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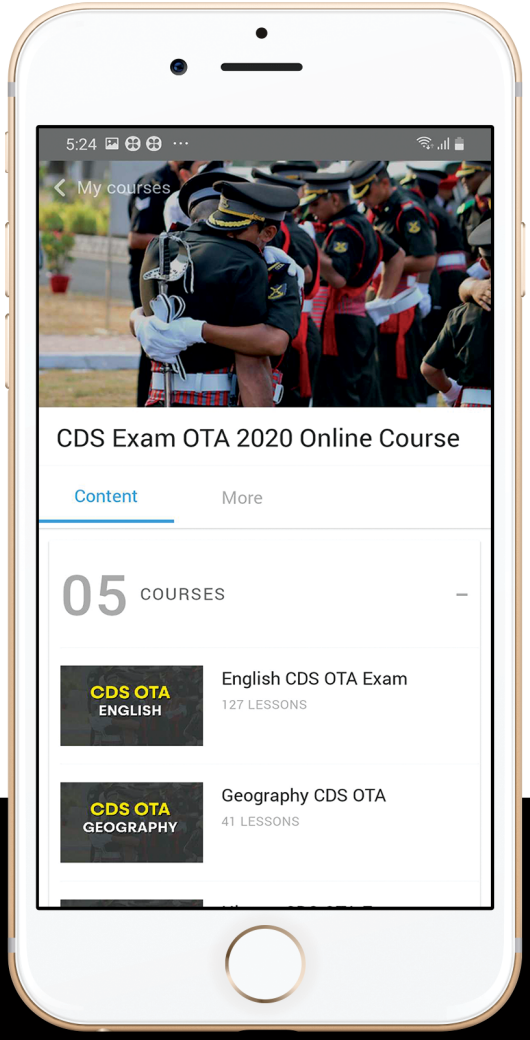

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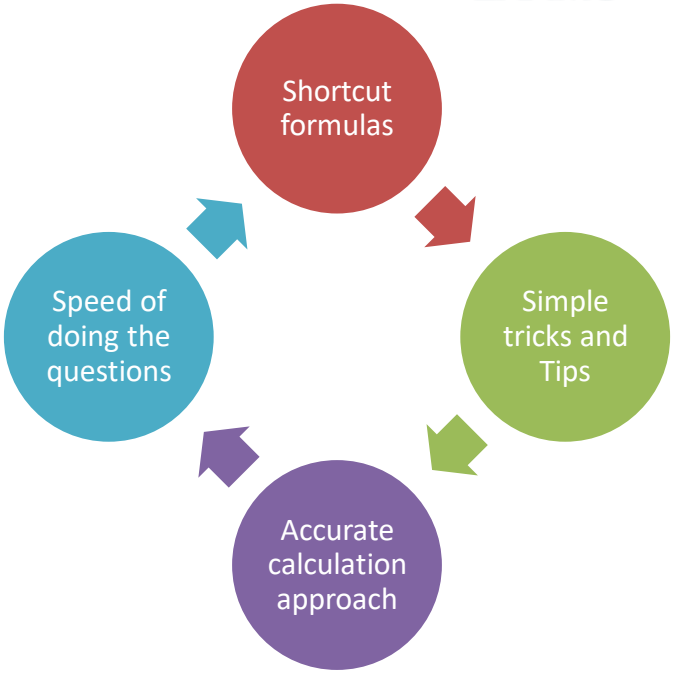
100 math's formulas, tips and trick for AFCAT exam

The math's curriculum of AFCAT is basically 8 topics of quantitative aptitude. These topics with **highest weightage to lowest weightage of questions in AFCAT Numerical Ability Section** which includes around **18** questions are;

1. Speed, Distance and Time
2. Work and Time
3. Percentage
4. Average
5. Simple and Compound interest
6. Ratio & Proportion
7. Profit & Loss.
8. Decimal Fraction/ Simplification

In AFCAT exam mathematics is the subject from where you can score 100%. Though questions in Numerical Ability Section are based on simple 10^{th} level arithmetic, what one needs to be good with are **the Important Formulas, Simple tricks and tips, Accurate calculation-based approach and finally Improves one's speed of doing the questions** which are interconnected and dependent as a cycle of shortcut bunch of Best confidence to have in one's to appear for any question in **Numerical Ability Section** of your AFCAT 2020 exam paper.



This article gives you clear idea about all those important formulas on each topic in **Numerical ability syllabus** as mentioned above starting with highest weightage topic to lowest weightage topic.

1. Speed, Distance and Time (SDT)

Speed: The distance travelled by any object or a person per unit time is known as speed of that object or a person.

Distance: The length of the path travelled by any object or a person or a vehicle between two places is known as 'Distance'.

Time: The duration in hours, minutes or seconds spent to cover distance is called 'Time'.

Conversion of unit: (Most frequently used shortcut in problem solving on SDT topic)

- To convert speed of an object from km/h to m/s, multiply it by $\frac{5}{18}$.
- To convert speed of an object from m/s to km/h, multiply it by $\frac{18}{5}$

Average Speed: The average speed of an object is defined as total distance travelled divided by total time taken. Shortcut formula

Relative Speed: The speed of an object with respect to other is called relative speed. Suppose two objects are moving with speeds of x km/h and y km/h respectively, then their relative speed will be;

- (x + y) km/h, if both the objects are moving in opposite direction.
- (x – y) km/h, if both the objects are moving in the same direction.

Important formulas to remember on SDT topic are as follows;

1. If A travels with speed x km/h for t hours and with speed y km/h for T hours, then average speed is given by $\frac{xt+yT}{t+T}$
2. If a man/ vehicle covers two equal distances with the speed of x km/h and y km/h respectively, then the average speed of the man/ vehicle for complete journey will be $\frac{2xy}{x+y}$
3. If a man changes his speed to $\frac{x}{y}$ of his usual speed and gets late by **t** min, then the usual time taken by him $\frac{tx}{y-x}$.
4. When a man travels from A to B with a speed x km/h and reaches t hours later after the fixed time and when he travels with a speed y km/hr from A to B, he reaches his destination T hours before the fixed time, then distance between A and B is $\frac{xy(t+T)}{y-x}$km.

5. A person travels from A to B with a speed x km/h and reaches t hours late. Later he increases his speed by y km/h to cover the same distance and he still gets late by T hours, then the distance between A and B is $(t - T)(x + y)\frac{x}{y}$.
6. **For Problems based on Trains:**
    - Time taken by a train ***x*** m long in passing a single post or pole or standing man = Time taken by the train to cover ***x*** m.
    - Time taken by a train ***x*** m long in passing an object of length ***y*** m = Time taken by the train to cover $(x + y)$ m.
    - Time taken by a train of length ***l*** meter moving at a speed of ***s*** m/s to cross another train of length ***L*** moving at a speed of ***S*** m/s in same or opposite direction is $\frac{l+L}{s \pm S}$.
    - If two trains start at the same time from points A and B towards each other and after crossing each other, they take ***t*** and ***T*** time in reaching points B and A respectively, then ratio of their speed is $\frac{s}{S} = \sqrt{\frac{T}{t}}$.
7. **For Problems based on Boats and Streams:**
    - **Still Water:** If the speed of water is zero, then water is still water.
    - **Stream Water:** If the water of a river is moving at a certain speed, then it is called stream water.
    - **Downstream motion:** In water, the direction along the stream is called downstream.
    - **Upstream motion:** In water, the direction against the stream is called upstream.
    - If the speed of a boat in still water be ***x*** km/h and speed of stream be ***y*** km/h, then
    a. **Speed of boat downstream =** $(x + y)$ **km/h**
    b. **Speed of boat upstream =** $(x - y)$ **km/h**
    - Let the speed of boat in downstream be u km/h and speed of boat in upstream be v km/h, then (most frequently used shortcut formula for problems based on Boats and Stream are);
    c. **Speed of boat in still water =** $\frac{1}{2}(u + v)$ **km/h**

d. **Speed of stream (current) =** $\frac{1}{2}(u - v)$ **km/h**

8. **For problems based on Races:**
   - A contest of speed in running, driving, riding, sailing or rowing over a specified distance is called a race.
   - Suppose A and B are two contestants in a race. If A beats B x m and length of the track is d m. Then the distance travelled by B when A finishes the race is equal to $d - x$ then,

$$\frac{Speed\ of\ A}{Speed\ of\ B} = \frac{d}{d - x}$$

   - **Note:**
     - **A gives B a start of x m means when A starts at starting point, B starts at starting point, B starts x m ahead from starting point.**
     - **A gives B a start of t s means A starts t s after B starts from the same point.**

2. Work and Time

Most of the aptitude questions on work and Time can be solved if you know the basic correlation between time, work and man-hours which you have learnt in your high school class.

Shortcuts for frequently asked Time and Work problems:

1. More men can do more work.
2. More work means more time required to do work.
3. More men can do more work in less time.
4. M men can do a piece of work in T hours, then
   Total effort or work =MT man hours
   Rate of work * Time = Work Done
5. If A can do a piece of work in D days, then A's 1 day's work = $\frac{1}{D}$
6. Part of work done by A for, t days =$\frac{t}{D}$.
7. If A's 1 day's work = $\frac{1}{D}$, then A can finish the work in D days.

$\frac{MDH}{W}$=Constant

Where,

M = Number of men

D = Number of days

H = Number of hours per day

W = Amount of work

8. If M1 men can do W1 work in D1 days working H1 hours per day and M2 men can do W2 work in D2 days working H2 hours per day, then $\frac{M_1D_1H_1}{W_1} = \frac{M_2D_2H_2}{W_2}$
9. If A is x times as good a workman as B, then:

   Ratio of work done by A and B = x:1

   Ratio of times taken by A and B to finish a work = 1:x

   i.e.; A will take $\frac{1}{x}$th of the time taken by B to do the same work.

10. If A and B can do a piece of work in x days and y days, respectively. Then, time taken by A and B together to complete the work is $\frac{xy}{x+y}$
11. If A and B can do a piece of work in x days. B and C can do work in y days, C and A can do same work in z days. Then, they will complete the same work in $\frac{2xyz}{xy+yz+zx}$ days by working together.
12. If A and B can complete a work in x days and A alone can finish that work in y days, then number of days required to complete the work by B is $= \frac{xy}{x-y}$
13. If two groups M_1, persons of the first group can do W_1 work in D_1 days working T_1 hours in a day and M_2 persons of the second group can do W_2 work in D_2 days working T_2 hours in a day. If each person of both group has the same efficiency of work, then $M_1D_1T_1W_2 = M_2D_2T_2W_1$
14. If m men or n women can do a piece of work in a day's then x men and y women can do the same work in $\frac{1}{\frac{x}{ma}+\frac{y}{na}}$ day.
15. If A can do a work in x days and B can do y% fast than A, then B will complete the work in $\frac{100x}{100+y}$ days.
16. If A, B and C can do a piece of work in x, y and z days, respectively and they received RS. K as wages by working together, then

    Share of A $= Rs.\frac{yz}{xy+yz+zx} \times k$

    Share of B $= Rs.\frac{xz}{xy+yz+zx} \times k$

Share of C $= \boldsymbol{Rs.}\frac{xy}{xy+yz+zx} \times \boldsymbol{k}$

Simple tricks to be followed to solve problems based on Pipes and Cisterns:

1. Time taken to fill tank is considered as positive and noted with (+) sign.
2. Time taken to empty tank is considered as negative noted with (-) sign.
3. If a pipe can fill or empty a tank in x hours, then the part of tank filled or emptied in 1 hour is 1/x.
4. If pipe can fill or empty 1/x part of a tank in 1 hour, then it can fill or empty the whole tank in x hours.
5. If a pipe fills a tank in x hours and another pipe fills the same tank in t hours. Then total part filled by both pipes in 1 hour is 1/x + 1/y.

3. Percentage

Per cent is a fraction whose denominator is 100 and numerator of the fraction is called the rate per cent. Per cent is denoted by the symbol '%'

Shortcuts for frequently asked Percentage problems:

1. For expressing a% as a fraction, we can write $\boldsymbol{a\% = \frac{a}{100}}$.
2. For expressing a fraction $\frac{a}{b}$ as a percent we can write $\frac{\boldsymbol{a}}{\boldsymbol{b}} = \left(\frac{\boldsymbol{a}}{\boldsymbol{b}} \times \boldsymbol{100}\right)\%$
3. To find how much percent one quantity is of another quantity;
   Required percentage $= \frac{\boldsymbol{The\ quantity\ to\ be\ expressed\ in\ per\ cent}}{\boldsymbol{2nd\ quantity}} \times \boldsymbol{100\%}$
4. Percentage increase or decrease in a quantity when it increases or decreases by some value.
   Percentage $= \frac{\boldsymbol{Increase\ or\ decrease\ in\ the\ value}}{\boldsymbol{Initial\ value}} \times \boldsymbol{100\%}$
5. If 'A' is x% more than 'B', then B would be $\left[\frac{\boldsymbol{x}}{\boldsymbol{100+x}} \times \boldsymbol{100}\right]\%$ less than 'A'.
6. If 'A' is x% less than 'B', then B would be $\left[\frac{\boldsymbol{x}}{\boldsymbol{100-x}} \times \boldsymbol{100}\right]\%$ more than 'A'.
7. If the price of commodity is increased or decreased by x%, then decrease or increase in consumption, so as not to increase or decrease the expenditure is $\left(\frac{\boldsymbol{x}}{\boldsymbol{100 \pm x}} \times \boldsymbol{100}\right)\%$.
8. If the value of an object is first changed (increased or decreased) by x% and then changed (increased or decreased) by y%, then
   Net effect $= \left(\boldsymbol{\pm x \pm y} + \frac{(\pm \boldsymbol{x})(\pm \boldsymbol{y})}{\boldsymbol{100}}\right)\%$

9. If the population of a town is P and it increase or decrease at the rate of R% per annum, then

   Population after n year $= \boldsymbol{P\left(1 \pm \frac{R}{100}\right)^{n}}$

   Population, n year ago $= \frac{\boldsymbol{P}}{\left(\boldsymbol{1 \pm \frac{R}{100}}\right)^{\boldsymbol{n}}}$

10. If present population of a city is P and there is an increment or decrement of $R_1\%$, $R_2\%$ and $R_3\%$ in first, second and third year respectively, then

    Population of city after 3 years $= \boldsymbol{P\left(1 \pm \frac{R_1}{100}\right)\left(1 \pm \frac{R_2}{100}\right)\left(1 \pm \frac{R_3}{100}\right)}$

4. Average

Average refers to the sum of observations divided by number of observations. Also called as mean average.

Shortcuts for frequently asked Average problems:

1. Average $= \frac{\boldsymbol{Sum\ of\ data\ values}}{\boldsymbol{Number\ of\ data\ values\ added\ above\ in\ numerator}}$
2. Average of first n natural numbers is $\frac{\boldsymbol{n+1}}{\boldsymbol{2}}$.
3. Average of squares of first 'n' natural numbers is $\frac{\boldsymbol{(n+1)(2n+1)}}{\boldsymbol{6}}$
4. Average of cubes of first 'n' natural numbers is $\frac{\boldsymbol{n(n+1)^2}}{\boldsymbol{4}}$
5. Average of first n even natural numbers is $\boldsymbol{(n+1)}$
6. Average of first n odd numbers is $\boldsymbol{n}$.

5. Simple & Compound Interest

Interest is the cost of borrowing money, where the borrower pays a fee to the lender for using the latter's money. The interest, typically expressed as a percentage, can be either simple or compounded. Simple interest is based on the principal amount of a loan or deposit, while Compound interest is based on the principal amount and the interest that accumulates on it in every period. Since simple interest is calculated only on the principal amount of a loan or deposit, it's easier to determine than compound interest.

Shortcuts for frequently asked Simple and Compound Interest problems:

1. Simple Interest$= \frac{\boldsymbol{PRn}}{\boldsymbol{100}}$, where P is Principal, R is rate of interest and n is duration.
2. If the sum of money becomes n times in 'T' years at simple interest, then rate of interest will be, $\boldsymbol{R = \left(\frac{100(n-1)}{T}\right)\%}$

3. If a certain Principal Amounts to ₹ A in t years and to B in T years, then the sum(P) is given by ₹ $\left(\frac{Bt-AT}{t-T}\right)$% and the rate of interest(R) is given by $\left(\frac{100(B-A)}{AT-Bt}\right)$%
4. At the same rate of simple interest, if a sum of money becomes n_1 times of itself in t_1 years and n_2 times in t_2 years, then $\boldsymbol{t_2 = \frac{(n_2-1)}{(n_1-1)} t_1}$ years.
5. When interest is compounded annually, then

   Amount$= \boldsymbol{P\left(1+\frac{R}{100}\right)^n}$ ***and compound interest CI*** $\boldsymbol{= A - P}$
6. When interest is compounded half-yearly, then $\boldsymbol{A = P\left(1+\frac{r}{200}\right)^{2n}}$
7. When interest is compounded quarterly, then $\boldsymbol{A = P\left(1+\frac{R}{400}\right)^{4n}}$
8. When interest is compounded annually but time is given fraction say $\boldsymbol{(t\frac{a}{b}\ year)}$,

   then $\boldsymbol{A = P\left(1+\frac{R}{100}\right)^t \times \left(\frac{1+\left(\frac{a}{b}\right)R}{100}\right)}$
9. When rate of interest for n_1, n_2 and n_3 years are R_1, $R_2$and R_3 respectively, then

   $\boldsymbol{Amount = P\left(1+\frac{R_1}{100}\right)^{n_1}\left(1+\frac{R_2}{100}\right)^{n_2}\left(1+\frac{R_3}{100}\right)^{n_3}}$
10. The difference D between simple and compound interest accrued on ₹ P at the rate of interest of r% is given by

    For 2 year, $\boldsymbol{D = \frac{PR^2}{100^2}}$

    For, 3 years, $\boldsymbol{D = \frac{PR^2(300+r)}{100^3}}$
11. If a certain sum at compound interest becomes A_1, in n years and A_2 in $\boldsymbol{(n+1)}$ years, then

    Rate of compound interest $= \frac{(A_2-A_1)}{A_1} \times 100\%$

    Sum$= \boldsymbol{A_1\left(\frac{A_1}{A_2}\right)^n}$

6. Ratio and Proportion

If a and b are two quantities of same kind, then the fraction a/b is called the ratio a to b and we write it as a: b. Here a is called antecedent and b is called the consequent.

Shortcuts for frequently asked Ratio and Proportion problems:

Compound Ratio: When two or more ratios are multiplied together, they are said to be compound ratio.

Duplicate Ratio: when a ratio is compounded with itself, the resulting ratio is called the duplicate ratio.

Triplicate Ratio: If a ratio is compounded three times with itself, then resulting ratio is called triplicate ratio.

Subduplicate Ratio: If two numbers are in ratio, then the ratio of their square roots is called Subduplicate ratio.

Subtriplicate Ratio: If two numbers are in ratio, then the ratio of their cube roots is called Subtriplicate ratio.

Reciprocal Ratio: If a: b is a ratio, then 1/a: 1/b is its reciprocal ratio.

Proportion: The equality of two ratios is called proportion. '::' is the sign of proportion.

Continued Proportion: The non-zero quantities of same kind, a, b, c, d, e, f, … are said to be continued proportion, if $\frac{a}{b} = \frac{b}{c} = \frac{c}{d} = \frac{e}{f} = \cdots$

Mean Proportional: If a, b and c are in continued proportion, then b is called the mean proportional of a and c.

Third Proportional: If $a : b :: b : c$, then c is called the third proportional to a and b.

Fourth Proportional: If four numbers or quantities a, b, c and d are in proportion, then d is known as fourth proportional.

Mixture: If two or more quantities are mixed in a certain ratio, then the product is called Mixture.

If two quantities are mixed in the ratio $n_1 : n_2$, then

$$\frac{n_1}{n_2} = \frac{Cheaper\ Quantity}{Dearer\ Quantity} = \frac{p_2 - p_m}{p_m - p_1}$$

7. Profit & Loss

Cost Price: The price, at which an article is purchased, is called its cost price, abbreviated as C.P.

Selling Price: The, price, at which an article is sold is called its selling price, abbreviated as S.P.

Profit or Gain: If S.P. is greater than C.P. the seller is said to have a Profit or Gain.

Loss: If S.P. is less than C.P. then the seller is said to have incurred a Loss.

Shortcuts for frequently asked Profit and Loss problems:

1. Gain = (S.P.) - (C.P.)
2. Loss = (C.P.) - (S.P.)
3. Gain Percentage: (Gain %) $= \left(\frac{Gain \times 100}{CP}\right)$

4. Loss percentage: (Loss%)$= \left(\frac{\boldsymbol{Loss \times 100}}{\boldsymbol{CP}}\right)$
5. Selling Price: (S.P.) $= \left(\frac{\boldsymbol{100 - Loss\%}}{\boldsymbol{100}}\right) \times \boldsymbol{CP}$
6. Selling Price: (S.P.) $= \left(\frac{\boldsymbol{100 + Gain\%}}{\boldsymbol{100}}\right) \times \boldsymbol{CP}$
7. Cost Price: (C.P.) $= \left(\frac{\boldsymbol{100}}{\boldsymbol{100 + Gain\%}}\right) \times \boldsymbol{SP}$
8. Cost Price: (C.P.) $= \left(\frac{\boldsymbol{100}}{\boldsymbol{100 - Loss\%}}\right) \times \boldsymbol{SP}$
9. If an article is sold at a gain of say 25%, then S.P. = 125% of C.P.
10. If an article is sold at a loss of say, 25% then S.P. = 75% of C.P.
11. When a person sells two similar items, one at a gain of say *x*%, and the other at a loss of *x*%, then the seller always incurs a loss given by:

$$\boldsymbol{Loss\%} = \left(\frac{\boldsymbol{Common\ Loss\ and\ Gain\ \%}}{\boldsymbol{10}}\right)^{\boldsymbol{2}} = \left(\frac{\boldsymbol{x}}{\boldsymbol{10}}\right)^{\boldsymbol{2}}$$

12. If a trader professes to sell his goods at cost price, but uses false weights, then

$$\boldsymbol{Gain\%} = \left(\frac{\boldsymbol{Error}}{\boldsymbol{True\ value - Error}} \times \boldsymbol{100}\right)\%$$

8. Decimal Fractions/Simplification

A decimal fraction is a fraction in which denominator is an integer power of ten. (The term decimals are commonly used to refer decimal fractions). Generally, a decimal fraction is expressed using decimal notation and its denominator is not mentioned explicitly.

Simplification: Rule of 'BODMAS': This BODMAS rule depicts the correct sequence in which the operations are to be executed, so as to find out the value of given expression. Full form of BODMAS is B – Bracket, O – of, D – Division, M – Multiplication, A – Addition and S – Subtraction. Thus, while solving or simplifying a problem, first remove all brackets, strictly in the order (), {} and ||. After removing the brackets, we will use the following operations strictly in the following order: (i) of (ii) Division (iii) Multiplication (iv) Addition (v) Subtraction.

Some Basic Formulas used to solve problems based on fractions and Simplification

1. $(a + b)(a - b) = (a^2 - b^2)$
2. $(a + b)^2 = (a^2 + b^2 + 2ab)$
3. $(a - b)^2 = (a2 + b2 - 2ab)$
4. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
5. $(a^3 + b^3) = (a + b)(a^3 - ab + b^2)$
6. $(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$

7. $(a^3 + b^3 + c^3 – 3abc) = (a + b + c) (a^2 + b^2 + c^2 – ab – bc – ac)$
8. When $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.

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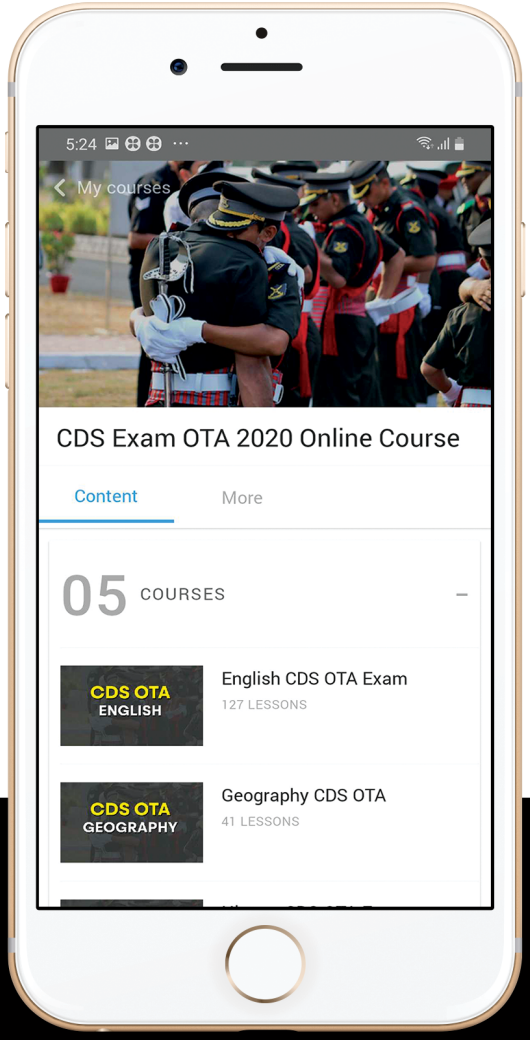

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