Exercise 5.1 Page No: 5.9

Question 1: Factorize $x^3 + x - 3x^2 - 3$
Solution:
$x^3 + x - 3x^2 - 3$
Here x is common factor in $x^3 + x$ and -3 is common factor in $-3x^2 - 3$
$x^3 - 3x^2 + x - 3$
$x^2 (x - 3) + 1(x - 3)$
Taking $(x - 3)$ common
$(x - 3)(x^2 + 1)$
Therefore $x^3 + x - 3x^2 - 3 = (x - 3)(x^2 + 1)$

Question 2: Factorize $a(a + b)^3 - 3a^2b(a + b)$
Solution:
$a(a + b)^3 - 3a^2b(a + b)$
Taking $a(a + b)$ as a common factor
$= a(a + b) \{(a + b)^2 - 3ab\}$
$= a(a + b) \{a^2 + b^2 + 2ab - 3ab\}$
$= a(a + b)(a^2 + b^2 - ab)$

Question 3: Factorize $x(x^3 - y^3) + 3xy(x - y)$
Solution:
$x(x^3 - y^3) + 3xy(x - y)$
$= x(x - y)(x^2 + xy + y^2) + 3xy(x - y)$
Taking $x(x - y)$ as a common factor
$= x(x - y)(x^2 + xy + y^2 + 3y)$
$= x(x - y)(x^2 + xy + y^2 + 3y)$

Question 4: Factorize $a^2x^2 + (ax^2 + 1)x + a$
Solution:
$a^2x^2 + (ax^2 + 1)x + a$
$= a^2x^2 + a + (ax^2 + 1)x$
$= a(ax^2 + 1) + x(ax^2 + 1)$
$= (ax^2 + 1)(a + x)$

Question 5: Factorize $x^2 + y - xy - x$
Solution:
$x^2 + y - xy - x$
$= x^2 - x - xy + y$
$= x(x- l) - y(x - 1)$
$= (x - 1)(x - y)$

Question 6: Factorize $x^3 - 2x^2y + 3xy^2 - 6y^3$

Solution:

$x^3 - 2x^2y + 3xy^2 - 6y^3$

$= x^2(x - 2y) + 3y^2(x - 2y)$

$= (x - 2y)(x^2 + 3y^2)$

Question 7: Factorize $6ab - b^2 + 12ac - 2bc$

Solution:

$6ab - b^2 + 12ac - 2bc$

$= 6ab + 12ac - b^2 - 2bc$

Taking 6a common from first two terms and –b from last two terms

$= 6a(b + 2c) - b(b + 2c)$

Taking (b + 2c) common factor

$= (b + 2c)(6a - b)$

Question 8: Factorize $(x^2 + 1/x^2) - 4(x + 1/x) + 6$

Solution:

$(x^2 + 1/x^2) - 4(x + 1/x) + 6$

$= x^2 + 1/x^2 - 4x - 4/x + 4 + 2$

$= x^2 + 1/x^2 + 4 + 2 - 4/x - 4x$

$= (x^2) + (1/x)^2 + (-2)^2 + 2x(1/x) + 2(1/x)(-2) + 2(-2)x$

As we know, $x^2 + y^2 + z^2 + 2xy + 2yz + 2zx = (x+y+z)^2$

So, we can write;

$= (x + 1/x + (-2))^2$

or $(x + 1/x - 2)^2$

Therefore, $x^2 + 1/x^2) - 4(x + 1/x) + 6 = (x + 1/x - 2)^2$

Question 9: Factorize $x(x - 2)(x - 4) + 4x - 8$

Solution:

$x(x - 2)(x - 4) + 4x - 8$

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

$= (x - 2)[x(x - 4) + 4]$

$= (x - 2)(x^2 - 4x + 4)$
$= (x - 2)[x^2 - 2(x)(2) + (2)^2]$
$= (x - 2)(x - 2)^2$
$= (x - 2)^3$

Question 10: Factorize $(x + 2)(x^2 + 25) - 10x^2 - 20x$

Solution :

$(x + 2)(x^2 + 25) - 10x(x + 2)$

Take $(x + 2)$ as common factor;

$= (x + 2)(x^2 + 25 - 10x)$

$= (x + 2)(x^2 - 10x + 25)$

Expanding the middle term of $(x^2 - 10x + 25)$

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

$= (x + 2)\{x(x - 5) - 5(x - 5)\}$

$= (x + 2)(x - 5)(x - 5)$

$= (x + 2)(x - 5)^2$

Therefore, $(x + 2)(x^2 + 25) - 10x(x + 2) = (x + 2)(x - 5)^2$

Question 11: Factorize $2a^2 + 2\sqrt{6}\,ab + 3b^2$

Solution:

$2a^2 + 2\sqrt{6}\,ab + 3b^2$

Above expression can be written as $(\sqrt{2}a)^2 + 2 \times \sqrt{2}a \times \sqrt{3}b + (\sqrt{3}b)^2$

As we know, $(p + q)^2 = p^2 + q^2 + 2pq$
Here $p = \sqrt{2}a$ and $q = \sqrt{3}b$

$= (\sqrt{2}a + \sqrt{3}b)^2$

Therefore, $2a^2 + 2\sqrt{6}\,ab + 3b^2 = (\sqrt{2}a + \sqrt{3}b)^2$

Question 12: Factorize $(a - b + c)^2 + (b - c + a)^2 + 2(a - b + c)(b - c + a)$

Solution:

$(a - b + c)^2 + (b - c + a)^2 + 2(a - b + c)(b - c + a)$

{Because $p^2 + q^2 + 2pq = (p + q)^2$}

Here $p = a - b + c$ and $q = b - c + a$

$= [a - b + c + b - c + a]^2$

$= (2a)^2$

$= 4a^2$

Question 13: Factorize $a^2 + b^2 + 2(ab+bc+ca)$

Solution:

$a^2 + b^2 + 2ab + 2bc + 2ca$

As we know, $p^2 + q^2 + 2pq = (p + q)^2$

We get,

$= (a+b)^2 + 2bc + 2ca$

$= (a+b)^2 + 2c(b + a)$

Or $(a+b)^2 + 2c(a + b)$

Take $(a + b)$ as common factor;

$= (a + b)(a + b + 2c)$

Therefore, $a^2 + b^2 + 2ab + 2bc + 2ca = (a + b)(a + b + 2c)$

Question 14: Factorize $4(x-y)^2 - 12(x - y)(x + y) + 9(x + y)^2$

Solution :

Consider $(x - y) = p$, $(x + y) = q$

$= 4p^2 - 12pq + 9q^2$

Expanding the middle term, -12 = -6 -6 also $4 \times 9 = -6 \times -6$

$= 4p^2 - 6pq - 6pq + 9q^2$

$= 2p(2p - 3q) - 3q(2p - 3q)$

$= (2p - 3q)(2p - 3q)$

$= (2p - 3q)^2$

Substituting back $p = x - y$ and $q = x + y$;

$= [2(x-y) - 3(x+y)]^2 = [2x - 2y - 3x - 3y]^2$

$= (2x-3x-2y-3y)^2$

$= [-x - 5y]^2$

$= [(-1)(x+5y)]^2$

$= (x+5y)^2$

Therefore, $4(x-y)^2 - 12(x - y)(x + y) + 9(x + y)^2 = (x+5y)^2$

Question 15: Factorize $a^2 - b^2 + 2bc - c^2$

Solution :

$a^2 - b^2 + 2bc - c^2$

As we know, $(a-b)^2 = a^2 + b^2 - 2ab$

$= a^2 - (b - c)^2$

Also we know, $a^2 - b^2 = (a+b)(a-b)$

$= (a + b - c)(a - (b - c))$

$= (a + b - c)(a - b + c)$

Therefore, $a^2 - b^2 + 2bc - c^2 = (a + b - c)(a - b + c)$

Question 16: Factorize $a^2 + 2ab + b^2 - c^2$

Solution:

$a^2 + 2ab + b^2 - c^2$

$= (a^2 + 2ab + b^2) - c^2$

$= (a + b)^2 - (c)^2$

We know, $a^2 - b^2 = (a + b)(a - b)$

$= (a + b + c)(a + b - c)$

Therefore $a^2 + 2ab + b^2 - c^2 = (a + b + c)(a + b - c)$

Exercise 5.2 Page No: 5.13

Factorize each of the following expressions:

Question 1: $p^3 + 27$

Solution:

$p^3 + 27$

$= p^3 + 3^3$

[using $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

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

Therefore, $p^3 + 27 = (p + 3)(p^2 - 3p - 9)$

Question 2: $y^3 + 125$

Solution:

$y^3 + 125$

$= y^3 + 5^3$

[using $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

$= (y+5)(y^2 - 5y + 5^2)$

$= (y + 5)(y^2 - 5y + 25)$

Therefore, $y^3 + 125 = (y + 5)(y^2 - 5y + 25)$

Question 3: $1 - 27a^3$

Solution:

$= (1)^3 - (3a)^3$

[using $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$]

$= (1 - 3a)(1^2 + 1\times 3a + (3a)^2)$

$= (1-3a)(1 + 3a + 9a^2)$

Therefore, $1-27a^3 = (1-3a)(1 + 3a + 9a^2)$

Question 4: $8x^3y^3 + 27a^3$

Solution:

$8x^3y^3 + 27a^3$

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

[using $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

$= (2xy + 3a)((2xy)^2 - 2xy \times 3a + (3a)^2)$

$= (2xy+3a)(4x^2y^2 - 6xya + 9a^2)$

Question 5: $64a^3 - b^3$
Solution:

$64a^3 - b^3$
$= (4a)^3 - b^3$

[using $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$]

$= (4a-b)((4a)^2 + 4a \times b + b^2)$

$=(4a-b)(16a^2 + 4ab + b^2)$

Question 6: $x^3 / 216 - 8y^3$
Solution:
$x^3 / 216 - 8y^3$

$$=\left(\frac{x}{6}\right)^3 - (2y)^3$$

$$\because \left[x^3 - y^3 = (x-y)\left(x^2 + xy + y^2\right)\right]$$

$$= \left(\frac{x}{6} - 2y\right)\left(\left(\frac{x}{6}\right)^2 + \frac{x}{6} \times 2y + (2y)^2\right)$$

$$=\left(\frac{x}{6} - 2y\right)\left(\frac{x^2}{36} + \frac{xy}{3} + 4y^2\right)$$

$$\therefore \frac{x^3}{216} - 8y^3 = \left(\frac{x}{6} - 2y\right)\left(\frac{x^2}{36} + \frac{xy}{3} + 4y^2\right)$$

Question 7: $10x^4 y - 10xy^4$

Solution:

$10x^4 y - 10xy^4$

$= 10xy(x^3 - y^3)$

[using $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$]

$= 10xy (x-y)(x^2 + xy + y^2)$

Therefore, $10x^4 y - 10xy^4 = 10xy (x-y)(x^2 + xy + y^2)$

Question 8: $54x^6 y + 2x^3y^4$

Solution:

$54x^6 y + 2x^3y^4$

$= 2x^3y(27x^3 + y^3)$

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

[using $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

$= 2x^3y \{(3x+y) ((3x)^2-3xy+y^2)\}$

$=2x^3y(3x+y)(9x^2 - 3xy + y^2)$

Question 9: $32a^3 + 108b^3$

Solution:

$32a^3 + 108b^3$

$= 4(8a^3 + 27b^3)$

$= 4((2a)^3+(3b)^3)$

[using $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

$= 4[(2a+3b)((2a)^2-2a\times3b+(3b)^2)]$

$= 4(2a+3b)(4a^2 - 6ab + 9b^2)$

Question 10: $(a-2b)^3 - 512b^3$
Solution:
$(a-2b)^3 - 512b^3$

$= (a-2b)^3 - (8b)^3$

[using $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$]

$= (a - 2b - 8b) \{(a-2b)^2 + (a-2b)8b + (8b)^2\}$

$=(a - 10b)(a^2 + 4b^2 - 4ab + 8ab - 16b^2 + 64b^2)$

$=(a-10b)(a^2 + 52b^2 + 4ab)$

Question 11: $(a+b)^3 - 8(a-b)^3$
Solution:
$(a+b)^3 - 8(a-b)^3$

$= (a+b)^3 - [2(a-b)]^3$

$= (a+b)^3 - [2a-2b]^3$

[using $p^3 - q^3 = (p - q)(p^2 + pq + q^2)$]
Here $p = a+b$ and $q = 2a-2b$

$= (a+b-(2a-2b))((a+b)^2+(a+b)(2a-2b)+(2a-2b)^2)$

$=(a+b-2a+2b)(a^2+b^2+2ab+(a+b)(2a-2b)+(2a-2b)^2)$

$=(a+b-2a+2b)(a^2+b^2+2ab+2a^2-2ab+2ab-2b^2+(2a-2b)^2)$

$=(3b-a)(3a^2+2ab-b^2+(2a-2b)^2)$

$=(3b-a)(3a^2+2ab-b^2+4a^2+4b^2-8ab)$

$=(3b-a)(3a^2+4a^2-b^2+4b^2-8ab+2ab)$

$=(3b-a)(7a^2+3b^2-6ab)$

Question 12: $(x+2)^3 + (x-2)^3$

Solution:

$(x+2)^3 + (x-2)^3$

[using $p^3 + q^3 = (p + q)(p^2 - pq + q^2)$]
Here $p = x + 2$ and $q = x - 2$

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

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

[Using : $(a+b)(a-b) = a^2-b^2$]

$= 2x(2x^2 + 8 - (x^2 - 2^2))$

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

$= 2x(x^2 + 12)$

Exercise 5.3 Page No: 5.17

Question 1: Factorize $64a^3 + 125b^3 + 240a^2b + 300ab^2$
Solution:

$64a^3 + 125b^3 + 240a^2b + 300ab^2$

$= (4a)^3 + (5b)^3 + 3(4a)^2(5b) + 3(4a)(5b)^2$, which is similar to $a^3 + b^3 + 3a^2b + 3ab^2$

We know that, $a^3 + b^3 + 3a^2b + 3ab^2 = (a+b)^3$]

$= (4a+5b)^3$

Question 2: Factorize $125x^3 – 27y^3 – 225x^2y + 135xy^2$
Solution:
$125x^3 – 27y^3 – 225x^2y + 135xy^2$

Above expression can be written as $(5x)^3–(3y)^3–3(5x)^2(3y) + 3(5x)(3y)^2$

Using: $a^3 – b^3 – 3a^2b + 3ab^2 = (a–b)^3$

$= (5x – 3y)^3$

Question 3: Factorize $8/27\ x^3 + 1 + 4/3\ x^2 + 2x$
Solution:

$8/27\ x^3 + 1 + 4/3\ x^2 + 2x$

$$= \left(\frac{2}{3}x^3\right)^3 + 1^3 + 3 \times \left(\frac{2}{3}x\right)^2 \times 1 + 3(1)^2 \times \left(\frac{2}{3}x\right)$$

$$\left[\because x^3 + b^3 + 3x^2b + 3xb^2 = (x+b)^3\right]$$

$$\therefore \frac{8}{27}x^3 + 1 + \frac{4}{3}x^2 + 2x = \left(\frac{2}{3}x + 1\right)^3$$

Question 4: Factorize $8x^3 + 27y^3 + 36x^2y + 54xy^2$

Solution:

$8x^3 + 27y^3 + 36x^2y + 54xy^2$

Above expression can be written as $(2x)^3 + (3y)^3 + 3\times(2x)^2\times3y + 3\times(2x)(3y)^2$

Which is similar to $a^3 + b^3 + 3a^2b + 3ab^2 = (a + b)^3$]

Here a = 2x and b = 3y

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

Therefore, $8x^3 + 27y^3 + 36x^2y + 54xy^2 = (2x+3y)^3$

Question 5: Factorize $a^3 - 3a^2b + 3ab^2 - b^3 + 8$

Solution:

$a^3 - 3a^2b + 3ab^2 - b^3 + 8$

Using: $a^3 - b^3 - 3a^2b + 3ab^2 = (a-b)^3$

$= (a-b)^3 + 2^3$

Again , Using: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$]

$=(a-b+2)((a-b)^2-(a-b) \times 2 + 2^2)$

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

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

$a^3 - 3a^2b + 3ab^2 - b^3 + 8 =(a-b+2)(a^2+b^2-2ab-2a+2b+4)$

Exercise 5.4 Page No: 5.22

Factorize each of the following expressions:

Question 1: $a^3 + 8b^3 + 64c^3 - 24abc$

Solution:

$a^3 + 8b^3 + 64c^3 - 24abc$

$= (a)^3 + (2b)^3 + (4c)^3 - 3 \times a \times 2b \times 4c$

[Using $a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2-ab-bc-ca)$]

$= (a+2b+4c)(a^2+(2b)^2 + (4c)^2-a \times 2b-2b \times 4c-4c \times a)$

$= (a+2b+4c)(a^2 +4b^2 +16c^2 -2ab-8bc-4ac)$

Therefore, $a^3 + 8b^3 + 64c^3 - 24abc = (a+2b+4c)(a^2 +4b^2 +16c^2 -2ab-8bc-4ac)$

Question 2: $x^3 - 8y^3 + 27z^3 + 18xyz$

Solution:

$= x^3 - (2y)^3 + (3z)^3 - 3 \times x \times (-2y)(3z)$

$= (x + (-2y) + 3z) (x^2 + (-2y)^2 + (3z)^2 -x(-2y)-(-2y)(3z)-3z(x))$

[using $a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2-ab-bc-ca)$]

$=(x -2y + 3z)(x^2 + 4y^2 + 9z^2 + 2xy + 6yz - 3zx)$

Question 3: $27x^3 - y^3 - z^3 - 9xyz$

Solution:

$27x^3 - y^3 - z^3 - 9xyz$

$= (3x)^3 - y^3 - z^3 - 3(3xyz)$

[Using $a^3 + b^3 + c^3 -3abc = (a + b + c)(a^2+b^2+c^2-ab-bc-ca)$]

Here a = 3x, b = -y and c = -z

$= (3x - y - z)\{ (3x)^2 + (- y)^2 + (- z)^2 + 3xy - yz + 3xz)\}$

$= (3x - y - z)\{ 9x^2 + y^2 + z^2 + 3xy - yz + 3xz)\}$

Question 4: $1/27\ x^3 - y^3 + 125z^3 + 5xyz$
Solution:
$1/27\ x^3 - y^3 + 125z^3 + 5xyz$
$= (x/3)^3+(-y)^3 +(5z)^3 - 3\ x/3\ (-y)(5z)$

[Using $a^3 + b^3 + c^3 -3abc = (a + b + c)(a^2+b^2+c^2-ab-bc-ca)$]

$= (x/3 + (-y) + 5z)((x/3)^2 + (-y)^2 + (5z)^2 -x/3(-y) - (-y)5z-5z(x/3))$

$= (x/3 -y + 5z)\ (x^2/9 + y^2 + 25z^2 + xy/3 + 5yz - 5zx/3)$

Question 5: $8x^3 + 27y^3 - 216z^3 + 108xyz$
Solution:
$8x^3 + 27y^3 - 216z^3 + 108xyz$

$= (2x)^3 + (3y)^3 +(-6y)^3 -3(2x)(3y)(-6z)$

$= (2x+3y+(-6z))\{ (2x)^2+(3y)^2+(-6z)^2 -2x\times3y-3y(-6z)-(-6z)2x\}$

$= (2x+3y-6z)\ \{4x^2 +9y^2 +36z^2 -6xy + 18yz + 12zx\}$

Question 6: $125 + 8x^3 - 27y^3 + 90xy$
Solution:
$125 + 8x^3 - 27y^3 + 90xy$
$= (5)^3 + (2x)^3 +(-3y)^3 -3\times5\times2x\times(-3y)$

$= (5+2x+(-3y))\ (5^2 +(2x)^2 +(-3y)^2 -5(2x)-2x(-3y)-(-3y)5)$

$= (5+2x-3y)(25+4x^2 +9y^2 -10x+6xy+15y)$

Question 7: $(3x-2y)^3 + (2y-4z)^3 + (4z-3x)^3$
Solution:
$(3x-2y)^3 + (2y-4z)^3 + (4z-3x)^3$

Let $(3x-2y) = a$, $(2y-4z) = b$, $(4z-3x) = c$

$a + b + c= 3x-2y+2y-4z+4z-3x = 0$

We know, $a^3 + b^3 + c^3 -3abc = (a + b + c)(a^2+b^2+c^2-ab-bc-ca)$
$\Rightarrow a^3 + b^3 + c^3 -3abc = 0$

or $a^3 + b^3 + c^3 = 3abc$

=> $(3x-2y)^3 + (2y-4z)^3 + (4z-3x)^3 = 3(3x-2y)(2y-4z)(4z-3x)$

Question 8: $(2x-3y)^3 + (4z-2x)^3 + (3y-4z)^3$

Solution:

$(2x-3y)^3 + (4z-2x)^3 + (3y-4z)^3$

Let $2x - 3y = a$, $4z - 2x = b$, $3y - 4z = c$

$a + b + c = 2x - 3y + 4z - 2x + 3y - 4z = 0$

We know, $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2+b^2+c^2-ab-bc-ca)$

=> $a^3 + b^3 + c^3 - 3abc = 0$

$(2x-3y)^3 + (4z-2x)^3 + (3y-4z)^3 = 3(2x-3y)(4z-2x)(3y-4z)$

Exercise VSAQs Page No: 5.24

Question 1: Factorize $x^4 + x^2 + 25$
Solution:
$x^4 + x^2 + 25$
$= (x^2)^2 + 5^2 + x^2$
[using $a^2 + b^2 = (a + b)^2 - 2ab$]
$= (x^2 +5)^2 -2(x^2)(5) + x^2$
$=(x^2 +5)^2 -10x^2 + x^2$
$=(x^2 + 5)^2 - 9x^2$
$=(x^2 + 5)^2 - (3x)^2$

[using $a^2 - b^2 = (a + b)(a - b$]

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

Question 2: Factorize $x^2 - 1 - 2a - a^2$
Solution:
$x^2 - 1 - 2a - a^2$
$x^2 - (1 + 2a + a^2)$
$x^2 - (a + 1)^2$
$(x - (a + 1)(x + (a + 1)$
$(x - a - 1)(x + a + 1)$
[using $a^2 - b^2 = (a + b)(a - b)$ and $(a + b)^2 = a^2 + b^2 + 2ab$]

Question 3: If $a + b + c =0$, then write the value of $a^3 + b^3 + c^3$.
Solution:
We know, $a^3 + b^3 + c^3 - 3abc = (a + b +c) (a^2 + b^2 + c^2 - ab - bc - ca)$
Put $a + b + c =0$
This implies
$a^3 + b^3 + c^3 = 3abc$

Question 4: If $a^2 + b^2 + c^2 = 20$ and $a + b + c =0$, find $ab + bc + ca$.
Solution:
We know, $(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

$0 = 20 + 2(ab + bc + ca)$

$-10 = ab + bc + ca$

Or $ab + bc + ca = -10$

Question 5: If $a + b + c = 9$ and $ab + bc + ca = 40$, find $a^2 + b^2 + c^2$.
Solution:

We know, $(a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$

$9^2 = a^2 + b^2 + c^2 + 2(40)$

$81 = a^2 + b^2 + c^2 + 80$

$\Rightarrow a^2 + b^2 + c^2 = 1$