TIME AND WORK

If one person can eat 5 chocolates per day for 4 days, in total 5 x 4 = 20 chocolates will be completed in 4 days

Time = 4 days
Efficiency = 5 chocolate / day
Work = 20 chocolates

Efficiency = work done in a day

Work = Time x Efficiency	Efficiency $= \dfrac{Total\ work}{Time}$	Time $= \dfrac{Total\ work}{Efficiency}$

If Time constant:
➢ If time is constant (or) same, ***Work is directly proportional to efficiency***
➢ If work ratio 2:3 then efficiency ratio also 2:3

Time	work	efficiency
4 days	20 chocolates	5 c/day
4 days	40 chocolates	10 c/day

If Efficiency is constant:
➢ If Efficiency is constant (or) same, ***Work is directly proportional to time***
➢ If work ratio 5:6 then time ratio also 5:6

efficiency	work	time
5 c/day	20 chocolates	4 days
5 c/day	40 chocolates	8 days

If Work is constant:
➢ If Work is constant (or) same, ***efficiency is inversely proportional to time***
➢ If efficiency ratio is 1:2 then time ratio will become 2:1

work	efficiency	time
40 chocolates	5 c/day	8 days
40 chocolates	10 c/day	4 days

WE HAVE TWO TYPES OF PROBLEMS IN TIME AND WORK
● **DIFFERENT EFFICIENCY PROBLEMS**
● **SAME EFFICIENCY PROBLEMS**

1. Different Efficiency

In different efficiency problems we have individual people each and every persons efficiency is different. We don't know what work they are doing and how much work they are doing,
● We will assume total work as LCM
● We will assume eating chocolates as a work

Example 1 : Mr. A can do a job in 12 days and Mr. B can do the dame job in 24 days. Find the time taken to complete the same work when they are working together.

Solution:

A - 12 days - 2 units/day ⟶ A efficiency
B - 24 days - 1 unit/day ⟶ B efficiency
   24 units   3 units/day ⟶ combined efficiency
   └⟶ Total work

  Time = 24/3 = 8 days.

Example 2: A and B can do a work in 30 days. B and C can do it in 15 days. C and A can do it in 18 days. Find the time taken to complete the work if A is working alone and all working together?

Solution: 90 C
      A+B = 30 days   3 c/d
      B+C = 15 days   6 c/d
      C+A = 18 days   5 c/d
                2(A+B+C) = 14 c/d
                A+B+C = 7 c/d

Time $= \dfrac{work}{efficiency} = \dfrac{90}{14} = 6\dfrac{3}{7}$ days

Practice Questions

1. A and B can do a piece of work in 6 days. B alone can do it in 9 days. In how many days A alone do it?
2. A can do a work in 20 days and B in 15 days. If they work on it together for 5 days, then the fraction of the work that is left is :
3. P, Q and R can do a job in 20, 30 and 60 days respectively. In how many days can P do the job if he is assisted by Q and R every third day?
4. A and B can do a work in 8 days, B and C can do the same work in 12 days. A, B and C together can finish it in 6 days. A and C together will do it in :
5. A can complete 1/3rd of work in 30 days. B can complete 1/6th of the work in 12 days. Together they can complete the work in how many days?
6. A alone can complete a work in 20 days. B alone can complete the same work in 30 days. In how many days the work will be completed if both work together?

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PARTIAL WORK

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●   In partial work they will divide the work and completes the work

Example 3: 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?

Solution: 60 C
        A = 20 days   3 c/d
        B = 12 days   5 c/d
B started the work and works for 9 days w= ext = 5x9 = 45 chocolates are over

Remaining chocolates= 60 - 45 = 15c (this will be done by A)
T=w/e= 15/3 = 5 days

Practice Questions:
1. A can do a certain job in 25 days which B alone can do it in 20 days. A started the work and was joined by B after 10 days. The work lasted for?
2. A can do a piece of work in 10 days and B can do the same work in 20 days. They started the work together but after 5 days, A leaves off. B will do the remaining work in?
3. A can complete the work in 20 days. B can complete the work in 26 days. They started working together but A left 3 days before completing the work. For how many days work happened

ALTERNATE DAYS
- In Alternate days, if two people A & B are working, 1st day A will work, 2nd day B will work, 3rd day A will work and so on
- Its very important who starts the work, Time will vary based on who starts the work

Example 4: Gautham and Karan can complete a job in 15 days and 12 days respectively. If they work alternatively for one day each, with Gautham starting the job, when will the job be completed?

Solution: 60 C
                    G = 15 hours   4 c/d
                    K = 12 hours   5 c/d
If Gautham starts the work
                    1st day ------> G ------> 4C
                    2nd day ------> K ------> 5C
                    ──────────────────────────────
                    2 days ----------------> 9C are over
                     x6   x6   (Nearest multiple of 9 near 60)
                    12 days ---------------> 54 C over
                    13th day-----> G ------>   4C
                    ──────────────────────────────
                    13 days ----------------> 58 C over
            14th day K will work t = w/e = 2/5   (2 chocolates remaining)
                    13+2/5 = $13\frac{2}{5}$ days
If Karan starts the work
                    1st day ------> G ------> 4C
                    2nd day ------> K ------> 5C
                    ──────────────────────────────
                    2 days ----------------> 9C are over
                     x6   x6   (Nearest multiple of 9 near 60)
                    12 days ---------------> 54 C over
                    13th day-----> K ------>   5C
                    ──────────────────────────────
                    13 days ----------------> 59 C over
            14th day G will work t = w/e = 1/5   (1 chocolate remaining)
                    13+1/5 = $13\frac{1}{5}$ days

Practice Questions:

1. X and Y can do a piece of work in 12 days and 18 days respectively. If they work on alternate days starting with X how many days will they take to finish the job?

2. A,B and C can do a piece of work in 30,20 and 10 days respectively. If A is assisted by B on one day and by C on next day alternatively. How long they take to complete the work?

EFFICIENCY BASED QUESTIONS

- In efficiency based questions they will compare efficiencies
- When work is constant then time is inversely proportional to efficiency

Example 5: A is thrice as efficient as B, together they can do a piece of work in 12 days. A alone can do the work in how many days?

Solution:

$$A = \quad 3 \ c/d$$
$$B = \quad 1 \ c/d$$
$$\overline{\qquad A+B = 4c/d \qquad}$$

Together time is 12 days given

$$W = ext = 4 \times 12 = 48 \ C$$

Time of A is $t = \dfrac{w}{e} = \dfrac{48}{3} = 16$ days

Practice Questions:

1. A works 4 times as fast as B. If B completes a job in 60 days, then in how many days can A and B together complete the same job?

2. P can complete a job in 60 days. Q is 25% less efficient than P. Find the time in which Q can complete it (in days).

3. A is thrice as good as B and is therefore able to finish a piece of work in 60 days less than B. Find the time in which they can do it,together?

4. A is 50% as efficient as B, C does half the work done by A and B together, if C alone can do the job in 40 days, then A,B,C can together do the job in how many days?

5. A can do a certain job in 12 days. B is 60% more efficient than A. How many days B alone will take to complete the job?

WAGES

- Till now we have calculated only time now we are distributing the wage
- Wage should be distributed based on their efficiency

Example 6: A and B can do a job in 60 and 40 days respectively. They earned 450/- for completing work together. What is the share of B? (in `)

Solution:
$$\qquad\qquad\qquad\qquad\qquad 120 \ C$$
$$A = 60 \ days \qquad 2 \ c/d$$
$$B = 40 \ days \qquad 3 \ c/d$$

Ratio of efficiency is 2:3, Total money = 450/-

Share of B is $\dfrac{3}{5} \times 450 = 270$/-

Practice Questions:
1. 20. A can complete a job in 6 days, B can complete in 8 days. A and B undertook it for 320/- with help of C they completed the job in 3 days. Find the share of C?
2. P and Q can complete the work for Rs. 1800. P and Q can complete the work in 10 days and 15 days respectively. With the help of R, they all together completed the work in 5 days. Find the share of R.
3. P and Q together can do a work for Rs. 3240. P and Q can do the work in 12 days and 18 days respectively. With the help of R, they all together completed the work in 6 days. Find the share of R.

2. SAME EFFICIENCY PROBLEMS
● In different efficiency problems we have individual people
● In same efficiency we have group of people

When a group of persons works together to complete a job in a given time, it will be known as compound work.

If a group of persons works together, we need to assume all the persons in that group has same efficiency.

$$\boxed{\text{Work = Time x Efficiency x Number of persons}}$$

$W = T \times E \times M \quad$ (M = Number of men)

$E_1 = \dfrac{W_1}{T_1 \ x \ M_1} \quad$ and $\quad E_2 = \dfrac{W_2}{T_2 \ x \ M_2}$

$E_1 = E_2 \quad$ (In compound work, Efficiency is same)

Therefore, $\dfrac{W_1}{T_1 \ x \ M_1} = \dfrac{W_2}{T_2 \ x \ M_2}$

Example 7: 10 men completes a work in 20 days. Find the time taken by 4 men to complete the same work.

Solution :

$\dfrac{W_1}{20 \ x \ 10} = \dfrac{W_1}{T_2 \ x \ 4} \qquad\qquad T_2 = 50$ days.

Practice Questions:
1. 20 People can complete a work in 12 days working 5 hours a day. 16 people can complete the same work in how many days working 20 hours a day?
2. 45 men can complete a work in 12 days. How many men are required to complete 25% of the work in 27 days ?
3. 60 men can complete a work in 20 days. How many more men are required to complete 2 times the work in 10 days?
4. 42 women can do a work in 25 days, how many more women are required to complete 2/3rd of work in 1/5th of time
5. 12 men can complete a piece of work in 9 days. After 3 days of the start of the work, six men joined the team to replace the 2 men who left. How many days will be required to complete the remaining work?

6. 10 women can complete a work in 7 days and 10 men take 14 days to complete the work. How many days will 5 women and 10 men take to complete the work?

7. If 15 women or 10 men complete a project in 55 days, in how many days will 5 women and 4 men working together complete the same project?

8. 10 men can complete a work in 15 days and 15 women can complete the same work in 12 days. Find the number of days that all the 10 men and the 15 women together will take to complete the work?

9. 12 men can complete a piece of work in 4 days while 15 women can complete the same work in 4 days. 6 men start working on the job and after working for 2 days, all of them stopped working. How many women should be put on the job to complete the remaining if it is to be completed in 3 days?

10. 3 men or 5 women or 8 boys can finish a work in 38 days. Then the number of days taken by 6 men, 10 women and 6 boys to finish the work is

11. If 8 men and 5 women can do a piece of work in 12 days, 6 men and 12 women can do the same work in 8 days, in how many days can 4 men and 9 women complete the work?

PIPES AND CISTERNS

- It is not a new topic, it is an application of Time and Work
- In pipes and cisterns, we have negative work
- If positive efficiency is more than negative efficiency then the tank will fill

Example 8: Pipe A can fill a tank in 15 minutes, Pipe B can empty a tank in 60 minutes. Find the time taken to fill the tank if both pipes are opened together.?

Solution: 60 L   (it is capacity of the tank)
    (+) A = 15 min +4 L/min
    (-) B = 60 min -1 L/min
    —————————————————————
      A+B = 3 L/min

T = w/e = 60/3 = 20 mins

 Practice Questions:
1. Pipe A can fill the tank in 30 minutes, due to leak in the bottom it is taking 45 minutes to fill the tank, find the time taken by the leak to empty the tank when the tank is full?

2. Two pipes can fill a cistern in 14 hrs and 16 hrs respectively. The pipes are opened simultaneously and it is found that due to the leakage in the bottom of the cistern it takes 32 minutes extra for the cistern to be filled. When the cistern is full, in what time will the leak empty it?

3. A cistern is normally filled in 5 hours. It takes 6 hours when there is a leak in the bottom. If the cistern is full, in what time shall the leak empty it?

4. Pipe A and B fills a tank in 12 hours and 15 hours respectively. Pipe C empties a tank in 20 hours. Find the time taken to fill the tank if all the pipes are opened together.

5. Pipe A fills a tank in 10 hours. Pipe B empties the same tank in 20 hours. Find the time taken to fill the tank if both the pipes are opened together.
A. 10 hours   B. 15 hours   C. 20 hours   D. 40 hours

6. Pipe A fills a tank in 4 hours and Pipe B empties a tank in 8 hours. Find the time taken to fill the tank if both the pipes are opened simultaneously.
A. 8 hours   B. 6 hours   C. 4 hours   D. 2 hours

7. Pipe A fills a tank in 20 mins. Find the time taken to fill the tank if 5 pipes with 20% efficiency of A opens together.
A. 15 mins   B. 4 mins   C. 5 mins   D. 20 mins

8. Pipe A, B and C fills the tank 10 minutes, 20 minutes and 30 minutes respectively. All the three pipes opened together and Pipe C is closed after 3 minutes. Find the total time taken to fill the tank.
A. 3 minutes   B. 6 minutes   C. 2 minutes   D. 4 minutes

9. Pipe A fills a tank in 36 minutes and Pipe B empties a tank in 45 minutes. Find the time taken to fill the tank if both the pipes are opened alternatively starts with A.
A. 3 minutes   B. 180 minutes   C. 176 minutes   D. 351 minutes

10. Pipe A fills a tank in 6 hours. After half of the tank is filled, two more similar pipes are opened together. Find the time taken to fill the tank.
A. 3 hours   B. 4 hours   C. 5 hours   D. 6 hours

11. Pipe A fills a tank in 4 hours. Due to leakage, it takes one more hour to fill the tank. Find the time taken to empty the full tank if leakage pipe alone opened.
A. 5 hours   B. 10 hours   C. 15 hours   D. 20 hours

12. Pipe A fills a tank in 28 mins. Pipe B empties the same tank at the rate of 2.5 litres per minutes. If both the pipes are opened together, tank is filled in 42 minutes. Find the capacity of the tank.
A. 20 litres   B. 315 litres   C. 105 litres   D. 210 litres

13. Pipe A and B fills a tank in 10 hours and 15 hours respectively. Both the pipes are opened together, after some time pipe B is closed. Then the remaining tank is filled in 5 hours. After how many hours pipe B was closed?