CAT Formula Sheet 2024 PDF

Number Systems

- Sum of first n natural numbers = n(n+1)/2
- 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
- Sum of first n odd numbers = n^2
- Dividend = (Divisor x Quotient) + Remainder

Profit, Loss, and Discount

- Profit Percentage = (Profit/Cost Price) x 100
- Loss Percentage = (Loss/Cost Price) x 100
- Selling Price = Cost Price + Profit
- Selling Price = Cost Price – Loss
- Cost Price = Selling Price – Profit
- Cost Price = Selling Price + Loss
- Profit = Selling Price – Cost Price
- Loss = Cost Price – Selling Price
- Discount = Marked Price – Selling Price
- Discount Percentage = (Discount/Marked Price) x 100
- Marked Price = Selling Price/(1 – Discount Percentage/100)
- Marked Price = Cost Price/(1 – Profit Percentage/100)
- Profit Percent = $\frac{\text{Profit}}{\text{C.P.}} \times 100$
- Loss Percent = $\frac{\text{Loss}}{\text{C.P.}} \times 100$
- Selling Price = $\frac{\text{Cost Price } (100 + \text{Profit\%})}{100}$

  Or

  $\frac{\text{Cost Price } (100 - \text{Loss\%})}{100}$
- Loss% = $(x/10)^2$
- Value of Loss = $\frac{2x^2S}{100^2 - x^2}$

HCF and LCM

To find the HCF of the given numbers

1. Break the given numbers into their prime factors
2. The HCF will be the product of all the prime factors common to all the numbers

To find the LCM of given numbers:

1. Break the given numbers into their prime factors
2. The LCM will be the product of the highest power of all the factors that occur in the given numbers

- HCF of A, B and C is the highest divisor which can exactly divide A, B, and C

- LCM of A, B and C is the lowest dividend which is exactly divisible by A, B, and C

- Other number = $\frac{\text{LCM x HCF}}{\text{1st number}}$

- HCF of fractions = $\frac{\text{HCF of the numerators}}{\text{LCM of the Denominators}}$

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Simple Interest

If we are given the Principal (P), the Rate of Interest (r), and the Time Period (t), we will have

Simple Interest (SI) = Prt/100

Amount (A) = P + Prt/ 100=P(1+rt/100)

Compound Interest (CI)

1. **CI = A – P**

A is the amount including interest and principal (*P*) both

2. Amount, **$A = P(1+r/100)^t$**

3. When the rate of interest is half-yearly

$A = P(1+r/2/ 100)^2t$

4. When the rate of interest is quarterly

$$A = P\left(1 + \frac{r/4}{100}\right)^{4t}$$

5. Difference between CI and SI for two years = **p(r/100)²**
6. Difference between CI and SI for three years = **p(r/100)² (r/100+3)**
7. Difference between CI and SI for *n* th year

$$= \frac{Pr}{100}\left[\left(1+\frac{r}{100}\right)^{n-1} - 1\right]$$

8. For compound interest, if *r* denotes the rate of interest, the change in amount over the previous year can be calculated or following.

$$\frac{\text{increase in amount in } n^{\text{th}} \text{ year}}{\text{increase in amount in } (n+1)^{\text{th}} \text{ year}} = \frac{100}{(100+r)}$$

Similarly,

$$\frac{\text{decrease in amount in } n^{\text{th}} \text{ year}}{\text{decrease in amount in } (n+1)^{\text{th}} \text{ year}} = \frac{100}{(100-r)}$$

Depreciation

It is common knowledge that the prices of certain items depreciate in value over time. When the value of an item decreases in terms of currency, we say that its value is depreciating.

$$V_f = V_i \left(1 - \frac{r}{100}\right)^t$$

Where,

V_i = Initial value of the article

V_f = Final (depreciated) value of article

r = rate of interest by which the price of article decreases over the time period '*t*'.

Time and Work

- Work Done = Time Taken × Rate of Work
- Rate of Work = 1 / Time Taken
- Time Taken = 1 / Rate of Work
- If a piece of work is done by A in n days, then A's 1 day's work = 1/n

- If A’s 1 day’s work = $1/n$, then A can finish the work in n days
- If A can do a piece of work in x days and B can do the same work in y days, then the work done by both A and B in one day = $1/x + 1/y$
- If A can do a piece of work in x days and B can do the same work in y days, then the time taken by both A and B to complete the work together = $(xy) / (x + y)$

Speed, Time and Distance

- Speed = Distance/Time – how quickly or slowly an object is moving or the amount of time it took to travel a certain distance divided by the distance travelled.
- Average Speed = (Total distance travelled) / (Total time taken)
- Speed is inversely correlated with time and directly correlated with distance. Hence,
    - (a) Distance = Speed X Time, and
    - (b) Time = Distance / Speed, The time required will reduce as the speed does, and vice versa.

Averages

- Average = (Sum of observations) / (Number of observations)
- If the average of n numbers is A, then the sum of the n numbers is nA.
- If the average of n numbers is A and m more numbers are added to the list, then the new average becomes $(nA + mB) / (n + m)$, where B is the average of the m numbers.
- If the average of n numbers is A and each number is increased by x, then the new average becomes $(nA + nx) / n$.
- If the average of n numbers is A and each number is decreased by x, then the new average becomes $(nA – nx) / n$.

Surds and Indices

- Product rule: $a^m \times a^n = a^{(m+n)}$
- Quotient rule: $a^m / a^n = a^{(m-n)}$
- Power rule: $(a^m)^n = a^{(m \times n)}$
- Negative exponent rule: $a^{(-m)} = 1 / a^m$
- Rational exponent rule: $a^{(m/n)}$ = nth root of a^m
- Fractional exponent rule: $a^{(p/q)}$ = qth root of a^p
- Surds multiplication rule: $\sqrt{a} \times \sqrt{b} = \sqrt{(ab)}$
- Surds division rule: $\sqrt{a} / \sqrt{b} = \sqrt{(a/b)}$
- Surds addition rule: $\sqrt{a} + \sqrt{b} \neq \sqrt{(a+b)}$
- Surds subtraction rule: $\sqrt{a} – \sqrt{b} \neq \sqrt{(a-b)}$

Logarithm

- Definition of a logarithm: If $x>0$ and b is a constant $(b\neq1)$, then $y = \log bx$ if and only if $x = by$.

- Logarithmic identities:
  - Log b(xy) = log bx + log by
  - Log b(x/y) = log bx – log by
  - Log b(x^p) = p log bx
  - Log b1 = 0
  - Log bb = 1
  - Log b(x) = 1 / log x(b)
- Change of base formula: log b(x) = log a(x) / log a(b)
- Common logarithm: log10(x) = log(x)
- Natural logarithm: log e(x) = ln(x)

Set Theory & Function

- De Morgan's Law: (A ∩ B)' = A' U B' and (A U B)' = A' ∩ B'
- Cardinality of a set: The number of elements in a set is called its cardinality.
- Union of sets: A U B = {x: x ∈ A or x ∈ B}
- Intersection of sets: A ∩ B = {x: x ∈ A and x ∈ B}
- Complement of a set: A' = {x: x ∉ A}
- Difference of sets: A – B = {x: x ∈ A and x ∉ B}
- Cartesian product of sets: A × B = {(a, b): a ∈ A and b ∈ B}
- n(A ∪ B) = n(A) +n(B) – n (A ∩ B)
- n(A∪B)=n(A)+n(B) {when A and B are disjoint sets}
- n(U)=n(A)+n(B)–n(A∩B)+n((A∪B)c)
- n(A∪B)=n(A−B)+n(B−A)+n(A∩B)
- n(A−B)=n(A∩B)−n(B)
- n(A−B)=n(A)−n(A∩B)
- n(Ac)=n(U)−n(A)
- n(PUQUR)=n(P)+n(Q)+n(R)–n(P∩Q)–n(Q∩R)–n(R∩P)+n(P∩Q∩R)

COMMUTATIVE LAWS

- A B = B A
- A ∩ B = B ∩ A

ASSOCIATIVE LAWS

- (A B) C = A (B C)
- (A ∩ B) ∩ C = A ∩ (B ∩ C)

DISTRIBUTIVE LAWS

- A (B ∩ C) = (A B) ∩ (A C)
- A ∩ (B C) = (A ∩ B) (A ∩ C)

IDENTITY LAWS

- A = A
- A ∩ U = A

COMPLEMENT LAWS

- A A^c = U
- A ∩ A^c =

DE MORGAN'S LAW

- $(A\ B)^C = A^C \cap B^C$
- $(A \cap B)^C = A^C\ B^C$

Trigonometry

- Sine = Opposite/ Hypotenuse
- Cosine = Adjacent/ Hypotenuse
- Tangent = Opposite/ Adjacent
- Secant = Hypotenuse/ Adjacent
- Cosecant = Hypotenuse/ Opposite
- Cotangent = Adjacent/ Opposite
- Sum and Difference Formulas:
    - sin(u + v) = sin(u)cos(v) + cos(u)sin(v)
    - cos(u + v) = cos(u)cos(v) – sin(u)sin(v)
    - sin(u – v) = sin(u)cos(v) – cos(u)sin(v)
    - cos(u – v) = cos(u)cos(v) + sin(u)sin(v)
- Reciprocal Identities:
    - cosec θ = 1/sin θ
    - sec θ = 1/ cos θ
    - cot θ = 1/tan θ
    - sin θ = 1/cosec θ
    - cos θ = 1/sec θ
    - tan θ = 1/cot θ

Mensuration

Mensuration Formulas for Circles

- Circumference of circle= 2πr
- Area of circle= πr^2
- Length of arc= θ/360×2πr
- Area of Sector= $\theta/360\times\pi r^2$
- Area of Segment= $\theta/360\times\pi r^2 - 1/2\times r^2\times\sin\theta$

Mensuration Formulas for Triangles

It is the sum of all three sides of a triangle. Let a, b, and c be the sides of a triangle then:

- Perimeter of triangle (P) = a + b + c
- Semi Perimeter of triangle (s) =(frac{a+b+c}{2})
- Area of triangle =1/2×b×h
- Area of triangle =√s(s–a)(s–b)(s–c)

Mensuration Formulas for Quadrilaterals

- Area of any Quadrilateral = 12×one diagonal×(h1+h2)12×one diagonal×(h1+h2)
- Area of any Quadrilateral = 1212×d_1d_2×sinθ, where d_1 and d_2 are the diagonals of the quadrilaterals and 'θ' is the angle between them
- Area of any Quadrilateral = √(s–a)(s–b)(s–c)(s–d)–abcd×cos2α(s–a)(s–b)(s–c)(s–d)–abcd×cos2α, where αα= Average of any pair of opposite angles of the quadrilateral and s= a+b+c+d2s=a+b+c+d2
- Perimeter of Rectangle = 2(length+breadth)
- Area of Rectangle= length x breadth
- Perimeter of Square= 4a
- Area of Square = a^2, where aa is the side of the square.
- Perimeter of Parallelogram = 2(a+b), where a and b are two adjacent sides of the parallelogram.
- Area of Parallelogram= base x height
- Perimeter of Rhombus = 4a
- Area of Rhombus = 12×d1×d212×d1×d2, where d1 and d2 are the two diagonals of the Rhombus.
- Area of Trapezium= 12×(a+b)×h12×(a+b)×h, where a and b are the parallel sides of the trapezium and hh is the perpendicular distance between a and b.

Mensuration Formulas for Polygons

- Area of a Regular Polygon= 1/2 (apothem)(perimeter)
- Sum of interior angles = (*n* – 2)·180°
- Interior angle =(n−2)/n×180° for regular polygons
- Exterior angle =360^0n for regular polygons

Coordinate Geometry

- Distance Formula: The distance between two points P(x1, y1) and Q(x2, y2) is given by √[(x2 – x1)^2 + (y2 – y1)^2].
- Slope Formula: The slope of a line passing through two points P(x1, y1) and Q(x2, y2) is given by (y2 – y1) / (x2 – x1).

- Equation of a Line: The equation of a line passing through a point (x1, y1) with slope m is given by y – y1 = m(x – x1) or y = mx + (y1 – mx1).
- Midpoint Formula: The midpoint of a line segment joining two points P(x1, y1) and Q(x2, y2) is given by [(x1 + x2) / 2, (y1 + y2) / 2].
- Section Formula: If a point R(x, y) divides the line segment joining two points P(x1, y1) and Q(x2, y2) in the ratio m:n, then x = [(nx2) + (mx1)] / (m + n) and y = [(ny2) + (my1)] / (m + n).
- Slope of a Parallel Line: The slope of a line parallel to a line with slope m is also m.
- Slope of a Perpendicular Line: The slope of a line perpendicular to a line with slope m is -1/m.

Permutation & Combination

Permutations of *n* Different Things

- Number of permutations of *n* different things taken all at a time = ${}^{n}P_{n} = n!$
- Number of permutations of *n* different things taken *r* at a time= ${}^{n}P_{r}$ = n!(n−r)!n!(n−r)!
- Number of permutations of *n* different things taken at Most *r* at a time= ${}^{n}P + {}^{n}P + {}^{n}P + \ldots + {}^{n}P_{r}$
- Number of permutations of *n* different things taken at least *r* at a time = ${}^{n}P_{r} + {}^{n}P_{r+1} + {}^{n}P_{r+2} + \ldots + {}^{n}P_{n}$
- Number of permutations of *n* different things taken *r* at a time, when one particular thing always occurs = $r \cdot ({}^{n-1}P_{r-1})$
- Number of permutations of *n* different things taken *r* at a time, when one particular thing never occurs = ${}^{n-1}P_{r}$
- Number of permutations of *n* different things taken *r* at a time, when *k* particular things, always occur = $({}^{r}P_{k})({}^{n-k}P_{r-k})$
- Number of permutations of *n* different things taken *r* at a time, when *k* particular things never occur = ${}^{n-k}P_{r}$
- Number of permutations of *n* different things, taken all at a time, when *m* specified things always come together = $m!(n-m+1)!$
- Number of permutations of *n* different things, taken all at a time, when *m* specified things never come together = $n! - [m!(n - m + 1)!]$

Combination of *n* Different Things

- Number of ways that n different things can be put together when x things always happen = ${}^{n-x}C_{r-x}$
- Number of ways n different things can happen at the same time when x things never happen = ${}^{n-x}C_{r}$
- Number of ways that n different things can be put together so that x things always happen and y things never happen = ${}^{n-x-y}C_{r-x}$
- Number of ways n different things can be put together r at a time when x things can not be put together in any pick = ${}^{n-x}C_{r-x}$

- Number of ways of selections of zero or more things from a group of n distinct things = ${}^{n}C_0 + {}^{n}C_1 + {}^{n}C_2 + {}^{n}C_3 + \ldots + {}^{n}C_n = 2^n$
- Number of ways of selections of one or more things from a group of n distinct things = ${}^{n}C_1 + {}^{n}C_2 + {}^{n}C_3 + \ldots + {}^{n}C_n = 2^n - 1$ $({}^{n}C_0 = 1)$