⚡ Vedic Maths Magic Tricks ⚡

Chapter 10: Squares by Duplex Method (Dwandwa Yoga)

1. The Vedic Sutra & Concept of Duplex (D)

The square of any number can be calculated instantly using the Vedic concept of **"Dwandwa Yoga"** (Duplex Combination). It simplifies squaring multi-digit numbers into small sums of cross-products and squares.

📜 Key Formulas & Rules

1. **Single Digit (a):** $D(a) = a^2$
2. **Two Digits (ab):** **D(ab) = 2ab** (Double the product of both digits)
3. **Odd Digit Groups:** Double all outer cross-pairs + add square of the center digit.
4. **Even Digit Groups:** Double all outer symmetric cross-pairs.

Digits	Duplex Pattern	Formula	Quick Example
1 (a)	Single Square	$D(a) = a^2$	$D(4) = 4^2 =$ **16**
2 (ab)	Double Product	$D(ab) = 2ab$	$D(28) = 2(2\times8) =$ **32**
3 (abc)	Outer Pair + Center Sq.	$D(abc) = 2ac + b^2$	$D(321) = 2(3\times1) + 2^2 =$ **10**
4 (abcd)	Two Cross-Pairs	$D(abcd) = 2ad + 2bc$	$D(4235) = 2(4\times5) + 2(2\times3) =$ **52**
5 (abcde)	Outer Pairs + Center Sq.	$D(abcde) = 2ae + 2bd + c^2$	$D(21364) = 2(2\times4) + 2(1\times6) + 3^2 =$ **37**

2. Case-1: 2-Digit Numbers [$(ab)^2$ = D(a) / D(ab) / D(b)]

Formula: $(ab)^2$ = D(a) / D(ab) / D(b)

📌 Eg-1: Find 28^2 (D(2) = 4, D(28) = 32, D(8) = 64)

LHS STEP	MIDDLE & RHS
D(2) + Carry	32 / 64 (Carry 6)
4 + 3 = 7	84

∴ 28^2 = **784**

📌 Eg-2: Find 73 ^{2} (Carrying Extra Digits) (D(7)=49, D(73)=42, D(3)=9)

LHS STEP	RHS STEP
49 + 4 (Carry)	2 | 9
53	29

∴ 73^2 = **5329**

📌 Eg-3: Find 46 ^{2} (D(4)=16, D(46)=48, D(6)=36)

Unadjusted: 16 / 48 / 36 → Carry 3 & Carry 5 → ∴ 46^2 = 2116

3. Case-2: 3-Digit Numbers [$(abc)^2$ = D(a) / D(ab) / D(abc) / D(bc) / D(c)]

📌 Eg-1: Find 321 ^{2}

Chain: D(3) / D(32) / D(321) / D(21) / D(1)
Unadjusted Values: 9 / 12 / ($2 \cdot 3 \cdot 1 + 2^2$) / 4 / 1 = **9 / 12 / 10 / 4 / 1**

Adjust Carries Leftward: 9 (+1) / 2 (+1) / 0 / 4 / 1 → ∴ 321^2 = **103,041**

📌 Eg-2: Find 893 ^{2}

Chain: D(8) / D(89) / D(893) / D(93) / D(3)
Unadjusted: 64 / 144 / 129 / 54 / 9

Adjust Carries: 64 + 15 = 79 | 57 → 7 | 34 → 4 | 4 | 9 → ∴ 893^2 = **797,449**

4. Case-3: 4-Digit & 5-Digit Multi-Step Expansions

📌 Eg-1: Find 4235 ^{2} (7-Step Expansion)

Pattern: D(4) / D(42) / D(423) / D(4235) / D(235) / D(35) / D(5)
Values: 16 / 16 / 28 / 52 / 29 / 30 / 25

∴ 4235^2 = **17,935,225**

📌 Eg-2: Find 21364 ^{2} (9-Step Expansion)

Pattern: D(2) / D(21) / D(213) / D(2136) / D(21364) / D(1364) / D(364) / D(64) / D(4)
Values: 4 / 4 / 13 / 30 / 37 / 44 / 60 / 48 / 16

∴ 21364^2 = **456,420,496**

5. Chapter 10 Exercises & Solutions

Solve the following square problems using the Duplex Method:

#	Problem	Duplex Setup	Unadjusted Chain	Carry Adjustments	Final Answer
1	27^2	D(2) / D(27) / D(7)	4 / 28 / 49	4 + 3 = 7 | 8 + 4 = 12 → 2 | 9	**729**
2	34^2	D(3) / D(34) / D(4)	9 / 24 / 16	9 + 2 = 11 | 4 + 1 = 5 | 6	**1156**
3	76^2	D(7) / D(76) / D(6)	49 / 84 / 36	49 + 8 = 57 | 4 + 3 = 7 | 6	**5776**
4	53^2	D(5) / D(53) / D(3)	25 / 30 / 9	25 + 3 = 28 | 0 | 9	**2809**
5	89^2	D(8) / D(89) / D(9)	64 / 144 / 81	64 + 15 = 79 | 44 + 8 = 52 → 2 | 1	**7921**
6	92^2	D(9) / D(92) / D(2)	81 / 36 / 4	81 + 3 = 84 | 6 | 4	**8464**

Summary Checklist for Duplex Squaring

🎯 Quick Recall Rules

1. **Step Count:** An *n*-digit number always requires **(2n - 1)** duplex steps.
2. **Expand & Contract:** Build up digit combinations from left to right, reach full length, then contract down to the last single digit.
3. **Duplex Computations:**
   - 1 digit: Square it → D(a) = a^2
   - 2 digits: Double product → D(ab) = 2ab
   - 3+ digits: Sum of outer double products (+ center square if odd).
4. **Single Digit Retention:** Retain only 1 digit per compartment (from right to left) and carry over extra left digits!

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