

## Factorising

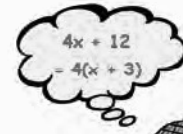
In Exercise 1, you learned how to multiply out brackets.

$$4(x + 3) = 4x + 12$$

Now we will find out how to do this in reverse

$$\Rightarrow 4x + 12 \text{ can be written as } 4(x + 3)$$

This is called "FACTORISING" the expression.


$$4x + 12 = 4(x + 3)$$



**Example :-** To factorise  $5x + 20$

- > **step 1** Find a number (5), which will divide into both  $5x$  and 20.
- > **step 2** Write this down with brackets  $\Rightarrow 5(\dots\dots\dots)$ .
- > **step 3** Decide what has to go into the brackets which, when multiplied by 5, takes you back to  $5x + 20 \Rightarrow 5x + 20 = 5(x + 4)$ .

### Exercise 3

1. Copy down each of the following and complete the factorisation :-

a  $4x + 20$   
 $= 4(x + \dots)$

b  $3x + 21$   
 $= 3(x + \dots)$

c  $5x - 15$   
 $= 5(x - \dots)$

d  $2x + 18$   
 $= 2(\quad)$

e  $7p + 35$   
 $= 7(\quad)$

f  $10m + 70$   
 $= 10(\quad)$

g  $6a - 36$   
 $= 6(\quad)$

h  $9t + 18$   
 $= 9(\quad)$

i  $15m + 30$   
 $= 15(\quad)$

j  $8d + 40$   
 $= 8(\quad)$

k  $3f + 36$   
 $= 3(\quad)$

l  $11z - 55$   
 $= 11(\quad)$ .

2. Factorise each of the following by taking out a common factor :-

a  $5x - 15$   
 $= 5(\quad)$

b  $7x + 7$   
 $= 7(\quad)$

c  $3x - 24$   
 $= \dots(\quad)$

d  $2x + 40$

e  $10t - 20$

f  $4a + 8b$

g  $6m - 18n$

h  $5g + 25h$

i  $6p - 42q$

j  $7d + 7e$

k  $8x - 80y$

l  $15b + 30c$ .

Be careful, when factorising, to take out the **HIGHEST** common factor.

(The largest number that divides into both parts).

**Examples :-**  $6x + 9$  can be factorised to  $3(2x + 3)$  ✓ and not  $6(\dots\dots)$  ✗

$8x - 14$  can be factorised to  $2(4x - 7)$  ✓ and not  $8(\dots\dots)$  ✗

$10x + 25$  can be factorised to  $5(2x + 5)$  ✓ and not  $10(\dots\dots)$  ✗

3. Factorise each of the following :-

a  $8x - 12$   
 $= 4(2x - \dots)$

b  $9x + 15$   
 $= 3(3x \dots)$

c  $4x - 18$   
 $= 2(\quad)$

d  $6x + 3$   
 $= 3(\quad)$

e  $12x - 8$   
 $= 4(\quad)$

f  $10x + 25$   
 $= 5(\quad)$

g  $20x - 30$   
 $= 10(\quad)$

h  $16x + 40$   
 $= 8(\quad)$

i  $12x - 15$   
 $= 3(\quad)$

j  $21x + 14y$   
 $= 7(\quad)$

k  $18x - 27y$   
 $= 9(\quad)$

l  $15x + 55y$   
 $= 5(\quad)$ .

4. Factorise each of the following fully :-

a  $4x + 18$

b  $12x - 6$

c  $8x + 20$

d  $9x + 21$

e  $6a + 9$

f  $10p + 35$

g  $12c + 16$

h  $8n + 10$

i  $15h - 12$

j  $20t + 24$

k  $25w + 45$

l  $16f - 20$

m  $18m + 15$

n  $14d - 35$

o  $8x + 36$

p  $50s + 40t$

q  $9m - 21n$

r  $15u - 35$

s  $12g + 18h$

t  $25c + 95d$

u  $6r - 20s$

v  $15m - 40n$

w  $24d - 32e$

x  $44m + 77n$ .

5. Extension of Factors (*A bit harder !!*).

Factorise :-

a  $ab + ac$

b  $pm - pn$

c  $xt + xs$

d  $mn + m$

e  $uv - u$

f  $de + df$

g  $ab + ac + ad$

h  $pi + pj + pk$

i  $wa + wb + w$

j  $ab + 2a$

k  $pq + 3p$

l  $5m + mn$

m  $6a + ab$

n  $ef - 7e$

o  $a^2 + ab$ .



6. Factorise fully :- (*Each has 3 terms this time*).

a  $2x + 2y + 2z$

b  $3a - 3b + 3c$

c  $2p + 4q + 6r$

d  $5m - 10n + 20$

e  $6s + 18t + 24$

f  $10a - 40b + 80c$

g  $6x + 8y + 10$

h  $12a - 9b + 6c$

i  $15p - 10q + 25r$

j  $ab + ac + ad$

k  $pr - ps + p$

l  $2ab + 4ac + 6ad$ .

## What Have I Learned ?



1. Multiply out the brackets :-

a  $2(x + 5)$

b  $7(x - 3)$

c  $4(a + b)$

d  $5(p - 7)$

e  $2(3x + 5)$

f  $10(2x - 3)$

g  $3(7t + 5s)$

h  $5(6m - 2n)$

i  $a(b + c)$ .

2. Multiply out the brackets and simplify :-

a  $4(x + 3) + 2$

b  $5(x + 1) - 4$

c  $2(3x + 5) - 7$

d  $3 + 2(x + 4)$

e  $5 + 3(x - 1)$

f  $10 + 2(3x + 4)$ .

3. Write down all the factors of :-

a 18

b 22

c 32.

4. What is the highest common factor of :-

a 8 and 12

b 16 and 18

c 27 and 36 ?

5. Factorise the following fully :-

a  $2x + 12$

b  $4x - 8$

c  $5x + 30$

d  $3a + 6b$

e  $7t - 14s$

f  $8p + 32q$ .

6. Factorise the following fully :-

a  $6x + 14$

b  $9a - 21$

c  $10p + 15q$

d  $8d - 12f$

e  $21x + 28y$

f  $18d - 45w$ .

7. Factorise the following fully :-

a  $7x - 7y + 7z$

b  $2t + 4w + 12z$

c  $5a - 20b + 30c$

d  $4a + 10b + 14c$

e  $6r - 12q + 15$

f  $gt - gh + gc$

g  $4abc + 2bc - 6ac$ .



5. a 16 and 20  
 b check drawing and 24  
 c  $5^2 - 21^2 = 25 - 9 = 16$   
 $6^2 - 4^2 = 36 - 16 = 20$   
 $7^2 - 5^2 = 49 - 25 = 24$   
 d (i)  $12^2 - 10^2 = 144 - 100 = 44$   
 (ii)  $22^2 - 20^2 = 484 - 400 = 84$
6. a  $5^2 + 6^2, 6^2 + 7^2, 7^2 + 8^2,$   
 b 5, 13, 25, 41, 61, 85, 113  
 c  $20^2 + 21^2$  d 841 e  $n^2 + (n+1)^2$

### Chapter 15 - Exercise 2 (page 219)

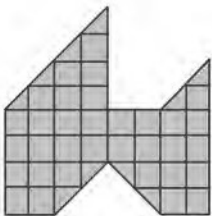
1. a check drawings  
 b 1,3,6,10,15,21,28,36,45  
 c the counters can be put in a triangular pattern  
 d snooker and pool  
 e 5th =  $1 + 2 + 3 + 4 + 5 = 15$   
 6th =  $1 + 2 + 3 + 4 + 5 + 6 = 21$   
 7th =  $1 + 2 + 3 + 4 + 5 + 6 + 7 = 28$   
 8th =  $1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 = 36$
2. a 1,3,6,10,15,21  
 b these are the triangular numbers  
 c (i) 210 (ii) 465  
 (iii) 1275 (iv) 125250
3. a 16,25,36,49 square numbers  
 b check drawing  
 c (i) 28 + 36  
 (ii) 36 + 45  
 (iii) 45 + 55  
 (iv) 55 + 66  
 (v) 66 + 78

### Chapter 15 - Exercise 3 (page 221)

1. a
- |               |
|---------------|
| 1             |
| 1 1           |
| 1 2 1         |
| 1 3 3 1       |
| 1 4 6 4 1     |
| 1 5 10 10 5 1 |
- b each no is sum of 2 above  
 c
- |                             |
|-----------------------------|
| 1 6 15 20 15 6 1            |
| 1 7 21 35 35 21 7 1         |
| 1 8 28 56 70 56 28 8 1      |
| 1 9 36 84 126 126 84 36 9 1 |
2. a 3 b (i) 10 (ii) 36 (iii) 190  
 3. 204  
 4. 35  
 5. 500500

### Review 14 - Scales/Enlargement (page 223)

1. Two times enlargement



2. 175 cm  
 3. a 2.5 cm by 4 cm  
 b 50ft by 80 ft  
 4. Scale drawing 6 cm by 2.5 cm
5. a Scale drawing b 18 cm c 90 m  
 6. a sw b 135° clockwise c se

### Chapter 16 - Exercise 1 (page 224)

1. a no coins will always weigh 0 grams  
 b 8 & 9 c 65 grams d 90 grams
2. a about 110 m b 70 cm
3. a the more you study the less you get wrong  
 b about 12 c 25  
 d about 9 1/2 hours
4. a/b scattergraph c line of best fit  
 d 50-55 dependant on line
5. a/b scattergraph and line of best fit  
 c 40-45 kg d 140-145 cm
6. a/b scattergraph and line of best fit  
 c about 70 kg d 16-19 plants

### Chapter 16 - Exercise 2 (page 227)

1. a 8 b 30 c 23  
 d 3 e 1/2
2. a/b/c frequencies - 3,7, 11, 6, 4, 1  
 d 32 e 10
3. a/b frequencies - 4, 2, 5, 8, 1  
 c 13 d 1/5 e bar graph
4. a/b frequencies - 2,3,7,11,5,1,1  
 c 11/30 d bar graph
5. a 9 b 22, 16, 13, 4, 11
6. a frequencies are 2, 8, 6, 3, 5 b 10-19
7. a frequencies are 1, 14, 8, 10, 5, 4  
 b 60-64 c 1/3

### Chapter 16 - Exercise 3 (page 231)

1. a 5 b 40 c 27  
 d 14th e 41
2. a 6 b 5  
 c 21 d 4
3. a 4 b 1  
 c 15 d 2
4. a frequencies - 2, 8, 3, 0, 1  
 b 1000 cc c 1200 cc d 14  
 e 1000,1000,1200,1200,1200,1200,1200,1200,  
 1200,1200,1800 - median = 1200 cc
5. a frequencies - 5, 10, 8, 6, 2, 1  
 b bar graph c 10 d 10  
 e 32 f 12
6. a 12, 14, 14, 14, 16 is one possibility  
 b 12, 14, 14, 15, 16  
 c 12, 14, 14, 16, 16

### Chapter 16 - Exercise 4 (page 234)

1. a 10 b none  
 c  $4 + 15 + 12 + 14 + 8 + 9$ , Totals = 10 and 62  
 d  $62 \div 10 = 6.2$
2. a 25 b  $6 + 0 + 15 + 30 + 63 + 48$   
 c mean =  $162 \div 25 = 6.48$   
 d 7 e 7 f 5
3. a  $736 \div 40 = 18.4$  b  $83 \div 40 = 2.075$

### Review 15 - Further Trig Work (page 236)

1. a 0.906 b 0.866 c 1.322  
 2. a 8.3 cm b 32.5 mm c 4.4 cm  
 3. 31.7 mm  
 4. a 45° b 30° c 70.5°  
 5. a 23.6° b 31.9° c 49.6°  
 6. 30°

### Chapter 17 - Exercise 1 (page 237)

1. a  $3x + 3$  b  $4x - 12$  c  $2x + 18$   
 d  $6x - 30$  e  $5t - 10$  f  $7p - 21$   
 g  $10b + 80$  h  $15m + 30$  i  $11h + 11$   
 j  $4x + 4y$  k  $6a - 6b$  l  $3f - 3g$   
 m  $9e + 9f$  n  $3a + 3b + 12$  o  $5x + 5y - 15$   
 p  $10x - 10y - 10$  q  $12x + 20$  r  $12a - 9$   
 s  $20p - 35$  t  $35t + 14$  u  $30m - 12$

2. a  $3x + 7$  b  $2x + 13$  c  $5p + 4$   
 d  $5h + 16$  e  $5m - 12$  f  $2x - 7$   
 g  $7y - 12$  h  $13x + 10$  i  $8d - 9$   
 j  $2x + 5$  k  $3x + 10$  l  $8x + 1$   
 m  $15t + 4$  n  $5x + 9$  o  $9g + 21$   
 p  $6w$  q  $21b + 13$  r  $17n + 9$

### Chapter 17 - Exercise 2 (page 238)

1. a true b false c false  
 d true e true f false  
 g true h false i true
2. a 1,2,5,10 b 1,2,13,16  
 c 1,2,3,4,6,12 d 1,2,4,5,10,20  
 e 1,2,3,4,6,8,12,24
3. a 1,2,4,8 b 1,2,7,14 c 1,17  
 d 1,2,3,5,6,10,15,30  
 e 1,2,3,4,6,9,12,18,36  
 f 1,2,5,10,25,50  
 g 1,23  
 h 1,2,4,5,10,20,25,50,100  
 i 1,2,3,4,5,6,10,12,15,20,30,60  
 j 1,3,9,27
4. a 1,2,3,6,9,18 b 1,3,9,27  
 c 1,3,9 d 9
5. a 3 b 5 c 3  
 d 10 e 6 f 7  
 g 5 h 5 i 4  
 j 5 k 10 l 9  
 m 12

### Chapter 17 - Exercise 3 (page 239)

1. a  $4(x + 5)$  b  $3(x + 7)$  c  $5(x - 3)$   
 d  $2(x + 9)$  e  $7(p + 5)$  f  $10(m + 7)$   
 g  $6(a - 6)$  h  $9(t + 2)$  i  $15(m + 2)$   
 j  $8(d + 5)$  k  $3(f + 12)$  l  $11(z - 5)$
2. a  $5(x - 3)$  b  $7(x + 1)$  c  $3(x - 8)$   
 d  $2(x + 20)$  e  $10(t - 2)$  f  $4(a + 2b)$   
 g  $6(m - 3n)$  h  $5(g + 5h)$  i  $6(p - 7q)$   
 j  $7(d + e)$  k  $8(x - 10y)$  l  $15(b + 2c)$
3. a  $4(2x - 3)$  b  $3(3x + 5)$  c  $2(2x - 9)$   
 d  $3(2x + 1)$  e  $4(3x - 2)$  f  $5(2x + 5)$   
 g  $10(2x - 3)$  h  $8(2x + 5)$  i  $3(4x - 5)$   
 j  $7(3x + 2y)$  k  $9(2x - 3y)$  l  $5(3x + 11y)$
4. a  $2(2x + 9)$  b  $6(2x - 1)$  c  $4(2x + 5)$   
 d  $3(3x + 7)$  e  $3(2a + 3)$  f  $5(2p + 7)$   
 g  $4(3c + 4)$  h  $2(4n + 5)$  i  $3(5h - 4)$   
 j  $4(5t + 6)$  k  $5(5w + 9)$  l  $4(4f - 5)$   
 m  $3(6m + 5)$  n  $7(2d - 5)$  o  $4(2x + 9)$   
 p  $10(5s + 4t)$  q  $3(3m - 7n)$  r  $5(3u - 7)$   
 s  $6(2g + 3h)$  t  $5(5c + 19d)$  u  $2(3r - 10s)$   
 v  $5(3m - 8n)$  w  $8(3d - 4e)$  x  $11(4m + 7n)$
5. a  $a(b + c)$  b  $p(m - n)$  c  $x(t + s)$   
 d  $m(n + 1)$  e  $u(v - 1)$  f  $d(e + f)$   
 g  $a(b + c + d)$  h  $p(i + j + k)$  i  $w(a + b + 1)$   
 j  $a(b + 2)$  k  $p(q + 3)$  l  $m(5 + n)$   
 m  $a(6 + b)$  n  $e(f - 7)$  o  $a(a + b)$
6. a  $2(x + y + z)$  b  $3(a - b + c)$   
 c  $2(p + 2q + 3r)$  d  $5(m - 2n + 4)$   
 e  $6(s + 3t + 4)$  f  $10(a - 4b + 8c)$   
 g  $2(3x + 4y + 5)$  h  $3(4a - 3b + 2c)$   
 i  $5(3p - 2q + 5r)$  j  $a(b + c + d)$   
 k  $p(r - s + 1)$  l  $2a(b + 2c + 3d)$

### Chapter 18 - National 4 Revision

#### Chapter 18a - Numeracy Revision (page 242)

1. a 9 b 11 c 28  
 2. a 100 b 560 c 1080  
 3. a 600 b 2300 c 23100  
 4. a 420 b 3100 c 57000  
 d 103000 e 77 f 71  
 g 830 h 320  
 5. a 16890 b 21720 c 31000  
 d 233 e 23 f 200