⚡ Vedic Maths Magic Tricks ⚡

Chapter 11: Square Roots in One Line

1. Checking if a Number is a Perfect Square

🔍 Rules of "Mere Observation"

1. A perfect square **MUST end in 0, 1, 4, 5, 6, or 9**.
2. A number is **NEVER a perfect square if it ends in 2, 3, 7, or 8**.
3. If it ends in zeros, it must have an **even number of zeros** (e.g., 00, 0000).
4. If the last digit is **6**, the tens digit (second last) **MUST be ODD** (e.g., 16, 36, 96).
5. If the last digit is **0, 1, 4, 5, or 9**, the tens digit **MUST be EVEN** (e.g., 04, 25, 81).
6. If the number is even, its last two digits **must be divisible by 4**.

Squares of First 10 Natural Numbers

Number	Square	Last Digit
1 / 9	1 / 81	**1**
2 / 8	4 / 64	**4**
3 / 7	9 / 49	**9**
4 / 6	16 / 36	**6**
5	25	**5**
10	100	**00**

Square Ending → Root Last Digit

Square Ends In	Root Last Digit
1	1 or 9
4	2 or 8
5	5
6	4 or 6
9	3 or 7
00	0

2. Square Root of a Perfect Square (Observation Method)

📌 Eg-1: Find √3481

- **Split into 2 parts:** 34 | 81
- **First Part (34):** Largest perfect square ≤ 34 is 25 (√25 = **5**). So tens digit is 5.
- **Second Part (81):** Ends in 1 → Last digit options are **1 or 9** (Answer is 51 or 59).
- **Decision Rule:** Check benchmark (55^2 = 3025). Since 3481 > 3025, pick the larger option.

∴ **√3481 =** **59**

📌 Eg-2: Find √421

- **Split in 2 parts:** 4 | 21
- **First Part (4):** Perfect square 4 → √4 = **2**.
- **Second Part (21):** Ends in 1 → Last digit options are **1 or 9** (Options: 21 or 29).
- **Decision Rule:** Benchmark 25^2 = 625. Since 421 < 625, pick the smaller option.

∴ **√421 =** **21**

📌 Eg-3: Find √2704

- **Split in 2 parts:** 27 | 04
- **First Part (27):** Perfect square ≤ 27 is 25 (√25 = **5**).
- **Second Part (04):** Ends in 4 → Last digit options are **2 or 8** (Options: 52 or 58).
- **Decision Rule:** Benchmark 55^2 = 3025. Since 2704 < 3025, pick the smaller option.

∴ **√2704 =** **52**

3. Perfect Square Exercises & Solutions

#	Problem	Split Parts	First Digit	Second Digit Options & Comparison	Final Answer
1	**√4096**	40 | 96	6 (36 ≤ 40)	Ends in 6 → 4 or 6. 4096 > (65^2=4225) → 64	**64**
2	**√676**	6 | 76	2 (4 ≤ 6)	Ends in 6 → 4 or 6. 676 > (25^2=625) → 26	**26**
3	**√1369**	13 | 69	3 (9 ≤ 13)	Ends in 9 → 3 or 7. 1369 > (35^2=1225) → 37	**37**
4	**√8976**	89 | 76	9 (81 ≤ 89)	Ends in 6 → 4 or 6. 8976 < (95^2=9025) → 94	**94**

4. Square Roots of Imperfect/Random Numbers (Duplex Method)

For any random number or imperfect square, we follow the **Straight Division / Duplex Method**.

📌 Eg-1: Find √3249

1. **Group in pairs from Right to Left:** 32 | 49
2. **Largest square ≤ 32:** 5^2 = 25. First quotient digit = **5**, Remainder = 7 (place before 4 → 74). Divisor = 2 × 5 = **10**.
3. **Divide 74 by 10:** Quotient = **7**, Remainder = 4 (Gross Digest GD = 49).
4. **Subtract Duplex:** Net Digest = 49 - D(7) = 49 - 49 = 0. Divide 0 by 10 = 0.

∴ **√3249 =** **57.0**

📌 Eg-2: Find √529

1. **Group in pairs:** 5 | 29
2. **Largest square ≤ 5:** $2^2 = 4$. First quotient digit = **2**, Remainder = 1 (GD = 12). Divisor = 2 × 2 = **4**.
3. **Divide 12 by 4:** Next digit = **3**, Remainder = 0 (GD = 09).
4. **Subtract Duplex D(3):** Net Digest = 09 - 3^2 = 0. Quotient = 0.
5. Put decimal point after 2 digits = 23.0.

∴ **√529 =** **23.0**

5. Imperfect Square Exercises & Solutions

#	Problem	Divisor (2a)	Steps & Duplex Adjustments	Final Answer
1	**√4624**	2 × 6 = 12	6^2=36 (R=10 → GD=102). 102 ÷ 12 = 8, R=6 (GD=64). 64 - D(8) = 0.	**68.0**
2	**√2209**	2 × 4 = 8	4^2=16 (R=6 → GD=60). 60 ÷ 8 = 7, R=4 (GD=49). 49 - D(7) = 0.	**47.0**
3	**√2656**	2 × 5 = 10	5^2=25 (R=1 → GD=15). 15 ÷ 10 = 1, R=5 (GD=56). 56 - D(1) = 55. 55 ÷ 10 = 5.	**51.5**

💡 Master Summary: Square Roots in One Line

1. **For Perfect Squares:** Use *Observation*. Determine the tens digit from the lower perfect square, and pick the ones digit option by comparing against the 5-ending benchmark (e.g., 35^2, 55^2).
2. **For Random / Imperfect Squares:** Use *Duplex Division*. Divisor is always double the first digit (2a). Subtract duplex of quotient digits at each step to get the net remainder.

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