Lesmahagow High School

Mathematics Department

S2

Factorising by Common Factor

&

Substitution

Factorising a sum of terms with a numerical common factor

1. Copy and complete each of the following:

    (a) $2x + 6 = 2(x + \quad)$ **(b)** $5a + 20 = 5(a + \quad)$

    (c) $4m - 24 = 4(\quad - \quad)$ **(d)** $3f - 6 = 3(\quad - \quad)$

    (e) $5x + 5y = 5(\quad + \quad)$ **(f)** $6p - 12q = 6(\quad - \quad)$

    (g) $3d - 12e = 3(\quad - \quad)$ **(h)** $14 + 7k = 7(\quad + \quad)$

    (i) $35 - 42b = 7(\quad - \quad)$ **(j)** $24a + 36b = 12(\quad + \quad)$

2. Factorise:

    (a) $2x + 2y$ **(b)** $3c + 3d$ **(c)** $6s + 6t$ **(d)** $12x + 12y$

    (e) $9a + 9b$ **(f)** $8b + 8c$ **(g)** $5p + 5q$ **(h)** $7g + 7h$

    (i) $4m + 4n$ **(j)** $9e + 9f$ **(k)** $13j + 13k$ **(l)** $14v + 14w$

3. Factorise:

    (a) $2x + 8$ **(b)** $3m + 12$ **(c)** $4y - 4$

    (d) $5p + 5$ **(e)** $8w - 16$ **(f)** $7u + 21$

    (g) $10z - 20$ **(h)** $6h + 24$ **(i)** $2d - 12$

    (j) $5r + 5s$ **(k)** $3k - 3l$ **(l)** $7w + 7x$

    (m) $4u + 8v$ **(n)** $6r - 18s$ **(o)** $2e + 20f$

4. Factorise:

    (a) $4x + 10$ **(b)** $6g - 15$ **(c)** $4f + 2$

    (d) $8y - 4$ **(e)** $12e + 8$ **(f)** $6m + 21$

    (g) $10a - 6$ **(h)** $9h + 12$ **(i)** $6r - 14$

    (j) $10r + 5s$ **(k)** $12k - 3l$ **(l)** $7w + 21x$

    (m) $4q + 8$ **(n)** $6 + 18g$ **(o)** $12m - 9$

5.   Factorise:

    (a) $2x + 4$ **(b)** $3d + 9$ **(c)** $6s + 3$ **(d)** $12x + 4$

    (e) $6 + 9a$ **(f)** $2b + 8$ **(g)** $5y + 10$ **(h)** $10 + 15c$

    (i) $12x + 16$ **(j)** $18m + 24$ **(k)** $30 + 36a$ **(l)** $14y + 21$

6.   Factorise:

    (a) $3x - 6$ **(b)** $4y - 8$ **(c)** $16 - 8a$ **(d)** $10c - 15$

    (e) $9s - 12$ **(f)** $2b - 14$ **(g)** $12x - 100$ **(h)** $22m - 33$

    (i) $15x - 10$ **(j)** $18 - 12y$ **(k)** $25b - 20$ **(l)** $18d - 30$

7.   Factorise:

    (a) $2a + 4b$ **(b)** $10x - 12y$ **(c)** $18m + 24n$ **(d)** $10c + 15d$

    (e) $6a - 9x$ **(f)** $18s - 12t$ **(g)** $12x + 15y$ **(h)** $14a - 7b$

    (i) $25c + 10d$ **(j)** $9b - 15y$ **(k)** $18x + 24y$ **(l)** $6a + 28b$

Factorising a sum of terms with a numerical common factor

EXAM QUESTIONS

1.   Factorise $35x + 56y$

2.   Factorise $36 + 42x$

3.   Factorise $30 - 6t$

4.   Factorise $15 - 25m$

5.   Factorise $24t - 32$

Evaluating an expression or formulae which has more than one variable

1. If $x = 10$ and $y = 4$, calculate

    (a) $x + y$ **(b)** $x - y$ **(c)** $2x$ **(d)** xy

    (e) $5y$ **(f)** $x + 7$ **(g)** $x - 3$ **(h)** $y + 15$

2. If $a = 8$, $b = 5$ and $c = 2$, calculate

    (a) $a + b$ **(b)** $a - b$ **(c)** $b + c$ **(d)** $a + 10$

    (e) $a - c$ **(f)** $3a - 6$ **(g)** $2a + 3c$ **(h)** $8c - 3b$

    (i) $a + b + c$ **(j)** $a + c - b$ **(k)** $a - b - c$ **(l)** $2a + 3b + 4c$

3. If $p = 3$, $q = 4$ and $r = 2$, calculate

    (a) $p + q$ **(b)** $q - p$ **(c)** $2q + r$ **(d)** $pq + 10$

    (e) $pr + q$ **(f)** $2p + 3r$ **(g)** $3q - 4p$ **(h)** $pq - pr$

    (i) $3p + 2q + 4r$ **(j)** $p + 2q - 5r$ **(k)** $20p - 10q$ **(l)** $100r - 50p$

4. Given that $a = b + d$, find a when

    (a) $b = 7$ and $d = 9$ **(b)** $b = 14$ and $d = 15$ **(c)** $b = 18$ and $d = 5$

    (d) $b = 33$ and $d = 12$ **(e)** $b = 24$ and $d = 17$ **(f)** $b = 190$ and $d = 40$

    (g) $b = 51$ and $d = 16$ **(h)** $b = 68$ and $d = 28$ **(i)** $b = 121$ and $d = 38$

5. Given that $X = 3Y - Z$, find X when

    (a) $Y = 4$ and $Z = 5$ **(b)** $Y = 10$ and $Z = 15$ **(c)** $Y = 20$ and $Z = 10$

    (d) $Y = 12$ and $Z = 8$ **(e)** $Y = 15$ and $Z = 5$ **(f)** $Y = 100$ and $Z = 80$

    (g) $Y = 50$ and $Z = 23$ **(h)** $Y = 17$ and $Z = 4$ **(i)** $Y = 11$ and $Z = 32$

6. **(a)** If $p = r - q$, find p when $r = 42$ and $q = 17$

(b) If $y = 4x - 9$, find y when $x = 7$

(c) If $A = 7B + C$, find A when $B = 9$ and $C = 8$

(d) If $R = S + 5T$, find R when $S = 22$ and $T = 6$

(e) If $H = G - 2F$, find H when $G = 50$ and $F = 15$

(f) If $k = 2m + 3n$, find k when $m = 12$ and $n = 3$

(g) If $c = 4d - 5e$, find c when $d = 11$ and $e = 8$

(h) If $P = 2Q + 10R$, find P when $Q = 10$ and $R = 2$

(i) If $g = 5e - 2f$, find g when $e = 7$ and $f = 17$

(j) If $M = 9C + 8D$, find M when $C = 8$ and $D = 7$

7. The formula for distance is $\mathbf{D = S \times T}$, where D is the distance in kilometres, S is the speed in km/h and T is the time in hours. Find D when

(a) S = 30 km/h and T = 2 h   **(b)** S = 50 km/h and T = 3 h

(c) S = 60 km/h and T = 5 h   **(d)** S = 80 km/h and T = 4 h

(e) S = 55 km/h and T = 3 h   **(f)** S = 70 km/h and T = 3½ h

(g) S = 68 km/h and T = 2½ h   **(h)** S = 54 km/h and T = 4½ h

8. The formula $\mathbf{V = IR}$ is used in electrical calculations. Use the formula to find V when

(a) I = 18 and R = 5   **(b)** I = 5 and R = 20   **(c)** I = 2·6 and R = 4·5

(d) I = 4·1 and R = 10   **(e)** I = 3·5 and R = 12   **(f)** I = 7 and R = 9·2

9. The formula **F = 1·8C + 32** is used to change a temperature from degrees Celsius (ºC) to degrees Fahrenheit (ºF). Change the following Celsius temperatures to Fahrenheit.
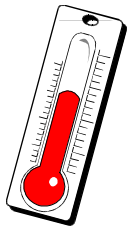
(a)	15ºC	**(b)**	35ºC	**(c)**	10ºC
(d)	20ºC	**(e)**	33ºC	**(f)**	5ºC
(g)	40ºC	**(h)**	22ºC		

10. The area of a triangle is given by the formula **A = ½bh**. Find the areas of the following triangles :

(a)	b = 10cm	h = 8cm	**(b)**	b = 50mm	h = 90mm
(c)	b = 12cm	h = 15cm	**(d)**	b = 140m	h = 60m
(e)	b = 18mm	h = 100mm	**(f)**	b = 27cm	h = 35cm
(g)	b = 16·4m	h = 12·2m	**(h)**	b = 2240mm	h = 1560mm

11. The scale on a map is 1: 20000. The formula to change a distance **d centimetres** on the map to the real distance **D metres** is

$$D = \frac{20000 \times d}{100}$$

Change these map distances to real distances :

(a)	4cm	**(b)**	5cm	**(c)**	3·5cm
(d)	7·2cm	**(e)**	0·7cm	**(f)**	0·96cm
(g)	1·04cm	**(h)**	12·57cm		

12. In a regular polygon with **n** sides, the size of an exterior angle is $\frac{360^{\circ}}{n}$.

Find the size of the exterior angle in a polygon with

(a)	5 sides	**(b)**	9 sides	**(c)**	12 sides	**(d)**	8 sides
(e)	18 sides	**(f)**	10 sides	**(g)**	30 sides	**(h)**	25 sides

13. A formula is given as $E = p^2 + 2$. Find the value of E when

(a)	$p = 2$	**(b)**	$p = 3$	**(c)**	$p = 6$	**(d)**	$p = 1$

14. A formula is given as $T = e^2 + 6$. Find the value of T when

(a) $e = 3$ (b) $e = 4$ (c) $e = 8$ (d) $e = 2$

15. A formula is given as $Q = 36 - r^2$. Find the value of Q when

(a) $r = 3$ (b) $r = 4$ (c) $r = 6$ (d) $r = 1$

16. A formula is given as $G = 45 - h^2$. Find the value of G when

(a) $h = 4$ (b) $h = 6$ (c) $h = 2$ (d) $h = 7$

17. A formula is given as $T = 2(s)^2 + 4$. Find the value of T when

(a) $s = 3$ (b) $s = 5$ (c) $s = 10$ (d) $s = 1$

18. A formula is given as $W = 25 + 3(x)^2$. Find the value of W when

(a) $x = 2$ (b) $x = 6$ (c) $x = 8$ (d) $x = 7$

19. A formula is given as $L = 2p^2 - 6$. Find the value of L when

(a) $p = 2$ (b) $p = 3$ (c) $p = 5$ (d) $p = 10$.

20. A formula is given as $H = t^2 + 2t + 1$. Find the value of H when

(a) $t = 2$ (b) $t = 4$ (c) $t = 3$ (d) $t = 10$.

21. A formula is given as $T = k^2 + 3k - 6$. Find the value of T when

(a) $k = 3$ (b) $k = 6$ (c) $k = 2$ (d) $k = 12$

22. A formula is given as $E = 3p + q$.

Find the value of E when   (a) $p = 4$ and $q = 2$ (b) $p = 6$ and $q = 3$

(c) $p = 5$ and $q = 1$ (d) $p = 3$ and $q = -6$

23. A formula is given as $T = 2d - 3e$.

Find the value of T when 　　　　**(a)** 　$d = 5$ and $e = 2$ 　**(b)** 　$d = 6$ and $e = 3$

　　　　　　　　　　　　　　　(c) 　$d = 8$ and $e = 5$ 　**(d)** 　$d = 12$ and $e = 8$

24. A formula is given as $F = 7r - 2s$.

Find the value of F when 　　　　**(a)** 　$r = 2$ and $s = 5$ 　**(b)** 　$r = 3$ and $s = 10$

　　　　　　　　　　　　　　　(c) 　$r = 4$ and $s = 4$ 　**(d)** 　$r = 6$ and $s = 20$

25. A formula is given as $V = u + at$.

Find the value of V when 　　　　**(a)** 　$u = 3$, $a = 2$ and $t = 4$

　　　　　　　　　　　　　　　(b) 　$u = 6$, $a = 3$ and $t = 7$

　　　　　　　　　　　　　　　(c) 　$u = 2$, $a = 8$ and $t = 10$

26. A formula is given as $C = 20 + 4pt$.

Find the value of C when 　　　　**(a)** 　$p = 4$ and $t = 3$

　　　　　　　　　　　　　　　(b) 　$p = 5$ and $t = 2$

　　　　　　　　　　　　　　　(c) 　$p = 8$ and $t = 0{\cdot}5$

27. A formula is given as $W = ab - 3c$.

Find the value of W when 　　　　**(a)** 　$a = 4$, $b = 6$ and $c = 4$

　　　　　　　　　　　　　　　(b) 　$a = 5$, $b = 2$ and $c = 3$

　　　　　　　　　　　　　　　(c) 　$a = 6$, $b = 4$ and $c = 8$

28. A formula is given as $A = 2lh + 2lb + 2bh$.

Find the value of A when 　　　　**(a)** 　$l = 6$, $b = 3$ and $h = 2$

　　　　　　　　　　　　　　　(b) 　$l = 5$, $b = 4$ and $h = 6$

　　　　　　　　　　　　　　　(b) 　$l = 8$, $b = 7$ and $h = 4$

Evaluating an expression or formulae which has more than one variable

EXAM QUESTIONS

1. Find the value of $3a - 2b$ when $a = -4$ and $b = 2$.

2. Evaluate the formula $W = \dfrac{10\sqrt{P}}{4d}$ when $P = 2 \cdot 56$ and $d = 0 \cdot 4$.

3. The force, F, needed to stop a train traveling at a speed, v m/s, within a stopping distance, s m, is given by the formula:

$$F = \frac{120v^2}{s}$$

Find the force that would stop a train travelling at 24 m/s in 400 m.

4. A formulae used in Electricity is

$$I = \sqrt{\frac{P}{R}}$$

where I is the current, P is the power and R is the resistance in a circuit.

Find the current (I) when there is a power of 100 and a resistance of 12.

5. The period of the swing of a pendulum is given as $T = 2\pi\sqrt{\dfrac{l}{g}}$.
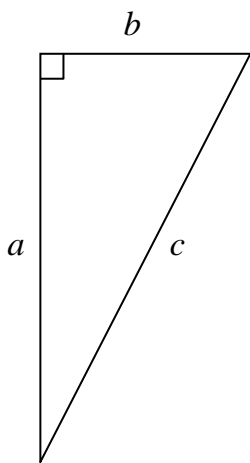
Calculate T when $l = 75$ and $g = 10$. $[\pi = 3 \cdot 14]$

6. The formula for finding the radius of a circle when the area is known is

$$R = \sqrt{\frac{A}{\pi}}$$

Taking $\pi = 3 \cdot 14$, find R when $A = 1256$.

7. The formula for finding the length of side a in this diagram is

$$a = \sqrt{(c^2 - b^2)}$$

b

Calculate the length of side a when

$b = 5$ and $c = 13$.

a   c

8. The formula for calculating the volume of a cone is $V = \dfrac{1}{3}\pi r^2 h$ where r is the radius and h is the height of the cone. $[\pi = 3\cdot14]$

Use the formula to calculate the volume of a cone with **diameter** 18cm and height 35cm, giving your answer to the nearest 10 cm^3.

9. Using the formula $m = \dfrac{E}{gh}$ calculate m when $E = 8$, $g = 10$ and $h = 40$.

Factorising a sum of terms with a numerical common factor

1. (a) $2x + 6 = 2(x + 3)$ (b) $5a + 20 = 5(a + 4)$

    (c) $4m - 24 = 4(m - 6)$ (d) $3f - 6 = 3(f - 2)$

    (e) $5x + 5y = 5(x + y)$ (f) $6p - 12q = 6(p - 2q)$

    (g) $3d - 12e = 3(d - 4e)$ (h) $14 + 7k = 7(2 + k)$

    (i) $35 - 42b = 7(5 - 6b)$ (j) $24a + 36b = 12(2a + 3b)$

2. (a) $2(x + y)$ (b) $3(c + d)$ (c) $6(s + t)$ (d) $12(x + y)$

    (e) $9(a + b)$ (f) $8(b + c)$ (g) $5(p + q)$ (h) $7(g + h)$

    (i) $4(m + n)$ (j) $9(e + f)$ (k) $13(j + k)$ (l) $14(v + w)$

3. (a) $2(x + 4)$ (b) $3(m + 4)$ (c) $4(y - 1)$

    (d) $5(p + 1)$ (e) $8(w - 2)$ (f) $7(u + 3)$

    (g) $10(z - 2)$ (h) $6(h + 4)$ (i) $2(d - 6)$

    (j) $5(r + s)$ (k) $3(k - l)$ (l) $7(w + x)$

    (m) $4(u + 2v)$ (n) $6(r - 3s)$ (o) $2(e + 10f)$

4. (a) $2(2x + 5)$ (b) $3(2g - 5)$ (c) $2(2f + 1)$

    (d) $4(2y - 1)$ (e) $4(3e + 2)$ (f) $3(2m + 7)$

    (g) $2(5a - 3)$ (h) $3(3h + 4)$ (i) $2(3r - 7)$

    (j) $5(2r + s)$ (k) $3(4k - l)$ (l) $7(w + 3x)$

    (m) $4(q + 2)$ (n) $6(1 + 3g)$ (o) $3(4m - 3)$

5. (a) $2(x + 2)$ (b) $3(d + 3)$ (c) $3(2s + 1)$ (d) $4(3x + 1)$

    (e) $3(2 + 3a)$ (f) $2(b + 4)$ (g) $5(y + 2)$ (h) $5(2 + 3c)$

    (i) $4(3x + 4)$ (j) $6(3m + 4)$ (k) $6(5 + 6a)$ (l) $7(2y + 3)$

6. (a) $3(x - 2)$ (b) $4(y - 2)$ (c) $8(2 - a)$ (d) $5(2c - 3)$

    (e) $3(3s - 4)$ (f) $2(b - 7)$ (g) $4(3x - 25)$ (h) $11(2m - 3)$

    (i) $5(3x - 2)$ (j) $6(3 - 2y)$ (k) $5(5b - 4)$ (l) $6(3d - 5)$

7. (a) $2(a + 2b)$ (b) $2(5x - 6y)$ (c) $6(3m + 4n)$ (d) $5(2c + 3d)$

    (e) $3(2a - 3x)$ (f) $6(3s - 2t)$ (g) $3(4x + 5y)$ (h) $7(2a - b)$

    (i) $5(5c + 2d)$ (j) $3(3b - 5y)$ (k) $6(3x + 4y)$ (l) $2(3a + 14b)$

Factorising

EXAM QUESTIONS

1. $7(5x + 8y)$ **2.** $6(6 + 7x)$ **3.** $6(5 - t)$

4. $5(3 - 5m)$ **5.** $8(3t - 4)$

Evaluating an expression or formulae which has more than one variable

#	(a)	(b)	(c)	(d)	(e)	(f)		
1.	(a) 14	(b) 6	(c) 20	(d) 40	(e) 20	(f) 17		
	(g) 7	(h) 19						
2.	(a) 13	(b) 3	(c) 7	(d) 18	(e) 6	(f) 18		
	(g) 22	(h) 1	(i) 15	(j) 5	(k) 1	(l) 39		
3.	(a) 7	(b) 1	(c) 10	(d) 22	(e) 10	(f) 12		
	(g) 0	(h) 6	(i) 25	(j) 1	(k) 20	(l) 50		
4.	(a) 16	(b) 29	(c) 23	(d) 45	(e) 41	(f) 230		
	(g) 67	(h) 96	(i) 159					
5.	(a) 7	(b) 15	(c) 50	(d) 28	(e) 40	(f) 220		
	(g) 127	(h) 47	(i) 1					
6.	(a) 25	(b) 19	(c) 71	(d) 52	(e) 20	(f) 33		
	(g) 4	(h) 40	(i) 1	(j) 128				
7.	(a) 60	(b) 150	(c) 300	(d) 320	(e) 165	(f) 245		
	(g) 170	(h) 243						
8.	(a) 90	(b) 100	(c) 11·7	(d) 41	(e) 42	(f) 64·4		
9.	(a) 59	(b) 95	(c) 50	(d) 68	(e) 91·4	(f) 41		
	(g) 104	(h) 71·6						
10.	(a) 40	(b) 2250	(c) 90	(d) 4200	(e) 900	(f) 472·5		
	(g) 100·04	(h) 1747200						
11.	(a) 800	(b) 1000	(c) 700	(d) 1440	(e) 140	(f) 192		
	(g) 208	(h) 2514						
12.	(a) 72º	(b) 40º	(c) 30º	(d) 45º	(e) 20º	(f) 36º		
	(g) 12º	(h) 14·4º						

13. (a) $E = 6$ (b) $E = 11$ (c) $E = 38$ (d) $E = 3$

14. (a) $T = 15$ (b) $T = 22$ (c) $T = 70$ (d) $T = 10$

15. (a) $Q = 27$ (b) $Q = 20$ (c) $Q = 0$ (d) $Q = 35$

16. (a) $G = 29$ (b) $G = 9$ (c) $G = 41$ (d) $G = -4$

17. (a) $T = 22$ (a) $T = 54$ (c) $T = 204$ (d) $T = 6$

18. (a) $W = 37$ (b) $W = 133$ (c) $W = 217$ (d) $W = 172$

19. (a) $L = 2$ (b) $L = 12$ (c) $L = 44$ (d) $L = 194$

20. (a) $H = 9$ (b) $H = 25$ (c) $H = 16$ (d) $H = 121$

21. (a) $T = 12$ (b) $T = 48$ (c) $T = 4$ (d) $T = 174$

22. (a) $E = 14$ (b) $E = 21$ (c) $E = 16$ (d) $E = 3$

23. (a) $T = 4$ (b) $T = 3$ (c) $T = 1$ (d) $T = 0$

24. **(a)** $F = 4$ **(b)** $F = 1$ **(c)** $F = 20$ **(d)** $F = 2$

25. **(a)** $V = 11$ **(b)** $V = 27$ **(c)** $V = 82$

26. **(a)** $C = 68$ **(b)** $C = 60$ **(c)** $C = 36$

27. **(a)** $W = 12$ **(b)** $W = 1$ **(c)** $W = 0$

28. **(a)** $A = 72$ **(b)** $A = 148$ **(c)** $A = 232$

Evaluating an expression

Exam Questions

1. -16 **2.** 10 **3.** $172{\cdot}8$ **4.** $2{\cdot}9$

5. $17{\cdot}2$ **6.** 20 **7.** 12 **8.** 2970

9. $0{\cdot}02$