



GENERAL APTITUDE

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Time & Distance

- **Speed = Distance / Time**
- **Distance = Speed x Time**
- Ram travels from A to B traveling distance of 10 km in 4 hrs. His speed is
- **$10/4 = 2.5 \text{ km/hr}$**
- Ram moves from Pune to Satara at the same speed taking 1 day & 10 hrs. The distance between Pune & Satara is
- **$(24+10) \times 2.5 = 34 \times 2.5 = 85 \text{ km}$**
- Ram now wants to reach back to Pune in 17 hours So he should travel back at a speed of
- **$85/17 = 5 \text{ km/hr}$**



Time & Distance

- If the same distance is traveled at different speeds S_1 & S_2 then average speed is given by-

$$S_a = \frac{(2 \times S_1 \times S_2)}{(S_1 + S_2)}$$

- If the same distance is traveled at different speeds S_1 , S_2 & S_3 then average speed is given by-

$$S_a = \frac{(3 \times S_1 \times S_2 \times S_3)}{(S_1S_2 + S_2S_3 + S_1S_3)}$$

- **Imp : Convert every term to same units**
- **1 Km/hr = $\frac{5}{18}$ m/s & 1 m/s = $\frac{18}{5}$ km/hr**
- If a bowler has a run up of 100 m & he runs at a speed of 36 km/hr the time he takes to complete his runup is
- **$36 \times \frac{5}{18} \text{ m/s} = 10 \text{ m/s}$**
- **$100 \text{ m} \div 10 \text{ m/s} = 10 \text{ s}$**



Time & Distance

If different distance D1,D2 & D3 travelled is at different speeds S1 ,S2 & S3 then average speed is given by-

$$S_a = \frac{(D1 + D2 + D3)}{\left(\frac{D1}{S1} + \frac{D2}{S2} + \frac{D3}{S3}\right)}$$

- Q. A man covers 10kms at a speed of 5 km/hr, 30kms at a speed of 7 km/hr and 20kms at a speed of 15 km/hr. Find out the average speed.

- $S_a = \frac{(10 + 30 + 20)}{\left(\frac{10}{5} + \frac{30}{7} + \frac{20}{15}\right)} = 7.77 \text{ km/hr}$

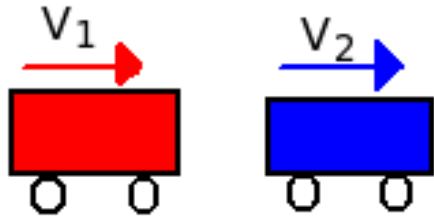


Time & Distance

- Speed & distance are directly proportional.
- $S \propto D$
- Distance & Time are directly proportional.
- $D \propto T$
- Speed & time are inversely proportional.
- $S \propto 1/T$
- **Relative speed** is **defined** as the **speed** of a moving object with respect to another. When two objects are moving in the same direction, **relative speed** is calculated as their difference and if objects are moving in opposite direction then calculate as their sum.
- **Relative speed = $X - Y$ (same direction)**
- **Relative speed = $X + Y$ (opposite direction)**

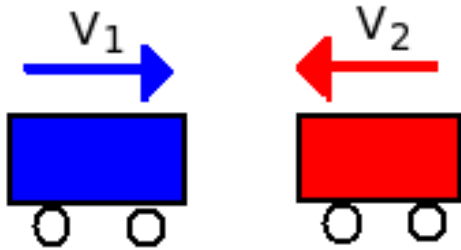


Relative Speed-



Objects Moving in Same direction

→ Relative Speed = $V_1 - V_2$



Objects Moving in Opposite Direction

→ Relative Speed = $V_1 + V_2$



Time & Distance

Q. A certain distance is covered by a car at a certain speed. If a motorcycle covers half the distance in double time, the ratio of the speed of the motorcycle to the car is

- A. 4:1 B. 1:2 C. 1:4 D. 2:3

Soln:

- Let Car cover distance d in time $t \rightarrow S_c = d \div t$
- Motorcycle covers dist $d/2$ in time $2t \rightarrow S_m = d/2 \div 2t$
- $\rightarrow S_m = d/4t$
- $\rightarrow S_m : S_c = d/t : d/4t = 1:4$
- **Ans : C**



Time & Distance

Q. A car traveled 20% of the time at 30 km/hr, 50% of the time at 40 km/hr and rest of the journey at 50 km/hr. What is the average speed of the car over the whole journey?

- A. 40 km/hr B. 35 km/hr C. 41 km/hr D. 45 km/hr

Soln:

Avg Speed = total dist / total time

Assume Journey = T hr

Total Distance = $(0.2T \times 30 + 0.5T \times 40 + 0.3T \times 50)$
= $6T + 20T + 15T$
= $41T$

Average Speed = $41T/T = 41 \text{ kmph}$

Ans: C

$$\begin{aligned} S_a &= \frac{(D_1 + D_2 + D_3)}{\left(\frac{D_1}{S_1} + \frac{D_2}{S_2} + \frac{D_3}{S_3}\right)} \\ &= \frac{(20 \times 30 + 50 \times 40 + 30 \times 50)}{\left(\frac{20 \times 30}{30} + \frac{50 \times 40}{40} + \frac{30 \times 50}{50}\right)} \\ &= \frac{4100}{100} = 41 \text{ km/hr} \end{aligned}$$



Time & Distance

Q. At 7:30 am two trains start from their respective stations A & B in opposite direction, 930 km apart at speeds of 60 km/hr & 90 km/hr respectively. At what time do they meet?

A. 12:30 pm

B. 1:30 pm

C. 1:42 pm

D. 1:50 am

Soln:

- Time = Distance/ Speed
- Time = 930 km / (60+90)km/hr (relative Speed adds up)
- Time = 6.20 hours = 6 hrs 12 min
- Time of meeting 1:42 pm

Ans: C



Time & Distance

Q. Walking at a speed of $\frac{4}{5}$ of the original speed a person reaches office 8 min late (8 mins more than normal time). Find the time required usually.

A. 24 min

B. 30 min

C. 32 min

D. 44 min

Soln:

	<u>Original</u>	<u>New</u>
Speed	S	$\frac{4S}{5}$
Time	T	T+8

Speed x Time = Distance is constant

$$\rightarrow ST = \frac{4S}{5} \times (T+8)$$

$$\rightarrow T = \frac{4}{5} \times (T+8)$$

$$\rightarrow \frac{5T}{4} = T+8$$

$$\rightarrow \frac{5T}{4} - T = 8$$

$$\rightarrow \text{Normal Time } T = 32 \text{ mins}$$

Ans: C



Time & Distance(Assignment)

Q. A boy starts from his house for college at a fixed time. If he walks at the rate of 5 kmph he is late by 7 mins. If he walks at 6 kmph he is 5 min early. Find College to home distance.

A. 5 km

B. 6 km

C. 7 km

D. 6.5 km

	<u>Original</u>	<u>Case1</u>	<u>Case2</u>
Speed	s	5	6
Time	t	t+7	t-5
Speed x Time = Distance is constant			
→	st =	5 x (t+7)/60	= 6 x (t-5)/60
→		5t + 35	= 6t - 30
→		t	= 65 mins
→	Using Case 1 Distance = 5 x (65+7)/60 = 6 km		

Ans B



Time & Distance(Assignment)

Q. One day a person travels to office at $\frac{5}{6}$ of his usual speed. He takes t minutes more than normal time. What is his normal time?

- A. $2t$ B. $3t$ C. $4t$ D. $5t$

Soln:

	<u>Original</u>	<u>New</u>
Speed	S	$\frac{5S}{6}$
Time	T	$T+t$

Speed x Time = Distance is constant

$$\rightarrow ST = \frac{5S}{6} \times (T+t)$$

$$\rightarrow T = \frac{5}{6} \times (T+t)$$

$$\rightarrow \frac{6T}{5} = T+t$$

$$\rightarrow \frac{T}{5} = t \rightarrow \text{Normal Time } T = 5t$$

Ans: D



Time & Distance(Assignment)

Q. A boy goes to school from home at a speed of 10km/hr and return back at 30km/hr. Find his average speed.

A. 15 km/hr

B. 14.5 km/hr

C. 10 km/hr

D. 20 km/hr

Ans: A



Time & Distance(Assignment)

Q. A man covers half of his journey at 6 km/h and the remaining half at 3 km/h. His average speed is-

A. 9 km/hr

B. 4.5 km/hr

C. 4 km/hr

D. 3 km/hr

Soln:

• Average speed = $\frac{2xy}{x+y} = \frac{2 \times 6 \times 3}{6+3} = \frac{36}{9} = 4 \text{ km/hr}$

Ans: C



Time & Distance(Assignment)

Q. On a journey, across Delhi, a Taxi averages 30 kmph for 60% of the distance, 20 kmph for 20% of it and 10kmph for the remainder. The average speed for the whole journey is :

A. 20km/hr

B. 22.5 km/hr

C. 24.625km/hr

D. 25km/hr

Ans: A



Time & Distance(Assignment)

Q. A distance is covered by a cyclist at a certain speed. If a jogger covers half of the distance in double the time, the ratio of the speed of the jogger to that of the cyclist is :

A. 1 : 4

B. 4 : 1

C. 1 : 2

D. 2 : 1

Ans: A



Time & Distance(Assignment)

Q. Walking at a speed of 20% more than the original a person requires 6 min less than normal time. Find the time required usually

A. 24 min

B. 30 min

C. 36 min

D. 44 min

• **Ans C**



Time & Distance(Assignment)

Q. Walking at a speed of 12 km/hr a person reaches 10 min late. But if he walks at 20 km/hr he reaches 14 min early. Find the distance.

A. 9 km

B. 12 km

C. 14 km

D. 15 km

Ans: B



Time & Distance(Assignment)

Q. Two cars started simultaneously travelling toward each other from town A and town B 480km apart. It took first car travelling from town A to town B and car covered the distance in 8hrs and car from town B to town A covers distance in 12hrs. Find distance from town A when they meet?

- A. 288km B. 250km C. 380km D. 240km

Ans: A

- Speed of first car = Distance/ time = $480 / 8 = 60\text{km/hr}$
- Speed of second car = Distance/ time = $480 / 12 = 40\text{km/hr}$
- The cars will meet in = $480 / (60+40) = 4.8 \text{ hrs}$ (relative Speed adds up as travelling in opposite directions)
- Dist from A where they will meet = speed of car from A x time
= $60 \times 4.8 = 288\text{km}$



Time & Distance(Assignment)

Q. A car travels $\frac{1}{3}$ of the distance on a straight road with a velocity of 10 km/h, next one-third with a velocity of 20 km/h and the last one-third with a velocity of 60 km/h. Then the average velocity of the car (in km/h) during the whole journey is-

A. 18km/hr

B. 24km/hr

C. 30km/hr

D. 20km/hr

Ans: A

$$\text{Time} = \frac{\text{Dist}}{\text{Speed}}$$

$$\begin{aligned}\text{Total Time} &= \frac{\frac{1}{3}D}{10} + \frac{\frac{1}{3}D}{20} + \frac{\frac{1}{3}D}{60} \\ &= \frac{D}{30} + \frac{D}{60} + \frac{D}{180} \\ &= \frac{6D + 3D + 1D}{180} \\ &= \frac{10D}{180} \text{ hrs}\end{aligned}$$

$$\text{Avg velocity} = \frac{\text{Dist}}{\text{time}}$$

$$\begin{aligned}&= \frac{D}{\frac{10D}{180}} \\ &= \frac{180D}{10D} \\ &= 18 \text{ km/hr}\end{aligned}$$



Time & Distance(Assignment)

Q. A man riding his bicycle covers 150 metres in 25 seconds. What is his speed in km per hour ?

- A. 25 km/hr
- B. 21.6 km/hr
- C. 23 km/hr
- D. 20 km/hr

Ans: B



Time & Distance(Assignment)

Q. A motorist travelled the distance between two towns, which is 65 km, in 2 hours and 10 minutes. Find his speed in meter per minute.

- A. 200 meters/min
- B. 500 meters/min
- C. 600 meters/min
- D. 700 meters/min

Ans: B



Trains

- Trains

- Let $S1$ = speed of train, $S2$ = Speed of Object

$L1$ = length of the train, $L2$ = Length of the object.

t = time taken by train to completely pass the object

Case A : Stationary object without considerable length

$$L1 = S1 \times t$$



Trains

- Trains

- Let $S1$ = speed of train, $S2$ = Speed of Object
 $L1$ = length of the train, $L2$ = Length of the object.
 t = time taken by train to completely pass the object

Case B : Stationary object with considerable length

$$L1 + L2 = S1 \times t$$



Trains

- Trains

- Let $S1$ = speed of train, $S2$ = Speed of Object
 $L1$ = length of the train, $L2$ = Length of the object.
 t = time taken by train to completely pass the object

Case C : Moving object without considerable length

$$L1 = (S1 \pm S2) \times t$$



Trains

- Trains

- Let $S1$ = speed of train, $S2$ = Speed of Object
 $L1$ = length of the train, $L2$ = Length of the object.
 t = time taken by train to completely pass the object

Case D : Moving Object with considerable length

$$L1 + L2 = (S1 \pm S2) \times t$$



Time & Distance

Q. Two trains of same length cross an electric pole in 12 sec & 20 sec respectively.
Find in how much time do they cross each other while traveling in same direction?

A. 45 sec

B. 50 sec

C. 60 sec

D. 75 sec

Soln:

Case A : $L_1 = S_1 \times t$ (Trains passing the pole)

$$L_1 = S_1 \times 12 \rightarrow S_1 = L_1/12$$

$$L_1 = S_2 \times 20 \rightarrow S_2 = L_1/20$$

Case B : $L_1 + L_2 = (S_1 \pm S_2) \times t$ (Train passing other train)

$$2L_1 = (L_1/12 - L_1/20) \times t$$

$$2 = (1/12 - 1/20) \times t$$

$$2 = 1/30 \times t \rightarrow t = 60 \text{ sec.}$$

Ans: C



Time & Distance

Q. A train of length 600 mt crossed a man going in the same direction at 12 km/hr in 45 sec while the same train crossed another man coming from the opposite direction on a bike in 20 sec. Find the speed of the bike.

A. 24 km/hr

B. 36 km/hr

C. 40 km/hr

D. 48 km/hr

Soln:

$$12 \text{ km/hr} = 12 \times \frac{5}{18} = \frac{10}{3} \text{ m/s}$$

Case A : $L_1 = (S_t - S_m) \times t$ (Train passing man)

$$600 = (S_t - \frac{10}{3}) \times 45$$

$$S_t = \frac{50}{3} \text{ m/s}$$

Case B : $L_1 = (S_t + S_b) \times t$ (Train passing the bike)

$$600 = (\frac{50}{3} + S_b) \times 20$$

$$S_b = \frac{40}{3} \text{ m/s} \times \frac{18}{5} = 48 \text{ km/hr}$$

Ans: D



Time & Distance

Q. A train of length 600 m crosses a man standing on a platform in 45 sec & the same train crosses the complete platform in 2 min. What is the length of the platform?

A. 500 m B. 700 m C. 900 m D. 1000 m

• **Soln:**

• Case A : $L_1 = S_1 \times t$ (Train passing the man)

$$\begin{aligned} 600 &= S_1 \times 45 \\ S_1 &= 600/45 \\ &= 40/3 \end{aligned}$$

• Case B : $L_1 + L_2 = S_1 \times t$ (Train passing the platform)

$$600 + L_2 = 40/3 \times 120$$

$$L_2 = 1600 - 600$$

$$L_2 = 1000 \text{ m}$$

• **Ans D**



Time & Distance(Assignment)

Q. Two trains of lengths 200 mt & 400 mt cross each other completely in 15 sec & 1.25 min respectively while going in opposite & same direction. Find the speed of the slower train.

A. 24 m/s

B. 16 m/s

C. 40 m/s

D. 8 m/s

Soln:

Case A : **$L_1 + L_2 = (S_1 + S_2) \times t$** (Trains passing opp direction)

$$200 + 400 = (S_1 + S_2) \times 15$$

$$S_1 + S_2 = 40 \text{ m/s} \dots\dots(1)$$

Case B : **$L_1 + L_2 = (S_1 - S_2) \times t$** (Trains passing same direction)

$$200 + 400 = (S_1 - S_2) \times 75$$

$$S_1 - S_2 = 8 \text{ m/s} \dots\dots(2)$$

$$2S_1 = 48 \rightarrow S_1 = 24, S_2 = 16$$

Ans: B



Time & Distance(Assignment)

Q. Person crosses a 600 m long street in 5 minutes. What is his speed in km per hour?

- A. 3.6 B. 7.2 C. 8.4 D. 10

Ans: B



Time & Distance(Assignment)

Q. An aeroplane covers a certain distance at a speed of 240 kmph in 5 hours. To cover the same distance in $1\frac{2}{3}$ hours, it must travel at a speed of:

- A. 300 kmph B. 360 kmph C. 600 kmph D. 720 kmph

Ans: D



Time & Distance(Assignment)

Q. The ratio between the speeds of two trains is 7 : 8. If the second train runs 400 km in 4 hours, then the speed of the first train is:

A. 70 km/hr

B. 75 km/hr

C. 84 km/hr

D. 87.5 km/hr

Ans: D



Time & Distance(Assignment)

Q. A man on tour travels first 160 km at 64 km/hr and the next 160 km at 80 km/hr. The average speed for the first 320 km of the tour is:

A. 35.55 km/hr

B. 36 km/hr

C. 71.11 km/hr

D. 71 km/hr

Ans: C



Trains(Assignment)

Q. A train running at the speed of 60 km/hr crosses a pole in 9 seconds. What is the length of the train ?

- A. 120 metres B. 180 metres C. 324 metres D. 150 metres

Ans : D



Trains(Assignment)

Q. A train 125 m long passes a man, running at 5 km/hr in the same direction in which the train is going, in 10 seconds. The speed of the train is:

A. 45 km/hr

B. 50 km/hr

C. 54 km/hr

D. 55 km/hr

Ans: B



Time & Distance(Assignment)

Q. Two trains run on parallel tracks in the same direction with speeds of 42 km/hr & 60 km/hr. A person sitting in the faster train crossed the slower train completely in 1.2 min. Find the length of the slower train.

A. 240 m

B. 360 m

C. 420 m

D. 480 m

Ans: B

Note – Man in the train has same speed as train but no length

Using case 3 from trains → Moving object without length

$$L_1 = (S_1 - S_2) \times t$$



Time & Distance

• Boats & Streams

- If Speed of boat in still water = x kmph
- Speed of the stream = y kmph then

- Speed of the boat downstream $S_d = (x+y)$ kmph
- Speed of the boat upstream $S_u = (x-y)$ kmph

- Speed of Boat in still water $X = \frac{1}{2} (S_d + S_u)$
- Speed of the stream $Y = \frac{1}{2} (S_d - S_u)$



Boats & Streams

Q. A boat goes 16 km upstream & returns back to original place in 6 hrs. If the speed of water is 2 kmph. Find the speed of boat in still water.

A. 3 kmph

B. 4 kmph

C. 6 kmph

D. 8 kmph

Soln

Let speed of boat = x , Speed of water $y = 2$

Case A : $S_u = x - 2$

Case B : $S_d = x + 2$

Total time = $T_u + T_d$

$$6 = 16/(x - 2) + 16/(x + 2)$$

$$6(x - 2)(x + 2) = 16(x + 2) + 16(x - 2)$$

$$6x^2 - 24 = 16(2x)$$

$$6x^2 - 32x - 24 = 0$$

$$3x^2 - 16x - 12 = 0 \rightarrow 3x^2 - 18x + 2x - 12 = 0 \rightarrow (3x + 2)(x - 6) = 0$$

$$\rightarrow x = 6 \text{ kmph}$$

Ans: C



Boats & Streams

Q. A man notices that it takes him thrice the time to row up than to row down the same distance. Find the speed of the boat in still water if the speed of water is 5 kmph?

A. 8 kmph

B. 8.5 kmph

C. 10 kmph

D. 10.5 kmph

Soln

$$T_d : T_u = 1 : 3 \rightarrow S_d : S_u = 3 : 1$$

Let speed of boat = x , Speed of water = 5

$$\rightarrow S_d = x+5, S_u = x-5$$

$$\rightarrow S_d/S_u = (x+5)/(x-5)$$

$$\rightarrow 3/1 = (x+5)/(x-5)$$

$$\rightarrow 3(x-5) = x+5$$

$$\rightarrow 3x-15 = x+5 \rightarrow 2x=20 \rightarrow x=10 \text{ kmph.}$$

Ans: C



Boats & Streams(Assignment)

Q. A person covers 200 m in 15 sec while going upstream & 5 km in 3 min while going downstream. Find the speed of boat in still water.

- A. 44 m/s B. 74 m/s C. 74 km/hr D. 80 km/hr

Ans: C



Boats & Streams(Assignment)

Q. A man rows at the rate of 12 kmph in still water. It takes him 4 hr 16 min to row to a place 24 km away & back. What is the speed of water?

A. 3 kmph

B. 2.5 kmph

C. 2 Kmph

D. 1.5 kmph

Ans : A



Boats & Streams(Assignment)

Q. A man notices that it takes him 5 times the time to row up than to row down the same distance. Find the speed of the boat in still water if the speed of water is 20 kmph?

A. 22 kmph

B. 25 kmph

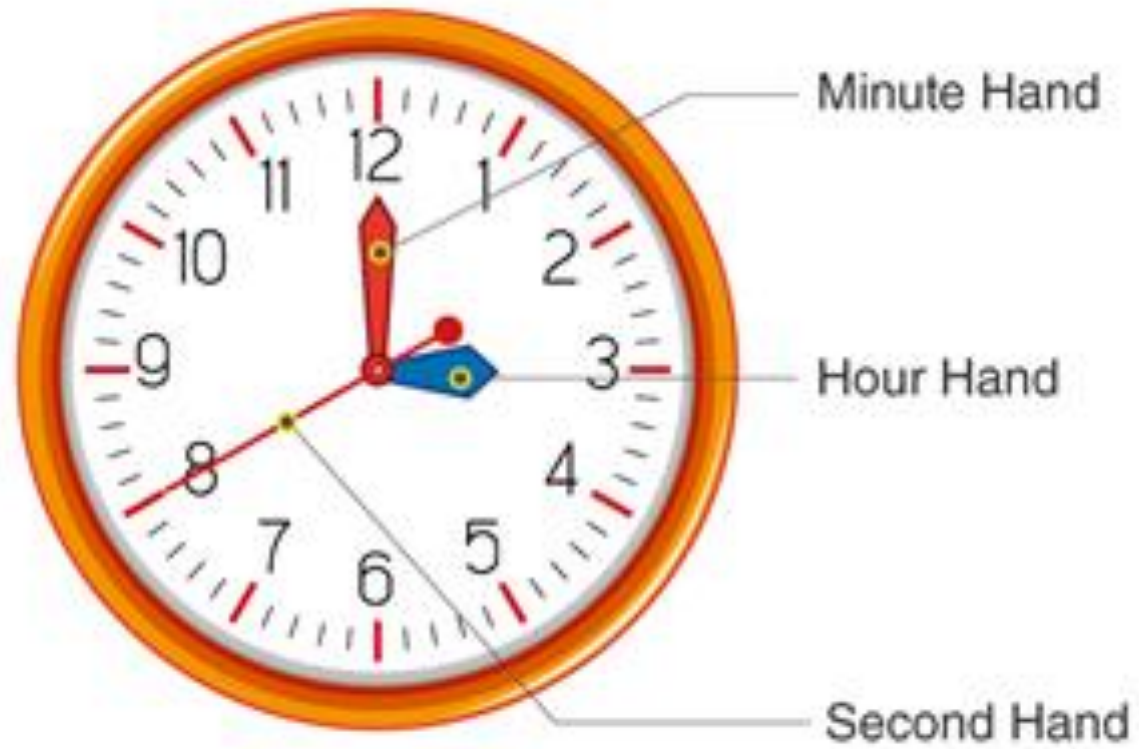
C. 27 Kmph

D. 30 kmph

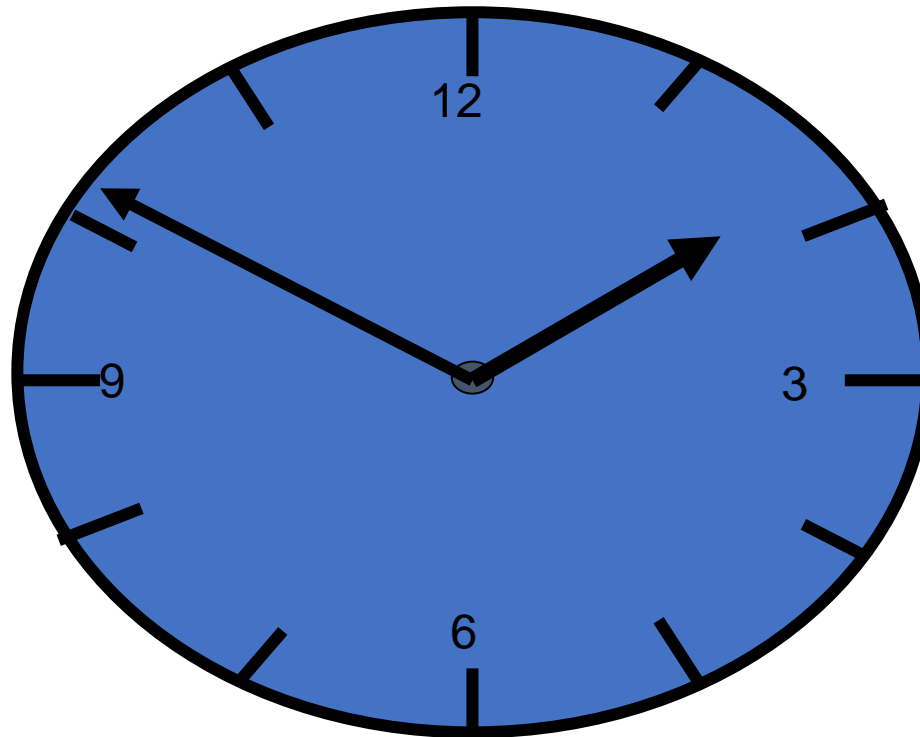
Ans: D



Clocks



Clocks



- → 360°
- → 60 minute spaces of 6° each
- → 12 Hours space of 30° each



Clocks

- The Face or dial of a watch is a circle whose circumference is divided into 60
- equal parts, called ***minute spaces***.
- A clock has two hands, the smaller one is called *the hour hand or short hand*
- while the larger one is called the ***minute hand or long hand***.
- i) In 60 minutes, the minute hand gains 55 minutes on the hour hand.
- ii) In every hour, both the hands coincide once.
- iii) The hands are in the same straight line when they are coincident or opposite to each other.
- iv) When the two hands are at right angles, they are 15 minute spaces apart.
- v) When the hands are in opposite directions, they are 30 minute spaces apart.
- vi) Angle traced by hour hand in 12 hrs = 360° .
- vii) Angle traced by minute hand in 60 min. = 360° .



Clocks

- $12 \text{ hr} \times 30^\circ = 360^\circ$
- At night 12, day starts , both hands are at same place.
- Every hour they coincide once **but between 11-12 it coincides at 12**, so its 11 times only.
- The two hands coincide -
 - 11 times in 12 hours
 - 22 times in 24 hours
- The two hand are in opposite direction –
 - 11 times in 12 hours
 - 22 times in 24 hours
 - **Between 5-7 it happens only once at 6 o'clock.**
- The two hand make right angles –
 - 22 times in 12 hours
 - 44 times in 24 hours



Clocks

- The hands of a clock coincide 11 times in every 12 hours (Since between 11 and 1, they coincide only once, *i.e.*, at 12 o'clock).

AM

PM

12:00

12:00

1:05

1:05

2:11

2:11

3:16

3:16

4:22

4:22

5:27

5:27

6:33

6:33

7:38

7:38

8:44

8:44

9:49

9:49

10:55

10:55

The hands overlap about every 65 minutes, not every 60 minutes.

∴ The hands coincide 22 times in a day.



Clocks

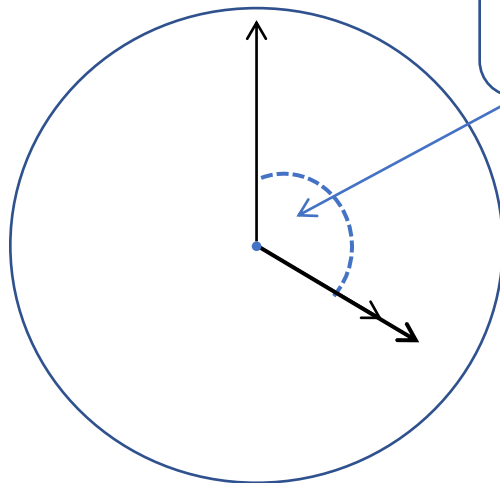
Q. At what time between 4 and 5 o'clock will the hands of a watch be together/coincide?

A. $10 \frac{9}{11}$ min past 4 B. $21 \frac{10}{11}$ min past 4 C. $11 \frac{10}{11}$ min past 4 D. $21 \frac{9}{11}$ min past 4

Soln:

• **Ans: D**

• Draw diagram of clock here



Distance travelled by minute hand is 20min-spaces.
So $D = 20$

$$\begin{aligned} T &= \frac{D}{S} \\ &= \frac{20}{11/12} \\ &= \frac{20 \times 12}{11} \\ &= \frac{240}{11} \\ &= 21 \frac{9}{11} \text{ mins. past 4} \end{aligned}$$



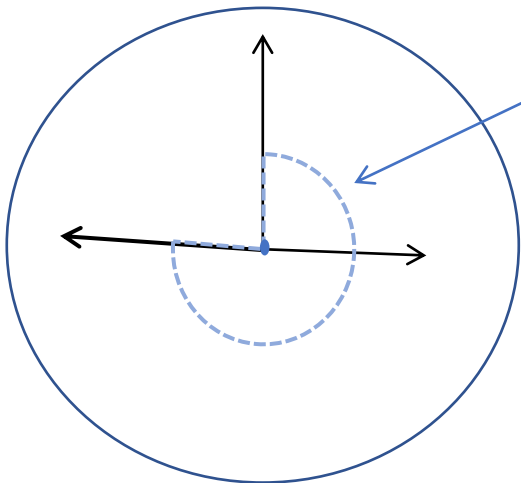
Clocks

Q. At what time between 3 & 4 o'clock will the hands of the clock be in the opposite direction.

- A. $40 \frac{9}{11}$ min past 3 B. $30 \frac{10}{11}$ min past 3
C. $49 \frac{1}{11}$ min past 3 D. $41 \frac{9}{11}$ min past 3

Ans : C

- Draw diagram of clock here



Distance travelled by minute hand is 45min-spaces.
So D = 45

$$\begin{aligned} T &= D/S \\ &= \frac{45}{11/12} \\ &= \frac{45 \times 12}{11} \\ &= \frac{540}{11} \\ &= 49 \frac{1}{11} \text{ mins. past 3} \end{aligned}$$



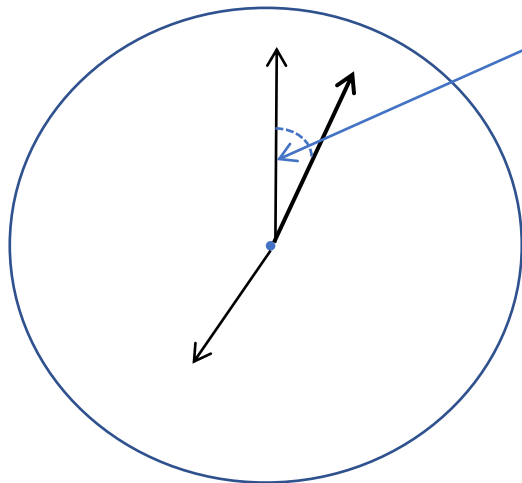
Clocks

Q. At what time between 7 and 8 o'clock will the hands of a clock be in the same straight line but, not together? ← means in opposite direction

A. 5 min. past 7 B. $5\frac{2}{11}$ min. past 7 C. $5\frac{3}{11}$ min. past 7 D. $5\frac{5}{11}$ min. past 7

Soln:

- **Ans: D**
- Draw diagram of clock here



Distance travelled by minute hand is 5 min-spaces.
So $D = 5$

$$\begin{aligned} T &= D/S \\ &= \frac{5}{11/12} \\ &= \frac{5 \times 12}{11} \\ &= \frac{60}{11} \\ &= 5\frac{5}{11} \text{ mins. past 7} \end{aligned}$$



Clocks

Q. What is the angle between the hands of a clock at 7:23 am?

A. 90° B. 85.5° C. 83.5° D. 81.5°

Soln:

$$\begin{aligned}\text{Angle } \theta &= 30H - 11/2 M \\ &= 30 \times 7 - \frac{11}{2} \times 23 \\ &= 210 - 253/2 \\ &= 210 - 126.5 \\ &= 83.5^\circ\end{aligned}$$

Ans : C



Clocks

Find the reflex angle between 2 hands of a clock at 10:25

A. 187.5° B. 192.5° C. 197.5° D. 207.5°

Soln:

$$\begin{aligned}\theta &= |30H - 11/2 M| \quad \text{OR } |30H - 5.5 M| \\ &= 30 \times 10 - 11/2 \times 25 \\ &= 300 - 275/2 \\ &= 300 - 137.5 \\ &= 162.5^\circ\end{aligned}$$

But reflex angle is greater than 180° and less than 360°

$$360 - 162.5 = 197.5^\circ$$

• **Ans: C**



Clocks

Q. Find non reflex angle between 2 hands of a clock at 10:10

Soln:

$$\begin{aligned}\theta &= |30H - 11/2 M| \quad \text{OR } |30H - 5.5 M| \\ &= 30 \times 10 - 11/2 \times 10 \\ &= 300 - 55 \\ &= 245^\circ \quad \text{----} > \text{its a reflex angle} > 180^\circ\end{aligned}$$

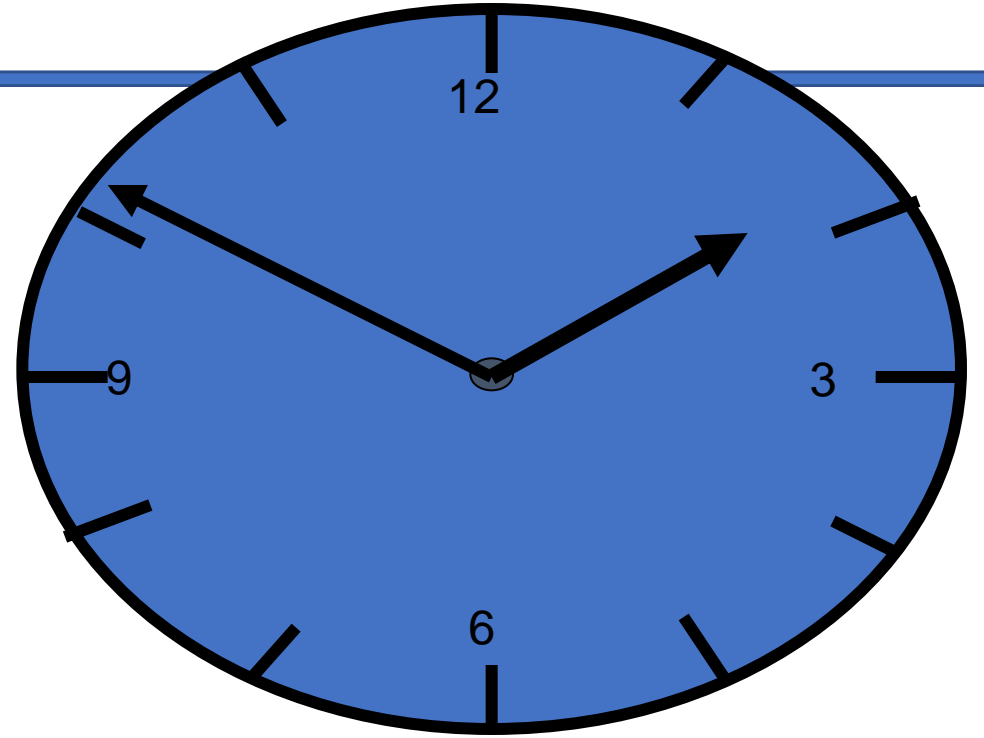
But reflex angle is greater than 180° and less than 360°

$$360 - 245 = 115^\circ \text{ ----} \rightarrow \text{non reflex angle}$$



Clocks

Please remember ,
In a clock that runs correctly,
hands overlap every **720/11 mins.** = $65\frac{5}{11}$ mins



Clocks - Method1

- The minute hands of a clock meet at intervals of 70 mins. How much does the clock gain or lose in one day?
- A. $90 \frac{10}{77}$ min B. $93 \frac{39}{77}$ min C. $93 \frac{35}{143}$ min D. None of these
- **Soln:**
- In a clock that runs correctly, hands overlap every $720/11$ mins.
- In this clock hands are together after every 70 mins.
- So gain/loss in 70 mins = $720/11 - 70$ mins = $(720-770)/11 = -50/11$
- 70 min $\rightarrow 50/11$ min loss
- 24×60 min $\rightarrow x$
- So loss in one day = $(\frac{50}{11} \times 24 \times 60) / 70 = 93 \frac{39}{77}$ min
- **Ans: B**



Clocks – Method2

Q. The minute hands of a clock meet at intervals of 70 mins. How much does the clock gain or lose in one day?

- A. $90 \frac{10}{77}$ min B. $93 \frac{39}{77}$ min C. $93 \frac{35}{143}$ min D. None of these

• **Soln:**

- The minute hand of a clock overtakes the hour hand at intervals of M minutes of correct time.

- The clock gains or loses in a day by $= (720/11 - M)(60 \times 24/M)$ minutes.

- Here $M = 70$.

- The clock gains or losses in a day by-

- Gain/loss $= (720/11 - M)(60 \times 24/M)$

$$= (720/11 - 70)(60 \times 24/70)$$

$$= \left(\frac{720 - 770}{11} \right) \left(\frac{6 \times 24}{7} \right)$$

$$= \left(\frac{-50}{11} \right) \left(\frac{144}{7} \right) = \frac{-7200}{77}$$

$$= 93 \frac{39}{77} \text{ min}$$



Clock(Assignment)

Q. A clock is set at 4am. It loses 16 minutes in 24 hours. What will be the correct time when the clock indicates 9pm on the 4th day?

- A. 8pm B. 7pm C. 10pm D. 11pm

- **Ans C**

- Time from 4am on a day to 9pm on the 4th day = 89 hours
- 23 hrs 44 minutes of this clock = 24 hours of the correct clock as this clock loses 16 minutes in 24 hours.
- $23 \text{ hrs } 44 \text{ minutes} = 23 \frac{44}{60} = 23 \frac{11}{15} = \frac{356}{15} \text{ hrs}$
- Now, $\frac{356}{15} \text{ hrs of this clock} = 24 \text{ hours of correct clock}$
- 89 hours of this clock = ?
- $\frac{24 \times 11}{356} * 89 = 90 \text{ hours of the correct clock, i.e. the correct clock gains one hour over the incorrect clock.}$
- The correct time on the fourth day will be 10pm.



Clocks(Assignment)

Q. An accurate clock shows 8 o'clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2 o'clock in the afternoon?

- A. 144° B. 150° C. 168° D. 180°

- Soln:
- In one hour ----- the hour hand rotates 30°
- In 6 hours ----- the hour hand rotates 180°
- OR
- Number of hours from 8am till 2pm = 6hrs
The rotation of an hour hand in one hour = 30°
Total degree of rotation = 360°

Therefore, the Angle traced by the hour hand in 6 hours is = $(360/12) \times 6 = 180^\circ$

- **Ans: D**



Clocks(Assignment)

Q. What is the angle between the hands of a clock at 7:20 ?

- A. 100° B. $192\frac{1}{2}^\circ$ C. 195° D. $197\frac{1}{2}^\circ$

Ans : A

What is the angle between the hands of a clock at 2:30 ?

- A. 144° B. 150° C. 105° D. 180°

Ans : C

What is the angle between the hands of a clock at 3:30 ?

- A. 144° B. 150° C. 105° D. 75°

Ans : D



Clocks(Assignment)

Q. The minute hand of a clock overtakes the hour hand at intervals of 65 mins of correct time. How much does the clock gain or lose in one day?

- A. $10\frac{10}{143}$ min B. $10\frac{21}{143}$ min C. $10\frac{100}{143}$ min D. None of these

Ans: A



Clocks(Assignment)

Q. A clock is so placed that at 12 noon its minute hand points towards North-east. In which direction does its hour hand point at 1:30 p.m ?

A. West

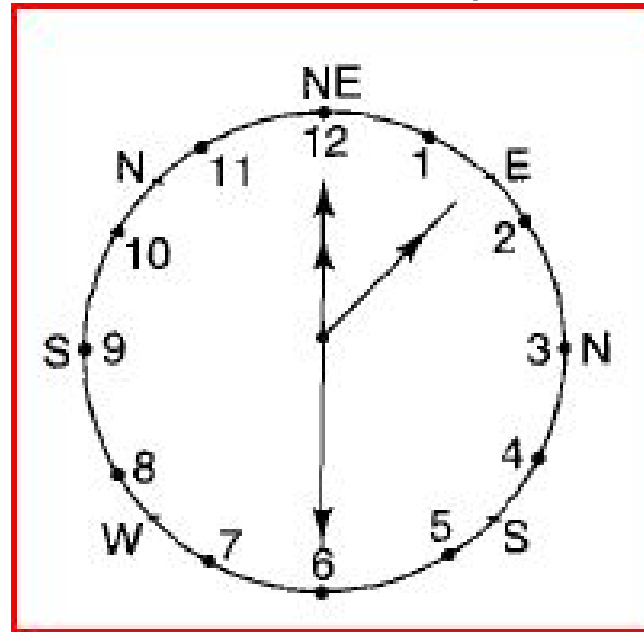
B. East

C. North

D. South

Ans: B

Diagram is shown as per the conditions in the question. Clearly at 1.30 p.m hour hand shall point - East.

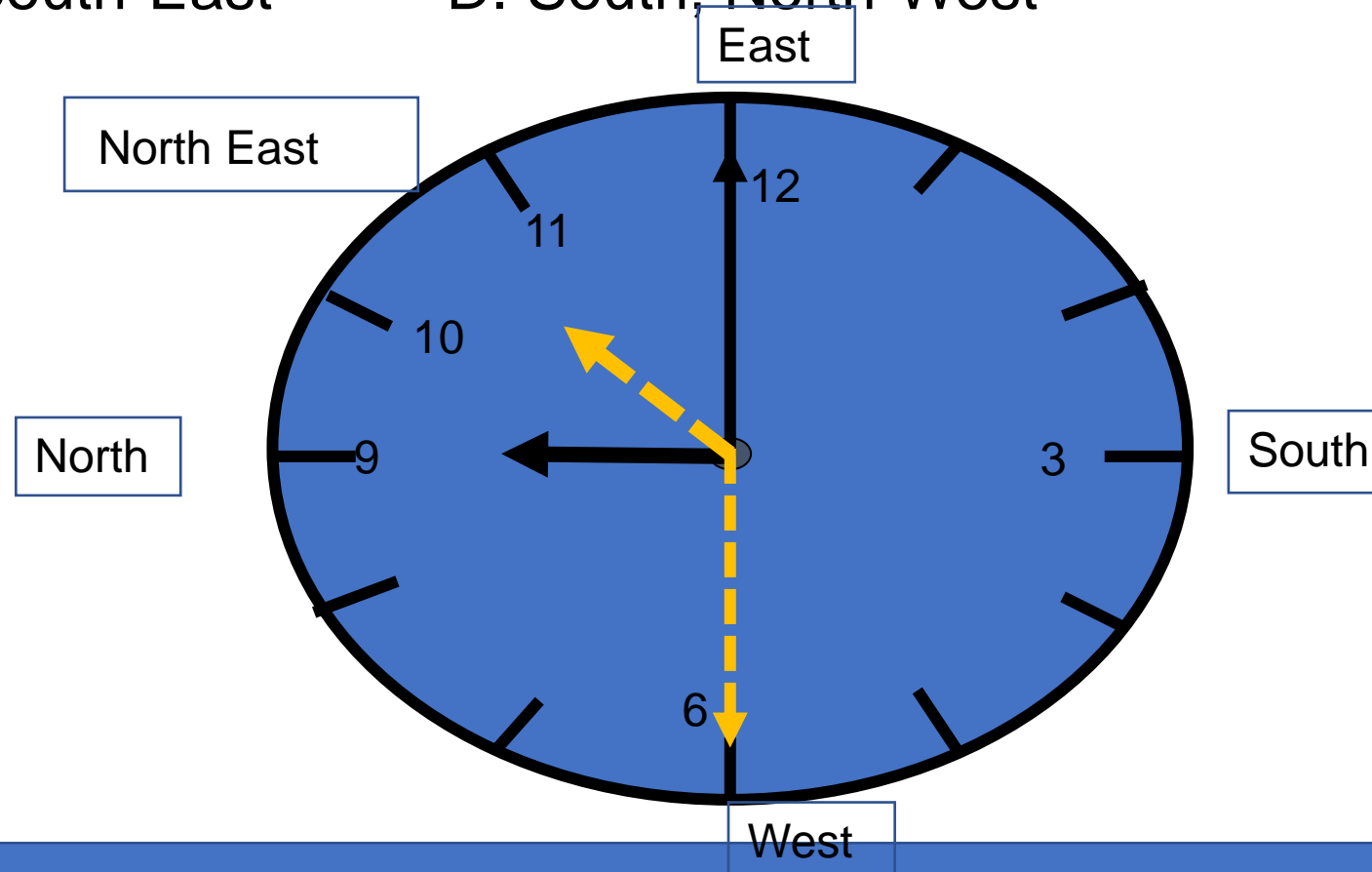


Clock(Assignment)

Q. Time piece kept in home is such that hour hand points to North at 9am..In which direction minute hand and hour hand point respectively at 10:30am?

- A. West, North-East B. East, North-West
C. North, South-East D. South, North-West

Ans: A



Permutation & Combination

- What is permutation?
- It is the number of ways a group of things can be arranged.

E.g: Consider 3 letters A,B,C . In how many ways they can be arranged?

- A B C
 - A C B
 - B A C
 - B C A
 - C A B
 - C B A
- 6 ways to arrange these 3 letters

- For 3 letter / 4 letter words its possible but for more number of letters we need a formula-
- $nPr = \frac{n!}{(n-r)!}$



Permutation & Combination

Q. Consider 4 letters A,B,C,D and arrange them in 3 spaces

- - - 3 spaces

No . Of letters = 4

No of spaces = 3

$$nPr = 4P_3 = \frac{4!}{(4-3)!} = \frac{4!}{1!} = 4! = 4 \times 3 \times 2 \times 1 = 24 \text{ ways it can be arranged}$$

Q. Arrange 7 letters A,B,C,D,E,F,G in 4 spaces

- - - - 4 spaces

$$nPr = 7P_4 = \frac{7!}{(7-4)!} = \frac{7!}{3!} = \frac{5040}{6} = 840$$



Permutation & Combination - Remember

$$0! = 1$$

$$1! = 1$$

$$2! = 2 \times 1 = 2$$

$$3! = 3 \times 2 \times 1 = 6$$

$$4! = 4 \times 3 \times 2 \times 1 = 24$$

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

$$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$$

$$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040$$



Difference between permutation and combination

Combination (order does not matter)

"My fruit salad is a combination of apples, grapes and bananas" We don't care what order the fruits are in, they could also be "bananas, grapes and apples" or "grapes, apples and bananas", its the same fruit salad.



Permutation (When the order does matter)

"The combination to the safe is 472". Now we **do** care about the order. "724" won't work, nor will "247". It has to be exactly **4-7-2**.



Difference between permutation and combination

What is permutation?

Permutation: The various ways of arranging a given number of things by taking some or all at a time are all called as permutations.

Permutation includes word formation, number formation, circular permutation, etc. **In permutation, objects are to be arranged in particular order.** It is denoted by ${}^n P_r$ or $P(n, r)$.

Example: Arrange the given 3 numbers 1, 2, 3 by taking two at a time.

Now these numbers can be arranged in 6 different ways: **(12, 21, 13, 31, 23, 32).**

Here,

12 and 21, 13 and 31 or 23 and 32 do not mean the same, because here order of numbers is important.



Difference between permutation and combination

- **What is combination?**

Combination: Each of different groups or selections formed by taking some or all number of objects is called a combination.

Combination is used in different cases which include team/group/committee.

In combination, objects are selected randomly and here order of objects doesn't matter. It is denoted by ${}^n C_r$ or $C(n, r)$ or ${}^n C_r = {}^n C_{(n-r)}$.

Example: If we have to select two girls out of 3 girls X, Y, Z, then find the number of combinations possible.

Now only two girls are to be selected and arranged. Hence, this is possible in 3 different ways: (XY, YZ, XZ,).

Here,
You cannot make a combination as XY and YX, because these combinations mean the same.



Permutation & Combination

Q. In how many ways can the letters of the word 'LEADER' be arranged?

A. 72 B. 144 C. 360 D. 720 E. None of these

Soln:

The word LEADER has 6 letters. So it can be arranged in $6!$ ways.

Out of these 6 letters, 2 letters are repeated (letter E repeated twice)

So we write it as - $\frac{6!}{2!}$

$6!$ ways to arrange letters in the word LEADER

$2!$ In the denominator as letter E is repeated twice

$$= \frac{6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 1}$$

$$= 360 \text{ ways}$$

Ans : C



Permutation & Combination

Q. In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?

- A. 360 B. 480 C. 720 D. 5040 E. None of these

Soln:

L E A D I N G \longrightarrow vowels in this word are E, A I

Remaining letters(consonants) are - L D N G

now we can arrange the vowels together in the remaining spaces as

_ L _ D _ N _ G _ in 5! ways and vowels be rearranged in those spaces in 3! ways

$$5! \times 3! = 720 \text{ ways}$$

Ans : C



Permutation & Combination

Q. In how many different ways can the letters of the word 'CORPORATION' be arranged so that the vowels always come together?

- A. 810 B. 1440 C. 2880 D. 50400 E. 5760

Soln:

C O R P O R A T I O N----- vowels in this word are O,O,A,I,O

Remaining letters(consonants) are - C R P R T N

now we can arrange the vowels together in the remaining spaces as

_C_R_P_R_T_N_ in 7! ways and vowels be rearranged in those spaces in 5! Ways

But the repeated letters are 2R in consonants and 3O in vowels

$$\frac{7!}{2!} \times \frac{5!}{3!} = 50400 \text{ ways}$$

Ans : D



Permutation & Combination

Q. Out of 7 consonants and 4 vowels, how many words of 3 consonants and 2 vowels can be formed?

- A. 210 B. 1050 C. 25200 D. 21400 E. None of these

Soln:

we need to form a 5 letter word with 3 consonants & 2 vowels = C C C V V

Ways to select, (3 consonants out of 7) AND (2 vowels out of 4)

$= 7C_3 \times 4C_2 \times 5!$ \leftarrow each group has 5 letters and they can be arranged in 5! ways

$$= \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{4 \times 3}{2 \times 1} \times 5!$$

$$= 35 \times 6 \times 120$$

$$= 25200 \text{ ways}$$

Ans : C



Permutation & Combination

Q. In how many different ways can the letters of the word 'DETAIL' be arranged in such a way that the vowels occupy only the odd positions?

- A. 32 B. 48 C. 36 D. 60 E. 120

Ans: C



Permutation & Combination

Q. From a group of 7 men and 6 women, five persons are to be selected to form a committee so that at least 3 men are there on the committee. In how many ways can it be done?

- A. 564 B. 645 C. 735 D. 756 E. None of these

Soln:

We may have (3 men and 2 women) or (4 men and 1 woman) or (5 men only).

Required number of ways = $({}^7C_3 \times {}^6C_2) + ({}^7C_4 \times {}^6C_1) + ({}^7C_5)$

$$\begin{aligned} &= \left(\frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{6 \times 5}{2 \times 1} \right) + ({}^7C_3 \times {}^6C_1) + ({}^7C_2) \rightarrow [\text{using } {}^nC_r = {}^nC_{(n-r)}] \\ &= 525 + \left(\frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{6}{1} \right) + \left(\frac{7 \times 6}{2 \times 1} \right) \\ &= 525 + 210 + 21 \\ &= 756 \end{aligned}$$

Ans: D



Permutation & Combination(Assignment)

Q. In a group of 6 boys and 4 girls, four children are to be selected. In how many different ways can they be selected such that at least one boy should be there?

- A. 159 B. 194 C. 205 D. 209 E. None of these

Soln:

(1 boy and 3 girls) or (2 boys and 2 girls) or (3 boys and 1 girl) or (4 boys).

$$= ({}^6C_1 \times {}^4C_3) + ({}^6C_2 \times {}^4C_2) + ({}^6C_3 \times {}^4C_1) + ({}^6C_4)$$

$$= ({}^6C_1 \times {}^4C_1) + ({}^6C_2 \times {}^4C_2) + ({}^6C_3 \times {}^4C_1) + ({}^6C_2) \quad \rightarrow \text{using } {}^nC_r = {}^nC_{(n-r)} \text{ (to reduce calculation)}$$

$$= (6 \times 4) + \left(\frac{6 \times 5}{2 \times 1} \times \frac{4 \times 3}{2 \times 1} \right) + \left(\frac{6 \times 5 \times 4}{3 \times 2 \times 1} \times 4 \right) + \frac{6 \times 5}{2 \times 1}$$

$$= (24 + 90 + 80 + 15)$$

$$= 209$$

Ans: D



Permutation & Combination(Assignment)

Q. How many 4-letter words with or without meaning, can be formed out of the letters of the word, 'LOGARITHMS', if repetition of letters is not allowed?

- A. 40
- B. 400
- C. 5040
- D. 2520

Ans: C



Permutation & Combination(Assignment)

Q. In how many different ways can the letters of the word 'MATHEMATICS' be arranged so that the vowels always come together?

- A. 10080
- B. 4989600
- C. 120960
- D. None of these

Ans: C



Permutation & Combination(Assignment)

Q. In how many different ways can the letters of the word 'OPTICAL' be arranged so that the vowels always come together?

- A. 120
- B. 720
- C. 4320
- D. 2160
- E. None of these

Ans: B



Permutation & Combination(Assignment)

Q. How many Permutations of the letters of the word APPLE are there?

A.600 B.120 C.240 D.60

Ans: D



Permutation & Combination(Assignment)

Q. How many different words can be formed using all the letters of the word ALLAHABAD?

A.7560

B.7890

C.7650

D. None of these

Ans: A



Permutation & Combination(Assignment)

Q. Find the value of ${}^{50}P_2$

- A. 4500
- B. 3260
- C. 2450
- D. 1470

Ans : C



Permutation & Combination(Assignment)

Q. How many words can be formed by using letters of the word 'DELHI'?

- a. 50
- b. 72
- c. 85
- d. 120

Ans : D



Permutation & Combination(Assignment)

Q. Find the number of ways the letters of the word 'RUBBER' can be arranged?

- A. 450
- B. 362
- C. 250
- D. 180

Ans: D



Permutation & Combination(Assignment)

Q. Out of 5 consonants and 4 vowels, how many words of 3 consonants and 2 vowels can be formed?

- A. 60
- B. 200
- C. 5230
- D. 7200

Ans : D



Permutation & Combination(Assignment)

Q. In how many ways can a group of 5 men and 2 women be made out of a total of 7 men and 3 women?

- A. 63
- B. 90
- C. 126
- D. 45
- E. 135

Ans: A



Races

Races

- A contest of speed in running, riding, driving, sailing or rowing is called a race.
- If in a race Ram is at starting point & Shyam starts from 20 mts ahead, then it is said that Ram has given Shyam a start of 20 mts or Ram gives Shyam 20 mts.
- This means that if they start from same point Ram would beat Shyam by 20 mts.



Races

Q. In a 100 mt race A gives B a start of 25 mt & still wins by 9 sec. Find the speed of A if speed of B is 6 kmph.

A. 8 kmph

B. 9 kmph

C. 10 kmph

D. 12 kmph

Soln

!-----100 m-----!

A<---25--->B<-----75m-----> A=t-9, B=t

$$S_b = 6 \text{ kmph} = 6 \times \frac{5}{18} = \frac{5}{3} \text{ m/s}$$

$$T_b = D_b / S_b = 75 / (\frac{5}{3}) = 45 \text{ sec}$$

$$T_a = T_b - 9 = 36 \text{ sec}$$

$$\begin{aligned} S_a &= D_a / T_a \\ &= 100 / 36 \text{ m/s} \\ &= 100 / 36 \times \frac{18}{5} \\ &= 10 \text{ kmph} \end{aligned}$$

Ans C



Races

Q. In a 100 m race A beat B by 10 m & C by 20 m. By how many metres will B beat C

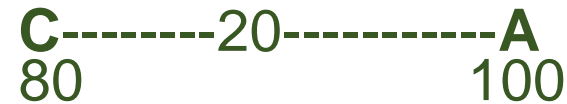
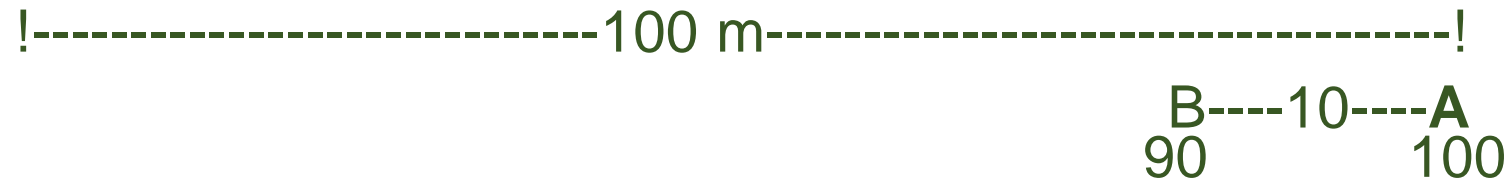
A. 8.08 m

B. 9.09 m

C. 10.10 m

D. 11.11 m

Soln



	A		B		C
Distance	100	:	90	:	80
			100	:	?

So when B covers 100 mts C covers $= 80 \times 100/90$
 $= 800/9$ m.

So B beats C by $100 - 800/9 = 100/9 = 11.11$ m.

Ans D



Races(Assignment)

Q. In a 100 m race, A can beat B by 25 m and B can beat C by 4 m. In the same race, A can beat C by:

A. 21 m

B. 26 m

C. 28 m

D. 29 m

• **Soln:-**

$$A : B = 100 : 75$$

$$B : C = 100 : 96$$

$$A:C=(\frac{A}{B}\times\frac{B}{C})=(\frac{100}{75}\times\frac{100}{96})=100:72$$

A beats C by $(100-72)=28$ m.

Ans: C



Circular Motion

- Use of both relative speed & LCM
- Let S_a, S_b = speeds of two persons.

S_r = Their relative speed

Distance traveled in 1 round = circumference

Case A : Both running in Same direction

Both meet again first time when \rightarrow **Time = dist/ S_r = Circumference/ $S_a - S_b$**

Case B : Both running in opposite directions(**DistA+ DistB =Circumference**)

Both meet first time when \rightarrow **Time = Circumference/ $S_a + S_b$**

Case C : Both running in same/opposite directions

Both meet again at starting point at LCM of their Lap times.



Circular Motion(Races)

Q. Two friends P & Q start from same point at the same time on a circular track 336 meters long in opposite directions at 6 m/s & 8 m/s respectively. After how much time will they meet again at the starting point for the first time?

A. 56 sec

B. 112 sec

C. 168 sec

D. 214 sec

Ans : C

Step1 – find the time taken by each member /player to complete 1 round

Step2 – Calculate LCM(Lap time)

$$\text{LapTm(P)} = \frac{\text{Circumference}}{S_p} = \frac{336}{6} = 56 \text{ sec}$$

$$\text{LapTm(Q)} = \frac{\text{Circumference}}{S_Q} = \frac{336}{8} = 42 \text{ sec}$$

$$\text{LCM}(42,56) = 168 \text{ sec}$$



Circular Motion(Assignment)

Q. A, B & C start together running along a circular track of 500 m at 8 km/hr, 5 km/hr & 3 km/hr respectively. After how much time will all three meet again at the starting point for the first time?

A. 20 min

B. 24 min

C. 30 min

D. 36 min

Ans: C



IMPORTANT FORMULAE

- **I.1.**Area of a rectangle=(length x breadth)
- Therefore length = (area/breadth) and breadth=(area/length)
- **2.**Perimeter of a rectangle = 2 x (length + breadth)

- **II.**Area of a square = (side)² =1/2(diagonal)²
- **III** Area of four walls of a room = 2*(length + breadth)*(height)

- **IV** 1.Area of the triangle=1/2(base*height)
- 2. Area of a triangle = (s*(s-a)(s-b)(s-c))^(1/2), where a,b,c are the sides of a triangle & s= ½(a+b+c)
- 3.Area of the equilateral triangle =((3^{1/2})/4)*(side)²



IMPORTANT FORMULAE

- **V.1.**Area of the parellogram =(base *height)
- 2.Area of the rhombus= $\frac{1}{2}$ (product of the diagonals)
- 3.Area of the trapezium= $\frac{1}{2}$ (size of parallel sides)*distance between them.

- **VI** 1.Area of a circle = πr^2 ,where r is the radius
- 2. Circumference of a circle = $2\pi R$.
- 3. Length of an arc = $\frac{2\pi R\theta}{360}$ where θ is the central angle
- 4. Area of a sector = $\frac{1}{2}$ (arc x R) = $\frac{\pi R^2 \theta}{360}$.

- **VII.** 1. Area of a semi-circle = $\frac{\pi R^2}{2}$.
- 2. Circumference of a semi-circle = πR .
- where, **π** = 3.142



VOLUME AND SURFACE AREA – IMPORTANT FORMULAE

- **I. CUBOID**

- Let length = l, breadth = b and height = h units. Then,
- **1. Volume** = (l x b x h) cubic.units.
- **2. Surface area** = $2(lb + bh + lh)$ sq.units.
- **3. Diagonal** = $\sqrt{l^2 + b^2 + h^2}$ units

- **II. CUBE**

- Let each edge of a cube be of length a. Then,
- **1. Volume** = a^3 cubic units.
- **2. Surface area** = $6a^2$ sq. units.
- **3. Diagonal** = $\sqrt{3} a$ units.

- **III. CYLINDER**

- Let radius of base = r and Height (or length) = h. Then,
- **1. Volume** = ($\pi r^2 h$) cubic units.
- **2. Curved surface area** = ($2\pi rh$). units.
- **3. Total surface area** = $2\pi r (h+r)$ sq. units



VOLUME AND SURFACE AREA – IMPORTANT FORMULAE

- **IV. CONE**

- Let radius of base = r and Height = h . Then,
- **1. Slant height, $l = \sqrt{h^2 + r^2}$**
- **2. Volume** = $(1/3) \pi r^2 h$ cubic units.
- **3. Curved surface area** = (πrl) sq. units.
- **4. Total surface area** = $(\pi rl + \pi r^2)$ sq. units.

- **V. SPHERE**

- Let the radius of the sphere be r . Then,
- **1. Volume** = $(4/3) \pi r^3$ cubic units.
- **2. Surface area** = $(4 \pi r^2)$ sq. units.

- **VI. HEMISPHERE**

- Let the radius of a hemisphere be r . Then,
- **1. Volume** = $(2/3) \pi r^3$ cubic units.
- **2. Curved surface area** = $(2 \pi r^2)$ sq. units.
- **3. Total surface area** = $(3 \pi r^2)$ units.



Surds and Indices

○ Rules of Indices: -

- i. $a^n * a^m = a^{m+n}$
- ii. $\frac{a^m}{a^n} = a^{m-n}$
- iii. $(a^n)^m = a^{mn}$
- iv. $(ab)^n = a^n * b^n$
- v. $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
- vi. $a^0 = 1$ (where $a \neq 0$)
- vii. $a^{-n} = \frac{1}{a^n}$

○ Rules of Surds: -

- i. $\sqrt[n]{a} = a^{\frac{1}{n}}$
- ii. $\sqrt[n]{ab} = a^{\frac{1}{n}} * b^{\frac{1}{n}}$
- iii. $\sqrt[n]{\frac{a}{b}} = \frac{a^{\frac{1}{n}}}{b^{\frac{1}{n}}}$
- iv. $\left(\sqrt[n]{a}\right)^n = a$
- v. $\left(\sqrt[n]{a}\right)^m = a^{\frac{m}{n}}$



