CHAPTER – 5
TIME AND DISTANCE

In this chapter, we will look at problems in the following different areas:

- General problems on Time, Speed and Distance
- Relative Speed
- Boats and Streams
- Races and Circular Tracks

Before we look at problems in various areas, let us first look at some basic concepts pertaining to speed, time and distance.

SPEED

Distance covered per unit time is called speed.
i.e., Speed = Distance/time

The above relationship between the three variables distance, speed and time can also be expressed as follows:

Distance = Speed x Time or
Time = Distance/Speed

- If two bodies travel with the same speed, Distance covered α Time (Direct Variation).
- If two bodies travel for the same period of time, Distance covered α Speed (Direct Variation).
- If two bodies travel the same distance,

  $$\text{Time } \alpha \ \frac{1}{\text{Speed}} \text{ (Inverse Variation)}$$

Distance is normally measured in kilometres, metres or miles; time in hours or seconds and speed in km/hr (also denoted by kmph), miles/hr (also denoted by mph) or metres/second (denoted by m/s).

To convert speed in kmph to m/sec, multiply it with 5/18.

To convert speed in m/sec to kmph, multiply it with 18/5.

In the case of moving trains, three different situations need to be considered.

When a train passes a stationary point, the distance covered (in the passing) is the length of the train. If the train is crossing a platform (or a bridge), the distance covered by the train (in the crossing) is equal to the length of the train plus the length of the platform (or bridge). If two trains pass each other (travelling in the same direction or in opposite directions), the total distance covered (in the crossing or the overtaking, as the case may be) is equal to the sum of the lengths of the two trains.

AVERAGE SPEED

Average speed of a body travelling at different speeds is defined as follows:

$$\text{Average Speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

Please note that the **Average speed** of a moving body is **Not equal** to the **Average of the speeds.**

If a body travels from point A to point B with a speed of p and back to point A (from point B) with a speed of q, then the average speed of the body can be calculated as **2pq/(p + q)**. Please note that this does not depend on the distance between A and B.

If a body covers part of the journey at speed p and the remaining part of the journey at speed q and the distances of the two parts of the journey are in the ratio m : n, then the average speed for the entire journey is **(m + n)pq/(mq + np)**.

Examples

5.01. Express 72km/hr in m/sec.

Sol: 72 km/hr = $(72)\left(\frac{5}{18}\right)$ i.e. 20 m/sec

5.02. A car can cover 90 km in 3 hours. If its speed is increased by 15 kmph, find the time taken by it to cover this distance.

Sol: Speed of the car = 30 kmph
If its speed is increased by 15 kmph,
time taken = $\frac{90}{30+15}$ = 2 hours.

5.03. Ashok covered a certain distance at a certain speed. If his speed was 20% more, he would take 10 minutes less to cover the same distance. Find the time he takes to cover the distance.

Sol: If his speed was 20% more, it would be 120% i.e., $\frac{6}{5}$ times his actual speed.

$\therefore$ Time taken would be $\frac{5}{6}$ times his actual time.

Reduction in time = $\frac{1}{6}$ (actual time)

= 10 minutes
$\therefore$ Actual time = 60 minutes.

5.04. A car covered a certain distance at 90 kmph and returned back at 60 kmph. Find its average speed for the entire journey.

Sol: Let x km be the distance to be covered, each way.
Total time of travel (in hours)

$$= \frac{x}{90} + \frac{x}{60} = \frac{5x}{180} = \frac{x}{36}$$

Average speed (in km / hr)

$$= \frac{\text{Total distance travelled}}{\text{Total time taken}} = \frac{2x}{\frac{x}{36}} = 72$$

5.05. Find the time taken by a 200 m long train running at 36 kmph to cross a boy standing on a platform.

Sol: Speed of the train = $(36)\left(\frac{5}{18}\right) = 10 \text{ m/sec}$

Distance to be travelled by the train to cross the stationary boy = length of the train
Time taken by the train to cross the boy
= $\frac{200}{10}$ = 20 sec

5.06. Find the time taken by a train, 100 m long, travelling at a speed of 63 kmph to cross a platform of length 250 m.

Sol: Speed of the train = $(63)\left(\frac{5}{18}\right) = \frac{35}{2} \text{ m/sec}$

Distance to be travelled by the train to cross the platform = length of the train + length of the platform.

Time taken to cross the platform = $\frac{100 + 250}{\frac{35}{2}}$

= 20 seconds

5.07. Find the length of the platform which a train 400 m long, travelling at 45 kmph can cross in 40 seconds.

Sol: Speed of the train = $(45)\left(\frac{5}{18}\right) = 12 \cdot 5 \text{ m/sec}$

Length of the platform = distance travelled by the train – length of the train
= (12·5) (40) – 400 = 100 m

5.08. Ashok would reach his office 15 minutes early if he walked at 4 kmph from his house. He would reach it 45 minutes late if he walked at 3 kmph from his house. Find the distance between his house and office.

Sol: Let the distance be x km. Time taken by Ashok if he walked at 4 kmph = $\frac{x}{4}$ hours.

Time taken by Ashok if he walked at 3 kmph = $\frac{x}{3}$ hours. In this case he would take one hour more to reach his office compared to the time taken if he had walked at 4 kmph.

$\therefore \frac{x}{3} - \frac{x}{4} = 1 \Rightarrow x = 12.$

> In general, if a person travelling between two points reaches p hours late travelling at a speed of u kmph and reaches q hours early travelling at v kmph, the distance between the two points is given by $\frac{vu}{v-u}(p+q)$.

Relative speed

The speed of one (moving) body in relation to another moving body is called the relative speed of these two bodies, i.e., it is the speed of one moving body as observed, from the second moving body.

If two bodies are moving in the same direction, the relative speed is equal to the difference of the speeds of the two bodies.

If two bodies are moving in opposite directions, the relative speed is equal to the sum of the speeds of the two bodies.

5.09. Find the time taken by a train 175 m long running at a speed of 54 kmph to overtake another train 75 m long running at a speed of 36 kmph.

Sol: Relative speed = 18 kmph = 5 m/sec
Time taken for the faster train to overtake the slower train =

$$\frac{(\text{Length of the faster train}) + (\text{Length of the slower train})}{\text{Their relative speed}}$$

= $\frac{175 + 75}{5}$ = 50 seconds

5.10. A train overtakes two persons, cyling at 9 kmph and 18 kmph in 40 seconds and 48 seconds respectively. Find its length and speed.

Sol: Let the length and the speed of the train be ℓ m and s kmph respectively.

$\ell = 40(s-9)\frac{5}{18} = 48(s-18)\frac{5}{18}$

$\Rightarrow \frac{s-9}{s-18} = \frac{48}{40} \Rightarrow s = 63$

$\therefore \ell = 40\ (63 - 9) \times \frac{5}{18} = 600\text{m}$

5.11. Two trains running at 36 kmph and 45 kmph cross each other in 20 seconds when they run in the opposite directions. When the trains run in the same direction, a person in the faster train observed that he overtook the slower train in 48 seconds. Find the lengths of the trains.

Sol: Let the lengths of the faster and the slower trains be f and s respectively.

Given that, $\frac{f+s}{(36+45)\frac{5}{18}} = 20$

f + s = 450 ———— (1)
When the trains run in the same direction, the time taken by the person in the faster train to overtake the slower train = $\frac{s}{(45-36)\frac{5}{18}} = 48$

s = 120
From (1), f = 330

5.12. Two trains have lengths of 300 m and 200 m. When they run in the same direction, the faster train will take 100 seconds to cross the slower train. When they run in the opposite directions, they will take 20 seconds to cross each other. Find the speeds of the trains.

Sol: Let the speeds of the trains be x m/sec and y m/sec where x > y.

$\frac{300 + 200}{x - y} = 100$

5 = x – y ———— (1)

$\frac{300 + 200}{x + y} = 20$

25 = x + y ———— (2)
Solving (1) and (2)
x = 15 and y = 10

BOATS AND STREAMS

Problems related to boats and streams are different in the computation of relative speed from those of trains/cars.

When a boat is moving in the same direction as the stream or water current, the boat is said to be moving **WITH THE STREAM OR CURRENT.**

When a boat is moving in a direction opposite to that of the stream or water current, it is said to be moving **AGAINST THE STREAM OR CURRENT.**

If the boat is moving with a certain speed in water that is not moving, the speed of the boat is then called the **SPEED OF THE BOAT IN STILL WATER.**

When the boat is moving upstream, the speed of the water opposes (and hence reduces) the speed of the boat.

When the boat is moving downstream, the speed of the water aids (and thus adds to) the speed of the boat. Thus, we have

Speed of the boat against stream
= Speed of the boat in still water – Speed of the stream
Speed of the boat with the stream
= Speed of the boat in still water + Speed of the stream

These two speeds, the speed of the boat against the stream and the speed of the boat with the stream, are RELATIVE SPEEDS.

If u is the speed of the boat down the stream and v is the speed of the boat up the stream, then we have the following two relationships.

Speed of the boat in still water = (u + v)/2
Speed of the water current = (u – v)/2

In problems, instead of a boat, it may be a swimmer but the approach is exactly the same. Instead of boats/swimmers in water, it could also be a cyclist cycling against or along the wind. In some problems it can be person(s) going up/down an ascending or descending escalator. The approach to solving the problems still remains the same.

5.13. A boat travels 30 km upstream in 5 hours and 100 km downstream in 10 hours. Find the speed of the boat in still water and the speed of the stream.

Sol: Upstream speed = $\frac{30}{5} = 6$ kmph

Downstream speed = $\frac{100}{10} = 10$ kmph

Speed in still water = $\frac{6+10}{2} = 8$ kmph

Speed of the stream = $\frac{10-6}{2} = 2$ kmph

5.14. Anand can row 20 km in 2 hours in still water. If the speed of the stream is 6 kmph, he would take 3·75 hours to cover a round trip journey. Find the distance that he would then cover each way.

Sol: Speed of the boat in still water = $\frac{20}{2} = 10$ kmph

Let the total distance covered be 2x km.

Given that, $\frac{x}{10+6} + \frac{x}{10-6} = 3 \cdot 75$

x = 12

5.15. Arun rowed a distance of 36 km in still water in 3 hours. He rowed 30 km in 2 hours with the current. Find the time he would take to row 27 km against the current.

Sol: Let the speed of his boat in still water and the speed of the current be x kmph and y kmph respectively

$x = \frac{36}{3} = 12$

Downstream speed = $x + y = \frac{30}{2} = 15$

$\Rightarrow$ y = 3 (As x = 12)

Required time = $\frac{27}{x-y} = \frac{27}{12-3}$ = 3 hours

5.16. In a certain time, a boat can cover either a certain distance upstream or $\frac{5}{2}$ times that distance downstream. If the speed of the current is 6 kmph, find the speed of the boat in still water.

Sol: Let the speed of the boat in still water be x kmph.

$\frac{x+6}{x-6} = \frac{5}{2} \Rightarrow 2x + 12 = 5x - 30$

$\therefore$ x = 14

5.17. Balu can row 2 km upstream in 20 minutes and can return in another 15 minutes. Find his average speed for the entire journey.

Sol: Average speed of Balu

$= \frac{2+2}{\frac{20}{60} + \frac{15}{60}} = \frac{48}{7}$ kmph

5.18. An escalator is moving downwards. Anil takes 60 steps to reach the bottom of the escalator starting from the top. Bala takes 140 steps to reach the top of the escalator starting from the bottom. The speeds of Anil and Bala are equal. Find the number of steps visible when the escalator is stationary.

Sol: Let the number of steps that the escalator moves for ten steps of Anil or Bala be e.
Let the number of steps visible when the escalator is stationary be N.
N = 60 + 6e = 140 – 14e
20e = 80
e = 4
N = 60 + 6e = 84

5.19. A takes 120 steps to reach the bottom of an escalator which is moving upwards. B takes 60 steps to reach the top of the escalator. If A takes two steps for every step of B, find the number of steps visible when the escalator is stationary.

Sol: Let us say the number of steps that the escalator takes when A takes 120 steps is e. In the time that A takes 120 steps, B takes 60 steps.
Let the number of steps on the escalator when it is stationary be N.
N = 120 – e = 60 + e
e = 30
N = 90

RACES AND CIRCULAR TRACKS

When two persons P and Q are running a race, they can start the race at the same time or one of them may start a little later than the other. In the second case, suppose P starts the race and after 5 seconds, Q starts. Then we say P has a "start" of 5 seconds. Alternatively, in a race between P and Q, P starts first and then when P has covered a distance of 10 metres, Q starts. Then we say that P has a "start" of 10 metres.

In a race between P and Q where Q is the winner, by the time Q reaches the winning post, if P still has another 15 metres to reach the winning post, then we say that Q has won the race by 15 metres. Similarly, if P reaches the winning post 10 seconds after Q reaches it, then we say that Q has won the race by 10 seconds.

In problems on RACES, we normally consider a 100 m race or a 1 km race. The length of the track NEED NOT necessarily be one of the two figures mentioned above but can be as given in the problem.

When two or more persons running around a circular track (starting at the same point and at the same time), then we will be interested in two main issues:

- When they will meet for the first time and
- When they will meet for the first time at the starting point

To solve the problems on circular tracks, you should keep the following points in mind.

When two persons are running around a circular track in **OPPOSITE** directions

- the relative speed is equal to the sum of the speeds of the two individuals and
- from one meeting point to the next meeting point, the two of them TOGETHER cover a distance equal to the length of the track.

When two persons are running around a circular track in the **SAME** direction

- the relative speed is equal to the difference of the speeds of the two individuals and
- from one meeting point to the next meeting point, the faster person covers one COMPLETE ROUND more than the slower person.

We can now tabulate the time taken by the persons to meet for the first time ever or for the first time at the starting point in various cases.

When TWO people are running around a circular track

Let the two people A and B with respective speeds of a and b (a > b) be running around a circular track (of length L) starting at the same point and at the same time. Then,

	When the two persons are running in the SAME direction	When the two persons are running in OPPOSITE directions
Time taken to meet for the FIRST TIME EVER	$\frac{L}{(a-b)}$	$\frac{L}{(a+b)}$
Time taken to meet for the first time at the STARTING POINT	LCM of $\left\{\frac{L}{a}, \frac{L}{b}\right\}$	LCM of $\left\{\frac{L}{a}, \frac{L}{b}\right\}$

Please note that when we have to find out the time taken by the two persons to meet for the first time at the starting point, what we have to do is to find out the time taken by each of them to complete one full round and then take the LCM of these two timings (L/a and L/b are the timings taken by the two of them respectively to complete on full round).

When THREE people are running around a circular track

Let the three people A, B and C with respective speeds of a, b and c (a > b > c)) be running around a circular track (of length L) starting at the same point at the same time. In this case we consider the three persons running in the same direction as the general case.

Time taken to meet for the FIRST TIME EVER	LCM of $\left\{\frac{L}{(a-b)}, \frac{L}{(b-c)}\right\}$
Time taken to meet for the first time at the STARTING POINT	LCM of $\left\{\frac{L}{a}, \frac{L}{b}, \frac{L}{c}\right\}$

The logic in obtaining the above is as follows:

A and B will be together with a time gap of L/(a – b); B and C will be together with a time gap of L/(b – c); for A, B and C to be together, A and B should be together as well as B and C should be together. Hence the LCM of the two timings L/(a – b) and L/(b – c) will give the time when A, B and C will all be together.

When we have to find out the time taken by the three persons to meet for the first time at the starting point, what we have to do is to find out the time taken by each of them to complete one full round and then take the LCM of these three timings (L/a, L/b and L/c are the timings taken by the three of them respectively to complete one full round).

Even if we are given a case where three persons are running around a circular track with two persons running in the same direction and the third in the opposite direction, we can work out the time taken by them to meet for the first time ever and for the first time at the starting point by extending the above logic.

5.20. In a 200 m race, A beats B by 10 m or 2 seconds. Find B's speed and A's speed.

Sol: A beats B by 10 m or 2 seconds.
$\Rightarrow$ When A reached the finishing line B was 10 m behind the finishing line and took 2 seconds to cover it.

$\therefore$ B's speed $= \frac{10}{2} = 5$ m/sec

Time taken by B to complete the race $= \frac{200\,\text{m}}{5\,\text{m/s}}$

= 40 seconds
$\therefore$ Time taken by A to complete the race
= 38 seconds

A's speed $= \frac{200}{38} = \frac{100}{19}$ m/sec

5.21. Ramu is 50% faster than Somu. In a race, Ramu gave Somu a head start of 200 m. Both finished the race simultaneously. Find the length of the race.

Sol: Let the length of the race be x m.

$$\frac{x}{x-200} = \frac{150}{100}$$

$\Rightarrow x = 600$.

5.22. In a 1200 m race, Ram beats Shyam by 300 m. In the same race, Shyam beats Tarun by 400 m. Find the distance by which Ram beats Tarun.

Sol: Let the speeds of Ram, Shyam and Tarun be r m/sec, s m/sec, and t m/sec respectively

$$\frac{r}{s} = \frac{1200}{1200-300} = \frac{4}{3}$$

$$\frac{s}{t} = \frac{1200}{1200-400} = \frac{3}{2}$$

$$\frac{r}{t} = \left(\frac{r}{s}\right)\left(\frac{s}{t}\right) = 2$$

$\Rightarrow$ By the time Ram covers 1200 m, Tarun covers 600 m.
$\therefore$ Ram beats Tarun by (1200 – 600) i.e. by 600 m.

5.23. In a 600 m race, P gives Q a start of 200 m. Ratio of the speeds of P and Q is 5 : 4. Who wins the race? By what distance does the winner beat the loser?

Sol: Q has to run 400 m to finish the race. In the time Q runs 400 m, P can run 500 m.
$\therefore$ When Q finished the race, P would have another 100 m to run.
$\therefore$ Q wins the race and he beats P by 100 m.

5.24. On a circular track of length 1800 m, X and Y start from the same point simultaneously with speeds of 36 kmph and 45 kmph respectively. Find the minimum time after which they will meet if they are running in
(i) the same direction.
(ii) opposite direction to each other.

Sol: (i) Time taken to meet for the first time

$$= \frac{1800}{(45-36)\frac{5}{18}} = 720 \text{ seconds}$$

(ii) Time taken to meet for the first time

$$\frac{1800}{(45+36)\frac{5}{18}} = 80 \text{ seconds}$$

5.25. In the previous example, find the time after which they will meet at the starting point for the first time.

Sol: Time taken to meet at the starting point for the first time

$$= \text{L.C.M}\left(\frac{1800}{(36)\left(\frac{5}{18}\right)}, \frac{1800}{(45)\left(\frac{5}{18}\right)}\right)$$

= LCM [180, 144] = 720 seconds

5.26. On a circular track of length 1200 m, P, Q and R start from the same point simultaneously with speeds of 18 kmph, 27 kmph and 36 kmph respectively. Find the minimum time after which they will meet if they are running in the same direction.

Sol: If three runners with speeds of a m/sec, b m/sec and c m/sec respectively start from the same point in the same direction on a circular track and a > b > c, they will meet for the first time after

$$\text{LCM}\left(\text{any two of } \frac{L}{a-b}, \frac{L}{b-c}, \frac{L}{a-c}\right) \text{seconds}$$

In the problem given, the required time

$$= \text{LCM}\left(\frac{1200}{(36-27)\frac{5}{18}}, \frac{1200}{(27-18)\frac{5}{18}}\right)$$

= LCM [480, 480] = 480 seconds

CLOCKS

The hours and minutes hands of a clock move in relation to each other continuously and at any given point of time, they make an angle between 0° and 180° with each other.

If the time shown by the clock is known, the angle between the hands can be calculated. Similarly, if the angle between two hands is known, the time shown by the clock can be found out.
When we say angle between the hands, we normally refer to the acute/obtuse angles (upto 180°) between the two hands and not the reflex angle (> 180).

For solving the problems on clocks, the following points will be helpful.

> Minutes hand covers 360° in 1 hour, i.e., in 60 mins. Hence **MINUTES HAND COVERS 6° PER MINUTE.**
>
> Hours hand covers 360° in 12 hours. Hence **HOURS HAND COVERS 30° PER HOUR** or **HOURS HAND COVERS 1/2° PER MINUTE**

All angles are measured in the clockwise direction starting from the vertical line at 12 o' clock.

Note: We can also solve the problems on clocks by the route of "Relative Speed"

In 1 minute, Minutes hand covers 6° and Hours hand covers 1/2°.

Therefore, Relative Speed = 6 – 1/2
= 5½° per minute.

Alternately, in 1 hour, minutes hand covers 60 minute divisions whereas hours hand covers 5 minute divisions.
∴ Relative Speed = 60 – 5 = 55 minute divisions per hour.

However, taking the route of actual angles covered is by far the simplest and easy to understand as well as helpful in solving ALL the different models of problems on CLOCKS. Hence, we will look at mainly that method only and not the relative speed method. This will not create any confusion.

The following additional points should also be remembered.

In general, every angle is made TWICE in ONE HOUR by the two hands of the clock.

In a period of 12 hours, the hands make an angle of

- 0° with each other (i.e., they coincide with each other) 11 times and hence the time gap between two successive coincidences is 12/11 hours, i.e., $1^1/_{11}$ hours, i.e., $65^5/_{11}$ minutes.
- 180° with each other (i.e., they lie on the same straight line) 11 times.
- 90° or any other angle with each other 22 times.

5.27. Find the angle between the hands of a clock when the time is 3:40 p.m.

Sol: From 12:00 p.m. to 3:00 p.m. the minute hand would effectively cover 3 (0°) = 0°. In the next 40 minutes, it would cover 40 (6°) = 240°
∴ The minute hand would have covered a total of 240° effectively by 3:40 p.m. Similarly the hour hand would cover a total of 110° effectively by 3:40 p.m. from the 12:00 noon.
∴ The angle between the hands is 240° – 110° i.e., 130° at 3:40 p.m.

5.28. At what time between 5 O' clock and 6 O' clock in the evening will the hands of a clock be at an angle of 90° with each other?

Sol: Let the time be 5:x p.m.
Angle effectively covered by the hour hand by 5:x p.m. = $\left(150+\frac{x}{2}\right)^\circ$
Angle effectively covered by the minute hand by 5:x p.m. = 6 x°

$\left(150+\frac{x}{2}\right)^\circ - 6x^\circ = 90^\circ$ (or)

$6x^\circ - \left(150+\frac{x}{2}\right)^\circ = 90^\circ$

$x = \frac{120}{11}$ or $\frac{480}{11}$

∴ The required time is

$5:10\frac{10}{11}$ p.m. or $5:43\frac{7}{11}$ p.m.

5.29. At what time between 8 O' clock and 9 O' clock in the evening will the hands of a clock be in a straight line and in opposite directions?

Sol: Let the time be 8:x p.m.
Angle between the hands = 180°
Angle effectively covered by the hour hand by 8:x p.m. = $\left(240+\frac{x}{2}\right)$
Angle effectively covered by the minute hand by 8:x p.m. = 6x°

$\left(240+\frac{x}{2}\right)^\circ - 6x^\circ = 180^\circ$ (or)

$6x^\circ - \left(240+\frac{x}{2}\right)^\circ = 180^\circ$

$\frac{11}{2}x = 60^\circ$ or 420

$x = \frac{120}{11}$ or $\frac{840}{11}$

If $x = \frac{840}{11}$, x > 60 which is not possible.

$\therefore x = \frac{120}{11} = 10\frac{10}{11}$

∴ The required time is $8:10\frac{10}{11}$ p.m

5.30. In 24 hours, how many times do the hands of a clock coincide?

Sol: In 12 hours, the hands of a clock coincide 11 times.
In 24 hours, they coincide (11) (2) = 22 times.

5.31. If the hands of a clock coincide every 66 minutes, how much time does the clock gain/lose per day?

Sol: In a clock showing correct time the hands coincide after every $65\frac{5}{11}$ minutes. If the hands coincide every 66 minutes, it take 66 minutes to cover $65\frac{5}{11}$ minutes of correct time.

∴ It is losing time. It loses $\frac{6}{11}$ minutes every 66 minutes

∴ In a day it loses $\frac{\frac{6}{11}}{66}(24)(60) = 11\frac{109}{121}$ minutes

5.32. At a certain time between 9 a.m. and 10 a.m. the angle between the hands of a clock is 6°. This time can be _____.

Sol: Let all possible times be denoted by 9 : x a.m. From 12 midnight to 9 : x a.m, the hour hand would have covered $\left(270+\frac{x}{2}\right)^\circ$, from 9:00 a.m. to 9:x a.m. the minute hand would have covered (6x)°.

$(6x) - \left(270+\frac{x}{2}\right) = 6 \Rightarrow \frac{11}{2}x = 276$

$\Rightarrow x = 50\ \frac{2}{11}$ OR

$270 + \frac{x}{2} - 6x = 6 \Rightarrow \frac{11x}{2} = 264 \Rightarrow x = 48$

∴ The time can be 9 : 50 $\frac{2}{11}$ a.m (or 9 : 48 a.m.)

Concept Review Questions

Directions for questions 1 to 50: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. Convert the following speeds into meters per second

(a) 36 km/hr
(A) 10 (B) 12 (C) 15 (D) 20

(b) 12.6 km/hr
(A) 3.5 (B) 4 (C) 0.35 (D) 6

(c) 252/35 km/hr
(A) 2.2 (B) 2.4 (C) 2 (D) 2.6

2. If a man rides a cycle at 2.5 m/s, what distance will he cover in 4 hours? (in km)

[ ]

3. If a man runs at 6 metres per second, what distance (in km) will he cover in 3 hours and 45 minutes?
(A) 81 (B) 96 (C) 91 (D) 27

4. The ratio of the speeds of X, Y and Z is 3 : 4 : 6. Find the ratio of the time that they take to travel a certain distance.
(A) 4 : 3 : 2 (B) 3 : 4 : 6 (C) 6 : 4 : 3 (D) 2 : 3 : 4

5. A train travels for a total of 16 hours. The first half of the distance at 35 km/hr and the second half at 45 km/hr. The total distance travelled is

[ ] km.

6. Travelling at 5/6th of his usual speed a man is 10 minutes late. What is the usual time he takes to cover the same distance?
(A) 50 minutes (B) 70 minutes
(C) 1 hour (D) 75 minutes

7. A person saves 6 minutes by increasing his speed by 25%. What is the time taken to cover the distance at his usual speed? (in minutes)

[ ]

8. X and Y are 270 km apart. At 9:00 a.m, buses A and B left X and Y for Y and X respectively. If the speeds of A and B are 50 kmph and 40 kmph respectively, find their meeting time.
(A) 11:00 a.m (B) 12:00 p.m
(C) 1: 00 p.m (D) 2:00 p.m

9. Car A left X for Y at 9:00 a.m. Car B left Y for X at 10:00 a.m. XY = 180 km. Speeds of A and B are 30 kmph and 20 kmph respectively. Find their meeting time.
(A) 12:36 p.m. (B) 1:36 p.m.
(C) 1:00 p.m (D) 2:00 p.m

10. Car P started driving north from X at 7:00 a.m. Car Q started driving north from X at 10:00 a.m. The ratio of the speeds of P and Q is 3:4. Find their meeting time.
(A) 7:00 p.m. (B) 12:15 p.m.
(C) 6:00 p.m (D) 10:00 p.m

11. Ashok left X and reached Y in 4 hours. His average speed for the journey was 90 kmph. Find the distance between X and Y (in km).

[ ]

12. Rakesh travelled for 2.5 hours at 40 kmph and for another 2.5 hours at 60 kmph. Find his average speed for the journey (in kmph).
(A) 48 (B) 50
(C) 45 (D) 52

13. Bala travelled for 3 hours at 40 kmph and then for 5 hours at 60 kmph. Find his average speed (in kmph) for the journey.
(A) 52.5 (B) 50
(C) 42 (D) 48

14. Alok travelled from Hyderabad to Tirupati at 60 kmph and returned at 90 kmph. Find his average speed for the journey (in kmph)

[ ]

15. When Ajay was about to leave for home from his office he noticed that his car had a problem. Hence he travelled at a reduced speed and took $\frac{5}{4}$ times the usual time. His average speed must have been

(A) $\frac{4}{5}$ th of the usual average speed.

(B) $\frac{5}{4}$ th of the usual average speed.

(C) $\frac{3}{4}$th of the usual average speed.

(D) $\frac{4}{3}$rd of the usual average speed.

16. Alok maintained his average speed for a journey at 25% more than his usual average speed. The time he must have taken to cover it must be

(A) $\frac{5}{4}$ th of the usual time.

(B) $\frac{4}{5}$ th of the usual time.

(C) $\frac{4}{3}$rd of the usual time

(D) $\frac{3}{4}$th of the usual time

17. A car travels x km at 60 km/hr and another 3x km at 90 km/hr. Find its average speed over the entire distance.
(A) 84 km/hr
(B) 75 km/hr
(C) 72 km/hr
(D) 80 km/hr

18. A car left X for Y and travelled at an average speed of 60 kmph. It reached Y, 2 hours after the scheduled time. If it had left X for Y and travelled at an average speed of 80 kmph it would have reached Y 2 hours before the scheduled time. At what average speed must it travel in order to reach Y at the scheduled time? (in kmph)

(A) $\frac{440}{7}$ (B) 70

(C) $\frac{500}{7}$ (D) $\frac{480}{7}$

19. The ratio of the speeds of Ram and Shyam is 5 : 4. Shyam is ahead of Ram by 12 km. If they are travelling in the same direction, what is the distance (in km.) that Ram has to cover to catch up with Shyam?

20. A and B start simultaneously from P and Q towards Q and P respectively. A takes 20 minutes to cover PQ. B takes 30 minutes to cover QP. Find the time they would take to meet each other (in minutes).

21. What is the time taken by a train 800 m long to cross an electric pole, if the speed of the train is 46 km/hr?
(A) 60 sec (B) 80 sec (C) 75 sec (D) 72 sec

22. A train of length 500 m takes 25 seconds to completely cross a pole. Find its speed (in kmph).
(A) 54 (B) 72 (C) 60 (D) 90

23. What is the time taken by a train 650 m long travelling at 72 km/hr to cross a 750 m long platform?
(A) 60 sec (B) 65 sec (C) 70 sec (D) 75 sec

24. A train 400 m long travels at a speed of 36 kmph. Find the time it would take to cross a bridge 300 m long. (in sec)

25. A train, 300 m long, crosses a bridge 1200 m long in 3 minutes. Find the speed of the train. (in kmph)

26. A train took 12 seconds to cross a person standing on a platform. If the speed of the train is 72 kmph then, find the length of the train.
(A) 180 m (B) 240 m (C) 300 m (D) 120 m

27. How long will a train 250 m long travelling at 90 kmph take to cross a train 200 m long travelling at 36 kmph in the same direction?
(A) 20 seconds (B) 22 seconds
(C) 30 seconds (D) 18 seconds

28. What is the time taken by a 750 m long train travelling at 99 km/hr to cross a boy running at 9 km/hr towards the train? (in sec)

29. Trains P and Q have lengths of 400 m, and 600 m respectively. They are running on parallel tracks towards each other. Find the total distance covered by the two trains from the time they start to cross each other to the time they completely cross each other.
(A) 200 m
(B) 1000 m
(C) 1200 m
(D) Cannot be determined

30. In a kilometer race, A beats B by 250 m. Find the ratio of the speeds of A and B.
(A) 3 : 4 (B) 4 : 3 (C) 5 : 4 (D) 4 : 5

31. In a 200 m race, Eswar gives Girish a start of 10 m and beats him by 10 m. Find the ratio of their speeds
(A) 1 : 1 (B) 9 : 10 (C) 10 : 9 (D) 19 : 20

32. X beats Y by 200 m in a kilometer race. Find Y's speed (in m/sec) if X's speed is 10 m/sec (in m/sec).
(A) 10 (B) 12.5 (C) 12 (D) 8

33. In a 100 m race, Ganesh beats Harish by 10 m or 2 seconds. Find Harish's speed (in m/sec).

(A) 5 (B) $5\frac{5}{9}$ (C) $4\frac{1}{2}$ (D) 6

34. In the previous question, find Ganesh's speed. (in m/sec).

(A) 5 (B) $5\frac{4}{9}$

(C) $5\frac{5}{9}$ (D) 6

35. In a 100 m race, Akbar gives Birbal a start of 2 seconds. Birlbal covers 10 m by the time Akbar starts. If both of them finish together, find Akbar's speed. (in m/sec)

(A) 5 (B) $5\frac{5}{9}$

(C) $4\frac{1}{2}$ (D) 4

36. In a race, P beats Q by 20 seconds. Q beats R by 30 seconds. By how many seconds did P beat R?

37. In a 100 m race, A beats B by 10 m and B beats C by 20 m. Find the distance by which A beats C. (in m)
(A) 30 (B) 28 (C) 32 (D) 36

38. Anand can row a boat in still water at a speed of 5 kmph. The speed of the stream is 3 kmph. Find the time taken by him to row 40 km downstream (in hours).

39. A and B are 2 points on a river. Akbar took 6 hours to row from A to B and 8 hours to row from B to A. Find the ratio of the speeds of his boat in still water and the river.
(A) 7 : 1 (B) 4 : 3 (C) 5 : 3 (D) 3 : 1

40. Ram, Shyam and Tarun started cycling from a point on a circular track 600 m long with speeds of 10 m/sec, 15 m/sec and 20 m/sec respectively. Find the time taken by them to meet at the starting point for the first time (in seconds).
(A) 120 (B) 60 (C) 240 (D) 600

41. Amar and Bhavan started simultaneously from a point on a circular track of length 600 m with speeds of 15m/sec and 5 m/sec respectively and cycled around it. Find the time taken by them to meet for the first time (in seconds) if

(i) they cycled in the same direction
(A) 60 (B) 30 (C) 20 (D) 40

(ii) they cycled in opposite directions
(A) 60 (B) 30 (C) 20 (D) 40

42. In the previous question, find the time taken (in seconds) by them to meet at the starting point for the first time if Bhavan's speed doubled.

43. Ram and Shyam are running along a circular track of length 60 m. If their speeds are 2 m/sec and 4 m/sec respectively, how many more rounds than Ram would Shyam have completed in an hour?
(A) 240 (B) 60 (C) 120 (D) 30

44. Ashwin and Bhaskar started running simultaneously from a point on a 300 m long circular track. They ran in opposite directions with speeds of 6 m/sec and 4 m/sec respectively. After meeting for the first time, they exchange their speeds. Who will reach the starting point first?
(A) Ashwin (B) Bhaskar
(C) Both reach simultaneously

45. Find the angle (in degrees) between the hands of a clock at 2:30 p.m. in degrees.

46. Find the number of times in a day that the hands of a clock will be at an angle of 63°.

47. Find the number of times in a day that the hands of a clock coincide.
(A) 11 (B) 44 (C) 22 (D) 12

48. Find the time interval (in minutes) between two successive instants when the hands of a clock concide.
(A) $55\frac{6}{11}$ (B) $55\frac{5}{11}$
(C) $65\frac{5}{11}$ (D) None of these

49. What is the time when the hands of a clock coincide between 12:00 p.m and 1:00 p.m?
(A) $1:05\frac{5}{11}$p.m (B) 1:05 p.m
(C) $1:06\frac{5}{11}$p.m (D) $1:07\frac{5}{11}$p.m

50. The minute and hour hands of a clock coincide after every 67 minutes. Is the clock losing time?
(A) Yes (B) No (C) Cannot say

Exercise – 5(a)

Directions for questions 1 to 35: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. Walking from home at 3/4^{ths} of his usual speed, a man reaches his office 20 minutes late. Had the person walked at 4/3^{rds} of his usual speed, find the time taken by the man to reach his office. (in minutes)

2. A boy walks from his home to school at 5 kmph, reaches the school 4 minutes early. If he walks from his home to school at 4 kmph, he reaches the school 2 minutes late. Find the time taken by him to go to school if he walks at 6 kmph.
(A) 15 minutes (B) 20 minutes
(C) 25 minutes (D) 30 minutes

3. M and N start at the same time from two ends S and T, at speeds of 3 m/sec and 4 m/sec towards each other, ST being 7 m. After reaching the opposite ends, they retrace their path and start moving towards each other. Find the total distance travelled by M when he meets N for the second time.
(A) 20 m (B) 15 m (C) 9 m (D) 26 m

4. A person travels a distance AB of 15.625 m in 5 seconds. In the last four seconds, every second he covers a distance equal to one-fourth of the total distance covered upto the end of the previous second. Find the distance covered in the 1st second. (in m)

5. A stone, allowed to fall under gravity falls $5t^2$ metres in t seconds. Find the distance travelled by the stone in the last two seconds before it reaches the ground, if the stone is dropped from a height of 180 m.
(A) 30 m (B) 60 m (C) 100 m (D) 90 m

6. A train crosses two bridges 430 m and 550 m long in 30 seconds and 36 seconds respectively. Find the speed of the train.
(A) 36 kmph (B) 72 kmph
(C) 27 kmph (D) 45 kmph

7. A train travelling at 60 kmph, crosses a cyclist who is cycling at 12 kmph in the opposite direction in 20 sec. Find the time taken by the train to cross another cyclist travelling at 20 kmph in the same direction as the train does. (in sec)

Directions for questions 8 and 9: These questions are based on the following data.

Train T of length 100 metres moving at 54 kmph and train U of length 150 metres moving at 90 kmph running on parallel tracks enter a 200-metre long tunnel at the same instant from opposite directions.

8. Which train exits the tunnel first and at the moment it exits, what length of the other train is still in the tunnel?
(A) T, 50 m (B) U, 10 m
(C) U, 90 m (D) T, 75 m

9. How far is the point where the rear ends of the two trains cross each other, from the point of entry of the slower train?
(A) 40.5 m (B) 81 m
(C) 84.5 m (D) 68.75 m

10. P, Q and R start from the same place X at a kmph, (a + b) kmph and (a + 2b) kmph respectively. If Q starts p hours after P, how many hours after Q should R start, so that both Q and R overtake P at the same time? (a > 0, b > 0)

(A) $\frac{pa}{a+b}$ (B) $\frac{a}{p(a+b)}$

(C) $\frac{p(a+b)}{a+2b}$ (D) $\frac{pa}{a+2b}$

11. Two men, M and N started walking towards each other simultaneously from two places F and G respectively, which are 50 km apart. They meet after 5 hours. After their meeting, M reduced his speed by 1 kmph and N increased his speed by 1 kmph. They arrived at G and F respectively at the same time. Find the initial speed of M. (in kmph)

12. A thief was running along to a median on a road at 6 kmph. He crossed a police jeep moving at 9 kmph in the opposite direction. The jeep had to continue for 10 more minutes before it could find a gap in the median and start chasing the thief. Find the total time taken by the jeep to catch the thief from the time it crossed him (in minutes).
(A) 45 (B) 50 (C) 55 (D) 60

13. Anand and Bala started from towns P and Q simultaneously towards Q and P respectively. After 6 hours, they crossed each other at town R. After that, Anand took 5 hours more to reach Q than Bala took to reach P. Find the sum of the times taken by them to reach their destinations from R (in hours).
(A) 15 (B) 11 (C) 13 (D) 17

14. A man left X for Y. Another man left Y for X at the same time. After reaching their destinations, they turned back without stopping. They crossed each other at a point 30 km from X on their onward trip and 20 km from Y on their return trip. Find XY. (in km)

15. P started from town X at 10 a.m. and went towards town Y. Q started from Y at 12 p.m. and went towards X. They met at 2 p.m. P reached his destination 20 minutes after Q did. At what time did Q reach his destination?
(A) 4:20 p.m. (B) 4:40 p.m.
(C) 5 p.m. (D) 5:20 p.m.

Directions for question 16: This question is based on the following data.

Three friends - Anil, Bala and Chetan, from X wanted to travel from town X to town Y which was 40 km. Anil who had a bike started along with Bala while Chetan started simultaneously on foot. After some time, Anil dropped Bala on the way and went back to pick up Chetan while Bala proceeded to Y on foot. Anil picked up Chetan and reached Y at the same time as Bala. Anil traveled at 50 km/hr. The speed at which Bala and Chetan walked was 10 km /hr.

16. (i) Find the time after which Anil turned back.
(A) 24 minutes (B) 48 minutes
(C) 36 minutes (D) 30 minutes

(ii) Find Bala's average speed for the entire trip.
(A) 12 km/hr (B) 24 km/hr
(C) 20 km/hr (D) 25 km/hr

17. Peter and Paul are running in opposite directions along a circular track of 600 m with initial speeds of 3 m/s and 6 m/s. They start at the same point and at the same time. Whenever they meet, they exchange their speeds and carry on in their respective directions. Find the distance between Peter and Paul (when measured along the track) when Peter completes $4^1/_4$ rounds. (in m)

18. Two runners run in the same direction along a circular track 3 km in length. The faster runner overtakes the slower every 1 hour. Find the speed of the slower runner, if the faster one completes one length of the track 2 minutes sooner than the other.
(A) 20 kmph (B) 18 kmph
(C) 15 kmph (D) 12 kmph

19. Prakash and Pramod are running along a circular track having started at the same time from the same point, in the same direction. How much more distance would Prakash have travelled compared to Pramod by the time they meet for the 11th time given that the radius of the track is 7 m, Prakash and Pramod run at 22 m/s and 11 m/s respectively? (in m)

20. P and Q started moving simultaneously from points X and Y respectively on a circular track in the same direction. XY = 2 km and the length of the track is 6 km. The initial position of P was behind that of Q. P caught up with Q for the second time in 40 minutes. Had P started in the opposite direction, they would have met for the first time in 12 minutes. Find the speed of P (in km/hr).
(A) 16 (B) 14 (C) 6 (D) 4

21. Anant started answering a mathematics test sometime between 2:00 p.m. and 3:00 p.m. and ended at sometime between 5:00 p.m. and 6:00 p.m. If it is known that the position of the minute hand and the hour hand at the start interchanged with the position at the end, for how long did Anant take the test?
(A) $2^5/_{11}$ hours (B) $2^{10}/_{13}$ hours
(C) $2^5/_7$ hours (D) $2^{13}/_{14}$ hours

22. Find the angle between the hands of the clock at 4:30 p.m.
(A) 30° (B) $52\frac{1}{2}^\circ$
(C) 60° (D) 45°

23. There are two clocks which have been correctly set at 8:00 a.m. on Sunday, 1st January. The first clock gains 4 minutes every hour uniformly, while the second clock loses 6 minutes every hour uniformly. When is the next time that the two clocks show 8:00 a.m. simultaneously?
(A) 9th January
(B) 15th January
(C) 13th January
(D) 31st January

24. If the hands of a clock coincide every 80 minutes. and the hands of another clock coincide every 65 minutes, what is approximate time difference between the two clocks in exactly 24 hours time interval as shown by a correct clock?
(A) 272 min (B) 145 min
(C) 220 min (D) 200 min

25. Flight A started from a city P at 4 a.m. local time and reached city Q at 8 a.m. local time. It started back from Q at 8 p.m. local time and reached P at 10 p.m. local time. If the speed of A for either direction was 800 km/hr, the distance between P and Q is (in km)

.

26. Anwar leaves home everyday at 4 p.m. to pick his wife from office and returns home at 6 p.m. One day, the office was over at 4 p.m. and his wife started walking home from office. Anwar, unaware of this, starts from home as usual and meets his wife on the way and returns home with wife 15 minutes early. If the speed of Anwar's car is 30 kmph, find the walking speed of his wife.
(A) 30/7 kmph (B) 3.6 kmph
(C) 34/5 kmph (D) 5.4 kmph

27. In a race of 500 m, L beats M by 40 seconds and beats N by 125 m. If M and N run a 500 m race, M beats N by 40 seconds. Find the time taken (in seconds) by M to run the race.
(A) 160 (B) 240 (C) 280 (D) 320

28. Rahim and Saleem are competing in a 1000 m race. Rahim gives Saleem a head start of 200 m, but his speed is twice that of Saleem. When Rahim reaches the 600 m mark, Rahim reduces his speed by half but still beats Saleem by 20 s. What is Saleem's speed?
(A) 14 m/s (B) 5 m/s
(C) 3.5 m/s (D) 7 m/s

29. Akbar takes a certain time to go downstream on a river between two villages. He takes 4 times as much time to cover the same distance upstream. What is the speed of the stream, if the distance between the villages is 10 km, which can be covered in 2 hours if the boat travels in still water? (in kmph)

30. A boat travels from point P to point Q upstream and returns from point Q to point P downstream PQ = 96 km. If the round trip takes 9 hours and the speed of the boat in still water is 8 kmph more than the speed of the stream, find the time taken for the downstream journey.
(A) 3 hours (B) 4 hours
(C) 8 hours (D) 6 hours

31. There are two identical escalators, one is ascending and the other is descending. A person took 90 seconds to go up using the descending escalator and 18 seconds to go up using the ascending escalator. Both times walking at the same speed. If the speed of the two escalators is the same, then the time taken to go up/down using either of the escalators when they are switched off is
[ ] sec.

32. A ship 154 km from the shore springs a leak which admits 4½ tonnes of water in 11 minutes. When 184 tonnes of water enter the ship, the ship would start sinking. But the pumps can throw out 1 tonne every five minutes. Find the average speed so that she may just reach the shore as she begins to sink.
(A) 10.5 kmph (B) 12 kmph
(C) 10 kmph (D) 13 kmph

33. An artillery gun is fired twice at an interval of 24 seconds. A motorist moving towards the gun heard the sounds of the gunfire at an interval of 22 seconds. If the speed of sound is 330 m/s, what is the speed of the car?
[ ] m/s

34. A car travels a total distance of 300 km. After travelling a part of the distance without any trouble, the car develops an engine problem and proceeds at $3/4^{th}$ of its former speed and arrives at the destination 80 minutes late. Had the problem developed 50 km further on, the car would have arrived 20 minutes sooner. Find the original distance it travelled without any problem, and the speed over that part of the journey.
(A) 100 km, 50 kmph
(B) 50 km, 75 kmph
(C) 150 km, 50 kmph
(D) 50 km, 100 kmph

35. One day, Hari walked along a circular track for 3 hours. He then cycled along the track for the time he would take to walk one round around the track and thereby covered a total of 9 rounds. Another day, he walked along the track for 4 hours and then drove his motorcycle along the track for the time he would take to walk one round around the track and thereby covered a total of 14 rounds. If the speeds of his cycling and motorcycle were 5 km/hr and 10 km/hr respectively, then find his walking speed.

(A) $\frac{5}{3}$ km/hr (B) $\frac{4}{3}$ km/hr
(C) 2 km/hr (D) $\frac{7}{3}$ km/hr

Exercise – 5(b)

Directions for questions 1 to 50: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. What is the distance covered by a cyclist in 20 seconds if he is travelling at a speed of 36 kmph?
(A) 720 metres (B) 18 metres
(C) 300 metres (D) 200 metres

2. Mr. Ashok takes 16 hours to go by train to a certain town and return by car. He would save 4 hours if he travelled both ways by car. Find the time he would lose, if he travelled both ways by train (in hours).
[ ]

3. Ram covers a distance of 100 m in a certain time. If he increases his speed to 3 times his original speed, the time taken reduces by 40 seconds. Find the original time taken (to cover the same distance of 100 m).
(A) 30 seconds
(B) 120 seconds
(C) 180 seconds
(D) 60 seconds

4. If Ashok travelled at $4/5^{th}$ of his usual speed, he would reach his destination 15 minutes late. By how many minutes would he be early if he travelled at $6/5^{th}$ of his usual speed?
(A) 12 (B) 10 (C) 15 (D) 20

5. A man reaches his destination which is 16 km away, 9 min late, if he travels at 8 kmph. What should his speed be if he wishes to reach 15 minutes ahead of the right time?
(A) 10 kmph
(B) 3 m/sec
(C) 20/9 m/sec
(D) 12 kmph

6. A person covered 50% of a certain distance at 15 kmph, 60% of the remaining distance at 18 kmph and the rest at 45 kmph. The total travel time of the person is 9.8 hours. Find the total distance covered. (in km)
[ ]

7. The distance between two points P and Q is 84 km. Two persons start at the same time but one travelling from P towards Q and the other travelling from Q towards P. If their respective speeds are 36 kmph and 27 kmph, where do they meet each other?
(A) 48 km from Q
(B) 24 km from P
(C) 36 km from P
(D) 48 km from P

8. Towns P and Q are 80 km apart. Cars A and B are stationed at towns P and Q respectively. If they start simultaneously towards each other, they would meet in an hour. If both start simultaneously in the same direction, the faster car would overtake the slower car in 4 hours. Find the speed of the faster car (in kmph).

9. A cat on seeing a dog 100 m away turns around and starts running away at 24 kmph. The dog spots him one minute later and starts chasing the cat at a speed of 33 kmph. After how much time, from the start of the cat's run, will the chase end?
(A) 160 s (B) 220 s
(C) 260 s (D) 280 s

10. Train A starts at 6 a.m. from city P towards city Q at a speed of 54 kmph. Another train 'B' starts at 9 a.m. from P towards Q at 72 kmph. If the distance between P and Q is 1440 km, find at what distance from Q would the two trains meet each other?
(A) 648 km (B) 792 km
(C) 486 km (D) 954 km

11. Towns P and Q are 265 km apart. Car A started from P at 60 km/hr at 8:00 a.m towards Q. Car B started from Q at 40 km/hr at 10:00 a.m, towards P. At 11:00 a.m, B stopped for half an hour. A stopped for 28 minutes at town S, which is at a distance of 210 km from P. Find the time at which B crossed A.
(A) 11:35 a.m. (B) 11:54:30 a.m.
(C) 11: 52:30 a.m. (D) 11:48 a.m.

12. P and Q are two stations. Train A started from P towards Q at 6:00 a.m at 90 kmph. At the same time, train B started from R, an intermediate station 60 km from P, and travelled towards Q at 60 kmph. Train C started from Q towards P at 7:00 a.m at 120 kmph. All the trains crossed each other simultaneously. Find PQ (in km).

13. Two cars left simultaneously from two places P and Q, and headed for Q and P respectively. They crossed each other after x hours. After that, one of the cars took y hours to reach its destination while the other took z hours to reach its destination. Which of the following always holds true?

(A) $x = \frac{y+z}{2}$ (B) $x = \frac{2yz}{y+z}$

(C) $x = \sqrt{yz}$ (D) $x = \frac{y^2+z^2}{y+z}$

14. Ram and Gopi run towards each other starting from K and L respectively with respective speeds of 2 kmph and 3 kmph. After meeting each other, to reach L, if Ram takes 7 hours less than the square of magnitude of the time (in hours) taken by Gopi to reach K, find the distance between K and L.
(A) 25 km (B) 28 km
(C) 30 km (D) 32 km

15. M and N are two points that are 8 m apart. Anand and Ajay started simultaneously from M and N respectively. Anand moved towards N at 3 m/sec. Ajay moved towards M at 5 m/sec. After reaching their destinations, both turned back at their original speeds towards their starting points. Find the total distance (in m) that Ajay would have travelled before crossing Anand for the second time.
(A) 12 (B) 13 (C) 15 (D) 14

16. P and Q are two points, 10 km apart. Anand started from P towards Q and at the same time, Ashok started from Q towards P. They crossed each other after 1 hour. After that, Anand reduced his speed by 2 kmph and Ashok increased his speed by 2 kmph. They reached their destinations simultaneously. Find Anand's initial speed (in kmph).

17. Mahesh travelled from Hyderabad to Tirupati at a certain speed and returned at a certain speed. His average speed for the entire trip was the average of his onward and return speeds. He travelled a total distance of 1200 km in 12 hours. Find his onward speed (in kmph).
(A) 100 (B) 80 (C) 60 (D) 40

18. A person travels one-third of a certain distance AB at x kmph, one-fourth of the remaining distance at 2x kmph and the remaining distance at 3x kmph. If his average speed for the entire journey is (x + 2) kmph, then find the total distance he covers.
(A) 60 km (B) 50 km
(C) 40 km (D) Cannot be determined

19. Rahul ran around a square plot ABCD of side 0·48 km once. He ran the distance AB, BC, CD and DA at speeds of 4 kmph, 6 kmph, 4 kmph, and 6 kmph respectively.
(i) Find his average speed from A to C (in kmph).
(A) 2·4 (B) 3·6 (C) 4·8 (D) 7·2

(ii) Find his average speed for the entire distance (in kmph).
(A) 2·4 (B) 3·6 (C) 4·8 (D) 7·2

(iii) Find the time taken for the entire distance (in hours).
(A) 0·05 (B) 0·53 (C) 0·4 (D) 0·27

20. Two cars C and D start from a junction along two perpendicular roads at 8:00 a.m. and 9:00 a.m. respectively. If at 12 noon, the cars, which travel at the same speed, are 150 km apart, then, find the speed of each car. (in kmph)

21. Rajesh started in his car from town P towards town Q at 51 km/hr. After every minute, the speed of his car increased by 1 km/hr. The distance between P and Q is $\frac{3775}{60}$ km. Find the time he would take to reach Q (in minutes).
(A) 40 (B) 45 (C) 55 (D) 50

22. A car had to travel a total distance of 600 km. After travelling a part of the distance, it developed an engine problem. It travelled the remaining distance at $4/5^{th}$ of its usual speed. It arrived an hour late at its destination. Had the engine problem occurred after it had travelled 150 km more, the car would have arrived half an hour earlier at its destination. Find the distance it travelled without any problem (in km).
(A) 150 (B) 250 (C) 200 (D) 300

23. Everyday, Ashwin starts at 3.00 pm from his home to pick up his son from school. They reach their house at 5.00 p.m. One day, school was over at 3.00 p.m. Ashwin, not aware of this, started from home as usual. He met his son on the way and they reached home 20 minutes earlier than usual. If the speed of his car is 55 kmph, find his son's speed (in kmph).

24. Two persons R and S had to meet at a place 36 km from where they were at that moment. S, who was given a head start of 2 hours, reached the destination 12 minutes earlier than R. If R travelled 18 kmph faster than S, at what speed did R travel?
(A) 25 kmph (B) 24 kmph
(C) 30 kmph (D) 16 kmph

25. In a race, Mohan beats Sohan by 40 m and Sohan beats Rohan by 80 m. Mohan beats Rohan by 104 m. Find the length of the race (in m).

26. (i) In a race of length d m, Amar beats Bhavan by x m and Charan by y m. By what distance does Bhavan beat Charan in the same race?

(A) $\frac{(y-x)d}{d-y}$ m (B) $\frac{(y-x)d}{d-x}$ m

(C) $\frac{d(d-y)}{d-x}$ m (D) $(y-x)$m

(ii) In a race of length d m, Amar beats Bhavan by x m. Bhavan beats Charan by y m. By what distance does Amar beat Charan (in m)?

(A) $x-y+\frac{xy}{d}$ (B) $y-x+\frac{xy}{d}$

(C) $x+y$ (D) $x+y-\frac{xy}{d}$

27. In a 100 m race, Ajay gives Bala a start of x m ($x \geq 20$) and is beaten by him by y m ($y \leq 20$). If the speeds of both are distinct, which of the following cannot be the ratio of the speeds of Ajay and Bala?
(A) 6 : 5 (B) 4 : 3
(C) 7 : 5 (D) 9 : 10

28. In a 500 m race A beats B by 25 m or 5 s, what is A's speed?

(A) $4\frac{4}{11}$ m/s (B) $5\frac{5}{19}$ m/s

(C) $7\frac{3}{13}$ m/s (D) $10\frac{1}{2}$ m/s

29. In a 200 m race, Raja gives Rakesh a start of 20 m and beats him by 20 m. If Raja beats Rakesh by 4 seconds, find Raja's speed (in m/sec).

30. In a kilometre race, Ram beats Shyam by one minute and Shyam beats Tarun by 30 seconds. If Ram beats Tarun by 250 m in the same race, find the time taken by Ram to run the race (in seconds).
(A) 180 (B) 270 (C) 360 (D) 330

31. In a 100 m race, Karna beats Kiran by 20 m and Kiran beats Kumar by 7.5 sec. What is Kiran's speed if Karna runs twice as fast as Kumar? (in m/sec)

32. In a 500 ft race, Habib beats Akram by 60 ft. If Habib takes 5 paces for every 4 paces taken by Akram, what is the ratio of the length of Habib's pace to that of Akram?
(A) 10 : 11 (B) 11 : 10
(C) 25 : 22 (D) 22 : 25

Directions for questions 33 and 34: These questions are based on the following data given below.

Two people Allen and Donald start off to complete a race of distance d km, with speeds of a kmph and b kmph respectively (where b > a). After reaching the halfway mark, Allen picks up speed and both of them reach the finishing post together.

33. What is Allen's speed (in kmph) after the halfway mark?

(A) $\frac{2a-b}{ab}$ (B) $\frac{d}{b-a}$

(C) $\frac{b+a}{2}$ (D) $\frac{ab}{2a-b}$

34. What is Allen's average speed over the entire journey?
(A) $\frac{a+b}{2}$ kmph (B) a^2 kmph
(C) a kmph (D) b kmph

35. A train takes 30 seconds to cross a 200 m long platform and 40 seconds to cross a 300 m long platform. Find its length (in m).

36. A train takes a minute to cross a stationary pole. It takes 240 seconds to cross another 3600 m long train traveling at 54 kmph. Find its speed (in kmph).
(A) 108 (B) 144 (C) 90 (D) 72

37. A train takes 2 minutes to overtake a cyclist traveling at 18 kmph and one and a half minutes to overtake a cyclist traveling at 9 kmph. Find its length (in m).
(A) 1200 (B) 800
(C) 1500 (D) 900

38. A train 360 m in length, travelling at a uniform speed overtook a car, travelling parallel to the tracks at 72 kmph and passed it in 12 sec. Fortyeight minutes later, the train starts overtaking a cyclist and passed him in 9 sec. How much time after the train overtook the cyclist would the car over take him?
(A) 2 hrs 24 min 36 sec
(B) 3 hrs 49 min 49 sec
(C) 3 hrs 12 min 9 sec
(D) 2 hrs 24 min 27 sec

39. A boat travels 30 km upstream in 5 hours and 24 km downstream in 3 hours. Find the speed of the boat in still water and the speed of the water current
(A) 7 kmph, 2 kmph
(B) 14 kmph, 1 kmph
(C) 7 kmph, 1 kmph
(D) 8 kmph, 2 kmph

40. A boat takes 9 hours to make a round trip in a river between two points 24 km apart. It would have taken 4 hours to cover the upstream distance in still water. Find the speed of the stream (in kmph).

41. The difference of the squares of the speed of a boat in still water and the speed of a river is six times the speed of the boat in still water. Find the average speed of the boat in covering a round trip. (Assume all speeds are in kmph)
(A) 3 (B) 6 (C) 9 (D) 7.5

42. Girish takes 1 minute to complete a round around a circular track. Harish is twice as fast as Girish, Suresh is thrice as fast as Harish. All three start at the same point. Find the time taken by them to meet at the starting point for the first time (in minutes).

43. Kavya, Suma and Sowmya are running along a circular track of length 1120 m in the same direction with respective speeds of 10 m/s, 8 m/s and 7 m/s.
(i) When will they be together again for the first time?
(ii) When will they be together again at the starting point for the first time?
(A) 280 s, 140 s (B) 756 s, 560 s
(C) 140 s, 1120 s (D) None of these

44. Tony and Harry begin to run in opposite directions on a circular path of radius 35 m at 20 m/sec and 11 m/sec respectively from the same point. What is the time taken by them to meet for the third time at the starting point?
(A) 11 min (B) 220 sec
(C) 8 min 40sec (D) 325 sec

45. Amar, Akbar and Anthony start running in the same direction and from the same point, around a circular track with speeds 7 m/sec, 11 m/sec and 22 m/sec respectively. If Akbar can complete 5 revolutions around the track in 40 sec, when will they meet for the first time after they start? (in sec)

46. P and Q start cycling simultaneously around a circular track 48000 m long with speeds of 10 m/sec and 30 m/sec respectively in opposite directions. After every crossing, P's speed increases by 10 m/sec and Q's speed decreases by 10 m/sec. Find the time taken by them to cross for the third time (in seconds).
(A) 3600 (B) 7200 (C) 4800 (D) 9600

47. Ram and Shyam started simultaneously from the same point on a circular track 1800 m long in opposite directions with speeds of 6 m/sec and 12 m/sec respectively. After every crossing, they exchanged their speeds and continued to travel in the same direction. Find the distance between them (measured along the track) when Ram completed $3\frac{1}{4}$ rounds. (in m)

48. P and Q are two points on a 1 km long circular track. The distance PQ, along the track is 200 m. Rohan started running from P. Sohan started running simultaneously in the same direction from Q. Both reached P for the first time simultaneously. If both started simultaneously from P in opposite directions, they would take $111\frac{1}{9}$ seconds to meet for the first time. Find the time taken by them to meet for the first time (in seconds), if they started simultaneously from Q in the same direction.

49. A watch set correctly at 10:00 a.m. on a Sunday shows 20 min more than the correct time at 6:00 p.m. on that day. When the clock shows 10:30 p.m. on the same day, what is the correct time?
(A) 7:00 p.m. (B) 10:00 p.m.
(C) 10:10 p.m. (D) 10:20 p.m.

50. Dinesh started answering a test at a time between 3:00 p.m and 4:00 pm. He noted the position of the hands of his watch. He ended the test at a time between 4:00 p.m and 5:00 p.m The positions of the hands were interchanged. For how many hours did the test last?
(A) $\frac{13}{14}$ (B) $\frac{12}{13}$ (C) $\frac{9}{10}$ (D) $\frac{10}{11}$

Directions for questions 51 to 60: Each question is followed by two statements I and II. Indicate your responses based on the following directives:

Mark (A) if the question can be answered using one of the statements alone, but cannot be answered using the other statement alone.
Mark (B) if the question can be answered using either statement alone.
Mark (C) if the question can be answered using I and II together but not using I or II alone
Mark (D) if the question cannot be answered even using I and II together.

51. Find the speed of the train, which crosses a signal post in 10 sec.
I. The length of the train is 200 m.
II. The train crosses a platform in 40 sec.

52. In a race, Ram gave Shyam a head start of at least x m and was beaten by him by at most y m. Was Ram faster than Shyam?
I. $x \geq y$
II. $x \leq y$

53. Mohan rowed his boat from a point A in a river 12 km upstream and returned to A. If the river was moving at a constant rate, then was his speed in still water more than 3 kmph?
I. He took four hours for the upstream journey.
II. He took three hours for the downstream journey

54. Two people A and B drove one car on a 500 Km trip. A drove for 5 hours, which was half an hour more than the time B drove. What was B's average speed?
I. B drove 50 km more than A.
II. A's average speed was 5 kmph less than that of B.

55. A boat started moving from A to B, what is the speed of boat in still water?
I. Speed of the river current is 2 m/sec.
II. The distance between A and the boat is increasing at the rate of 1 m/s.

56. What is the distance covered by a car during a certain trip?
I. The average speed of the car is 50 kmph.
II. The car would have covered 100 km more (in the same time) if the average speed increases by 25%.

57. If Ram walked from his home to his office at a kmph, he would be a minutes early. Instead had he walked at b kmph, he would be b minutes early, where a and b are distinct. Find the usual time he takes to reach his office.
I. $a + b = 10$
II. $a - b = 2$

58. Trains A and B have their lengths in the ratio 3 : 2. A takes x seconds to cross platform P_1. B takes y seconds to cross platform P_2. Is $\frac{x}{y} > \frac{5}{4}$?
I. A and B have equal speeds.
II. P_1 and P_2 have equal lengths.

59. Train A takes 50 seconds to cross a bridge B_1 500 m long. Train B is twice as long as A and has half its speed. Find the time taken by it to cross bridge B_2.
I. Length of A is 300 m.
II. Length of B_2 is 1000 m.

60. In a kilometre race, A beats B by x m and B beats C by y m. Does A beat C by more than 400 m?
I. $x = 200$; $y \geq 200$
II. $x = 200$; $y \leq 200$

Key

Concept Review Questions

1.	(a) A	6. A	13. A	20. 12	27. C	34. C	41. (i) A	47. C
	(b) A	7. 30	14. 72	21. D	28. 25	35. B	(ii) B	48. C
	(c) C	8. B	15. A	22. B	29. B	36. 50	42. 120	49. A
2.	36	9. C	16. B	23. C	30. B	37. B	43. C	50. A
3.	A	10. A	17. D	24. 70	31. C	38. 5	44. C	
4.	A	11. 360	18. D	25. 30	32. D	39. A	45. 105	
5.	630	12. B	19. 60	26. B	33. A	40. A	46. 44	

Exercise – 5(a)

1. 45	7. 36	13. C	18. C	24. A	30. A
2. B	8. C	14. 70	19. 484	25. 2400	31. 30
3. C	9. D	15. B	20. A	26. A	32. A
4. 6.4	10. D	16. (i) C	21. B	27. C	33. 30
5. C	11. 5.5	(ii) D	22. D	28. B	34. A
6. B	12. D	17. 150	23. D	29. 3	35. A

Exercise – 5(b)

1. D	12. 300	21. D	31. 8	42. 1	53. A
2. 4	13. C	22. D	32. A	43. D	54. B
3. D	14. C	23. 11	33. D	44. A	55. C
4. B	15. C	24. C	34. D	45. 88	56. A
5. A	16. 6	25. 200	35. 100	46. A	57. A
6. 180	17. A	26. (i) B	36. B	47. 450	58. D
7. D	18. D	(ii) D	37. D	48. 1000	59. A
8. 50	19. (i) C	27. D	38. D	49. B	60. A
9. C	(ii) C	28. B	39. C	50. B	
10. B	(iii) C	29. 6.25	40. 2	51. A	
11. C	20. 30	30. B	41. B	52. A	