Exercise 1C

1 a $4x + 8 = 4(x + 2)$

b $6x - 24 = 6(x - 4)$

c $20x + 15 = 5(4x + 3)$

d $2x^2 + 4 = 2(x^2 + 2)$

e $4x^2 + 20 = 4(x^2 + 5)$

f $6x^2 - 18x = 6x(x - 3)$

g $x^2 - 7x = x(x - 7)$

h $2x^2 + 4x = 2x(x + 2)$

i $3x^2 - x = x(3x - 1)$

j $6x^2 - 2x = 2x(3x - 1)$

k $10y^2 - 5y = 5y(2y - 1)$

l $35x^2 - 28x = 7x(5x - 4)$

m $x^2 + 2x = x(x + 2)$

n $3y^2 + 2y = y(3y + 2)$

o $4x^2 + 12x = 4x(x + 3)$

p $5y^2 - 20y = 5y(y - 4)$

q $9xy^2 + 12x^2y = 3xy(3y + 4x)$

r $6ab - 2ab^2 = 2ab(3 - b)$

s $5x^2 - 25xy = 5x(x - 5y)$

t $12x^2y + 8xy^2 = 4xy(3x + 2y)$

u $15y - 20yz^2 = 5y(3 - 4z^2)$

v $12x^2 - 30 = 6(2x^2 - 5)$

w $xy^2 - x^2y = xy(y - x)$

x $12y^2 - 4yx = 4y(3y - x)$

2 a $x^2 + 4x = x(x + 4)$

b $2x^2 + 6x = 2x(x + 3)$

2 c $x^2 + 11x + 24 = x^2 + 8x + 3x + 24$
$= x(x + 8) + 3(x + 8)$
$= (x + 8)(x + 3)$

d $x^2 + 8x + 12 = x^2 + 2x + 6x + 12$
$= x(x + 2) + 6(x + 2)$
$= (x + 2)(x + 6)$

e $x^2 + 3x - 40 = x^2 + 8x - 5x - 40$
$= x(x + 8) - 5(x + 8)$
$= (x + 8)(x - 5)$

f $x^2 - 8x + 12 = x^2 - 2x - 6x + 12$
$= x(x - 2) - 6(x - 2)$
$= (x - 2)(x - 6)$

g $x^2 + 5x + 6 = x^2 + 3x + 2x + 6$
$= x(x + 3) + 2(x + 3)$
$= (x + 3)(x + 2)$

h $x^2 - 2x - 24 = x^2 - 6x + 4x - 24$
$= x(x - 6) + 4(x - 6)$
$= (x - 6)(x + 4)$

i $x^2 - 3x - 10 = x^2 - 5x + 2x - 10$
$= x(x - 5) + 2(x - 5)$
$= (x - 5)(x + 2)$

j $x^2 + x - 20 = x^2 - 4x + 5x - 20$
$= x(x - 4) + 5(x - 4)$
$= (x - 4)(x + 5)$

k $2x^2 + 5x + 2 = 2x^2 + x + 4x + 2$
$= x(2x + 1) + 2(2x + 1)$
$= (2x + 1)(x + 2)$

l $3x^2 + 10x - 8 = 3x^2 - 2x + 12x - 8$
$= x(3x - 2) + 4(3x - 2)$
$= (3x - 2)(x + 4)$

m $5x^2 - 16x + 3 = 5x^2 - 15x - x + 3$
$= 5x(x - 3) - (x - 3)$
$= (x - 3)(5x - 1)$

n $6x^2 - 8x - 8 = 6x^2 - 12x + 4x - 8$
$= 6x(x - 2) + 4(x - 2)$
$= (x - 2)(6x + 4)$
$= 2(x - 2)(3x + 2)$

2 o $2x^2 + 7x - 15 = 2x^2 + 10x - 3x - 15$
$= 2x(x + 5) - 3(x + 5)$
$= (x + 5)(2x - 3)$

p Let $y = x^2$
$2x^4 + 14x^2 + 24 = 2y^2 + 14y + 24$
$= 2y^2 + 6y + 8y + 24$
$= 2y(y + 3) + 8(y + 3)$
$= (y + 3)(2y + 8)$
$= (x^2 + 3)(2x^2 + 8)$
$= 2(x^2 + 3)(x^2 + 4)$

q $x^2 - 4 = x^2 - 2^2$
$= (x + 2)(x - 2)$

r $x^2 - 49 = x^2 - 7^2$
$= (x + 7)(x - 7)$

s $4x^2 - 25 = (2x)^2 - 5^2$
$= (2x + 5)(2x - 5)$

t $9x^2 - 25y^2 = (3x)^2 - (5y)^2$
$= (3x + 5y)(3x - 5y)$

u $36x^2 - 4 = 4(9x^2 - 1)$
$= 4((3x)^2 - 1^2)$
$= 4(3x + 1)(3x - 1)$

v $2x^2 - 50 = 2(x^2 - 25)$
$= 2(x^2 - 5^2)$
$= 2(x + 5)(x - 5)$

w $6x^2 - 10x + 4 = 2(3x^2 - 5x + 2)$
$= 2(3x^2 - 3x - 2x + 2)$
$= 2\ (3x(x - 1) - 2(x - 1))$
$= 2(x - 1)(3x - 2)$

x $15x^2 + 42x - 9 = 3(5x^2 + 14x - 3)$
$= 3(5x^2 - x + 15x - 3)$
$= 3\ (x(5x - 1) + 3(5x - 1))$
$= 3(5x - 1)(x + 3)$

3 a $x^3 + 2x = x(x^2 + 2)$

b $x^3 - x^2 + x = x(x^2 - x + 1)$

c $x^3 - 5x = x(x^2 - 5)$

d $x^3 - 9x = x(x^2 - 9)$
$= x(x^2 - 3^2)$
$= x(x + 3)(x - 3)$

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

f $x^3 + 11x^2 + 30x = x(x^2 + 11x + 30)$
$= x(x^2 + 5x + 6x + 30)$
$= x(x(x + 5) + 6(x + 5))$
$= x(x + 5)(x + 6)$

g $x^3 - 7x^2 + 6x = x(x^2 - 7x + 6)$
$= x(x^2 - x - 6x + 6)$
$= x(x\ (x - 1) - 6(x - 1))$
$= x(x - 1)(x - 6)$

h $x^3 - 64x = x(x^2 - 64)$
$= x(x^2 - 8^2)$
$= x(x + 8)(x - 8)$

i $2x^3 - 5x^2 - 3x = x(2x^2 - 5x - 3)$
$= x(2x^2 + x - 6x - 3)$
$= x(x\ (2x + 1) - 3(2x + 1))$
$= x(2x + 1)(x - 3)$

j $2x^3 + 13x^2 + 15x = x(2x^2 + 13x + 15)$
$= x(2x^2 + 3x + 10x + 15)$
$= x(x(2x + 3) + 5(2x + 3))$
$= x(2x + 3)(x + 5)$

k $x^3 - 4x = x(x^2 - 4)$
$= x(x^2 - 2^2)$
$= x(x + 2)(x - 2)$

l $3x^3 + 27x^2 + 60x = 3x(x^2 + 9x + 20)$
$= 3x(x^2 + 4x + 5x + 20)$
$= 3x(x(x + 4) + 5(x + 4))$
$= 3x(x + 4)(x + 5)$

4 $x^4 - y^4 = (x^2)^2 - (y^2)^2$
$= (x^2 + y^2)(x^2 - y^2)$
$= (x^2 + y^2)(x + y)(x - y)$

5 $6x^3 + 7x^2 - 5x = x(6x^2 + 7x - 5)$
$= x(6x^2 + 10x - 3x - 5)$
$= x(2x(3x + 5) - (3x + 5))$
$= x(3x + 5)(2x - 1)$

Challenge
$4x^4 - 13x^2 + 9 = (4x^4 - 4x^2 - 9x^2 + 9)$
$= 4x^2(x^2 - 1) - 9(x^2 - 1)$
$= (x^2 - 1)(4x^2 - 9)$
$= (x^2 - 1^2)((2x)^2 - 3^2)$
$= (x + 1)(x - 1)(2x + 3)(2x - 3)$