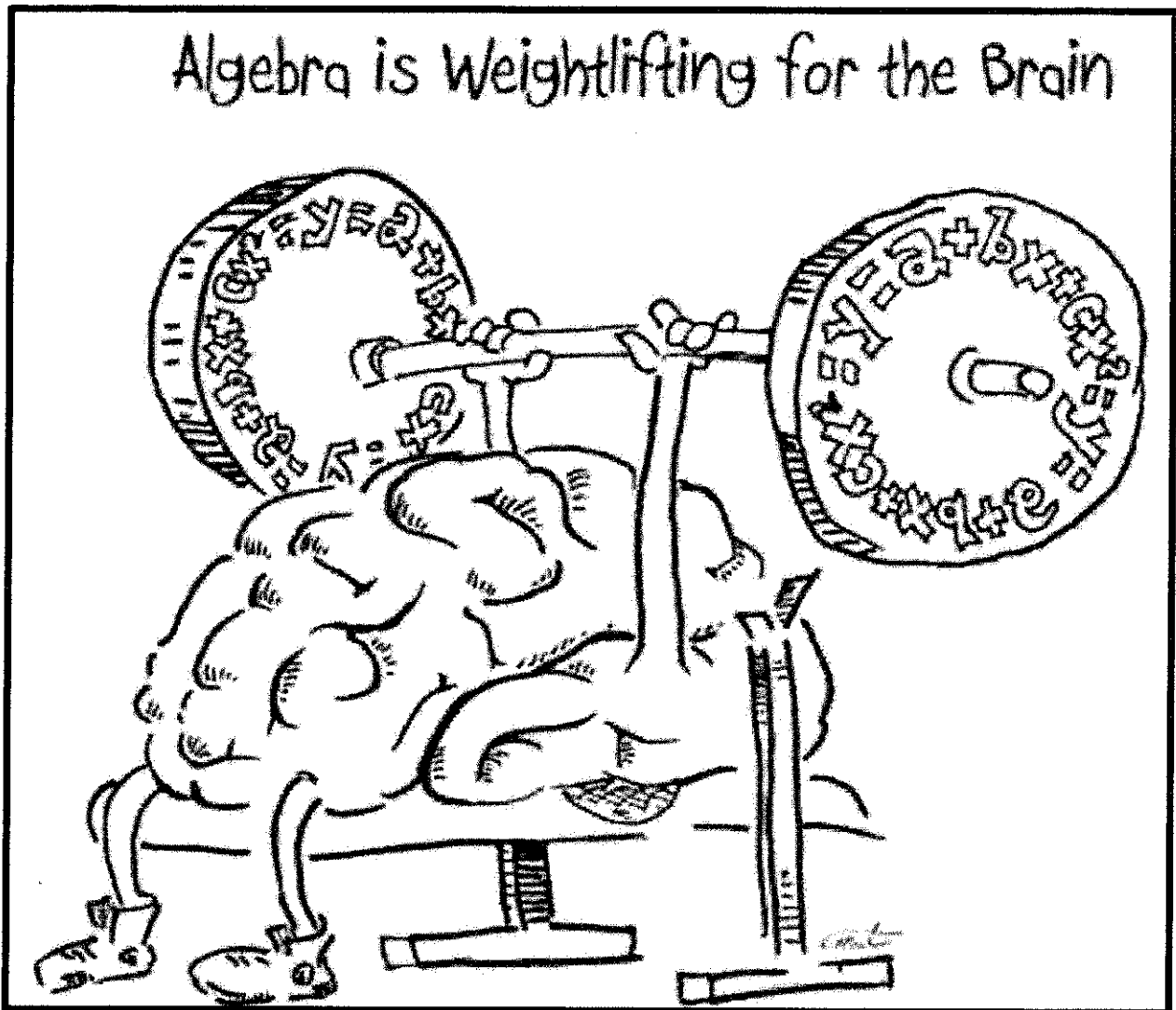


Name: _____

Tutor Group: _____

Tutor: _____

Algebraic Techniques



Mrs Manners (2018)

Like Terms

A	Like Terms have the same: <div style="display: flex; justify-content: space-around; align-items: center;"> 1. <u>letters</u> AND 2. p<u>owers</u> </div>
B	Like Terms can be added and subtracted to form simpler algebraic expressions. Eg. $15a + 5a - 7a = \underline{13a}$ Eg. $2m + 4m - 10m = \underline{-4m}$
C	When adding and subtracting like terms, do not change the p <u>owers</u> . Eg. $e^2 + e^2 + e^2 = \underline{3e^2}$ Eg. $2b^3 + 7b^3 - 3b^2 = \underline{9b^3 - 3b^2}$



3.2 Like terms or not?

Circle **Yes** or **No** to indicate whether each pair consists of like terms.

- | | | | |
|-----------------|---|-----------------------|---|
| 1. $-2p, -2q$ | Yes / <input checked="" type="radio"/> No | 10. $5j, -3j$ | Yes / <input checked="" type="radio"/> No |
| 2. $3m, 7m$ | <input checked="" type="radio"/> Yes / No | 11. h, h^3 | Yes / <input checked="" type="radio"/> No |
| 3. $5r, 5t$ | Yes / <input checked="" type="radio"/> No | 12. $2g, 3g$ | <input checked="" type="radio"/> Yes / No |
| 4. $-6u, -6u^2$ | Yes / <input checked="" type="radio"/> No | 13. $2g^2, 2g^3$ | Yes / <input checked="" type="radio"/> No |
| 5. $k^2, 3k^2$ | <input checked="" type="radio"/> Yes / No | 14. pq, qp | <input checked="" type="radio"/> Yes / No |
| 6. $x, 3x$ | <input checked="" type="radio"/> Yes / No | 15. $2mn, 3nm$ | <input checked="" type="radio"/> Yes / No |
| 7. $y, -y$ | <input checked="" type="radio"/> Yes / No | 16. $3ab^2, 10a^2b$ | Yes / <input checked="" type="radio"/> No |
| 8. $2w, 8w$ | <input checked="" type="radio"/> Yes / No | 17. $2pqr^2, 5r^2qp$ | <input checked="" type="radio"/> Yes / No |
| 9. $2j, 3j^2$ | Yes / <input checked="" type="radio"/> No | 18. $-4c^2de, 4cde^2$ | Yes / <input checked="" type="radio"/> No |

Collecting Like Terms

Watch Video 1

Complete the examples below:

Simplify $12m - 5n - m + 8n$. $\underline{11m + 3n}$	Simplify $4x^2 - 9x + 9x^2 - 12x$. $\underline{13x^2 - 21x}$	Simplify $10ab^2 - 4a^2b + 7a^2b$. $\underline{10ab^2 + 3a^2b}$
--	--	---





3.5 Collecting like terms without directed number

Simplify the following algebraic expressions by collecting the like terms.

Set 1 $(7g) - (1g) + (9g) = 15g$

Tip: Each + or - sign belongs to the term to the right of the sign.

1. $x + x = 2x$

2. $n + n + n + n = 4n$

3. $5m + 8m = 13m$

4. $2h + 3h + h = 6h$

5. $20q - 13q = 7q$

6. $15f + 10f - 3f = 22f$

7. $15q - 2q - 13q = 0$

8. $12b + b - 4b = 9b$

9. $5c + 30c - 11c + 20c = 44c$

10. $23r + 10r - 5r - 8r = 20r$

Set 2 $(15a) + (19b) - (1a) - (10b) = 14a + 9b$

1. $5m - 2m + 7q = 3m + 7q$

2. $25g + 10h - 5g = 20g + 10h$

3. $b + 12b - 4a = 13b - 4a$

4. $7y - y - 10x = 6y - 10x$

5. $10y + 20y + 10z = 30y + 10z$

6. $22c + 4d - 10c + 3d = 12c + 7d$

7. $50e + 40g - e - g = 49e + 39g$

8. $18j + k - 6j + 11k = 12j + 13k$

9. $12p + 22q - p + 8q = 11p + 30q$

10. $33d + 14w - 20d - 9w = 13d + 5w$

Set 3 $(p^2) + (7p^2) - (3p^2) = 5p^2$

Tip: The powers stay the same when adding and subtracting like terms.

1. $b^2 + b^2 + b^2 = 3b^2$

2. $6a^2 + 11a^2 = 17a^2$

3. $22n^3 - 4n^3 = 18n^3$

4. $4pq + 6pq = 10pq$

5. $20ab - ba = 19ba$

6. $4pq + 3pr = 4pq + 3pr$

7. $6a^2b + 4ba^2 = 10a^2b$

8. $14d^2e + 6e^2d = 14d^2e + 6e^2d$

9. $36m^2n - 12n^2m = 36m^2n - 12n^2m$

10. $15m^2n - 12nm^2 = 3m^2n$

Set 4

1. $-35m - 15m = -50m$

2. $6f - 2g - 8f - g = -2f - 3g$

3. $-10bd + 15db - 30bd = -25bd$

4. $11m^5 - 40m^5 = -29m^5$

5. $a^2 + b^2 - 4a^2 = -3a^2 + b^2$

6. $pq - 12qp + pq^2 = -11pq + pq^2$

7. $4a^2b - 19ba^2 = -15a^2b$

8. $-uv^2 + 30v^2u = 29uv^2$

9. $15uv^2 - 4vu^2 = 15uv^2 - 4vu^2$

10. $4zy + 4z^2y = 4zy + 4z^2y$

11. $5z^2y - 12zy^2 = 5z^2y - 12zy^2$

12. $11r^2 - 9r - 15r^2 = -4r^2 - 9r$

Multiplying Algebraic Terms - Understanding

$$2 \times 2 = \underline{2^2}$$

$$2 \times 2 \times 2 = \underline{2^3}$$

$$2 \times 2 \times 2 \times 2 = \underline{2^4}$$

$$2 \times 2 \times 2 \times 2 \times 2 = \underline{2^5}$$

$$2 \times 2 \times 2 \times 2 \times 2 \times 2 = \underline{2^6}$$

$$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = \underline{2^7}$$



$$2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 = \underline{2^4 \times 3^3}$$

$$5 \times 5 \times 7 \times 7 \times 7 \times 7 \times 7 = \underline{5^2 \times 7^5}$$

$$4 \times 4 \times 6 \times 6 \times 6 \times 6 \times 5 = \underline{4^2 \times 6^4 \times 5}$$



$$a \times a = \underline{a^2}$$

$$a \times a \times a = \underline{a^3}$$

$$a \times a \times a \times a = \underline{a^4}$$

$$a \times a \times a \times a \times a = \underline{a^5}$$

$$a \times a \times a \times a \times a \times a = \underline{a^6}$$

$$a \times a \times a \times a \times a \times a \times a = \underline{a^7}$$

$$a \times a \times b \times b \times b \times b = \underline{a^2 b^4}$$

$$e \times e \times e \times e \times e \times e \times a = \underline{e^6 a}$$

As we increase the number of times 2 is multiplied by itself, its power increases.

The number 2 is called a b_____.

We do not combine different bases. We write them separately with their own power.

We will use the exact same rules for letters as we did for the numbers. As we increase the number of times a is multiplied by itself, its **power** increases.

We do not combine different bases like a and b or e and a . We write these terms separately with their own power.

Multiplying Algebraic Terms – Applying your Understanding

EASY

Set 1

- $3 \times a = 3a$
- $10 \times m = 10m$
- $7 \times 2p = 14p$
- $5 \times 4c = 20c$
- $9b \times 3 = 27b$
- $b \times a = ab$
- $a \times b = ab$
- $p \times q \times r = pqr$
- $3n \times 2m = 6mn$
- $5a \times 3b = 15ab$
- $2f \times 6 = 12f$
- $11g \times 5 = 55g$
- $7 \times u = 7u$
- $p \times q = pq$
- $5p \times 4q = 20pq$
- $11 \times 2n = 22n$
- $a \times 9 = 9a$

Set 2

- $a \times a = a^2$
- $a \times a \times a = a^3$
- $c \times c = c^2$
- $c \times d \times c = c^2d$
- $5p \times p = 5p^2$
- $2q \times p = 2pq$
- $2q \times q = 2q^2$
- $2q \times 5 = 10q$
- $d \times e \times 6 = 6de$
- $e \times e \times 7 = 7e^2$
- $n \times n = n^2$
- $n \times m \times n = mn^2$
- $n \times 4 \times 2 = 8n$
- $a \times b \times c = abc$
- $c \times b \times c = c^2b$
- $b \times b \times b = b^3$
- $3 \times b \times 5 = 15b$

Multiplying Algebraic Terms – Applying your Understanding

HARDER

Set 1

- $3a \times 2a \times a = 6a^3$
- $-5m \times 4m \times -m = 20m^3$
- $-f \times -f \times -f = -f^3$
- $-11p \times 5 \times 2p = -110p^2$
- $3n^2 \times -5r = -15n^2r$
- $-12n^2 \times -5n^5 = 60n^7$
- $-6g^2 \times -2g^2 \times -2g^2 = -24g^6$
- $-h^4 \times -h^2 \times -h^2 = -h^8$
- $-7o^{10} \times -5o^{20} \times -o = -35o^{31}$
- $-3r^5 \times -9r^8 \times -2t^2 = -54r^{13}t^2$
- $-4z^{10} \times -15x^{10} = 60z^{10}x^{10}$
- $-w^3 \times -x^4 \times -2y^5 = -2w^3x^4y^5$
- $-8a \times -b^{11} \times -7c^4 = -56ab^{11}c^4$
- $-3d \times -d^4 \times -22d = -66d^6$
- $-5m^2 \times -5m^2 \times -5m^2 = -125m^6$

Set 2

- $-y \times y \times -y = y^3$
- $-y \times y \times y = -y^3$
- $-f \times -e \times -b = -feb$
- $-q \times -r \times q = q^2r$
- $-h^7 \times -h^9 = h^{16}$
- $-11d^8 \times -10b^{12} = 110b^{12}d^8$
- $-j^2 \times -17j^{11} \times j = 17j^{14}$
- $-3s^3 \times -5s^6 \times -s^2 = 15s^{11}$
- $-u^3 \times -u^3 \times -u^4 \times -u = u^{11}$
- $-n \times n \times -n \times -n = -n^4$
- $2a \times -b \times -3a \times -b^2 = -6a^2b^3$
- $-7f^3 \times c^5 \times -4f^{12} \times -c^3 = -28f^{15}c^8$
- $-3m \times 5n \times 2d \times -4m = 120m^2nd$
- $-7m^{11} \times n \times -12n^9 \times -m = -84m^{12}n^{10}$
- $-8m \times -n \times -9n \times -m = +72m^2n^2$





4. Multiplication and division

4.1 Multiplication basics and beyond

Multiply each of these algebraic expressions and write the answer.

Set 1

- $a \times a = a^2$
- $a \times a \times a = a^3$
- $a \times a \times b = a^2b$
- $a \times b \times c = abc$
- $m \times m \times m \times m = m^4$
- $p \times q \times r = pqr$
- $m \times n = mn$
- $m \times n \times m = m^2n$
- $p \times q \times p \times q = p^2q^2$
- $a \times a \times a \times b \times b = a^3b^2$

Set 3

- $4 \times a \times b = 4ab$
- $3 \times m \times 2 \times p = 6mp$
- $6 \times m \times 5 \times m = 30m^2$
- $g \times h \times 4 \times d = 4ghd$
- $6 \times w \times w \times w = 6w^3$
- $10 \times a^2 \times 5 \times a^5 = 50a^7$
- $3 \times p^3 \times 7 \times p^2 = 21p^5$
- $11 \times m^3 \times 4 \times q^3 = 44m^3q^3$
- $12 \times r^5 \times 4 \times t = 48r^5t$
- $9 \times y^{10} \times 12 \times y^2 = 108y^{12}$

Set 2

- $a^2 \times b^2 = a^2b^2$
- $a^2 \times a = a^3$
- $a^2 \times a^2 = a^4$
- $a^2 \times a^5 = a^7$
- $m^2 \times m^5 = m^7$
- $c^4 \times c^{10} = c^{14}$
- $p^2 \times p^3 \times p^5 = p^{10}$
- $f \times f^4 \times f = f^6$
- $d^2 \times e^2 \times f^2 = d^2e^2f^2$
- $d^2 \times e^2 \times d^2 = d^4e^2$

Set 4

- $5mn \times 7mn = 35m^2n^2$
- $12pq \times 3q^9 = 36pq^{10}$
- $3a^2b \times 2ab = 6a^3b^2$
- $8fg^2 \times 7f^2g = 56f^3g^3$
- $9d^5 \times 6e^5 = 54d^5e^5$
- $8e^3g^2 \times 6g^3e = 48e^4g^5$
- $10k^{10}j^5 \times 8k^{10}j^2 = 80k^{20}j^7$
- $4b^4c^6 \times 9c^3b^5 = 36b^9c^9$
- $6p^2q^8 \times 7q^{10}r = 42p^2q^{18}r$
- $8p^6q^5 \times 12q^5p^6 = 96p^{12}q^{10}$

4 Quick Quizzes

Set 1

1. $a + a = 2a$
2. $10a + 7a = 17a$
3. $3a - 3a = 0$
4. $4a - 6a = -2a$
5. $2a + 2a + 2a = 6a$
6. $3 \times 2a = 6a$
7. $a \times a = a^2$
8. $a \times a \times a = a^3$
9. $a \times a \times a = a^3$
10. $5a \times 6a = 30a^2$

Set 2

1. $x + x + x = 3x$
2. $5x - 3x = 2x$
3. $2x - 3x = -x$
4. $x \times x = x^2$
5. $x \times 5 \times x = 5x^2$
6. $2 \times x \times 10 \times x = 20x^2$
7. $x \times 4 \times x \times 2 \times x = 8x^3$
8. $12x - 9x = 3x$
9. $9x - 12x = -3x$
10. $x - x = 0$

Set 3

1. $b^2 + b^2 = 2b^2$
2. $b^2 + b^3 = b^2 + b^3$
3. $5b^2 - 2b^2 = 3b^2$
4. $b \times b = b^2$
5. $b \times b \times b = b^3$
6. $b^2 + b^3 = b^2 + b^3$
7. $b^2 + c^2 = b^2 + c^2$
8. $4b^2 + 8b^2 - 9b^2 = 3b^2$
9. $b^2 + b^2 + b^2 = 3b^2$
10. $b^3 + b^3 + b^3 = 3b^3$

Set 4

1. $y^3 + y^3 = 2y^3$
2. $11y^3 - 4y^3 = 8y^3$
3. $y \times y \times y = y^3$
4. $y^2 \times y^2 \times y^2 = y^6$
5. $d^2 \times e^2 = d^2 e^2$
6. $d^2 + d^2 = 2d^2$
7. $d^2 \times d^2 = d^4$
8. $d^2 + d^2 + d^2 = 3d^2$
9. $d^2 \times d^2 \times d^2 = d^6$
10. $3d^2 \times 5d^4 = 15d^6$



Dividing Algebraic Terms

Watch Video 3

Simplify the following:

a $a^9 \div a^5 = a^4$	b $x^7 \div x^3 = x^4$	c $y^{12} \div y^{10} = y^2$
d $6x^7 \div x^5 = 6x^2$	e $18a^6 \div 9a^4 = 2a^2$	f $36m^7 \div 9m^6 = 4m$
g $15n^{10} \div 5n^6 = 3n^4$	h $9a^9 \div 9a^7 = a^2$	i $48a^6 \div 16a^4 = 3a^2$
j $a^{13} \div a^9 = a^4$	k $k^{12} \div k^5 = k^7$	l $p^7q^7 \div p^4q = p^3q^6$
m $12a^{10} \div 6a^8 = 2a^2$	n $24m^7 \div 12m^3 = 2m^4$	o $m^6n^3 \div m^5 = mn^3$
p $p^9q^6 \div p^6q^3 = p^3q^3$	q $a^{10}n^7 \div a^8 = a^2n^7$	r $12a^6b^4 \div 6a^5b^3 = 2ab$

Write each of the questions below as a fraction before simplifying.

Q1 $27y \div 3 = 9y$	Q9 $32m \div 6mn = \frac{16}{3n}$
Q2 $15xy \div 3 = 5xy$	Q10 $4a^2b \div a^2b = 4$
Q3 $24ab \div 8ac = \frac{3b}{c}$	Q11 $4a^2 \div ab^2 = \frac{4a}{b^2}$
Q4 $32xy \div 24yz = \frac{4x}{3z}$	Q12 $6t \div 12t^2 = \frac{1}{2t}$
Q5 $50mn \div 35n = \frac{10m}{7}$	Q13 $-5abc \div ab = -5c$
Q6 $4x \div 8 = \frac{x}{2}$	Q14 $-36x \div -28y = \frac{9x}{7y}$
Q7 $-3t \div 9t = -\frac{1}{3}$	Q15 $-84mn \div 12m = -7n$
Q8 $-12a^2 \div -6a^2 = 2$	



Order of Operations

B ackets
P owers
D ivision & M ultiplication
A ddition & S ubtraction

Work from left to right if you have both

- division and multiplication
- addition and subtraction

Use order of operations to simplify the following expressions.

$4x + 2x \times 2y$ $= 4x + 4xy$	$3x \times -2y + 4xy$ $= -6xy + 4xy$ $= -2xy$
$5a \times 2b + 3b \times -10a$ $= 10ab + -30ab$ $= 10ab - 30ab$ $= -20ab$	$-7x \times w - 4w \times -2z + wz + 2zw$ $= -7xw + 8wz + wz + 2zw$ $= -7xw + 11zw$
$10a - 40ab \div 10b$ $= 10a - 4a$ $= 6a$	$26xyz \div 2xz + 6y$ $= 13y + 6y$ $= 19y$
$14mn \div 2n - 6m$ $= 7m - 6m$ $= m$	$xz \times 24xyz \div 4xz$ ← left to right $= 24x^2yz^2 \div 4xz$ $= 6xyz$
$20xy \div 5x + 30yz \div 6z$ $= 4y + 5y$ $= 9y$	$15d \times 3f - 200def \div 10e$ $= 45df - 20df$ $= 25df$
$\frac{3y + 4y + 5y}{2y \times 3y \times y}$ $= \frac{12y}{6y^3}$ $= \frac{2}{y^2}$	$\frac{4y \times 2y \times 2y}{4y + 2y + 2y}$ $= \frac{16y^3}{8y}$ $= 2y^2$



Expanding Brackets

Watch Video 4

Set 1: Expand the following brackets. Draw in the imaginary \times sign and the rainbow for each question.

$$5(3-a) = 15 - 5a$$

$$u^2(u-4) = u^3 - 4u^2$$

$$b(b+4) = b^2 + 4b$$

$$2u^8(u^3-3) = 2u^{11} - 6u^8$$

$$z(z-3) = z^2 - 3z$$

$$3p^2(f-3) = 3p^2f - 9p^2$$

$$-5(g^2-2) = -5g^2 + 10$$

$$7c^2(2-c) = 14c^2 - 7c^3$$

$$3(g+h+2) = 3g + 3h + 6$$

$$8m^3(m-z) = 8m^4 - 8m^3z$$

$$-2(k+2y-1) = -2k - 4y + 2$$

$$-4r(r+2) = -4r^2 - 8r$$

$$m(m-6j) = m^2 - 6mj$$

$$-4r^5(r-7) = -4r^6 + 28r^5$$

$$9d(d-5) = 9d^2 - 45d$$

$$-4r^3(r^4-2r) = -4r^7 + 8r^4$$



Set 2: Expand the following brackets: Draw in the imaginary \times sign and the rainbow for each question.

$$2(a-3) + 3(a+5) = 2a - 6 + 3a + 15$$

$$= 5a + 9$$

$$4(a-7) - 3a = 4a - 28 - 3a$$

$$= a - 28$$

$$4(b-3) + 7(b+5) = 4b - 12 + 7b + 35$$

$$= 11b + 23$$

$$5c(c-7) - 3c^2 = 5c^2 - 35c - 3c^2$$

$$= 2c^2 - 35c$$

$$m(m-3) - 1(m+2) = m^2 - 3m - m - 2$$

$$= m^2 - 4m - 2$$

$$7y(y-3) - 6y(y-2) = 7y^2 - 21y - 6y^2 + 12y$$

$$= y^2 - 9y$$

$$p(p+8) + 5p(p+2) = p^2 + 8p + 5p^2 + 10p$$

$$= 6p^2 + 18p$$

$$8(g-7) + 20g = 8g - 56 + 20g$$

$$= 28g - 56$$

$$9f(w-5) + 3w(f+2) = 9fw - 45f + 3wf + 6w$$

$$= 12wf - 45f + 6w$$

$$3(e-4) - e(e-2) = 3e - 12 - e^2 + 2e$$

$$= 5e - 12 - e^2$$

$$k(k+10) + k(k-2) = k^2 + 10k + k^2 - 2k$$

$$= 2k^2 + 8k$$

$$6b(a-3) - 2a(b+5) = 6ab - 18b - 2ab - 10a$$

$$= 4ab - 18b - 10a$$





5. Expanding and factorising

5.1 Expanding brackets

Expand each of the following brackets.

Set 1

Reminder: When multiplying, a + and a - result in a _____.

- $3(a + 5)$ $3a + 15$
- $2(m - 4)$ $2m - 8$
- $10(2 - m)$ $20 - 10m$
- $4(p - q)$ $4p - 4q$
- $8(5 + u)$ $40 + 8u$
- $6(2y - 5)$ $12y - 30$
- $4(3q + 5)$ $12q + 20$
- $9(3 - 2w)$ $27 - 18w$
- $10(5 + 3g)$ $50 + 30g$
- $11(e - d)$ $11e - 11d$

Set 2

Reminder: $p \times q =$ _____ and $p \times p =$ _____.

- $f(g - h)$ $fg - fh$
- $u(v - w)$ $uv - wu$
- $d(e - d)$ $de - d^2$
- $m(m - n)$ $m^2 - mn$
- $q(r - q)$ $qr - q^2$
- $a(b - c)$ $ab - ac$
- $a(a - b)$ $a^2 - ab$
- $a(b - a)$ $ab - a^2$
- $x(x - y)$ $x^2 - xy$
- $x(x + y)$ $x^2 + xy$

Set 3

Reminder: $4n \times m = 4nm$; $3a \times 2e = 6ae$

- $3e(d + f)$ $3ed + 3ef$
- $5q(2 + p)$ $10q + 5pq$
- $5q(2 + q)$ $10q + 5q^2$
- $6d(2f - 3)$ $12df - 18d$
- $9j(2f - g)$ $18jf - 9jg$
- $7r(r + w)$ $7r^2 + 7rw$
- $7r(w - r)$ $7rw - 7r^2$
- $7r(5 - 3r)$ $35r - 21r^2$
- $11m(m - n)$ $11m^2 - 11mn$
- $11m(d - e)$ $11md - 11me$

Set 4

Reminder: When multiplying, a - and a - result in a _____.

- $-5(a + 2)$ $-5a - 10$
- $-4(a - 3)$ $-4a + 12$
- $-10(m + 5)$ $-10m - 50$
- $-7(3 + 2p)$ $-21 - 14p$
- $-6(9a - 4)$ $-54a + 24$
- $-4p(p - g)$ $-4p^2 + 4pg$
- $-2m(h - d)$ $-2mh + 2md$
- $-8z(z + 8)$ $-8z^2 - 64z$
- $-3j(j - 9)$ $-3j^2 + 27j$
- $-11k(i + t)$ $-11ki - 11kt$

Finding the Highest Common Factor (HCF)

Watch Video 5

The highest common factor (HCF) is the largest number that divides exactly into two or more numbers without remainder.

Find the HCF of the following numbers:

1. 5, 20, 10	HCF <u>5</u>	2. 16, 20, 18	HCF <u>2</u>
3. 18, 9, 12	<u>3</u>	4. 8, 24, 40	<u>8</u>
5. 20, 10, 50	<u>10</u>	6. 11, 5, 30	<u>1</u>
7. 25, 10, 15	<u>5</u>	8. 22, 16, 8	<u>2</u>
9. -6, -12	<u>-6</u>	10. -30, -50	<u>-10</u>
11. -21, -14	<u>-7</u>	12. -27, -15	<u>-3</u>

Note: If both terms are negative, the HCF will be negative.

If we have algebraic terms, the HCF is the largest **term** that divides into several algebraic terms.

Find the HCF of the following algebraic terms:

1. $a, 3a, 6a$	HCF <u>a</u>	2. $2p, 5p, 3p$	HCF <u>p</u>
3. $10h, 5h, 20h$	<u>$5h$</u>	4. $12n, 6n, 15n$	<u>$3n$</u>
5. ab, a, b	<u>1</u>	6. n, mn, m	<u>1</u>
7. $3pq, 6p$	<u>$3p$</u>	8. $3pq, 6pq$	<u>$3pq$</u>
9. $20d, 60de$	<u>$10d$</u>	10. $20d, 60e$	<u>10</u>
11. abc, bcd	<u>bc</u>	12. $4abc, 2bcd$	<u>$2bc$</u>
13. u^2, u	<u>u</u>	14. u^3, u^2	<u>u^2</u>
15. x^5, x^2	<u>x^2</u>	16. $2x^3, 4x^2$	<u>$2x^2$</u>
17. $15a^3, 6a^3$	<u>$3a^3$</u>	18. $15a^3, 30a^2$	<u>$15a^2$</u>
19. $12xy^2, 20xy$	<u>$4xy$</u>	20. $12xy^2, 20x^2y$	<u>$4xy$</u>
21. $25a^2b, 10ab^2$	<u>$5ab$</u>	22. $50ab^2, 10a^2b^2$	<u>$10ab^2$</u>
23. $15d, 12d^2$	<u>$3d$</u>	24. $30pq, 20q^3$	<u>$10q$</u>
25. fg, g^2, f^2	<u>1</u>	26. fg, fg^2, f^2g	<u>fg</u>



Factorising

Watch Video 6

Means to take out the highest common factor in an algebraic expression. The highest common factor is written at the front of the bracket.

Type 1: Taking out only a **number** eg. 5(_____).

$$1. \quad 2p + 4q + 12 = 2(p + 2q + 6)$$

$$2. \quad 5a^2 - 30a + 15 = 5(a^2 - 6a + 3)$$

$$3. \quad 24u - 15w = 3(8u - 5w)$$

$$4. \quad 8n - 2q = 2(4n - q)$$

$$5. \quad 12a - 8b = 4(3a - 2b)$$

$$6. \quad 33u - 22b = 11(3u - 2b)$$

$$7. \quad 6z + 18 = 6(z + 3)$$

$$6. \quad 5g - 20 = 5(g - 4)$$

$$9. \quad 10k - 15 = 5(2k - 3)$$

$$10. \quad 24j - 18 = 6(4j - 3)$$

$$11. \quad 50x - 10 = 10(5x - 1)$$

$$12. \quad 50x - 20y = 10(5x - 2y)$$

$$13. \quad 12u - 15 = 3(4u - 5)$$

$$14. \quad 12u - 15k = 3(4u - 3k)$$

$$15. \quad 10g - 25h + 15d = 5(2g - 5h + 3d)$$

$$16. \quad 9f - 3u + 21 = 3(3f - u + 7)$$

$$17. \quad -2p - 22g = -2(p + 11g)$$

$$18. \quad -5b - 15c = -5(b + 3c)$$

$$19. \quad -2g - 7h = -(2g + 7h)$$

$$20. \quad -15y - 9 = -3(5y + 3)$$

$$21. \quad -9y - 15 = -3(3y + 5)$$

$$22. \quad -20p - 30q = -10(2p + 3q)$$

$$23. \quad -8p - 16 = -8(p + 2)$$

$$24. \quad -8p - 12q - 16 = -4(2p + 3q + 4)$$

* If both terms are negative you must take out the minus sign.



Type 2: Taking out a **letter** eg. $m(\underline{\hspace{2cm}})$.

1. $4a + a^2 = a(4+a)$

2. $xy + y^2 + y^3 = y(x+y+y^2)$

3. $abc + bc + ab = b(ac+c+a)$

4. $ab + b^2 = b(a+b)$

5. $10b + b^2 = b(10+b)$

6. $m - mn + m^2n^2 = m(1-n+mn^2)$

7. $12p - 11p^2 = p(12-11p)$

6. $de + d^2 = d(e+d)$

9. $e + e^2 = e(1+e)$

10. $pq + p = p(q+1)$

11. $pq + q^2 = q(p+q)$

12. $f^5 - f^4 = f^4(f-1)$

13. $u^3 + u^5 = u^3(1+u^2)$

14. $abc + bcd = bc(a+d)$

15. $d + 2d^2 = d(1+2d)$

16. $xy + y^2 = y(x+y)$

17. $5d - d^2 + 2d^3 = d(5-d+2d^2)$

18. $gh - hg^2 = gh(1-g)$

19. $a^2b + ab^2 = ab(a+b)$

20. $b^5 - b^3 = b^3(b^2-1)$

21. $zy + zw = z(y+w)$

22. $z^2 + 4zy = z(z+4y)$

23. $-ab - bc = -b(a+c)$

24. $-mp - gm = -m(p+g)$

25. $-h^2 - h^3 = -h^2(1+h)$

26. $-u^2 - u^{10} = -u^2(1+u^8)$

*** If both terms are negative you must take out the minus sign.**



Type 3: Taking out a **number** and a **letter** eg. $4b(\text{_____})$.

1. $5g + 10g^2 = 5g(1 + 2g)$

2. $10n - 15n^3 = 5n(2 - 3n^2)$

3. $2xy + 4y = 2y(x + 2)$

4. $20mn - 10m = 10m(2n - 1)$

5. $8f + 4f^3 = 4f(2 + f^2)$

6. $2xy + 10xz = 2x(y + 5z)$

7. $4ab + 8ac + 12a^2 = 4a(b + 2c + 3a)$

6. $3r + 6r^2 = 3r(1 + 2r)$

9. $24d + 36ed = 6d(4 + 6e)$

10. $16n^2 + 14n = 2n(8n + 7)$

11. $22n - 55mn = 11n(2 - 5m)$

12. $24ab - 15a = 3a(8b - 5)$

13. $15pq + 21q^2 + 3q = 3q(5p + 7q + 1)$

14. $20z^3 - 10z = 10z(2z^2 - 1)$

15. $6b - 9b^2 = 3b(2 - 3b)$

16. $25u - 50u^3 = 25u(1 - 2u^2)$

17. $3pq - 6q + 21q^2 = 3q(p - 2 + 7q)$

18. $27n - 33n^2 + n = n(27 - 33n + 1)$

19. $-5y - 10y^2 = -5y(1 + 2y)$

20. $-30g - 10gh = -10g(3 + h)$

21. $-15pq - 25pq^2 = -5pq(3 + 5q)$

22. $-12z - 21z^2 = -3z(4 + 7z)$

23. $-2q - 2q^2 = -2q(1 + q)$

24. $-18fg - 15f^2 = -3f(6g + 5f)$

25. $-28n - 21n^2 = -7n(4 + 3n)$

26. $-2q - 4q^3 = -2q(1 + 2q^2)$

*** If both terms are negative you must take out the minus sign.**





5.4 Factorising practice

Factorise each of the algebraic expressions by taking out the highest common factor.

Set 1

1. $5p - 20$ $5(p - 4)$
2. $18 - 12e$ $6(3 - 2e)$
3. $12r - 15$ $3(4r - 5)$
4. $25m - 35$ $5(5m - 7)$
5. $54 - 36u$ $6(9 - 6u)$
6. $42g - 49$ $7(6g - 7)$
7. $50 - 15w$ $5(10 - 3w)$
8. $15 - 60s$ $15(1 - 4s)$
9. $36 - 24y$ $6(6 - 4y)$
10. $32h - 56$ $8(4h - 7)$
11. $9a - 12b$ $3(3a - 4b)$
12. $24d - 8$ $8(3d - 1)$

Set 3

1. $4p - 20p^2$ $4p(1 - 5p)$
2. $25a - 20a^3$ $5a(5 - 4a^2)$
3. $45m - 30mn$ $15m(3 - 2n)$
4. $24a + 32ab$ $8a(3 + 4b)$
5. $15st - 12s$ $3s(5t - 4)$
6. $30d - 27d^3$ $3d(10 - 9d^2)$
7. $2x + 6y + 4z$ $2(x + 3y + 2z)$
8. $15a - 21b + 30$ $3(5a - 7b + 10)$
9. $5e - 20f + 40$ $5(e - 4f + 8)$
10. $28m + 40mn - 16m^2$ $4m(7 + 10n - 4m)$
11. $12s - 24t + 30s^2t$ $6(2s - 4t + 5s^2t)$
12. $12ed + 16e^2d + 8de$ $4ed(3 + 4e + 2)$

Set 2

1. $w - w^2$ $w(1 - w)$
2. $w^2 - w^3$ $w^2(1 - w)$
3. $g^2 - g^3$ $g^2(1 - g)$
4. $m - mn$ $m(1 - n)$
5. $abc - ab$ $ab(c - 1)$
6. $ed - e$ $e(d - 1)$
7. $ed - e^2$ $e(d - e)$
8. $pq - p^2q^2$ $pq(1 - pq)$
9. $s^2t - st$ $st(s - 1)$
10. $st - st^3$ $st(1 - t^2)$
11. $a^4b - a^2$ $a^2(a^2b - 1)$
12. $vw^2 - v^2w^2$ $vw^2(1 - v)$

Set 4

1. $-a - b - c$ $-(a + b + c)$
2. $-20 - 30b$ $-10(2 + 3b)$
3. $-80r - 48m$ $-8(10r + 6m)$
4. $-45y - 54y^2$ $-9y(5 + 6y)$
5. $-42a - 36b$ $-6(7a + 6b)$
6. $-60a - 20a^2$ $-20a(3 + a)$
7. $-51m - 17m^3$ $-17m(3 + m^2)$
8. $-ab - ab^2$ $-ab(1 + b)$
9. $-36ab - 45ab^2$ $-9ab(4 + 5b)$
10. $-50mn - 75mp$ $-25m(2n + 3p)$
11. $-48e^3f - 24fe^2$ $-24e^2f(2e + 1)$
12. $-14st - 28t^3$ $-14t(s + 2t^2)$

Homework Sets

Set 1: Expand

1. $2(m + 5) = 2m + 10$

2. $6(p + 3) = 6p + 18$

3. $b(c - d) = bc - bd$

4. $b(c - b) = bc - b^2$

5. $8(2a - 4) = 16a - 32$

6. $y(5x - 2y) = 5xy - 2y^2$

7. $11(p - q) = 11p - 11q$

8. $4(2 - 3r) = 8 - 12r$

9. $b(10d - 3) = 10bd - 3b$

10. $9(2q + 5) = 18q + 45$

11. $7(d + b - n) = 7d + 7b - 7n$

12. $2a(y - 12h) = 2ay - 24ah$

13. $8b(2a - 4) = 16ab - 32b$

14. $3x(5x - 2y) = 15x^2 - 6xy$

15. $11p(p - q) = 11p^2 - 11pq$

Set 2: Factorise

1. $3a - 6 = 3(a - 2)$

2. $5q - 20 = 5(q - 4)$

3. $12z - 15 = 3(4z - 5)$

4. $xy - y^2 = y(x - y)$

5. $ab + bc = b(a + c)$

6. $n^2 + n^4 = n^2(1 + n^2)$

7. $c - c^5 = c(1 - c^4)$

8. $8a - 4a^3 = 4a(2 - a^2)$

9. $2p - 6pq = 2p(1 - 3q)$

10. $2p - 6p^2 = 2p(1 - 3p)$

11. $15m - 5n = 5(3m - n)$

12. $15m - 5mn = 5m(3 - n)$

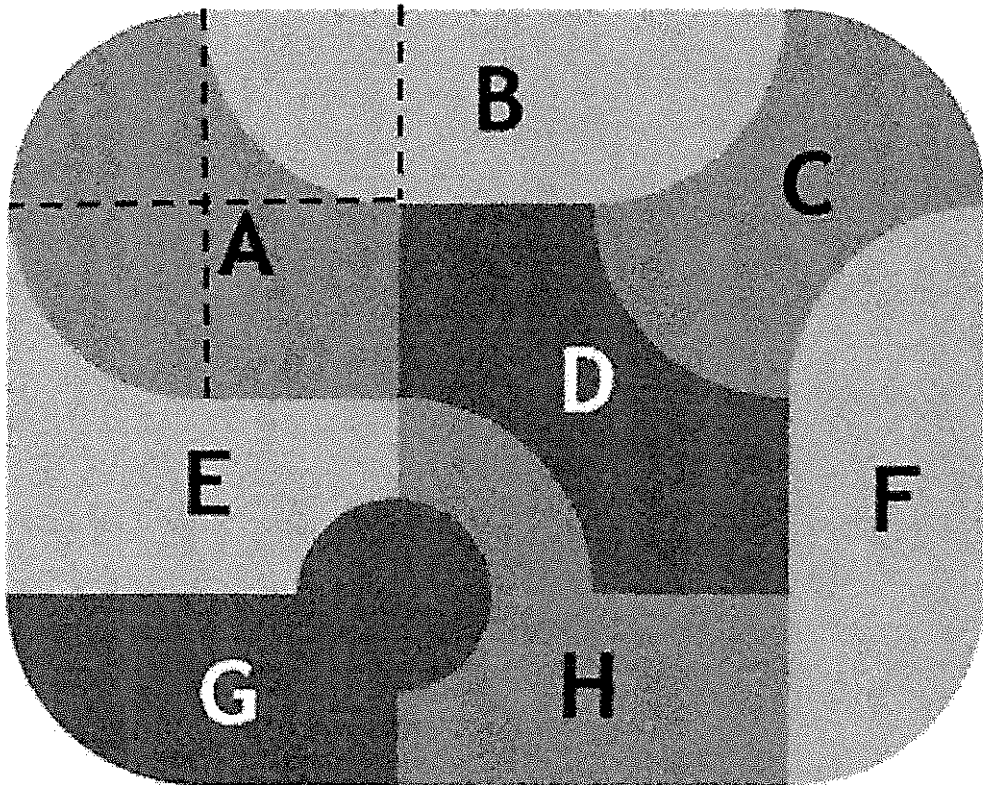
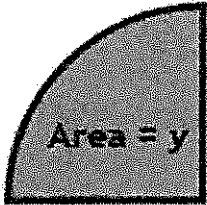
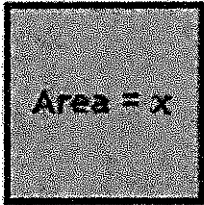
13. $15m - 5m^2n = 5m(3 - mn)$

14. $ab^2 + ab^3 = ab^2(1 + b)$

15. $a^2b + a^3b^2 = a^2b(1 + ab)$

Challenge 1:

Given a square with area x ,
and quadrant with area y , determine
the area of the individual shapes (A \rightarrow H)
within the larger composite shape below.



A _____

B _____

C _____

D _____

E _____

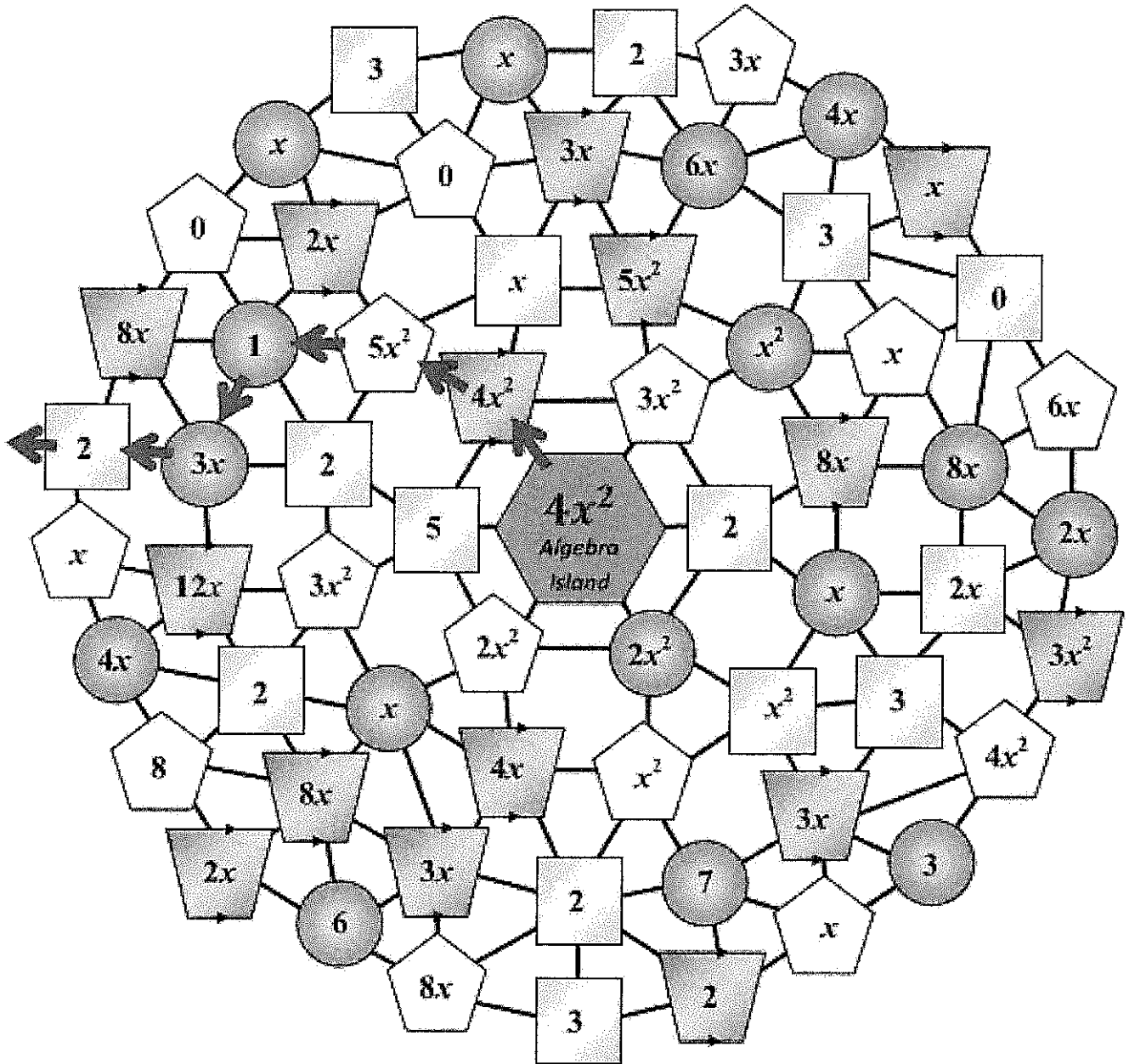
F _____

G _____

H _____

Challenge 2:

Escape from algebra island puzzle



One path has been found for you!

$$(((4x^2 + 4x^2) - 5x^2) \div 1) \div 3x \times 2 = 2x$$

- Square steps = multiply
 - Circle steps = divide
 - Trapezium steps = add
 - Pentagon steps = subtract
- } Remember, like terms only!

Starting with a value of $4x^2$, travel along the lines from step to step until you get to the outer edge. Each step affects your value. If you have exactly $2x$ left when you reach one of the shapes at the outer edge, then you have escaped! Good luck.

How many paths can you find to get away from Algebra Island?

How many steps is the longest path you can find?

