



Class 9 Maths – Ganita Manjari



Chapter 4: Exploring Algebraic Identities

★ End-of-Chapter Exercises – Solutions

These solutions are based on the **new Ganita Manjari Grade 9 Part I textbook**. The End-of-Chapter Exercises contain **13 questions** covering identities, calculations, factorisation, rational expressions and applications.



Q1. Use suitable identities to find the following products

(i) $(-3x + 4)^2$

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

$$= 9x^2 - 24x + 16$$

✓ Answer: $9x^2 - 24x + 16$

(ii) $(2s + 7)(2s - 7)$

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

$$= (2s)^2 - 7^2$$

✓ Answer: $4s^2 - 49$

(iii) $(p^2 + 1/2)(p^2 - 1/2)$

$$= (p^2)^2 - (1/2)^2$$

✓ Answer: $p^4 - 1/4$

(iv) $(2n + 7)(2n - 7)$

$$= (2n)^2 - 7^2$$

✓ Answer: $4n^2 - 49$

(v) $(s - 2t)(s^2 + 2st + 4t^2)$

Using:

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

✓ Answer: $s^3 - 8t^3$

(vi) $(1/(2r) - 4r)^2$

Using $(a-b)^2$:

$$= 1/(4r^2) - 4 + 16r^2$$

✓ Answer: $1/(4r^2) - 4 + 16r^2$

(vii) $(-3m + 4k - l)^2$

Using $(a+b+c)^2$:

$$= 9m^2 + 16k^2 + l^2 - 24mk + 6ml - 8kl$$

✓ Answer: $9m^2 + 16k^2 + l^2 - 24mk + 6ml - 8kl$

(viii) $(x - y/3)^3$

Using $(a-b)^3$:

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

✓ **Answer:** $x^3 - x^2y + xy^2/3 - y^3/27$

(ix) $(7k/2 - 2m/3)^3$

Using $(a-b)^3$:

$$= 343k^3/8 - 49k^2m/2 + 14km^2/3 - 8m^3/27$$

✓ **Answer:** $343k^3/8 - 49k^2m/2 + 14km^2/3 - 8m^3/27$

The nine products are listed in the textbook's End-of-Chapter Exercises.

Q2. Find the values using suitable identities

(i) 17×21

$$= (19 - 2)(19 + 2)$$

$$= 19^2 - 2^2$$

$$= 361 - 4$$

✓ **Answer:** 357

(ii) 104×96

$$= (100 + 4)(100 - 4)$$

$$= 100^2 - 4^2$$

$$= 10000 - 16$$

✓ **Answer:** 9984

(iii) 24×16

$$= (20 + 4)(20 - 4)$$

$$= 20^2 - 4^2$$

$$= 400 - 16$$

 **Answer: 384**

(iv) 147^3

$$= (150 - 3)^3$$

Using $(a-b)^3$:

$$= 150^3 - 3(150^2)(3) + 3(150)(3^2) - 3^3$$

$$= 3,176,523$$

 **Answer: 3,176,523**

(v) 199^3

$$= (200 - 1)^3$$

$$= 200^3 - 3(200^2)(1) + 3(200)(1) - 1$$

$$= 7,880,599$$

 **Answer: 7,880,599**

(vi) 127^3

$$= (125 + 2)^3$$

$$= 125^3 + 3(125^2)(2) + 3(125)(2^2) + 2^3$$

$$= 2,048,383$$

 **Answer: 2,048,383**

(vii) $(-107)^3$

$$= -(107^3)$$

$$107^3 = 1,225,043$$

✓ Answer: $-1,225,043$

(viii) $(-299)^3$

$$= -(299^3)$$

$$299^3 = 26,730,899$$

✓ Answer: $-26,730,899$

Q3. Factorise the following algebraic expressions

(i) $4y^2 + 1 + 1/(16y^2)$

$$= (2y)^2 + 2(2y)(1/4y) + (1/4y)^2$$

✓ Answer: $(2y + 1/(4y))^2$

(ii) $9m^2 - 1/(25n^2)$

Using difference of squares:

$$= (3m)^2 - (1/5n)^2$$

✓ Answer: $(3m - 1/(5n))(3m + 1/(5n))$

(iii) $27b^3 - 1/(64b^3)$

$$= (3b)^3 - (1/(4b))^3$$

Using $a^3 - b^3$:

✓ **Answer: $(3b - 1/(4b))(9b^2 + 3/4 + 1/(16b^2))$**

(iv) $x^2 + 5x/6 + 1/6$

Find two numbers whose sum is $5/6$ and product is $1/6$:

$1/2$ and $1/3$.

Therefore:

$$= (x + 1/2)(x + 1/3)$$

(v) $27u^3 - 1/125 - 27u^2/5 + 9u/25$

This is:

$$(3u - 1/5)^3$$

✓ **Answer: $(3u - 1/5)^3$**

(vi) $64y^3 + z^3/125$

$$= (4y)^3 + (z/5)^3$$

Using sum of cubes:

✓ **Answer: $(4y + z/5)(16y^2 - 4yz/5 + z^2/25)$**

(vii) $p^3 + 27q^3 + r^3 - 9pqr$

Using:

$$a^3+b^3+c^3-3abc$$

with $a=p$, $b=3q$, $c=r$:

✓ Answer:

$$(p + 3q + r)(p^2 + 9q^2 + r^2 - 3pq - pr - 3qr)$$

$$\text{(viii)} \quad 9m^2 - 12m + 4$$

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

✓ Answer: $(3m - 2)^2$

$$\text{(ix)} \quad 9x^3 - 8y^3/3 + z^3/3 + 6xyz$$

Factorising:

✓ Answer:

$$(3x - 2y + z)/3 \times (9x^2 + 6xy - 3xz + 4y^2 + 2yz + z^2)$$

$$\text{(x)} \quad 4x^2 + 9y^2 + 36z^2 + 12xz + 36yz + 24xy$$

Recognise the perfect square:

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

✓ Answer: $(2x + 3y + 6z)^2$

$$\text{(xi)} \quad 27u^3 - 1/216 - 9u^2/2 + u/4$$

$$= (3u - 1/6)^3$$

✓ Answer: $(3u - 1/6)^3$

The textbook lists these eleven factorisation problems as Question 3.

Q4. Simplify

(i)

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

Numerator:

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

Denominator:

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

Cancel:

 **Answer:** $(2x + 1)/(2x - 1)$

(ii)

$$9(3a^3 - 24b^3)/(9a^2 - 36b^2)$$

$$= 27(a^3 - 8b^3) / [9(a^2 - 4b^2)]$$

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

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

 **Answer:** $3(a^2 + 2ab + 4b^2)/(a + 2b)$

(iii)

$$(s^3 + 125t^3)/(s^2 - 2st - 35t^2)$$

Numerator:

$$= s^3 + (5t)^3$$

$$= (s + 5t)(s^2 - 5st + 25t^2)$$

Denominator:

$$= (s - 7t)(s + 5t)$$

Cancel $(s + 5t)$:

✓ **Answer:** $(s^2 - 5st + 25t^2)/(s - 7t)$

📌 The textbook specifies that denominators are assumed to be non-zero.

Q5. Find possible length and breadth

(i) $25a^2 - 30ab + 9b^2$

$$= (5a - 3b)^2$$

Therefore:

✓ **Length = $5a - 3b$**

✓ **Breadth = $5a - 3b$**

(ii) $36s^2 - 49t^2$

$$= (6s - 7t)(6s + 7t)$$

Therefore:

✓ **Length = $6s - 7t$**

✓ **Breadth = $6s + 7t$**

The textbook asks for possible expressions for the dimensions of rectangles having these areas.

Q6. Find possible length, breadth and height

(i) $6a^2 - 24b^2$

$$= 6(a^2 - 4b^2)$$

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

Therefore, one possible set is:

✓ Length = 6

✓ Breadth = $a - 2b$

✓ Height = $a + 2b$

(ii) $3ps^2 - 15ps + 12p$

Take $3p$ common:

$$= 3p(s^2 - 5s + 4)$$

$$= 3p(s - 1)(s - 4)$$

Therefore:

✓ Length = $3p$

✓ Breadth = $s - 1$

✓ Height = $s - 4$

Q7. Area of the path around the playground

Original square side = 40 m

Path width = **s m**

Outer side:

$$= 40 + 2s$$

Area of outer square:

$$= (40 + 2s)^2$$

Area of playground:

$$= 40^2 = 1600$$

Therefore:

Area of path

$$= (40 + 2s)^2 - 1600$$

$$= 1600 + 160s + 4s^2 - 1600$$

✓ **Answer: $4s^2 + 160s$ square metres**

Q8. Number plus its reciprocal

Let the number be **x**.

Given:

$$x + 1/x = 10/3$$

Multiply by $3x$:

$$3x^2 + 3 = 10x$$

$$3x^2 - 10x + 3 = 0$$

Factorising:

$$(3x - 1)(x - 3) = 0$$

Therefore:

$$x = 1/3 \text{ or } x = 3$$

✓ Answer: 3 or 1/3

Q9. Rectangular pool

Area:

$$2x^2 + 7x + 3$$

Factorise:

$$= (2x + 1)(x + 3)$$

$$\text{Width} = 2x + 1$$

Therefore:

✓ Length = $x + 3$ hastas

Q10. Prove that $p = r$

Given:

$$x - 2 \text{ and } x - 1/2$$

are factors of:

$$px^2 + 5x + r$$

Since the roots are:

$$x = 2 \text{ and } x = 1/2$$

The polynomial is proportional to:

$$(x - 2)(x - 1/2)$$

$$= x^2 - 5x/2 + 1$$

Comparing with:

$$px^2 + 5x + r$$

we get:

$$-5p/2 = 5$$

$$p = -2$$

And:

$$r = p = -2$$

Therefore:

$$\checkmark p = r$$

Q11. Prove that $a^3 + b^3 + c^3 - 3abc = -25$

Given:

$$a + b + c = 5$$

$$ab + bc + ca = 10$$

Use:

$$a^3 + b^3 + c^3 - 3abc$$

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

Now:

$$a^2+b^2+c^2$$

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

$$= 25 - 20$$

$$= 5$$

Therefore:

$$= 5(5 - 10)$$

$$= 5(-5)$$

✓ Answer: -25

Q12. Prove $n^3 - n$ is always divisible by 6

Factorise:

$$n^3 - n$$

$$= n(n^2 - 1)$$

$$= n(n - 1)(n + 1)$$

These are **three consecutive integers**.

Among three consecutive integers:

- ♦ One is divisible by 3.
- ♦ At least one is even.

Therefore, their product is divisible by:

$$3 \times 2 = 6$$

Hence:

✓ $n^3 - n$ is always divisible by 6 for every natural number n .

Q13. Find the value

(i) $x^3 + y^3 - 12xy + 64$, when $x + y = -4$

Using:

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

$$= (-4)^3 - 3xy(-4)$$

$$= -64 + 12xy$$

Therefore:

$$x^3 + y^3 - 12xy + 64$$

$$= -64 + 12xy - 12xy + 64$$

$$= 0$$

✓ Answer: 0

(ii) $x^3 - 8y^3 - 36xy - 216$, when $x = 2y + 6$

Since:

$$x - 2y = 6$$

Using:

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

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

Therefore:

$$x^3 - 8y^3 - 36xy - 216$$

$$= 6(x^2 + 2xy + 4y^2) - 36xy - 216$$

Substituting $x = 2y + 6$ gives:

$$= 0$$

✓ Answer: 0

The textbook gives both conditions exactly in Question 13.



QUICK ANSWER KEY

Q1

(i) $9x^2 - 24x + 16$

(ii) $4s^2 - 49$

(iii) $p^4 - 1/4$

(iv) $4n^2 - 49$

(v) $s^3 - 8t^3$

(vi) $1/(4r^2) - 4 + 16r^2$

(vii) $9m^2 + 16k^2 + l^2 - 24mk + 6ml - 8kl$

(viii) $x^3 - x^2y + xy^2/3 - y^3/27$

(ix) $343k^3/8 - 49k^2m/2 + 14km^2/3 - 8m^3/27$

Q2

(i) 357

(ii) 9984

(iii) 384

(iv) 3,176,523

(v) 7,880,599

(vi) 2,048,383

(vii) -1,225,043

(viii) -26,730,899

Q3

(i) $(2y + 1/4y)^2$

(ii) $(3m - 1/5n)(3m + 1/5n)$

(iii) $(3b - 1/4b)(9b^2 + 3/4 + 1/16b^2)$

(iv) $(x + 1/2)(x + 1/3)$

(v) $(3u - 1/5)^3$

(vi) $(4y + z/5)(16y^2 - 4yz/5 + z^2/25)$

(vii) $(p + 3q + r)(p^2 + 9q^2 + r^2 - 3pq - pr - 3qr)$

(viii) $(3m - 2)^2$

(ix) $(3x - 2y + z)/3 \times (...)$

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

(xi) $(3u - 1/6)^3$

Q4

- (i) $(2x + 1)/(2x - 1)$
(ii) $3(a^2 + 2ab + 4b^2)/(a + 2b)$
(iii) $(s^2 - 5st + 25t^2)/(s - 7t)$

Q5

- (i) $5a - 3b$, $5a - 3b$
(ii) $6s - 7t$, $6s + 7t$

Q6

- (i) 6 , $a - 2b$, $a + 2b$
(ii) $3p$, $s - 1$, $s - 4$

Q7

$$4s^2 + 160s \text{ m}^2$$

Q8

3 or $1/3$

Q9

$x + 3$ hastas

Q10

$$p = r = -2$$

Q11

-25

Q12

$$n^3 - n = n(n-1)(n+1), \text{ divisible by } 6$$

Q13

- (i) 0
(ii) 0