QUANTITATIVE ABILITY

SESSION – 1

☙ SPEED MATHS – I
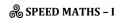
Introduction

Learning Mathematics is a pleasure and working out sums is an interesting activity. If you don't find it interesting, that means you haven't tried to understand it. Since Maths plays an important role in the Competitive Examinations, you should have a firm determination to learn it.

The most basic things in Mathematics are the four fundamental operations – addition, subtraction, multiplication and division. All these are useful and atleast one of them are used in any type of Mathematical question.

So if we do our basic mathematical calculations faster, our valuable time is saved in each question. Speed and accuracy are very important and can be achieved only by constant practice.

Speed Maths helps you to perform the calculations faster than our traditional methods. You should also know the multiplication tables up to 20 and it is always good to practise them.

Learning the one line addition, subtraction, multiplication and division methods also is useful.

ADDITION AND SUBTRACTION

1. Solve the following using one line addition method 4234 + 8238 + 646 + 5321 + 350.

   Solution:

   Step 1:

   Start adding the last digit from the right.

   During inning total, don't exceed 10. When we exceed 10, make a tick anywhere near about our calculation and go about with the number exceeding 10.

   $4234 + 8238 + 646 + 5321 + 350 =$ ... 9

   Step 2:

   Add the number of ticks with the digits in the second place.

   $4234 + 8238 + 646 + 5321 + 350 =$ ... 89

   Step 3:

   Add the number of ticks with the digits in the third place.

   $4234 + 8238 + 646 + 5321 + 350 =$ 789

   Step 4:

   Add the number of ticks with the digits in the fourth place.

   $4234 + 8238 + 646 + 5321 + 350 = 18789$

   ∴ 4234 + 8238 + 646 + 5321 + 350 = 18789

2. Simplify 412 – 83 + 70

   Solution:

   Step 1:

   $53921 + 6308 + 86 + 7025 + 11132 =$ ... 2

   Step 2:

   $53921 + 6308 + 86 + 7025 + 11132 =$ ... 72

   Step 3:

   $53921 + 6308 + 86 + 7025 + 11132 =$ ... 472

   Step 4:

   $53921 + 6308 + 86 + 7025 + 11132 =$ ... 8472

   $53921 + 6308 + 86 + 7025 + 11132 = 78472$

   ∴ 53921 + 6308 + 86 + 7025 + 11132 = 78472

3. Simplify 412 – 83 + 70

   Solution:

   Step 1:

   To get the unit's digit required, add and subtract the digits in the unit's places according to the sign attached.

   Here 2 – 3 + 0 = – 1

   So write as

   412 – 83 + 70 = ... (–1)

   Step 2:

   Similarly we get 1 – 8 + 7 = 0

   ∴ 412 – 83 + 70 = (0) (–1)

   Step 3:

   412 – 83 + 70 = 4(0) (–1)

   Step 4:

   Replace the above temporary figures by real figures.

   To replace (–1) by a +ve digit, borrow from digits in tens. As the digit is 0, borrow from hundreds

(–1)	(10)(–1)	(10)
(4)	(0)	(–1)
3	9	9

   ∴ 412 – 83 + 70 = 399

4. Simplify 89978 – 12345 – 36218

   Solution:

Step 1:	(4)	(1)	(4)	(2)	(–5)
Step 2:	4	1	4	1	5

   ∴ 89978 – 12345 – 36218 = 41415

5. Simplify 28369 + 38962 – 9873

   Solution:

Step 1:	(5)	(7)	(4)	(5)	(8)
Step 2:	5	7	4	5	8

   ∴ 28369 + 38962 – 9873 = 57458

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6. Simplify 10789 + 3946 − 2310 − 1223

    Solution:

    Whenever we get a value more than 10 on adding and subtracting the digits, we will put the unit's digit and carry over the ten's digit and add it to the positive value.

    $$\overset{+1\ +1\ +1}{10\ 7\ 8\ 9} + 3946 - 2310 - 1223$$

    $$= (1)\ (1)\ (2)\ (0)\ (2) = 11202$$

    $$\therefore\ 10789 + 3946 - 2310 - 1223 = 11202$$

7. Simplify 765.819 − 89.003 + 12.038 − 86.89

    Solution:

    First the number of digits after the decimal have to be equated.

    765.819 − 89.003 + 12.038 − 86.890

    $$= \overset{-1\ -1\ -1\ \ -1\ +1}{7\ 6\ 5\ .\ 8\ 1\ 9} - 89.003 + 12.038 - 86.890$$

    $$= 7\ (-9)\ (-8)\ .0\ (-4)\ (4)$$

    $$= 601.964$$

    $$\therefore\ 765.819 - 89.003 + 12.038 - 86.890 = 601.964$$

8. Simplify 792.02 + 101.32 − 306.76

    Solution:

    792.02 + 101.32 − 306.76

    $$= (5)\ (9)\ (-3)\ (-4)\ (-2)$$

    $$= 5\ \ 8\ \ 6\ .\ 5\ \ \ 8$$

    $$\therefore\ 792.02 + 101.32 - 306.78 = 586.58$$

9. Simplify 1 + .1 + .01 + .001

    Solution:

    1.000 + 0.100 + 0.010 + 0.001 = 1.111

10. Simplify 892.7 − 573.07 − 95.007

    Solution:

    892.700 − 573.070 − 95.007

    $$= 3\ (-7)\ (-6)\ (7)\ (-7)\ (-7)$$

    $$\ 2\ \ \ 2\ \ \ 4\ \ \ 6\ \ \ 2\ \ \ 3$$

    $$\therefore\ 892.700 - 573.070 - 95.007 = 224.623$$

SPLIT AND MERGE

1. Simplify 5358 × 101

    Solution:

    Here distributive property a(b + c) = ab + ac is made use of

    5358 × 101 = 5358 × (100 + 1)

    $$= 535800 + 5358 = 541158$$

2. Simplify 3897 × 999

    Solution:

    3897 × 999 = 3897 × (1000 − 1)

    $$= 3897000 - 3897 = 3893103$$

3. Simplify 72519 × 9999

    Solution:

    72519 × 9999 = 72519 × (10000 − 1)

    $$= 725190000 - 72519 = 725117481$$

4. Simplify 1397 × 1397

    Solution:

    1397 × 1397 = (1400 − 3) (1400 − 3)

    Here we make use of the formula

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

    $$\therefore\ 1397 \times 1397 = (1400)^2 + (3^2) - 6 \times 1400$$

    $$= 1960000 + 9 - 8400 = 1960009 - 8400$$

    $$= 1951609$$

5. Simplify 12345679 × 72

    Solution:

    12345679 × 72 = (12345679) × (70 + 2)

    $$= 864197530 + 24691358 = 888888888$$

6. Simplify 839478 × 625

    Solution:

    $$839478 \times 625 = 839478 \times \left(\frac{10}{2}\right)^4$$

    $$= \frac{839478 \times 10^4}{24} = \frac{8394780000}{16} = 524673750$$

(a + b) (a − b) = a² − b²

1. Evaluate $658^2 - 358^2$

    Solution:

    $$658^2 - 358^2 = (658 + 358)(658 - 358)$$

    $$= 1016 \times 300 = 304800$$

2. Evaluate $9717^2 - 283^2$

    Solution:

    $$9717^2 - 283^2 = (9717 + 283)(9717 - 283)$$

    $$= 10000 \times 9434 = 94340000$$

3. Evaluate $\dfrac{476^2 - 424^2}{119^2 - 106^2}$

    Solution:

    $$\frac{476^2 - 424^2}{119^2 - 106^2} = \frac{(476 + 424)(476 - 424)}{(119 + 106)(119 - 106)}$$

    $$= \frac{900 \times 52}{225 \times 13} = \frac{900}{225} \times \frac{52}{13} = 4 \times 4 = 16$$

4. Evaluate $625^2 - 575^2$

    Solution:

    $$625^2 - 575^2 = (625 + 575)(625 - 575)$$

    $$= 1200 \times 50 = 60000$$

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5. Evaluate $\dfrac{(0.783)^2 - (0.217)^2}{0.566}$

    Solution:

    $\dfrac{(0.783)^2 - (0.217)^2}{0.566} = \dfrac{(0.783 + 0.217)(0.783 - 0.217)}{0.566}$

    $= \dfrac{1 \times 0.566}{0.566} = 1$

6. If $64^2 - 36^2 = 20 \times x$ find x.

    Solution:

    $64^2 - 36^2 = 20x$

    $\Rightarrow (64 + 36)(64 - 36) = 20x$

    $\Rightarrow 2800 = 20x$

    $\Rightarrow x = 140$

MULTIPLICATION BY 5 AND 25

To multiply by 5 follow the following 2 steps

   (i) Multiply by 10

   (ii) Divide by 2

To multiply by 25 follow the following 2 steps.

   (i) Multiply by 100

   (ii) Divided by 4

1. Multiply 257892 by 5

    Solution:

    $257892 \times 10 = 2578920$

    $2578920 \div 2 = 1289460$

    $\therefore 257892 \times 5 = 1289460$

2. Multiply 984670 by 5

    Solution:

    $984670 \times 10 = 9846700$

    $9846700 \div 2 = 4923350$

    $\therefore 984670 \times 5 = 4923350$

3. Multiply 12569025 by 25

    Solution:

    $12569025 \times 100 = 1256902500$

    $1256902500 \div 4 = 314225625$

    $\therefore 12569025 \times 25 = 314225625$

4. $857609845 \times 25 = ?$

    Solution:

    $857609845 \times 100 = 85760984500$

    $85760984500 \div 4 = 21440246125$

    $\therefore 857609845 \times 25 = 21440246125$

5. Simplify 7543.572×5

    Solution:

    $7543.572 \times 10 = 75435.72$

    $75435.75 \div 2 = 37717.86$

    $\therefore 7543.572 \times 2 = 37717.86$

6. $257942.652 \times 25 = ?$

    Solution:

    $257942.652 \times 100 = 25794265.2$

    $25794265.2 \div 4 = 6448566.3$

    $\therefore 257942.652 \times 25 = 6448566.3$

MULTIPLICATION WITH 11 TO 13

(1) Multiplication by 11

Step 1: The last digit of the number is put down as the right hand figure of the answer.

Step 2: Each successive digit of the number is added to its neighbour at the right.

1. Simplify 5892×11

    Solution:

    Step 1: Put down the last figure 5892 as the right hand figure of the answer $\dfrac{5892 \times 11}{2}$

    Step 2: 9 + 2 = 11 (Put 1 below the line and carry over 1) $\dfrac{5892 \times 11}{12}$

    Step 3: $\dfrac{5892 \times 11}{812}$ (8 + 9 + 1 = 18, put 8 below and carry over 1)

    Step 4: $\dfrac{5892 \times 11}{4812}$ (5 + 8 + 1 = 14, put 4 below and carry over 1)

    Step 5: $\dfrac{5892 \times 11}{64812}$ (5 + 1 = 6, put 6 as the left hand figure)

    $\therefore 5892 \times 11 = 64812$

2. Evaluate 23145×11

    Solution:

    Steps: $\dfrac{23145 \times 11}{5}$ $(5 \times 1 = 5)$

    $\dfrac{23145 \times 11}{95}$ $(4 + 5 = 9)$

    $\dfrac{23145 \times 11}{595}$ $(1 + 4 = 5)$

    $\dfrac{23145 \times 11}{4595}$ $(3 + 1 = 4)$

    $\dfrac{23145 \times 11}{54595}$ $(2 + 3 = 5)$

    $\dfrac{23145 \times 11}{254595}$ $(0 + 2 = 2)$

    $\therefore 23145 \times 11 = 254595$

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3. Evaluate 89067×11

Solution:

Steps: $7 \times 1 = 7$

$6 + 7 = 13$ (write 3 and carry over 1)

$0 + 6 + 1 = 7$

$9 + 0 = 9$

$8 + 9 = 17$ (write 7 and carry over 1)

$0 + 8 + 1 = 9$

$\therefore 89067 \times 11 = 979737$

MULTIPLICATION BY 12

To multiply the number by 12,

Step 1: Double the right hand figure of the number

Step 2: Double each digit in turn and add to the right hand neighbour.

1. Evaluate 5324×12

Solution:

$\dfrac{5324 \times 12}{8}$ (Double the right hand figure $4 \times 2 = 8$ and write as the right hand figure of the answer)

$\dfrac{5324 \times 12}{88}$ $(2 \times 2 + 4 = 8,$ write down 8)

$\dfrac{5324 \times 12}{888}$ $(3 \times 2 + 2 = 8,$ write down 8)

$\dfrac{5324 \times 12}{3888}$ $(5 \times 2 + 3 = 13,$ write down 3, carry over 1)

$\dfrac{5324 \times 12}{63888}$ $(0 \times 2 + 5 + 1 = 6,$ write down 6)

$\therefore 5324 \times 12 = 63888$

2. Evaluate 22200007×12

Solution:

$\dfrac{22200007 \times 12}{4}$ $(7 \times 2 = 14,$ write down 4, carry over 1)

$\dfrac{22200007 \times 12}{84}$ $(1 + 0 + 7 = 8,$ write down 8)

$\dfrac{22200007 \times 12}{084}$ $(0 + 0 = 0,$ write down 0)

$\dfrac{22200007 \times 12}{0084}$ $(0 + 0 = 0,$ write down 0)

$\dfrac{22200007 \times 12}{00084}$ $(0 + 0 = 0,$ write down 0)

$\dfrac{22200007 \times 12}{400084}$ $(2 \times 2 + 0 = 4,$ write down 4)

$\dfrac{22200007 \times 12}{6400084}$ $(2 \times 2 + 2 = 6,$ write down 6)

$\dfrac{22200007 \times 12}{66400084}$ $(2 \times 2 + 2 = 6,$ write down 6)

$\dfrac{22200007 \times 12}{266400084}$ $(0 \times 2 + 2 = 2)$

$\therefore 22200007 \times 12 = 266400084$

MULTIPLICATION BY 13

To multiply the number by 13

Step 1: Multiply the right hand figure by 3.

Step 2: Table each digit in turn and add to the right neighbour.

1. Simplify 9483×13

Solution:

Step 1: $\dfrac{9483 \times 13}{9}$ (Treble the right hand figure and write it down)

Step 2: $\dfrac{9483 \times 13}{79}$ $(8 \times 3 + 3 = 27,$ write down 7 and carry over 2)

Step 3: $\dfrac{9483 \times 13}{279}$ $(4 \times 3 + 8 + 2 = 22,$ write down 2 and carry over 2)

Step 4: $\dfrac{9483 \times 13}{3279}$ $(9 \times 3 + 4 + 2 = 33,$ write down 3 and carry over 3)

Step 5: $\dfrac{9483 \times 13}{13279}$ $(0 \times 3 + 9 + 3 = 12,$ write down 12)

$\therefore 9483 \times 13 = 1,23,279$

2. Simplify 456789×13

Solution:

Steps: $\dfrac{456789 \times 13}{7}$ $(9 \times 3 = 27,$ write 7, carry over 2)

$\dfrac{456789 \times 13}{57}$ $(2 + 24 + 9 = 35,$ write 5, carry over 3)

$\dfrac{456789 \times 13}{257}$ $(3 + 21 + 8 = 32,$ write 2, carry over 3)

$\dfrac{456789 \times 13}{8257}$ $(3 + 18 + 7 = 28,$ write 8, carry over 2)

$\dfrac{456789 \times 13}{38257}$ $(2 + 15 + 6 = 23,$ write 3, carryover 2)

$\dfrac{456789 \times 13}{938257}$ $(2 + 12 + 5 = 19,$ write 9, carry over 1)

$\dfrac{456789 \times 13}{5938257}$ $(1 + 4 = 5,$ write 5)

$\therefore 456789 \times 13 = 5938257$

MULTIPLICATION: NUMBERS CLOSER TO 100

For example to find $103 \times 104,$ we make use of 2 steps.

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(i) Multiply the right side digits $3 \times 4 = 12$

(ii) $103 + 4 = 104 + 3 = 107$

$\therefore 103 \times 104 = 10712$

1. Simplify 107×102

    Solution:

    $107 + 2 = 102 + 7 = 109$

    $7 \times 2 = 14$

    $\therefore 107 \times 102 = 10914$

2. Simplify 109×105

    Solution:

    $109 + 5 = 105 + 9 = 114$

    $9 \times 5 = 45$

    $\therefore 109 \times 105 = 11445$

3. Simplify 98×86

    Solution:

    $98 = 100 - 2, 86 = 100 - 14$

    $98 - 2$

    $86 - 14$

    $98 - 14 = 86 - 2 = 84$

    $2 \times 14 = 28$

    $\therefore 98 \times 86 = 8428$

4. Simplify 98×95

    Solution:

    $98 = 100 - 2, 95 = 100 - 5$

    $98 - 2$

    $95 - 5$

    $98 - 5 = 95 - 2 = 93$

    $2 \times 5 = 10$

    $\therefore 98 \times 95 = 9310$

5. Simplify $112 \times 107 + 93 \times 96$

    Solution:

    $112 = 100 + 12, 107 = 100 + 7$

    $112 + 7 = 119, 107 + 12 = 119$

    $12 \times 7 = 84$

    $\therefore 112 \times 107 = 11984$

    $93 = 100 - 7, 96 = 100 - 4$

    $93 - 4 = 89, 96 - 7 = 89$

    $97 \times 4 = 28$

    $\therefore 93 \times 96 = 8928$

    $\therefore 112 \times 107 + 93 \times 96$

    $= 11984 + 8928 = 20912$

MULTIPLICATION: TWO DIGIT NUMBERS

1. Simplify 17×18

Solution:

Here the vertically and crosswise formula is made use of.

There are 3 steps.

Step 1: Multiply vertically on the right $7 \times 8 = 56$

Write 6 as the last digit and carry over 5

Step 2: Multiply crosswise and add with the carry over $1 \times 8 + 1 \times 7 + 5 = 20$

Write 0 as the middle digit and carry over 2.

Step 3: Multiply vertically on the left and add with the carry over $1 \times 1 + 2 = 3$

Write this as the first digit.

$\therefore 17 \times 18 = 306$

2. Find the product 87×92

Solution:

$7 \times 2 = 14 \rightarrow 4$ is the last digit

$8 \times 2 + 9 \times 7 + 1 = 80 \rightarrow 0$ is the middle digit.

$8 \times 9 + 8 = 80 \rightarrow 80$ gives the first 2 digits.

$\therefore 87 \times 92 = 8004$

3. Simplify 61×31

Solution:

$1 \times 1 = 1 \rightarrow 1$ is the last digit.

$6 \times 1 + 3 \times 1 = 9 \rightarrow 9$ is the middle digit.

$6 \times 3 = 18 \rightarrow 18$ gives the first 2 digits

$\therefore 61 \times 31 = 1891$

4. Simplify 33×97

Solution:

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$3 \times 7 = 21 \rightarrow 1$ is the last digit and carry over 2.

$3 \times 7 + 3 \times 9 + 2 = 50 \rightarrow 0$ is the middle digit carry over 5

$3 \times 9 + 5 = 32$

$\therefore 33 \times 97 = 3201$

5. Simplify 81×89

Solution:

$1 \times 9 = 9 \rightarrow 9$ is the last digit

$8 \times 9 + 8 \times 1 = 80 \rightarrow 0$ is the middle digit

$8 \times 8 + 8 = 72 \rightarrow 72$ is the first 2 digits

$\therefore 81 \times 89 = 7201$

SESSION – 2

ஃ SPEED MATHS – II

MULTIPLICATION: 2 DIGIT NUMBER WITH 3 DIGIT NUMBER

1. Solve 325×17

   Solution:

   Step 1: $5 \times 7 = 35$, write down 5, carry over 3

   Step 2: $2 \times 7 + 5 \times 1 + 3 = 22$ write down 2, carry over 2

   Step 3: $3 \times 7 + 2 \times 1 + 2 = 25$ write down 5, carry over 2

   Step 4: $3 \times (1) + 2 = 3 + 2 = 5$ write down 5

   $\therefore 325 \times 17 = 5525$

2. Solve 675×78

Solution:

Step 1: $5 \times 8 = 40$, write down 0 carry over 4

Step 2: $7 \times 8 + 5 \times 7 + 4 = 95$ write down 5, carry over 9

Step 3: $6 \times 8 + 7 \times 7 + 9 = 106$ write down 6, carry over 10

Step 4: $6 \times 7 + 10 = 52$ write down 52

$\therefore 675 \times 78 = 52650$

3. Simplify 95×847

Solution:

Step 1: $5 \times 7 = 35$, write down 5, carry over 3

Step 2: $9 \times 7 + 5 \times 4 + 3 = 86$ write down 6, carry over 8

Step 3: $8 \times 5 + 9 \times 4 + 8 = 84$ write down 4, carry over 9

Step 4: $8 \times 9 + 8 = 80$ write down 90

$\therefore 95 \times 847 = 80465$

4. Simplify 275×64

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Solution:

Step 1:
$$2\ 7\ 5$$
$$6\ 4$$
$$0$$
$5 \times 4 = 20,$ write down 0 carry over 2

Step 2:
$$2\ 7\ 5$$
$$6\ 4$$
$$0\ 0$$
$7 \times 4 + 6 \times 5 + 2 = 60$ write down 0,

carry over 6

Step 3:
$$2\ 7\ 5$$
$$6\ 4$$
$$6\ 0\ 0$$
$2 \times 4 + 7 \times 6 + 6 = 56$ write down 6,

carry over 5

Step 4:
$$2\ 7\ 5$$
$$6\ 4$$
$$17\ 6\ 0\ 0$$
$2 \times 6 + 5 = 17$ write down 17

$\therefore 275 \times 64 = 17600$

5. Solve $251 \times 27 + 362 \times 34$

Solution:

Step 1:
$$2\ 5\ 1$$
$$2\ 7$$
$$7$$
$1 \times 7 = 7,$ write down 7

Step 2:
$$2\ 5\ 1$$
$$2\ 7$$
$$7\ 7$$
$5 \times 7 + 2 \times 1 = 37,$ write down 7 carry

over 3

Step 3:
$$2\ 5\ 1$$
$$2\ 7$$
$$7\ 7\ 7$$
$2 \times 7 + 5 \times 2 + 3 = 27$ write down 7,

carry over 2

Step 4:
$$2\ 5\ 1$$
$$2\ 7$$
$$6\ 7\ 7\ 7$$
$2 \times 2 + 2 = 6$ write down 6

$\therefore 251 \times 27 = 6777$

Step 1:
$$3\ 6\ 2$$
$$3\ 4$$
$$8$$
$2 \times 4 = 8,$ write down 8

Step 2:
$$3\ 6\ 2$$
$$3\ 4$$
$$0\ 8$$
$6 \times 4 + 2 \times 3 = 30$ write down 0, carry

over 3

Step 3:
$$3\ 6\ 2$$
$$3\ 4$$
$$3\ 0\ 8$$
$3 \times 4 + 6 \times 3 + 3 = 33$ write down 3,

carry over 3

Step 4:
$$3\ 6\ 2$$
$$3\ 4$$
$$1\ 2\ 3\ 0\ 8$$
$3 \times 3 + 3 = 12$ write down 12

$\therefore 362 \times 34 = 12308$

So, $251 \times 27 = 362 \times 34 = 6777 + 12308 = 19085$

MULTIPLICATION: 3 DIGIT NUMBERS

1. Simplify 321×132

Solution:

Step 1:
$$3\ 2\ 1$$
$$1\ 3\ 2$$
$$2$$
$1 \times 2 = 2$

Step 2:
$$3\ 2\ 1$$
$$1\ 3\ 2$$
$$7\ 2$$
$2 \times 2 + 3 \times 1 = 7$

Step 3:
$$3\ 2\ 1$$
$$1\ 3\ 2$$
$$3\ 7\ 2$$
$3 \times 2 + 1 \times 1 + 2 \times 3 = 13$ (write down

3, carry over 1)

Step 4:
$$3\ 2\ 1$$
$$1\ 3\ 2$$
$$2\ 3\ 7\ 2$$
$3 \times 3 + 1 \times 2 + 1 = 12$ (write down 2,

carry over 1)

Step 5:
$$3\ 2\ 1$$
$$1\ 3\ 2$$
$$4\ 2\ 3\ 7\ 2$$
$3 \times 1 + 1 = 4$

$\therefore 321 \times 132 = 42372$

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2. Simplify 275×526

Solution:

Step 1:

$$\begin{array}{c} 2\ 7\ 5 \\ \downarrow \\ 5\ 2\ 6 \\ \hline 0 \end{array}$$

$5 \times 6 = 30$, write down 0, carry over 3

Step 2:

$$\begin{array}{c} 2\ 7\ 5 \\ \times \\ 5\ 2\ 6 \\ \hline 5\ 0 \end{array}$$

$7 \times 6 + 5 \times 2 + 3 = 55$, write down 5, carry over 5

Step 3:

$$\begin{array}{c} 2\ 7\ 5 \\ 5\ 2\ 6 \\ \hline 6\ 5\ 0 \end{array}$$

$2 \times 6 + 5 \times 5 + 7 \times 2 + 5 = 56$ write down 6, carry over 5

Step 4:

$$\begin{array}{c} 2\ 7\ 5 \\ 5\ 2\ 6 \\ \hline 4\ 6\ 5\ 0 \end{array}$$

$2 \times 2 + 7 \times 5 + 5 = 44$, write down 4 carry over 4

Step 5:

$$\begin{array}{c} 2\ 7\ 5 \\ 5\ 2\ 6 \\ \hline 14\ 4\ 6\ 5\ 0 \end{array}$$

$2 \times 5 + 4 = 14$, write down 14

$\therefore 275 \times 526 = 144650$

3. Simplify 336×678

Solution:

Step 1:

$$\begin{array}{c} 3\ 3\ 6 \\ \downarrow \\ 6\ 7\ 8 \\ \hline 8 \end{array}$$

$6 \times 8 = 48$, write down 8, carry over 4

Step 2:

$$\begin{array}{c} 3\ 3\ 6 \\ 6\ 7\ 8 \\ \hline 0\ 8 \end{array}$$

$3 \times 8 + 6 \times 7 + 4 = 70$ write down 0, carry over 7

Step 3:

$$\begin{array}{c} 3\ 3\ 6 \\ 6\ 7\ 8 \\ \hline 8\ 0\ 8 \end{array}$$

$3 \times 8 + 6 \times 6 + 3 \times 7 + 7 = 88$ write down 8, carry over 8

Step 4:

$$\begin{array}{c} 3\ 3\ 6 \\ 6\ 7\ 8 \\ \hline 7\ 8\ 0\ 8 \end{array}$$

$3 \times 7 + 6 \times 3 + 8 = 47$ write down 7, carry over 4

Step 5:

$$\begin{array}{c} 3\ 3\ 6 \\ \uparrow \\ 6\ 7\ 8 \\ \hline 22\ 7\ 8\ 0\ 8 \end{array}$$

$3 \times 6 + 4 = 22$, write down 22

$\therefore 336 \times 678 = 227808$

4. Simplify 569×952

Solution:

Step 1:

$$\begin{array}{c} 5\ 6\ 9 \\ \downarrow \\ 9\ 5\ 2 \\ \hline 8 \end{array}$$

$9 \times 2 = 18$, write down 8, carry over 1

Step 2:

$$\begin{array}{c} 5\ 6\ 9 \\ 9\ 5\ 2 \\ \hline 8\ 8 \end{array}$$

$6 \times 2 + 9 \times 5 + 1 = 58$ write down 8, carry over 5

Step 3:

$$\begin{array}{c} 5\ 6\ 9 \\ 9\ 5\ 2 \\ \hline 6\ 8\ 8 \end{array}$$

$5 \times 2 + 9 \times 9 + 6 \times 5 + 5 = 126$ write down 6, carry over 12

Step 4:

$$\begin{array}{c} 5\ 6\ 9 \\ 9\ 5\ 2 \\ \hline 1\ 6\ 8\ 8 \end{array}$$

$5 \times 5 + 6 \times 9 + 12 = 91$ write down 1, carry over 9

Step 5:

$$\begin{array}{c} 5\ 6\ 9 \\ \uparrow \\ 9\ 5\ 2 \\ \hline 54\ 1\ 6\ 8\ 8 \end{array}$$

$5 \times 9 + 9 = 54$ write down 54

$\therefore 569 \times 952 = 541688$

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QUANTITATIVE ABILITY

5. Simplify $102 \times 304 + 207 \times 121$

   Solution:

   102×304

   Step 1:

   $$1 \ 0 \ 2$$
   $$3 \ 0 \ 4$$
   $$\overline{8}$$

   $2 \times 4 = 8$, write down 8

   Step 2:

   $$1 \ 0 \ 2$$
   $$3 \ 0 \ 4$$
   $$\overline{0 \ 8}$$

   $0 \times 4 + 2 \times 0 = 0$, write down 0

   Step 3:

   $$1 \ 0 \ 2$$
   $$3 \ 0 \ 4$$
   $$\overline{0 \ 0 \ 8}$$

   $1 \times 4 + 2 \times 3 + 0 \times 0 = 10$ write down

   0, carry over 1

   Step 4:

   $$1 \ 0 \ 2$$
   $$3 \ 0 \ 4$$
   $$\overline{10 \ \ 0 \ 8}$$

   $1 \times 0 + 3 \times 0 + 1 = 1$, write down 1

   Step 5:

   $$1 \ 0 \ 2$$
   $$3 \ 0 \ 4$$
   $$\overline{31 \ 0 \ \ 0 \ 8}$$

   $1 \times 3 = 3$, write down 3

   $\therefore 102 \times 304 = 31008$

   207×121

   Step 1:

   $$2 \ 0 \ 7$$
   $$1 \ 2 \ 1$$
   $$\overline{7}$$

   $7 \times 1 = 7$, write down 7

   Step 2:

   $$2 \ 0 \ 7$$
   $$1 \ 2 \ 1$$
   $$\overline{4 \ 7}$$

   $0 \times 1 + 7 \times 2 = 14$, write down 4 carry

   over 1

   Step 3:

   $$2 \ 0 \ 7$$
   $$1 \ 2 \ 1$$
   $$\overline{0 \ 4 \ 7}$$

   $2 \times 1 + 7 \times 1 + 0 \times 2 + 1 = 10$ write

   down 0 carry over 1

   Step 4:

   $$2 \ 0 \ 7$$
   $$1 \ 2 \ 1$$
   $$\overline{5 \ 0 \ 4 \ 7}$$

   $2 \times 2 + 1 \times 0 + 1 = 5$ write down 5

   Step 5:

   $$2 \ 0 \ 7$$
   $$1 \ 2 \ 1$$
   $$\overline{2 \ 5 \ 0 \ 4 \ 7}$$

   $2 \times 1 = 2$

   $\therefore 207 \times 121 = 25047$

   $102 \times 304 + 207 \times 121$

   $= 31008 + 25077 = 56055$

MULTIPLICATION – COMPLEMENTARY NUMBERS

Numbers having the same digits except the right most digits whose sum is 10 are called complementary pairs.

For example: 83, 87; 114, 116, 342, 348 are complementary pairs.

To multiply complementary numbers, there are 2 steps. If the numbers are 94 and 96 multiply the right most digits $4 \times 6 = 24$.

Multiply the first number by the number one up $9 \times 10 = 90$

$\therefore 94 \times 96 = 9024$

1. Simplify 32×38

   Solution:

   $3 \times 4 = 12$

   $2 \times 8 = 16$

   $\therefore 32 \times 38 = 1216$

2. Simplify 87×83

   Solution:

   $8 \times 9 = 72$

   $7 \times 3 = 21$

   $\therefore 87 \times 83 = 7221$

3. Simplify 126×124

   Solution:

   $12 \times 13 = 156$

   $6 \times 4 = 24$

   $\therefore 126 \times 124 = 15624$

4. Simplify 243×247

   Solution:

   $24 \times 25 = 600$

   $3 \times 7 = 21$

   $\therefore 243 \times 247 = 60021$

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QUANTITATIVE ABILITY

5. Simplify $92 \times 98 + 67 \times 63$

   Solution:

   $92 \times 98 = 9016$
   $\qquad \begin{bmatrix} 9 \times 10 = 90 \\ 2 \times 8 = 16 \end{bmatrix}$

   $67 \times 63 = 4221$
   $\qquad \begin{bmatrix} 6 \times 7 = 42 \\ 7 \times 3 = 21 \end{bmatrix}$
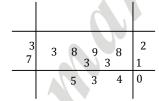
   $\therefore 92 \times 98 + 67 \times 63$

   $= 9016 + 4221 = 13237$

DIVISION – ONE LINE METHOD

1. Divide 38982 by 73

   Solution:

   73 is the divisor. We put down only the first digit 7 in the divisor column and put the other digit 3 on the top of it. As one digit (3) has been put on the top, we allot one place at the right end of the dividend to the remainder position of the answer and mark it off from the digits by a vertical line.

3 7	3	8	9	8	2
		3	3		1
	5	3	4		0

   Step 1: Since 3 is less than 7, 38 is the first dividend. Divide 38 by 7, Q = 5, R = 3.

   Write down 5 as the first digit of the quotient and prefix the remainder (3) before 9 of the dividend.

   Step 2: Now our dividend is 39. From this the product of the indexed (3) and the first digit of the quotient (5) or $3 \times 5 = 15$ is to be deducted.

   The net dividend is 39 – 15 = 24.

   Dividing 24 by 7, Q = 3, R = 3.

   Write down 3 as the second digit of the quotient and prefix the remainder 3 before 8 of the dividend.

   Step 3: Now, the dividend is 38. From this the product 3×3 is to be subtracted and the net dividend is 38 – 9 = 29.

   Dividing 29 by 7, Q = 4 and R = 1.

   Write down 4 as the third digit of the quotient and prefix 1 before 2.

   Step 4: Now, the dividend is 12. From this the product $3 \times 4 = 12$ is to be subtracted and we obtain 0 as the remainder.
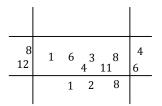
   $\therefore 38982 \div 73 = 534$

2. Divide 16384 by 128

   Solution:

   Take 12 as the first digit and put 8 at the top of it.

   Also, allot one place at the right end of the dividend to the remainder position of the answer.

8 12	1	6	3	8	4
			4	11	6
		1	2	8	

   Step 1: Divide 16 by 12, Q = 1, R = 4

   Step 2: 43 – 8 × 1 = 35 is the next dividend

   Divide 35 by 12, Q = 2, R = 11

   Step 3: 118 – 8 × 2 = 118 – 16 = 102 is the next dividend.

   Divide 102 by 12, Q = 8, R = 6

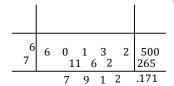   **Step 4:** 64 – 8 × 8 = 64 – 64 = 0 which is the remainder

   So 16384 ÷ 128 = 128

3. Divide 601325 by 76

   Solution:

   Take 7 as the first digit and put 6 at the top of it.

   Also allot one place at the right end of the dividend to the remainder position of the answer.

6 7	6	0	1	3	2	500
		11	6	2		265
	7	9	1	2	.171	

   Step 1: Divide 60 by 7, Q = 8, R = 4

   If we put 8 down, then 41 – 6 × 8 = 41 – 48 becomes negative which is absurd.

   $\therefore$ Q = 7, R = 11.

   Step 2: $111 - 6 \times 7 = 111 - 42 = 69$ is the next dividend.

   Dividing 69 by 7, Q = 9, R = 6

   Step 3: 63 – 6 × 9 = 63 – 54 = 9 is the next dividend.

   Dividing 9 by 7, Q = 1, R = 2

   Step 4: 22 – 6 × 1 = 16 is the next dividend.

   Dividing 16 by 7, Q = 2, R = 2

   Step 5: 25 – 6 × 2 = 25 – 12 = 13 is the remainder.

   If it is to be converted as a decimal, add zeros after 5 and proceed as above.

   Dividing 13 by 7, Q = 1, R = 6

   60 – 6 × 1 = 54

   Dividing 54 by 7, Q = 7, R = 5

   50 – 6 × 7 = 50 – 42 = 8

   Dividing 8 by 7, Q = 1, R = 1

   The process can be continued for any number of digits after the decimal.

   $\therefore 60132 \div 76 = 7912.171$

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QUANTITATIVE ABILITY

4. Divide 710.014 by 39 (to 4 places of decimals)

Solution:

```
    |           |
  9 | 7  1 | 0  0  1  4  0
  3 |    4 | 8  2  2  6  7
    | 1  8 | 2  0  5  4
```

Take 3 as the first digit and put 9 at the top of it. Also allot one place before the decimal point at the right end of the dividend and also write the digits after the decimal point.

Step 1: Divide 7 by 3, Q = 2, R = 1

But if Q = 2, the next dividend will become negative. So, Q = 1, R = 4

Step 2: $41 - 9 \times 1 = 41 - 9 = 32$

Dividing 32 by 3, Q = 8, R = 8

$80 - 9 \times 8 = 80 - 72 = 8$

Dividing 8 by 3, Q = 2, R = 2

$20 - 9 \times 2 = 20 - 18 = 2$

Dividing 2 by 3, Q = 0, R = 2

$21 - 9 \times 0 = 21 - 0 = 21$

Dividing 21 by 3, Q = 5, R = 6

$64 - 9 \times 5 = 64 - 45 = 19$

Dividing 19 by 3, Q = 4, R = 7

$\therefore 710.014 \div 39 = 18.2054$

5. Divide 64932 by 99

Solution:

Take 9 as the first digit and put 9 at the top of it. Also allot one place at the right end of the dividend to the remainder position of the answer.

```
    |                      |
  9 | 6   4   9   3 | 2   0   0   0   0
  9 |    10  10    | 13  15  15  15  15
    | 6   5   5    | 8   7   8   7
```

64 is the first dividend.

Divide 64 by 9, Q = 6, R = 10

$109 - 6 \times 9 = 109 - 54 = 55$

Divide 55 by 9, Q = 5, R = 10

$103 - 9 \times 5 = 103 - 45 = 58$

Divide 58 by 9, Q = 5, R = 13

$132 - 45 = 87$

Divide 87 by 9, Q = 8, R = 15

$150 - 9 \times 8 = 150 - 72 = 78$

Divide 78 by 9, Q = 7, R = 15

$150 - 9 \times 7 = 150 - 63 = 87$

Divide 87 by 9, Q = 8, R = 15

$150 - 9 \times 8 = 150 - 72 = 78$

Divide 78 by 9, Q = 7, R = 15

The process can be continued.

$\therefore 64932 \div 99 = 655.8787$

PERCENTAGE CALCULATIONS

To calculate the product of 2 numbers, percentage is used.

1. Find the value of 43×78 using percentage.

Solution:

Consider 43% of 78

43% of 78 = 10% of 78 + 10% of 78 + 10% of 78 + 10% of 78 + 1% of 78 + 1% of 78 + 1% of 78

$\quad = 7.8 + 7.8 + 7.8 + 7.8 + .78 + .78 + .78 = 33.54$

43% of 78 = $.43 \times 78$ and the digits for 43×78 will be the same. Now, put back the decimal point

$\therefore 43 \times 78 = 3354$

2. Find the product 324×82 using percentage

Solution:

Consider 324% of 82 = 3.24×82

$= 3 \times 82 + 8.2 + 8.2 + .82 + .82 + .82 + .82$

$= 246 + 16 + 3.68 = 265.68$

$\therefore 324 \times 82 = 26568$

3. Find the product 252×151 using percentage

Solution:

Consider 252% of 151

252% of 151 = 2.52×151

$= 2 \times 151 + 15.1 + 15.1 + 15.1 + 15.1 + 15.1 + 1.51 + 1.51$

$= 302 + 75.5 + 3.02 = 380.52$

$\therefore 252 \times 151 = 38052$

4. Find the percentage value of the ratio $\dfrac{53}{81}$

Solution:

$$\frac{53}{81} = \frac{40.5 + 8.1 + 4.4}{81}$$

$$= \frac{40.5}{81} + \frac{8.1}{81} + \frac{4.4}{81}$$

$$= 50\% + 10\% + \frac{4.4}{81}$$

$$= 60\% + \frac{4.05}{81} + \frac{0.35}{81}$$

$$= 65\% + 0.43\% = 65.43\%$$

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QUANTITATIVE ABILITY

5. Compare $\dfrac{173}{212}$ with $\dfrac{181}{241}$ using percentage.

    Solution:

    $\dfrac{173}{212} = \dfrac{106}{212} + \dfrac{53}{212} + \dfrac{10.6}{212} + \dfrac{3.4}{212}$

    $\qquad = 50\% + 25\% + 5\% + \dfrac{3.4}{212}$

    $\qquad = 80\% + 1.6\% = 81.6$

    $\dfrac{181}{241} = \dfrac{120.5}{241} + \dfrac{60.25}{241} + \dfrac{.25}{241}$

    $\qquad = 50\% + 25\% + .001\% = 75.001\%$

    $81.6 > 75.001\%$

    $\Rightarrow \dfrac{173}{212} > \dfrac{181}{241}$

SQUARES

1. Find the square of 207

    Solution:

    207^2

    (1) $7^2 = 49$, write down 9 as the last digit and carry over 4.

    (2) $2 \times 0 \times 7 + 4 = 4$, write it down in the next position.

    (3) $2 \times 2 \times 7 + 0^2 = 28$, write down 8 in the third position and carry over 2.

    (4) $2 \times 0 \times 2 + 2 = 2$ write down 2 in the fourth place.

    (5) $2^2 = 4$ write down 4

    $\therefore 207^2 = 42849$

2. Find the square of 897

    Solution:

    (1) $7^2 = 49$, write down 9 in the last place and carry over 4.

    (2) $2 \times 9 \times 7 + 4 = 130$, write down 0 in the next place and carry over 13.

    (3) $2 \times 8 \times 7 + 9^2 + 3 = 206$, write down 6 in the next place and carry over 20.

    (4) $2 \times 8 \times 9 + 20 = 164$, write down 4 and carry over 16.

    (5) $8^2 + 16 = 80$, write it down.

    $\therefore (897)^2 = 804609$

3. Find the square of 8432.

    Solution:

    (1) $2^2 = 4$, write down 4 as the last digit.

    (2) $2 \times 3 \times 2 = 12$, write down 2 as the next digit and carry over 1.

(3) $2 \times 4 \times 2 + 3^2 + 1 = 26$, write down 6 as the next digit and carry over 2.

(4) $2 \times 8 \times 2 + 2 \times 4 \times 3 + 2 = 58$, write down 8 as the next digit and carry over 5.

(5) $2 \times 8 \times 3 + 4^2 + 5 = 69$, write down 9 as the next digit and carry over 6.

(6) $2 \times 8 \times 4 + 6 = 70$, write down 0 as the next digit and carry over 7.

(7) $8^2 + 7 = 71$, write down 71.

$\therefore (8432)^2 = 71098624$

SQUARES OF NUMBERS FROM 51 TO 59

$(51)^2 = 25 + 1 / 1^2 = 26 / 01 = 2601$

$(52)^2 = 25 + 2 / 2^2 = 27 / 04 = 2704$

$(53)^2 = 25 + / 3^2 = 28 / 09 = 2809$

$(54)^2 = 25 + 4 / 4^2 = 29 / 16 = 2916$

$(55)^2 = 25 + 5 / 5^2 = 30 / 25 = 3025$

$(59)^2 = 25 + 9 / 9^2 = 34 / 81 = 3481$

1. $57^2 = 25 + 7 / 7^2 = 32 / 49 = 3249$

SQUARES OF NUMBERS WITH UNIT DIGIT AS 5

1. $15^2 = 1 \times (1+1) / 5^2 = 2 / 25 = 225$

2. $35^2 = 3 \times (3+1) / 5^2 = 12 / 5^2 = 1225$

3. $85^2 = 8 \times 9 / 25 = 7225$

4. $225^2 = 22 \times 23 / 25 = 506 / 25 = 50625$

SQUARES OF NUMBERS NEARER TO 10^x, $x \in N$

Here the algebraic formula is used.

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

1. $98^2 = (98+2)(98-2) + 2^2$

    $\qquad = 9600 + 4 = 9604$

2. $(104)^2 = (104+4)(104-4) + 4^2$

    $\qquad = 10800 + 16 = 10816$

3. $(1007)^2 = (1007+7)(1007-7) + 7^2$

    $\qquad = 1014000 + 49 = 1014049$

PRACTICE EXERCISE

1. Find the square of 307.

2. Find the squares of numbers 61 – 69.

3. Find the square of numbers 45 and 235.

4. Find the squares of numbers 96 and 106.

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QUANTITATIVE ABILITY

SESSION – 3

☸ SPEED MATHS – III

SQUARE ROOTS

If $y = x^2$, then $x = \sqrt{y}$ is called the square root of y.

Square roots of numbers can be found out

(i) by factorisation method (ii) by division method

1. Evaluate $\sqrt{6084}$ by factorisation method

   Solution:

   $6084 = 2 \times 2 \times 3 \times 3 \times 13 \times 13$

   $ = 2^2 \times 3^2 \times 13^2$

   $\therefore \sqrt{6084} = \sqrt{2^2 \times 3^2 \times 13^2}$

   $\phantom{\therefore \sqrt{6084}} = 2 \times 3 \times 13 = 78$

   $\therefore \sqrt{6084} = 78$

   ```
   2 | 6084
   2 | 3042
   3 | 1521
   3 | 507
   13| 169
     | 13
   ```

2. Find the square root of 53824 by division method.

   Solution:

   (i) Mark off all the digits in pairs starting from the unit's digit.

   (ii) $2^2 = 4$, remainder 1, bring down the next pair. The dividend is 138.

   (iii) Double 2 and put 3 as the unit's digit. The divisor is 43.

   (iv) Bring down 24, continue the process.

   $\therefore \sqrt{53824} = 232$

   ```
            232
   2  | 5, 3, 8, 24
      |  4
   43 |  138
      |  129
   462|  924
      |  924
      |    0
   ```

3. Evaluate $\sqrt{248 + \sqrt{51 + \sqrt{169}}}$

   Solution:

   $\sqrt{248 + \sqrt{51 + \sqrt{169}}} = \sqrt{248 + \sqrt{51 + 13}}$

   $= \sqrt{248 + \sqrt{64}} = \sqrt{248 + 8} = \sqrt{256} = 16$

   $\therefore \sqrt{248 + \sqrt{51 + \sqrt{169}}} = 16$

4. Evaluate $\sqrt{\dfrac{95 \times 85 \times 18900}{17 \times 19 \times 21}}$

   Solution:

   $\sqrt{\dfrac{95 \times 85 \times 18900}{17 \times 19 \times 21}} = \sqrt{5 \times 5 \times 900} = \sqrt{5 \times 5 \times 30 \times 30}$

   $= 5 \times 30 = 150$

5. Find the square root of $\sqrt{175.2976}$

   Solution:

   ```
                 13.24
   1   | 1,75.29,76
       |  1
   23  |  075
       |   69
   262 |  629
       |  524
   2644|  10576
       |  10576
       |      0
   ```

   (i) Mark of all the digits in pairs starting from either side of the decimal point.

   $\therefore \sqrt{175.2976} = 13.24$

6. Find the value of $\sqrt{\dfrac{0.289}{0.00121}}$

   Solution:

   $\sqrt{\dfrac{0.289}{0.00121}} = \sqrt{\dfrac{28900}{121}} = \dfrac{170}{11}$

7. Find the greatest number of 4 digits which is a perfect square.

   Solution:

   The greatest number of 4 digits is 9999

   ```
            99
   9   | 9999
       |  81
   189 | 1899
       | 1701
       |  198
   ```

   Since 198 is the remainder, 9999 – 198 will be a perfect square.

   9999 – 198 = 9801

   $\therefore$ The greatest number of 4 digits which is a perfect square is 9801.

8. Find the smallest number to be subtracted from 549162 to make it a perfect square.

   Solution:

   ```
   7   | 549162 (741
       |  49
   144 |  591
       |  576
   1481|  1562
       |  1481
       |    81
   ```

   $\therefore$ 549162 – 81 will become a perfect square.

   $\therefore$ The smallest number to be subtracted is 81.

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QUANTITATIVE ABILITY

9. Simplify $\sqrt{.0025} \times \sqrt{2.25} \times \sqrt{.0001}$

   Solution:

   $\sqrt{.0025} \times \sqrt{2.25} \times \sqrt{.001}$

   $= \sqrt{.0025 \times 2.25 \times .0001}$

   $= \sqrt{\dfrac{25}{10000} \times \dfrac{225}{100} \times \dfrac{1}{10000}}$

   $= \dfrac{\sqrt{25 \times 225}}{\sqrt{10000000000}}$

   $= \dfrac{5 \times 15}{100000} = \dfrac{75}{100000} = 0.00075$

10. Find the smallest number by which 5808 should be multiplied to make it a perfect square.

    Solution:

    $5808 = 2 \times 2 \times 2 \times 2 \times 11 \times 11 \times 13$

    $\qquad = 2^4 \times 11^2 \times 3$

    $\therefore$ The required smallest number is 3.

    ```
    2 | 5808
    2 | 2904
    2 | 1452
    2 | 726
    3 | 363
   11 | 121
      | 11
    ```

PRACTICE EXERCISE:

1. Evaluate: $\sqrt{248 + \sqrt{51 + \sqrt{169}}}$

2. Evaluate: $\sqrt{\dfrac{0.289}{0.00121}}$

3. Find the greatest number of 4 digits which is a perfect square.

CUBES

Cubes of 2 digit numbers

To calculate the cube value of a 2 digit number.

Step 1: Put down the cube of the ten's digit in a row of 4 figures. Find the ratio between the digits of the given number. So, the other 3 digits in the row are in the geometrical ratio in the exact proportion.

Step 2: Put down under the second and third digits, 2 times of the second and the third digit. Then add up the 2 rows.

1. Calculate 12^3

   Solution:

   The ten's digit of the number is 1

   So we write the first digit as $1^3 = 1$

   The ratio between the digits is 1:2, the next digits will be double the previous one.

   So the first row is $\qquad$ 1 2 4 8

   The second ad the third digits are 2 and 4.

   So write down 4 and 8 below 2 and 4 and then add.

   ```
   1  2  4  8
      4  8
   ─────────
   1  7  2  8
   ```

   $\therefore 12^3 = 1728$

2. Calculate 21^3

   Solution:

   ```
   8  4  2  1
      8  4
   ─────────
   9  2  6  1
   ```

   $\left[8 = 2^3, 8 \div 4 = 2, \ 4 \div 2 = 1, \ 2 \div 1 = 2 \right]$

   $\left[4 \times 2 = 8, \ 2 \times 2 = 4 \right]$

   $\therefore 21^3 = 9261$

3. Calculate 34^3

   Solution:

   ```
   27   36   48   64
        72   96
   ─────────────────
   39  ₁₂3  ₁₅0  ₆4
   ```

   $\left[\begin{array}{l} 3^3 = 27 \text{ and the ratio is } 3:4 \text{ and so} \\ \text{the next number is } \dfrac{4}{3} \text{ or the previous} \end{array} \right]$

   $\therefore 34^3 = 39304$

4. Calculate 93^3

   Solution:

   ```
   729  243   81   27
        486  162
   ──────────────────
   804  ₇₅3  ₂₄5  ₂7
   ```

   $\left[\begin{array}{l} 9^3 = 729, 9:3 = 3:1 \\ \therefore \text{ Each term is obtained by dividing by 3} \end{array} \right]$

   $\therefore 93^3 = 804357$

5. Calculate 77^3

   Solution:

   ```
    343  343  343  343
   +      686  686
   ──────────────────
    456 ₁₁₃5 ₁₀₆3  ₃₄3
   ```

   $\left[7^3 = 343, \text{ ratio } 1:1 \right]$

   $\therefore 77^3 = 456533$

CUBE ROOTS

If $y = x^3$, then x is called the cube root of y and is written as

$x = \sqrt[3]{y}$

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QUANTITATIVE ABILITY

1. Find the cube root of 2744.

   Solution:

   $2744 = 2 \times 2 \times 2 \times 7 \times 7 \times 7$

   $\qquad = 2^3 \times 7^3$

   $\therefore \sqrt[3]{2744} = 2 \times 7$

   $\qquad\qquad = 14$

2	2744
2	1372
2	686
7	343
7	49
	7

2. Find the cube root of 0.000512

   Solution:

   $\sqrt[3]{0.000512} = \sqrt[3]{\dfrac{512}{1000000}} = \dfrac{\sqrt[3]{512}}{100}$

   $\sqrt[3]{512} = \sqrt{2^9}$

   $\therefore \sqrt{512} = 2^3 = 8$

   $\therefore \sqrt[3]{0.000512} = \dfrac{8}{100} = 0.08$

2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
	2

3. Evaluate $\sqrt[3]{4\dfrac{12}{125}}$

   Solution:

   $\sqrt[3]{4\dfrac{12}{125}} = \sqrt[3]{\dfrac{512}{125}} = \dfrac{\sqrt[3]{512}}{\sqrt[3]{125}} = \dfrac{8}{5} = 1\dfrac{3}{5^2}$

4. Find the smallest number by which 3600 be divided to make it a perfect cube.

   Solution:

   $3600 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5$

   $\qquad = 2^4 \times 3^2 \times 5^2$

   $\therefore$ 3600 should be divided by $2 \times 3^2 \times 5^2$ to make it a perfect cube 8.

   $\therefore$ The required number is $2 \times 9 \times 25 = 450$

2	3600
2	1800
2	900
2	450
5	225
3	45
3	15
	5

5. Find the largest 5 digit number which is a perfect cube.

   Solution:

   The largest 5 digit cube is $46^3 = 97336$

PRACTICE EXERCISE – II

1. Calculate 23^3.

2. Calculate 97^3.

3. Find the cube root of 5832.

4. Find the cube root of 0.000216.

5. Find the smallest number by which 33275 be divided to make it a perfect cube.

✤ SIMPLIFICATION

Introduction

While performing simplification greatest care has to be taken to avoid mistakes. Developing ability to calculate is one of the major thrust areas. Developing the calculation speed is very important. Addition perhaps is the critical skill to develop the calculations. Try to practise adding 2 digit numbers to improve the calculation speed. Make sure that you are through with addition before attempting the process of subtraction. The multiplication methods followed in speed maths is useful for fast calculations.

For simplification BODMAS rule depicts the correct sequence in which the operations are to be executed so as to find out the value of a given expression.

B – Bracket, O – Of, D – Division, M – Multiplication, A – Addition, S – Subtraction.

When you simplify an expression, first the brackets have to be removed and then the other operations in the given order.

1. Simplify $100 + 20 \times 55$

   Solution:

   $100 + 20 \times 55 = 100 + 1100$

   $\qquad\qquad\qquad = 1200$

2. Simplify $50040 \div 139 - 60$

   Solution:

   $= \dfrac{50040}{139} - 60$

   $= 360 - 60 = 300$

9	5 0 0 4	0
13	115	
	3 6 0	

3. Simplify $\dfrac{480 \times 15 - 12 \times 20 + 7 \times 60}{140 \times 8 + 2 \times 55}$

   Solution:

   $\dfrac{480 \times 15 - 12 \times 20 + 7 \times 60}{140 \times 8 + 2 \times 55} = \dfrac{7200 - 240 + 420}{1120 + 110}$

   $= \dfrac{6960 + 420}{1230} = \dfrac{7380}{1230} = 6$

4. Simplify $\dfrac{3}{5}$ of $\dfrac{4}{7}$ of $\dfrac{5}{9}$ of $\dfrac{21}{24}$ of 504.

   Solution:

   $\dfrac{3}{5}$ of $\dfrac{4}{7}$ of $\dfrac{5}{9}$ of $\dfrac{21}{24}$ of 504

   $= \dfrac{3}{5} \times \dfrac{4}{7} \times \dfrac{5}{9} \times \dfrac{21}{24} \times 504$

   $= 84$

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QUANTITATIVE ABILITY

5. Simplify $4\frac{1}{2} \times 4\frac{1}{3} - 8\frac{1}{3} \div 5\frac{2}{3}$

Solution:

$\frac{9}{2} \times \frac{13}{3} - \frac{25}{3} \times \frac{3}{17}$

$= \frac{39}{2} - \frac{25}{17} = \frac{663 - 50}{34} = \frac{613}{34} = 18\frac{1}{34}$

6. Simplify $0.008 \times 0.01 \times 0.0072 \div (0.12 \times 0.0004)$

Solution:

$0.008 \times 0.01 \times 0.0072 \div (0.12 \times 0.0004)$

$= 0.00008 \times \frac{0.0072}{0.000048}$

$= \frac{0.8 \times 0.0072}{0.48} = \frac{8}{10} \times \frac{72}{10000} \times \frac{100}{48} = \frac{12}{1000} = 0.012$

7. If $3 - \left[1.6 - \left\{3.2 - (3.2 + 2.25 \div x)\right\}\right] = 0.65$, find the value of x.

Solution:

$3 - \left[1.6 - \left\{3.2 - (3.2 + 2.25 \div x)\right\}\right] = 0.65$

$\Rightarrow 3 - \left[1.6 - \left\{3.2 - \left(3.2 + \frac{2.25}{x}\right)\right\}\right] = 0.65$

$\Rightarrow 3 - \left[1.6 - \left(3.2 - 3.2 - \frac{2.25}{x}\right)\right] = 0.65$

$\Rightarrow 3 - \left[1.6 + \frac{2.25}{x}\right] = 0.65$

$\Rightarrow 3 - 1.6 - \frac{2.25}{x} = 0.65$

$\Rightarrow 1.4 - \frac{2.25}{x} = 0.65$

$\Rightarrow \frac{2.25}{x} = 1.4 - 0.65 = 0.75$

$\Rightarrow x = \frac{2.25}{0.75} = \frac{225}{75} = 3$

8. Simplify $\dfrac{2 + \dfrac{1}{3\frac{4}{5}}}{2 + \dfrac{1}{1 + \frac{1}{4}}}$

Solution:

$\dfrac{2 + \dfrac{1}{3\frac{4}{5}}}{2 + \dfrac{1}{3 + \dfrac{1}{1 + \frac{1}{4}}}} = \dfrac{2 + \dfrac{1}{\frac{19}{5}}}{2 + \dfrac{1}{3 + \dfrac{1}{\frac{5}{4}}}} = \dfrac{2 + \dfrac{5}{19}}{2 + \dfrac{1}{3 + \frac{4}{5}}}$

$= \dfrac{2 + \dfrac{5}{19}}{2 + \dfrac{1}{\frac{19}{5}}} = \dfrac{2 + \dfrac{5}{19}}{2 + \dfrac{5}{19}} = 1$

9. If $\frac{37}{13} = 2 + \cfrac{1}{x + \cfrac{1}{y + \cfrac{1}{z}}}$, where x, y, z are natural numbers, find x, y, z.

Solution:

$\frac{37}{13} = 2 + \cfrac{1}{x + \cfrac{1}{y + \cfrac{1}{z}}}$

$\Rightarrow \frac{37}{13} = 2 + \cfrac{1}{x + \cfrac{1}{y + \cfrac{1}{z}}}$

$\Rightarrow 2 + \frac{11}{13} = 2 + \cfrac{1}{x + \cfrac{1}{y + \cfrac{1}{z}}}$

$\Rightarrow \frac{11}{13} = \cfrac{1}{x + \cfrac{1}{y + \cfrac{1}{z}}} \Rightarrow x + \cfrac{1}{y + \frac{1}{z}} = \frac{13}{11} = 1 + \frac{2}{11}$

$\Rightarrow x = 1, \cfrac{1}{y + \frac{1}{z}} = \frac{2}{11} \Rightarrow x = 1, y + \frac{1}{z} = \frac{11}{2}$

$\Rightarrow x = 1, y + \frac{1}{z} = 5 + \frac{1}{2} \Rightarrow x = 1, y = 5, z = 2$

$\therefore$ x, y, z are 1, 5, 2.

10. If $4x + 5y = 83$ and $\frac{3x}{2y} = \frac{21}{22}$, find y – x.

Solution:

$\left.\begin{array}{l} 4x + 5y = 83 \\ \frac{3x}{2y} = \frac{21}{22} \end{array}\right\}$

$\Rightarrow 66x = 42y \Rightarrow y = \frac{66}{42}x = \frac{11}{7}x$

$4x + 5 \times \frac{11}{7}x = 83$

$\Rightarrow 28x + 55x = 581$

$\Rightarrow 83x = 581 \Rightarrow x = 7$

$4x + 5y = 83 \Rightarrow 4 \times 7 + 5y = 83 \Rightarrow 5y = 55 \Rightarrow y = 11$

$\therefore y - x = 11 - 7 = 4$

11. Find the sum

$\frac{1}{2} + \frac{1}{6} + \frac{1}{12} + \frac{1}{20} + \frac{1}{30} + \frac{1}{42} + \frac{1}{56} + \frac{1}{72} + \frac{1}{90} + \frac{1}{110} + \frac{1}{132}$

Solution:

$\frac{1}{2} + \frac{1}{6} + \frac{1}{12} + \frac{1}{20} + \frac{1}{30} + \frac{1}{42} + \frac{1}{56} + \frac{1}{72} + \frac{1}{90} + \frac{1}{110} + \frac{1}{132}$

QUANTITATIVE ABILITY

$$= \frac{1}{2} + \frac{1}{2.3} + \frac{1}{3.4} + \frac{1}{4.5} + \frac{1}{5.6} + \frac{1}{6.7}$$

$$+ \frac{1}{7.8} + \frac{1}{8.9} + \frac{1}{9.10} + \frac{1}{10.11} + \frac{1}{11.12}$$

$$= \frac{1}{2} + \left(\frac{1}{2} - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{4}\right) + \left(\frac{1}{4} - \frac{1}{5}\right) + \left(\frac{1}{5} - \frac{1}{6}\right) + \left(\frac{1}{6} - \frac{1}{7}\right)$$

$$+ \left(\frac{1}{7} - \frac{1}{8}\right) + \left(\frac{1}{8} - \frac{1}{9}\right) + \left(\frac{1}{9} - \frac{1}{10}\right) + \left(\frac{1}{10} - \frac{1}{11}\right) + \left(\frac{1}{11} - \frac{1}{12}\right)$$

$$= \frac{1}{2} + \frac{1}{2} - \frac{1}{12} = 1 - \frac{1}{12} = \frac{11}{12}$$

12. Simplify $\dfrac{(856+167)^2 + (856-167)^2}{856 \times 856 + 167 \times 167}$

Solution:

$$\frac{(856+167)^2 + (856-167)^2}{856^2 + 167^2}$$

$$= \frac{2\left[856^2 + 167^2\right]}{856^2 + 167^2}$$

[use the formula $(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$]

$$= 2$$

13. Simplify $\dfrac{\left(3\frac{2}{3}\right)^2 - \left(2\frac{1}{2}\right)^2}{\left(4\frac{3}{4}\right)^2 - \left(3\frac{1}{3}\right)^2} \div \dfrac{3\frac{2}{3} - 2\frac{1}{2}}{4\frac{3}{4} - 3\frac{1}{3}}$

Solution:

$$\frac{\left(3\frac{2}{3}\right)^2 - \left(2\frac{1}{2}\right)^2}{\left(4\frac{3}{4}\right)^2 - \left(3\frac{1}{3}\right)^2} \div \frac{3\frac{2}{3} - 2\frac{1}{2}}{4\frac{3}{4} - 3\frac{1}{3}}$$

$$= \frac{\left(3\frac{2}{3}\right)^2 - \left(2\frac{1}{2}\right)^2}{\left(4\frac{3}{4}\right)^2 - \left(3\frac{1}{3}\right)^2} \times \frac{\left(4\frac{3}{4}\right) - \left(3\frac{1}{3}\right)}{\left(3\frac{2}{3}\right) - \left(2\frac{1}{2}\right)}$$

$$= \frac{3\frac{2}{3} + 2\frac{1}{2}}{4\frac{3}{4} + 3\frac{1}{3}}$$

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

$$= \frac{\frac{11}{3} + \frac{5}{2}}{\frac{19}{4} + \frac{10}{3}} = \frac{\frac{22+15}{6}}{\frac{57+40}{12}} = \frac{37}{6} \times \frac{12}{97} = \frac{74}{97}$$

14. Simplify $\dfrac{\left(\frac{3}{5}\right)^3 - \left(\frac{2}{5}\right)^3}{\left(\frac{3}{5}\right)^2 - \left(\frac{2}{5}\right)^2}$

Solution:

$$\frac{\left(\frac{3}{5}\right)^3 - \left(\frac{2}{5}\right)^3}{\left(\frac{3}{5}\right)^2 - \left(\frac{2}{5}\right)^2} = \frac{\left[\left(\frac{3}{5}\right) - \left(\frac{2}{5}\right)\right]\left[\left(\frac{3}{5}\right)^2 + \left(\frac{2}{5}\right)^2 + \frac{3}{5} \times \frac{2}{5}\right]}{\left[\left(\frac{3}{5}\right) - \left(\frac{2}{5}\right)\right]\left[\left(\frac{3}{5}\right) + \left(\frac{2}{5}\right)\right]}$$

$$= \frac{\frac{9}{25} + \frac{4}{25} + \frac{6}{25}}{\frac{3}{5} + \frac{2}{5}} = \frac{\frac{19}{25}}{\frac{5}{5}} = \frac{19}{25}$$

PRACTICE EXERCISE

1. If $\dfrac{37}{13} = 2 + \dfrac{1}{x + \dfrac{1}{y + \dfrac{1}{z}}}$ where x, y, z are natural numbers

   find x, y, z.

2. If $4x + 5y = 83$ and $\dfrac{3x}{2y} = \dfrac{21}{22}$, find $y - x$.

3. Simplify $\dfrac{\left(\frac{3}{5}\right)^3 - \left(\frac{2}{5}\right)^3}{\left(\frac{3}{5}\right)^2 - \left(\frac{2}{5}\right)^2}$

4. Find the sum $\dfrac{1}{2} + \dfrac{1}{6} + \dfrac{1}{12} + \dfrac{1}{20} + \dfrac{1}{30} + \dfrac{1}{42} + \dfrac{1}{56} \dots + \dfrac{1}{132}$

SESSION – 4

⚙ SPEED MATHS – IV

PRACTICE EXERCISE

1. Add 707325, 192382, 58009, 564943 and 656.
   (a) 1523315 (b) 331969 (c) 1623225 (d) 3129621

2. Simplify: $5124 - 829 + 731 - 435$
   (a) 4732 (b) 4591 (c) 3921 (d) 3865

3. Solve: 5732×1002
   (a) 5743464 (b) 5742464 (c) 5843464 (d) 5925461

4. Evaluate: $8492^2 - 508^2$
   (a) 70856000 (b) 7284600
   (c) 71856000 (d) 70856000

5. Multiply 84726 by 5.
   (a) 435630 (b) 432650 (c) 423630 (d) 413630

6. Multiply 625 by 25.
   (a) 15625 (b) 30625 (c) 15725 (d) 120625

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