QUANTITATIVE APTITUDE SHORTCUTS & TRICKS

A handbook for Quantitative aptitude important formulas and shortcuts that are useful in competitive exam preparation

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Chapter 1:Basic Maths Shortcuts

1. Division-shortcuts

In division instead of direct division, use factoring method

Example:1848/264=(2*3*4*7*11)/(2*3*4*11)=7

2.Multiplication-shortcuts

SUM – 10 METHOD:

Example: 78 and 72. These two numbers, if we add the numbers in the unit's place, the resultant is 10 and the numbers in the ten's place are both the same. In such cases, we can have a simple solution.
Step1: multiply the numbers in the unit's place and write down the resultant. (8*2 = 16)
Step2: say, the number in the ten's digit is a, then multi a*(a+1) and write down the resultant. => (7*(7+1) = 56)
Step3: write the final result: 5616

Example:118*112 follow above steps
8*2 = 16; and 11*(11+1) = 11*12 = 132. And hence
the result is: 13216.
In short: ab*ac = (a*(a+1))(b*c)

Base Method:

Base numbers, in general, are nothing but multiples of 10. If the given numbers are nearer to

base numbers, then you can follow this method to multiply them.
Example: 98*95 =?

Here 98 is ,2 less than the base number 100 and 95 is ,5 less than 100. We can write them like this:
98 -2
95 -5
The first step will be deducting/subtracting the resultant of the diff between the base number and the given number with the given number in a cross-way! That is, you need to subtract 98 and 5 (which is the resultant of difference between the base number and 95) or you can also cross-subtract 95 and 2, the result will be same. This result forms the 1st part of the resultant

at the start. The last part of the resultant will be multiplication of the differences from base numbers (i.e., 2 * 5 = 10)
98 -2
95 -5
(98 – 5) (-2 * -5)
Hence, the answer will be: 9310

Example: 998*997 =?
998 -2
997 -3
Observe carefully, in the second part, the multiplication of difference yield in a single digit number, but no. of zeroes in the base number, here 1000, is three. Hence add two zeroes before the result. Therefore, the answer will be:
(998-3) | (-2 * -3) = 995006

What if the numbers we get are like this? I mean, the base is 50 here. We will follow the same procedure as above but a small difference that the resultant in the first part will be halved. And if the base is 200, then the number will be doubled and so on based on the base number.

Multiplication with 5,25,50 etc...

Substitute 5 by 10/2,25 by 100/4 and 50 by 100/2.
Examples:

1. 5*18=18*10/2=180/2=90
2. 24*25=24*100/4=2400/4=600
3. 73*50=73*100/2=7300/2=3650

Multiplication with 9, 99,999 etc..

Examples:

1. 13*9=13*(10-1)=130-13=117
2. 26*99=26*(100-1)=2600-26=2574
3. 350*999=350*(1000-1)=350000-350=349650

3.Square-Shortcut Tricks

Method1:Apply $(a+b)^2 = a^2 + b^2 + 2ab$
Example1:$18^2 = (10+8)^2 = 10^2 + 8^2 + 2 \times 10 \times 8 = 100 + 64 + 160 = 324$
Example2:$103^2 = 100^2 + 3^2 + 2 \times 100 \times 3 = 10000 + 9 + 600 = 10609$

Example3:$56^2 = 50^2 + 6^2 + 2 \times 50 \times 6 = 2500 + 36 + 600 = 3136$

Method2:Square of a number ending with 5
$(X5)^2 = X * (X + 1)\ and\ 5^2$
Example1:$35^2 = 3 * (3 + 1)\ and\ 5^2 = 12\ 25$
Example2:$65^2 = 6 * (6 + 1)\ \ and\ 5^2 = 42\ 25$
Example3:$115^2 = 11 * (11 + 1)\ and\ 5^2 = 132\ 25$

Method3:Squres of numbers from 51-59
Add 25 to unit digit and square unit digit
Example1:$57^2 = 7 + 25\ and\ 7^2 = 32\ 49$
Example2:$53^2 = 3 + 25\ and\ 3^2 = 28\ 09$
Example3:$59^2 = 9 + 25\ and\ 9^2 = 34\ 81$

Method4:square if you know square of previous number
$(n + 1)^2 = n^2 + n + (n + 1)$
Example1:$31^2 = 30^2 + 30 + 31 = 961$
Example2:$26^2 = 25^2 + 25 + 26 = 676$
Example3:$81^2 = 80^2 + 80 + 81 = 6561$

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Method 5:Square of a number if you know square of any other number.
Let X and Y be two numbers. You know the square of X then you can deduce square of Y.
$X^2 - Y^2 = (X + Y)(X - Y)$
$=> X^2 = (X + Y)(X - Y) + Y^2$
Or $Y^2 = X^2 - (X + Y)(X - Y)$
Example1:$115^2 = ?$
Choose a nearby number whose square is known to you.
Suppose we choose 110 whose square is 12100

$115^2 = 110^2 + (115 - 110)(115 + 110)$
$=> 12100 + 5 * 225 = 13225$
Example2:$48^2 = 50^2 - [(50 - 48)(50 + 48)] = 2500 - 2 * 98 = 2304$
Example3:$27^2 = 30^2 - [(30 - 27)(30 + 27)] = 900 - 3 * 57 = 729$
Example4:$43^2 = 40^2 + 3 * 83 = 1849$

4.Cubes-Shortcut

Apply $(a + b)^3 = a^3 + b^3 + 3a^2b + 3ab^2$

Example1:$15^3 = (10+5)^3 = 10^3 + 5^3 + 3*10^2*5 + 3*10*5^2 = 1000 + 125 + 1500 + 750 = 3375$
Example2:$23^3 = (20+3)^3 = 20^3 + 3^3 + 3*20^2*3 + 3*20*3^2 = 8000 + 27 + 3600 + 540 = 12167$

5.Square roots (applicable only for perfect squares)

Method 1
Example1:Square root of 2704

step1:Seperate number into group of two from right to left ie 27 04.
step2:What number can be squared and less than 27=5, with remainder 2
step3:Bringdown the second group of digits next to remainder to get 204
step4:Double first part of answer to get 5*2=10
step5:Find a number X so that 10 X * X= 204, we get X=2
Thus final answer=52

```
    5  2
  5|2704
   |25
 102  204
      204
      000
```

Example2: Example1:Square root of 9604

step1:Seperate number into group of two from right to left ie 96 04.
step2:What number can be squared and less than 96=9, with remainder 15
step3:Bringdown the second group of digits next to remainder to get 1504
step4:Double first part of answer to get 9*2=18
step5:Find a number X so that 18 X * X= 1504, we get X=8
Thus final answer=98

```
    9  8
  9|9604
   |81
 188 1504
     1504
     0000
```

Method2:Square root by prime factorisation.

Example1: $\sqrt{44100} = \sqrt{(2*2*3*3*5*5*7*7)}$ =2*3*5*7=210
Exampl2:$\sqrt{254016} = \sqrt{9*9*8*8*7*7} = 9*8*7 = 504$

6.Cube root(for perfect cubes only)

$1^3 = 1, 2^3 = 8, 3^3 = 27, 4^3 = 64, 5^3 = 125, 6^3 = 216, 7^3 = 343, 8^3 = 512, 9^3 = 729,$
Memorize this.
Example1: $\sqrt[3]{21952}$
step1: Divide digits into group of three from right to left 21 952
step2: Last digit of rightmost group is 2.That means number ends with 8
step3: Now consider leftmost group 21.Cube of 2=8 and cube of 3=27 ,since 21 is between them we must use smaller one,2. Thus final answer is 28

Example2: $\sqrt[3]{32768}$
step1: Divide digits into group of three from right to left 32 768
step2: Last digit of rightmost group is 2.That means number ends with 8
step3: Now consider leftmost group 32. Cube of 3=27 and cube of 4=64,since 32 is between them we must use smaller one,3. Thus final answer is 32.

Chapter 2:Ratio and Fractions

1.Ratios-Important rules and shortcuts
Example:If P:Q=2:3, Q:R=4:5 then P:R=?
P/R=(P/Q)*(Q/R)=2/3*4/5=8/15,thus P:R=8:15

Example:P:Q:R=2:3:4,then P/Q:Q/R:R/P=?
P/Q:Q/R:R/P=2/3:3/4:4/2=8:9:24

Example:If 2P=3Q=4R then P:Q:R=?
Let 2P=3Q=4R=K,
we get P=K/2,Q=K/3,R=K/4
=> P:Q:R=K/2:K/3:K/4=1/2:1/3:1/4=6:4:3

Example:P:Q=1:2,Q:R=4:5,R:S=10:3 then P:Q:R:S=?
Make the Q term in first and second fraction same and make the R term similar in second and third fractions as follows

P:Q Q:R R:S
1:2 4:5 10:3

P:Q Q:R R:S
2:4 4:5 5:3/2

P:Q:R:S=2:4:5:3/2=4:8:10:3

2.Comparison of ratios and Fractions

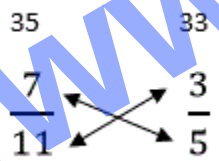
Method1:To compare two fractions we can make either denominators same or numerators same.
Example:2/5 and 3/10
To find out which is greater, make denominators same. We get 4/10 and 3/10.From this we can conclude,2/5>3/10
or make numerator same
Fractions will become 6/15 and 6/20,obviously 6/15>6/20.

Method2:This method can be applied if difference between numerator and denominator is same for all given fractions.
Example:1/2,3/4,7/8. Here 2-1=4-3=8-7=1.In such cases, just look at the numerator .Smaller the numerator will be smaller fraction.1/2<3/4<7/8.

Method3:this method is applicable for all fractions.
If a/b and c/d are fractions under consideration, cross multiply numerator and denominator .ie a*d and c*b.
If a*d>b*c, then a/b>c/d

Example:7/11 and 3/5

cross multiply denominator and numerator. We get 7*5 and 11*3



Since 7*5>11*3 ,7/11>3/5

Chapter 3.Simple Interest and Compound Interest

1.Simple Interest

Simple interest is given by the formula I= PRT /100
P=PRINCIPLE R=RATE OF INTEREST per annum T=TIME PERIOD

- If principle doubles in T years,then R=100/T
- If principle triples in T years ,then R=200/T
- if principle becomes four times in T years,then R=300/T

2.Compound Interest

Compound interest is given by,

$$CI = P[(1 + \frac{R}{100})^T - 1]$$

Amount after T years ,

$$A = P\,(1 + \frac{R}{100})^T$$

- If rate is R1,R2 & R3 for 1st,2nd and 3rd year respectively then amount is ,

$$A = P(1 + \frac{R1}{100})(1 + \frac{R2}{100})(1 + \frac{R3}{100})$$

- If difference of S.I and C.I is given for 2 years

$$\text{Difference} = \text{Priciple}(\frac{R}{100})^2$$

Eg:Difference between simple interest on certain sum of money for 2 years at 4% and compound interest for same period at same rate is 200.Find sum

Ans:Principle=difference*(100/2)^2=200*100/2*100/2=RS 500000.

- If difference of S.I and C.I is given for 3 years

$$\text{Difference} = \text{Priciple}\frac{R^2(300+R)}{100^3}$$

- If amount compounded half yearly R will be replaced by R/2 and T will be replaced by 2T

$$A = P\,(1+\frac{R/2}{100})^{2T}$$

- If amount compounded quarterly R will be replaced by R/4 and T will be replaced by 4T

$$A = P\,(1+\frac{R/4}{100})^{4T}$$

Eg :Find the compound interest of Rs.10,000 in 9 months at 4%per annum interest payable quarterly.
Rate=4/4=1%,Time period= 9 months=3 quarter years.

$$CI = P[(1+\frac{R}{100})^T - 1]$$

CI=10,000*((1+1/100)^3 -1)=303.01.

- If an amount A becomes B in T1 years ,then at T2 years

$$sum = \frac{B^{\frac{T2}{T1}}}{A^{\frac{T1}{T2}-1}}$$

Chapter4:Mixture and Alligation

1.When Two quantities are mixed

If two different commodities, one of which is cheaper than the other, are mixed to obtain a new mixture, Cost Price of unit value of this new mixture is called mean price.

$$\frac{Quantity\ of\ Cheaper}{Quantity\ of\ dearer} = \frac{C.P\ of\ dearer - Mean\ Price}{Mean\ Price - C.P\ of\ cheaper}$$

Example:A merchant blends two types of rice costing Rs.15 per kg and Rs.20 per kg .In what ratio should these two rice to be mixed so that resulting mixture may cost Rs.16.50 per kg.

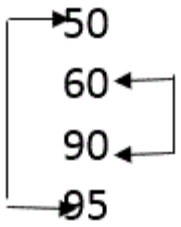
$$\frac{Quantity\ of\ Cheaper}{Quantity\ of\ dearer} = \frac{20 - 16.50}{16.50 - 15} = \frac{3.5}{1.5} = \frac{7}{3}$$

Note:
When water is mixed in milk or any liquid in such away that resulting mixture gives a profit of x% when sold at C.P of milk/liquid. Then ratio of Quantity water:Quantity of milk=x:100
Eg: In what ratio should water be mixed in milk so that seller makes a profit of 10% when mixture is sold at cost price of milk? Water : milk =10:100=1:10.

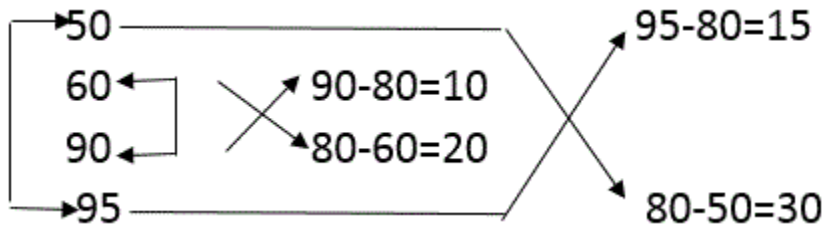
2.If more than two different commodities are mixed

Eg:If A cost 95 per kg,B cost 60 per kg,C cost 90 per kg and D cost 50 per kg. They are blended in such a way that the cost price of resulting mixture is 80.In what ratio four commodities are mixed?
To solve these kind of problems follow the steps below
Step1: Arrange them in ascending order
50
60
90
95

Step2: Make couples ,one is above mean price and other is below mean price



Step3:Now find difference between price and mean price and write it opposite to the price linked to it.



Step3: Required ratio Qt of A: Qt of B: Qt of C: Qt of D=15:10:20:30=3:2:4:6

Note:
In 'n' equal sized vessels two liquid P and Q are filled in the ratio p1:q1,p2:q2,p3:q3…….. pn:qn respectively
When they are mixed,

$$\frac{Quantity\ of\ P}{Quantity\ of} = \frac{\frac{p1}{p1+q1} + \frac{p2}{p2+q2} + \cdots\cdots\cdots \frac{pn}{pn+pq}}{\frac{q1}{p1+q1} + \frac{q2}{p2+q2} + \cdots\cdots \frac{qn}{pn+qn}}$$

If vessels are of different quantities say x1,x2,x3….xn.

$$\frac{Quantity\ of\ P}{Quantity\ of} = \frac{\frac{p1x1}{p1+q1} + \frac{p2x2}{p2+q2} + \cdots\cdots\cdots \frac{pnxn}{pn+pq}}{\frac{q1x1}{p1+q1} + \frac{q2x2}{p2+q2} + \cdots\cdots\cdots \frac{qnxn}{pn+qn}}$$

3.Removal and replacement

A vessel contains x litre of milk. y litre is drawn and replaced by water.Then again y litre of solution is replaced by water. If this process is repeated 'n' times,then

$$\frac{quantity\ of\ milk\ left}{quantity\ of\ initial\ milk} = \left[\frac{x-y}{x}\right]^n$$

Eg:9 litre are drawn from a cask full of milk and then filled with water.9 litre of mixture are drawn and cask is again filled with water.Quantity of milk now left in the cask is to that of water in at is as 16:9.What is the capacity of cask in litre?

Ans:let x be the capacity of cask which is=quantity of initial milk,

$$\frac{quantity\ of\ milk\ left\ in\ cask}{quantity\ of\ initial\ milk} = [\frac{x-9}{x}]^2$$

$\Rightarrow \frac{16}{16+9} = [\frac{x-9}{x}]^2$

$\Rightarrow \frac{4}{5} = \frac{x-9}{x}$

$\Rightarrow 4x = 5x - 45$

$\Rightarrow x = 45\ litre$

Chapter 5:Work and Time

For solving **work and time** problems ,first of all work done in 1 day is calculated.If a person X completes a work in Y days,then Work done by X in one day is 1/Y

Work done in 1 day =1/Total days taken to complete the work
and Total days taken to complete the work=1/Work done in 1 day

If A can do a work in X days and B can do the same work in Y days,in how many days A and B together can finish the work

Work done by A in one day=1/X
Work done by B in one day=1/Y
Work done by A and B together in 1 day=1/X+1/Y
Then total days taken to complete the work by A and B together=1/ Work done by A and B together in 1 day
=1/(1/X+1/Y)
=1/((X+Y)/XY))
=XY/(X+Y)

Example:If A can do a work in 8 days and B can do the same work in days,in how many days A and B together can finish the work

Ans:Applying above formula
no of days taken to finish the work=8*6/(8+6)
Instead of solving this directly take the LCM of 8 and 6

8*6/(8+6)=LCM(8,6)/(LCM(8,6)/8 + LCM(8,6)/6)=24/(3+4)=24/7=3 3/7

Notes:

*If A completes a work in X days and b completes the same work in Y days then ratio of work done by A and B in one day will be Y:X
*If A can finish the work in X days ,B can finish it in Y days and C finishes it in Z days,then no of days taken to complete the wor if all three work together=XYZ/(XY+YZ+XZ)
*If A&B together can finish the work in x days,B&C together finishes in y days and C&A together finishes in z days,
then work done by A,B and C together in 1day=1/2(1/x+1/y+1/z)
*If a man can do x/y of work in 1 hr,then he will take y/x hrs to finish the work

Chapter 6.Profit and loss formulas and shortcuts

Cost price(C.P)is the price at which a particular article is bought.
Selling price(S.P) is that price at which a particular item is sold.
Profit=S.P - C.P
Loss =C.P- S.P
Profit%=(profit*100)/C.P
Loss%=(loss*100)/C.P
the profit or loss percentage is always calculated based on C.P

- If P sold an article at a profit R1% to Q.Q sold it to R at a profit of R2% and R sold it to S at a profit of R3%.Then money spent by S for buying article C.P of S = C.P of P * (1+ R1/100)(1+ R2/100)(1+ R3/100).

Example:A sells a radio to B at a gain of 10% and B sells to c at a gain of 5%.If C pays Rs.462 for it,what did it cost to A?
C.P of radio to C=C.P of radio to A * (1+10/100)(1+5/100)
=> 462=C.P of radio to A * 110/100 *105/100
=>C.P of radio to A=(462*100*100)/(105*110)
=400

- if there are two successive profits (R1% and R2%) obtained on an article then total profit%=(R1+R2+ R1R2/100).

Example:A dishonest shopkeeper deceives by 15% at the time of purchase of article and also 15% at the time of sale.Find out the profit percentage
Profit%=15+15+(15*15 / 100)=30 + 225/100 =30+2.25=32.25%.

- If a seller mark P% above costprice and gives a discount of Q%,the final Profit/loss %=P-Q-(PQ/100).

Example:A car costs a dealer Rs.50,000.Dealer raised price by Rs.10,000 and then deducted 4% of new price.
What is the profit/loss %?
Ans: Let P be the percentage of price raised=(10000/500000) * 100 =20%
Discount %=4%
profit %=(20-4- 20*4/100) =15.2%

Chapter 7:Pipe And Cistern Shortcuts

1.If two pipes A and B

A can fill a tank in x hrs
and B can fill the same tank in y hrs
If both pipes are opened simultaneously ,then time taken to fill the tank is =xy/(x+y)
Work done by both pipes together in 1hr=1/x +1/y

2.If two pipes A and B
A can fill a tank in x hrs
and B can empty the same tank in y hrs
If both pipes are opened simultaneously ,then time taken to fill the tank is =xy/(y-x)
Work done by both pipes together in 1hr=1/x -1/y

3.If three pipes A ,B and C
A can fill a tank in x hrs
B can fill the same tank in y hr
and C takes z hrs for filling the same tank.

If three pipes are opened simultaneously ,then time taken to fill the tankis =xyz/(xy+yz+xz)
Work done by three pipes together in 1hr=1/x +1/y +1/z

Example: A can fill the tank in 28hrs
B can fill the tank in 14 hrs
and C takes 7hrs.
If all three pipes are opened simultaneously ,how long it will take to fill the tank?

Ans:time taken=(28*14*7*)/(28*14 + 14*7 + 28*7)
To solve this quicker find out LCM(28,14,7)
we get 28
Time taken =28/(28/28 + 28/14 + 28/7)
=28/(1+2+4)
=28/7
=4

4.If A can fill a tank in x hrs
B can fill the same tank in y hr
and C takes z hrs for emptying the same tank.
If three pipes are opened simultaneously time taken to fill the tank is=xyz/(yz+xz-xy)
Work done by three pipes together in 1hr=1/x +1/y -1/z

Example: A can empty the tank in 28hrs
B can fill the tank in 14 hrs
and C takes 7hrs for filling.
If all three pipes are opened simultaneously ,how long it will take to fill the tank?
Ans:time taken=(28*14*7*)/(28*14 - 14*7 + 28*7)
To solve this quicker find out LCM(28,14,7)
we get 28
Time taken =28/(-28/28 +28/14 + 28/7)
=28/(-1+2+4)
=28/5
=5.6 hrs
=5hr 36 minutes

Chapter8:Time distance and speed

speed=distance/time
Unit of speed is km/hr or m/s

If speed is given in km/hr,then inorder to convert it in to m/s multiply by 5/18
1km/hr=5/18m/s
If speed is given in m/s,then inorder to convert it in to km/hr multiply by 18/5

1.Ratio of speed

- If ratio of speed of two moving object is a:b, then ratio between times taken for covering same distance is b:a.
- If two objects A and B moving in opposite direction from two different places reach at common point in t1 and t2 hrs respectively Then Speed of A:Speed of B=sqrt(t2/t1)

2.Average speed

- average speed=total distance/total time taken.
- If a moving object covers a certain distance with a speed of x km/hr and again covers same distance with a speed of ykm/hr, then average speed is 2xy/(x+y).
- If a moving object covers a certain distance with a speed of x km/hr and again covers same distance with a speed of ykm/hr and again with zkm/hr,then average speed is=3xyz/(xy+yz+xz)

3.Points to be noted while doing 'train and time' problems

- If two trains are travelling in same direction ,then their relative speed is equal to difference of their speeds.Then Time taken by the fast train to cross the slower train is =**Sum of lengths of both trains/difference of their speed**
- If two trains are travelling in opposite direction ,then their relative speed is equal to sum of their speeds.Then time taken to pass one another is =**Sum of lengths of both trains/sum of their speed.**
- when a train is clearing a pole or a point, then distance covered by train is equal to its length
- When a train is covering a platform or bridge or tunnel ,then distance covered by train is equal to sum of the length of train and the length of platform/tunnel/bridge.
- When a moving train crosses another train, then distance covered is equal to sum of lengths of both trains.

Example:A 480-metre-long train crosses a platform in 140 seconds. What is the speed of the train?
Ans:Cannot be determined,since length of platform is not given

Example:A train 100m long is running at 21km/hr and another train 150m is running at 36km/hr in the same direciton.how long will the faster train take to pass the other train?
Sum of length of both train=100+150=250m
difference of their speed is=36-21 km/hr=15km/hr=15*(5/18) m/s=25/6 m/s
Time taken=250/(25/6)=60 seconds.

4.Boat and stream problems

- If speed of stream=xkm/hr and speed of boat in still water is ykm/hrthen speed of boat in downstream=x+y km/hr speed of boat in upstream=y-x km/hr
- If speed of boat in upstream and speed of boat in down stream is given then,
  speed of boat in still water=1/2(speed in upstream+speed in downstream)
  speed of stream=1/2(Speed in downstream - speed in upstream)

Example: A boat is moving at 30 km/hr upstream, when it travels down stream its speed is 36km/hr.What is the speed of boat in still water and what is the speed of stream?
Speed of boat in still water=1/2 (30+36)=66/2=33 km/hr.
speed of stream=speed of boat downstream-speed of boat in still water
=36-33=3km/hr

Note:
A person walks at x kh/hr he reaches destination t1 hrs late,if he walks at y km/hr,then reaches t2 hrs early
then distance to the destination =(xy/(y-x)) * (t1+t2)

Example:A person walking at 2km/hr reaches his office 6 minutes late .If he walks at 3km/hr he reaches there 6 minute early. How far is the office from his house?
Distance=(2*3)/(3-2) *((6+6)/60)=6*12/60=1.2 km .