

## GAYAZA HIGHN SCHOOL

## S.2 MATH WORKSHEET NINE

## NUMBER BASES

## Summary:

1. Number bases are different ways of writing down numbers.
2. The most common base system is base **10**.
3. The digits of a number in any base are less than the base itself
4. The digits **10** and **11** are represented by **t** and **e** respectively in number bases

## NOTE:

(i) Base 10 is called **decimal base**

(ii) Base 2 is called **binary base**

(iii) Base 3 is called **trinary base**

(iv) Base 8 is called **octal base**

## EXAMPLES:

1. Convert the following to base ten

(i)  $1011_{two}$                       (ii)  $312.21_{four}$

$$\begin{aligned}
 \text{(ii) } 312.21_{four} &= (3 \times 4^2) + (1 \times 4^1) + (2 \times 4^0) + (2 \times 4^{-1}) + (1 \times 4^{-2}) \\
 &= (3 \times 16) + (1 \times 4) + (2 \times 1) + (2 \times \frac{1}{4}) + (2 \times \frac{1}{16}) \\
 &= 54 + \frac{1}{2} + \frac{1}{16} \\
 &= 54 \frac{9}{16}_{ten} \quad \text{or} \quad 54.5625_{ten}
 \end{aligned}$$

Question.1: Convert the following to base ten

1.	$346_{seven}$
2.	$2210_{three}$
3.	$530 \cdot 12_{six}$
4.	$6205 \cdot 45_{seven}$

## CONVERTING FROM BASE TEN TO OTHER BASES

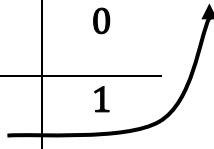
Summary:

- (i) Divide the number repeatedly by the required bases
- (ii) The remainder in reverse order gives the required number

EXAMPLES:

1. Convert  $64_{ten}$  to base three

3	64	R
3	21	1
3	7	0
	2	1



$$\therefore 64_{ten} = 2101_{three}$$

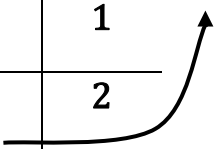
2. Convert  $246_{ten}$  to base five

3. Convert  $2101_{three}$  to base seven

Hint: First convert  $2101_{three}$  to base ten

$$\begin{aligned} 2101_{three} &= (2 \times 3^3) + (1 \times 3^2) + (0 \times 3^1) + (1 \times 3^0) \\ &= 64_{ten} \end{aligned}$$

7	64	R
7	9	1
	1	2



$$\therefore 2101_{three} = 121_{seven}$$

## Question.2 Convert the following as required

1.	$198_{\text{ten}}$ to base five
2.	$864_{\text{eight}}$ to base ten
3.	$361_{\text{seven}}$ to base four
4.	$1001001001_{\text{two}}$ to base six

5.	2020 <sub>ten</sub> to binary
6.	816 <sub>nine</sub> to binary

### Finding the base

**When finding the unknown base, express everything as base ten and then solve**

### Example

1. Find the value of n from,  $4001_n = 501_{ten}$

$$(4 \times n^3) + (0 \times n^2) + (0 \times n^1) + (1 \times n^0) = 501$$

$$4n^3 + 1 = 501$$

$$4n^3 = 500$$

$$n^3 = 125$$

$$n = \sqrt[3]{125} = 5$$

$$\therefore n = \text{five}$$

2. Find the value of n from,  $201_n = 53_{six}$

$$(2 \times n^2) + (0 \times n^1) + (1 \times n^0) = (5 \times 6^1) + (3 \times 6^0)$$

$$2n^2 + 1 = 30 + 3$$

$$2n^2 = 32$$

$$n^2 = 16$$

$$n = \sqrt{16} = 4$$

$$\therefore n = \mathbf{four}$$

Question: Find the value of **n** in the following equations:

1.	$45_n = 1112_{three}$
2.	$21_n = 19_{ten}$
3.	$303_n = 410_{six}$

4.	$202_n = 37_{\text{nine}}$
5.	$112_n + 304_n = 421_n$