GS FOUNDATION (2023-24) BOOKLET 18
&
CSAT FOUNDATION 1.0 (2023-24) BOOKLET 17
TARGET PRELIMS 2023: CSAT
QUANTITATIVE APTITUDE: 10 TIME-SPEED-DISTANCE

Contents

1) BASICS OF TIME-SPEED-DISTANCE

- Time: Tells us about how long the activity is happening. Units of time can be seconds, minutes, hours etc.
- Distance: Units of distance – metres, KMs, CMs, feet, miles, inches, yards etc.
- Speed: Tells us about how fast an object or a person is moving. Units of speed – m/s, km/s, km/hr, mile/hr etc.

Interrelation:

Distance = Speed × Time	**Speed =** $\frac{\text{Distance}}{\text{Time}}$	**Time =** $\frac{\text{Distance}}{\text{Speed}}$

NOTE: In most questions, one of the three variables is given as constant. We can easily work with other two **using proportionality** as follows.

- Distance is directly proportional to Speed if time is constant
- Distance is directly proportional to Time if speed is constant
- Speed is inversely proportional to Time if distance is constant

Q. A person travels from one place to another at 40 km/hr and returns at 80 km/hr.

- Here distance is constant
- We know that speed is inversely proportional to time
- Note – speeds are in the ratio 1:2
- So, times for journeys will be in the ratio 2:1

Q. A car travels with speed of 10kmph for 30 minutes and with speed of 60 kmph for next 30 minutes.

- Here time is constant
- Distance and speed are directly proportional in such case
- Speeds are in the ratio 1:6
- Thus, distances covered will also be in the ratio 1:6

2) CONVERSION OF UNITS:

- 1Km = 1000 metre
- 1 mile = 1.609 km
- 1 km/hour = 5/18 m/sec (multiply by 5/18 to convert)
- 1 m/sec = 18/5 km/hr = 3.6kmph (multiply by 18/5)

Q. Convert 90kmph into m/sec

Q. Convert 45 m/s into kmph

3) AVERAGE SPEED

Average Speed: $\frac{\text{Total distance}}{\text{Total time}}$

Case 1: When time is constant

If x and y are two speeds with which object travels for same time.

Let time be 't'.

Total distance = $x \times t + y \times t = (x + y) \times t$

Total time = 2t

Average speed = $\frac{Total\ Distance}{Total\ time} = \frac{x+y}{2}$

Q. A car travels with speed of 10kmph for 30 minutes and with speed of 60 kmph for next 30 minutes. Find the average speed for the journey.

Case 2: When distance is constant

If x is a speed with which car travels from A to B and y is the speed with which car travels from B to A. What is the average speed?

Average Speed: $\frac{\text{Total distance}}{\text{Total time}}$

Total distance = 2d

Total time = time needed for travelling from A to B + time needed for travelling from B to A

Using time = distance/speed

Total time = $\frac{d}{x} + \frac{d}{y}$

Thus, average speed = $\frac{2d}{\frac{d}{x}+\frac{d}{y}} = \frac{2}{\frac{1}{x}+\frac{1}{y}} = \frac{2xy}{x+y}$

Q. A person travels from one place to another at 40 km/hr and returns at 80 km/hr. Find the average speed for the journey in metre/second.

Q. Traveling at 3/5th of the original Speed a train is 10 minutes late. Find the usual Time taken by the train to complete the journey?

NOTE: distance covered is same in both cases – speed and time are inversely proportional

Q. After traveling 50km, a train meets with an accident and travels at (3/4) of the usual Speed and reaches 45 min late. Had the accident happened 10km further on it would have reached 35 min late. Find the usual Speed?

- Note: the difference between times is only due to 10km i.e whether the accident happens at 50km or 60km (constant distance)
- In first case, 10 km is travelled at (3/4) of usual speed
- In second case, 10 km is travelled at usual speed
- Thus, the ratio of speeds is 3:4
- Recalling that, in case of constant distance, speed and time are inversely proportional
- Ratio of times taken to travel those 10km is 4:3
- Let actual times be 4x and 3x, it is given that difference is 10 min (45-35)
- Thus, 4x – 3x = x = 10
- Thus, usual time taken to travel 10km is 3x = 30min

- Usual speed is 10km/30min = 20km/hour
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4) MEETING POINT QUESTIONS:

Case-1: Two persons/objects travelling towards each other

- In this type of questions, two persons/objects are travelling towards each other starting from point A and B.
- Here distance travelled together by two persons is constant. Two persons meet at a point at some time.
- So, time travelled is the constant here. In this case, distance and speed are directly proportional.
- If two people are walking towards each other from A and B, when they meet for the first Time, they together cover a Distance "d"
- When they meet for the second Time, they together cover a Distance "3d"
- When they meet for the third Time, they together cover a Distance of "5d" and so on

Q. A train 'X' leaves station 'A' at 3 p.m. and reaches station 'B' at 4.30 p.m., while another train 'Y' leaves station 'B' at 3.00 p.m. and reaches station 'A' at 4.00 p.m. These two trains cross each other at what time?

- Note that distance is constant say, d. thus, speed and time are inversely proportional
- Let at time 't' hours after starting, trains cross each other.
- Distance travelled by train X in time t is $\frac{d}{1.5} \times t$
- Distance travelled by train Y in time t is $\frac{d}{1} \times t$
- Total distance travelled by X and Y together is d
- Thus, $\frac{d}{1.5} \times t + \frac{d}{1} \times t = d$;
- Thus, t = 0.6 hours = 36 minutes
- Trains cross at 3:36 pm

Q. A train 300 metres long is running at a speed of 25 metres per second, it will cross a bridge 200 metres long in how much time?

- Train will cross bridge when last point of train is past the last point of the bridge

A _____ Train → _____ B X _____ Bridge _____ Y

- That is when point A crosses point Y
- So, total distance to be covered = 300 + 200 = 500 mts.
- Speed= 25 m/s So, time taken = 500/25 = 20 seconds

Case-2: Two persons starting from the same point and walking in same or opposite directions:

- If A and B travel in same direction with speeds (in kmph) S_1 and S_2,
- Distance between them after 1 hour will be (S_1 - S_2) km

- Thus, A and B will be 1 km apart in $\frac{1}{(S1 - S2)}$ hour
- So, A and B will be X km apart in $\frac{x}{(S1 - S2)}$ hour

- Similarly, if A and B walk in opposite direction with speeds (in kmph) S_1 and S_2,
- Distance between them after 1 hour will be $(S_1 + S_2)$ km
- Thus, A and B will be 1 km apart in $\frac{1}{(S1 + S2)}$ hour
- So, A and B will be X km apart in $\frac{x}{(S1+S2)}$ hour

Q. Raju and Neha start running from a hotel at constant speeds 10 kmph and 8 kmph respectively. What would be distance between them in 2 hours if,

i. They run in opposite directions
ii. They run in same direction

Case-3: Two persons/things travelling in a circle starting at same point

- In this type of questions, two persons start at same point and run around a circular track
- They travel a different speeds and question asks how many times they meet in specific time or to meet given number of times how much time needs to pass or how much distance do they need to cover

Q. P and Q are running around a 400m circular track. P runs at constant speed of 12 kmph and Q runs at constant speed of 10kmph. If they begin from a common point, how many times does P cross Q in 3 hours after starting at same time.

- Note: time is constant for P and Q
- In one hour, P gains 2km over Q. Thus, in 3 hours, P will gain 6 km or 6000 metres over Q.
- Since the track is of 400m, P overtakes Q when he gains 400 metres over Q.
- Since in 3 hours, P gains 6000m, P overtakes/crosses Q 6000/400 = 15 times

Q. P and Q are running around a 400m circular track. P runs at constant speed of 12 kmph and Q runs at constant speed of 10kmph. If they begin from a common point, what distance does P have to cover to cross Q 27 times?

Q. P and Q are running around a 400m circular track. P runs at constant speed of 12 kmph and Q runs at constant speed of 10kmph. If they begin from a common point, after how much time does P cross Q 7 times?

5) BOATS AND STREAMS:

When a Boatman is rowing in still water, he would be moving at a speed at which he can row. This Speed is called the speed of the Boat in still water or simply the speed of the boat.

But consider the same Boatman in a stream. Because of the current he is either helped (if rowing in direction of stream, this is called downstream) or will be opposed (If rowing against the stream, called upstream)

If speed of Boatman in still water B and speed of Stream is S, we have:

- Downstream Speed, D = B + S
- Upstream Speed, U = B – S
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If downstream speed = D and upstream speed = U

- Speed of the boat in still water = $\frac{D+U}{2}$
- Speed of stream = $\frac{D-U}{2}$

Q. A boatman rows to a place and back in 14 hrs. He finds that he can row 4 km with the stream in the same time as 3 Km against the stream in the same time. Find the rate of stream if distance to a place is 48km.

- Since, the time is given constant, speed and distance are directly proportional
- Since, distance travelled downstream and upstream is in ratio 4:3, speeds upstream and downstream are in same ratio i.e., D:U = 4:3
- Also, distance to a place to and fro is constant, so time and speed are inversely proportional.
- Time needed downstream: Time needed upstream = 3:4
- Total time is given as 14 hours – thus it takes 6 hours to travel downstream and 8 hours to travel upstream
- D = 48/6 = 8
- U = 48/8 = 6
- Stream speed = (8-6)/2 = 1 kmph

6) PYQS

CSE 2022: X and Y run a 3 km race along a circular course of length 300m.Their speeds are in the ratio 3:2. If they start together in the same direction, how many times would the first one pass the other (the start off is not counted as passing)?

(a) 2

(b) 3

(c) 4

(d) 5

CSE 2022: A man started from home at 14:30 hours and drove to village, arriving there when the village clock indicated 15:15 hours. After staying for 25 minutes, he drove back by a different route of length 1.25 times the first route at a rate twice as fast reaching home at 16:00 hours. As compared to the clock at home, the village clock is

(a) 10 minutes slow

(b) 5 minutes slow

(c) 10 minutes fast
(d) 5 minutes fast

CSE 2021: A person X from a place A and another person Y from a place B set out at the same time to walk towards each other. The places are separated by a distance of 15 km. X walks with a uniform speed of 1.5 km/hr and Y walks with a uniform speed of 1 km/hr in the first hour, with a uniform speed of 1.35 km/hr in the second hour and with a uniform speed of 1.5 km/hr in the third hour and so on.
Which of the following is/are correct?
1. They take 5 hours to meet.
2. They meet midway between A and B.
Select the correct answer using the code given below:
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

CSE 2021: A car travels from a place X to place Y at an average speed of V km/hr, from Y to X at an average speed of 2v km/hr, again from X to Y at an average speed of 3v km/hr and again from Y to X at an average speed of 4v km/hr. Then the average speed of the car for the entire journey
(a) is less than v km/hr
(b) lies between v and 2v km/hr
(c) lies between 2v and 3v km/hr
(d) lies between 3v and 4v km/hr

CSE 2021: A man takes half time in rowing a certain distance downstream than upstream. What in still water to the speed of current?
(a) 1: 2
(b) 2: 1
(c) 1: 3
(d) 3: 1

CSE 2019: X, Y and Z are three contestants in a race of 1000 m. Assume that all run with different uniform speeds. X gives Y a start of 40 m and X gives 7 a start of 64 m. IIY and 2 were to compete in a race of 1000 m, how many metres start will Y give to 27
(a) 20
(b) 25
(c) 30
(d) 35

CSE 2019: When a runner was crossing the 12 km mark, she was informed that she had completed only 80% of the race. How many kilometres was the runner supposed to run in this event?

a.14

b. 15

c. 16

d. 16.5

CSE 2019: X, Y and Z are three contestants in a race of 1000 m. Assume that all run with different uniform speeds. X gives Y a start of 40 m and X gives 7 a start of 64 m. IIY and 2 were to compete in a race of 1000 m, how many metres start will Y give to Z

a. 20

b. 25

c.30

d. 35

CSE 2017: Q. A freight train left Delhi for Mumbai at an average speed of 40 km/hr. Two hours later, an express train left Delhi for Mumbai, following the freight train on a parallel track at an average speed of 60 km/hr. How far from Delhi would the express train meet the freight train?

(a) 480 km

(b) 260 km

(c) 240 km

(d) 120 km

CSE 2016: A and B walk around a circular park. They start at 8 a.m. from the same point in the opposite directions. A and B walk at a speed of 2 rounds per hour and 3 rounds per hour respectively. How many times shall they cross each other after 8 00 a.m. and before 9.30. a.m.?

(a) 7

(b) 6

(c) 5

(d) 8

CSE 2015: Shahid and Rohit start from the same point in opposite directions. After each 1 km, Shahid always turns left and Rohit always turns right. Which of the following statements is correct?

(a) After both have travelled 2 km, the distance between them is 4 km.

(b) They meet after each has travelled 3km.

(c) They meet for the first time after each has travelled 4 km.

(d)They go on without ever meeting again

CSE 2015: In a 500 metres race, B starts 45 metres ahead of A, but A wins the race while B is still 35 metres behind. What is the ratio of the speeds of A to B assuming that both start at the same time?
(a) 25: 21
(b) 25: 20
(c) 5:3
(d) 5:7

CSE 2015: Two cities A and B are 360 km apart. A car goes from A to B with a speed of 40 km/hr and returns to A with a speed of 60 km/hr. What is the average speed of the car?
(a) 45 km/hr
(b) 48 km/hr
(c) 50 km/hr
(d) 55 km/hr

CSE 2014: A worker reaches his factory 3 minutes late if his speed from his house to the factory is 5 km/hr. If he walks at a speed of 6 km/hr then he reaches the factory 7 minutes early the distance of the factory from his house is
(a) 3 km
(b) 4 km
(c) 5 km
(d) 6 km

CSE 2014: Two cars start towards each other, from two places A and B which are at a distance of 160 km. They start at the same time 08 : 10 AM. If the speeds of the cars are 50 km and 30 km per hour respectively, they will meet each other at
(a) 10: 10 AM
(b) 10: 30 AM
(c) 11: 10 AM
(d) 11: 20 AM

CSE 2013: A person can walk a certain distance and drive back in six hours. He can also walk both ways in 10 hours. How much time will he take to drive both ways?
(a) Two hours
(b) Two and a half hours
(c) Five and a half hours
(d) Four hours

CSE 2013: A thief running at 8 km/hr is chased by a policeman whose speed is 10 km/hr. If the thief is 100 m ahead of the policeman, then the time required for the policeman to catch the thief will be
a) 2 min

b) 3 min
c) 4 min
d) 6 min

CSE 2013: A train travels at a certain average speed for a distance of 63 km and then travels a distance of 72 km at an average speed of 6 km/hr more than its original speed. If it takes 3 hours to complete the total journey, what is the original speed of the train in km/hr?
a) 24
b) 33
c) 42
d) 66

CSE 2013: Mr. Kumar drives to work at an average speed of 48km/hr. The time taken to cover the first 60% of the distance is 10 minutes more than the time taken to cover the remaining distance. How far is his office?
a) 30km
b) 40km
c) 45km
d) 48km

CSE 2011: If a bus travels 160 km in 4 hours and a train travels 320 km in 5 hours at uniform speeds, then what is the ratio of the distances travelled by them in one hour?
(a) 8: 5
(b) 5: 8
(c) 4: 5
(d) 1: 2

7) COMPREHENSION

In an expanding economy, debt is not a sin and becomes a problem only when it turns unsustainable. A government is vulnerable when it finds it difficult to meet its fiscal obligations efficiently. As per the 2022-23 Budget, the public debt/GSDP ratio of Kerala is 37.2% which is clearly high particularly when compared to the average of 14.6% for the 1981-91 decade. That the Fourteenth Finance Commission fixed the upper limit at 25% underscores the vulnerability. Only Kerala, Jharkhand and West Bengal crossed the debt target stipulated by the Fifteenth Finance Commission (FC-15). That the yield rate to be paid for the special development loans issued by the State auctioned by the RBI is pegged high (8.3% in 2018-19. and around that now) keeps Kerala in a bad light. The increasing incremental borrowing along with the growing level of outstanding liabilities, off-budget borrowings, and mounting guarantees foretell a poor situation. Kerala has already breached several fiscal norms. During the last five years, the famous Domar stability rule — namely that interest rate adjusted for inflation should be lower than the GSDP growth rate — has been broken except for 2019-20 and 2020-2021. The condition that the increase in nominal GSDP growth rate should be higher

than the debt growth rate is also violated. During the last 10 years from 2013-14 through 2022-23, except for two years the rate of debt growth exceeded GSDP growth. The growth dynamics of the State needs to be closely investigated given its admittedly high per capita consumption, high savings (bank deposits in March 2021 were above ₹6.05 trillion, with a non-resident Indian component of ₹2.29 trillion) along with its weak investment trajectory.

Q. Which of the following statements would the author agree with most?

A. Debt is one of the prime issues for any economy
B. Kerala breaching fiscal norms is not unusual for an Indian state
C. Domar stability rule being broken is an indication of unsustainable debt of the state of Kerala
D. Kerala is one of the three Indian states on the path of sustainable debt dynamics

To augment its own source revenue, the State has to streamline its tax administration to reduce arrears and evasion and tap its tremendous non-tax revenue potential. Property tax could have been easily doubled. Non-tax revenue can be stepped up by enhancing fees and user charges along with visible quality improvements. Without noticeable quid-pro-quo in services, users will naturally resist hikes. The dividend from the public sector undertakings can be increased if there is efficient rationalisation of management. Unbundling of land values can yield good income. The Kerala State Road Transport Corporation (KSRTC) is a millstone around the fiscal neck of Kerala. Monetisation of the land and asset values of the KSRTC along with restructuring of management can be a solution. Permitting private universities of world class standards can arrest the exodus of brilliant students. Why Kerala with a fabulous remittance inflow since the mid-1970s has failed to be a happy place for the enterprising private sector to create wealth for the State is a moot question for which honest answers elude us. A meaningful pension reform including raising retirement and recruitment ages can make big changes. If the Kerala government wants to put its fiscal house in order, it has to experiment with zero-base budgeting or at least with performance budgeting with determination. Departments have to improve their accountability significantly. In the fiscal federal polity of India, with yawning mismatches between resources and responsibilities, all inter-governmental transfers must be normative and formula-based. Central transfers are entitlements and certainly not largesses. That 35% of the transfers are still outside the Finance Commission is against the canons of cooperative federalism.

Q. What are some of the ways passage suggests to augment state's revenue?

1. Enhancing user charges for use of public resources
2. Zero based budgeting
3. Monetisation of assets of public undertakings
4. Bringing all revenues within ambit of Finance commission and not only net tax proceed as is happening currently

Which of the above are correct in context of the passage?

A. 1 and 3 only
B. 1 and 3 and 4 only

C. 3 only
D. 1, 2, 3 and 4

Although most of the Genetically Modified (GM) crops cultivated now are genetically engineered for a single trait, in future, crops genetically engineered for more than one trait will be the norm. Thus, biotechnology's role in agriculture and the regulation of the same cannot be generation of GM crops. Instead, there is a need to take a comprehensive look, taking into account various aspects, including socio-economic impacts, so that the potential of the technology can be harnessed while minimizing negative impacts. Given the importance of biotechnology in developing varieties that can help in climate change mitigation and adaptation, not using biotechnology as a part of the climate change action plan cannot be an option. Domestic regulation of biotechnology cannot be viewed in isolation of trade policy and obligations under various international treaties and conventions.

Q. With reference to the above passage, the following assumptions have been made:

1. Biotechnology regulation is an evolving process.
2. Participation of people is needed in policy decisions regarding biotechnology regulation.
3. Biotechnology regulation should take into account socio-economic aspects in decision-making.
4. Wider involvement of political executive in biotechnology regulation improved its effectiveness in dealing with the country's trade policies and international obligations.

Which of the above assumptions are valid?

(a) 1, 2 and 4 only
(b) 1 and 3 only.
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4