Exploring Algebraic Identities

Standard difficulty · 20 questions · 40 marks · Time: 29 minutes

Name: _____ Date: _____ Score: ____ / 40

Show your working for Sections B and C. Answers are on the last page — try every question first!

Section A — Choose the correct answer — 8 × 1 = 8 marks

1. $(x + 6)^3$ expands to:

(a) $x^3 + 18x^2 + 18x + 216$ **(b)** $x^3 + 216$

(c) $x^3 + 6x^2 + 36x + 216$ **(d)** $x^3 + 18x^2 + 108x + 216$

2. $(3x - 9)^3$ expands to:

(a) $27x^3 - 243x^2 + 729x - 729$ **(b)** $27x^3 - 729$

(c) $27x^3 + 243x^2 - 729x - 729$ **(d)** $27x^3 - 243x^2 - 729x - 729$

3. $(a + b)^3$ equals:

(a) $a^3 + 3a^2b + b^3$ **(b)** $a^3 + 3ab + b^3$

(c) $a^3 + 3a^2b + 3ab^2 + b^3$ **(d)** $a^3 + b^3$

4. Using $(a + b)^3$, 13^3 equals:

(a) 2206 **(b)** 1027 **(c)** 2197 **(d)** 1690

5. Since $6 + 4 + (-10) = 0$, the value of $6^3 + 4^3 + (-10)^3$ is:

(a) −720 **(b)** −240 **(c)** 0 **(d)** 720

6. If $x + y = 7$ and $xy = 7$, then $x^2 + y^2$ is:

(a) 42 **(b)** 49 **(c)** 63 **(d)** 35

7. Using an identity, 102^2 equals:

(a) 10444 **(b)** 10204 **(c)** 10004 **(d)** 10404

8. $64x^3 + 27$ factorises as:

(a) $(4x + 3)(16x^2 - 12x + 9)$ **(b)** $(4x - 3)(16x^2 + 12x + 9)$

(c) $(4x + 3)(16x^2 + 12x + 9)$ **(d)** $(4x + 3)^3$

Section B — Short answer — 8 × 2 = 16 marks

9. Expand $(x + 6y + 3z)^2$.

10. Expand $(3x - 4)^3$.

11. Find 1002^3 using an identity.

12. If $x + y = 11$ and $xy = 18$, find $x^3 + y^3$.

13. Factorise $x^2 + 10x + 16$.

14. Factorise $64x^2 - 81$.

15. Factorise $64x^3 - 125$.

16. Without cubing, find $10^3 + 6^3 + (-16)^3$.

Section C — Word problems — 4 × 4 = 16 marks

17. A cube of side $(x + 5)$ cm is built from small cubes of side 1 cm. Write its volume as an expanded polynomial, then find the volume when $x = 17$.

18. A square plot of side 39 m has a square pond of side 32 m dug in it. Use an identity to find the area left, quickly.

19. Kabir picks two numbers whose sum is 5 and whose product is 6, and says the sum of their squares is 13. Show this is right using an identity, without finding the numbers.

20. A box measures $(x + 4)$ by $(x + 2)$ by $(x + 3)$ cm. Expand its volume as a polynomial in x.

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Answer key

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Q	Answer	Working
1	**(d) $x^3 + 18x^2 + 108x + 216$**	$a = x, b = 6$: $a^3 + 3a^2b + 3ab^2 + b^3$
2	**(a) $27x^3 - 243x^2 + 729x - 729$**	$a = 3x, b = 9$: $a^3 - 3a^2b + 3ab^2 - b^3$
3	**(c) $a^3 + 3a^2b + 3ab^2 + b^3$**	—
4	**(c) 2197**	$(10 + 3)^3$
5	**(a) −720**	$3abc = 3 \times 6 \times 4 \times (-10)$
6	**(d) 35**	$7^2 - 2 \times 7$
7	**(d) 10404**	$10000 + 400 + 4$
8	**(a) $(4x + 3)(16x^2 - 12x + 9)$**	$a = 4x, b = 3$: $(a + b)(a^2 - ab + b^2)$
9	**$x^2 + 36y^2 + 9z^2 + 12xy + 36yz + 6zx$**	$a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
10	**$27x^3 - 108x^2 + 144x - 64$**	$(3x)^3 - 3(3x)^2(4) + 3(3x)(4)^2 - 4^3$
11	**1006012008**	$(1000 + 2)^3 = 1000000000 + 6000000 + 12000 + 8$
12	**737**	$(x + y)^3 - 3xy(x + y) = 1331 - 594$
13	**$(x + 2)(x + 8)$**	$8 + 2 = 10, 8 \times 2 = 16$
14	**$(8x + 9)(8x - 9)$**	$a^2 - b^2$ with $a = 8x, b = 9$
15	**$(4x - 5)(16x^2 + 20x + 25)$**	$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
16	**−2880**	the numbers add to 0, so the sum of cubes is $3 \times 10 \times 6 \times (-16)$
17	**$x^3 + 15x^2 + 75x + 125$; 10648 cm^3**	$(x + 5)^3$; $22^3 = 10648$
18	**497 m^2**	$39^2 - 32^2 = (39 + 32)(39 - 32) = 71 \times 7$
19	**13**	$x^2 + y^2 = (x + y)^2 - 2xy = 25 - 12$
20	**$x^3 + 9x^2 + 26x + 24$**	$x^3 + (4 + 2 + 3)x^2 + (8 + 6 + 12)x + 4 \times 2 \times 3$

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