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* NUMBER SYSTEM:-

V → Vinieculum (BAR)
B → Bracket . {}
O → of .
D → Division. (÷)
M → Multiplication (x)
A → Addition . (+)
S → Subsbraction (-)

Q1) Convert the following recurring forms into their corresponding P/q forms?

a) $27.\overline{17}$ → Complete Bar → $27.171717\ldots$ (Bar immediately after point).

b) $27.2\overline{17}$ → Partial Bar → $27.21717\ldots$

c) $0.00\overline{17}$ → Partial Bar → $0.0017171717\ldots$

Soln:- a) $27.\overline{17}$

$x = 27.171717\ldots$

$100x = 2717.1717\ldots$

$100x - x = 2717.1717 - 27.1717$

$99x = 2690$

$$\boxed{x = \frac{2690}{99}}$$

SHORTCUT

$x = 27.\overline{17}$

$$P/q = \frac{2717 - 27}{99}$$

$$= \frac{2690}{99}$$

b) 27.217

$x = 27.21717\ldots$

$$\frac{P}{q} = \frac{27217 - 272}{990}$$

$$\boxed{\frac{P}{q} = \frac{26945}{990}}$$

c) $0.00\overline{17}$

$$\frac{P}{q} = \frac{00017 - 000}{9900}$$

$$\boxed{\frac{P}{q} = \frac{17}{9900}}$$

02) $27.\overline{27} \times 33 + 6$

Soln: $\frac{(2727 - 27)}{99} \times 33 + 6$

$= \frac{2700}{3} \times 3 + 6$

$= 906.$

03) What is the units digit in the expansion of a) $(766)^{136}$. ← Based on cyclicity or Power cycle → b) $(277)^{134}$. c) $(454)^{41}$. d) $(888)^{103}$. e) $(1028)^{100}$. f) $(459)^{40}$.

Soln: a) $(766)^{136}$

$0^N = 0$

$1^N = 1$

$2^N =$

$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$
$2^6 = 64$
$2^7 = 128$
$2^8 = 256$
$2^9 = 512$

→ cyclicity of 2^N is 4 ie 2, 4, 8, 6

3^N ← cyclicity is 4 ie (3, 9, 7, 1)

$3^1 = 3$
$3^2 = 9$
$3^3 = 27$
$3^4 = 81$
$3^5 = 243$
$3^6 = 729$
3^7

4^N ← cyclicity is (4, 6)

$4^1 = 4$
$4^2 = 16$
$4^3 = 64$
$4^4 = 256$
$4^5 = 1024$

NUMBERS	FREQN OF NOS. as POWER CYCLE
0, 1, 5, 6	STAY AS IT IS
2, 3, 7, 8	4
4, 9	2

~~a) $(766)^{136}$ → unit digit = 6.~~

~~b) $(277)^{134}$ → 4~~

~~c) $(454)^{134}$ → 2~~

~~d) $(888)^{103}$ → 4~~

a) $(766)^{136}$ = 766 x 766 x 766 x 766 x ----- 136 times.

= ... 6 x ... 6 x ... 6 x .. 6 x ....

= 6

$$(\ldots.0/1/5/6)^{\alpha\alpha\alpha\alpha\ldots\alpha} = \ldots.0/1/5,6$$

b) $(277)^{134}$ = 277 x 277 x 277 x 277 x .... 134 times.

= ...7x...7x...7 x ...7x..... 134 times.

... x ... x ... x .... x (277 x 277)

49

↓

units digit is (9)

33 ← Complete sections.

4 | 134 | 12 | 14 | 12 | x 2

Short cut:

$(277)^{134}$ → Power cycle = 4

4 | 33 | 134 | 12 | x 14 | 12 | x 2

7 = 49

↓

units place (units digit)

* $(454)^{41}$ ⟶ Power cycle = 2

$$2\overline{)41}\ 20,\ 40,\ \times 1$$

$4^1 = 4$

* $(888)^{103}$ ⟶ Power cycle = 4

$$4\overline{)103}\ 25,\ 100,\ 3$$

$8^3 = 512$

* $(1028)^{100}$ ⟶ Power cycle = 4

$$4\overline{)100}\ 25,\ 100,\ 000 \leftarrow \text{Remainder}$$

$8^0 = 1$

* $(459)^{40}$ ⟶ Power cycle = 2

Remainder = 0

*Special case of Remainder zero:

* All complete sections.
* No incomplete section.

$(1028)^{100}$ ⟶ P.C = 4

$$4\overline{)100}\ 25,\ 100,\ \times\times\times\ 0$$

$8^4 = 8^2 \times 8^2$

$= 64 \times 64$

$= \ldots 6$

$(459)^{40}$ ⟶ P.C = 2

$$2\overline{)40}\ 20,\ 40,\ 00$$

$9^2 = 9 \times 9 = 81$

*Remainder 0 short cut:

After getting Remainder = 0 →
- Even Base = 6
- odd Base = 1

Q4) What is the unit's digit in the expansion of the following expression:

$(666)^{666} \times (877)^{134} + (959)^{20}$

$$4\overline{)134}\ 33,\ 132,\ 2 \qquad 7^2 = 49$$

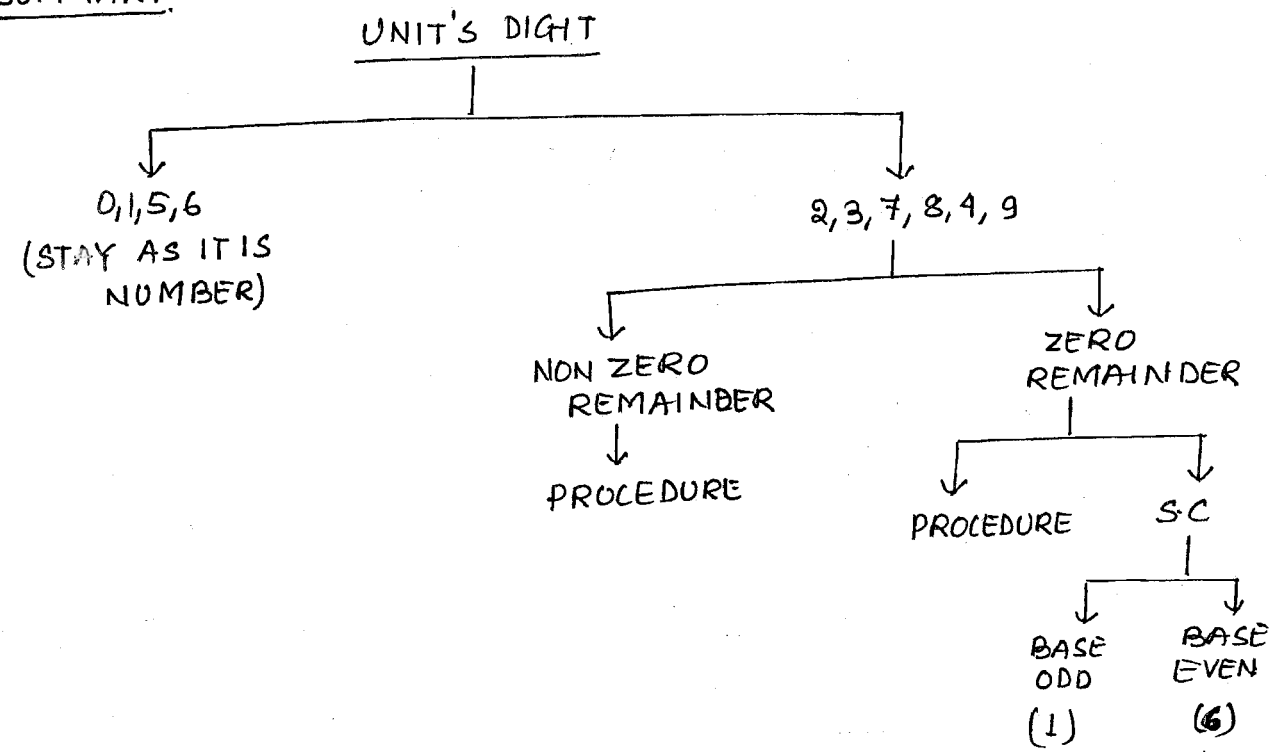
$$4\overline{)20}\ 5,\ 20,\ 00$$

Soln: $(\ldots 6 \times \ldots 9) + \ldots + 1$

$= (\ldots 4) + (\ldots 1) = \ldots 5$

(959) ⟶ odd Base = 1

SUMMARY



Q) How many zeroes are there at last in the expansion of

a) $25 \times 4 \times 8 \times 7 \times 10 \times 16 \times 100$

b) $(25)^{125} \times 4^{40}$

Soln:- a) $25 \times 4 \times 8 \times 7 \times 10 \times 16 \times 100$

$100 \times 56 \times 16 \times 1000$

$= 56 \times 16 \times 100000$

$5^2 \times 2^2 \times 2^3 \times 7 \times 5 \times 2 \times 2^4 \times 2^2 \times 5^2$

$= 2^{12} \times 5^{5} = 2^7 \times 2^5 \times 5^{5}$ (5: least power)

$= 2^7 \times 10^5$

LEAST POWER $\rightarrow = 5$ ZEROS

b) $(25)^{125} \times (4)^{40}$

$(5)^{250} \times 2^{(80)}$ (80: LEAST POWER)

80 ZERO

Note:- $7^{125} \times 4^{50}$

$7^{125} \times 2^{100}$

NO ZEROS

ZERO'S AT LAST CONDITION :-

i) Multiple of 10 $\rightarrow$ direct multiple ie 10,100,1000----

ii) Hidden multiple $\rightarrow$ (2,5)

*The total no. of (2x5) combinations = no. of zeros at last in the expansion

(total no. of (2x5) combn) = (no. of zeroes at last in expansion)

Q6) How many zeros are there at last in the expansion of :.

a) 6!
b) 10!
c) 100!
d) 145!
e) 1000!

Note :.

1! ; 2! = 2 ; 3! = 6; 4! = 24

5! = 120

↓ onwards only zeros will start coming not before that.

Soln :. a) $6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$= 6 \times 5^1 \times 3 \times 2^3$

720 $= 1$ ZERO.

b) $10! = 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

$= 2 \times 5 \times 9 \times 2^3 \times 7 \times 3 \times 2 \times 5 \times 2^2 \times 3 \times 2 \times 1$

(3628800) $= 2^8 \times 5^2$

$= 2$ ZEROS

c) 100!

↓

100 → 20×5
95 → 19×5
90 → 18×5
85 → 17×5
80 → 16×5
75 → 15×5 = 3×5×5
70 → 14×5

65 → 13×5
60 → 12×5
55 → 11×5
50 → 10×5 = 2×5×5
45 → 9×5
40 → 8×5
35 → 7×5

30 → 6×5
25 → 5×5
20 → 5×4
15 → 3×5
10 → 2×5
5 → 1×5

Note :. For 100! zeroes are by default. They will come by default. and no. of zeroes depends on no. of 5's present in it.

$100! = 1 \times 2 \times 3 \times 4 \times (5) \times 6 \times 7 \times 8 \times 9 \times (10) \times 11 \times 12 \times 13 \times 14 \times (15) \times 16 \times 17 \times 18 \times 19 \times (20) \times \dots \times 100$

(2×5 at 10; 3×5 at 15; 4×5 at 20)

$\frac{100}{5} = 20$ sections ← divide the complete 100! in 20 sections.

* In these sections some special nos (which contain 2 5's will also be there). such as :.

Already taken into account in dividing sections.

25 → 5 × (5) (NOT TAKEN INTO ACCOUNT IN 20 SECTIONS)
50 → 5 × (5) × 2
75 → 5 × (5) × 3
100 → 5 × (5) × 4

NOW taking $= \left(\frac{100}{5} + \frac{100}{25}\right) = 24.$