

CountingLecture 2

	Base 2	Base 3	Base 4
0	0	0	0
1	1	1	1
2	<u>10</u>	2	2
3	11	<u>10</u>	3
4	100	11	<u>10</u>
5		12	11
6		<u>20</u>	12
7		21	13
8		<u>22</u>	21
9		100	<u>23</u>
<u>10</u>			30
11			<u>31</u>
12			32
13			33
14			100

If you want to represent the base itself  
of any number it should be  $(10)$ anybase

Conversion

$$(25.625)_{10} \rightarrow 11001.101$$

2   25	.625
2   12 1	$\times 2$
2   6 0	<u>1.250</u>
2   3 0	$\times 2$
2   1 1	<u>0.500</u>
0 1	X
	<u>.10</u>

→ Divide by n before point  
 Multiply by n after point

$$(36.5)_{10} \rightarrow (1100.\overline{1})_3$$

$$\begin{array}{r} 3 | 36 \\ 3 | 12 \ 0 \\ 3 | 4 \ 0 \\ 3 | 1 \ 1 \\ \hline 0 \ 1 \end{array} \quad \begin{array}{r} .5 \\ -3 \\ \hline 1.5 \\ -3 \\ \hline 1.5 \end{array}$$

$$1100 \quad \xrightarrow{\times 3} \quad (10.\overline{100})$$

$$(2.6)_{10} \rightarrow (10.\overline{100})$$

$$\begin{array}{r} 9 | 2 \\ 2 | 1 \ 0 \\ \hline 0 \ 1 \end{array} \quad \begin{array}{r} .6 \\ -2 \\ \hline 1.2 \\ \times 2 \\ \hline 0 \ 4 \end{array}$$

$$(189.75)_{10} - (1)_{32} \quad \begin{array}{r} \underline{0.8} \\ \times 2 \\ \hline \underline{1.6} \end{array}$$

$$\begin{array}{r} 32 | 189 \\ 32 | 5 \ 29 \\ \hline 0 \ 5 \end{array} \quad 75 = \frac{3}{4} \times 3^2$$

$$(5 \ 29.24)_{32}$$

$$2 \quad ( )_n \rightarrow ( )_{10}$$

$$(11.001_0101)_2 =$$

$$1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \quad 1 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3}$$

$$25.625$$

$$(1020)_3 = 10 \text{ base } 10$$

$$\begin{array}{cccc} 1 & 0 & 2 & 0 \\ 3^3 & 3^2 & 3^1 & 3^0 \end{array}$$

$$27 + 6 = (33)_{10}$$

$$(36)_n = (30)_{10}$$

$$3 \times n^1 + 6 \times n^0 = 30$$

$$3n + 6 = 30$$

$$3n = 24$$

$$n = 8$$

$$(ii) y = (36)_{10}$$

Find x & y

$$x \cdot y^1 + * \cdot y^0 = 36$$

$$xy + 1 = 36$$

$$\begin{array}{l} xy = 35 \\ n \quad y \end{array}$$

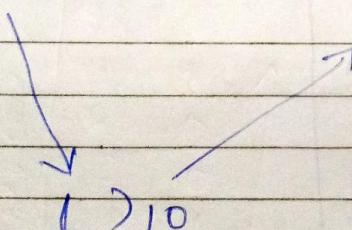
$$7 \times 5 = 35$$

$$5 \times 7 = 35$$

$$1 \times 35 = 35$$

$$35 \times 1 = 35$$

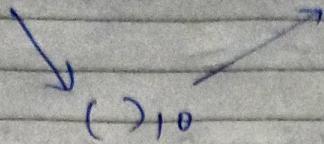
$$( )_n = ( )_y$$



digit should be less than it  
base Henry  $n < y$

(2)

$$(212 \cdot 13)_4 \rightarrow (\quad)_5$$



$$\begin{array}{r} 2 \quad 1 \quad 2 \quad . \quad 1 \quad 3 \\ 4^2 \quad 4^1 \quad 4^0 \quad . \quad 4^{-1} \quad 4^{-2} \end{array}$$

$$32 + 4 + 2 + \frac{1}{4} + \frac{3}{16}$$

$$(38 \cdot 4375)_{10}$$

$$\begin{array}{r} 5 | 38 \\ 5 | 7 \quad 3 \\ 5 | 1 \quad 2 \uparrow \\ 0 \quad 1 \end{array}$$

$$\begin{array}{r} \cdot 4375 \\ \times 5 \\ \hline 2.1875 \\ \times 5 \\ \hline 0.9375 \\ \underline{\times 5} \\ 0.46875 \end{array}$$

$$\begin{array}{r} 312 \cdot 20432 \\ 123 \cdot 2043 \end{array}$$

$$\begin{array}{r} \underline{0.46875} \\ \times 5 \\ \hline 3.04375 \\ \underline{\times 5} \\ 1.52 \end{array}$$

Converting in base 10 to verify

$$\begin{array}{r} 1 \quad 2 \quad 3 \\ 5^2 \quad 5^1 \quad 5^0 \\ 25 + 10 + 3 \end{array} \quad \begin{array}{r} 2043 \\ 5^{-1} \quad 5^{-2} \quad 5^{-3} \quad 5^{-4} \end{array}$$

$$2 \quad 38 \quad \frac{2}{5} + 0 + \frac{4}{125} + \frac{3}{625}$$

$$38 + 0.4 + 0.032 + 0.0096 = (38.4375)_{10}$$

•  $(101)_2 - (\quad)_3$

$$\begin{array}{r} 1 \ 0 \ 1 \\ 2^2 \ 2^1 \ 2^0 \end{array}$$

$$4 + 1 = (5)_{10}$$

$$\begin{array}{r} 3 \mid 5 \\ 3 \mid 1 \ 2 \\ 0 \ 1 \end{array}$$

$$(12)_3 \text{ Ans}$$

•  $(212)_3 - (\quad)_5$

$$\begin{array}{r} 2 \ 1 \ 2 \\ 3^3 \ 3^1 \ 3^0 \end{array}$$

$$18 + 3 + 2 = (23)_{10}$$

$$\begin{array}{r} 5 \mid 23 \\ 5 \mid 4 \ 3 \\ 0 \ 4 \end{array}$$

$$(43)_5$$

•  $(11)_2 + (22)_3 + (33)_4 + (44)_5 = (abc)_6$

Find abc?

GATE Question

$$3 + 8 + 15 + 24 = (50)_{10}$$

$$\begin{array}{r} 6 \mid 50 \\ 6 \mid 8 \ 2 \\ 6 \mid 1 \ 2 \\ 0 \ 1 \end{array}$$

$$(122)_6$$

•  $(123)_5 = (xyz)_y$   $x < y \quad 88y > z$

$$25 + 10 + 3 = xy + z$$

$$30 = xy$$

$x$	$y$	30
1	30	
2	15	
3	10	
<del>5</del>	<del>6</del>	<u>Ans</u>

•  $(42)_9 = (xyz)_y$

$$36 + 2 = ny + 3$$

$$ny = 35$$

$x$	$y$	35
1	35	
5	7	

•  $(123)_x = (12x)_3$

$$x^2 + 2x + 3 = 9 + 6 + x$$

$$x^2 + x - 12 = 0$$

$$(x+4)(x+3) = 0$$

$$x = -4, 3$$

$\checkmark$  ✓ Base must be positive

\* Not allowed

Ans

o  $(n)_y = (44)_8 \quad n < y$

$$\begin{aligned} ny + 1 &= 4 \times 8 + 4 \\ ny + 1 &= 36 \\ ny &= 35 \end{aligned}$$

$$\begin{array}{r} n \quad y \\ 1 \quad 35 \\ 5 \quad 7 \\ \hline \end{array}$$

possible solutions

o  $(73)_x = (54)_y$

- (a) 8, 16    (b) 10, 12    (c) 9, 13     (d) 8, 11

$$7x + 3 = 5y + 4 \quad x > 7 \text{ and } y > 5$$

$$7x - 5y = 1$$

(d)  $7 \times 8 - 5 \times 11 = 1$

o  $\sqrt{(121)_8} = (?)_8$

$$\sqrt{(8^2 + 2 \cdot 8 + 1)_{10}} = (?)_8$$

$$\sqrt{(8+1)^2}_{10} \Rightarrow (8+1)^{\frac{2}{2}}_{10}$$

$$(8+1)_{10} \rightarrow (11)_8 \quad \underline{\text{Ans}}$$