisation Using Algebraic Identities ..... 52
4.5 Factorisation Using Grouping ..... 61
4.6 Spot the Mistakes! ..... 70
Chapter Review ..... 72

\section*{\section*{1 <br> <br> Introduction <br> <br> Introduction <br> to Algebra}

### 1.1 Let's Recap Algebra Skills from Secondary 1

## Basics of Algebra

- Algebra is the use of symbols to represent an unknown variable.
- A constant has a fixed value whereas a variable has a value that is not fixed.

- Like and unlike terms

| Algebraic Expressions | Like terms |
| :--- | :--- |
| $14 a+2 a+5$ | $14 a, 2 a$ |
| $7 x-25 y-12 x$ | $7 x,-12 x$ |
| $\frac{1}{6} t+10 s t-3 s t$ | $10 s t,-3 s t$ |
| $y x+3 y-10 x y+23-10$ | $y x,-10 x y$ |
| $23,-10$ |  |

## Note!

$x y$ and $y$ are unlike terms! $x y$ and are like terms!

### 1.2.5 Four Operations in Algebra

- Just like numbers, we follow the same rules when it comes to algebraic expressions.
- We can use the acronym BODMAS to solve algebraic expression involving more than one operations. The table below summarises the use of BODMAS.

| B | Solve the operations within the $\mathbf{B}_{\text {rackets first. If there }}$ are more than one bracket, solve the innermost bracket first. Apply BODMAS within the bracket. |
| :---: | :---: |
| O | Evaluate indices and $\mathrm{p} \mathrm{O}_{\text {wers. Example, square, square root etc }}$ |
| DM | Evaluate Division and $^{\text {Multiplication. Do it from left to right. }}$ |
| AS | Evaluate $\mathbf{A d d i t i o n ~ a n d ~} \mathbf{S u b t r a c t i o n}$. Do it from left to right. $_{\text {d }}$ |

- Examples of BODMAS application in algebraic expressions

| $\begin{aligned} & 3 m+n-2 m+5(m-3 n) \\ & =3 m+n-2 m+5 m-15 n \\ & =6 m-14 n \end{aligned}$ | $\begin{aligned} & (2 f-4 g)-(f-4 g+3 f) \\ & =2 f-4 g-(4 f-4 g) \\ & =2 f-4 g-4 f+4 g \\ & =-2 f \end{aligned}$ |
| :---: | :---: |
| $\begin{aligned} & 11\left(x y^{2}-2 y\right)-27 x^{2} y \div 3 x^{2} \\ & =11 x y^{2}-22 y-9 y \\ & =11 x y^{2}-31 y \end{aligned}$ | $\begin{aligned} & \left(-45 s^{2} t\right) \div 9 t-(3 s)(4 s)+4 t^{2} \\ & =-5 s^{2}-12 s^{2}+4 t^{2} \\ & =-17 s^{2}+4 t^{2} \end{aligned}$ |
| $\begin{aligned} & 18 y+7[10 x-4(y-3 x)] \\ & =18 y+7[10 x-4 y+12 x] \\ & =18 y+7[22 x-4 y] \\ & =18 y+154 x-28 y \\ & =154 x-10 y \end{aligned}$ | $\begin{aligned} & \left(-42 s^{2} t\right) \div 6 t-(7 s)(4 s)+4 t^{2} \\ & =-7 s^{2}-28 s^{2}+4 t^{2} \\ & =-35 s^{2}+4 t^{2} \end{aligned}$ |

## Quiz A

(1) State the constants, co-efficient of the algebraic terms in the following algebraic expression $2 x-\frac{1}{2} x y$.

Constant $=$
Co-efficient of $x y=$
Co-efficient of $x=$
(2) Simplify the following algebraic expression.
$8 m+16 n+2 m n+10 m n+3 n$
(3) Simplify the following algebraic expression. $22 m n-m-12 m-4 n m$
(4) Simplify the following algebraic expression. $-5(16 n-20 p)$
(5) Simplify the following algebraic expression. $39 b \div 3 b^{3}$
(6) Write algebraic expression for this phrase: the difference of 5 and $k$ square divided by the product of $m$ and $n$.
(7) Factorise the algebraic expression completely. $-15 q^{2} p^{3}-80 q^{3} p^{2}$

8 Solve the equation.
$22-7 b=48-3 b$
(9) Solve the equation.
$12(4-17 x)=84(8 x-10)$
(10) Solve the equation.
$\frac{1}{2+x}+\frac{1}{4}=12$

## Quiz B

(1) Write algebraic expression for this phrase: Half of $x y$ plus $u$.
(2) Simplify the following algebraic expression. $10 m n-m+12 m-n m$
(3) Simplify the following algebraic expression. $9 v-9 v^{2}-19 v^{2}-9 v$
(4) Write an algebraic expression for this phrase: Subtract efg from 10xyz.
(5) Simplify the following algebraic expression. $(14 b-d)(10 b-20 d)$
(6) Write an algebraic expression for this phrase: $4 h$ divided by $2 k$.
$(7$ Simplify the following algebraic expression.
$\frac{2(2 x-3 y)}{5}-\frac{(x-3 y)}{15}+1$

8 Factorise the algebraic expression completely. $24 p+16 p q r-32 p r$
(9) Solve the equation.
$0.6 x+17.4=2(1.7+1.8 x)$
(10) Solve the equation.
$3.4(5 h-2.5)=2.4(1.3-0.8 h)$.
(11) Solve the equation.

$$
\frac{4 x-3}{5}+\frac{x-2}{6}=0
$$

| Simplify the Quadratic Expressions | Notes |
| :---: | :---: |
| $\begin{aligned} & \frac{8}{9} x^{2}-\frac{7}{9} x^{2} \\ & =\frac{8 x^{2}-7 x^{2}}{9} \\ & =\frac{x^{2}}{9} \text { or } \frac{1}{9} x^{2} \end{aligned}$ | Like terms: $\frac{8}{9} x^{2},-\frac{7}{9} x^{2}$ <br> Since both fractions have the same denominators, there is no need to change into a common denominator. <br> Note! <br> $\frac{8}{9} x^{2}$ is the same as $\frac{8 x^{2}}{9}$ |
| $\begin{aligned} & \frac{8}{9} x^{2}-\frac{7}{27} x^{2} \\ & =\frac{24}{27} x^{2}-\frac{7}{27} x^{2} \\ & =\frac{24 x^{2}-7 x^{2}}{27} \\ & =\frac{17 x^{2}}{27} \text { or } \frac{17}{27} x^{2} \end{aligned}$ | Like terms: $\frac{8}{9} x^{2},-\frac{7}{27} x^{2}$ <br> LCM of 9 and 27 will be the common denominator. |
| $\begin{aligned} & -3 x^{2}-\frac{8}{11} x y+x^{2}-\frac{7}{11} x y \\ & =-3 x^{2}+x^{2}-\frac{8}{11} x y-\frac{7}{11} x y \\ & =-2 x^{2}-\frac{15}{11} x y \text { or }=-2 x^{2}-1 \frac{4}{11} x y \end{aligned}$ | Like terms: $\begin{aligned} & -3 x^{2}, x^{2} \\ & -\frac{8}{11} x y,-\frac{7}{11} x y \end{aligned}$ |
| $\begin{aligned} & 22 x-\frac{8}{19} x^{2} y+x^{2}+\frac{13}{19} x^{2} y \\ & =-\frac{8}{19} x^{2} y+\frac{13}{19} x^{2} y+x^{2}+22 x \\ & =\frac{5}{19} x^{2} y+x^{2}+22 x \end{aligned}$ | Like terms $-\frac{8}{19} x^{2} y, \frac{13}{19} x^{2} y$ <br> Always try to put the quadratic terms at the beginning, even if it has a negative co-efficient. |
| $\begin{aligned} & 5 a^{2}-\left(4 a^{2}+\frac{8}{11} a b+a^{2}-\frac{7}{22} a b\right) \\ & =5 a^{2}-\left(4 a^{2}+a^{2}+\frac{8}{11} a b-\frac{7}{22} a b\right) \\ & =5 a^{2}-\left(5 a^{2}+\frac{16}{22} a b-\frac{7}{22} a b\right) \\ & =5 a^{2}-5 a^{2}-\frac{9}{22} a b \\ & =-\frac{9}{22} a b \end{aligned}$ | Firstly, simplify the terms within the parenthesis. Next, remove the parenthesis. |

