Clock and faulty clock concepts

This concept improves time-based problem-solving, logical reasoning, and analytical thinking, especially in time-related challenges. Commonly asked in Cognizant, Amazon, Cisco, VISA, etc.

Types of problems in clock

1. Finding the angle between two hands of a clock when we are given time.
2. Finding the time when we are given with angle between two hands of a clock.
3. Faulty clock (clock gaining or losing).

Key points to remember

a) Hour hand covers a distance of 360° in 12 hours.
b) Hour hand covers a distance of 30° in 1 hour.
c) Hour hand covers a distance of 0.5° in 1 minute
d) Minute hand covers a distance of 360° in 60 minutes.
e) Minute hand covers a distance of 6° in 1 minute.
f) Relative speed between two hands of a clock = 6°/min – 0.5°/min = $\frac{11^\circ}{2}$/min.

1. **Finding the angle between two hands of a clock when time is given.**

Question1 : Find the central angle between two hands of a clock at 4:20?

Solution: Step-1 : At 4:00, the gap between hour hand and minute hand is 4 hour and every hour, hour hand will make an angle of 30°, So angle at 4:00 will be 30°x4 = 120°

Step-2 : Now in 20 minutes, minute hand will move $20\text{x}\frac{11}{2}$ since the speed of minute hand is $\frac{11^\circ}{2}$/min.

$20\text{x}\frac{11}{2} = 110^\circ$

Therefore, the angle is 120° - 110° = 10°

Question2: Find the central angle between two hands of a clock at 8:30?

Solution: Step-1 : At 8:00, the gap between hour hand and minute hand is 8 hour and every hour, hour hand will make an angle of 30°, so angle at 8:00 is 30°x8 = 240°

Step-2 : Now in 30 minutes, minute will move $30\text{x}\frac{11}{2}$ since the speed of minute hand is $\frac{11^\circ}{2}$/min.

$30\text{x}\frac{11}{2} = 165^\circ$

Therefore, the angle is 240° - 165° = 75°

2. Finding the time when we are given with angle between two hands of a clock.

Coincide

Question1: How many times in a day the two hands of clock coincide with each other?

Solution: The minute hand and hour hand meet once in every hour but in 12 hours they will coincide 11 times only because they miss once between 11 and 1. So, if in 12 hours they coincide 11 times. In 24 hours, they will coincide 22 times.

Hence the answer is 22 times

Question2: At what time between 5 and 6 'o'clock the two hands of a clock coincide?

Solution: First find the angle between two hands of a clock at 5 'o'clock in clockwise direction and it will be 30°x5 = 150°.

Considering 150° a relative distance uses relative speed to catch up with the hour hand.

So, $\frac{150°}{11/2}$ = 150° x $\frac{2}{11}$ = $\frac{300}{11}$ = $27\frac{3}{11}$ minutes past 5 'o'clock.

In opposite direction

Question1: How many times in a day the two hands of a clock are in opposite direction?

Solution: The minute hand and hour hand are in opposite direction once in every hour but in 12 hours they will be opposite 11 times only because they miss once between 5 and 7. So, if in 12 hours they are 11 times in opposite direction. In 24 hours, they will be 22 times in opposite direction.

Question2: At what time between 10 and 11 the two hands of a clock are in opposite direction?

Solution: First find the angle between two hands of a clock at 10 'o'clock in clockwise direction and it will be 30°x10 = 300°.

Now, considering hour hand at 10, the minute hand should be at 4 to make the minute hand in opposite direction, the relative distance should be = 30° x 4 = 120° is to be covered with relative speed.

Therefore, the answer should be $\frac{120°}{11/2}$ = $\frac{240}{11}$ = $21\frac{9}{11}$ min past 10 'o'clock.

Make right angles

Question1: How many times in a day the two hands of a clock make right angles?

Solution: The minute hand and hour hand make right angle twice in every hour but in 12 hours they will make only 22 right angles because they miss once between 2 and 4 and once between 8 and 10. So, if in 12 hours they make 22 right angles. In 24 hours, they will make 44 right angles.

Question2: At what times between 7 and 8 'o'clock the two hands of clock make right angles?

Solution: there will be two right angles one is clockwise and other once is anti-clockwise.

Considering that hour hand is at 7, to make a 90-degree angle with the hour hand, the minute hand has to be at 4 or 10.

For the first right angle, the minute hand has to cover a relative distance of (4x30) = 120°.
For the 2nd right angle, the minute hand has to cover a relative distance of (10*30)= 300°.

We have discussed earlier that the relative speed between the two hands is of $\frac{11°}{2}$ per minute.

Therefore, time required for 1st angle = $\frac{120}{11/2} = \frac{240}{11} = 21\frac{9}{11}$ minutes past 7 'o'clock.

Time required for 2nd angle = $\frac{300°}{11/2} = \frac{600°}{11} = 54\frac{6}{11}$ minutes past 7 'o'clock.

Some key points to remember

- Both the hands coincide once. In 12 hours, they will coincide 11 times. It happens due to only one such incident between 11 and 1'o clock.
- The hands are in the same straight line when they are coincident or opposite to each other.
- When the two hands are at a right angle, they are 15-minute spaces apart. In one hour, they will form two right angles and in 12 hours there are only 22 right angles. It happens due to right angles formed by the minute and hour hand at 3'o clock and 9'o clock.
- When the hands are in opposite directions, they are 30-minute spaces apart.
- If both the hour hand and minute hand move at their normal speeds, then both the hands meet after $65\frac{5}{11}$ minutes.

Faulty clock

A clock which shows incorrect time is a faulty or defective clock. Candidates will be questioned based on the same. For example, if a clock indicates 4 hours 10 minutes when the correct time is 4, then the clock is gaining, whereas if it indicates 4:40 when the correct time is 5, then the clock is losing. There are two types of problems in faulty clock:

1. When true time is given, and we have to find the faulty time.
2. When faulty time is given, and we have to find true time.

Question1: A clock is gaining 5 seconds in every 3 minutes. It was correct at 7:00 AM, what time it will show at 7:00 PM of the same day?

Solution: To solve this question, first calculate the rate of gain which is $\frac{5\,sec}{180\,sec} = \frac{1}{36}$

Now, total time from 7:00 AM to 7:00 PM is 12 hours or 12 x 60 = 720 minutes.

Time gained = $\frac{1}{36}$ x 720 = 20 minutes

Therefore, the clock will show 20 minutes more than the original time which is 7:20 PM.

Question2: A clock is losing 5 seconds in every 1 minutes. It was correct at 5:00 AM, what time it will show at 11:00 AM of the same day?

Solution: To solve this question, first calculate the rate of gain which is $\frac{5\,sec}{60\,sec} = \frac{1}{12}$

Now, total time from 7:00 AM to 11:00 AM is 6 hours or 6 x 60 = 360 minutes.

Time lost = $\frac{1}{12}$ x 360 = 30 minutes

Therefore, the clock will show 30 minutes less than the original time which is 10:30 AM.

Question3: A clock is gaining 5 seconds in every 3 minutes. It was correct at 7:00 AM, What is the true time if the clock is showing quarter past 4 'o'clock of same day?

Solution: To solve this question, first calculate the rate of gain which is $\frac{5\,sec}{180\,sec} = \frac{1}{36}$

Now, if we are not given with true time, we can make one equation:

True time + gain = time with gain

Time with gain = 9 hr, 15 min or 9 x 60 + 15 = 555 minutes, here quarter past 4 is 4:15.

Assuming true time is x

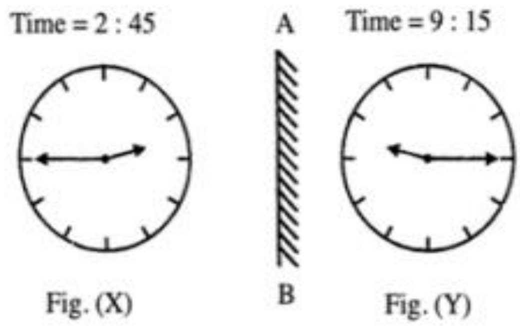
$x + \frac{1}{36}x$ = 555 minutes

$\frac{37}{36}x$ = 555 x = 555 x $\frac{36}{37}$ = 540 minutes

Therefore, if true time is 540 minutes and clock is showing 555 minutes. It means there is a gain of 15 minutes. If with gain clock is showing 4:15, the correct time should be 4:00.

Mirror image of a clock

The image of an object as seen in a mirror is its mirror reflection or mirror image. In such an image, the right side of the object appears on the left side and vice versa. A mirror-image is therefore said to be laterally inverted and the phenomenon is called the lateral inversion.



Water image

A water image is a reflection of an object in water that appears upside down. It is created when light reflects off the surface of water.