TRAIN PROBLEMS

Types

1. Conversion
2. Time & Distance formula
3. Train & Object
4. Theory of relativity

TYPE 1 - CONVERSION

kmph to m/s -> * 5/18
m/s to kmph -> * 18/5

TYPE 2 - TIME & DISTANCE

Speed = Distance/Time

TYPE 3 - TRAIN & OBJECT

a) Pole/Man/Tree

   The distance covered by the train to cross pole/man/tree is the length of the train
   s=d/t = l/t

b) Bridge/Tunnel/Platform
   s=d/t = (l1+l2)/t

TYPE 4 - THEORY OF RELATIVITY

a) Opposite Direction
   s=d/t => t=d/s => t= (l1+l2)/(u1+v1)

b) Same Direction
   s=d/t => t=d/s => t=(l1+l2)/(u1-v1)

RATIO AND PROPORTION

1. Duplicate ratio - $x^2 : y^2$
2. Sub-duplicate - $\sqrt{x} : \sqrt{y}$

3. Triplicate - x^3 **:** y^3
4. Sub-triplicate - $x^{1/3}$ **:** $y^{1/3}$
5. Mean proportion - $\sqrt{xy}$
6. Compound ratio of (a:x),(b:y),(c:z) is (abc:xyz)
7. If (x:y) > (a:b) then x/y > a/b
8. a:b :: c:d => a:b = c:d => a/b = c/d
   Product of means = Product of extremes
   bxc = axd
9. If a=kb for some constant k, then we can say that a is directly proportional to b
10. If ba=k then a is inversely proportional to b
11. If m:n=a:x, n:p=b:y, p:q=c:z then m:n:p:q=abc:xbc:xyc:xyz
12. If a number ‘a’ is divided in the ratio x:y then
    First part = ax/(x+y)
    Second part = ay/(x+y)

PERCENTAGES

1. x is what percentage of y => x/y * 100
2. If a value is increased by a% and b% then resultant increase is $a + b + \frac{ab}{100}$
3. If the price of goods increases by R% then the reduction in consumption so as not to increase the expenditure can be calculated as $\left[\frac{R}{(100+R)} * 100\right]$%
4. If the price of goods decreases by R% then the increase in consumption so as not to decrease the expenditure can be calculated as $\left[\frac{R}{(100-R)} * 100\right]$%
5. Population after n years = P $\left[1 + \frac{R}{100}\right]^n$
6. Population n years ago = $\frac{P}{\left[1+\frac{R}{100}\right]^n}$
7. Value of machine after n years = P $\left[1 - \frac{R}{100}\right]^n$
8. Value of machine n years ago = $\frac{P}{\left[1-\frac{R}{100}\right]^n}$
9. Increase N by S% = N$\left[1 + \frac{S}{100}\right]$

PROFIT & LOSS

1. Profit(P) = Selling Price(SP) - Cost Price(CP)
2. Loss(L) = Cost Price(CP) - Selling Price(SP)
3. P% = $\frac{P}{CP}$* 100
4. L% = $\frac{L}{CP}$* 100
5. SP = $\frac{(100+Profit\%)}{100}$* CP
6. SP = $\frac{(100-Losst\%)}{100}$* CP
7. CP = $\frac{100}{(100+Gain\%)}$* SP
8. CP = $\frac{100}{(100-Loss\%)}$* SP
9. SP = CP * Profit%
10. If a person professes to sell his goods at CP but uses false weights,then Profit% = $\left[\frac{Error}{True\,Value - Error} * 100\right]$%
11. When a person sells two similar items one at a gain of x% and other at a loss of x% then seller always incurs a loss given by, Loss% = $\left[\frac{x}{10}\right]^{2}$
12. If a seller makes x% above CP and offers a discount of y% then profit% or loss% can be calculated using the formula P% or L% = $(x - y) - \frac{xy}{100}$
13. Discount% = $\frac{Discount}{Marked\ Price(MP)}$* 100
14. If D1,D2,D3 are percentage of successive discounts on MP, then SP = Marked Price * $\left(1 - \frac{D1}{100}\right)\left(1 - \frac{D2}{100}\right)\left(1 - \frac{D3}{100}\right)$
15. If a and b are two successive discount percentages then Single equivalent discount percentage = $\left[(a + b) - \frac{ab}{100}\right]$
16. If cost price of x articles is equal to selling price of y articles then profit can be calculated as
    a) CP of x = SP of y
    b) Number of x articles > Number of y articles

Profit% = $\frac{Number\ of\ x\ articles - Number\ of\ y\ articles}{Number\ of\ y\ articles}$* 100

BOATS AND STREAMS

1. Speed of boat in still water = $\frac{1}{2}$(a+b)
2. Speed of stream = $\frac{1}{2}$(a-b)
3. Boat upstream speed = (u-v) kmph
4. Boat downstream speed = (u+v) kmph

   NOTE: Upstream -> Boat going opposite direction to river

   a -> Downstream

   b-> Upstream

   u-> Speed of boat

   v-> Speed of stream
5. If a boat moves to a certain distance downstream in t1 hours and returns the same distance upstream in t2 hours then

   Speed of boat in still water = y$\frac{(t2+t1)}{(t2-t1)}$
6. If a boat moves at x kmph speed and covers the same distance up and down in a stream of speed y kmph then

   Average speed of boat = $\frac{Downstream * Upstream}{Speed\ in\ still\ water}$ = $\frac{(x+y)(x-y)}{x}$
7. If a boat takes time t hours more going upstream than to move downstream for the same distance, then the distance is given by

   Distance = $\frac{(x^2 - y^2)(t)}{2y}$
8. If a boat takes t hours to move a certain place and come back again then

   Distance between places = $\frac{t\ (x^2 - y^2)}{2x}$

AVERAGES

1. Average = $\frac{Sum\ of\ observations}{Total\ number\ of\ observations}$
2. Average of n natural numbers = $\frac{n+1}{2}$
3. Average of n even numbers = n+1
4. When a person is added in a group and the average age increases then

   Age of new member added is

   Given previous avg. + (Increase in avg. after new member is added * Total members)

5. There are two batches in the class A & B, then average of whole class can be calculated using the formula $\frac{ax + by}{a+b}$

   NOTE: a-> Number of students in batch A
   b-> Number of students in batch B
   x-> Average of batch A
   y-> Average of batch B

PROBLEMS ON AGES

1. Always take the present age as x
2. Age after n years = x+n
3. Age n years ago = x-n
4. n times age = n*x
5. If ages in the numerical are mentioned in ratio A:B then A:B will be Ax and Bx
6. If sum of ages of x and y is A and ratio of their ages is p:q, then you can determine age of y by using the below formula

   Age of y = $\frac{ratio\ of\ y}{sum\ of\ ratios} * sum\ of\ ages$

SIMPLE INTEREST

1. Simple Interest(SI) = $\frac{P*N*R}{100}$
2. If sum of money becomes z times in T years at simple interest, then rate of interest R can be calculated using

   R% = $\frac{100(z-1)}{T}$

ALLIGATION & MIXTURE

1. If two ingredients are mixed, then

   $\left(\frac{Quantity\ of\ cheaper}{Quantity\ of\ dearer}\right) = \left(\frac{C.P\ of\ dearer - Mean\ Price}{Mean\ Price - C.P\ of\ cheaper}\right)$ => $\frac{x}{y} = \frac{d-m}{m-c}$
2. Suppose a container contains *T* of liquid from which *R* units are taken out and replaced by water.

After n operations, the quantity of pure liquid(Q) = $T\left(1 - \frac{R}{T}\right)^{n}$

PIPES AND CISTERN

1. If a pipe can fill a tank in *x* hours, then part filled in 1 hr is $\frac{1}{x}$
2. If a pipe can empty a tank in *y* hours, then part emptied in 1 hr is $-\frac{1}{y}$
3. If a pipe can fill a tank in *x* hours and another pipe can empty the full tank in *y* hours (where *y* > *x*), then on opening both the pipes, then net part filled in 1 hour is $\left(\frac{1}{x} - \frac{1}{y}\right)$
4. If a pipe can fill a tank in *x* hours and another pipe can empty the full tank in *y* hours (where *x* > *y*), then on opening both the pipes, then net part emptied in 1 hour is $\left(\frac{1}{y} - \frac{1}{x}\right)$
5. Net work done = (Sum of work done by inlets) - (Sum of work done by outlets)
6. Suppose that pipe A fills the tank as fast as the other pipe B. If pipe B(slower) and pipe A(faster) take x min and $\frac{x}{n}$min to fill up an empty tank together then

   Part of the tank filled in 1 hr = $\frac{n+1}{x}$
7. Work done by waste pipe in 1min = (Part filled by total pipes together) - (Part filled by 1st pipe + Part filled by 2nd pipe)

TIME AND WORK

1. If A can do a piece of work in n days, then A's 1 day work = $\frac{1}{n}$
2. If A's 1 day work is $\frac{1}{n}$then A can finish the work in n days.
3. If A is thrice as good as workman as B then
   a) Ratio of work done by A and B = 3:1
   b) Ratio of time taken by A and B to finish the work = 1:3
4. If A and B can finish the work in x and y days then

   (A+B)'s 1 day work = $\frac{1}{x} + \frac{1}{y} = \frac{x+y}{xy}$

5. If A and B together perform some part of work in x days, B and C together perform it in y days and C and A perform it in z days then

(A+B)'s 1 day work = $\frac{1}{x}$

(B+C)'s 1 day work = $\frac{1}{y}$

(C+A)'s 1 day work = $\frac{1}{z}$

$\frac{1}{x}+\frac{1}{y}+\frac{1}{z}$= 2(A+B+C)'s 1 day work

(A+B+C)'s 1 day work = $\frac{\frac{1}{x}+\frac{1}{y}+\frac{1}{z}}{2}$

6. $\frac{M*D*H}{W}$= constant where M=Man, W=Work/Wages, D=Days, H=Hours

7. If men are fixed then work is proportional to time. If work is fixed then time is inversely proportional to men, thus $\frac{M1*T1}{W1}=\frac{M2*T2}{W2}$

COMPOUND INTEREST

1. Interest compounded annually => Amount = P$\left[1+\frac{R}{100}\right]^{n}$
2. Interest compounded half yearly => Amount = P $\left[1+\frac{(R/2)}{100}\right]^{2n}$
3. Interest compounded quarterly => Amount = P $\left[1+\frac{(R/4)}{100}\right]^{4n}$
4. If rates are different for different years(ie. R1% for first year, R2% for second year, R3% for third year) then
   Amount for n years = P$\left[1+\frac{R1}{100}\right]\left[1+\frac{R2}{100}\right]\left[1+\frac{R3}{100}\right]$
5. Present worth of sum of Rs x due n years hence R% p.a. compound interest is given by

Present worth = $\dfrac{x}{\left[1+\frac{R}{100}\right]^{n}}$

6. Time required for an amount to double itself at a given rate of interest is

   Time = $\dfrac{72}{Rate\ of\ interest}$

7. If difference between CI and SI is given for

   A. Two years => CI - SI = P$\left(\frac{R}{100}\right)^{2}$

   B. Three years => CI - SI = P$\left(\dfrac{R^{2}}{100^{2}}\right)$* $\left(\frac{300+R}{100}\right)$