

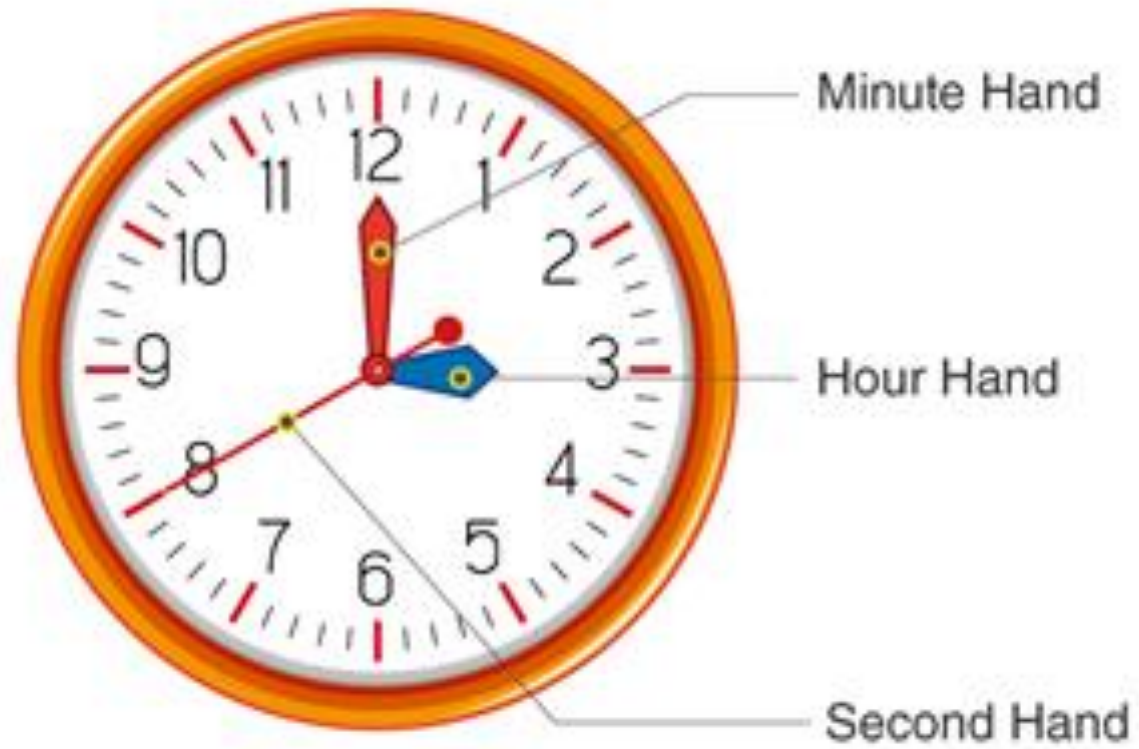


GENERAL APTITUDE

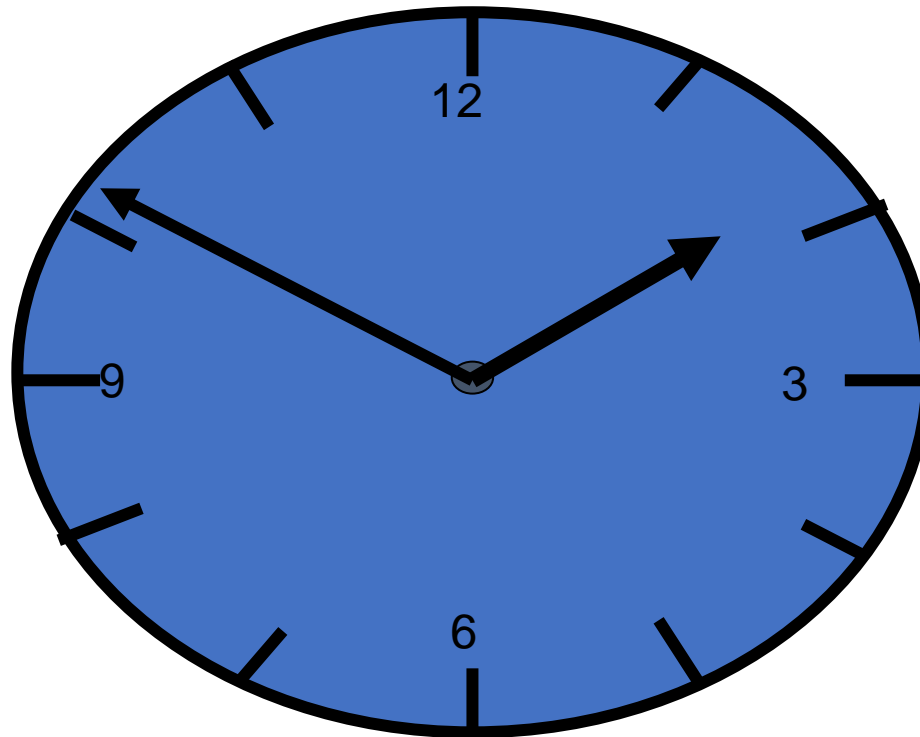
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Clocks



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

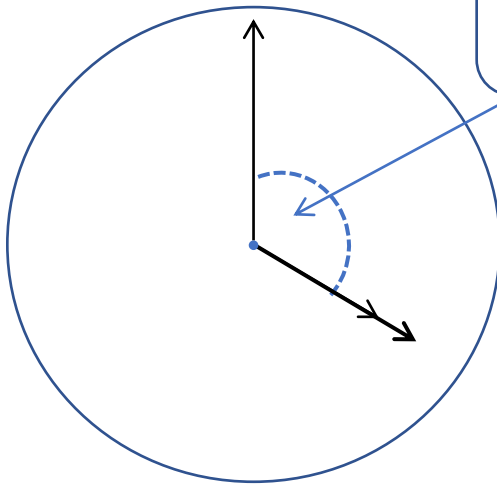
Q. At what time between 4 and 5 o'clock will the hands of a watch be together/coincide?

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 $D = 20$

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



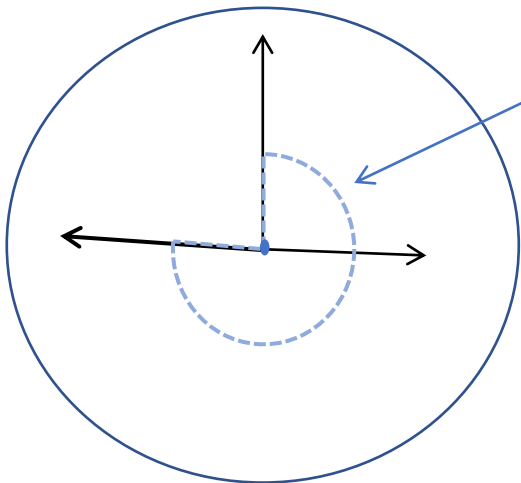
Clocks

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 $D = 45$

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



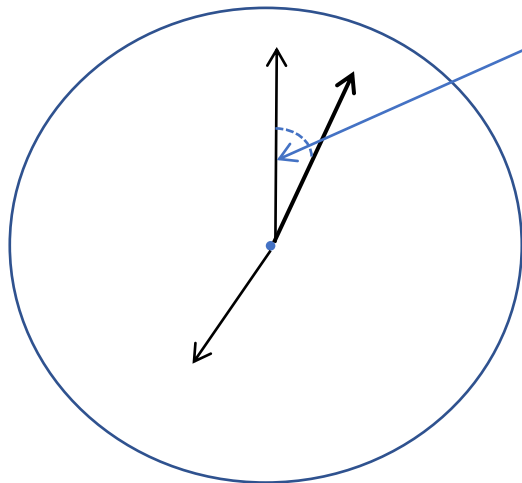
Clocks

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:

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

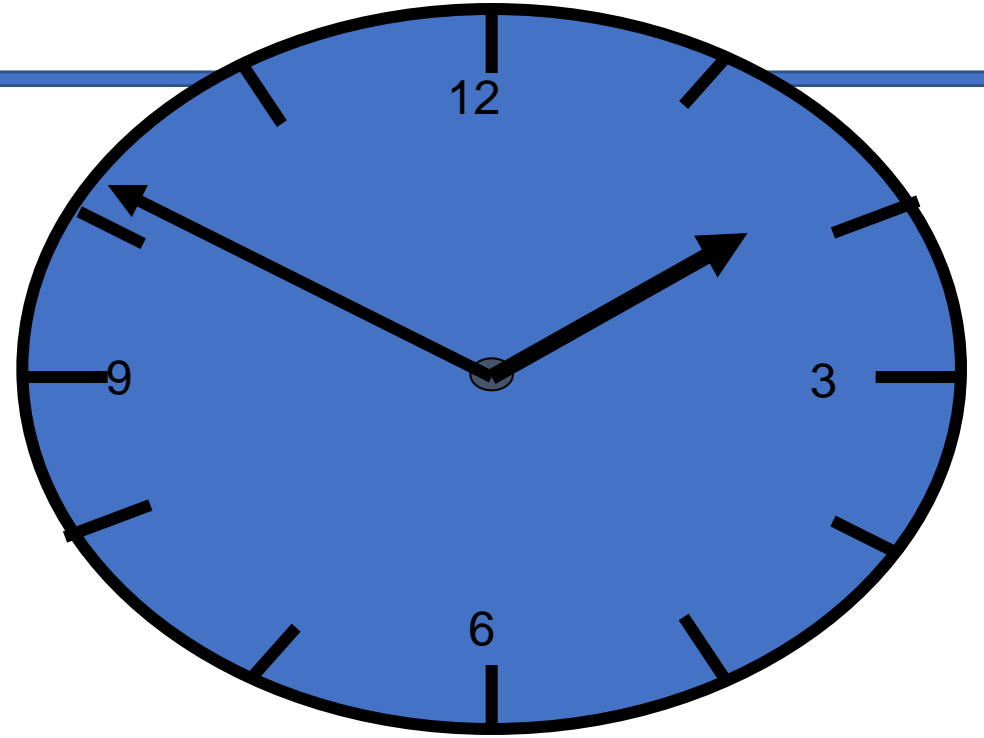
But reflex angle is greater than 180° and less than 360°

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



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 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 gain 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

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

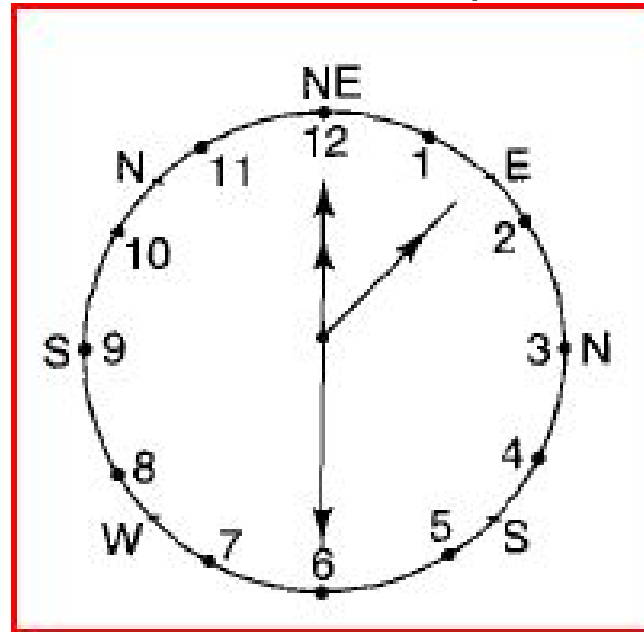
B. East

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.



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. Out of 100 balls we choose 98 balls

Note – if no. of ball we need to choose is less (instead of reducing 98 times we just subtract 100-98)

$${}^{100}C_{98} = 100 - 98 = 2$$

$${}^{100}C_2 = \frac{100 \times 99}{1 \times 2} = 4950$$

Q. Out of 200 balls we choose 197 balls

$${}^{200}C_{197} = 200 - 197 = 3$$

$${}^{200}C_3 = \frac{200 \times 199 \times 198}{1 \times 2 \times 3} = 1313400$$



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



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= $1/2$ (product of the diagonals)
- 3.Area of the trapezium= $1/2$ (size of parallel sides)*distance between them.

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

- **VII.** 1. Area of a semi-circle = $(\pi) * R^2$.
- 2. Circumference of a semi-circle = $(\pi) * R$.
- 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.



