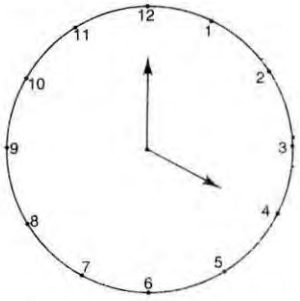
UNIT 17

Problems on Clocks

1. A day is defined as the average time in which the earth completes one full round about its axis. There are 24 hours in a day. The machine that measures time is called a clock or a watch. The face of the watch is known as a dial which is in the form of circle. The circumference of the circle is divided into sixty equal parts and each part is called a minute.



2. The clock has two hands–*a minute hand* and *an hour hand*. The minute hand (M.H.) is also called the longer hand and the hour hand is called the smaller hand. The minute hand of the clock moves 12 times as fast as the hour hand, because in an hour, the minute hand moves 60 minutes where as an hour hand moves only 5 minutes. Clearly we find that the minute hand moves 55 minutes more than the hour hand i.e. in 60 minutes and the minute hand gains 55 minutes. Thus, in order to gain 1 minute over the hour hand, the minute hand moves $\frac{60}{55}$ minutes or $\frac{12}{11}$ minutes.
3. The minute hand moves through 6° in a minute and the hour hand moves through only $\frac{1^\circ}{2}$ in a minute.
4. In every hour, the hands of a clock coincide once and in 12 hours the hands coincide 11 times. This is because from 11 o'clock to 1 o'clock, the hands coincide only once i.e. at 12 o'clock. Thus in 24 hours i.e. in a day, the hands coincide 22 times.
5. The hands of a clock are straight, but not together, i.e. they are opposite each other once in every hour and in 12 hours time, the hands are straight 11 times. This is because between 5 o'clock and 7 o'clock, the hands are straight only once i.e. at 6 o'clock. Thus the hands are 22 times in the opposite direction in 24 hours or in a day. Clearly in this situation, the hands are 30 minutes apart.
6. When the hands are at right angles, they are 15 minutes apart. In every hour, the hands are at right angles twice and 22 times in 12 hours. This is due to the fact that in 12 hours, the hands are at right angles where the time is 3 o'clock and 9 o'clock. Between 2 o'clock and 4 o'clock the hands are at right angle 3 times

as 3 o'clock position is a common one. Similarly between 8 o'clock and 10 o'clock the hands are at right angles 3 times as 9 o'clock position is a common one. Thus in a day i.e. in 24 hours, the hands are at right angles 44 times.

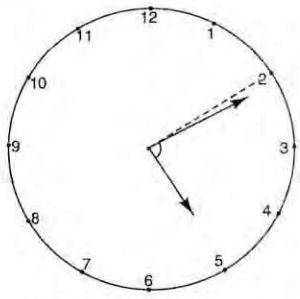
7. **Reflection of the clock in a mirror when it is in the front:** The logic of mirror reflection is that the left side object shifts to the right and vice versa. It is clear that in a clock, the numbers 1 and 11; 2 and 10; 3 and 9; 4 and 8; 5 and 7 are opposite to one another. So when the time is 4 o'clock by the watch, its reflection time in the mirror is 8 o'clock, when the time is 4:30 in the clock, its reflection time is 7:30. So there is a very simple short cut for such questions. "Whatever is the time whether actual or reflection time, subtract it from 12 to get the other time."

Example 1. Between 2 o'clock to 10 o'clock, how many times the hands of a clock are at right angle?

(a) 14 (b) 12
(c) 16 (d) 15

Sol: Between 2 and 4 o'clock; 8 and 10 o'clock, the hands are at right thrice in each case. Between 4 and 8 o'clock, the hands are at right angles. So total number of times the hands are at right angles $= 3 + 3 + (2 \times 4) = 14$. Hence, the answer is (a).

Example 2. Find the angle between the hour hand and the minute hand of a clock when the time is 2:25.



Sol: At 2:25, the hands of a clock are shown in the diagram. At 2 o'clock, the hour hand is at 2. In next 25 minutes hour hand has moved $25 \times \frac{1^\circ}{2}$ i.e. $12\frac{1^\circ}{2}$. Angle between 2 and 5 is 90°. Thus the required angle is $90^\circ - 12\frac{1^\circ}{2} = 77\frac{1^\circ}{2}$.

Ans: $77\frac{1^\circ}{2}$.

Example 3. Between 1 o'clock and 2 o'clock, find the time when the minute hand and an hour hand are

(a) coinciding
(b) straight i.e. in opposite direction
(c) at angle of 90° for the first time.

Sol: (a) At 1 o'clock, the minute hand is 5 minutes behind the hour hand. The minute hand gains 5 minutes in $5 \times \frac{12}{11}$ minutes i.e. in $5\frac{5}{11}$ minutes. Thus the hands will coincide at $5\frac{5}{11}$ minutes past 1 o'clock.

(b) When the hands are in opposite direction, the difference is 30 minutes. So the minute hand has to gain (5 + 30) min. i.e. 35 minutes which it can do in $35 \times \frac{12}{11}$ minutes i.e. $38\frac{2'}{11}$. The time is $38\frac{2}{11}$ minutes past 1 o'clock.

(c) When the hands are at right angle, they are 15 minutes apart. So the hands are at right angle for the first time when the minute hand will gain (5 + 15) minutes i.e. 20 minutes and it can do it in $20 \times \frac{12}{11}$ minutes i.e. in $21\frac{9}{11}$ minutes. The time will be $21\frac{9'}{11}$ past 1 o'clock.

Example 4. A wall clock takes 10 seconds to strike 6. How much time it will take to strike 12.

Sol: Between 1 o'clock to 6 o'clock there are 5 gaps of time.

Now 5 intervals of time takes 10 seconds so 1 interval of time takes 2 seconds, i.e. we hear the strike in a clock after every 2 seconds. Now 12 strikes will have 11 intervals which takes 11×2 i.e. 22 seconds.

Example 5. A mirror is placed in front of the clock. The clock shows time 5:40. What will be its reflection in the mirror?

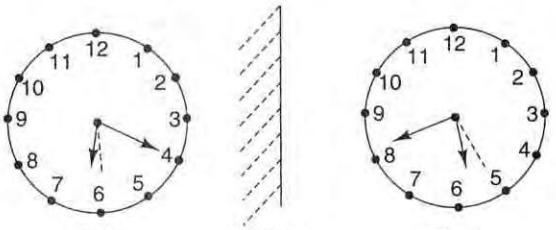


Fig. 2 Fig. 1

Sol: Figure 1 is the clock that shows time 5:40. On its left-side a mirror is placed and Fig. 2 is the reflection figure of Fig. 1.
Clearly time seems to be 6:20.
Short cut: Subtract 5:40 from 12, we get 6:20.

EXERCISE

1. How many times in a day, the two hands of a clock coincide?
   (a) 11 (b) 12
   (c) 22 (d) 24
2. How many times in a day, the two hands of a clock are at 90°?
   (a) 4 (b) 12
   (c) 22 (d) 44
3. How many times in a day the hands of the clock are in a straight line but not together?
   (a) 24 (b) 22
   (c) 12 (d) 11
4. When the clock shows time 25 minutes past 2, the angle between the hands is:
   (a) 75° (b) $67\frac{1^\circ}{2}$
   (c) $77\frac{1^\circ}{2}$ (d) 65°
5. When the time by the watch is 20 minutes past 7, the angle between the hands of the watch is:
   (a) 100° (b) 90°
   (c) 80° (d) 95°
6. The time by my watch is 10 minutes to 7, find the angle between the hour hand and the minute hand.
   (a) 110° (b) 120°
   (c) 105° (d) 95°
7. Find the angle between the hands of a clock when the time is 3.25.
   (a) 60° (b) $47\frac{1^\circ}{2}$
   (c) $52\frac{1^\circ}{2}$ (d) $55\frac{1^\circ}{2}$
8. Find the angle between the hour hand and the minute hand of a clock when the time is 25 minutes to 8
   (a) $12\frac{1^\circ}{2}$ (b) $17\frac{1^\circ}{2}$
   (c) 20° (d) $22\frac{1^\circ}{2}$
9. When the time is 4.20, the angle between the hands of the clock is:
   (a) 20° (b) 15°
   (c) $12\frac{1^\circ}{2}$ (d) 10°
10. The reflex angle between the hands of the clock at 10:25 is:
    (a) 180° (b) $192\frac{1^\circ}{2}$
    (c) 195° (d) $197\frac{1^\circ}{2}$
11. At what time between 2 and 3 o'clock will the hands of a clock be together?
    (a) $10\frac{10}{11}$ min. past 2 (b) $11\frac{10}{11}$ min. past 2
    (c) $13\frac{10}{11}$ min. past 2 (d) $7\frac{10}{11}$ min. past 2
12. At what time between 4 and 5 o'clock will the hands of a clock be at right angle for the first time?
    (a) $9\frac{5}{11}$ min. past 4 (b) $5\frac{5}{11}$ min. past 4

(c) $11\frac{5}{11}$ min. past 4 (d) $9\frac{7}{11}$ min. past 4

13. Find the time between 8 and 9 o'clock when the hands of clock be in the same straight line but not together.

(a) $10\frac{9}{11}$ min. past 8 (b) $10\frac{10}{11}$ min. past 8

(c) $11\frac{10}{11}$ min. past 8 (d) none of these

14. If a mirror is placed opposite to a clock and the time shown in the clock is 4:30, then what will be time in the mirror's clock?

(a) 8:30 (b) 9:30

(c) 7:30 (d) 4:30

15. At 12 o'clock, the minute hand is point East. At 4:30, in which direction will the hour hand point?

(a) North-west (b) South-east

(c) South (d) South-west

16. Between 4 and 5 o'clock, when the hands will be inclined at 60° for the first time?

(a) $10\frac{10}{11}$ min. past 4 (b) $11\frac{10}{11}$ min. past 4

(c) 12 min. past 4 (d) $9\frac{10}{11}$ min. past 4

17. The wall clock takes 6 seconds to strike 4, how much time it will take to strike 12?

(a) 18 seconds (b) 20 seconds

(c) 22 seconds (d) 24 seconds

18. The clock shows time 12 minutes past 8 o'clock. Find its reflection time if the mirror is place in front of the clock.

(a) 4:12 (b) 4:24

(c) 3:48 (4) 4:48

19. A wall clock strike 12 and it takes 33 seconds to do so. How much time it will take to strike 4?

(a) 9 seconds (b) 10 seconds

(c) 11 seconds (d) 12 seconds

20. At what time between 5.30 and 6 will the hands of the clock be inclined at 90°?

(a) 45 min. past 5 (b) $43\frac{5}{11}$ min. past 5

(c) $43\frac{7}{11}$ min. past 5 (d) 40 min. past 5

ANSWERS

1. (c)	2. (d)	3. (b)	4. (c)	5. (a)
6. (d)	7. (b)	8. (b)	9. (d)	10. (d)
11. (a)	12. (b)	13. (b)	14. (c)	15. (d)
16. (a)	17. (c)	18. (c)	19. (a)	20. (c)