Time, Speed, & Distance Time & Work, Mensuration

Relevel
by Unacademy

Introduction

Speed= Distance/ Time ; S= D/T

Units of conversion:

- 1 km/hr =(5/18) m/sec
- 1 m/sec = (18/5) km/hr
- 1.6 kms = 1 miles
- 1 mile = 1600 m
- 1 km/hr = (5/8) miles/hr
- 1 yard = 3 feet
- 1 km= 1000 m

TSD- Type of Questions

Type A: If "D" is Constant, S proportional to 1/T

If "D" is Constant, i.e. when the same journey is travelled under different conditions

S1* T1 = S2* T2

S1/S2= T2/ T1

Example 1: A train does a journey without stopping in 8 hours. If it had travelled 5 km/hr faster, it would have done the journey in 6 hours 40 minutes. What is its speed?

Example 2: A train covered 180 km in 4 hours. If it travels with 2/3rd of its usual speed, then find the extra time to cover the same distance?

TSD- Type of Questions

Type – B: For the same distance, If speed changes by a/b , time changes by b/a

Let usual speed = U km/hr and usual time of the journey = T hours

If New speed = (a/b)* U km/hr, then new time of the journey =(b/a)*T hours

Hence, change in the time of Journey = |((b/a)-1)*T|

Example 1: Walking 5/7 of his usual speed, a boy reaches his school 6 minutes late. Find his usual time to reach the school.

TSD- Type of Questions

Type C- Difference of Time

Example 1: If I walk at 4 km/hr, I miss the train by 10 minutes. If I walk at 5 km/hr, I reach 5 minutes before the departure of the train. How far I walk to reach the train/station. Also, find my usual time and usual speed.

Type D: Increasing or Decreasing Speed

Example 1: If a man increases his speed by 2 km/hr, he reaches the place 1 hour early and if he decreases his speed by 2 km/hr, he reaches 1 hour 30 minutes late. Find his usual speed and usual time and the distance.

TSD- Type of Questions

Type E: If “T” is Constant, S is proportional to D,

S1/S2= D1/ D2

Example 1: Points A, P, Q and B lie on the same line such that P, Q and B are respectively 100km, 200km, and 300km away from A. Cars 1 and 2 leave A at the same time and move towards B. Simultaneously, Car 3 leaves B and moves towards A. Car 3 meets Car1 at Q and Car 2 at P. If each car is moving at a uniform speed, then the ratio of the speed of Car 2 to that of Car 1 is-

(a) 1:4 (b) 1:2 (c) 2:7 (d) 2:9

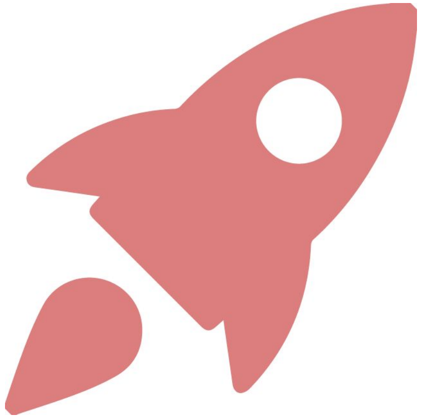
Average Speed

Points to Understand:

1. Average Speed= Total Distance travelled/ Total Time taken

2. Average Speed as a Harmonic Mean

3. When 2UV/ (U+V) fails ?



Average Speed

Example 1. A goes to a certain place at 20 km/hr and returns at 30 km/hr, find his average speed.

Solution: Using the formula, Average speed= 2UV/ (U+V) ,

Average Speed = 2*20*30/ (20+30) = 24 km/hr

Note: This formula can be used when speeds are relevant for each half of the total distance covered

Example 2. A covers 75% of the journey at 20 km/hr and rest at 30 km/hr, find his average speed.

Solution: Note that, we cannot use the formula 2UV/ (U+V).

Let distance = 100 km

Average Speed= 100/ ((75/20)+(25/30)) = 21.81 km/hr

Average Speed

Example 3. An aeroplane is flying over a square region with the respective speeds of 100 km/hr, 200 km/hr, 300 km/hr and 400 km/hr.

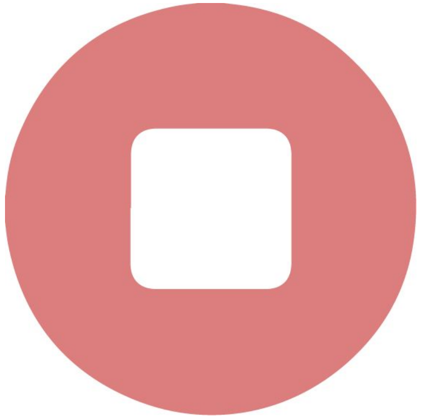
Find the average speed of the aeroplane.

(a) 250 km/hr (b) 292 km/hr (c) 192 km/hr (d) None

Example 4. A bus travels 150 km in 3 hours partly at a speed of 80 km/hr and partly at a speed of 40 km/hr. Find the distance travelled at a speed of 80 km/hr.

(a) 90 km (b) 60 km (c) 70 km (d)80 km

Stoppage Time

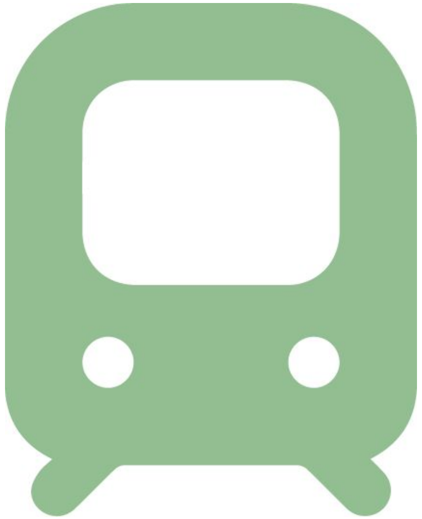


- Without stoppages, the average speed of the journey = x km/hr
- With stoppages, the average speed of the journey = y km/hr
- Then stoppage time per hour = ((x-y)/y)*60 mins per hour
- Short cut: (Difference of speeds/ Faster Speed)* 60 mins per hour

Stoppage Time

Example 1. The average speed of a train including stoppages is 27km/ hr and excluding stoppages 45 km/hr. How many

minutes/hr does the train stop?



Example 2. Without stoppages, a train travels a certain distance with an average speed of 80 km/hr and with stoppages, it

covers the same distance with an average speed of 60km/hr. How many minutes per hour does the train stop?

(a) 20 min (b) 30 min (c) 15 min (d) Cannot be determined

Relative Speed

1. When objects are going in the same direction, Relative speed = Difference of Speeds
2. When objects are going in the opposite Direction, Relative Speed = Sum of Speeds
3. Time of meeting = GAP/Relative Speed

Relative Speed

Example 1. A thief is spotted by a policeman from a distance of 400 meters. When the policeman starts chasing, the thief starts running. If the speed of the thief is 10 km/hr and that of the policeman is 15 km/hr. How far the thief would have run when he is overtaken?

Example 2. A train of 300 m is travelling with a speed of 45 km/hr when it passes point A completely. At the same time, a motorbike starts from point A with a speed 70 km/hr. When it reaches exactly the middle point of the train, the train increases its speed to 60 km/hr and the motorbike reduces its speed to 65 km/hr. How much distance will the motorbike travel while passing the train completely?

Example 3. A, B and C start from the same place at 1 p.m., 2 p.m. and 3 p.m. respectively @ 3 km/hr, 4km/hr and 5 km/hr. When B catches A, he gives a message to A to be delivered it to C. When and where will C receive the message?

Trains

Let Speed = x km/hr,   Length = L Meters

Case (1): Crossing a width less stationary Object

Distance travelled to cross = L mete

Speed of crossing = x km/hr

Time taken to cross = $\{L/ ((5/18)*x)\}$ secs

Case (2): Crossing/overtaking a width less moving object @ y km/hr

Distance travelled to cross = L meter

Speed of crossing = x km/ hr

Time taken to cross = $[L/ \{(x + \text{or} - y)*(5/18)\}]$ secs

Trains

Case (3): Crossing a stationary object of length of P meter

Distance travelled to cross = L meter

Speed of crossing = x kmph

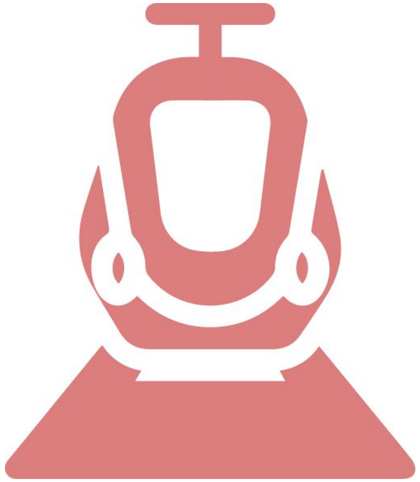
Time taken to cross = $\{(L+P)/(5x/18)\}$ secs

Case (4): Crossing/Overtaking a TRAIN of the length of P meter and running with y km/hr

Distance travelled to cross = L meter

Speed of crossing = x kmph

Time taken to cross = $[(L+P)/\{(x + \text{or} - y)*(5/18)\}]$ secs



Trains

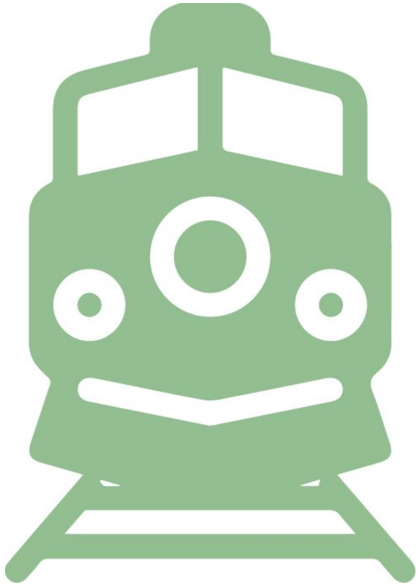
Example 1: A 200 meters long train is travelling at 30km/ hr. Find the time in which

(i) It will cross an electric pole

(ii) It will cross a platform 300 meter.

(iii) It will be overtaken by a train (300, 60).

(iv) A man sitting in it will overtake a train (300,15)



Example 2: A train crosses a man standing on a platform 200 meters long in 3 seconds and the platform in 5 seconds. Find the speed and length of the train.

Trains

Example 3: A train 150 meters long, traveling at 75 km/ hr overtakes another train with 45 km/hr in 30 seconds. In how many seconds does the first train pass a passenger sitting in the second train? Also find the length of slower train.

Example 4: Two trains of equal lengths are running on parallel lines in the same direction at the rate of 46 km/hr. and 36 km/hr. The faster train passes the slower train in 36 seconds. Find the length of each train.

Trains

Example 5: A train of length 150 meters takes 10 seconds to pass over another train 100 meters long coming from opposite direction. If the speed of the first train be 30 km/hr, find the speed of the second train.

Example 6: A 150 meters long train crosses a man walking at the speed of 6 km/hr. in the opposite direction in 6 seconds. The speed of the train in km/hr is ______

Example 7: A train speeds past a pole in 15 seconds and speeds past a platform 100 meters long in 25 seconds. Its length in meters is:

Trains

Example 8: Two trains run on parallel tracks at 90 km/hr and 72 km/hr respectively. When they are running in opposite directions, they cross each other in 5 seconds. When they are running in the same direction at speeds same as before a passenger sitting in the faster train sees the other train passing him in 25 seconds. Find the length of each train.

Example 9: A train passes two men walking in the direction opposite to the train at 3 m/sec. and 5 m/s in 6 seconds and 5 seconds respectively. Find the length of the train.

Boats

Case (1): UPSTREAM MOTION – Against the flow

Let speed of Boat = B km/hr

Speed of river = R km/hr

Upstream speed = (B – R) km/hr

Case (2): DOWNSTREAM MOTION – Along the flow

Let speed of Boat = B km/hr

Speed of river = R km/hr

Downstream speed = (B + R) km/hr

Boats

Example 1: The speed of a boat in standing water is 12 km/hr and that of current is 3 km/hr. Find the distance travelled in 12 minutes.

(i) downstream (ii) upstream

Example 2: The speed of the boat is 10 km/hr and it goes downstream 9 km in 45 min. Find the speed of the current.

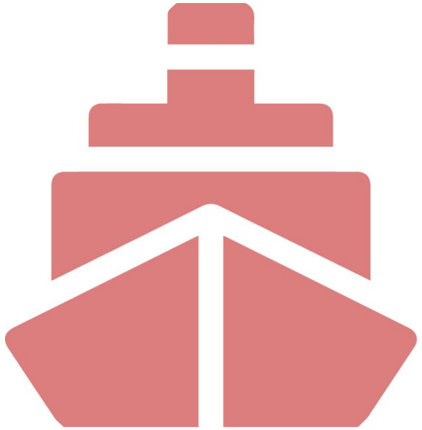
Example 3: The speed of a boat in standing water is 12 km/hr and the speed of the stream is 3 km/hr. In what time will the boat go 7.2 km? upstream?

Boats

Example 4: A boat goes 35 km upstream in 5 hours and 54 km downstream in 6 hrs, find the speed of the boat & current?

Example 5: In still water Ram rows 8 km/hr. With the help of current, he can make a 44 km trip in 4 hours. What is the speed of the current?

Example 6: On a river, B is equidistant and intermediate to A and C. If a boat can go from A to B and back in 6 hours and from A to C in 7 hours, how long it would take from C to A?



Races and Circular Motion

Example 1: In a km race A beats B by 125m or 8 seconds. Find A's time over the course?

Example 2: In a km race A can give a start of 100 m to B, and B can also give 100 m start to C in a km. race. How many meters start can A give to C in 500 m race?

Example 3: A runs 11/ 8 times as fast as B. if A gives 120 metres start to B, how far the winning post must be so that the race may end in a dead heat.

Example 4: A can give to B 50 m start and to C 240 m start in a km race. How many meters start can B gives C in the same race?

Races and Circular Motion

Motion on Circular Track/Closed Path

Let A, B, C, D and E start running from the same point at the same time on a circular track, then-

When they will be together at the starting point again

= LCM (L/A, L/B, L/C, L/D, L/E)

Where L is the length of track and L/A represents the time taken by A to complete one round.

Example 1: A & B run at 150 m/sec & 80 m/sec respectively round a circle of circumference 1200 metres. If they travel at the same time in the same direction and from the same point, then

(i) find the time when they will meet at their starting point for the first time.

(ii) when they will meet again for the first time other than starting point?

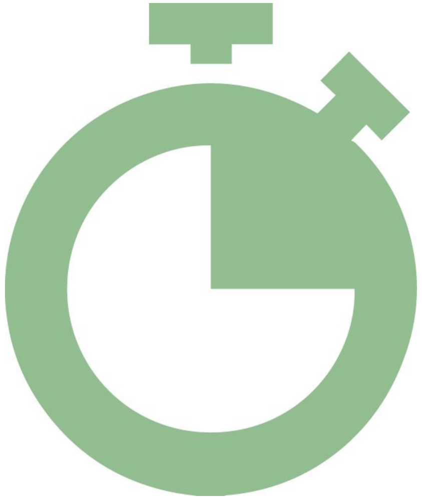
Time and Work- Types of Questions

1. If A can do a work in 20 days while B in 30 days, in how many days A & B together will finish the work?

2. A & B together can finish a work in 12 days. However, A can alone do it in 15 days. In how many days B can do it alone?

3. A & B can respectively finish the same work in 12 & 20 days. A worked for 9 days at it. Find in how many days B will finish the remaining work.

4. A can do a work in 15 days while B in 30 days. Both started together but A left after 6 days. In how many days the whole work finished?



Time and Work- Types of Questions

5. A & B can finish a work in 18 & 24 days respectively. A started it alone and B joined after 6 days. In how many days the whole work was finished?

6. A worked for 8 days on a task which he can complete fully in 12 days, but B finished the rest in 6 days. In how many days can B finish the whole work alone?

7. A can do a piece of work in 20 days. He worked for 5 days at it and then B joined him. The whole work lasted for 15 days. In how many days B can do it alone?

8. A & B together can finish a work in 12 days. A is twice as good a workman as B. In how many days B can do the work alone?

Time and Work- Types of Questions

9. A takes thrice as long to do a piece of work as B takes. A & B together do it in 7.5 days. In how many days A can do it alone.

10. To do a piece of work the number of days taken by A is half as much as taken by B. In which ratio they will divide the wages?

11. A is twice as good a workman as B and takes 8 days less to do a work than what B takes. In how many days A and B together can do the work?

12. A takes 48 days more to complete a work alone, compared to the number of days he would have taken if he had worked in association with B. Similarly B takes 75 days more to complete a work alone, compared to the number of days he would have taken if he had worked in association with A. In how many days they together can complete the work.

Time and Work- Types of Questions

13. In the above question in how many days each of them can complete the work alone.

14. A garrison of 1500 soldiers had provisions just sufficient for 48 days. After 13 days, a few more soldiers joined and the provisions were consumed in 25 more days. How many new soldiers joined?

15. A contractor engaged 21 men to complete a work in 19 days and allowed only 8 hrs per day per person of work. After 10 days, due to an accident, 6 workers were injured and the work was held up for 2 days. How many more men should he employ so that work may be completed as scheduled originally with 9 hrs per day per person of work?

16. Five men working all day can finish a work in 21 days, but one of them having other engagements could work only half time and another worker only quarter time. In how many days the work was finished?

Time and Work- Types of Questions

17. A can do a work in 12 days. A and B together completed the work and were paid Rs. 54 and Rs.81 respectively. How many days must they have taken to complete the work together?

18. A has worked for 9 days on a job and found that only 20% of the work is done. Now work is completed by B who is 80% more efficient (more skilled). In how many days, the whole work is completed?

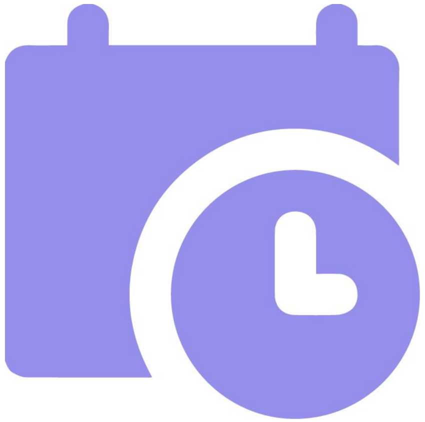
19. A pipe can fill a tank in 20 minutes but due to leakage, it was actually filled in 25 minutes. In what time the leakage alone can empty a 2/3rd full tank?

20. In the above question, if both pipes are working, find in what time a 1/4th full tank is filled completely?

Time and Work- Types of Questions

21. Two pipes can fill a tank in 24 mins and 32 mins respectively. When should the first pipe be turned off so that the cistern may be 3/4th full in 16 min.?

22. Two pipes can fill a tank in 10 mins and 15 mins respectively while a third pipe can empty the tank in 12 min. If all the three pipes are opened at the same time, when will a 2/3rd full tank be empty?



23. A pipe can fill a tank in 36 mins and the other in 18 mins. When should the first pipe be opened so that the tank may be full in 15 mins? Assume that the second pipe has been functioning since the beginning.

Time and Work- Types of Questions

24. Two pipes can fill a tank in 36 mins & 45 mins respectively while a waste pipe can empty it in 30 mins. If the waste pipe is opened 7 mins after the first two pipes, at what time, the empty tank will be full?

25. Two pipes which can fill a tank in 20 hrs. and 30 hrs. respectively are opened at the same time. When the tank was 2/5th full, a leakage is developed such that 40% of the water supplied by the two pipes is drained out. Find the total time to fill the tank.

Answers

1. 12 days
2. 60 days
3. 5 days
4. 18 days
5. 12 $\frac{6}{7}$ days
6. 18 days.
7. 40 days
8. 36 days.
9. 30 days
10. 2 :1
11. 5 $\frac{1}{3}$ days
12. 60 days
13. A in 108 days, B in 135 days
14. 600
15. 9 men
16. 70 day
17. 4 $\frac{4}{5}$ days
18.29 days
19. 66 $\frac{2}{3}$ min.
20. 6 $\frac{1}{4}$
21. After 6 min.
22. After 4 min.
23. After 6 min from beginning
24.46 min.
25. 16 hrs 48 min.

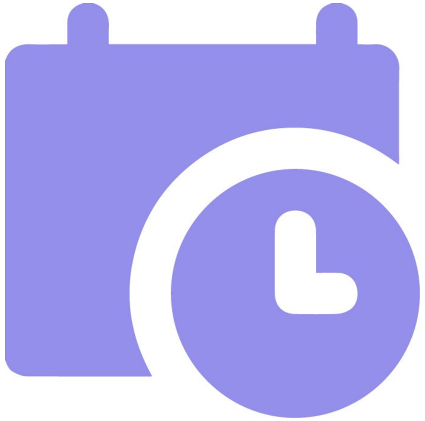
Mensuration- Important Formulae

Shapes	Area (A)	Perimeter (P)	Nomenclature
Square	a^2	4a	Side = a
Rectangle	l x b	2(l+b)	Length = l, Breadth = b
Rhombus	½ × d1 × d2	4a	Diagonals = d1 and d2
Parallelogram	p x h	2(p+q)	Base = p, Side = q Height= h
Circle	• πr^2 • (πr^2)/2 (semi circle)	• 2πr • R(π+2) (semi circle)	Radius = r

Mensuration- Important Formulae

Triangles	Area (A)	Perimeter (P)	Nomenclature
Scalene	(bh)/2	a+b+c	Sides = a,b,c Height = h
Isosceles	1/2 x b x h S(S-a)(S-b)(S-c)*	2a+b	Semi-perimeter = S
Equilateral	a^2 x √3/4	3a	Side = a
Right-Angled	(ab)/2	a+b+c	Sides = a,b,c

In the next class, we will focus on



- Partnerships
- Averages
- Simple Interest & Compound Interest
- Profit & Loss