# Quantitative Aptitude – Time and Work Problems for the Electrical Engineer

This is based on my dissatisfaction with the messed up way time and work problems are handled in quantitative aptitude examination guides. They take a simple idea, threaten you with time constraints and leave you feeling broken and guilty because you couldn't solve them quickly enough.

And having an education in fundamental electrical engineering, I couldn't help but notice the underlying symmetry between

$$\textit{Amount of work} = \textit{Speed of work} \times \textit{Time taken}$$

and

$$\textit{Ohm's Law: } V = IR$$

So, this is my proposal. Model the given time and work problem as a very simple resistive network and the problem will solve itself!

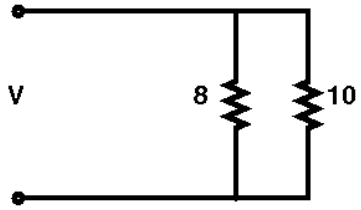
**Analogies obtained from the formula**

Amount of work *is analogous to* Voltage
Speed of work *is analogous to* Current
Time taken *is analogous to* Resistance

To show how these analogies hold, I shall work out the time and work problems from the book, "Quantitative Aptitude by Dr. R. S. Aggarwal".

**Ex. 1. Worker A takes 8 hours to do a job. Worker B takes 10 hours to do the same job. How long should it take both A and B working together, but independently, to do the same job?**

Ra = 8
Rb = 10
A and B working together *is analogous to* Ra || Rb
Ra || Rb = 40/9 days




**Ex. 2. A and B together can complete a piece of work in 4 days. If A alone can complete the same work in 12 days, in how many days can B alone complete that work?**

Ra || Rb = 4
Ra = 12
Rb = ?
Solving, Rb = 6

**Ex. 3. A can do a piece of work in 7 days of 9 hours each and B can do it in 6 days of 7 hours each. How long will they take to do it, working together (8+2/5) hours a day?**

Express everything in hours.
Ra = 63 hours
Rb = 42 hours
Ra || Rb = 126/5 hours = (126/5) × (5/42) days = 3 days

**Ex. 4. A and B can do a piece of work in 18 days; B and C can do it in 24 days, A and C can do**

**it in 36 days. In how many days will A, B and C finish it, working together and separately?**

Ra || Rb = 18 ==> $Ra^{-1}+Rb^{-1}=18^{-1}$
Rb || Rc = 24 ==> $Rb^{-1}+Rc^{-1}=24^{-1}$
Ra || Rc = 36 ==> $Ra^{-1}+Rc^{-1}=36^{-1}$
Summing, $2(Ra \parallel Rb \parallel Rc)=8^{-1}$
Ra || Rb || Rc = 8
Upon simple substitution, Ra = 48, Rb = 144/5

**Ex. 5. A is twice as good a workman as B and together they finish a piece of work in 18 days. In how many days will A alone finish the work?**

A is twice as good a workman as B. That means A finishes the work in half the time as B.
Ra = Rb/2
Ra || Rb = 18
On solving, Rb = 27

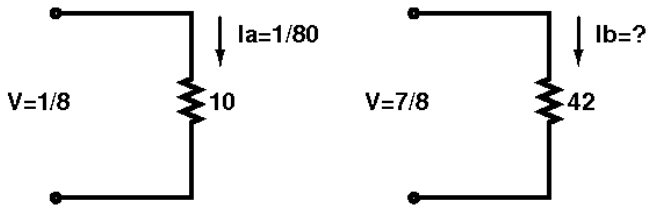
*Note: In an electrical analogy, A being twice as good a workman as B means the current through Ra is twice the current through Rb, that is, A's speed of work is twice that of B.*

**Ex. 6. A can do a certain job in 12 days. B is 60% more efficient than A. How many days does B alone take to do the same job?**

B is 60% more efficient than A.
Ib=1.6 × Ia ==> Ra=1.6Rb
Ra = 12
Therefore, Rb = 15/2

**Ex. 7. A can do a piece of work in 80 days. He works at it for 10 days and then B alone finishes the remaining work in 42 days. In how much time will A and B, working together, finish the work?**

*Note: In an electrical analogy, V=1 V, means that all of the work has been completed. V=1/3 V means that one third of the work has been completed and so on.*




Ra = 80 ==> Ia=1/80
A works only for 10 days. Therefore, he completes only V=Ia×10=1/8 of the work.
The remaining work, 1-1/8=7/8 is done by B.
And B takes 42 days to 7/8 of the work.
Therefore, V=Ib×42 ==> 7/8=Ib×42 ==> Ib = 1/48
Therefore, time B will take to complete all of the work, Rb = 48
Ra || Rb = 30

*Think about it. It'll make sense...*

**Ex. 8. A and B undertake to do a piece of work for Rs. 600. A alone can do it in 6 days while B alone can do it in 8 days. With the help of C, they finish it in 3 days. Find the share of each.**

Ra = 6 ==> Ia=1/6
Rb = 8 ==> Ib=1/8

Ra || Rb || Rc = 3 ==> Rc = 24 ==> Ic=1/24

The currents are a measure of the speed of work of each. The faster worker naturally does more work and gets paid more.

The share of the money for A, B and C is therefore 1/6:1/8:1/24 = 4:3:1
From the obtained ratio,
A's share=600×(4/8)=Rs. 300
B's share=600×(3/8)=Rs. 225
C's share=600×(1/8)=Rs. 75

**Ex. 9. A and B working separately can do a piece of work in 9 and 12 days respectively. If they work for a day alternately, A beginning, in how many days will the work be completed?**

Ra = 9 ==> Ia=1/9
Rb = 12 ==> Ib=1/12
Work done in a pair of days = (Ia×1) + (Ib×1) = 7/36
In 5 pairs of days, 35/36 of the work will be done.
The last 1/36 of the work will have to be done by A, who will finish it in
R=V/Ia=(1/36)/(1/9)=1/4 days
Therefore, the total time taken was (5×2)+(1/4) = 10+(1/4) days

**Ex. 10. 45 men can complete a work in 16 days. Six days after they started working, 30 more men joined them. How many days will they now take to complete the remaining work?**

Time for one man to finish the job
Rm=16×45=720 ==> Im=1/720
Work completed by 45 men in 6 days
=(45×Im)×6=3/8
Remaining work=5/8
Time taken for remaining work to be completed,
R = (5/8)/(75Im) = 6 days

*Notice that if Im is the current (or speed of work) of one man, 45Im is the current (or speed of work) corresponding to 45 men. Also 75Im is the current (or speed of work) corresponding to 75 men.*

**Ex. 11. 2 men and 3 boys can do a piece of work in 10 days while 3 men and 2 boys can do the same work in 8 days. In how many days can 2 men and 1 boy do the work?**

R1 = 10 ==> I1 = 1/10
R2 = 8 ==> I2 = 1/8
Let Im and Ib be the speed (or current) of 1 man and 1 boy respectively.
2Im+3Ib=I1 ==>2Im+3Ib=1/10
3Im+2Ib=I2 ==>3Im+2Ib=1/8
Solving for Im and Ib and calculating 2Im+Ib, we get
2Im+Ib=2/25
Therefore, 2 men and 1 boy can do the work in 25/2 days.

# Quantitative Aptitude – Pipes and Cisterns Problems for the Electrical Engineer

Compared to time and work, I thought pipes and cisterns (and leaks) were a lot easier to imagine and solve mentally. But even these problems could benefit from an analogy to Ohm's law.

**Analogies are the same**

> Amount of liquid that has flowed *is analogous to* Voltage
> Rate of flow *is analogous to* Current
> Time taken *is analogous to* Resistance

Pipes and inlets may be modelled with positive resistances and currents, while leaks and outlets may be modelled with negative resistances and currents.
From an electrical point of view, negative resistances might seem absurd, but it is only weird not absurd or unheard of.

**Ex. 1. Two pipes A and B can fill a tank in 36 hours and 45 hours respectively. If both the pipes are opened simultaneously, how much time will be taken to fill the tank?**

Ra = 36
Rb = 45
Ra || Rb = 20

**Ex. 2. Two pipes can fill a tank in 10 hours and 12 hours respectively while a third pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time will the tank be filled?**

Ra = 10
Rb = 12
Rc = -20
Ra || Rb || Rc = 15/2

**Ex. 3. If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours does it take the second pipe to fill the reservoir?**

Ra || Rb = 12
Rb = Ra + 10
Solving, Ra = 20, Rb = 30

**Ex. 4. A cistern has two taps which fill it in 12 minutes and 15 minutes respectively. There is also a waste pipe in the cistern. When all the three are opened, the empty cistern is full in 20 minutes. How long will the waste pipe take to empty the full cistern?**

Ra = 12
Rb = 15
Ra || Rb || Rc = 20
Solving, Rc = -10
Therefore, the waste pipe takes 10 minutes to empty the cistern.

**Ex. 5. An electric pump can fill a tank in 3 hours. Because of a leak in the tank, it took 3½ hours to fill the tank. If the tank is full, how much time will the leak take to empty it?**

Ra = 3
Ra || Rb = 7/2
Solving, Rb = -21
Therefore, the leak will take 21 hours to empty the tank.

**Ex. 6. Two pipes can fill a cistern in 14 hours and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom it took 32 minutes more to fill the cistern. When the cistern is full, in what time will the leak empty it?**

Ra = 14
Rb = 16
Ra || Rb || Rc = Ra || Rb + 32
Solving, Rc = -112

**Ex. 7. Two pipes A and B can fill a tank in 36 minutes and 45 minutes respectively. A water pipe C can empty the tank in 30 minutes. First A and B are opened. After 7 minutes, C is also opened. In how much time is the tank full?**

Ra = 36 ==> Ia = 1/36
Rb = 45 ==> Ib = 1/45
Rc = -30 ==> Ic = -1/30

Amount of liquid filled in 7 minutes = 7(Ia+Ib) = 7/20
Amount of liquid to be filled by A, B and C together = 1-7/20 = 13/20
From Ohm's law, 13/20=(Ia+Ib+Ic)×R
Solving for R, we get R = 39
Therefore, total time taken = 39 + 7 = 46 minutes

**Ex. 8. Two pipes A and B can fill a tank in 24 minutes and 32 minutes respectively. If both the pipes are opened simultaneously, after how much time B should be closed so that the tank is full in 18 minutes?**

Ra = 24 ==> Ia = 1/24
Rb = 32 ==> Ib = 1/32

After a certain time x, pipe B is closed.
Amount of liquid filled in x minutes = (Ia+Ib)×x = (7/96)x
Amount of liquid left to be filled = 1-(7/96)x
(89/96)x amount of liquid is filled in (18-x) minutes by A alone.
Therefore, 1-(7/96)x = Ia×(18-x)
Solving, x = 8
Therefore, B should be closed in 8 minutes.