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# 20. Number system

Real No

- ~~Real~~ Irrational
  $\sqrt{2}, \sqrt{3}, \pi$
- Rational $= \frac{p}{q} \neq 0$
  - Fraction
    - ~~Terminative~~ $\frac{5}{2} = 2.5$
    - non-~~terminative~~ $\frac{1}{3} = 0.\overline{3333}$
  - Integers
    - -ve (-1, -2)
    - 0
    - +ve (1, 2, 3)

whole number :- 0, 1, 2, 3, 4, 5, ——— ———

Natural number :- 1, 2, 3, 4, 5, 6, ——— ———

- 1
- Prime (2, 3, 5, 7)
- Composite (4, 6, 8, 9, 10)

GCD (HCF) ⟶ (Prime Factor)

| | | 150, 210, 375 | | |
|---|---|---|---|---|
| 5×3 | 5 | 30 | 42 | 75 |
| = 15 | 3 | 10 | 14 | 25 |

HCF ⟶ common काढणे जो पर्यंत common निघतात तो पर्यंत

$150 \Rightarrow 15 \times 10 = 3 \times 5 \times 2 \times 5$
$= 2 \times 3 \times 5 \times 5$

$210 \Rightarrow 7 \times 3 \times 10 = 7 \times 3 \times 5 \times 2$
$= 2 \times 3 \times 5 \times 7$

$375 \Rightarrow 25 \times 15 = 5 \times 5 \times 5 \times 3$
$= 3 \times 5 \times 5 \times 5$

$\boxed{HCF = 5 \times 3 = 15}$

LCM :- shortcut

| | 150 | 210 | 375 |
|---|---|---|---|
| 10 | 15 | 21 | 375 |
| 15 | 1 | 21 | 25 |

LCM $= 10 \times 15 \times 21 \times 25$
$= 78750$

LCM ⟶ common काढणे जो पर्यंत last no. no common No. नाही निघत पाहिजे and सर्व Factors ची multiply करणे.

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| | 150 | 210 | 375 |
|---|---|---|---|
| 5 | 30 | 42 | 75 |
| 3 | 10 | 14 | 25 |
| 5 | 2 | 14 | 5 |
| 2 | 1 | 7 | 5 |

LCM = $5 \times 3 \times 5 \times 2 \times 7 \times 5$ = **5250**

# HCF of fraction ⇒ $\frac{\text{HCF of Numarator}}{\text{LCM of denomator}}$

# LCM of fraction ⇒ $\frac{\text{LCM of Numerator}}{\text{HCF of denomator}}$

#

A B

$a \xleftarrow{HCF} ax \quad ay \xrightarrow{LCM} axy$

$\boxed{x : y}$

#

$N_1$ & $N_2$

$\boxed{LCM \times HCF = N_1 \times N_2}$

1) Find the common factors for the numbers :-

a) 24 and 64

$8 \xleftarrow{HCF} 24, 64$

1 2 4 8

$\boxed{3 : 8}$

b) 42, 294 and 882

HCF = $6 \leftarrow 42, 294, 882$

$6 \times 7 = 42$

$7 \leftarrow 7 : 49 : 147$

2 3 6 7 42

$\boxed{1 : 7 : 21}$

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ⓒ 60, 120 and 220

| | | | |
|---|---|---|---|
| 10 ← | 60, | 120, | 220 |
| 2 ← | 6 | 12 | 22 |
| | 3 | 6 | 11 |

HCF = 10 × 2
= 20

1 2 4 5 10 20

2) Find the HCF of

ⓐ 420 and 1782

| | 420 | 1782 |
|---|---|---|
| HCF → 6 | 70 | 297 |

ⓑ 36 and 48

| | 36 | 48 |
|---|---|---|
| HCF → 12 | 3 | 4 |

ⓒ 54, 72, 198

| | 54 | 72 | 198 |
|---|---|---|---|
| 9 | 6 | 8 | 22 |
| 2 | 3 | 4 | 11 |

HCF → 18

ⓓ 62, 186, 279

| | 62 | 186 | 279 |
|---|---|---|---|
| HCF ← 31 | 2 | 6 | 9 |

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3) Find the LCM of

a) 13, 23 and 48

$\boxed{13 \times 23 \times 48} \Rightarrow 14352$ Co-Prime no.

b) 24, 36, 44, 62

| | | | | |
|---|---|---|---|---|
| 4 | 24 | 36 | 44 | 62 |
| 2 | 6 | 9 | 11 | 62 |
| 3 | 3 | 9 | 11 | 31 |
| | 1 | 3 | 11 | 31 |

$4 \times 2 \times 3 \times 3 \times 11 \times 31 \Rightarrow 24552$

c) 22, 33, 45 and 72

| | | | | |
|---|---|---|---|---|
| 11 | 22 | 33 | 45 | 72 |
| 3 | 2 | 3 | 45 | 72 |
| 3 | 2 | 1 | 15 | 24 |
| 2 | 2 | 1 | 5 | 8 |
| | 1 | 1 | 5 | 4 |

$11 \times 3 \times 3 \times 2 \times 5 \times 4 = 3960$

4) Find the series of common multiples of

a) 54 and 36

| | | |
|---|---|---|
| 9 | 54 | 36 |
| 2 | 6 | 4 |
| | 3 | 2 |

LCM $= 9 \times 2 \times 3 \times 2 = 108, 216, 324, 432, ----$

b) 33, 45 and 60

| | | | |
|---|---|---|---|
| 15 | 33 | 45 | 60 |
| 3 | 33 | 3 | 4 |
| | 11 | 1 | 4 |

LCM $\Rightarrow 15 \times 3 \times 11 \times 4 = 1980, 3960, 5940, ----$

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5) The LCM of two numbers is 936. if their HCF is 4 and one of the number is 72, the other is:

⇒

$LCM \times HCF = N_1 \times N_2$

$936 \times 4 = 72 \times N_2$

$N_2 = \frac{936 \times 4}{72}$

$\boxed{N_2 = 52}$

6) Two alarm clocks ring their alarms at regular interval of 50 seconds and 48 seconds. If they ~~first~~ first beep together at 12 noon. at what time will they beep again for the first time?

⇒ LCM काढणे

| | | |
|---|---|---|
| 2 | 50 | 48 |
| | 25 | 24 |

$LCM = 2 \times 25 \times 24 = \frac{1200 sec}{60} = \boxed{20 min}$

12:20 pm

7) 4 Bells toll together at 9:00 A.M. They toll after 7, 8, 11 and 12 seconds respectively. How many times will they toll together again in the next 3 hours?

⇒

| | | | | |
|---|---|---|---|---|
| 4 | 7 | 8 | 11 | 12 |
| | 7 | 2 | 11 | 3 |

$LCM = 4 \times 7 \times 2 \times 11 \times 3 \Rightarrow 1848 = 30 min\ 48 sec.$

$\frac{180 min}{30 min} = 6$ times then 48 sec Extra

so 5 times

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8) on Ashok marg three consecutive traffic lights change after 36, 42 and 72 seconds respectively. if the lights are first switched on at 9:00 AM. sharp, at what time will they change simultaneously.

⇒ LCM

36 42 72 $\xrightarrow{LCM}$ 504

8min 24sec

$\boxed{9:08:24}$

9) The HCF of 2472, 1284 and a third number 'N' is 12. If their LCM is $2^3 \times 3^2 \times 5^1 \times 103 \times 107$, then the number 'N' could be:

⇒

| HCF | ax | ay | az | LCM |
|---|---|---|---|---|
| a | x : | y : | z | axyz / xy |

HCF

12

2472 1284 N

206 : 107 : $\boxed{\frac{N}{12}}$

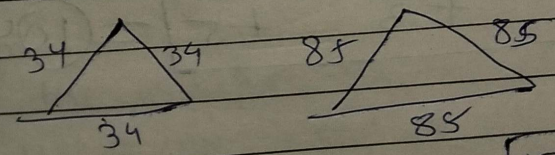
LCM

$\frac{2^3 \times 3^2 \times 5^1 \times 103 \times 107}{\frac{206}{2} \times 107}$

N → $\boxed{2^2 \times 3^2 \times 5^1}$ ans

10) Two equilateral triangles have the sides of lengths 34 and 85 respectively.

a) The greatest length of tape that can measure both of them exactly is:




HCF → 34, 85 → $\boxed{17}$

$\boxed{2:5}$

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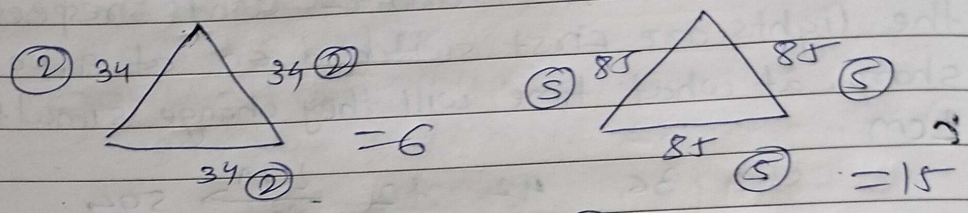
b) How many such equal parts can be measured?




$6+15 = 21$

11) Two numbers are in the ratio 17:13. if their HCF is 15. what are the numbers?

→

| HCF | A | B |
|---|---|---|
| 15 | 17 : | 13 |
| | 17×15 : | 13×15 |
| | 255 : | 195 |

12) A Forester want to plant 44 apple, 66 bannans and 110 mango trees in equal rows (in terms of number of rows). Also he wants to make distinct rows of trees. (i.e. only one type of tree in one row). The number of rows (minimum) that are required are:

→

| HCF | 2 | 3 | 5 → 10 |
|---|---|---|---|
| | 44 A | 66 B | 110 M |
| × 11 | 4 | 6 | 10 |
| 2 | 2 : | 3 | 5 |

22 $\boxed{2 + 3 + 5} = 10$

13) Three runners running around a circular track can complete one revolution in 2, 4 and 5.5 hours respectively. when will they meet at the

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starting Point?

⇒

2 4 5.5

11 ✗

22 ✗

44 LCM

→ ans

14) The HCF and LCM of two numbers are 33 and 264 respectively, when the first number is divided by 2 the quotient is 33. The other number is?

⇒ $2 \times 33 = \boxed{66}$

$LCM \times HCF = N_1 \times N_2$

$\cancel{33} \times 264 = \cancel{66}^{2} \times N_2$

$\frac{264}{2} = N_2$

$\boxed{N_2 = 132}$

15) The greatest number which will divide 4003, 4126, and 4249

⇒ HCF

4003 4126 4249 → Prime numbers

so HCF = 1

16) Find the greatest number of 5 digits, that will give us a remainder of 5, when divided by 8 and 9 is respectively.

⇒ 8 and 9 $\xrightarrow{LCM}$ $\boxed{72}$

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```
      1388
72) 99999
    -72
     279
    -216
      639
     -579
       639
       576
        63
```

```
99999
 -  63
99936
```
Ans

(17) The least perfect square number which is divisible by 3, 4, 6, 8, 10 and 11 is:

⟹

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | 3 | 4 | 6 | 8 | 10 | 11 |
| 3 | 3 | 1 | 6 | 2 | 10 | 11 |
| 2 | 1 | 1 | 2 | 2 | 10 | 11 |
| | 1 | 1 | 1 | 1 | 5 | 11 |

$4 \times 3 \times 2 \times 5 \times 11 \Rightarrow$

perfect square:

$4 \times 9 \times 4 \times 25 \times 121 \Rightarrow 435600$

(18) Find the HCF of $(3^{125}-1)$ & $(3^{35}-1)$:

Formula:-

$(a^m-1)$ and $(a^n-1) = (a^{HCF\ of\ m,n}-1)$

$(3^{125}-1)$ & $(3^{35}-1)$

$HCF = (3^{HCF\ 125,35}-1)$.

HCF → 5 | 125 35
25 : 7

$HCF = (3^5-1)$

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19) What will be the least possible number of the plants if three pieces of timber 42m, 49m and 63m long have to be divided into plants of the same length?

⇒

7 ← HCF 42m 49m 63m

6 : 7 : 9 ⇒ 22

20) Find the greatest number which will divide 215, 167, and 135 so as to leave the same remainder in each case.

⇒

215 167 135

48 33

80

Ans

16 ← HCF 48 80 32

3 : 5 : 2

21) Find the LCM of 2.5, 0.5 and 0.175.

⇒

2.500, 0.500, 0.175

| | | | |
|---|---|---|---|
| 25 | 2500 | 500 | 175 |
| 20 | 100 | 20 | 7 |
| | 5 | 1 | 7 |

LCM = 25×20×5×7 ⇒ 17500

= 17.5

22) The LCM of 4.5; 0.009 and 0.18 = ?

4.500 0.009 0.180

| | | | |
|---|---|---|---|
| 9 | 4500 | 9 | 180 |
| 20 | 500 | 1 | 20 |
| | 25 | 1 | 1 |

LCM = 9×20×25 ⇒ 4500

= 4.5

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23) What is the greatest possible rate at which a man can walk 51 km and 85 km in an exact number of minute.

⇒

(17) ← HCF 51 85
3 : 5

$\boxed{17 \text{ km/min}}$

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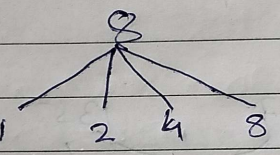
# Divisibility → factors




① No. of factors ⇒ 4
② Sum of No. of factors ⇒ 15
③ No. of Even factors ⇒ 3
④ Sum of No. of Even factors ⇒ 14
⑤ No. of odd factors ⇒ 1
⑥ sum of No. of odd factors ⇒ 1

$240 \Rightarrow 8 \times 30 \Rightarrow 8 \times 2 \times 3 \times 5 \Rightarrow 2^4 \times 3^1 \times 5^1$

① No. of factors ⇒ $(4+1)\times(1+1)\times(1+1) = 5\times2\times2 = 20$
② Sum of No. of factors ⇒ $(2^0+2^1+2^2+2^3+2^4)\times(3^0+3^1)\times(5^0+5^1)$
$\Rightarrow 31\times4\times6 \Rightarrow \underline{744}$
③ No. of Even factors ⇒ $4\times(1+1)\times(1+1) = 4\times2\times2 = \underline{16}$
④ Sum of No. of Even factors ⇒ $(2^1+2^2+2^3+2^4)\times(3^0+3^1)$
$\times(5^0+5^1) \Rightarrow 30\times4\times6 \Rightarrow \underline{720}$
⑤ No. of odd factors ⇒ $1\times(1+1)\times(1+1) \Rightarrow 1\times2\times2 = \underline{4}$
⑥ sum of No. of odd factors ⇒ $1\times(3^0+3^1)\times(5^0+5^1)$
$= 1\times4\times6$
$= \underline{24}$

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1) For the number 2450 find

$2450 \Rightarrow 50 \times 49 = 2 \times 25 \times 49$

$= \boxed{2^1 \times 5^2 \times 7^2}$

1) The sum and number of all factors :-

No. $\Rightarrow 2 \times 3 \times 3 \Rightarrow 18$

Sum $\Rightarrow (1+2) \times (1+5+25) \times (1+7+49)$

$= 3 \times 31 \times 57 \Rightarrow \underline{5301}$

2) The sum and number of even factors :- /divisible by 2.

No $\Rightarrow 1 \times 3 \times 3 = 9$

Sum $\Rightarrow 2 \times (1+5+25) \times (1+7+49)$

$= 2 \times 31 \times 57 \Rightarrow 3534$

3) The sum and number of odd factors :-

No $\Rightarrow 3 \times 3 = 9$

Sum $\Rightarrow (1+5+25) \times (1+7+49)$

$\Rightarrow 31 \times 57 = \underline{1767}$

4) The sum and number of factors divisible by 5

No $\Rightarrow 2 \times 2 \times 3 = \underline{12}$

Sum $\Rightarrow (1+2) \times (5+25) \times (1+7+49)$

$= 3 \times 30 \times 57 = \underline{5130}$

5) The sum and number of factors divisible by 35 $\Rightarrow$ $5 \times 7$

No $\Rightarrow 2 \times 2 \times 2 = 8$

Sum $\Rightarrow (1+1) \times (5+25) \times (7+49)$

$= 3 \times 30 \times 56 \Rightarrow \underline{5040}$

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6) The sum and number of factors divisible by 245.

~~No~~ $245 \Rightarrow 5 \times 49 = 5 \times 7^2$

$No \Rightarrow 2 \times 2 \times 1 = 4$

$Sum \Rightarrow (1+2) \times (5+25) \times 49$

$= 3 \times 30 \times 49 = \underline{4410}$

2) For the number 7200 find

$7200 \Rightarrow 72 \times 100 \Rightarrow 2^2 \times 3^2 \times 2^1 \times 5^2 \times 2^2$

$\Rightarrow 2^5 \times 3^2 \times 5^2$

1) The sum and number of all factors:-

$No \Rightarrow 6 \times 3 \times 3 \Rightarrow 54$

$Sum \Rightarrow (1+2+4+8+16+32) \times (1+3+9) \times (1+5+25)$

$\Rightarrow 63 \times 13 \times 31$

$\Rightarrow 25389$

2) The sum and number of even factors:-

$No \Rightarrow 5 \times 3 \times 3 = 45$

$Sum \Rightarrow (2+4+8+16+32) \times (1+3+9) \times (1+5+25)$

$\Rightarrow 62 \times 13 \times 31$

$\Rightarrow 24986$

3) The sum and numbers of odd factors:-

$No \Rightarrow 3 \times 3 = 9$

$Sum \Rightarrow (1+3+9) \times (1+5+25)$

$\Rightarrow 13 \times 31$

$\Rightarrow 403$

4) The sum and number of factors divisible by 25.

$25 \Rightarrow 5^2$

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$(3-2)$

No $= 6 \times 3 \times 1 = 18$

sum $\Rightarrow (1+2+4+8+16+32) \times (1+3+9) \times (25)$

$\Rightarrow 63 \times 13 \times 25$

$\Rightarrow 20475$

5) The sum and number of factors divisible by 40.

$40 \Rightarrow 8 \times 5 = 2^3 \times 5^1$

$(6-3) \quad (3-1)$

No $\Rightarrow 3 \times 3 \times 2 \Rightarrow 18$

sum $\Rightarrow (8+16+32) \times (1+3+9) \times (5+25)$

$\Rightarrow 56 \times 13 \times 30$

$\Rightarrow 21840$

6) The sum and number of factors divisible by 150.

$150 \Rightarrow 25 \times 6 \Rightarrow 2^1 \times 3^1 \times 5^2$

$(6-1) \quad (3-1) \quad (3-2)$

No $\Rightarrow 5 \times 2 \times 1 = \underline{10}$

sum $\Rightarrow (2+4+8+16+32) \times (3+9) \times (25)$

$\Rightarrow 62 \times 12 \times 25$

$\Rightarrow 18600$

7) The sum and number of factors divisible by

$75 \Rightarrow 3^1 \times 5^2$

No $\Rightarrow 6 \times 2 \times 1 = 12$

sum $\Rightarrow (1+2+4+8+16+32) \times (3+9) \times (25)$

$= 63 \times 12 \times 25$

$\Rightarrow 18900$

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3) Find the number of divisors of 1728.

⇒ $1728 \Rightarrow 4 \times 432 \Rightarrow 4 \times 4 \times 108$

$\Rightarrow 4^3 \times 27$

$\Rightarrow \boxed{2^6 \times 3^3}$

No. of factors $= 7 \times 4 = 28$

4) Find the number of divisors of 544 excluding 1 and 544.

⇒ 544

$\frac{544}{1} = 2$

$544 \Rightarrow 4 \times 136$

$\Rightarrow 4 \times 4 \times 34 \Rightarrow 2^2 \times 2^2 \times 2^1 \times 17^1$

$\Rightarrow 2^5 \times 17^1$

No. of factors $= 6 \times 2 = 12$

$\boxed{12 - 2 = 10}$

5) Find the number of divisors of 1080 excluding the divisors which are perfect squares.

⇒

$1080 \Rightarrow 2^3 \times 3^2 \times 5^1$

No square factor = Total − square factor

Total factor $\Rightarrow 4 \times 4 \times 2 = \boxed{32}$

No. of square factor $= 2 \times 2 = 4$

No square $= 32 - 4 = 28$

6) Find the sum of divisors of 544 excluding 1 and 544.

$544 \Rightarrow 2^5 \times 17^1$ $(1 + 544) = 545$

Sum $= 545$

$(1+2+4+8+16+32) \times (1+17) = 545$

$= 63 \times 18 = 545$

$= \underline{589}$

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7) Find the sum of divisors of 544 which are perfect squares.

⇒ $(1+2+4+8+16+32)$

$1+4+16 = 21$

8) Find the sum of odd divisors of 544.

⇒ $544 = 2^5 \times 17^1$

sum $= (1+17) = 18$

9) Find the sum of the sum of even divisors of 96 and the sum of odd divisors of 3600.

$96 \Rightarrow 2^4 \times 6 = 2^5 \times 3^1$

Sum (Even) $\Rightarrow (2+4+8+16+32) \times (1+3)$

$\Rightarrow 248$

$3600 = 6^2 \times 2^2 \times 5^2 \Rightarrow 2^2 \times 3^2 \times 2^2 \times 5^2$

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

Sum(odd) $= (1+3+9) \times (1+5+25)$

$= 403$

$\boxed{248 + 403 \Rightarrow 651}$

No. of Prime Factors $\Rightarrow 5 \times 1 = 5$

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- Number of zeroes in an Expression :-

$10 \Rightarrow 2 \times 5 \rightarrow$ zero

$(2 \times 5)^7 \Rightarrow 7$ zero

(#) $192 \times 65 \times 1250 \times 750 \times 855$

$16 \times 12 \times 13 \times 5 \times 5^3 \times 10 \times 5^2 \times 3 \times 10 \times 11 \times 5$

$4^2 \times 4 \times 3 \times 13 \times 5^1 \times 5^3 \times 5^1 \times 2 \times 5^2 \times 3 \times 5^1 \times 2 \times 11 \times 5^1$

$2^4 \times 2^2 \times 2^1 \times 2^1 \Rightarrow 2^8$ $\quad (2 \times 5)^8 \Rightarrow$ '8' zeros.

$\Rightarrow 5^9$

(#) $1 \times 2 \times 3 \times 4 \times 5 \times \text{----} \times 100$

| | |
|---|---|
| 5 | 100 |
| 5 | 20 |
| | 4 |

$\Rightarrow 24 \rightarrow$ No. of zeros

(#) $1 \times 2 \times 3 \times 4 \times \text{-----} \times 87$

| | |
|---|---|
| 5 | 87 |
| 5 | 17 |
| | 3 |

$\Rightarrow \boxed{20} \rightarrow$ No. of zeros.

1) Find the number of zeroes in an Expression

1) 47!

$1 \times 2 \times 3 \times \text{----} \times 47 =$

| | |
|---|---|
| 5 | 47 |
| 5 | 9 |
| | 1 |

$\Rightarrow 10$

2) 58!

$1 \times 2 \times 3 \times \text{----} \times 58 =$

| | |
|---|---|
| 5 | 58 |
| 5 | 11 |
| | 2 |

$\Rightarrow 13$

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3) $13 \times \frac{15}{1} \times \frac{22}{1} \times \frac{125}{3} \times \frac{44}{2} \times \frac{35}{1} \times 11$

2 → 3 times
5 → 5 times
→ 3

4) $\frac{12}{2} \times \frac{15}{1} \times \frac{5}{1} \times \frac{24}{3} \times 13 \times 17$

2 → 5 times
5 → 2 times
→ 2

5) 173!

$1 \times 2 \times 3 \times 4 \times \text{----} \times 173 \Rightarrow$

| | |
|---|---|
| 5 | 173 |
| 5 | 34 |
| 5 | 6 |
| | 1 |

+ + → 41

6) $144! \times \frac{5}{1} \times \frac{15}{1} \times \frac{22}{1} \times 11 \times \frac{44}{2} \times \frac{135}{1}$

| | |
|---|---|
| 5 | 144 |
| 5 | 28 |
| 5 | 5 |
| | 1 |

+ + 34 + 3 = 37

7) 148!

$1 \times 2 \times 3 \times 4 \times \text{----} \times 148 \Rightarrow$

| | |
|---|---|
| 5 | 148 |
| 5 | 29 |
| 5 | 5 |
| | 1 |

+ + → 35

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8) 1093!

$1 \times 2 \times 3 \times \text{----} \times 1093 \Rightarrow$

| | |
|---|---|
| 5 | 1093 |
| 5 | 218 |
| 5 | 43 |
| 5 | 8 |
| | 1 |

+ + + 270

9) 1132!

$1 \times 2 \times 3 \times \text{----} \times 1132 \Rightarrow$

| | |
|---|---|
| 5 | 1132 |
| 5 | 226 |
| 5 | 45 |
| 5 | 9 |
| | 1 |

+ + + = 281

2) n! has 23 zeroes. what is the maximum Possible Value of n?

$\Rightarrow$

100! $\Rightarrow$ $\boxed{24}$

95! = $\boxed{22}$

96!

97!

98!

99!

$\boxed{\text{Cannot be determind}}$

3) Find the number of zeroes in the Product $1^1 \times 2^2 \times 3^3 \times 4^4 \times 5^5 \times 6^6 \times \text{----} \times 49^{49}$

$\Rightarrow$

$5^5 \rightarrow 5$

$10^{10} \rightarrow 10$

$15^{15} \rightarrow 15$

$20^{20} \rightarrow 20$

$25^{25} \rightarrow 50$

$30^{30} \rightarrow 30$

$35^{35} \rightarrow 35$

$40^{40} \rightarrow 40$

$45^{45} \rightarrow 45$

250

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4) Find the number of zeroes in:
$1^{1!} \times 2^{2!} \times 3^{3!} \times 4^{4!} \times 5^{5!} \times \text{-----} \times 10^{10!}$

$5! \Rightarrow 120$
$+ 10! \Rightarrow 3628800$
$3628920$

5) Find the number of zeroes in the value of
$\underset{4}{2^2 \times 5^4} \times \underset{8}{4^6 \times 10^8} \times \underset{12}{6^{10} \times 15^{12}} \times \underset{16}{8^{14} \times 20^{16}} \times \underset{18}{10^{18}} \times \underset{40}{25^{20}}$

$4 + 8 + 12 + 16 + 18 + 40 \Rightarrow 98$

6) What is the number of zeroes in the following:
a) $3200 + 1000 + 40000 + 32000 + 15000000$
$= 2$

b) $3200 \times 1000 \times 40000 \times 32000 \times 16000000$
$2 + 3 + 4 + 3 + 6 \Rightarrow \boxed{18}$

7) Find the highest power of 7 which divides 81!
$\Rightarrow$ 81! ~~में 7 factors कितने?~~

| | |
|---|---|
| 7 | 81 |
| 7 | 11 |
| | 1 |

$+12$

8) Find the highest Power of 42 which divides 122!
$\Rightarrow$ 42
2 3 7

| | |
|---|---|
| 7 | 122 |
| 7 | 17 |
| | 2 |

$\boxed{19}$

9) Find the highest Power of 84 which divides 342!

84
$2^2$ 3 7
$\alpha$ $\alpha$

| | |
|---|---|
| 7 | 342 |
| 7 | 48 |
| | 6 |

+54

10) Find the highest Power of 175 which divides 344!

⇒

175
25 × 7
5×5 × 7
$\boxed{5^2 \times 7}$
41 57

| | |
|---|---|
| 7 | 344 |
| 7 | 49 |
| 7 | 7 |
| | 1 |

+ + 57

| | |
|---|---|
| 5 | 344 |
| 5 | 68 |
| 5 | 13 |
| | 2 |

+83
2

$5^2 \rightarrow 41$

11) Find the highest Power of 360 which divides 520!

⇒ 360
9×4×10(5×2)
$2^3 \times 3^2 \times 5^1$

| | |
|---|---|
| 5 | 520 |
| 5 | 104 |
| 5 | 20 |
| | 4 |

+ + 128

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# Divisibility :-

$2 \longrightarrow$ last digit divisible by 2

$2^2 \Rightarrow 4 \longrightarrow$ last 2 digit —"— by 4 $\longrightarrow$ 40362(16)

$2^3 \Rightarrow 8 \longrightarrow$ last 3 digit —"— 8 $\longrightarrow$ 4036(568)

$2^4 \Rightarrow 16 \longrightarrow$ last 4 digit —"— 16 $\longrightarrow$ 5628 (32 64)

---

$3^1 \longrightarrow$ sum of digit divisible by 3 $\Rightarrow 27396 = \frac{27}{3}$

$3^2 = 9 \longrightarrow$ sum of digit divisible by 9 $\Rightarrow 27396 = \frac{27}{9}$

$5 \longrightarrow$ last digit '0'/5

$6 \longrightarrow$ 2 & 3 divisible number

$11 \longrightarrow$ difference 0/11 multiple $\Rightarrow$ 2 3 1 $\quad$ 2 3 4 3

3 $\quad$ 6 6

$(3-3)=0 \quad (6-6)$

7

2 2 4 5 1

7

$(7-7)=0$

$12 \longrightarrow$ 3 & 4 divisible number

---

# The Remainder Theorem :-

(1) $\frac{17}{6}$, $R = 5, -1$ $\quad$ (2) $\frac{27}{10}$, $R = 7, -3$

(3) $\frac{3}{5}$, $R = 3, -2$ $\quad$ (4) $\frac{9}{13}$, $R = 9, -4$

(5) $\frac{13}{9}$, $R = 4, -5$ $\quad$ (6) $\frac{49}{9}$, $R = 4, -5$

(7) $\frac{54 \times 73}{8}$ $\quad$ $\cancel{-2 \times 1}$ $\quad$ $R = -2$ $\quad$ $(8-2)$ 6

(8) $\frac{49 \times 65}{9}$, $R = 8$ $\quad$ $\cancel{4 \times 2}$

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$1 + 2 + 6 = 9$

$1 \quad 1\times2 \quad 1\times2\times3 \quad 1\times2\times3\times4$

9) $\dfrac{1! * 2! + 3! + 4! + 5! \; ---- + 100000!}{8} \Rightarrow R = \dfrac{9}{8} = 1$

$1 + 2 + 6 \quad 1\times2\times3\times4$

10) $\dfrac{1! + 2! + 3! + 4! + 5! \; ---- 1000!}{12} = R \Rightarrow 9$

11) $\dfrac{(10)^{756}}{9} \Rightarrow (1)^{756} = 1$

12) $\dfrac{(8)^{396}}{9} \Rightarrow (-1)^{396} \Rightarrow 1$

13) $\dfrac{(19)^{321}}{9} \Rightarrow (1)^{321} = 1$

14) $\dfrac{(17)^{3291}}{9} = (-1)^{3291} \Rightarrow -1$ $(9-1) = 8$

---

1) Find the remainder when $73 + 75 + 78 + 57 + 197$ is divided by 34

$5 \quad 7 \quad 10 \quad -11 \quad 7$

$\dfrac{73 + 75 + 78 + 57 + 197}{34} = (5 + 10 - 11) = (5 - 1)$
$= 4$ ✓

2) Find the remainder when $73 \times 75 \times 78 \times 57 \times 197$ is divided by 34.

$1 \quad 10 \times 9 = 90$

$\dfrac{73 \times 75 \times 78 \times 57 \times 197}{34} = \boxed{22}$ ✓

3) Find the remainder when $43^{197}$ is divided by 7

$\dfrac{(43)^{197}}{7} \Rightarrow (1)^{197} = 1$ ✓

4) Find the remainder when $51^{203}$ is divided by 7.

$\boxed{1 \times 4}$

$\dfrac{(51)^{203}}{7} \Rightarrow \dfrac{(2)^{203}}{7} \Rightarrow \dfrac{(2^3)^{67} \times 2^2}{7} = 4$ ✓

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5) Find the remainder when $59^{28}$ is divided by 7.

$$\frac{(59)^{28}}{7} \Rightarrow \frac{(3)^{28}}{7} = \frac{\overbrace{(3^6)^4}^{\boxed{1}} \times 3^4}{7} = 4$$

6) Find the remainder when $67^{99}$ is divided by 7.

$$\frac{(67)^{99}}{7} \Rightarrow \frac{(4)^{99}}{7} \Rightarrow \frac{2^{198}}{7} \Rightarrow \frac{\overbrace{(2^3)^{66}}^{\boxed{1}}}{7} = 1$$

7) Find the remainder when $75^{80}$ is divided by 7.

$\Rightarrow$

$$\frac{(75)^{80}}{7} \Rightarrow \frac{(5)^{80}}{7} \Rightarrow \frac{(-2)^{80}}{7} \Rightarrow \frac{\overbrace{((-2)^3)^{26}}^{\boxed{1}} \times (-2)^2}{7}$$

$$\Rightarrow \boxed{4}$$

8) Find the remainder when $41^{77}$ is divided by 7.

$$\frac{(41)^{77}}{7} = (-1)^{77} \Rightarrow -1 / 6$$

$(7-1) = 6$

9) Find the remainder when $21^{875}$ is divided by 17.

$$\frac{(21)^{875}}{17} \Rightarrow \frac{(4)^{875}}{17} \Rightarrow \frac{(2)^{1750}}{17}$$

$$\Rightarrow \frac{(2^4)^{437} \times 2^2}{17}$$

$$\Rightarrow (-1)^{437} \times 4 = -4 / 13$$

$(17-4) = 13$

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10) Find the remainder when $54^{124}$ is divided by 17.

$\Rightarrow$

$$\frac{(54)^{124}}{17} \Rightarrow \frac{(3)^{124}}{17} \Rightarrow \frac{(3^4)^{31}}{17} = \frac{(-4)^{31}}{17}$$

$$\Rightarrow \frac{((-4)^2)^{15} \times -4}{17}$$

$$\Rightarrow (-1)^{15} \times -4$$

$$\Rightarrow -1 \times -4 \Rightarrow 4$$

11) Find the remainder when $83^{261}$ is divided by 17.

$$\frac{(83)^{261}}{17} \Rightarrow \frac{(-2)^{261}}{17}$$

$$\Rightarrow \frac{(-2^4)^{65} \times (-2)^1}{17}$$

$$\Rightarrow (-1)^{65} \times -2$$

$$\Rightarrow -1 \times -2 = 2$$

12) Find the remainder when $25^{102}$ is divided by 17.

$$\frac{(25)^{102}}{17} \Rightarrow \frac{(8)^{102}}{17}$$

$$= \frac{2^{306}}{17}$$

$$\Rightarrow \frac{(2^4)^{76} \times 2^2}{17}$$

$$\Rightarrow (-1)^{76} \times 4$$

$$= 1 \times 4 = 4$$

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# Unit's Digit :- → cyclicity

$2^1 = \boxed{2}$
$2^2 = \boxed{4}$
$2^3 = \boxed{8}$
$2^4 = 1\boxed{6}$
$2^5 = 3\boxed{2}$
$2^6 = 6\boxed{4}$
$2^7 = 12\boxed{8}$
$2^8 = 25\boxed{6}$

unit digit

| |
|---|
| 2 |
| 3 |
| 7 |
| 8 |

→ $\boxed{4}$

① $(4321\boxed{2})^{362} \Rightarrow 2^{362/4} \Rightarrow 2^2 = \boxed{4}$ ✓

Remainder → 2

② $(321\boxed{3})^{466} \Rightarrow 3^{466/4} \Rightarrow 3^2 = \boxed{9}$ ✓

→ 2

③ $(314\boxed{7})^{4664} \Rightarrow 7^{4664/4} \Rightarrow 7^4 = \boxed{1}$ ✓

→ 0

unit digits

| |
|---|
| 0 |
| 1 |
| 5 |
| 6 |

→ 1

$(4939\boxed{0})^{76053} = 0$ ✓

$(4312\boxed{1})^{76291} \Rightarrow 1$ ✓

$(5329\boxed{5})^{760000} \Rightarrow 5$ ✓

$(5329\boxed{6})^{78321} \Rightarrow 6$ ✓

$4^1 = \boxed{4}$
$4^2 = 1\boxed{6}$
$4^3 = 6\boxed{4}$
$9^1 = \boxed{9}$
$9^2 = 8\boxed{1}$
$9^3 = 72\boxed{9}$

4 → $\boxed{2}$
9 →

4 — odd → 4
4 — Even → 6
9 — odd → 9
9 — Even → 1

$(763\boxed{4})^{469} = 4$

$(362\boxed{4})^{400} \Rightarrow 6$

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Find the units digit in each of the following:-

1) $2^2 \times 4^4 \times 6^6 \times 8^8$ $\quad 8^{8/4} \to \boxed{0}$ $\quad 8^4 \Rightarrow \boxed{6}$

$4 \times 6 \times 6 \times 6$ (4, 4, 4) $\Rightarrow 4$

2) $1^1 \times 2^2 \times 3^3 \times 4^4 \times 5^5 \times 6^6 \times \ldots \times 100^{100} \Rightarrow 0$

3) $17 \times 23 \times 51 \times 32 + 15 \times 17 \times 16 \times 22$ (0)

$2 + 0 \Rightarrow 2$

4) $13 \times 17 \times 22 \times 34 + 12 \times 6 \times 4 \times 3 - 13 \times 33$ (8, 4, 9)

$8 + 4 - 9 = 3$

5) $37^{123/4} \times 43^{144/4} \times 57^{226/4} \times 32^{127/4} \times 52^{5!/4} \to 0$

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

$3 \times 1 \times 9 \times 8 \times 6$ (7, 6, 6) $\Rightarrow 6$

6) $67 \times 37 \times 43 \times 91 \times 42 \times 33 \times 42$ (9, 7, 7, 4, 2, 4) $\Rightarrow 4$

7) $67 \times 35 \times 43 \times 91 \times 47 \times 33 \times 49$ (5, 5, 5, 5, 5, 5) $\Rightarrow 5$

8) $67 \times 35 \times 45 \times 91 \times 42 \times 33 \times 81$ (5, 5, 5, 0, 0, 0) $\Rightarrow 0$

9) $67 \times 35 \times 45 + 91 \times 42 \times 33 \times 82$ (5, 5, 2, 6, 2)

$5 + 2 = 7$

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10) $(52)^{97/4} \times (43)^{72/4}$ → 1 → 0/4

$2^1 \times 3^4$

$2 \times 1 = 2$

11) $(55)^{75} \times (93)^{175} \times (107)^{275}$

$5 \times (3)^{175/4} \times (7)^{275/4}$ → 3 → 3

$5 \times 3^3 \times 7^3$

$5 \times 7 \times 3 \Rightarrow 5$

12) $(173)^{45} \times (152)^{77} \times (777)^{999}$

$(3)^{45/4} \times (2)^{77/4} \times (7)^{999/4}$ → 1 → 1 → 3

$3^1 \times 2^1 \times 7^3$

$3 \times 2 \times 3 \Rightarrow 8$

13) $81 \times 82 \times 83 \times 84 \times 86 \times 87 \times 88 \times 89$

2 6 4 4 8 4 6 $\Rightarrow 6$

14) $432 \times 532 + 532 \times 974 + 537 \times 531 * 947 \times 997$

4 8 7 9

$4 + 8 + 7 + 9 \Rightarrow 8$

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1) The last digit of the number obtained by multiplying the numbers $81 \times 82 \times 83 \times 84 \times 85 \times 86 \times 87 \times 88 \times 89$ will be

$\Rightarrow$

$81 \times 82 \times 83 \times 84 \times 85 \times 86 \times 87 \times 88 \times 89$

2 6 4 0 0 0 0 0

$\Rightarrow$ 0

2) The sum of the digits of a two-digit number is 10, while when the digits are reversed the number decreases by 54. Find the changed number.

a) 28 b) 19
c) 37 d) 46

By option

$28 - 82 = 56$

reversed no.

3) The sum of two numbers is 15 and their geometric mean is 20% lower than their arithmetic mean. Find the numbers.

a) 11, 4 b) 12, 3 c) 13, 2 d) 10, 5

$a, b$, $a+b = 15$

$AM = \frac{a+b}{2} = \frac{15}{2} = 7.5$

$-1.5$ 20%

6

$GM = \sqrt{a \times b}$

$\Rightarrow a \times b = 36$

$12 \times 3$

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4) If A381 is divisible by 11. Find the value of the smallest natural number A.

15

A 3 8 1

7 4

$\square - 4 = 0$

$\boxed{15} - 4 = 11$

7

5) If 381A is divisible by 9. Find the value of smallest natural number A.

sum of digits is divisible by 9

38 1 A

$12 + \boxed{6} = 18$

$\boxed{6}$

6) What will be the remainder obtained when $(9^6+1)$ will be divided by 8?

$$\frac{9^6+1}{8} = (1)^6+1 = 2$$

7) Find the ratio between the LCM and HCF of 5, 15 and 20.

⇒ HCF 5 | 5 15 20 | LCM 60

1 : 3 : 4

LCM : HCF

$\boxed{12 : 1}$

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8) Find the LCM of 5/2, 8/9, 11/14.

$\frac{5}{2}$ $\frac{8}{9}$ $\frac{11}{14}$

$\frac{\text{LCM Numarator}}{\text{HCF Denomator}} \Rightarrow \frac{5 \times 8 \times 11}{1} = 440$

9) A five-digit number is taken. sum of the first four digits (excluding the number at the units digit) equals sum of all the five digits. which of the following will not divide this number necessarily?

⇒ _ _ _ _ _ → 0

a) 10 b) 2 ~~c)~~ 4 d) 5

4 is not divide

10) Two numbers $P = 2^3 . 3^{10} . 5$ and $Q = 2^5 . 3^1 . 7^1$ are given Find the GCD of P and Q.

⇒

$P = 2^3 \times 3^{10} \times 5^1$

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

GCD = HCF (common) ⇒ $\boxed{2^3 \times 3^1}$ ← common in both

LCM = $2^5 \times 3^{10} \times 5^1 \times 7^1$ ← Highest power of all

11) Find the units digit of the expression $25^{6251} + 36^{528} + 73^{54}$

⇒

$25^{6251} + 36^{528} + 73^{54/4} \rightarrow 2$

$3^2 = 9$

$5 + 6 + 9 \Rightarrow 20$ $\boxed{0}$

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12) Find the number of zeroes at the end of 1090!

⇒

| | |
|---|---|
| 5 | 1090 |
| 5 | 218 |
| 5 | 43 |
| 5 | 8 |
| | 1 |

+ + +

270 ← no. of zeroes

13) If 146! is divisible by $5^n$ then find the maximum value of n.

⇒

| | |
|---|---|
| 5 | 146 |
| 5 | 29 |
| 5 | 5 |
| | 1 |

+ +

35

$5^{35}$ → value of n

14) Find the number of divisors of 1420.

⇒ $1420 \Rightarrow 4 \times 355 = 4 \times 5 \times 71$

$\Rightarrow 2^2 \times 5^1 \times 71^1$

no. of divisors $= 3 \times 2 \times 2 = 12$

15) There are 576 boys and 448 girls in a school that are to be divided into equal sections of either boys or girls alone. Find the minimum total number of section thus formed

⇒

| B | G |
|---|---|
| 576 | 448 |
| 144 | 112 |
| 36 | 28 |
| 9 | 7 |

$\xrightarrow{HCF} 4 \times 4 \times 4$

$\boxed{9 + 7} \Rightarrow 16$

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(16) A milkman has three different qualities of milk. 403 gallons of 1st quality, 465 gallons of 2nd quality and 496 gallons of 3rd quality. Find the least possible number of bottles of equal size in which different milk of different qualities can be filled without mixing.

403 465 496 $\xrightarrow{HCF}$ 31

$\boxed{13 + 15 + 16} \Rightarrow 44$

465)496(1
465
31

(17) What is the greatest number of 4 digits that when divided by any of the numbers 6, 9, 12, 17 leaves a remainder of 1?

$\Rightarrow$

9999

6, 9, 12, 17 $\xrightarrow{LCM}$ 612

612) 9999 (16
612
3879
3672
207

9999
207
9792 + 1 = $\boxed{9793}$

leaves remainder 1.

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$\boxed{2, 3, 7, 8}$ → last digits → not a perfect square

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(18) Four bells ring at the intervals of 6, 8, 12 and 18 seconds. They start ringing together at 12'o'clock After how many seconds will they ring together again?

⇒ 6, 8, 12, 18 —LCM— 72 sec ✓

1min 12sec

(19) The units digit of the expression $125^{813} \times 553^{3703} \times 4532^{828}$ is

⇒ $125^{813} \times 553^{3703/4} \times 4532^{828/4}$ (3, 0/4)

$5 \times 7 \times 6 \Rightarrow 0$ ✓

(20) Find the remainder when the number $9^{100}$ is divided by 8.

⇒ $\frac{9^{100}}{8} \Rightarrow (1)^{100} = 1$ ✓

(21) Find the remainder of $2^{1000}$ when divided by 3.

⇒ $\frac{2^{1000}}{3} = (-1)^{1000} \Rightarrow 1$ ✓

(22) Find the GCD of the polynomials $(x+3)^2 (x-2) (x+1)^2$ and $(x+1)^3 (x+3) (x+4)$

$(x+3)^2 (x-2) (x+1)^2$
$(x+1)^3 (x+3) (x+4)$

GCD ⇒ $(x+3)^1 (x+1)^2$ → common with lowest power

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23) The sum of the squares of the digits constituting a Positive two-digit number is 13. If we subtract 9 from that number, we shall get a number written by the same digits in the reverse order. Find the number.

a) 12 b) 32 c) 42 d) 52

By option: a) $1^2 = 1$, $2^2 = 4$ + = 5 ✗

b) $3^2 = 9$, $2^2 = 4$ + 13 ✓

24) What digits should be put in place of c in 38c to make it divisible by

1. 2 → 0, 2, 4, 6, 8 → value of C
2. 3 → 1, 4, 7
3. 4 → 0, 4, 8
4. 5 → 0, 5
5. 6 → 0, 1, 2, 4, 6, 7, 8
6. 9 → 7
7. 10 → 0

25) Amitesh buys a Pen, a Pencil and an eraser for ₹41. If the least cost of any of the three items is ₹12 and it is known that a pen costs less than a pencil and an eraser costs more than a pencil. answer the following.

1) What is the cost of the Pen?

a) 12 b) 13 c) 14 d) 15

Pn Pc E → 41

Pn < Pc < E → 41/3 = 13

12 12 12

1 4

2 3

12 < 13 < 16 ✗

12 < 14 < 15 ✓

Pencil

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2) If it is known that the eraser's cost is not divisible by 4. the cost of the pencil could be:

a) 12 b) 13 c) 14 d) 15

26) The cost of four mangoes, six guavas and sixteen watermelons is ₹500. while the cost of seven mangoes, nine guavas and nineteen watermelons is ₹620. What is the cost of one mango, one guava and one watermelon?

⇒

$$4m + 6G + 16w = 500$$
$$7m + 9G + 19w = 620$$
$$3m + 3G + 3w = 120$$

$$3(m+G+w) = 120$$
$$m+G+w = \frac{120}{3}$$
$$\boxed{m+G+w = 40}$$

27) A man sold 38 pieces of clothing (combined in the form of shirts, trousers and ties). If he sold at least 11 pieces of each item and he sold more shirts than trousers and more trousers than ties, then the number of ties that he must have sold is:

a) Exactly 11 b) At least 11
c) At least 12 d) cannot be determined

38
S Tr Tie

Tie < Tr < S
11 11 11 → 33
1 4
2 3

11 < 12 < 15 → 38
11 < 13 < 14 → 38

Tie fixed

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b) Find the number of shirts he must have sold.

a) At least 13 ✓ b) At least 14

c) At least 15 d) At most 16

28) Find the least number which when divided by 12, 15, 18 or 20 leaves in each case a remainder 4.

→ 12, 15, 18, 20 $\xrightarrow{LCM}$ $\boxed{180}$

+4

184 ✓

29) What is the least 3 digit number that when divided by 2, 3, 4, 5, or 6 leaves a remainder of 1?

a) 131 b) 161 ✓ c) 121 d) None of these

2, 3, 4, 5, 6 $\xrightarrow{LCM}$ $\boxed{60}$ ×2

120 + 1 = 121 ✓

30) The highest common factor of 70 and 245 is equal to

✓ a) 35 b) 45 c) 55 d) 65

| | | |
|---|---|---|
| 5 | 70 | 245 |
| ×7 | 14 | 49 |
| 35 ✓ | 2 | 7 |

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31) The greatest 4-digit number exactly divisible by 88 is
a) 8888 b) 9768 c) 9944 d) 9988

```
88)9999(113
   88
   ---
   119
    88
   ---
    319
    264
    ---
     55
```

9999
− 55
9944

32) Three bells ring at intervals of 5 seconds, 6 seconds and 7 seconds respectively. If they toll together for the first time at 9 AM in the morning, after what interval of time will they together ring again for the first time?

⇒

5 6 7 — LCM — 210 sec