Time and Work

Important Relations

1. **Work and Person** Directly proportional (more work, more men and conversely more men, more work).
2. **Time and Person** Inversely proportional (more men, less time and conversely more time, less men).
3. **Work and Time** Directly proportional (more work, more time and conversely more time, more work).

Basic Rules Related to Work and Time

Rule - 1: Work from Days:

4. If a person can do a piece of work in *n* days (hours), then that person's 1 day's (hour's), work = *1/n*

Rule- 2 : Days from Work:

5. If a person's 1 day's (hour's) work = *1/n*, then the person will complete the work in *n* days (hours).

Rule - 3

6. If a person is *n* times efficient than second person, then work done by :
7. Ratio of work done by First person and Second person = *n* : 1.

Rule - 4

8. If ratio of numbers of men required to complete a work is *m : n*, then the ratio of time taken by them will be *n : m*.

Basic Concepts of Work and Time

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

1. Analogy between problems on time and work to time, distance and speed:

1. Speed is equivalent to rate at which work is done
2. Distance travelled is equivalent to work done.
3. Time to travel distance is equivalent to time to do work.

2. Man - Work - Hour Formula:

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.
5. Rate of work * Time = Work Done
6. If *A* can do a piece of work in *D* days, then *A's* 1 day's work = *1/D*.
   Part of work done by *A* for t days = *t/D*.
7. If *A's* 1 day's work = *1/D*, then *A* can finish the work in *D* days.

Techniques - 1

M D H / W = Constant

Where,

M = Number of men
D = Number of days
H = Number of hours per day
W = Amount of work

Techniques - 2

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

M1 D1 H1 / W1 = M2 D2 H2 / W2

Techniques - 3

If *A* is x times as good a workman as *B*, then:

1. Ratio of work done by *A* and *B* = *x : 1*
2. Ratio of times taken by *A* and *B* to finish a work = *1 : x* ie; *A* will take $(1/x)^{th}$ of the time taken by *B* to do the same work.

Techniques - 4

A and *B* can do a piece of work in *'x'* days and *'y'* days respectively, then working together:

1. They will complete the work in *(xy/x+y)* days
2. In one day, they will finish $(x+y/xy)^{th}$ part of work.

Techniques - 5

If *A* can do a piece of work in *'x'* days, *B* can do in *'y'* days and *C* can do in *'z'* days then,

A, B and C together can finish the same work in *(xyz/xy+yz+zx)* days

Techniques - 6

If *A* can do a work in *'x'* days and *A* and *B* together can do the same work in *'y'* days then,

Number of days required to complete the work if *B* works alone = *(xy/x-y)*days

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Q1. 21 binders can bind 1400 books in 15 days. How many binders will be required to bind 800 books in 20 days?

Q2. A does a work in 10 days and B does the same work in 15 days. in how many days they together will do the same work?

Q3. 0 men can make a wall in 8 days. How many men required for completing the same work in half days?

Q4. Rohan and Sunil separately can complete a work in 8 hours and 4 hours respectively. How much time will they take when working together ?

Q5. A is thrice as good as workman as B and therefore is able to finish a job in 60 days less than B. Working together, they can do it in:

Q6. A can lay railway track between two given stations in 16 days and B can do the same job in 12 days. With help of C, they did the job in 4 days only. Then, C alone can do the job in:

Q7. A can do a work in 15 days and B in 20 days. If they work on it together for 4 days, then what fraction of the work that is left?

Q8. A can do a piece of work in 20 days which B can do in 12 days. B worked at it for 9 days. A can finish the remaining work in ?

Q9. A can do $\frac{1}{3}$ of a work in 5 days and B can do $\frac{2}{5}$ of the work in 10 days. In how many days both A and B together can do the work?

Q10. A and B can do a piece of work in 18 days, B and C in 24 days, A and C in 36 days. In what time can they do it all working together?

Q11. A can do a piece of work in 4 hours; B and C together can do it in 3 hours, while A and C together can do it in 2 hours. How long will B alone take to do it?

Q12. A can do a certain work in the same time in which B and C together can do it. If A and B together could do it in 10 days and C alone in 50 days, then B alone could do it in

Q13. A is twice as good a workman as B and together they finish a piece of work in 14 days. In how many days can a alone finish the work?

Q14. A alone can do a certain job in 15 days, while B alone can do it in 10 days. A started the work and was joined by B after 5 days. The work lasted for how many days?

Q15. s 20 % less work then B. If A can complete a of work in $7\frac{1}{2}$h, then B can do it in:

Q16. men can do a piece of work in 6 days. 5 women can do the same work in 18 days. If 4 men and 10 women work together, then how long will it take to finish the work?

Q17. A does 80% of a work in 20 days. He then calls in B and they together finish the remaining work in 3 days. How long B alone would take to do the whole work?

Q18. A machine P can print one lakh books in 8 hours, machine Q can print the same number of books in 10 hours while machine R can print them in 12 hours. All the machines are started at 9 A.M. while machine P is closed at 11 A.M. and the remaining two machines complete work. Approximately at what time will the work (to print one lakh books) be finished?

Q19. P can complete a work in 12 days working 8 hours a day. Q can complete the same work in 8 days working 10 hours a day. If both P and Q work together, working 8 hours a day, in how many days can they complete the work?

Q20. Ravi and Kumar are working on an assignment. Ravi takes 6 hours to type 32 pages on a computer, while Kumar takes 5 hours to type 40 pages. How much time will they take, working together on two different computers to type an assignment of 110 pages?

Q21. A takes twice as much time as B or thrice as much time as C to finish a piece of work. Working together, they can finish the work in 2 days. B can do the work alone in:

Q22. Bhavika alone would take 8 hours more to complete the job than when Bhavika and Ritika worked together. If Ritika worked alone, she would take 4½ hours more to complete the job than when Bhavika and Ritika worked together. What time would they take if both Bhavika and Ritika worked together?

Q23. A can do a piece of work in 10 days, while B alone can do it in 15 days. They work together for 5 days and the rest of the work is done by C in 2 days. If they get Rs 450 for the whole work, how should they divide the money?

Work done by A and B in 5 days

$= \left(\frac{1}{10}+\frac{1}{15}\right)\times 5 = \frac{5}{6}$

Work remaining

$= 1-\frac{5}{6}=\frac{1}{6}$

∴ C alone can do the work in 6 × 2 = 12 days

Ratio of their share work

$= \frac{5}{10}:\frac{5}{15}:\frac{2}{12}=3:2:1$

Share of wages = Rs 225, Rs 150, Rs 75.

Q24. A contractor undertook to do a piece of work in 9 days. He employed certain number of laboures but 6 of them were absent from the very first day and the rest could finish the work in only 15 days. Find the number of men originally employed.

Pipes and Cisterns

- **Inlet:** A pipe connected with a tank (or a cistern or a reservoir) is called an inlet, if it fills it.
- **Outlet:** A pipe connected with a tank is called an outlet, if it empties it.
- If an inlet pipe can fill a cistern in A hours, the part filled in 1 hour = 1/A (same as work and time fundamental)
- If an Outlet pipe can empty the tank in B hours, the part filled in 1 hour = 1/B (same as work and time fundamental)
- If pipe A is 'x' times bigger than pipe B , then pipe A will take $\frac{1}{x^{th}}$ of the time taken by pipe B to fill the cistern
- If an inlet pipe can fill a tank in *a* hours and an outlet pipe empties the full tank in *b* hours, then the net part filled in 1 hour when both the pipes are opened = $\frac{1}{a}-\frac{1}{b}$
- In 1 hour, the part filled (or emptied) = $\frac{1}{a}-\frac{1}{b}$

- Time required to fill or empty the tank = $\frac{ab}{b-a}$ hours.
- If x and y fill/empty a cistern in 'm' and 'n' hours, then together they will take
- $\left(\frac{mn}{m+n}\right)$ hours to fill/empty the cistern and in one hour $\frac{n+m}{nm}$ th part of the cistern will be filled/ emptied. (same as time and work)

If an inlet pipe fills a cistern in '*a*' minutes and takes '*x*' minutes longer to fill the cistern due to a leak in the cistern, then the time in which the leak will empty the cistern is *a* ($1+\frac{a}{x}$).

If a pipe fills a tank in x hours and another fills the same tank is y hours, but a third one empties the full tank in z hours, and all of them are opened together, then net part filled in 1 hr

$=\left[\frac{1}{x}+\frac{1}{y}-\frac{1}{z}\right]$

∴ Time taken to fill the tank

$=\frac{xyz}{yz+xz-xy}$ hours.

A cistern has a leak which can empty it in X hours. A pipe which admits Y litres of water per hour into the cistern is turned on and now the cistern is emptied in Z hours. Then the capacity of the cistern is

$\frac{X+Y+Z}{Z-X}$ litres.

A cistern is filled by three pipes whose diameters are X cm., Y cm. and Z cm. respectively (where X < Y < Z) . Three pipes are running together. If the largest pipe alone will fill it in P minutes and the amount of water flowing in by each pipe is proportional to the square of its diameter, then the time in which the cistern will be filled by the three pipes is $\left[\frac{PZ^2}{X^2+Y^2+Z^2}\right]$ minutes.

If one filling pipe A is n times faster and takes X minutes less time than the other filling pipe B, then the time they will take to fill a cistern, if both the pipes are opened together, is

$\left[\frac{nX}{(n^2-1)}\right]$ minutes.

A will fill the cistern in $\left(\frac{X}{n-1}\right)$ minutes and B will take to fill the cistern $\left(\frac{nX}{n-1}\right)$ minutes.

Here, A is the faster filling pipe and B is the slower one.

Two filling pipes A and B opened together can fill a cistern in t minutes. If the first filling pipe A alone takes X minutes more or less than t and the second fill pipe B along takes Y minutes more or less than t minutes, then t is given by $[t=\sqrt{xy}]$ minutes.

Example 4: Pipe A can fill a tank in 20 hours while pipe B alone can fill it in 30 hours and pipe C can empty the full tank in 40 hours. If all the pipes are opened together, how much time will be needed to make the tank full?

Example 1: It takes 4 hrs for pipe A to empty a 100 litre tank, if another pipe B which double the size of pipe is employed how long will it take to empty the tank?

Solution: Since the Pipe is double the size,

it will take $\frac{1}{2}$ time of the time taken by the smaller pipe

Therefore $\frac{1}{2}\times 4$ = 2 hrs

Example 2: There are two pipes (inlet and outlet) attached with a tank of 1000 litres, the inlet pipe can fill the tank in 2 hrs, the outlet pipe can empty the tank in 4 hrs. What is the time required to fill the tank in case both are open? In one hour what part of tank will be filled?

Solution: For Inlet pipe, time to fill the tank = 2 hrs
For Outlet pipe, time to empty the tank = 4 hrs
Time to fill the tank

$=\frac{2\times 4}{4-2}=\frac{8}{2}$ = 4 hrs

Net part filled/emptied in one hour

$=\frac{1}{2}-\frac{1}{4}=\frac{1}{4}$ th part of the tank, which is even obvious from the earlier result.

Example 3: There is a pipe attached with a tank of 1000 liters, the inlet pipe can fill the tank in 2 hrs, there is a leak in the tank due to which it takes 2 hrs more to fill the tank. In what time can leak empty the tank?

Solution: Time taken by pipe to empty the tank = 2 hrs
Extra time taken due to the leak = 2 hrs
By the formula, Time taken for leak to empty the tank

$=\left(1+\frac{a}{x}\right)=2\left(1+\frac{2}{2}\right)$

= 2 × 2 = 4 hours

Example 4: Pipe A can fill a tank in 20 hours while pipe B alone can fill it in 30 hours and pipe C can empty the full tank in 40 hours. If all the pipes are opened together, how much time will be needed to make the tank full?

Solution: By direct formula, The tank will be fill in

$=\frac{20\times 30\times 40}{30\times 40+20\times 40-20\times 30}=\frac{120}{7}=17\frac{1}{7}$ hrs.

Example 5: Three pipes A, B and C can fill a tank in 6 minutes, 8 minutes and 12 minutes, respectively. The pipe C is closed 6 minutes before the tank is filled. In what time will the tank be full?

Solution: Let it takes t minutes to completely fill the tank.

Now, $\frac{t}{6}+\frac{t}{8}+\frac{t-6}{12}=1$

or $\frac{4t+3t+2t-12}{24}=1$

or 9t – 12 = 24

or 9t = 36

∴ t = 4 min.