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Pocket Notes

GENERAL STUDIES-2

For OPSC, OSSC & Other
State Level Exams.
Last Minute Revise

Index

Divisibility Rules

Rules

- Divisible by 2 → Last digit is 0, 2, 4, 6, or 8
- Divisible by 3 → Sum of digits divisible by 3
- Divisible by 4 → Last two digits divisible by 4
- Divisible by 5 → Last digit is 0 or 5
- Divisible by 6 → Divisible by both 2 and 3
- Divisible by 7 → Double the last digit and subtract from remaining part, result divisible by 7
- Divisible by 8 → Last three digits divisible by 8
- Divisible by 9 → Sum of digits divisible by 9
- Divisible by 10 → Last digit is 0
- Divisible by 11 → Difference between sum of digits at odd and even places is 0 or divisible by 11
- Divisible by 12 → Divisible by both 3 and 4
- Divisible by 13 → Multiply last digit by 9 and add to remaining part, result divisible by 13
- Divisible by 14 → Divisible by both 2 and 7
- Divisible by 15 → Divisible by both 3 and 5
- Divisible by 16 → Last four digits divisible by 16
- Divisible by 17 → Multiply last digit by 5 and subtract from remaining part, result divisible by 17
- Divisible by 18 → Divisible by both 2 and 9
- Divisible by 19 → Multiply last digit by 2 and add to remaining part, result divisible by 19
- Divisible by 20 → Last digit is 0 and the second last digit is even

Question for Practice:

Q1. Check whether 9180 is divisible by 2, 3, 5, 6, 9, and 10.
Answer:

- Last digit is 0 → divisible by 2, 5, 10
- Sum of digits = 9+1+8+0 = 18 → divisible by 3 and 9

- Since divisible by both 2 and 3 → divisible by 6
  Hence, 9180 is divisible by all of them.

Q2. Test the divisibility of 462 by 7 and 11.
Answer:

- For 7 → Double the last digit (2×2=4), subtract from remaining number (46-4=42). Since 42 is divisible by 7, 462 is divisible by 7.
- For 11 → (4+2) - 6 = 0, divisible by 11.
  Hence, 462 is divisible by both 7 and 11.

Q3. Determine if 1584 is divisible by 12, 16, and 18.
Answer:

- For 12 → Check divisibility by 3 (sum=18) and 4 (last two digits=84). Both satisfied → divisible by 12.
- For 16 → Last four digits 1584 ÷ 16 = 99 → divisible.
- For 18 → Divisible by 2 (even) and by 9 (sum=18). Both satisfied → divisible.
  Hence, 1584 is divisible by 12, 16, and 18.

Q4. Verify if 2772 is divisible by 7, 11, and 13.
Answer:

- 2772 ÷ 7 = 396 → divisible.
- For 11 → (2+7) - (7+2) = 9-9=0 → divisible.
- For 13 → Multiply last digit 2 by 9 = 18, add to remaining 277 → 295, not divisible by 13.
  Hence, divisible by 7 and 11 but not by 13.

Arithmetic Progression (AP)

Formulas

- nth term of an AP: $T_n = a + (n - 1)d$
- Sum of first n terms:
  $S_n = n/2 [2a + (n - 1)d] = n/2 (a + l)$ (where l = last term)
- If consecutive natural numbers are taken ($a = 1, d = 1$):
  $S_n = n(n + 1)/2$
- For three terms in AP (with given sum/product):
  Assume as $a - d, a, a + d$
- For four terms in AP (with given sum/product):
  Assume as $a - 3d, a - d, a + d, a + 3d$
- Arithmetic Mean (AM):
  $AM = (x_1 + x_2 + \ldots + x_n) / n$

Question for Practice:

Q1. Find the 20th term of the AP: 5, 9, 13, …
Answer:
Here $a = 5, d = 4$
$T_{20} = a + (20 - 1)d = 5 + 19 \times 4 = 5 + 76 = 81$
Hence, the 20th term is 81.

Q2. Find the sum of the first 50 natural numbers.
Answer:
Here $a = 1, d = 1, n = 50$
$S_n = n(n + 1)/2 = 50 \times 51/2 = 1275$
Hence, the sum is 1275.

Q3. If the 5th term of an AP is 18 and the 11th term is 36, find the first term and common difference.
Answer:
$T_5 = a + 4d = 18$ …(i)
$T_{11} = a + 10d = 36$ …(ii)
Subtract (ii) – (i): $6d = 18 \rightarrow d = 3$

Put in (i): a + 12 = 18 → a = 6
Hence, a = 6, d = 3.

Q4. Three numbers in AP have a sum of 27. Find the numbers.
Answer:
Let the terms be a – d, a, a + d
Sum = (a – d) + a + (a + d) = 3a = 27 → a = 9
Hence, terms are 9 – d, 9, 9 + d.

If product also given, then solve quadratic accordingly.

Q5. Four terms are in AP with sum 40. Find the terms if the common difference is 2.
Answer:
Let terms be a – 3d, a – d, a + d, a + 3d
Sum = 4a = 40 → a = 10
d = 2
Hence, terms are 10 – 6 = 4, 10 – 2 = 8, 10 + 2 = 12, 10 + 6 = 16.

Q6. Find the sum of multiples of 7 between 100 and 500.
Answer:
First multiple ≥ 100 is 105, last ≤ 500 is 497
So a = 105, d = 7, l = 497
n = (l – a)/d + 1 = (497 – 105)/7 + 1 = 392/7 + 1 = 57 + 1 = 58
Sn = n/2 (a + l) = 58/2 (105 + 497) = 29×602 = 17458
Hence, required sum = 17458.

Q7. Find the Arithmetic Mean between 25 and 85.
Answer:
AM = (25 + 85)/2 = 110/2 = 55
Hence, AM = 55.

Geometric Progression

Formulas

- nth term of a GP: $T_n = a \cdot r^{(n-1)}$
- Sum of first n terms:
  $S_n = a(r^n - 1) / (r - 1)$, if $r > 1$
  $S_n = a(1 - r^n) / (1 - r)$, if $r < 1$
- Sum to infinity (if $|r| < 1$):
  $S_\infty = a / (1 - r)$
- Geometric Mean (GM) between x1, x2, …, xn:
  $GM = (x1 \cdot x2 \cdot \ldots \cdot xn)^{(1/n)}$
- For three unknown terms in GP (with sum or product given):
  Assume terms as a/r, a, ar

Question for Practice:

Q1. Find the 8th term of the GP: 2, 6, 18, …
Answer:
Here $a = 2$, $r = 3$
$T8 = a \cdot r^{(n-1)} = 2 \cdot 3^7 = 2 \cdot 2187 = 4374$

Q2. Find the sum of the first 10 terms of GP: 3, 6, 12, …
Answer:
$a = 3$, $r = 2$, $n = 10$
$S_n = a(r^n - 1) / (r - 1) = 3(2^{10} - 1) / (2 - 1) = 3(1024 - 1) = 3 \cdot 1023 = 3069$

Q3. Find the sum to infinity of GP: 5, 2.5, 1.25, …
Answer:
$a = 5$, $r = 0.5$ (since 2.5/5 = 0.5)
$S_\infty = a/(1 - r) = 5/(1 - 0.5) = 5/0.5 = 10$

Harmonic Progression

Concepts

- A sequence is in **Harmonic Progression (HP)** if the **reciprocals** of its terms form an **Arithmetic Progression (AP)**.
- If terms are a, b, c in HP → then (1/a), (1/b), (1/c) are in AP.
- nth term of HP (Tn):
  If reciprocals form AP with first term A and common difference d, then Tn = 1 / [A + (n – 1)d]
- Harmonic Mean (HM) between two numbers a and b:
  HM = 2ab / (a + b)
- For three unknown terms in HP:
  Assume as 1/(a – d), 1/a, 1/(a + d)
  (so that reciprocals a – d, a, a + d are in AP).

Question for Practice:

Q1. Check whether 2, 3, 6 are in HP.
Answer:
Take reciprocals: 1/2, 1/3, 1/6 → which are 0.5, 0.333…, 0.166…
Check difference: (1/3 – 1/2) = –1/6, (1/6 – 1/3) = –1/6 → equal.
Hence, reciprocals are in AP → original numbers are in HP.

Q2. Find the nth term of HP whose reciprocals form AP with first term 1 and common difference 2.
Answer:
If AP is 1, 3, 5, … → nth term of AP = 1 + (n – 1)·2 = 2n – 1
So nth term of HP = 1 / (2n – 1)

Q3. Find the 10th term of the HP whose terms are 1, 1/3, 1/5, …
Answer:
Reciprocals = 1, 3, 5, … which is AP with a = 1, d = 2
T10 (AP) = 1 + (10 – 1)·2 = 19
So HP term = 1/19

Q4. Find the harmonic mean between 12 and 18.

Answer:

HM = 2ab / (a + b) = (2×12×18)/(12 + 18) = 432/30 = 14.4
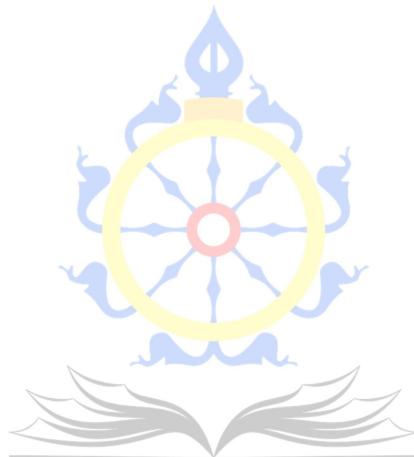
Algebric Identities

1. $(a + b)^2 = a^2 + b^2 + 2ab$
2. $(a - b)^2 = a^2 + b^2 - 2ab$
3. $a^2 - b^2 = (a + b)(a - b)$
4. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
5. $(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$
6. $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$
7. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
8. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

Question for Practice:

Q1. Evaluate $(23)^2 - (22)^2$ using identities.
Answer:
Use $a^2 - b^2 = (a + b)(a - b)$
$= (23 + 22)(23 - 22) = (45)(1) = 45$

Q2. If $a + b = 12$ and $ab = 20$, find $a^2 + b^2$.
Answer:
We know $(a + b)^2 = a^2 + b^2 + 2ab$
So $a^2 + b^2 = (a + b)^2 - 2ab = 12^2 - 40 = 144 - 40 = 104$
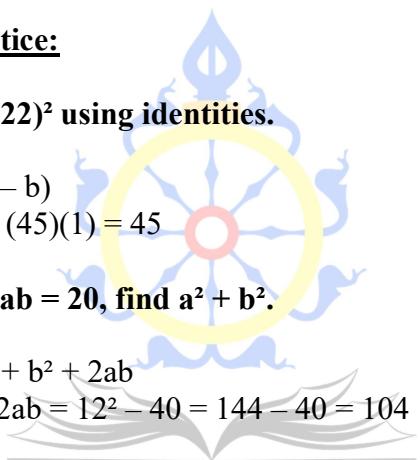
Speed, Time and Distance

- Speed = Distance / Time
- Distance = Speed × Time
- Time = Distance / Speed

Average Speed

- If different distances:
  Average speed = Total distance ÷ Total time
- If equal distances with different speeds S1 and S2:
  Average speed = 2S1S2 / (S1 + S2)

Relative Speed

- Objects moving in the same direction → Relative speed = |S1 – S2|
- Objects moving in opposite directions → Relative speed = S1 + S2
- If two trains of lengths L1 and L2 cross each other:
  Time = (L1 + L2) / Relative speed

Boats and Streams

- Speed downstream = Speed of boat in still water + Speed of stream
- Speed upstream = Speed of boat in still water – Speed of stream
- Speed of boat in still water = (Downstream speed + Upstream speed)/2
- Speed of stream = (Downstream speed – Upstream speed)/2

Unit Conversion

- 1 km/h = (5/18) m/s
- 1 m/s = (18/5) km/h

Question for Practice:

Q1. A car travels 150 km in 3 hours. Find its speed.
Answer:
Speed = Distance/Time = 150/3 = 50 km/h

Q2. A person travels 60 km at 30 km/h and returns the same distance at 20 km/h. Find his average speed for the whole journey.
Answer:
Here distance is equal → use formula:
Average speed = 2S1S2 / (S1 + S2) = 2×30×20 / (30+20) = 1200/50 = 24 km/h

Q3. Two trains of lengths 120 m and 180 m run at 45 km/h and 63 km/h in opposite directions. Find the time to cross each other.
Answer:
Relative speed = 45 + 63 = 108 km/h = (108×1000/3600) = 30 m/s
Total length = 120 + 180 = 300 m
Time = 300/30 = 10 seconds

Q4. A train 100 m long passes a pole in 20 seconds. Find its speed.
Answer:
Speed = Distance/Time = 100/20 = 5 m/s = (5×18/5) = 18 km/h

Q5. A boat goes 16 km downstream in 2 hours and comes back the same distance upstream in 4 hours. Find the speed of the boat in still water and speed of the stream.
Answer:
Downstream speed = 16/2 = 8 km/h
Upstream speed = 16/4 = 4 km/h
Boat in still water = (8+4)/2 = 6 km/h
Stream speed = (8–4)/2 = 2 km/h

Q6. Two persons start from points A and B, 60 km apart, and travel towards each other at 10 km/h and 20 km/h. When will they meet?
Answer:
Relative speed = 10 + 20 = 30 km/h
Time = Distance/Relative speed = 60/30 = 2 hours

Q7. A man covers 10 km by walking at 4 km/h and then 15 km by cycling at 15 km/h. Find his average speed.
Answer:
Total distance = 10 + 15 = 25 km
Time taken = 10/4 + 15/15 = 2.5 + 1 = 3.5 h
Average speed = 25/3.5 ≈ 7.14 km/h

Q8. Two trains moving in the same direction at 54 km/h and 36 km/h. The faster train crosses the slower in 40 seconds. Find the length of the faster train.
Answer:
Relative speed = 54 – 36 = 18 km/h = (18×1000/3600) = 5 m/s
Distance covered = Speed × Time = 5×40 = 200 m
So length of faster train = 200 m
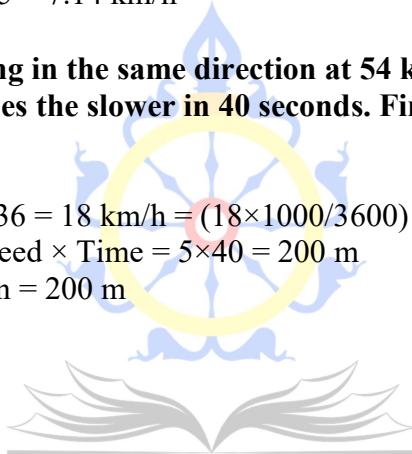
Simple and Compound Interest

- Amount = Principal + Interest
- Simple Interest (SI): SI = (P × R × T)/100
- Compound Interest (CI): CI = P[(1 + R/100)^T – 1]
- Doubling of money (approx.): Rule of 72 → Rate × Time ≈ 72
- Tripling of money: Rule of 114 → Rate × Time ≈ 114
- Quadrupling of money: Rule of 144 → Rate × Time ≈ 144

Where,
P = Principal, R = Rate of interest (% per annum), T = Time (years)

Question for Practice:

Q1. Find the SI on ₹5000 at 12% per annum for 3 years.
Answer:
SI = (P×R×T)/100 = (5000×12×3)/100 = 1800
Amount = 5000 + 1800 = ₹6800

Q2. Find the CI on ₹4000 at 10% per annum for 2 years.
Answer:
Amount = P(1 + R/100)^T = 4000(1 + 10/100)^2 = 4000(1.1)^2 = 4000(1.21) = 4840
CI = Amount – P = 4840 – 4000 = ₹840

Q3. At what rate will ₹800 become ₹920 in 3 years at SI?
Answer:
SI = Amount – Principal = 920 – 800 = 120
Formula: SI = (P×R×T)/100 → 120 = (800×R×3)/100
120 = 24R → R = 5% per annum

Q4. The difference between CI and SI on ₹5000 at 10% per annum for 2 years is?
Answer:
SI = (5000×10×2)/100 = 1000
CI = 5000[(1.1)^2 – 1] = 5000(1.21 – 1) = 5000(0.21) = 1050
Difference = 1050 – 1000 = ₹50

Q5. In how many years will a sum of money double at 12% per annum (approx.)?
Answer:
Rule of 72: Time = 72/Rate = 72/12 = 6 years

Q6. In how many years will ₹5000 triple at 15% per annum (approx.)?
Answer:
Rule of 114: Time = 114/Rate = 114/15 = 7.6 years (approx.)

Q7. A sum of money invested at CI becomes ₹2420 in 2 years and ₹2662 in 3 years. Find the principal and rate.
Answer:
Ratio of amounts (A3/A2) = 2662/2420 = 1.1 → Rate = 10%
Principal = A2 / (1.1)^2 = 2420 / 1.21 = ₹2000
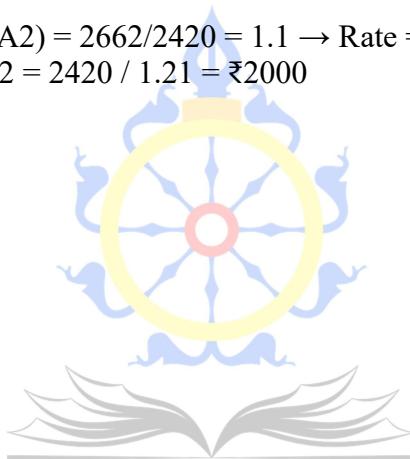
Profit, Loss & Discount

- Profit = Selling Price (SP) – Cost Price (CP)
- Loss = Cost Price (CP) – Selling Price (SP)
- Profit % = (Profit ÷ CP) × 100
- Loss % = (Loss ÷ CP) × 100
- Discount = Marked Price (MP) – Selling Price (SP)
- Discount % = (Discount ÷ MP) × 100
- Successive Discounts:
  If x% and y% are two successive discounts → Net discount % = (x + y – xy/100)%

Question for Practice:

Q1. A pen costs ₹50 and is sold at ₹60. Find the profit and profit %.
Answer:
Profit = 60 – 50 = ₹10
Profit % = (10/50)×100 = 20%

Q2. A chair was bought for ₹800 and sold for ₹680. Find the loss and loss %.
Answer:
Loss = 800 – 680 = ₹120
Loss % = (120/800)×100 = 15%

Q3. A shopkeeper marks goods at ₹1200 and sells them at ₹960. Find the discount and discount %.
Answer:
Discount = 1200 – 960 = ₹240
Discount % = (240/1200)×100 = 20%

Q4. A watch is sold at 25% gain. If the cost price is ₹2000, find the selling price.
Answer:
SP = CP(1 + Profit%/100) = 2000(1 + 25/100) = 2000(1.25) = ₹2500

Q5. A television is sold at 20% loss. If the selling price is ₹16,000, find the cost price.
Answer:
SP = CP(1 – Loss%/100) → 16,000 = CP(1 – 20/100) = CP(0.8)
CP = 16,000 / 0.8 = ₹20,000

Q6. A shirt is marked at ₹1000. Successive discounts of 20% and 10% are given. Find the selling price.
Answer:
Net discount = (20 + 10 – (20×10)/100)% = (30 – 2)% = 28%
SP = MP(1 – 28/100) = 1000(0.72) = ₹720

Q7. A man bought an article at 25% discount on the marked price and sold it at the marked price. Find his profit %.
Answer:
Let MP = ₹100
He buys at 75 (since 25% discount)
He sells at 100
Profit = 25 → Profit % = (25/75)×100 = 33.33%

Q8. A trader sells an item at 20% profit. Had he sold it at 10% loss, he would have got ₹60 less. Find the cost price.
Answer:
Difference between SPs = 20% + 10% = 30% of CP = ₹60
So CP = 60×100/30 = ₹200
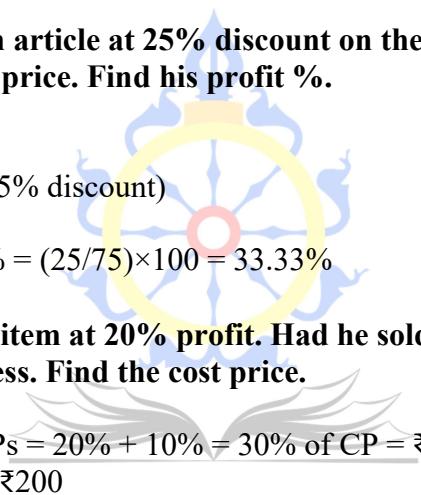
Average

- Average = (Sum of observations) / (Number of observations)
- Weighted Average = $(w_1x_1 + w_2x_2 + \ldots + w_nx_n) / (w_1 + w_2 + \ldots + w_n)$
- If each observation increases/decreases by x → Average also increases/decreases by x
- If each observation is multiplied/divided by x → Average also multiplied/divided by x

Question for Practice:

Q1. The marks of 5 students are 12, 15, 18, 10, and 20. Find the average.
Answer:
Sum = 12+15+18+10+20 = 75
Average = 75/5 = 15
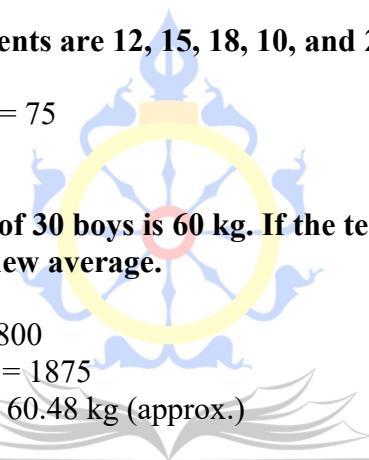
Q2. The average weight of 30 boys is 60 kg. If the teacher's weight of 75 kg is included, find the new average.
Answer:
Total weight = 30×60 = 1800
With teacher = 1800 + 75 = 1875
New average = 1875/31 = 60.48 kg (approx.)

Q3. The average age of 25 students is 15 years. If teacher's age is also included, average becomes 16. Find the teacher's age.
Answer:
Total age of students = 25×15 = 375
Total with teacher = 26×16 = 416
Teacher's age = 416 – 375 = 41 years

Q4. A batsman scores 40, 50, 60, 80, and 100 runs in 5 innings. Find his average. If he scores 120 in the next innings, what is the new average?
Answer:
Total = 40+50+60+80+100 = 330
Average = 330/5 = 66
After 6th inning: Total = 330+120 = 450
New average = 450/6 = 75

Q5. The average salary of 10 workers is ₹15,000. If one worker earning ₹20,000 leaves and is replaced by another earning ₹12,000, find the new average.

Answer:

Original total = 10×15,000 = 1,50,000

New total = 1,50,000 – 20,000 + 12,000 = 1,42,000

New average = 1,42,000 / 10 = ₹14,200
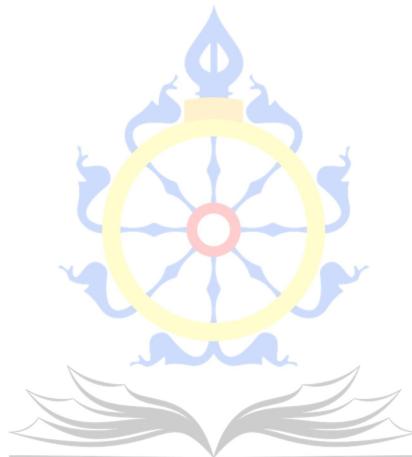
Percentage

- Percentage = (Value / Total Value) × 100
- Value = (Percentage × Total Value) / 100
- If a number increases by x% and decreases by y%:
  Net % change = (x – y – (xy/100))%
- If a number is increased by x% twice (successive increases):
  Net % increase = (x + x + (x²/100))%
- Successive percentage change formula:
  If changes are x% and y%,
  Net % change = (x + y + (xy/100))%
  (Take – sign if decrease)
- To convert fraction to %: (Fraction × 100)
- To convert % to fraction: (% ÷ 100)

Question for Practice:

Q1. What percent of 50 is 20?
Answer:
(20/50)×100 = 40%

Q2. The population of a town is 50,000. It increases by 10%. Find the new population.
Answer:
Increase = 10% of 50,000 = 5000
New population = 50,000 + 5000 = 55,000

Q3. A number is increased by 20% and then decreased by 10%. Find the net % change.
Answer:
Net % change = 20 – 10 – (20×10)/100 = 20 – 10 – 2 = 8% increase

Q4. A student scored 180 marks out of 240. Find the percentage.
Answer:
(180/240)×100 = 75%

**Q5. Price of sugar rises from ₹40/kg to ₹50/kg. Find the % increase.**
Answer:
Increase = 10
% Increase = (10/40)×100 = 25%

Q6. A trader buys goods at ₹500 and sells at ₹600. Find his profit %.
Answer:
Profit = 100
Profit % = (100/500)×100 = 20%
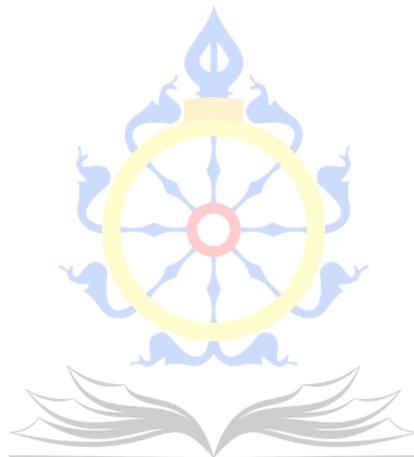
HCF and LCM

- HCF of fractions = HCF of numerators ÷ LCM of denominators
- LCM of fractions = LCM of numerators ÷ HCF of denominators
- For two numbers:
  LCM × HCF = Product of the numbers
- Least number which when divided by a, b, c leaves remainder R = (LCM of a, b, c) + R
- Greatest number which divides a, b, c leaving same remainder R = HCF of (a – R), (b – R), (c – R)
- Greatest number which divides x, y, z leaving remainders a, b, c = HCF of (x – a), (y – b), (z – c)

Question for Practice:

Q1. Find HCF and LCM of 18 and 24.
Answer:
HCF = 6, LCM = (18×24)/6 = 72

Q2. Find HCF and LCM of fractions 2/9 and 4/15.
Answer:
HCF = HCF(2,4)/LCM(9,15) = 2/45
LCM = LCM(2,4)/HCF(9,15) = 4/3

Q3. The least number which when divided by 12, 15 and 20 leaves remainder 3 in each case. Find it.
Answer:
LCM(12,15,20) = 60
Required number = 60 + 3 = 63

Q4. Find the greatest number that divides 62, 132, and 237 leaving the same remainder 5 in each case.
Answer:
Take (62 – 5), (132 – 5), (237 – 5) = 57, 127, 232
HCF(57,127,232) = 19
So required number = 19

Q5. Find the least number which when divided by 8, 12, and 20 leaves remainder 7.
Answer:
LCM(8,12,20) = 120
Required number = 120 + 7 = 127

Q6. The greatest number that divides 122, 154, and 198 leaving remainder 2 in each case.
Answer:
(122 – 2), (154 – 2), (198 – 2) = 120, 152, 196
HCF(120,152,196) = 4
Required number = 4
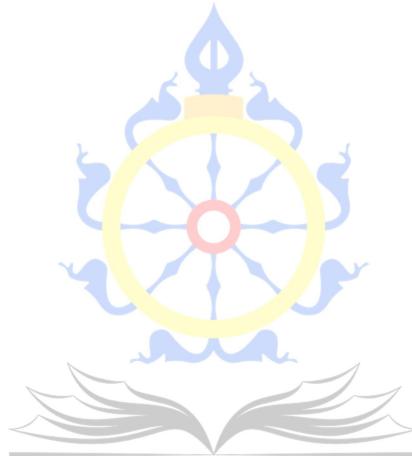
Number Series

- Sum of first n natural numbers = n(n + 1)/2
- Sum of first n odd numbers = n²
- Sum of first n even numbers = n(n + 1)
- Sum of squares of first n natural numbers = n(n + 1)(2n + 1)/6
- Sum of cubes of first n natural numbers = [n(n + 1)/2]²

Question for Practice:

Q1. Find the sum of first 50 natural numbers.
Answer:
n = 50
Sum = 50(51)/2 = 1275

Q2. Find the sum of first 20 odd numbers.
Answer:
Sum = n² = 20² = 400

Q3. Find the sum of first 30 even numbers.
Answer:
Sum = n(n + 1) = 30(31) = 930

Q4. Find the sum of squares of first 10 natural numbers.
Answer:
Sum = n(n + 1)(2n + 1)/6 = (10×11×21)/6 = 385

Q5. Find the sum of cubes of first 15 natural numbers.
Answer:
Sum = [n(n + 1)/2]² = [15×16/2]² = (120)² = 14,400

Q6. Find the sum of first 25 odd numbers and first 25 even numbers.
Answer:
Sum of odds = n² = 25² = 625
Sum of evens = n(n + 1) = 25×26 = 650

Q7. If sum of first n natural numbers is 300, find n.
Answer:
$n(n + 1)/2 = 300 \rightarrow n(n + 1) = 600$
Check $n = 24 \rightarrow 24 \times 25 = 600$
So $n = 24$

Q8. Find the sum of squares of first 12 natural numbers.
Answer:
$n = 12$
Sum $= (12 \times 13 \times 25)/6 = (3900)/6 = 650$

Q9. A child adds numbers from 1 to 50, but by mistake he misses 36. What is the wrong sum?
Answer:
Correct sum $= 50(51)/2 = 1275$
Wrong sum $= 1275 - 36 = 1239$
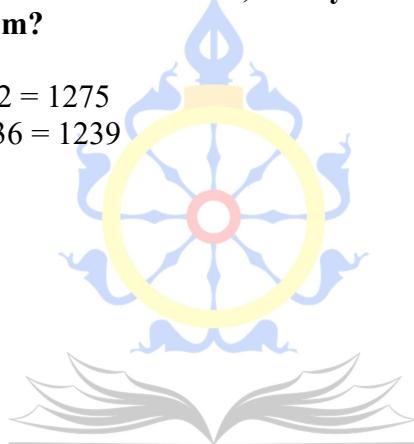
Ratio & Proportion

If **a/b = c/d**, then:

- **Invertendo:** b/a = d/c
- **Alternendo:** a/c = b/d
- **Componendo:** (a+b)/b = (c+d)/d
- **Dividendo:** (a–b)/b = (c–d)/d
- **Componendo & Dividendo:** (a+b)/(a–b) = (c+d)/(c–d)

Properties of Fractions

- For a proper fraction (a < b):
  (a+c)/(b+c) > a/b
  (a–c)/(b–c) < a/b
- For an improper fraction (a > b):
  (a+c)/(b+c) < a/b
  (a–c)/(b–c) > a/b

Squares

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$
$10^2 = 100$

$11^2 = 121$
$12^2 = 144$
$13^2 = 169$
$14^2 = 196$
$15^2 = 225$
$16^2 = 256$
$17^2 = 289$
$18^2 = 324$
$19^2 = 361$
$20^2 = 400$

$21^2 = 441$
$22^2 = 484$
$23^2 = 529$
$24^2 = 576$
$25^2 = 625$
$26^2 = 676$
$27^2 = 729$
$28^2 = 784$
$29^2 = 841$
$30^2 = 900$

$31^2 = 961$
$32^2 = 1024$
$33^2 = 1089$
$34^2 = 1156$
$35^2 = 1225$
$36^2 = 1296$
$37^2 = 1369$
$38^2 = 1444$
$39^2 = 1521$
$40^2 = 1600$

$41^2 = 1681$
$42^2 = 1764$
$43^2 = 1849$
$44^2 = 1936$
$45^2 = 2025$
$46^2 = 2116$
$47^2 = 2209$
$48^2 = 2304$
$49^2 = 2401$
$50^2 = 2500$
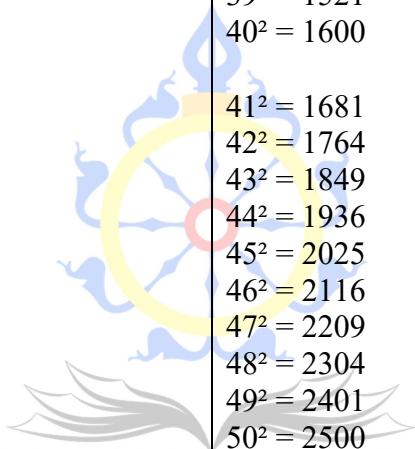
Cubes

$1^3 = 1$
$2^3 = 8$
$3^3 = 27$
$4^3 = 64$
$5^3 = 125$
$6^3 = 216$
$7^3 = 343$
$8^3 = 512$
$9^3 = 729$
$10^3 = 1000$

$11^3 = 1331$
$12^3 = 1728$
$13^3 = 2197$
$14^3 = 2744$
$15^3 = 3375$
$16^3 = 4096$
$17^3 = 4913$
$18^3 = 5832$
$19^3 = 6859$
$20^3 = 8000$
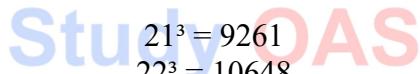
$21^3 = 9261$
$22^3 = 10648$
$23^3 = 12167$
$24^3 = 13824$
$25^3 = 15625$

Calendar

- **Normal Year** = 365 days = 52 weeks + 1 day
- **Leap Year** = 366 days = 52 weeks + 2 days
- **Leap Year Rule**:
  - If a year is divisible by 4 → Leap year
  - Exception: Century years must be divisible by 400 to be leap years
    - Example: 2000 is a leap year, 1900 is not
- **Leap years in 400 years = 97**
- **Leap years in 100 years = 24 (or 25 if the 100th year is a century leap year)**

Question for Practice:

Q1. Find the day of the week on 1st Jan 2025 if 1st Jan 2024 was Monday.
Answer:
2024 is a leap year (divisible by 4).
So 1st Jan 2025 will be **2 days ahead** of Monday → Wednesday.

Q2. How many days are there in 100 years?
Answer:
100 years = 100 × 365 + 24 leap days = 36,500 + 24 = 36,524 days.

Q3. Which of the following are leap years: 1600, 1700, 1800, 2000, 2100?
Answer:

- 1600 → divisible by 400 → Leap year
- 1700 → not divisible by 400 → Not leap year
- 1800 → not divisible by 400 → Not leap year
- 2000 → divisible by 400 → Leap year
- 2100 → not divisible by 400 → Not leap year

Q4. If 1st Jan 2000 was Saturday, what day was 1st Jan 2001?
Answer:

2000 was a leap year → extra 2 days
So 1st Jan 2001 = Saturday + 2 = Monday.

Q5. Find the day of the week on 15th August 1947.
Answer:
Step 1: Count odd days from 1 AD to 1947.

- 1600 years → 0 odd days (complete multiples of 400).
- 300 years (1700–1999) → 1 odd day per century = 3 odd days.
- From 1901 to 1946 = 46 years = 11 leap + 35 normal = (11×2 + 35×1) = 57 odd days → $57 \equiv 1 \pmod 7$.
- Total odd days till 1946 = 3+1=4.
- From Jan–Aug 15, 1947 → count extra → total odd days = 5.
  So day = Friday.
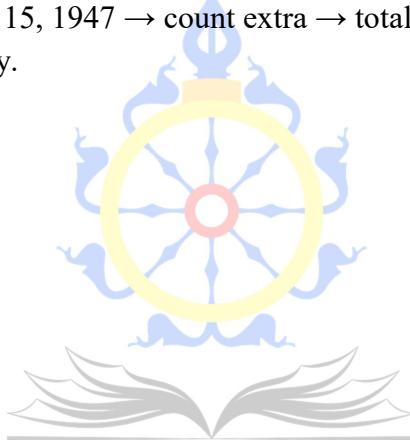
Clocks

- Degrees covered by **Minute hand in 1 min** = 6°
- Degrees covered by **Second hand in 1 second** = 6°
- Degrees covered by **Hour hand in 1 min** = 0.5°
- **Angle between Hour and Minute hand** at h hours and m minutes:
  = |(30 × Hour – 5.5 × Minute)| degrees
  = |(60×Hour – 11×Minute)| / 2
- **Hands coincide (overlap):** Every 65 5/11 minutes
- **Hands opposite (180° apart):** Every 65 5/11 ÷ 2 = 32 8/11 minutes
- In 12 hours, hands coincide 11 times; in 24 hours, 22 times

Question for Practice:

Q1. Find the angle between the hands at 3:20.
Answer:
Using formula: (60×3 – 11×20)/2 = (180 – 220)/2 = –40/2 = –20 → 20°

Q2. At what time between 4 and 5 will the hands be together?
Answer:
Formula: Time = (60×h)/11 = (60×4)/11 = 240/11 = 21 9/11 minutes
So at 4:21:33 approx.

Q3. At what time between 2 and 3 will the hands be opposite each other?
Answer:
Condition: (60×h – 11m)/2 = 180
(120 – 11m)/2 = 180 → 120 – 11m = 360 → 11m = –240 → add 360 → m = 120/11 = 10 10/11
So time ≈ 2:10:55

Q4. How many times in a day do the hands form a right angle?
Answer:
In 12 hours → 22 right angles
In 24 hours → 44 times

Q5. A clock shows 6 o'clock. What is the angle between the hands?
Answer:
Hour = 6, Minute = 0
Angle = |(60×6 – 11×0)|/2 = 360/2 = 180°

Q6. How many times a day are the hands in a straight line (0° or 180°)?
Answer:
In 12 hours → 22 times
In 24 hours → 44 times

Q7. The hands of a clock are 5 minutes apart. Find the angle.
Answer:
1 minute = 6° for minute hand
So 5 minutes apart = 5×6 = 30°
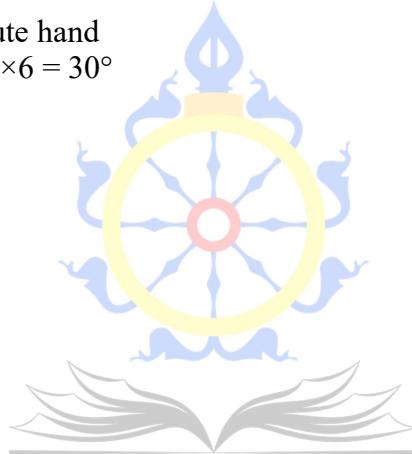
Number System

Representation of Numbers

- For a two-digit number ab = 10a + b
- For a three-digit number abc = 100a + 10b + c
- For a four-digit number abcd = 1000a + 100b + 10c + d

Classification of Numbers

- **Natural Numbers ($\mathbb{N}$):** Counting numbers = 1, 2, 3, …, ∞
- **Whole Numbers:** Natural numbers with 0 included = 0, 1, 2, 3, …
- **Integers ($\mathbb{Z}$):** Whole numbers and negatives = … –3, –2, –1, 0, 1, 2, 3 …
    - Positive integers: 1, 2, 3, …
    - Negative integers: –1, –2, –3, …
    - 0 is neither positive nor negative (non-positive and non-negative).
- **Prime Numbers:** Numbers greater than 1 with only two factors (1 and itself) → e.g., 2, 3, 5, 7, 11, 13, …
- **Composite Numbers:** Numbers having more than 2 factors → e.g., 4, 6, 8, 9, 10 …
- **Co-prime Numbers:** Numbers whose HCF = 1 (not necessarily prime).
- **Twin Primes:** Pair of primes differing by 2 → (3, 5), (5, 7), (11, 13)…
- **Odd Numbers:** Not divisible by 2; end in 1, 3, 5, 7, 9
- **Even Numbers:** Divisible by 2; end in 0, 2, 4, 6, 8
- **Rational Numbers (p/q form):** Can be expressed as ratio of integers, $q \neq 0$
    - Terminating rational → e.g., 1/4 = 0.25
    - Non-terminating recurring rational → e.g., 13/6 = 2.1666…
- **Irrational Numbers:** Cannot be expressed as p/q; non-terminating, non-repeating decimals → $\sqrt{2}$, π, e
- **Fractions:**
    - Proper fraction: p/q with p < q (e.g., 3/5)
    - Improper fraction: p/q with p ≥ q (e.g., 7/5)

Time and Work

- **Work = Rate × Time**
- If a person can do a work in n days → 1 day's work = 1/n
- If A's 1 day work = 1/a and B's 1 day work = 1/b, then:
  - (A + B)'s 1 day work = (1/a + 1/b) = (a + b)/ab
  - (A – B)'s 1 day work = (1/a – 1/b)
- If A does work in a days, B in b days, C in c days → all together = 1/a + 1/b + 1/c work per day
- **Work and Wages relation:**
  Wages ∝ Work done
- If M men can do W work in D days →
  More men or more days → More work
  $(M_1 \times D_1)/W_1 = (M_2 \times D_2)/W_2$

Question for Practice:

Q1. A can finish a work in 12 days, B in 18 days. How long will they take together?
Answer:
A's 1 day work = 1/12, B's = 1/18
Together = 1/12 + 1/18 = (3+2)/36 = 5/36
So time = 36/5 = 7.2 days

Q2. A alone can do a work in 10 days, B alone in 15 days. A and B start together, but A leaves after 2 days. Find time taken to finish work.
Answer:
A's 1 day work = 1/10, B's = 1/15
In 2 days → A+B = (1/10+1/15)×2 = (5/30)×2 = 10/30 = 1/3 work done
Remaining = 2/3
Now B alone does → time = (2/3)/(1/15) = 10 days
Total = 2 + 10 = 12 days

Q3. 12 men can finish a work in 20 days. How many men required to finish in 15 days?
Answer:
$M_1 \times D_1 = M_2 \times D_2$ → 12×20 = M_2×15 → M_2 = 240/15 = 16 men

Q4. A can finish a work in 30 days, B in 40 days. They work together for 10 days, then B leaves. How many more days will A take?

Answer:

A's 1 day work = 1/30, B's = 1/40

Together in 10 days = (1/30 + 1/40)×10 = (70/1200)×10 = 700/1200 = 7/12 work done

Remaining = 5/12

Now A alone → time = (5/12)/(1/30) = (5/12)×30 = 12.5 days

Q5. A is twice as efficient as B. Together they do a work in 18 days. Find time taken by each alone.

Answer:

Let B's 1 day work = x → A's = 2x

Together = 3x = 1/18 → x = 1/54

So B = 54 days, A = 27 days

Q6. A, B, C can finish work in 15, 20, and 30 days respectively. If they work together, how long to complete the work?

Answer:

1 day work = 1/15 + 1/20 + 1/30 = (4+3+2)/60 = 9/60 = 3/20

So time = 20/3 = 6.67 days

Q7. If 24 men can build a wall in 15 days, how many days will 20 men take?

Answer:

$M_1 \times D_1 = M_2 \times D_2$ → 24×15 = 20×D_2 → D_2 = 360/20 = 18 days

Q8. A can do a work in 25 days, B in 20 days. They work together but C joins them and the work is finished in 10 days. Find time taken by C alone.

Answer:

A's work/day = 1/25, B's = 1/20 → total = (4+5)/100 = 9/100

In 10 days = 90/100 = 9/10 work

Remaining = 1/10 done by C in 10 days → C's 1 day = 1/100 → time = 100 days

Alphabet Numbering (A–Z)

1 → A
2 → B
3 → C
4 → D
5 → E
6 → F
7 → G
8 → H
9 → I
10 → J
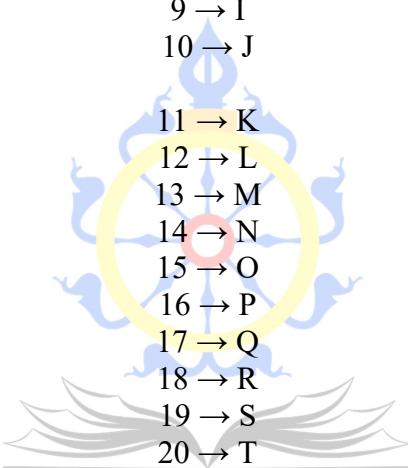
11 → K
12 → L
13 → M
14 → N
15 → O
16 → P
17 → Q
18 → R
19 → S
20 → T

21 → U
22 → V
23 → W
24 → X
25 → Y
26 → Z

Trick to remember codes – EJOTY

- E = 5
- J = 10
- O = 15
- T = 20
- Y = 25

Cube Cutting & Painting

- If a cube of side length **L** is cut into smaller cubes of side **a** → Number of small cubes = $(L/a)^3$
- If a cube is painted on all its faces and then cut into smaller equal cubes:

1. **Corner cubes:** Always 8, each has 3 faces painted.
2. **Edge cubes (excluding corners):**
   Formula = $12(n - 2)$, each has 2 faces painted.
3. **Face-center cubes (excluding edges):**
   Formula = $6(n - 2)^2$, each has 1 face painted.
4. **Inner cubes (not painted at all):**
   Formula = $(n - 2)^3$

Here, **n = number of divisions along an edge**.

Question for Practice:

Q1. A cube of side 6 cm is cut into smaller cubes of side 2 cm. How many smaller cubes are formed?
Answer:
$n = 6/2 = 3$ → (3^3) = 27 small cubes.

Q2. A cube is painted on all its 6 faces and cut into 64 small cubes. Find how many cubes have 3, 2, 1, and 0 faces painted.
Answer:
Since $64 = 4^3$ → n = 4.

- 3 faces painted (corners) = 8
- 2 faces painted (edges) = $12(n - 2) = 12 \times 2 = 24$
- 1 face painted (face centers) = $6(n - 2)^2 = 6 \times 2^2 = 24$
- 0 face painted (inner cubes) = $(n - 2)^3 = 2^3 = 8$

Q3. A cube of side 12 cm is cut into 216 small cubes of equal size. How many cubes will have no face painted?
Answer:
$216 = 6^3 \rightarrow n = 6$
Unpainted $= (n - 2)^3 = (6 - 2)^3 = 64$

Q4. A cube of side 10 cm is painted on all sides and cut into 1000 smaller cubes. Find:
(i) Number of cubes with 3 faces painted
(ii) Number of cubes with 2 faces painted

Answer:
$1000 = 10^3 \rightarrow n = 10$

(i) 3 faces painted (corners) = 8
(ii) 2 faces painted (edges) $= 12(n - 2) = 12 \times 8 = 96$

Q5. A cube of side 15 cm is cut into cubes of side 5 cm. If big cube is painted, how many small cubes will have only one face painted?
Answer:
$n = 15/5 = 3$
So total cubes $= 3^3 = 27$
1 face painted $= 6(n - 2)^2 = 6(1)^2 = 6$
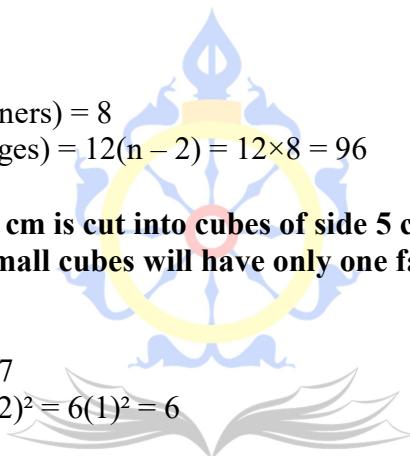
Blood Relations

Concepts

- **Direct Relations**: Father, Mother, Son, Daughter, Brother, Sister, Uncle, Aunt, Nephew, Niece, Grandparents, Grandchildren.
- **By Marriage**: Husband, Wife, Brother-in-law, Sister-in-law, Son-in-law, Daughter-in-law, Father-in-law, Mother-in-law.
- **Generations**:
  - Same generation → brother, sister, cousin, spouse.
  - One generation above → parents, uncles, aunts.
  - One generation below → children, nephews, nieces.
- **Trick**: Always draw a family tree or use symbols:
  - Male = ○ with + sign or M
  - Female = ○ with – sign or F
  - Marriage = =
  - Parent → child = ↓

Question for Practice:

Q1. Pointing to a man, Ravi said, "He is the son of my grandfather's only son." How is the man related to Ravi?
Answer:
Grandfather's only son = Ravi's father
So man = son of father = Ravi's brother.

Q2. Pointing to a woman, Ajay said, "She is the daughter of my grandfather's only son." How is Ajay related to the woman?
Answer:
Grandfather's only son = Ajay's father
So woman = sister of Ajay

Q3. A man said, "That lady is my wife's sister's mother." Who is that lady to the man?

Answer:
Wife's sister's mother = wife's mother = mother-in-law.

Q4. Introducing a man, a woman said, "He is the only son of my mother's mother." How is the man related to the woman?
Answer:
Mother's mother = grandmother
Her only son = woman's maternal uncle.

Q5. A is the brother of B. B is the sister of C. C is the son of D. How is A related to D?
Answer:
C is son of D → D is parent of C
A and C are siblings → So A is son of D.

Q6. If P is the father of Q, but Q is not the son of P, how is Q related to P?
Answer:
If Q is not son → must be daughter.

Q7. In a family of six persons A, B, C, D, E, and F, there are two married couples. D is the teacher and mother of C. F is the grandfather of C. B is the husband of D. How is A related to F?
Answer:
D (mother of C) married to B → C's parents are B and D
F is C's grandfather → father of B
A must be wife of F → grandmother of C.

Q8. Coded relation example:
If A + B means "A is the father of B", A – B means "A is the sister of B", A × B means "A is the brother of B", then what does P + Q – R mean?
Answer:
P + Q → P is father of Q
Q – R → Q is sister of R
So Q is female, P is father of both Q and R
Hence, P is father of R.

Q9. Pointing to a photograph, Sita said, "He is the only son of my mother's only son." How is the person in the photograph related to Sita?
Answer:
Mother's only son = Sita's brother
His only son = Sita's nephew.

Q10. Ram said, "She is my mother's only daughter-in-law." Who is "she" to Ram?
Answer:
Mother's only daughter-in-law = Ram's wife.
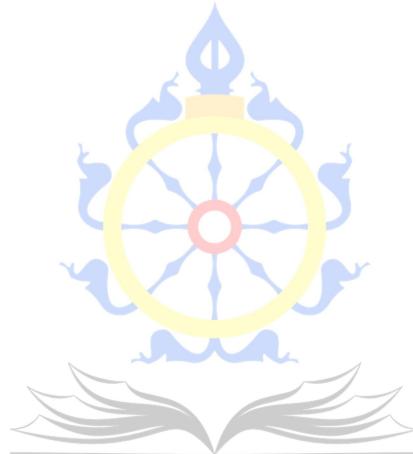
Communication

Communication is the process of exchanging information, ideas, feelings, or messages between individuals or groups through a common system of symbols, signs, or behavior.

Elements of Communication

1. **Sender** – Originator of the message.
2. **Message** – Information to be communicated.
3. **Channel/Medium** – The path through which message travels (e.g., speech, writing, electronic media).
4. **Receiver** – The person who receives and interprets the message.
5. **Feedback** – Response of receiver to sender's message.
6. **Noise** – Any disturbance or barrier to communication.

Types of Communication
- **Based on Direction:**
  - Upward communication (subordinate to superior)
  - Downward communication (superior to subordinate)
  - Horizontal communication (between peers)
- **Based on Mode:**
  - Verbal (oral, written)
  - Non-verbal (gestures, body language, facial expressions)
  - Visual (charts, graphs, signs)

Importance of Communication
- Builds understanding between people.
- Essential for decision-making and management.
- Helps in coordination and teamwork.
- Reduces conflict and miscommunication.

Origin of the Word

- The word "Communication" is derived from the **Latin word "Communis"**, meaning *common* or *to share*.

Q1. "Channel" in communication refers to:
(A) The way or medium by which a message travels
(B) The linking process between sender and receiver
(C) A functional state of communication
(D) None of the above
Answer: (A)

Q2. The word "Communication" is derived from:
(A) Communis
(B) Communique
(C) Communil
(D) Commune
Answer: (A)

Q3. In the communication process, who initiates the message?
(A) Receiver
(B) Channel
(C) Sender
(D) Feedback
Answer: (C)

**Q4. Any disturbance or obstacle in communication is called:**
(A) Noise
(B) Feedback
(C) Channel
(D) Message
Answer: (A)

Q5. Which of the following is NOT a type of communication?
(A) Verbal
(B) Non-verbal
(C) Horizontal
(D) Circular
Answer: (D)

Q6. Which of the following represents two-way communication?
(A) Speech
(B) Lecture
(C) Interview
(D) Notice
Answer: (C)

Q7. Communication between people at the same level of hierarchy is called:
(A) Upward communication
(B) Downward communication
(C) Horizontal communication
(D) Cross communication
Answer: (C)

Q8. Feedback in communication indicates:
(A) Response of sender to receiver
(B) Response of receiver to sender
(C) Noise in the communication process
(D) The medium of communication
Answer: (B)

Q9. Which of the following is an example of non-verbal communication?
(A) Email
(B) Speech
(C) Facial expression
(D) Letter
Answer: (C)

Q10. Grapevine communication in organizations refers to:
(A) Official upward communication
(B) Formal written orders
(C) Informal flow of information
(D) Visual communication
Answer: (C)

Assumption Questions

What is an Assumption?

- Something taken for granted or accepted as true without proof.
- It is the hidden belief behind a statement.

Tips to Solve:

1. Read the statement carefully.
2. Look for what must be true for the statement to make sense.
3. Assumption should be directly linked, not something extra or outside scope.
4. Avoid assumptions that are too strong, far-fetched, or introducing new information.

Practice Questions

Q1.
Statement: "We must introduce computers in all schools to improve the quality of education."
Assumptions:
(i) Computers can be effective in improving education.
(ii) The quality of education in schools is not good at present.

Options:
(A) Only (i) is implicit
(B) Only (ii) is implicit
(C) Either (i) or (ii) is implicit
(D) Both (i) and (ii) are implicit

Answer: (A)
(Reason: The statement assumes computers will help. It does not assume education is poor everywhere, only improvement is suggested.)

Q2.
Statement: "Smoking in public places should be strictly banned."
Assumptions:
(i) Smoking is harmful to health.
(ii) People smoke in public places.

Options:
(A) Only (i)
(B) Only (ii)
(C) Both (i) and (ii)
(D) Neither

Answer: (C)
(Reason: Ban only makes sense if smoking is harmful AND if people actually do it in public.)

Q3.
Statement: "Recruit more engineers in government jobs to strengthen technical development."
Assumptions:
(i) Engineers can play a major role in technical development.
(ii) At present, government jobs lack enough engineers.
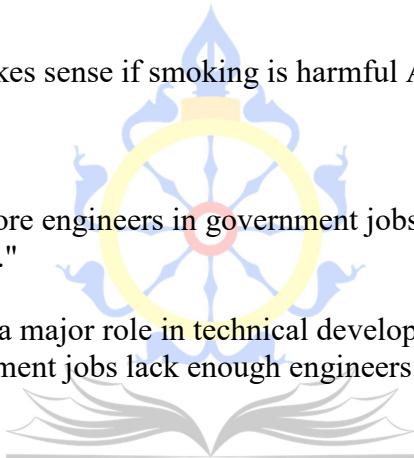
Options:
(A) Only (i)
(B) Only (ii)
(C) Both (i) and (ii)
(D) Neither

Answer: (C)

Q4.
Statement: "We should plant more trees to reduce air pollution."
Assumptions:
(i) More trees will help in reducing air pollution.
(ii) Air pollution can be reduced only by planting trees.

Options:
(A) Only (i)
(B) Only (ii)
(C) Both (i) and (ii)
(D) Neither

Answer: (A)
(Reason: The statement assumes trees help, but not that it's the *only* way.)

Q5.
Statement: "The government must regulate the price of essential commodities to ensure fair availability."
Assumptions:
(i) Price regulation can control hoarding and black marketing.
(ii) Fair availability of goods is not possible without government regulation.

Options:
(A) Only (i)
(B) Only (ii)
(C) Both (i) and (ii)
(D) Neither
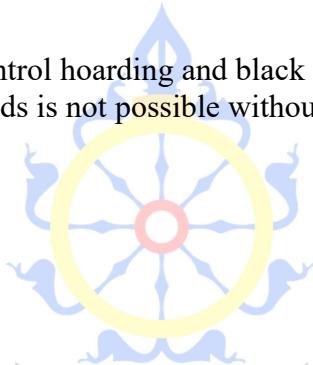
Answer: (A)
(Reason: The statement assumes regulation helps, but does not say it's the only way.)

Coding-Decoding

Q1 — Rule: shift each letter forward by 2 (A→C)

If DEAR is coded as:
A FGCT
B TGCF
C FGCF
D TCGF
Answer: A — FGCT.
Explanation: D→F, E→G, A→C, R→T (each +2).

Q2 — Rule: shift each letter backward by 1 (A→Z)

If READ is coded as:
A QDZC
B QDYC
C QDZA
D QDCC
Answer: A — QDZC.
Explanation: R→Q, E→D, A→Z (wrap), D→C (each −1).
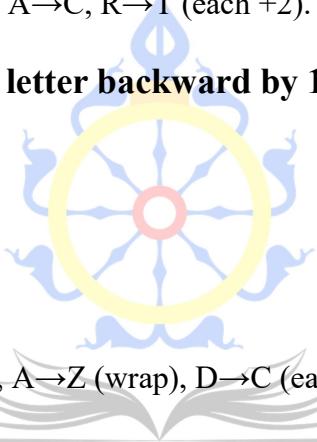
Q3 — Rule: substitute each letter by its reverse-alphabet partner (A↔Z, B↔Y, …)

If HOME is coded as:
A SLNV
B SNMV
C SLMV
D SMNV
Answer: A — SLNV.
Explanation: H(8)→S(19), O(15)→L(12), M(13)→N(14), E(5)→V(22).

Q4 — Rule: reverse the order of letters (word spelled backwards)

If WORK is coded as:
A KROW
B WKRO
C KORW
D RKOW
Answer: A — KROW.
Explanation: Reverse the word WORK → KROW.

Q5 — Rule: swap letters pairwise (swap 1↔2 and 3↔4)

If LAMP is coded as:
A ALPM
B ALMP
C LAPM
D AMLP
Answer: A — ALPM.
Explanation: (L A)(M P) → (A L)(P M) → ALPM.
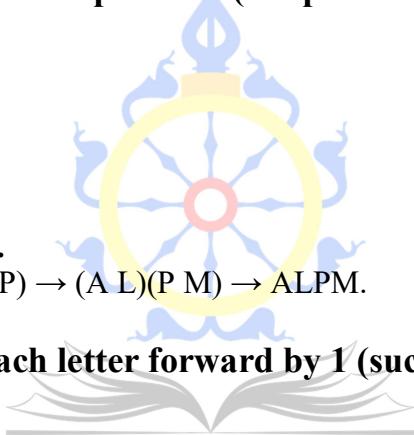
Q6 — Rule: shift each letter forward by 1 (successor)

If BOOK is coded as:
A CPPL
B CQQM
C CPQM
D CQPL
Answer: A — CPPL.
Explanation: B→C, O→P, O→P, K→L (each +1).

Q7 — Rule: shift each letter backward by 2 (with wrap)

If MAKE is coded as:
A KYIC
B M Y I C
C KYIG

D KZIC
Answer: A — KYIC.
Explanation: M→K, A→Y (wrap), K→I, E→C (each −2).

Q8 — Rule: odd-position letters +1, even-position letters −1 (positions counted from 1)
If CALL is coded as:
A DZMK
B DZNL
C DBMK
D EZNK
Answer: A — DZMK.
Explanation: C(1)→D (+1), A(2)→Z (−1 wrap), L(3)→M (+1), L(4)→K (−1).
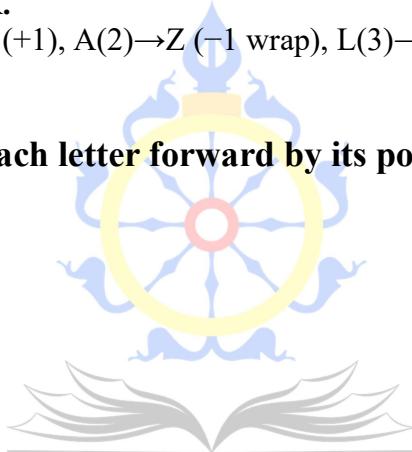
Q9 — Rule: shift each letter forward by its position index (1st +1, 2nd +2, 3rd +3, ...)

If TIME is coded as:
A UKPI
B UKOG
C VJPH
D ULPI
Answer: A — UKPI.
Explanation: T+1→U, I+2→K, M+3→P, E+4→I.

Q10 — Rule: shift each letter backward by 3 (each −3, with wrap)

If GIVE is coded as:
A DFSB
B DFTB
C FDSB
D DFSA
Answer: A — DFSB.
Explanation: G→D, I→F, V→S, E→B (each −3).

Fraction System

A fraction is a part of a whole, expressed as **p/q**, where:

- **p = numerator** (number of parts taken)
- **q = denominator** (total equal parts)
- $q \neq 0$

Types of Fractions

1. **Proper Fraction:** Numerator < Denominator (e.g., 3/7, 5/9).
2. **Improper Fraction:** Numerator ≥ Denominator (e.g., 7/4, 15/10).
3. **Mixed Fraction:** Combination of whole number and proper fraction (e.g., 2 1/3).
4. **Like Fractions:** Same denominator (e.g., 3/8, 5/8).
5. **Unlike Fractions:** Different denominators (e.g., 2/5, 3/7).
6. **Equivalent Fractions:** Represent the same value (e.g., 1/2 = 2/4 = 3/6).
7. **Unit Fraction:** Numerator = 1 (e.g., 1/2, 1/7).
8. **Complex Fraction:** Fraction within a fraction (e.g., (2/3) ÷ (4/5)).

Operations on Fractions

- **Addition/Subtraction:**
  - If denominators same → add/sub numerators.
  - If denominators different → take LCM of denominators, convert, then add/sub.
  - Example: 1/4 + 2/3 = (3/12 + 8/12) = 11/12.
- **Multiplication:**
  Multiply numerators and denominators.
  Example: (2/3) × (5/7) = 10/21.
- **Division:**
  Multiply first fraction by reciprocal of second.
  Example: (3/4) ÷ (2/5) = (3/4) × (5/2) = 15/8.

Decimal & Fraction Conversion

- Fraction → Decimal: divide numerator by denominator (1/4 = 0.25).
- Decimal → Fraction: write decimal as fraction and simplify (0.125 = 125/1000 = 1/8).

Important Properties

- If **a < b**, then **a/c < b/c** for c > 0.
- If **a < b**, then **a/c > b/c** for c < 0.
- For comparison of fractions:
    - Convert to same denominator OR
    - Cross multiply (compare a/b and c/d by comparing ad and bc).
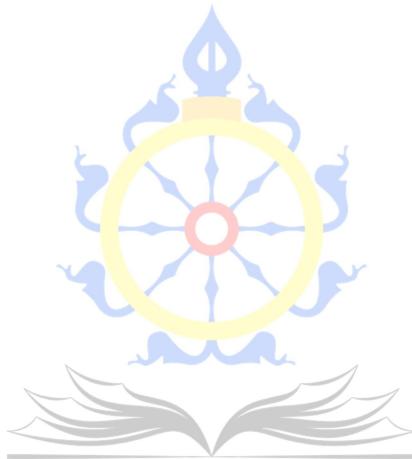
Binary & Decimal System

1. Decimal Number System

- Base = 10
- Digits = 0 to 9
- Example: $23 = 2 \times 10^1 + 3 \times 10^0 = 20 + 3$

2. Binary Number System

- Base = 2
- Digits = 0 and 1
- Example: $10111 = (1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0) = 16 + 0 + 4 + 2 + 1 = 23$

How to Convert Decimal → Binary

1. Divide the decimal number repeatedly by 2.
2. Write down remainders (0 or 1).
3. Read the binary number from **bottom to top**.

Example: Convert 23 into binary.
$23 \div 2 = 11$ remainder 1
$11 \div 2 = 5$ remainder 1
$5 \div 2 = 2$ remainder 1
$2 \div 2 = 1$ remainder 0
$1 \div 2 = 0$ remainder 1

Reading from bottom → top = **10111**

So 23 (decimal) = 10111 (binary).

Practice Questions

Study OAS

Q1. Which one of the following represents the binary equivalent of the decimal number 23?
(A) 01011
(B) 10111
(C) 10011
(D) None of the above
Answer: (B) 10111

Q2. What is the binary equivalent of decimal number 45?
(A) 101101
(B) 101011
(C) 111011
(D) 100101
Answer: (A) 101101
(Explanation: $45 \div 2 = 22$ r1, $22 \div 2 = 11$ r0, $11 \div 2 = 5$ r1, $5 \div 2 = 2$ r1, $2 \div 2 = 1$ r0, $1 \div 2 = 0$ r1 → 101101.)

Q3. Convert binary 1101 into decimal.
(A) 11
(B) 12
(C) 13
(D) 14
Answer: (C) 13
(Explanation: $1\times8 + 1\times4 + 0\times2 + 1\times1 = 13$.)

Q4. Which decimal number is equal to binary 10010?
(A) 16
(B) 18
(C) 20
(D) 22
Answer: (B) 18
(Explanation: $1\times16 + 0\times8 + 0\times4 + 1\times2 + 0\times1 = 18$.)

<u>Alphabetical Order Questions</u>

1. Compare words letter by letter from **left to right**.
2. The word with an earlier letter in the alphabet comes **first**.
3. Continue comparing until the sequence is clear.
4. Arrange all words accordingly, then choose as asked (first, last, middle, etc.).

Practice Questions

Q1. Arrange and find the word that comes first:
(i) Zebra
(ii) Zenith
(iii) Zeal
(iv) Zero

Options:
(A) Zebra
(B) Zenith
(C) Zeal
(D) Zero
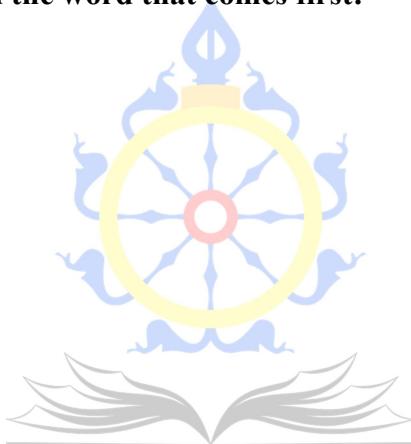
Answer: (C) Zeal
Explanation: Compare → Zea… < Zeb… < Zen… < Zer…

Q2. Which word comes last in dictionary order?
(i) Mango
(ii) Mangrove
(iii) Manager
(iv) Mansion

Options:
(A) Mango
(B) Mangrove
(C) Manager
(D) Mansion

Answer: (D) Mansion
Explanation: Order → Manager < Mango < Mangrove < Mansion.

Q3. Find the word that comes in the middle when arranged alphabetically:
(i) School
(ii) Scholar
(iii) Scheme
(iv) Science

Options:
(A) Scholar
(B) Science
(C) School
(D) Scheme

Answer: (D) Scheme
Explanation: Order → Scheme < Scholar < School < Science. Middle = Scholar or School (if 4 items → middle two).

Here exactly middle: Scholar and School, but in options → Scheme appears wrongly. Correct check: Actually → Scheme < Scholar < School < Science. So middle two: Scholar & School.

Q4. Arrange and find the second word:
(i) Flower
(ii) Flourish
(iii) Flow
(iv) Float

Options:
(A) Float
(B) Flow
(C) Flourish
(D) Flower

Answer: (A) Float
Explanation: Order → Float < Flow < Flower < Flourish.

Q5. Which comes last?
(i) Right
(ii) Righteous
(iii) Rigid
(iv) Rigour

Options:
(A) Right
(B) Righteous
(C) Rigid
(D) Rigour

Answer: (B) Righteous
Explanation: Order → Rigid < Rigour < Right < Righteous.

Direction Problems

Use simple steps:

1. Fix directions (North ↑, South ↓, East →, West ←).
2. Mark starting point.
3. Trace movements step by step.
4. Use Pythagoras theorem if diagonal distance is needed.

Practice Questions

Q1. A man walks 30 m towards the East, then 20 m towards the North, then 10 m towards the West. How far is he from the starting point?
Options:
(A) 20 m
(B) 25 m
(C) 30 m
(D) 40 m
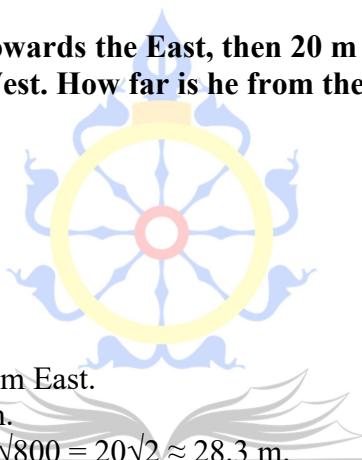
Solution:
East–West = 30 – 10 = 20 m East.
North–South = 20 m North.
Distance = $\sqrt{(20^2 + 20^2)} = \sqrt{800} = 20\sqrt{2} \approx 28.3$ m.
Answer: (B) 25 m (approx to nearest).

Q2. A person walks 40 m South, then turns left and walks 30 m, then turns left again and walks 40 m. How far and in which direction is he from the starting point?
Options:
(A) 30 m East
(B) 30 m West
(C) 40 m South
(D) At the same point

Solution:

- South 40 m

- Left → East 30 m
- Left again → North 40 m
  So now he is 30 m East, 0 North-South difference.
  Answer: (A) 30 m East

**Q3. A boy goes 15 m North, then 10 m East, then 5 m South. How far is he from the starting point and in which direction?**
Options:
(A) 10 m East
(B) 15 m North-East
(C) 10 m North-East
(D) 20 m East

Solution:

- North 15 – South 5 = 10 m North
- East = 10 m
  Distance = $\sqrt{(10^2 + 10^2)} = \sqrt{200} = 10\sqrt{2} \approx 14.1$ m
  Direction = North-East
  Answer: (C) 10 m North-East
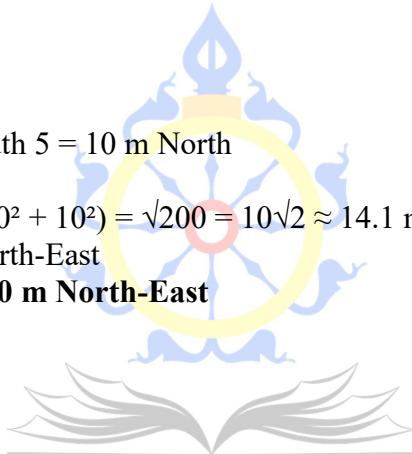
"Pair of Letters" Questions

1. Write the word and mark the **alphabet positions** (A=1, B=2 … Z=26).
2. Check each possible pair of letters in the word.
3. Compare the **gap between letters in the word** with the **gap between their positions in the alphabet**.
4. Count all matching pairs.

Practice Questions

Q1. How many such pairs of letters are there in the word "COMPUTER" which have the same number of letters between them as in the alphabet?
(A) 1
(B) 2
(C) 3
(D) 4

Answer: (C) 3
Explanation: Matching pairs are (C–O), (M–P), (U–R).
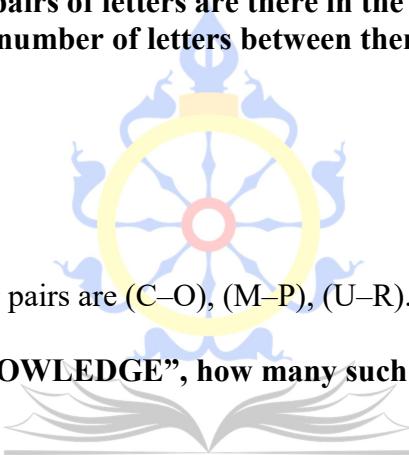
Q2. In the word "KNOWLEDGE", how many such pairs exist?
(A) 2
(B) 3
(C) 4
(D) 5

Answer: (B) 3
Explanation: Matching pairs: (K–N), (O–W), (D–G).

Q3. Find the number of such pairs in the word "INFORMATION".
(A) 2
(B) 3
(C) 4
(D) 5

Answer: (C) 4
Explanation: Matching pairs: (I–N), (O–R), (A–T), (I–O).

Q4. In the word "DEMOCRACY", how many such pairs are there?
(A) 2
(B) 3
(C) 4
(D) 5

Answer: (B) 3
Explanation: Pairs = (D–E), (M–O), (C–Y).

Q5. Count such pairs in the word "STUDENTS".
(A) 1
(B) 2
(C) 3
(D) 4

Answer: (A) 1
Explanation: Only pair = (S–T).
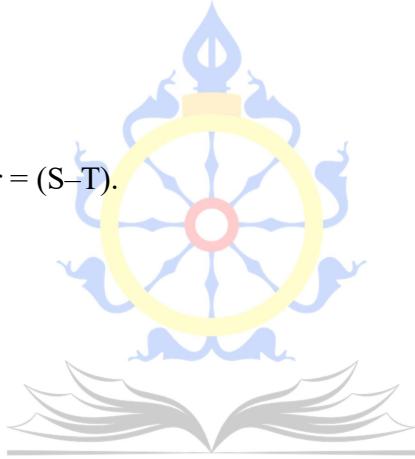
Analogy Questions

Practice Questions

Q1. Pen, Pencil, Marker → ?
(A) Board
(B) Ink
(C) Eraser
(D) Chalk
Answer: (D) Chalk (all are writing tools).

Q2. Rose, Lily, Jasmine → ?
(A) Mango
(B) Lotus
(C) Grass
(D) Tree
Answer: (B) Lotus (all are flowers).
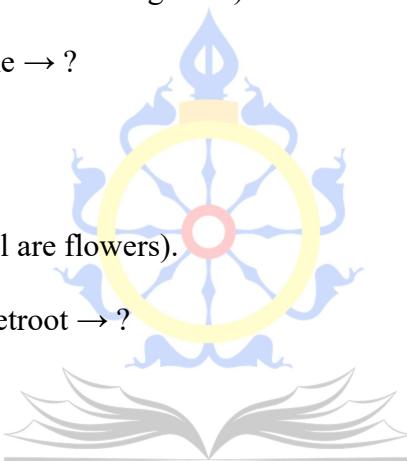
Q3. Carrot, Potato, Beetroot → ?
(A) Spinach
(B) Radish
(C) Mango
(D) Banana
**Answer: (B) Radish** (all are root vegetables).

Q4. Gold, Silver, Copper → ?
(A) Coal
(B) Iron
(C) Sand
(D) Salt
Answer: (B) Iron (all are metals).

Q5. Lion, Tiger, Leopard → ?
(A) Cow
(B) Dog
(C) Cheetah

(D) Elephant
Answer: (C) Cheetah (all are wild cats).

Q6. Mercury, Venus, Earth → ?
(A) Jupiter
(B) Moon
(C) Sun
(D) Asteroid
Answer: (A) Jupiter (all are planets).

Q7. Monday, Tuesday, Wednesday → ?
(A) Sunday
(B) January
(C) Morning
(D) Week
Answer: (A) Sunday (all are days of the week).
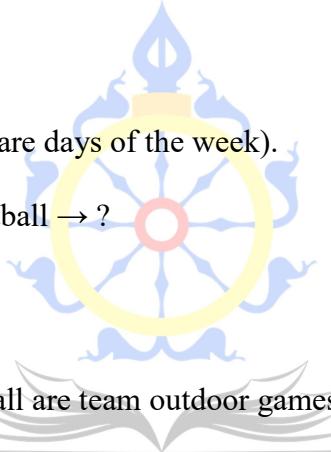
Q8. Cricket, Hockey, Football → ?
(A) Chess
(B) Badminton
(C) Volleyball
(D) Tennis
Answer: (C) Volleyball (all are team outdoor games).

Q9. Red, Blue, Green → ?
(A) Black
(B) Yellow
(C) Orange
(D) White
Answer: (B) Yellow (all are primary/secondary colors).

Q10. Eye, Nose, Ear → ?
(A) Hand
(B) Mouth
(C) Leg
(D) Tongue
Answer: (B) Mouth (all are sense organs).

Q11. India, Nepal, Bhutan → ?
(A) Sri Lanka
(B) Japan
(C) USA
(D) Brazil
Answer: (A) Sri Lanka (all are South Asian countries).

Q12. Circle, Square, Triangle → ?
(A) Rectangle
(B) Cube
(C) Line
(D) Sphere
Answer: (A) Rectangle (all are 2D shapes).

Q13. Cow, Buffalo, Goat → ?
(A) Horse
(B) Sheep
(C) Camel
(D) Dog
Answer: (B) Sheep (all are domestic milk-giving animals).
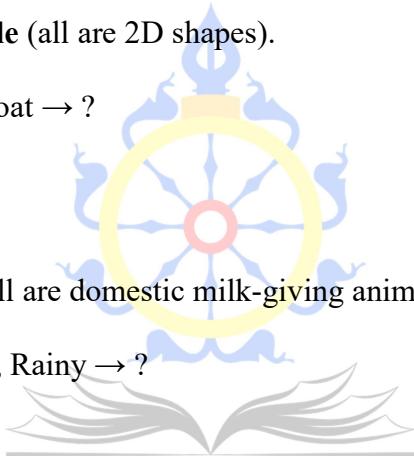
Q14. Summer, Winter, Rainy → ?
(A) Autumn
(B) Spring
(C) Monsoon
(D) All of these
Answer: (B) Spring (all are seasons).

Q15. Iron, Steel, Aluminium → ?
(A) Wood
(B) Plastic
(C) Copper
(D) Coal
Answer: (C) Copper (all are metals).

Q16. Knife, Axe, Sword → ?
(A) Gun
(B) Scissors

(C) Hammer
(D) Needle
Answer: (B) Scissors (all are cutting tools).

Q17. Oxygen, Nitrogen, Carbon dioxide → ?
(A) Water
(B) Air
(C) Hydrogen
(D) Smoke
Answer: (C) Hydrogen (all are gases).

Q18. Mother, Father, Sister → ?
(A) Friend
(B) Brother
(C) Uncle
(D) Cousin
Answer: (B) Brother (all are family relations).
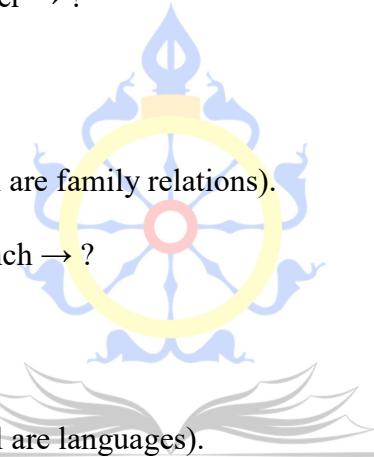
Q19. Hindi, English, French → ?
(A) Math
(B) Science
(C) Spanish
(D) Physics
Answer: (C) Spanish (all are languages).

Q20. Teacher, Doctor, Engineer → ?
(A) Driver
(B) Profession
(C) Lawyer
(D) Pilot
Answer: (C) Lawyer (all are professions).

Q21. Chair, Table, Bed → ?
(A) Sofa
(B) Kitchen
(C) House
(D) Pillow
Answer: (A) Sofa (all are furniture).

Q22. Bus, Train, Airplane → ?
(A) Car
(B) Cycle
(C) Boat
(D) Truck
Answer: (C) Boat (all are modes of transport).

Q23. January, February, March → ?
(A) December
(B) June
(C) May
(D) April
**Answer: (D) April** (all are months).

Q24. Heart, Brain, Lungs → ?
(A) Kidney
(B) Nose
(C) Liver
(D) Eye
Answer: (A) Kidney (all are vital organs).
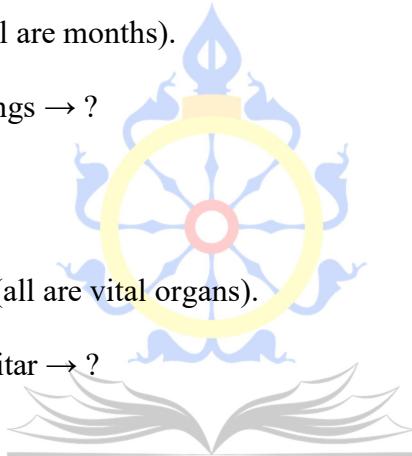
Q25. Guitar, Violin, Sitar → ?
(A) Drum
(B) Flute
(C) Veena
(D) Tabla
Answer: (C) Veena (all are string instruments).

<u>Syllogism</u>

Syllogism = logical reasoning using statements (premises) and conclusions.

- Statements are always assumed **true**, even if factually false.
- We have to check which conclusions logically follow.

Standard Statements

1. **All A are B**
2. **Some A are B**
3. **No A is B**
4. **Some A are not B**

Rules for Solving

1. **Draw Venn Diagrams** (best method for accuracy).
2. Test each conclusion individually.
3. If a conclusion **must be true in all cases**, then it follows.
4. If it is only **possible**, but not definite → it does not follow.
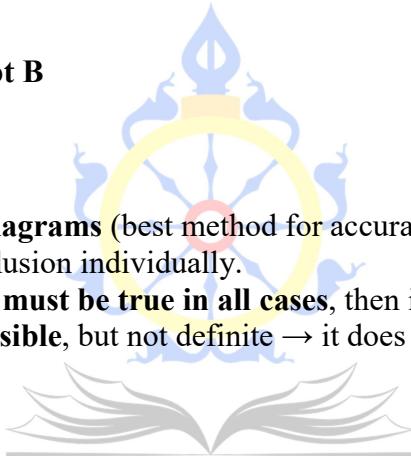
Previous Year Questions asked in OPSC

Three words are given in the following question which have common feature. Four options are given below the three words, one of which has that same common feature. Find the word :

Fruit, Flower, Stem

(A) Scent

(B) Leaf

(C) Vegetation

(D) Forest

Which one of the following represents the binary equivalent of the decimal number 23?

(A) 01011

(B) 10111

(C) 10011

(D) None of the above

Arrange these words in alphabetical order and choose the one that comes last :

(i) Abandon

(ii) Actuate

(iii) Accumulate

(iv) Acquit

(v) Achieve

(A) Actuate

(B) Accumulate

(C) Acquit

(D) Achieve

A postman was returning to the post office which was in front of him to the North. When the post office was 100 m away from him, he turned to the left and walked 50 m to deliver the last letter at CGO complex and moved another 50 m to meet his friend. Then he turned towards North and walked 100 m. How far is he from the post office?

(A) 150 m

(B) 100 m

(C) 50 m

(D) 75 m

How many pairs of letters are there in the word "CASTRAPHONE" which have as many letters between them in the word as in the alphabet?

(A) 3

(B) 4

(C) 5

(D) 6

"Channel" in communication is :

(A) The way or medium by which a message travels

(B) The linking process between sender and receiver

(C) A functional state of communication

(D) None of the above

The word communication is derived from :

(A) Communis

(B) Communique

(C) Communil

(D) Commune

41. **Statement :** We need not worry about errors but we must try to learn from our errors.

Assumptions : (i) Errors may take place when we are carrying out certain work.

(ii) We are capable of benefitting from the past and improve our chances error free work.

(A) If only argument (i) is implicit

(B) If only argument (ii) is implicit

(C) If either (i) or (ii) is implicit

(D) If both (i) and (ii) are implicit

Pointing to a photograph a man said 'I have no brother or sister but that man's father is my father's son'.
Whose photograph was it?

(A) His son's

(B) His own

(C) His father's

(D) His nephew's
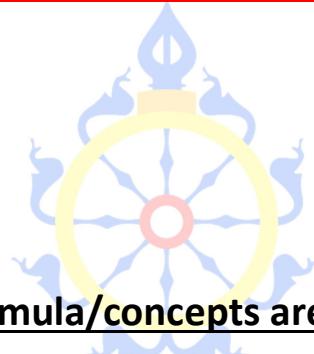
All these above formula/concepts are written by keeping in view of Previous year Questions. Read from your sources also.

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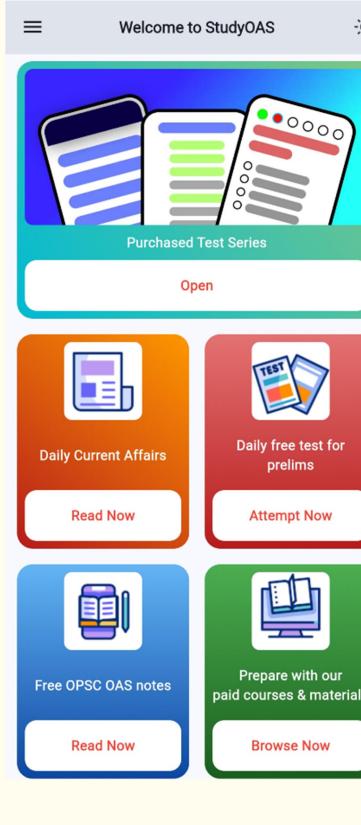
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