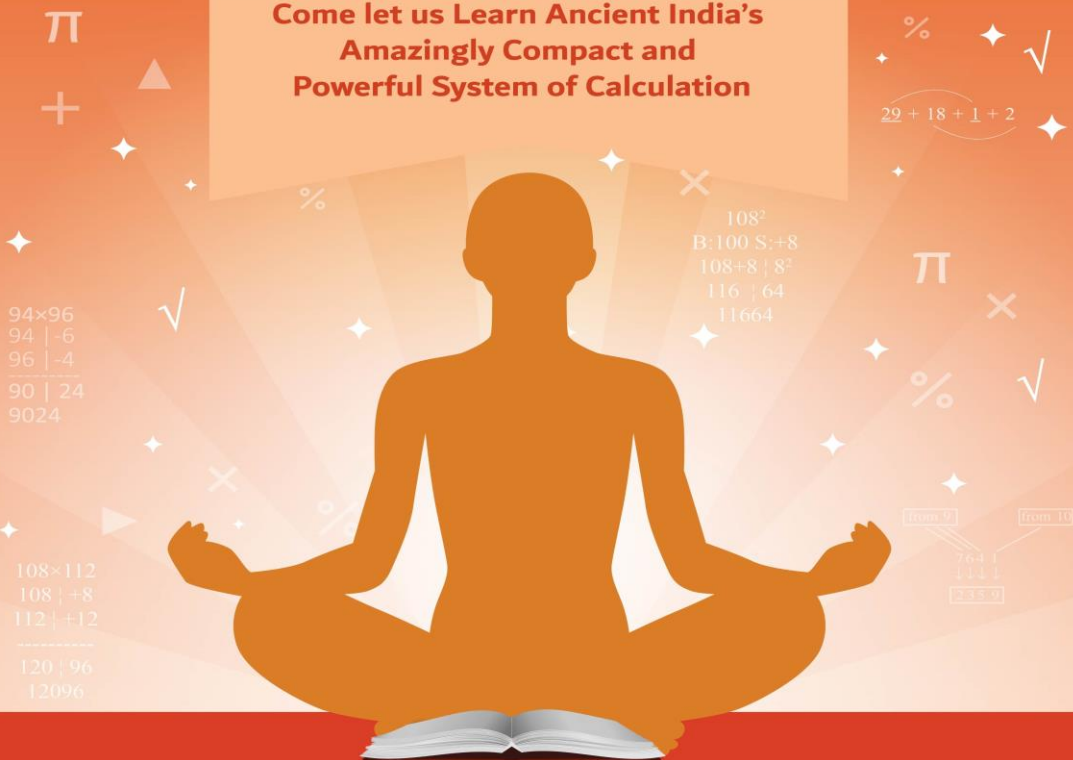


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Unit 1: MULTIPLICATION

1.1 Multiplication using Base Method

Case 1: When both numbers are greater than the working base:

Ex.1	Ex.2	Ex.3	Ex.4	Ex.5	Ex.6
104 +4 109 +9 ----- 113 36	106 112 ----- 	117 103 ----- 	124 106 ----- 	131 102 ----- 	149 106 -----
11136					

Ex.7	Ex.8	Ex.9	Ex.10	Ex.11	Ex.12
108 112 ----- 	109 112 ----- 	1003 1024 ----- 	1412 1020 ----- 	108 124 ----- 	111 108 -----

Ex.13	Ex.14	Ex.15	Ex.16	Ex.17	Ex.18
121 105 ----- 	136 106 ----- 	125 125 ----- 	1024 1006 ----- 	1045 1030 ----- 	1036 1002 -----

Case 2: When both numbers (multiplicand and multiplier) are less than the working base:

Ex.1	Ex.2	Ex.3	Ex.4	Ex.5	Ex.6
94 -6 96 -4 ----- 90 24	88 12 91 09 ----- 79 108 79+1 08	87 93 ----- 	79 98 ----- 	84 92 ----- 	89 92 -----
9024	8008				

Ex.7	Ex.8	Ex.9	Ex.10	Ex.11	Ex.12
96 83 ----- 	47 98 ----- 	81 89 ----- 	82 94 ----- 	79 96 ----- 	93 76 -----

Ex.13	Ex.14	Ex.15	Ex.16	Ex.17	Ex.18
78 96 ----- 	90 79 ----- 	58 96 ----- 	95 81 ----- 	87 93 ----- 	88 92 -----

Case 3: When one number is lesser and other is greater than the working base:

Ex.1	Ex.2	Ex.3	Ex.4	Ex.5
104 +4 096 -4 ----- 100 -16 100-1 -16+100 99 84	112 089 ----- 	1024 0984 ----- 	102 089 ----- 	116 088 -----
9984				

Ex.6	Ex.7	Ex.8	Ex.9	Ex.10
124 095 ----- 	142 098 ----- 	162 096 ----- 	108 093 ----- 	1040 0960 -----

Ex.11	Ex.12	Ex.13	Ex.14	Ex.15
1043 0989 ----- 	1024 0890 ----- 	109 088 ----- 	113 079 ----- 	129 088 -----

Case 4: Working with two different Bases:

Ex.1	Ex.2	Ex.3	Ex.4	Ex.5
12×114	120×13	1024×106	984×96	94×994
120 +20 114 +14 ----- 134 280 136 80 1368	120 13 ----- 	1024 106 ----- 	984 96 ----- 	94 994 -----

Ex.6	Ex.7	Ex.8	Ex.9	Ex.10
89×964	111×1024	17×160	89×986	12×991
89 964 ----- 	111 1024 ----- 	17 160 ----- 	89 986 ----- 	12 991 -----

Ex.11	Ex.12	Ex.13	Ex.14	Ex.15
104×896	103×1022	960×16	93×1021	19×112
104 896 ----- 	103 1022 ----- 	960 16 ----- 	93 1021 ----- 	19 112 -----

Case 5: When both numbers are not nearer to working base:

Ex.1	Ex.2	Ex.3	Ex.4	Ex.5	Ex.6	Ex.7	Ex.8
304×346	388×412	789×804	547×503	76×77	645×703	236×323	560×640
304 +04 346 +46 ----- 350 184 1050 184 1051 84 105184	388 412 ----- 	789 804 ----- 	547 503 ----- 	76 77 ----- 	645 703 ----- 	236 323 ----- 	560 640 -----

1.2 Multiplication using Criss Cross Method

Case 1: Two Digit Numbers (2D×2D and 2D×1D) {D: Digit}

Answer consists of three parts.

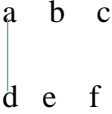
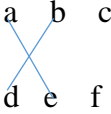
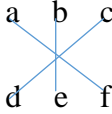
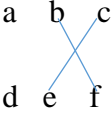
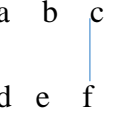
First Part:	Second Part:	Third Part:
$\begin{array}{cc} a & b \\ & \\ c & d \end{array}$	$\begin{array}{cc} a & b \\ \diagdown & \diagup \\ c & d \end{array}$	$\begin{array}{cc} a & b \\ & \\ c & d \end{array}$
(a×c)	(a×d) + (b×c)	(b×d)

Ex. 1: 42 × 57	Ex. 2: 84 × 36	Ex. 3: 87 × 26
$(4 \times 5) (4 \times 7 + 2 \times 5) (2 \times 7)$ 20 28+10 14 20 38 14 20 38+1 4 20 39 4 20+3 9 4 23 9 4 2394	$(8 \times 3) (8 \times 6 + 4 \times 3) (4 \times 6)$ 24 48+12 24 24 60 24 24 60+2 4 24 62 4 24+6 2 4 30 2 4 3024	

Ex. 4: 71 × 39	Ex. 5: 78 × 19	Ex. 6: 67 × 48

Ex. 7: 46×67	Ex. 8: 37×58	Ex. 9: 49×83

Case 2: Three Digit Numbers ($3D \times 3D$; $3D \times 2D$ and $3D \times 1D$) Answer consists of Five Parts.

First Part:	Second Part:	Third Part:	Fourth Part:	Fifth Part:
				
$(a \times d)$	$(a \times e) + (b \times d)$	$(a \times f) + (b \times e) + (c \times d)$	$(b \times f) + (c \times e)$	$(c \times f)$

Ex. 1: 417×765	Ex. 2: 644×589	Ex. 3: 478×637
$(4 \times 7) \mid (4 \times 6) + (1 \times 7) \mid (4 \times 5 + 1 \times 6 + 7 \times 7) \mid (1 \times 5 + 7 \times 6) \mid (7 \times 5)$ $28 \mid 24+7 \mid 20+6+49 \mid 5+42 \mid 35$ $28 \mid 31 \mid 75 \mid 47 \mid 35$ $28 \mid 31 \mid 75 \mid 47+3 \mid 5$ $28 \mid 31 \mid 75 \mid 50 \mid 5$ $28 \mid 31 \mid 75+5 \mid 0 \mid 5$ $28 \mid 31 \mid 80 \mid 0 \mid 5$ $28 \mid 31+8 \mid 0 \mid 0 \mid 5$ $28 \mid 39 \mid 0 \mid 0 \mid 5$ $28+3 \mid 9 \mid 0 \mid 0 \mid 5$ $31 \mid 9 \mid 0 \mid 0 \mid 5$	$6 \ 4 \ 4$ $5 \ 8 \ 9$ <hr/> $30 \ 68 \ 106 \ 68 \ 36$ $37 \ 79 \ 113 \ 71 \ 36$ $37 \ 9 \ 3 \ 1 \ 6$	$4 \ 7 \ 8$ $6 \ 3 \ 7$ <hr/>
319005	379316	

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Ex. 4: 874×632	Ex. 5: 328×476	Ex. 6: 337×749
$\begin{array}{r} 874 \\ 632 \\ \hline \end{array}$	$\begin{array}{r} 328 \\ 476 \\ \hline \end{array}$	$\begin{array}{r} 337 \\ 749 \\ \hline \end{array}$

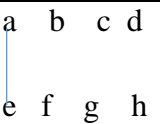
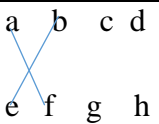
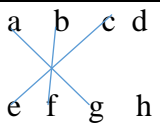
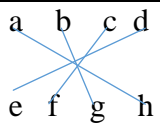
Ex. 7: 727×149	Ex. 8: 648×987	Ex. 9: 324×657
$\begin{array}{r} 727 \\ 149 \\ \hline \end{array}$	$\begin{array}{r} 648 \\ 987 \\ \hline \end{array}$	$\begin{array}{r} 324 \\ 657 \\ \hline \end{array}$

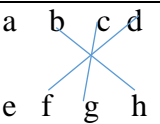
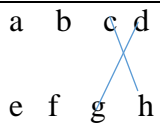
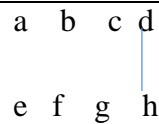
Ex. 10: 251×893	Ex. 11: 894×274	Ex. 12: 349×369
$\begin{array}{r} 251 \\ 893 \\ \hline \end{array}$	$\begin{array}{r} 894 \\ 274 \\ \hline \end{array}$	$\begin{array}{r} 349 \\ 369 \\ \hline \end{array}$

Ex. 13: 812×436	Ex. 14: 941×328	Ex. 15: 812×549
$\begin{array}{r} 812 \\ 436 \\ \hline \end{array}$	$\begin{array}{r} 941 \\ 328 \\ \hline \end{array}$	$\begin{array}{r} 812 \\ 549 \\ \hline \end{array}$

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CASE 3: (4×3; 4×3; 4×2; 4×1) Answer consists of seven parts.

First Part:	Second Part:	Third Part:	Fourth Part:
			
(a×e)	(a×f) + (b×e)	(a×g) + (b×f) + (c×e)	(a×h) + (b×g) + (c×f) + (d×e)

Fifth Part:	Sixth Part:	Seventh Part:
		
(b×h) + (c×g) + (d×f)	(c×h) + (d×g)	(d×h)

Ex.1: 4563 × 8336?	Ex.2: 6379 × 2346?	Ex.3: 7453 × 8743?
$\begin{array}{r} 4 \ 5 \ 6 \ 3 \\ \times 8 \ 3 \ 3 \ 6 \\ \hline \end{array}$ <p> = 32 12 + 40 12 + 15 + 48 24 + 15 + 18 + 2 4 30 + 18 + 9 36 + 9 18 = 32 52 75 81 57 45 18 = 32 52 75 81 57 45 + 1 = 46 8 = 32 52 75 81 57 + 4 = 61 6 8 = 32 52 75 81 + 6 = 87 1 6 8 = 32 52 75 + 8 = 83 7 1 6 8 = 32 52 + 8 = 60 3 7 1 6 8 = 32 + 6 0 3 7 1 6 8 = 38 0 3 7 1 6 8 = 38037168 </p>	$\begin{array}{r} 6 \ 3 \ 7 \ 9 \\ \times 2 \ 3 \ 4 \ 6 \\ \hline \end{array}$ <p> = 12 24 47 87 73 78 54 14 9 6 5 1 3 4 = 14965134 </p>	$\begin{array}{r} 7 \ 4 \ 5 \ 3 \\ \times 8 \ 7 \ 4 \ 3 \\ \hline \end{array}$

Ex.4: 8745 × 3214?	Ex.5: 3125 × 6478?	Ex.6: 2148 × 6348?
$\begin{array}{r} 8 \ 7 \ 4 \ 5 \\ \times 3 \ 2 \ 1 \ 4 \\ \hline \end{array}$	$\begin{array}{r} 3 \ 1 \ 2 \ 5 \\ \times 6 \ 4 \ 7 \ 8 \\ \hline \end{array}$	$\begin{array}{r} 2 \ 1 \ 4 \ 8 \\ \times 6 \ 3 \ 4 \ 8 \\ \hline \end{array}$

Ex.7: 4874 × 3147?	Ex.8: 2147 × 9745?	Ex.9: 3647 × 4129?
$\begin{array}{r} 4 \ 8 \ 7 \ 4 \\ \times 3 \ 1 \ 4 \ 7 \\ \hline \end{array}$	$\begin{array}{r} 2 \ 1 \ 4 \ 7 \\ \times 9 \ 7 \ 4 \ 5 \\ \hline \end{array}$	$\begin{array}{r} 3 \ 6 \ 4 \ 7 \\ \times 4 \ 1 \ 2 \ 9 \\ \hline \end{array}$

Ex.10: 6423 × 3928?	Ex.11: 2419 × 9824?	Ex.12: 8346 × 3148?
$\begin{array}{r} 6423 \\ \times 3928 \\ \hline \end{array}$	$\begin{array}{r} 2419 \\ \times 9824 \\ \hline \end{array}$	$\begin{array}{r} 8346 \\ \times 3148 \\ \hline \end{array}$

CASE 4: (5×5; 5×4; 5×3; 5×2; 5×1): Answer consists of **nine** parts.

First Part:	Second Part:	Third Part:
$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$
(a×f)	(a×g)+(b×f)	(a×h)+(b×g)+(c×f)

Fourth Part:	Fifth Part:	Sixth Part:
$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$
(a×i)+(b×h)+(c×g)+(d×f)	(a×j)+(b×i)+(c×h)+(d×g)+(e×f)	(b×j)+(c×i)+(d×h)+(e×g)

Seventh Part:	Eighth Part:	Ninth Part:
$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e \\ f\ g\ h\ i\ j \end{array}$
(c×j)+(d×i)+(e×h)	(d×j)+(e×i)	(e×j)

CASE 5: (6×6; 6×5; 6×4; 6×3; 6×2; 6×1) (Do it Yourself) Answer consists of eleven parts.

First Part:	Second Part:	Third Part:	Fourth Part:
$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$

Fifth Part:	Sixth Part:	Seventh Part:	Eighth Part:
$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$	$\begin{array}{c} a\ b\ c\ d\ e\ f \\ g\ h\ i\ j\ k\ l \end{array}$

Nineth Part:	Tenth Part:	Eleventh Part:
a b c d e f	a b c d e f	a b c d e f
g h i j k l	g h i j k l	g h i j k l

5*5:

Ex.1: 23456 × 67456?	Ex.2: 33214 × 254?	Ex.3: 47896 × 21456?
2 3 4 5 6 × 6 7 4 5 6 -----	3 3 2 1 4 × 0 0 2 5 4 -----	4 7 8 9 6 × 2 1 4 5 6 -----

Ex.4: 64789 × 23487?	Ex.5: 24578 × 3648?	Ex.6: 97458 × 31231?
6 4 7 8 9 × 2 3 4 8 7 -----	2 4 5 7 8 × 0 3 6 4 8 -----	9 7 4 5 8 × 3 1 2 3 1 -----

6*6:

Ex.1: 234568 × 674563?	Ex.2: 164589 × 314789?
2 3 4 5 6 8 × 6 7 4 5 6 3 -----	1 6 4 5 8 9 × 3 1 4 7 8 9 -----

Ex.3: 874569 × 242681?	Ex.4: 324716 × 64789?
8 7 4 5 6 9 × 2 4 2 6 8 1 -----	3 2 4 7 1 6 × 0 6 4 7 8 9 -----

1.3 Special Cases

1.3.1 Multiplying numbers with repeating 9's

Case-1: When Multiplicand is Smaller than Multiplier

Ex.1: 7×9	Ex.2: 37×99	Ex.3: 874×999
(Base=10)	(Base=100)	(Base=1000)
$(7-1) \downarrow (10-7)$ 6 3	$(37-1) \downarrow (100-37)$ 36 63	$(874-1) \downarrow (1000-874)$ 873 126
63	3663	873126

Case-2: When Multiplicand is Greater than Multiplier

Ex.4: 27×9	Ex.5: 346×99	Ex.6: 7389×9
(Base=10)	(Base=100)	(Base=10)
{2Digit \times 1Digit} $(27-1-2) \downarrow (10-7)$ 24 3	{3Digit \times 2Digit} $(346-1-3) \downarrow (100-46)$ 342 54	{4Digit \times 1Digit} $(7389-1-738) \downarrow (10-9)$ 6650 1
243	34254	66501

7. $76 \times 99 = 76-1 \downarrow 100-76 = 75 \downarrow 24 = 7524$

8. $384 \times 999 = 384-1 \downarrow 1000-384 = 383 \downarrow 616 = 383616$

9. $5468 \times 9999 = 5468-1 \downarrow 10000-5468 = 5467 \downarrow 4532$

10. $64 \times 999 = 64-1 \downarrow 1000-64 = 63 \downarrow 936 = 63936$

11. $863 \times 99 = 863-1-8 \downarrow 100-63 = 854 \downarrow 37 = 85437$

12. $6478 \times 99 = 6478-1-64 \downarrow 100-78 = 6413 \downarrow 22 = 641322$

13. $84 \times 99 =$

14. $68 \times 99 =$

15. $39 \times 99 =$

16. $647 \times 999 =$

17. $347 \times 999 =$

18. $4789 \times 9999 =$

19. $3478 \times 9999 =$

20. $24 \times 9 =$

21. $241 \times 99 =$

22. $216 \times 99 =$

23. $346 \times 99 =$

24. $3366 \times 999 =$

25. $27 \times 999 =$

26. $8745 \times 999 =$

27. $125 \times 999 =$

28. $364 \times 9999 =$

29. $744 \times 99999 =$

30. $901 \times 99 =$

1.3.2 When final digits added up gives power of 10 (10 or 100 or 1000 etc)

Ex.1: 17×13 {7+3=10} (1×2) (7×3) 2 21 221	Ex.2: 28×22 {8+2=10} 2×3 8×2 6 16 616	Ex.3: 44×46 {4+6=10} 4×5 4×6 20 24 2024
---	---	---

1. $32 \times 38 =$
2. $49 \times 41 =$
3. $57 \times 53 =$
4. $76 \times 74 =$
5. $29 \times 21 =$
6. $39 \times 31 =$
7. $47 \times 43 =$
8. $54 \times 56 =$
9. $77 \times 73 =$
10. $192 \times 108 =$

1.3.3: Multiplication by 11 (x×11)

Ex.1: 45×11 45 ×11 ----- 4 (4+5) 5 4 9 5 495	Ex.2: 88×11 88 ×11 ----- 8 4+8 8 9 6 8 968	Ex.3: 67×11 67 ×11 -----	Ex.4: 324×11 324 ×11 -----	Ex.5: 697×11 697 ×11 -----	Ex.6: 987×11 987 ×11 -----
--	--	--	--	--	--

7: 3464×11 3464 ×11 -----	8: 6978×11 6978 ×11 -----	9: 68974×11 68974 ×11 -----	10: 3697895×11 3697895 ×11 -----	11: 345789645×11 345789645 ×11 -----
---	---	---	--	--

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1.3.4 Multiplication by 12 (x12)

Ex.1: 34×12	Ex.2: 89×12	Ex.3: 67×12	Ex.4: 324×12	Ex.5: 697×12	Ex.6: 987×12
34 ×12 ----- 3!(3+3+4)!(4 +4) 3!10!8 (3+1)!0!8 4!0!8 408	89 ×12 ----- 8!25!18 10!6!8 1068	67 ×12 -----	324 ×12 -----	697 ×12 -----	987 ×12 -----
408	1068				

7: 3464×12	8: 6978×12	9: 68974×12	10: 3697895×12	12: 345789645×12
3464 ×12 -----	6978 ×12 -----	68974 ×12 -----	3697895 ×12 -----	345789645 ×12 -----

1.3.5 Multiplication by 5, 25 or 125 (n×5, n×25, n×125)

Multiplication by 5: ($5 = \frac{10}{2}$); Multiplication by 5 is same as that of multiplying the number by 10 and then dividing the obtained product by 2.

Q: 46×5

A: (46×10)/2 = 460/2 = 230

Q: 29×5

A:

Q: 84×5

A:

Q: 569×5

A:

Q: 3489×5

A:

Q: 4789×5

A:

Q: 345×5

A:

Q: 249×5

A:

Q: 3477×5

A:

Q: 6458×5

A:

Q: 4789×5

A:

Q: 347×5

A:

Q: 149×5

A:

Q: 3478967×5

A:

Multiplication by 25 ($25 = \frac{100}{4}$); Multiplication by 25 is same as that of multiplying the number by 100 and then dividing the obtained product by 4.

Q: 46×25

A: $(46 \times 100) / 4 = 4600 / 4 = 1150$

Q: 29×25

A:

Q: 84×25

A:

Q: 569×25

A:

Q: 3489×25

A:

Q: 4789×25

A:

Q: 345×25

A:

Q: 249×25

A:

Q: 3477×25

A:

Q: 6458×25

A:

Q: 4789×25

A:

Q: 347×25

A:

Q: 149×25

A:

Q: 3478967×25

A:

Multiplication by 125: ($125 = \frac{1000}{8}$); Multiplication by 125 is same as that of multiplying the number by 1000 and then dividing the obtained product by 8.

Q: 46×125

A: $(46 \times 1000) / 8 = 46000 / 8 = 5750$

Q: 29×125

A:

Q: 84×125

A:

Q: 569×125

A:

Q: 3489×125

A:

Q: 4789×125

A:

Q: 345×125

A:

Q: 249×125

A:

Q: 34771×125

A:

Q: 6458×125

A:

Q: 4789×125

A:

Q: 347×125

A:

Q: 149×125

A:

Q: 3478967×125

A:

Exercises: (Solve using relevant methods)

1. 14×17	2. 19×16	29. 477×510	30. 369×764
3. 121×119	4. 116×109	31. 415×698	32. 286×478
5. 1024×1005	6. 1039×1010	33. 389×855	34. 475×996
7. 88×91	8. 96×89	35. 785×774	36. 475×875
9. 99×97	10. 980×978	37. 9987×9900	38. 9985×10200
11. 976×988	12. 955×990	39. 7007×7050	40. 9875×9980
13. 971×980	14. 1024×1010	41. 78×99	42. 7×99
15. 1100×1046	16. 1020×1005	43. 874×99	44. 649×999
17. 89×121	18. 91×115	45. 87×999	46. 7436×999
19. 94×117	20. 97×109	47. 96354×999	48. 7465×9999
21. 990×1050	22. 977×1020	49. 316×9999	50. 547×9999
23. 455×485	24. 475×485	51. 54×56	52. 77×73
25. 585×620	26. 690×725	53. 736×764	54. 349×351
27. 78×86	28. 475×520	55. 369×179	56. 411×296

1. 14×17	2. 19×16	3. 121×119	4. 116×109	5. 1024×1005	6. 1039×1010

7. 88×91	8. 96×89	9. 99×97	10. 980×978	11. 976×988	12. 955×990

13. 971×980	14. 1024×1010	15. 1100×1046	16. 1020×1005	17. 89×121	18. 91×115

19. 94×117	20. 97×109	21. 990×1050	22. 977×1020	23. 455×485	24. 475×485

25. 585×620	26. 690×725	27. 78×86	28. 475×520	29. 477×510	30. 369×764

31. 415×698	32. 286×478	33. 389×855	34. 475×996	35. 785×774	36. 475×875

37. 9987×9900	38. 9985×10200	39. 7007×7050	40. 9875×9980	41. 78×99	42. 7×99

43. 874×99	44. 649×999	45. 87×999	46. 7436×999	47. 96354×999	48. 7465×9999

49. 316×9999	50. 547×9999	51. 54×56	52. 77×73	53. 736×764	54. 349×351

55. 369×179	56. 411×296	<ol style="list-style-type: none"> Books, eBooks, Video Course, FREE Workbook & FREE Online Training on Vedic Speed Mathematics, C & Python Programming: www.Speed16.com/books/vm 3D Printers (Sales & Service; Anywhere in the World). eBook Creation (epub/mobi) & Publishing (Amazon Kindle, iBooks, Kobo etc.) Services. IT Solutions and Services Reach us for FREE Home Delivery of Vedic Speed Mathematics (Anywhere in the World) Contact: Chaitanya Patil; info@speed16.com

Answers:

1. 238	2. 304	29. 243270	30. 281916
3. 14399	4. 12644	31. 289670	32. 136708
5. 1029120	6. 1049390	33. 332595	34. 473100
7. 8008	8. 8544	35. 607590	36. 415625
9. 9603	10. 958440	37. 98871300	38. 101847000
11. 964288	12. 945450	39. 49399350	40. 98552500
13. 951580	14. 1034240	41. 7722	42. 693
15. 1150600	16. 1025100	43. 86526	44. 648351
17. 10769	18. 10465	45. 86913	46. 7428564
19. 10998	20. 10579	47. 96257646	48. 74642535
21. 1039500	22. 996540	49. 3159684	50. 5469453
23. 220675	24. 230375	51. 3024	52. 5621
25. 362700	26. 500250	53. 562304	54. 122499
27. 6708	28. 247000	55. 66051	56. 121656

Unit 2: DIVISION

(Solve by using any suitable method)

1. $147 \div 11$	2. $194 \div 17$	3. $121 \div 104$

4. $116 \div 212$	5. $1024 \div 342$	6. $1039 \div 544$

7. $1256 \div 66$	8. $2896 \div 87$	9. $1254 \div 94$

10. $21458 \div 976$	11. $364578 \div 988$	12. $6457896 \div 994$

13. $2971 \div 76$	14. $647859 \div 89$	15. $3145697 \div 4364$

16. $5647895 \div 6457892$	17. $4789566 \div 31971$	18. $974586 \div 465764$

19. $64589 \div 645792$	20. $3247931 \div 8124568$	21. $87456963 \div 324588$

22. $7412456 \div 1020$	23. $874565412 \div 114$	24. $3457896452 \div 324567$

25. $987456321 \div 519475$	26. $64578963 \div 864$	27. $98745632 \div 31254$

28. $245896475 \div 37452$	29. $36478956 \div 2364$	30. $8547996 \div 34779$

31. $8475569 \div 3147$	32. $6457855 \div 97$	33. $345698 \div 63456$

34. $974586 \div 102145$	35. $9745689 \div 201238$	36. $347931568 \div 345687$

Ex.1: 7898+8567	Ex.2: 34856+97458+745+6478	Ex.3: 647566+314789+9874+364
7898	3 4 8 5 6	6 4 7 5 6 6
+ 8567	+ 9 7 4 5 8	+ 3 1 4 7 8 9
-----	0 0 7 4 5	0 0 9 8 7 4
(7+8),(8+5),(9+6),(8+7)	0 6 4 7 8	0 0 0 3 6 4
15,13,15,15	-----	-----
15 ,13,(15+1),5		
15,13,16,5		
15,(13+1),6,5		
15,14,6,5		
(15+1),4,6,5		
16,4,6,5		
16465		

Ex.4: 3645+6975+74 <div> <div>3645</div> <div>+6975</div> <div>74</div> <div>-----</div> </div>	Ex.5: 8745+11456+987+32+679 <div> <div>08745</div> <div>+11456</div> <div>00987</div> <div>00032</div> <div>00679</div> <div>-----</div> </div>	Ex.6:697892+9978+33145+6478956 <div> <div>0697892</div> <div>+0009978</div> <div>0033115</div> <div>6478956</div> <div>-----</div> </div>

Ex.7: 12569+369+69	Ex.8: 6974125+3645+233+1142	Ex.9: 247896+12364+32117858
1 2 5 6 9 +0 0 3 6 9 0 0 0 6 9 -----	6 9 7 4 1 2 5 +0 0 0 3 6 4 5 0 0 0 0 2 3 3 0 0 0 1 1 4 2 -----	0 0 2 4 7 8 9 6 +0 0 0 1 2 3 6 4 3 2 1 1 7 8 5 8 -----

Ex.10: 14578+21+364	Ex.11: 678965+336654+647895	Ex.12: 5748312+3697489+9999999
$\begin{array}{r} 1\ 4\ 5\ 7\ 8 \\ +0\ 0\ 0\ 2\ 1 \\ 0\ 0\ 3\ 6\ 4 \\ \hline \end{array}$	$\begin{array}{r} 6\ 7\ 8\ 9\ 6\ 5 \\ +3\ 3\ 6\ 6\ 5\ 4 \\ 6\ 4\ 7\ 8\ 9\ 5 \\ \hline \end{array}$	$\begin{array}{r} 0\ 5\ 7\ 4\ 8\ 3\ 1\ 2 \\ +0\ 3\ 6\ 9\ 7\ 4\ 8\ 9 \\ 9\ 9\ 9\ 9\ 9\ 9\ 9\ 9 \\ \hline \end{array}$

3.2 Other Scenarios

Q: Add 78+9

A: First Add 78+10=88 and then subtract 88-1=87.

Q: Add 369+489

A: First Add 300+400=700; 60+80=140; 9+9=18; 700+140+18=858. **OR**

A: 400-31+489 = 400+481-31 = 889-31=858 **OR**

A: 369+500-11 = 869-11 = 858.

Q: 648+965

A:

A:

Q: 425+716

A:

A:

Q: 3146+6314

A:

A:

Q: 1478+9822

A:

A:

Q: 1233+632

A:

A:

Q: 145+654

A:

A:

Q: 198+236

A:

A:

Q: 258+988

A:

A:

Q: 1235+3456

A:

A:

Q: 1456+6213

A:

A:

Q: 1399+3321

A:

A:

Q: 4587+9888

A:

A:

Q: 337+655

A:

A:

Q: 249+312

A:

A:

Q: 222+548

A:

A:

Q: 478+985

A:

A:

Q: 544+689

A:

A:

Q: 382+378

A:

A:

Q: 326+974

A:

A:

Q: 3478+985

A:

A:

Q: 3647+9874

A:

A:

Q: 8236+6321

A:

A:

Q: 747+698

A:

3.3 Mixed Examples (Solve using any appropriate methods).

1. 8+9	2. 7+8	3. 9+9	4. 12+18

5. 9+19	6. 3+48	7. 38+48	8. 74+79

9. 87+109	10. 74+114	11. 245+289	12. 348+405

13. 475+916	14. 477+1023	15. 1047+987	16. 967+475

17. 744+888	18. 365+706	19. 7456+8569+745	20. 7458+9874+6325

21. 4782+648+8743	22. 47896+3548+589	23. 3498+6731+94385+69	24. 15+568+87+2368+3+58

Answers:

1. 17	2. 15		13. 1391	14. 1500
3. 18	4. 30		15. 2034	16. 1442
5. 28	6. 51		17. 1632	18. 1071
7. 86	8. 153		19. 16770	20. 23657
9. 196	10. 488		21. 14173	22. 52033
11. 534	12. 753		23. 104683	24. 3099

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Unit 4: SUBTRACTION

4.1 Subtraction Using Base Method

Ex.1:100-46	Ex.2:1000-148	Ex.3:1000-871	Ex.4:1000-048	Ex.5:10000-7200
9-4=5 10-6=4	9-1=8 9-4=5 10-8=2	9-8=1 9-7=2 10-1=9	9-0=9 9-4=5 10-8=2	9-7=2 10-2=8 0 0
54	852	129	952	2800

Ex.6: 100-58	Ex.7: 1000-367	Ex.8: 1000-648	Ex.9: 10000-873	Ex.10:1000-540

Ex.11:10000-632	Ex.12:10000-657	Ex.13:1000-910	Ex.14:10000-987	Ex.15:1000-297

4.2 Subtraction using Purification

Sub Sutra: 15. Śūddha (शुद्धः); Meaning: Purification

Ex.1: 92-56	Ex.2: 8756-6898	Ex.3: 6145-3473	Ex.4: 87456-9842
92 -56 ----- 4,6 (4-1), 6 3,6	8756 -6898 ----- 2,9,6,8 (2-1),9, 6,8 1,9,6,8 1,(9-1),6,8 1,8,6,8 1,8,6-1,8	6145 -3473 ----- 3,7,7,2 (3-1),7,7,2 2,7,7,2 2,(7-1),7,2 2,6,7,2	
36	1858	2672	

Ex.5: 9871-364	Ex.6: 2745-2345	Ex.7: 9648-57893	Ex.8: 69745-59999
		First Find Difference (Bigger – Smaller) 5 7 8 9 3 - 0 9 6 4 8 ----- 5, 8, 2, 5, 5 (5-1), 8, 2, (5-1), 5 4 8 2 4 5 Add Sign of Bigger Number	
		-48245	

Ex.9: 14758-69785	Ex.10: 64753-3321	Ex.11: 64789-61254	Ex.12: 5478-998745

Ex.13: 34569--547896	Ex.14: 1459-5789645	Ex.15: 9745-3645896	Ex.16: 69745-369745

4.3 Other Scenarios

Q: Subtract 78-9

A: First Subtract $78-10=68$ and then add $68+1=69$.

Q: Subtract 136-47

A: $136-46=90$; $90-1=89$

Q: 9745-345

A:

Q: 8736-426

A:

Q: 7456-461

A:

Q: 8912-822

A:

Q: 3645-231

A:

Q: 7896-986

A:

Q: 1458-658

A:

Q: 47569-1489

A:

Q: 8796-364

A:

Q: 364589-9874

A:

Q: 31222-6999

A:

Q: 6475-364

A:

4.4 Mixed Examples (Solve using any appropriate methods).

1. 18-9	2. 17-8	3. 16-9	4. 12-18

5. 99-19	6. 98-84	7. 758-48	8. 974-79

9. 745-109	10. 674-114	11. 345-289	12. 348-405

13. 1000-916	14. 100-64	15. 1000-87	16. 10000-475

17. 10000-7888	18. 10000-745	19. 47456-8569-745	20. 7458-1874-3325

21. 4782-648-8743	22. 47896-3548-589	23. 9498-1731-4385-69	24. 15568-87-2368-3-58

Answers:

1. 9	2. 9		3. 7	4. -6
5. 80	6. 14		7. 710	8. 895
9. 636	10. 560		11. 56	12. -57
13. 84	14. 36		15. 913	16. 9525
17. 2112	18. 9255		19. 38142	20. 2259
21. -4609	22. 43759		23. 3313	24. 13052

Unit 5: SQUARES

What is Square: a square is the result of multiplying a number by itself.

For ex. Square of 3 is 9 (3×3); Square of -45 is 2025 (-45×-45)

Square of 12 is 144 (12×12); Square of -12 is 144 (-12×-12)

5.1 Square Using One More than the Previous One

Ex.1: 15^2	Ex.2: 25^2	Ex.3: 75^2	Ex.4: 95^2	Ex.5: 115^2
		7 5	9 5	11 5
		7×8 25	9×10 25	11×12 25
		56 25	90 25	132 25
		5625	9025	13225

Ex.6: 35^2	Ex.7: 45^2	Ex.8: 55^2	Ex.9: 65^2	Ex.10: 85^2

Ex.11: 105^2	Ex.12: 125^2	Ex.13: 135^2	Ex.14: 145^2	Ex.15: 155^2

5.2 Square Using Complements/Surpluses

Case 1: When Number is below the Working Base.

Ex.1: 94^2	Ex.2: 91^2	Ex.3: 87^2	Ex.4: 88^2
B: 100; C: -06		B: 100; C: -13	
$94-6$ -6^2		$87-13$ -13^2	
88 36		74 169	
		$74+1$ 69	
		75 69	
8836		7569	

Ex.5: 92^2	Ex.6: 83^2	Ex.7: 84^2	Ex.8: 86^2

Ex.9: 975^2	Ex.10: 984^2	Ex.11: 993^2	Ex.12: 979^2

Case 2: When Number is above the Working Base.

Ex.1: 108^2	Ex.2: 103^2	Ex.3: 107^2	Ex.4: 106^2
B: 100; Surplus: +08	B: 100; Surplus: +03		
$108+8 \mid 8^2$	$103+3 \mid 3^2$		
116 64	106 09		
11664	10609		

Ex.5: 112^2	Ex.6: 124^2	Ex.7: 102^2	Ex.8: 119^2

Ex.9: 1024^2	Ex.10: 1017^2	Ex.11: 10016^2	Ex.12: 10026^2

Note: Prefer Square using Criss Cross Method if numbers are not nearer to Working Bases and not ending with Digit 5.

5.4 Square using Criss Cross Method

Ex.1: 83^2	Ex.2: 678^2	Ex.3: -59^2	Ex.4: 536^2
$\begin{array}{r} 83 \\ 83 \\ \hline 64 \quad 24+24 \quad 9 \\ 64 \quad 48 \quad 9 \\ 64+4 \quad 8 \quad 9 \\ 68 \quad 8 \quad 9 \end{array}$	$\begin{array}{r} 678 \\ 678 \\ \hline 36; 42+42; 48+49+48; \\ 56+56; 64 \\ 36 \quad 84 \quad 145 \quad 112 \quad 64 \\ 45 \quad 99 \quad 156 \quad 118 \quad 64 \\ 459684 \end{array}$	$\begin{array}{r} 59 \\ 59 \\ \hline 25 \quad 45+45 \quad 81 \\ 25 \quad 90 \quad 81 \\ 34 \quad 98 \quad 81 \\ 3481 \end{array}$	
6889	459684	3481	

Ex.5: 748^2	Ex.6: 347^2	Ex.7: 248^2	Ex.8: -241^2

Ex.9: 3458^2	Ex.10: 6974^2	Ex.11: 97456^2	Ex.12: 36548^2

Ex.13: 34233^2	Ex.14: 78954^2	Ex.15: 97411^2	Ex.16: -69748^2

5.5 Mixed Examples (Solve using any appropriate methods).

1. 25	2. 35	3. 45	4. 55

5. 65	6. 135	7. 185	8. 195

9. 355	10. 495	11. 49	12. 94

13. 104	14. 112	15. 109	16. 113

17. 97	18. 93	19. 473	20. 239

21. 477	22. 369	23. 89	24. 74

25. 76	26. 98	27. 73	28. 36

29. 984	30. 746	31. 638	32. 697

33. 1005	34. 977	35. 983	36. 1036

Answers:

1. 625	2. 1225	21. 227529	22. 136161
3. 2025	4. 3025	23. 7921	24. 5476
5. 4225	6. 18225	25. 5776	26. 9604
7. 34225	8. 38025	27. 5329	28. 1296
9. 126025	10. 245025	29. 968256	30. 556516
11. 2401	12. 8836	31. 407044	32. 485809
13. 10816	14. 12544	33. 1010025	34. 954529
15. 11881	16. 12769	35. 966289	36. 1073296
17. 9409	18. 8649	Always Think Positively.	
19. 223729	20. 57121		

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Unit 6: SQUARE ROOTS

Case 1: Square Root of Perfect Square Numbers (Upto 6 Digits)

‘**n**’ = Given Number

‘**p**’ = Number except last two digits

‘**q**’ = Lower Square of p

‘**r**’ = Square root of q ($r = \sqrt{q}$) (First Part of Square Root)

‘**s**’ = $r \times (r+1)$

‘**t**’ = Last Digit of Square Root

‘**u**’ = Final Answer (Square root of Given Number)

	N	p	q	r	s	t	u
1	256	2	1	1	2	4 or 6	16
2	361	3	1	1	2	1 or 9	19
3	576	5	4	2	6	4 or 6	24
4	841	8	4	2	6	1 or 9	29
5	900	9	9	3	12	0	30
6	9409						
7	7569						
8	1369						
9	1849						
10	6724						
11	1521						
12	1936						
13	3364						
14	3969						
15	2116						
16	2601						
17	4096						
18	5329						
19	4489						
20	5929						
21	1089						
22	8464						
23	6889						
24	15129						
25	21609						
26	6241						
27	37249						
28	8649						
29	43681						
30	9604						

Case 2: Square Root of Bigger Numbers using Duplex Combination Process

Ex.1: $\sqrt{52374169}$	Ex.2: $\sqrt{71791729}$
52 : 3 7 4 1 6 9 14 3; 5; 11; 4; 4; 4 7; 2; 3; 7; 0; 0; 0	
Answer: 7237	

Ex.3: $\sqrt{48818169}$	Ex.4: $\sqrt{968785}$
	96 : 8 7 8 5 18 15; 14; 11; 18 9; 8; 4; 2; 7
	Answer: 984.27

Ex.5: $\sqrt{574564}$	Ex.6: $\sqrt{96452041}$

Ex.7: $\sqrt{9840769}$	Ex.8: $\sqrt{369785}$

Mixed Examples (Solve using any appropriate methods).

1. 625	2. 1255	3. 2025	4. 3025

5. 4225	6. 18225	7. 34225	8. 38025

9. 126025	10. 245025	11. 2401	12. 8836

13. 10816	14. 12544	15. 11881	16. 12769

17. 9409	18. 8649	19. 223729	20. 57121

21. 227529	22. 136161	23. 7921	24. 5476

25. 5776	26. 9604	27. 5329	28. 1296

29. 968256	30. 556516	31. 407044

32. 485809	33. 1010025	34. 954529

35. 966289	36. 1073296	37. 1119364

38. 443556	39. 93025	40. 978121

41. 9654788	42. 64658965	43. 3145896

44. 8564523

Answers:

1. 25	2. 35	3. 45	4. 55	5. 65	6. 135
7. 185	8. 195	9. 355	10. 495	11. 49	12. 94
13. 104	14. 112	15. 109	16. 113	17. 97	18. 93
19. 473	20. 239	21. 477	22. 369	23. 89	24. 74
25. 76	26. 98	27. 73	28. 36	29. 984	30. 746
31. 638	32. 697	33. 1005	34. 977	35. 983	36. 1036
37. 1058	38. 666	39. 305	40. 989	41. 3107.215	
42. 8041.079		43. 1773.667	44. 2926.520 Be Good. Do Good.		

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Unit 7: CUBES

7.1 Cube Using Complements or Surpluses

Case 1: When number is above the working base

General Formula: $n+2s \mid (n+2s-b) \times s \mid s^3$

Ex.1: 12^3	Ex.2: 109^3	Ex.3: 114^3
B:10; S:+2	B:100; S:+9	B:100; S:+14
$12+4 \mid (12+4-10) \times 2 \mid 2^3$ $16 \mid 12 \mid 8$ $16+1 \mid 2 \mid 8$ $17 \mid 2 \mid 8$	$109+18 \mid (109+18-100) \times 9 \mid 9^3$ $127 \mid 243 \mid 729$ $127 \mid 243+7 \mid 29$ $127 \mid 250 \mid 29$ $127+2 \mid 50 \mid 29$ $129 \mid 50 \mid 29$	
1728	1295029	

Ex.4: 16^3	Ex.5: 18^3	Ex.6: 107^3

Ex.7: 13^3	Ex.8: 112^3	Ex.9: 1015^3

Case 2: When number is below the working base

General Formula: $n+2c \mid (n+2c-b) \times c \mid c^3$

Ex.1: 94^3	Ex.2: 97^3	Ex.3: 89^3
B:100; C:-6		
$94-12 \mid (94-12-100) \times -6 \mid -6^3$ $82 \mid 108 \mid -216$ $82 \mid 108-3 \mid -216+300$ $82 \mid 105 \mid 84$ $82+1 \mid 05 \mid 84$ $83 \mid 05 \mid 84$		
830584		

Ex.4: 96^3	Ex.5: 91^3	Ex.6: 92^3

Ex.7: 984^3	Ex.8: 993^3	Ex.9: 989^3

7.2 Cube Using Proportionately

General Formula:

For Two Digit Numbers: $(ab)^3 = a^3 + 3 \times a^2 \times b + 3 \times a \times b^2 + b^3$

{How to remember? it is same as: $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$ }

For Three Digit Numbers: $(abc)^3 = (ab)^3 + 3 \times (ab)^2 \times c + 3 \times (ab) \times c^2 + c^3$

Ex.1: 79^3	Ex.2: 94^3	Ex.3: 368^3
$7^3 3 \times 7^2 \times 9 3 \times 7 \times 9^2 9^3$ 343 1323 1701 729 343 1323 1701 + 72 9 343 1323 1773 9 343 1323 + 177 3 9 343 1500 3 9 343 + 150 0 3 9 493 0 3 9 493039		$36^3 3 \times 36^2 \times 8 3 \times 36 \times 8^2 8^3$ 46656 31104 6912 512 46656 31104 6912 + 51 2 46656 31104 6963 2 46656 31104 + 696 3 2 46656 31800 3 2 46656 + 3180 0 3 2 49836 0 3 2 49836032

Ex.4: 24^3	Ex.5: 39^3	Ex.6: 213^3

Ex.7: 54^3	Ex.8: 67^3	Ex.9: 304^3

Ex.10: 81^3	Ex.11: 1004^3	Ex.12: 1209^3

Mixed Examples (Solve using any appropriate methods).

1. 9	2. 17	3. 43

4. 94	5. 95	6. 96

7. 97	8. 98	9. 99

10. 104	11. 105	12. 106

13. 107	14. 108	15. 109

16. 113	17. 980	18. 990

19. 993	20. 994	21. 1001

22. 1002	23. 1003	24. 1004

Answers:

1. 729	2. 4913	3. 79507	4. 830584
5. 857375	6. 884736	7. 912673	8. 941192
9. 970299	10. 1124864	11. 1157625	12. 1191016
13. 1225043	14. 1259712	15. 1295029	16. 1442897
17. 941192000	18. 970299000	19. 979146657	20. 982107784
21. 1003003001	22. 1006012008	23. 1009027027	24. 1012048064

Unit 8: CUBE ROOTS

Case 1: Cube Root of Perfect Cube Numbers (upto Six Digit)

‘Sr’ = Serial Number

‘n’ = Given Number after Grouping

‘p’ = Lower cube value of first part

‘q’ = $\sqrt[3]{p}$ = Cuberoot of ‘p’ => First digit of Cube Root

‘r’ = Last Digit of given Number

‘s’ = Last Digit of Cube Root based on ‘r’

‘t’ = Cube Root of given Number (combining ‘q’ and ‘s’)

Sr	N	p	Q	r	s	T
1	2;197	1	1	7	3	13
2	5;832	1	1	2	8	18
3	12;167	8	2	7	3	23
4	24;389	8	2	9	9	29
5	27;000	27	3	0	0	30
6	262144					
7	438976					
8	148877					
9	493039					
10	704969					
11	39304					
12	970299					
13	941192					
14	804357					
15	531441					
16	50653					
17	185193					
18	287496					
19	389017					
20	456533					
21	571787					
22	830584					
23	79507					
24	205379					
25	328509					
26	884736					
27	103823					
28	250047					
29	658503					
30	912673					

Case 2: Cube Root of Numbers (upto Nine Digit)

Ex.1: $\sqrt[3]{580093704}$	Ex.2: $\sqrt[3]{46726}$
580: 0 9 3 7 0 4 192 68; 104; 65; 50; 15; 6 8; 3; 4; 0; 0; 0	46: 7 2 6 27 19; 35; 28 3; 6; 0; 2
Answer: 834	Answer: 36.02

Ex.3: $\sqrt[3]{30959144}$	Ex.4: $\sqrt[3]{315821241}$

Ex.5: $\sqrt[3]{395446904}$	Ex.6: $\sqrt[3]{364758965}$

Mixed Examples (Solve using any appropriate methods).

Find cube root values of following numbers.

1. 729	2. 4913	3. 79507

4. 830584	5. 857375	6. 884736

7. 912673	8. 941192	9. 970299

10. 1124864	11. 1157625	12. 1191016

13. 1225043	14. 1259712	15. 1295029

16. 1442897	17. 941192000	18. 970299000

19. 979146657	20. 982107784	21. 1003003001

22. 1006012008	23. 1009027027	24. 1012048064

Answers:

1. 9	2. 17	3. 43	4. 94	Love Yourself. It is Important to stay positive because Beauty comes from the inside out : Jenn Proske
5. 95	6. 96	7. 97	8. 98	
9. 99	10. 104	11. 105	12. 106	
13. 107	14. 108	15. 109	16. 113	
17. 980	18. 990	19. 993	20. 994	
21. 1001	22. 1002	23. 1003	24. 1004	

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Unit 10: DIVISIBILITY

Exercise: Check divisibility of following using appropriate method.

1. 348698 by 2	2. 478956 by 3	3. 4789624 by 4
4. 4789654 by 4	5. 47896 by 5	6. 4789650 by 5
7. 74695 by 6	8. 32458 by 7	9. 47896 by 8
10. 74698 by 9	11. 14789 by 11	12. 47856 by 13
13. 456951 by 29	14. 20727 by 21	15. 23126 by 31
16. 22701 by 23	17. 16778 by 17	18. 27602 by 37
19. 26649 by 27	20. 32273 by 33	21. 289068 by 39
22. 1478625 by 25	23. 1579920 by 16	24. 177570 by 18
25. 98740 by 20	26. 2172346 by 22	27. 1885512 by 24
28. 47856963 by 25	29. 1942018 by 26	30. 2764804 by 28
31. 29623680 by 30	32. 11330159 by 31	

Answers: Write YES/NO.

1.	2.	3.
4.	5.	6.
7.	8.	9.
10.	11.	12.
13.	14.	15.
16.	17.	18.
19.	20.	21.
22.	23.	24.
25.	26.	27.
28.	29.	30.
31.	32.	

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Unit 11: DECIMALS, FRACTIONS AND PERCENTAGES

Conversion

Sr.	Decimal	Fraction	Percentage
1	1.0	1/1	100%
2	0.25	1/4	25%
3		1/2	50%
4	0.75	3/4	
5		7/6	125%
6		50/2 or 25/1	
7	0.99		
8	0.9		
9			68%
10		-1/1	
11	-0.25	-1/4	
12			-50%
13		-3/4	-75%
14	0.02		74%
15	3.46		
16		64/8	
17			81%
18		960/160	
19			91%
20	7.896		
21			3200%
22		54/7	
23		81/8	
24	163.569		
25			6120%
26		960/320	
27	478.25		
28			12450%
29	56.69		
30			36000%

1) 12.36+96.3+0.36	2) 4+63.6+98.6+0.003	3) 6+3.3+3.33+0.303

4) $86.369+986.1+658.3$	5) $74.3+65.8+965.69$	6) $478.33+658.98+0.75$

7) $165.36-0.325-6.201$	8) $412.0-658.3-65.3698$	9) $0.036-0.7896-63.369$

10) $413.9-478-0.0034-0.13$	11) $4789-0.365-2.356$	12) $45.3+658-69.36-0.1$

13) $0.36 \times 85.3 \times 4.3$	14) $45.3 \times 45.6 \times 0.03$	15) $98.3 \times 78.63 \times 0.02$

16) $14.4 \div 12$	17) $3.24 \div 1.8$	18) 44.1×2.1

19) $\frac{458}{120} + \frac{452}{120}$	20) $\frac{29}{30} + \frac{31}{15}$	21) $\frac{12}{18} + \frac{33}{7}$

22) $\frac{458}{120} - \frac{452}{120}$	23) $\frac{29}{30} - \frac{31}{15}$	24) $\frac{12}{18} - \frac{33}{7}$

25) $\frac{35}{140} \times \frac{40}{160}$	26) $\frac{164}{42} \times \frac{23}{69}$	27) $\frac{24}{16} \times \frac{36}{32}$

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

36) $36 \div 37$

Divisor																	
Dividend																	
Quotient																	
Remainder																	

Ex.37: $0.32+13.35+45.058+696.368+31.004$

Ex.38: $143+365.9+0.04+36.02+6986.36+7469.3$

Ex.39: $47.69+36475.6+32143.6547+694.3+447+58746.6+0.03$

Ex.40: $69.3+698.3+1143.33+2145.52+2546.36+744.444+3.3636$

Ex.41: $475.54+47896.3+36.31456+7896.149+3645.002+364789.3214$

Ex.42: $1114.36+3654.65+312.003+3123.333+78954.21+9874.365$

Ex.43: $7451.21+1423.21+144.012+3665.31+3111.26+9999.914$

Ex.44: $345896.36+1475.26+3642.0103+312.215+3654.321+3648.635$

Ex.37:	Ex.38:	Ex.39:	Ex.40:
000.3200	0143.00		
013.3500	0365.90		
045.0580	0000.04		
696.3680	0036.02		
+ 031.0040	6986.36		
<hr/>	+7469.30		
786.1000	<hr/>		
	15000.62		
786.1	15000.62		

Ex.41:	Ex.42:	Ex.43:	Ex.44:

Percentages

Q: What is 12% of 8745?

A:

Q: What is 36% of 97458?

A:

Q: What percent of 6489 is 76?

A:

Q: What percent of 9745 is 12365?

A:

Q: Increase 8746 by 54%.

A:

Q: Increase 364789 by 231%.

A:

Q: Decrease 364789 by 21%.

A:

Q: Decrease 3126 by 236%.

A:

Q: Value of an item increased from 4569 to 5614. How much % is increased?

A:

Q: Value of an item decreased from 3645 to 1265. How much % is decreased?

A:

Unit 12: POLYNOMIALS

12.1 Multiplication using Criss Cross Method

Ex.1: $(x+3)(x+5)$	Ex.2: $(x+7)(x-9)$	Ex.3: $(x-7)(x-9)$
$\begin{array}{r} 1 \ 3 \\ 1 \ 5 \\ \hline (1 \times 1) (1 \times 5 + 1 \times 3) (3 \times 5) \\ 1 \ \ 8 \ \ 15 \\ x^2 + 8x + 15 \end{array}$		
$x^2 + 8x + 15$		

Ex.4: $(3x+12)(-7x)$	Ex.5: $(-3x+13)(5)$	Ex.6: $(-x-3)(-x)$

Ex.7: $(x^2+5x+1)(3x^2-10x+15)$	Ex.8: $(3x^2-8x-9)(3x^2-11x+8)$
$\begin{array}{r} 1 \quad 5 \quad 1 \\ 3 \quad -10 \quad 15 \\ \hline (1 \times 3) (1 \times -10 + 3 \times 5) (1 \times 15 + 5 \times -10 + 1 \times 3) \\ (5 \times 15 + -10 \times 1) (1 \times 15) \\ 3 \ \ 5 \ \ -32 \ \ 65 \ \ 15 \\ 3x^4 + 5x^3 - 32x^2 + 65x + 15 \end{array}$	
$3x^4 + 5x^3 - 32x^2 + 65x + 15$	

Ex.9: $(7x^2-6x-8)(-6x-13)$	Ex.10: $(-12x^2-3x+6)(5x^2-8x-9)$

Ex.11: $(3x^2-6x-7) (-7x^2-13)$	Ex.12: $(8x^2-12x+17) (2x^2-8x-9)$

Ex.13: $(x^3+5x^2+3x+2)(2x^3-4x^2-7x+3)$	Ex.14: $(2x^3-3x^2-7x+9)(3x^3-8x^2-12)$

Ex.15: $(7x^3-3x^2-9x-19)$ $(6x^3-8x^2+3x+9)$	Ex.16: $(7x^3-8x^2-9x+3)$ $(8x^3-3x^2-3x)$

Ex.17: $(2x^4+3x^3+3x^2+2x+4) (3x^4-2x^3+4x^2-7x-8)$	Ex.18: $(3x^5-2x^4-4x^3+2x^2-3x+3) (4x^5-6x^4+3x^3-2x^2+6x+2)$
$\begin{array}{r} 2 \ 3 \ 3 \ 2 \ 4 \\ 3 \ -2 \ 4 \ -7 \ -8 \\ \hline \end{array}$	$\begin{array}{r} 3 \ -2 \ -4 \ 2 \ -3 \ 3 \\ 4 \ -6 \ 3 \ -2 \ 6 \ 2 \\ \hline \end{array}$
$\begin{array}{cccccccccc} & & & & & & & & & \\ \hline \end{array}$	$\begin{array}{cccccccccccc} & & & & & & & & & & & \\ \hline \end{array}$
$6x^8+5x^7+11x^6-2x^5-17x^4-45x^3-22x^2-44x-32$	$12x^{10}-26x^9+5x^8+20x^7-14x^6+38x^5-59x^4+19x^3-20x^2+12x+6$

19. $(2x^3-3x^2+2x+3) (x^3-2x^2-3x+4)$	20. $(3x^3+4x^2+2) \times (2x^3+6x^2-7x-2)$

21. $(3x^4-2x^3-2x^2+4) \times (3x^3+2x^2-4x-3)$	22. $(2x^4+3x^3+x^2) \times (2x^3-5x^2-x-7)$

12.2 Division using Transpose and Apply

Ex.1: $(x^3+9x^2+20x+12) \div (x+1)$	Ex.2: $(3x^4-2x^3+x^2-2x+3) \div (x-3)$
$ \begin{array}{r} -1 \# \ x^3+9x^2+20x+12 \\ \underline{-1 \quad -8 \quad -12} \\ 1 \quad 8 \quad 12 \mid 0 \end{array} $	$ \begin{array}{r} +3 \# \ 3x^4-2x^3+x^2-2x+3 \\ \underline{+9 \quad +21 \quad +66 \quad +192} \\ 3 \quad +7 \quad +22 \quad +64 \mid +195 \end{array} $
Q: $x^2+8x+12$ R: 0	Q: $3x^3+7x^2+22x+64$ R: 195

Ex.3: $(3x^4-2x^3+x^2-2x+3) \div (x^2-2x+6)$	Ex.4: $(2x^5+2x^4-x^3+x^2-2x+2) \div (x^2+3x-4)$

Ex.5: $(2x^5+2x^4-x^3+x^2-2x+2) \div (x^3+3x-4)$	Ex.6: $(9x^4+3x^2-69) \div (x^3-7)$

Ex.7: $(3x^5-2x^4-7x^3+8x^2-6x+17) \div (3x^3+6x-12)$	Ex.8: $(12x^4-7x^2-34) \div (2x^3-12x-16)$

Ex.9: $(6x^5 - 3x^4 - 9x^3 - 6x^2 - 7x + 9) \div (x^3 - 7x + 16)$	Ex.10: $(12x^4 - 17x^2 - 6x + 12) \div (x^3 - 3x + 7)$

Ex.11: $(8x^6 - 7x^4 - 12x^3 + 3x^2 - 9x + 23) \div (x^3 - 8x - 7)$	Ex.12: $(12x^5 + 7x^4 - 2x^2 - 32x) \div (3x^4 + 6x^3 - 33)$

Ex.13: $(2x^6 + x^4 - x^3 + x^2 - 2x - 2) \div (x^2 - 3x + 5)$	Ex.14: $(x^6 + 2x^4 - 3x^3 + x^2 - 2x - 4) \div (x^3 - 2x + 6)$

Ex.15: $(x^5 + 2x^4 - 3x^3 - 4) \div (x^2 + 3)$	Ex.16: $(3x^6 + 4x^5 - 3x^3 + x^2 - 4) \div (2x^3 - 2x + 6)$

Unit 13: FACTORIZATION

13.1 Type I: Factorization of Simple Quadratic Polynomials using “Proportionately” and “The First by the First & Last by the Last”

	Ex.1: $x^2+7x+12$	Ex.2: $5x^2+24x+27$	Ex.3: $5x^2-38x+48$
a;b;c	1; 7; 12	5; 24; 27	
i & j	3 & 4	15 & 9	
∴	$7=3+4$; $1 \times 12=3 \times 4$	$24=15+9$; $5 \times 27=15 \times 9$	
1 st F	(x+3)	$5x+15 \Rightarrow 5(x+3) \Rightarrow$ (x+3)	
2 nd F	(x+4)	(5x+9)	
Final	(x+3) and (x+4)	x+3 and 5x+9	
V	$(1+3)(1+4)=(1+7+12)$ $20=20$	$(1+3)(5+9)=(5+24+27)$ $56=56$	

	Ex.4: $3x^2+18x+15$	Ex.5: $-3x^2 - 2x + 8 = 0$	Ex.6: $6x^2 - 13x - 19 = 0$
a;b;c			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

	Ex.7: $2x^2 - 16x + 32 = 0$	Ex.8: $7x^2 - 8x - 12 = 0$	Ex.9: $x^2 + 11x + 30 = 0$
a;b;c			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

	Ex.10: $x^2 - 24x + 128=0$	Ex.11: $7x^2 - x - 8=0$	Ex.12: $9x^2 + 9x - 4=0$
a;b;c			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

13.2 Type II: Factorization of Homogeneous Quadratic Polynomials

General Form of Quadratic Equation: $ax^2+hxy+by^2$

	Ex.1: $x^2+7xy+12y^2$	Ex.2: $3x^2+18xy+24y^2$	Ex.3: $6x^2-26xy-20y^2$
a;h;b	1; 7; 12		
i & j	3 & 4		
∴	7=3+4 and 1×12=3×4		
1 st F	$x+3y$		
2 nd F	$x+4y$		
Final	$x+3y$ and $x+4y$		
V	$(1+3)(1+4)=(1+7+12);$ $20=20$		

	Ex.4: $x^2-6xy-16y^2$	Ex.5: $x^2-10xy+24y^2$	Ex.6: $x^2+3xy+2y^2$
a;h;b			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

	Ex.7: $12x^2+5xy-3y^2$	Ex.8: $2x^2-8xy+8y^2$	Ex.9: $25x^2+5xy-6y^2$
a;h;b			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

	Ex.10: $8x^2+8xy-6y^2$	Ex.11: $4x^2-4xy+y^2$	Ex.12: $x^2-5xy+6y^2$
a;h;b			
i & j			
∴			
1 st F			
2 nd F			
Final			
V			

Mixed Examples (Solve using appropriate methods).

1. $x^2+2x-24$	2. $x^2+2x-63$	3. $x^2-17x+72$

4. $x^2+18x+65$	5. $x^2-19x+88$	6. $2x^2+7xy-15y^2$

7. $21x^2+33xy-18y^2$	8. $6x^2-37xy+56y^2$	9. $56x^2-56y^2$

10. $54x^2+3xy-15y^2$	11. $x^2-6y^2+12z^2+xy+yz+zx$	12. $x^2+24y^2+48z^2+10xy-68yz-14zx$

13. $6x^2+21y^2+15z^2-23xy-44yz+21zx$	14. $2x^2-24y^2-24z^2+2xy+52yz-8zx$	15. $2x^2-6y^2-3z^2+xy+11yz-5zx$

16. $x^3+x^2-54x-144$	17. $x^3-5x^2-57x+189$	18. $x^3-2x^2-69x+270$

19. $x^3-13x^2+39x-27$	20. $x^3-22x^2+136x-192$

Unit 14: HIGHEST COMMON FACTOR

Ex.1: Find HCF of x^2+6x+8 and x^2-2x-8	
Addition	Subtraction
x^2+6x+8 $+ x^2-2x-8$ ----- $2x^2+4x+0$ $2x(x+2)$ {Here 2x is common} $\mathbf{x+2}$ {after ignoring common}	x^2+6x+8 $- x^2-2x-8$ ----- $0+8x+16$ $8(x+2)$ {Here 8 is common} $\mathbf{x+2}$ {after ignoring common}
HCF of x^2+6x+8 and x^2-2x-8 is $\mathbf{x+2}$.	

Ex.2: $x^3+x^2-54x-144$ and $x^3-22x^2+136x-192$	

Ex.3: $x^3-5x^2-57x+189$ and $x^3-13x^2+39x-27$	

Ex.4: $x^3-8x^2-3x+90$ and $x^3-6x^2-51x+280$	

Ex.5: $x^3+21x^2+146x+336$ and $x^3+9x^2-x-105$	

Ex.6: $x^3+7x^2-4x-28$ and $x^3+5x^2-2x-24$	

Ex.7: $x^3+15x^2+74x+120$ and $x^2+2x-15$	

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Unit 15: SIMPLE EQUATIONS

1) $6x+7 = 8x+3$	2) $5x-3 = 7x-5$	3) $4x-6 = 6x-4$

4) $(x+3)(x-2) = (x-7)(x-6)$	5) $(x-6)(x+7) = (x-2)(x-3)$	6) $(x+8)(x-9) = (x-12)(x+6)$

7) $\frac{3x+5}{6x+7} = \frac{8}{3}$	8) $\frac{5x+2}{4x+3} = \frac{4}{3}$	9) $\frac{3}{x+3} + \frac{3}{x-6} = 0$

10) $\frac{5}{x+5} + \frac{5}{x+7} = 0$	11) $\frac{4x+5}{2x+6} = \frac{6x+3}{8x+2}$	12) $\frac{6x+6}{9x+5} = \frac{x+3}{4x+2}$

13) $\frac{3x+4}{x+3} = \frac{5x+6}{3x+2}$	14) $\frac{7x+8}{6x+4} = \frac{x+2}{5x+3}$	15) $(x+1)(x+2) = (x+3)(x+4)$
16) $\frac{-7x+2}{x-9} = \frac{-5x-2}{8x+3}$	17) $(x-7)(x-12) = (x-21)(x-4)$	18) $(x+12)(x-4) = (x-8)(x+6)$
19) $\frac{-7}{9x+8} = \frac{-7}{5x+13}$	20) $\frac{-9x-7}{3x-5} = \frac{-9x-8}{7x+9}$	21) $\frac{8x+7}{5x-5} = \frac{6x-8}{9x+4}$

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Unit 16: QUADRATIC EQUATIONS

1) $x^2+x-4=0$	2) $x^2-3x-4=0$	3) $20x^2-15x-10=0$

4) $3x^2+4x+2=0$	5) $2x^2-64=0$	6) $9x^2+49=0$

7) $x + \frac{1}{x} = \frac{26}{5}$	8) $x + \frac{1}{x} = \frac{145}{12}$	9) $x - \frac{1}{x} = \frac{21}{10}$

10) $x - \frac{1}{x} = \frac{72}{27}$	11) $\frac{3x+2}{2x-3} + \frac{2x-3}{3x+2} = \frac{74}{35}$	12) $\frac{4x+5}{2x+7} - \frac{2x+7}{4x+5} = \frac{21}{10}$

13) $\frac{3x+6}{5x+6} = \frac{7x+2}{5x+2}$	14) $\frac{7x+2}{3x+6} = \frac{2x+5}{6x+1}$	15) $\frac{3x-9}{6x+4} = \frac{2x+2}{-x-11}$

16) $\frac{4x+6}{3x-2} = \frac{5x-1}{6x+7}$	17) $x + \frac{1}{x} = \frac{82}{9}$	18) $x^2 - 3x - 10 = 0$

19) $x^2 - 45x + 324 = 0$	20) $100x^2 - 20x + 1 = 0$	21) $2x^2 + x - 6 = 0$

4. $2x^3-3x^2-8x-3=0$	5. $x^3-x=0$	6. $x^3+3x^2-4x-12=0$

7. $x^3-2x^2-4x+3=0$	8. $x^3+5x^2+14x=0$	9. $x^3+2x^2-9x-18=0$

10. $2x^3-5x^2-23x-10=0$	11. $x^3+7x^2+11x+5=0$	12. $4x^3+2x^2-2x=0$

16. $4x^3+2x^2-2x=0$	17. $x^3+3x^2-x-3=0$	18. $x^3-7x-6=0$

Unit 18: BIQUADRATIC EQUATIONS

1. $x^4-12x^3+41x^2-18x-72=0$	2. $3x^4-8x^3-37x^2+2x+40=0$

3. $x^4 - 10x^3 + 35x^2 - 50x + 24 = 0$	4. $x^4 - 2x^3 - 5x^2 + 10x - 3 = 0$

5. $x^4-8x^3+9x^2+8x-10=0$	6. $x^4+4x^3-6x^2+20x+8=0$

7. $x^4+2x^3-7x^2-8x+12=0$	8. $x^4-3x^2-42x-40=0$

9. $4x^4-20x^3+33x^2-20x+4=0$	10. $x^4-3x^2-6x-2=0$

11. $x^4-12x^3+41x^2-18x-72=0$	12. $x^4+4x^3-35x^2-78x+360=0$

5. $3x+5y=31$ and $2x+3y=20$	6. $5x+3y=-74$ and $-2x-3y=26$

7. $7x+2y=47$ and $5x-4y=1$	8. $3x+2y=36$ and $5x+4y=64$

9. $7x-y=15$ and $3x-2y=19$	10. $2x+13y=36$ and $13x+2y=69$

11. $3x + 2y = 4$ and $4x + 5y = 17$	12. $x+y=6$ and $2x+y=10$

13. $3x+y=2$ and $6x-y=25$	14. $6x - 2y = 15$ and $4x + 3y = -3$

15. $3x + 7y = 26$ and $4x + 5y = 13$	16. $x^2 + 2y=9$ and $-y=-x-3$

17. $x-y=3$ and $2x-y=11$	18. $2x+y=10$ and $x+y=4$

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