28 Clocks

IMPORTANT FACTS

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°.

Too Fast and Too Slow **:** *If a watch or a clock indicates 8.15, when the correct time is 8, it is said to be 15 minutes too fast.*

On the other hand, if it indicates 7.45, when the correct time is 8, it is said to be 15 minutes too slow.

Both the hands of a clock are together after every $65\frac{5}{11}$ min. So, if both the hands are meeting after an interval less than $65\frac{5}{11}$ min, the clock is running fast and if they meet after an interval greater than $65\frac{5}{11}$ min, the clock is running slow.

Interchange of Hands: Whenever the hands of the clock interchange positions (i.e., the minute hand takes the place of hour hand and the hour hand and takes the place of minute hand), the sum of the angles traced by hour hand and minute hand is 360°.

Suppose this happens after x minutes.

Angle traced by minute hand in x min = $(6x)°$.

Angle traced by hour hand in x min = $(0.5x)°$.

$\therefore\ 0.5x + 6x = 360 \Leftrightarrow 6.5x = 360 \Leftrightarrow x = \frac{3600}{65} = 55\frac{5}{13}$.

Thus, the hands of a clock interchange positions after every $55\frac{5}{13}$ minutes.

SOLVED EXAMPLES

Ex. 1. ***Find the angle between the hour hand and the minute hand of a clock when the time is 3.25.***

Sol. Angle traced by the hour hand in 12 hours = 360°.

Angle traced by it in 3 hrs 25 min., i.e.

$\frac{41}{12}\text{ hrs} = \left(\frac{360}{12}\times\frac{41}{12}\right)^\circ = 102\frac{1}{2}^\circ$.

Angle traced by minute hand in 60 min. = 360°.

Angle traced by it in 25 min. = $\left(\frac{360}{60}\times 25\right)^\circ = 150°$.

$\therefore$ Required angle = $\left(150° - 102\frac{1}{2}^\circ\right) = 47\frac{1}{2}^\circ$.

Ex. 2. ***At what time between 2 and 3 o'clock will the hands of a clock be together?***

Sol. At 2 o'clock, the hour hand is at 2 and the minute hand is at 12, i.e. they are 10 min. spaces apart.
To be together, the minute hand must gain 10 minutes over the hour hand.
Now, 55 minutes are gained by it in 60 min.

$\therefore$ 10 minutes will be gained in $\left(\frac{60}{55}\times 10\right)\text{min.} = 10\frac{10}{11}\text{min.}$

$\therefore$ The hands will coincide at $10\frac{10}{11}\text{min.}$ past 2.

Ex. 3. ***At what time between 4 and 5 o'clock will the hands of a clock be at right angle?***

Sol. At 4 o'clock, the minute hand will be 20 min. spaces behind the hour hand.
Now, when the two hands are at right angles, they are 15 min. spaces apart.
So, they are at right angles in following two cases.

Case I. *When minute hand is 15 min. spaces behind the hour hand* :
In this case min. hand will have to gain (20 – 15) = 5 minute spaces.
55 min. spaces are gained by it in 60 min.

5 min. spaces will be gained by it in $\left(\frac{60}{55}\times 5\right)\text{min.} = 5\frac{5}{11}\text{min.}$

$\therefore$ They are at right angles at $5\frac{5}{11}\text{min.}$ past 4.

Case II. *When the minute hand is 15 min. spaces ahead of the hour hand* :
To be in this position, the minute hand will have to gain (20 + 15) = 35 minute spaces.
55 min. spaces are gained in 60 min.
35 min. spaces are gained in

$\left(\frac{60}{55}\times 35\right)\text{min.} = 38\frac{2}{11}\text{min.}$

$\therefore$ They are at right angles at $38\frac{2}{11}\text{min.}$ past 4.

Ex. 4. ***Find at what time between 8 and 9 o'clock will the hands of a clock be in the same straight line but not together.***

Sol. At 8 o'clock, the hour hand is at 8 and the minute hand is at 12, i.e. the two hands are 20 min. spaces apart.
To be in the same straight line but not together they will be 30 minute spaces apart.
So, the minute hand will have to gain (30 – 20) = 10 minute spaces over the hour hand.
55 minute spaces are gained in 60 min.

10 minute spaces will be gained in $\left(\frac{60}{55}\times 10\right)\text{min.} = 10\frac{10}{11}\text{min.}$

$\therefore$ The hands will be in the same straight line but not together at $10\frac{10}{11}$ min. past 8.

Ex. 5. ***At what time between 5 and 6 o'clock are the hands of a clock 3 minutes apart?***

Sol. At 5 o'clock, the minute hand is 25 min. spaces behind the hour hand.

Case I. *Minute hand is 3 min. spaces behind the hour hand.*
In this case, the minute hand has to gain (25 – 3) = 22 minute spaces.
55 min. are gained in 60 min.

22 min. are gained in $\left(\frac{60}{55}\times 22\right)\text{min.} = 24\text{ min.}$

$\therefore$ The hands will be 3 min. apart at 24 min. past 5.

Case II. *Minute hand is 3 min. spaces ahead of the hour hand.*
In this case, the minute hand has to gain (25 + 3) = 28 minute spaces.

55 min. are gained in 60 min.

28 min. are gained in $\left(\frac{60}{55}\times 28\right) = 31\frac{5}{11}$ min.

$\therefore$ The hands will be 3 min. apart at $31\frac{5}{11}$ min. past 5.

Ex. 6. ***The minute hand of a clock overtakes the hour hand at intervals of 65 minutes of the correct time. How much a day does the clock gain or lose?*** **(M.A.T., 2003)**

Sol. In a correct clock, the minute hand gains 55 min. spaces over the hour hand in 60 minutes.

To be together again, the minute hand must gain 60 minutes over the hour hand.

55 min. are gained in 60 min.

60 min. are gained in $\left(\frac{60}{55}\times 60\right)\text{min.} = 65\frac{5}{11}\text{ min.}$

But, they are together after 65 min.

$\therefore$ Gain in 65 min. $= \left(65\frac{5}{11} - 65\right)\text{min.} = \frac{5}{11}\text{ min.}$

Gain in 24 hours $= \left(\frac{5}{11}\times\frac{60\times 24}{65}\right)\text{min.} = 10\frac{10}{43}\text{ min.}$

$\therefore$ The clock gains $10\frac{10}{43}$ minutes in 24 hours.

Ex. 7. ***A watch which gains uniformly, is 5 min. slow at 8 o'clock in the morning on Sunday and it is 5 min. 48 sec. fast at 8 p.m. on following Sunday. When was it correct?***

Sol. Time from 8 a.m. on Sunday to 8 p.m. on following Sunday = 7 days 12 hours = 180 hours.

$\therefore$ The watch gains $\left(5+5\frac{4}{5}\right)\text{min.}$ or $\frac{54}{5}\text{ min.}$ in 180 hrs.

Now $\frac{54}{5}$ min. are gained in 180 hrs.

$\therefore$ 5 min. are gained in $\left(180\times\frac{5}{54}\times 5\right)$hrs. = 83 hrs 20 min. = 3 days 11 hrs 20 min.

$\therefore$ Watch is correct 3 days 11 hrs 20 min. after 8 a.m. of Sunday.

$\therefore$ It will be correct at 20 min. past 7 p.m. on Wednesday.

Ex. 8. ***A clock is set right at 5 a.m. The clock loses 16 minutes in 24 hours. What will be the true time when the clock indicates 10 p.m. on 4th day?***

Sol. Time from 5 a.m. on a day to 10 p.m. on 4th day = 89 hours.

Now 23 hrs 44 min. of this clock = 24 hours of correct clock.

$\therefore$ $\frac{356}{15}$ hrs of this clock = 24 hours of correct clock.

89 hrs of this clock $= \left(24\times\frac{15}{356}\times 89\right)$hrs of correct clock = 90 hrs of correct clock.

So, the correct time is 11 p.m.

Ex. 9. ***A clock is set right at 8 a.m. The clock gains 10 minutes in 24 hours. What will be the true time when the clock indicates 1 p.m. on the following day?***

Sol. Time from 8 a.m. on a day to 1 p.m. on the following day = 29 hours.

24 hours 10 min. of this clock = 24 hours of the correct clock.

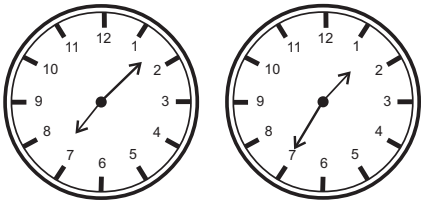
$\frac{145}{6}$ hrs of this clock = 24 hrs of the correct clock.

29 hrs of this clock $= \left(24\times\frac{6}{145}\times 29\right)$ hrs of the correct clock

= 28 hrs 48 min. of correct clock.

$\therefore$ The correct time is 28 hrs 48 min. after 8 a.m. This is 48 min. past 12.

Ex. 10. ***Rohan leaves home between 7 a.m. and 8 a.m. and returns between 1 p.m. and 2 p.m. to find that the minute and hour hands have interchanged their positions. How long was Rohan out of the house?***



Sol. Clearly, the hands will interchange positions after crossing each other 6 times i.e. they together will make (6 + 1) or 7 complete revolutions.

Since the hands interchange positions after every $55\frac{5}{13}$ minutes, we have:

Required time interval $= \left(55\frac{5}{13}\times 7\right)$ min $= \left(\frac{720}{13}\times 7\right)$ min $= \frac{5040}{13}$ min

$= 387\frac{9}{13}$ min $= 6$ hrs $27\frac{9}{13}$ min.

EXERCISE

(OBJECTIVE TYPE QUESTIONS)

Directions: ***Mark (✓) against the correct answer:***

1. London time is five and a half hours behind Delhi time. What time is it in London if it is 0.2.35 in Delhi? **(E.P.F.O.S.S.A., 2004)**

(*a*) 07.05 (*b*) 08.05

(*c*) 21.05 (*d*) 21.35

2. A bus leaves at 12.25 noon and reaches destination at 10.45 am. The duration of the journey is **(R.R.B., 2005)**

(*a*) 22 hrs 20 min (*b*) 22 hrs 40 min

(*c*) 24 hrs 20 min (*d*) 24 hrs 40 min

3. An accurate clock shows 80′ clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2O′ clock in the afternoon?

(*a*) 144° (*b*) 150°

(*c*) 168° (*d*) 180°

4. How many rotations will the hour hand of a clock complete in 72 hours? **(Bank Recruitment, 2006)**

(*a*) 3 (*b*) 6

(*c*) 9 (*d*) 12

5. Through what angle does the minute hand of a clock turn in 5 minutes? **(E.S.I.C., 2006)**

(*a*) 30° (*b*) 32°

(*c*) 35° (*d*) 36°

6. In an accurate clock, in a period of 2 hours 20 minutes the minute hand will move over

(*a*) 140° (*b*) 320°

(*c*) 520° (*d*) 840°

7. A clock is started at noon. By 10 minutes past 5, the hour hand has turned through

(*a*) 145° (*b*) 150°

(*c*) 155° (*d*) 160°

8. At 9:38 A.M, through how many degrees the hour hand of a clock moved since noon the previous day? **(SNAP, 2004)**

(*a*) 323 (*b*) 612

(*c*) 646 (*d*) 649

9. At 3.40, the hour hand and the minute hand of a clock form an angle of **(Hotel Management, 2004; Campus Recruitment, 2008)**

(*a*) 120° (*b*) 125°

(*c*) 130° (*d*) 135°

10. The angle between the minute hand and the hour hand of a clock when the time is 8.30, is **(R.R.B. 2006)**

(*a*) 80° (*b*) 75°

(*c*) 60° (*d*) 105°

11. The angle between the minute hand and the hour hand of a clock when the time is 4.20, is **(P.C.S., 2008)**

(*a*) 0° (*b*) 10°

(*c*) 5° (*d*) 20°

12. At what angle the hands of a clock are inclined at 15 minutes past 5? **(L.I.C.A.A.O., 2003)**

(*a*) $58\frac{1}{2}°$ (*b*) 64°

(*c*) $67\frac{1}{2}°$ (*d*) $72\frac{1}{2}°$

13. The reflex angle between the hands of a clock at 10.25 is

(*a*) 180° (*b*) $192\frac{1}{2}°$

(*c*) 195° (*d*) $197\frac{1}{2}°$

14. Match List I with List II and select the correct answer using the codes given below the lists:

List I (Time)		List II (Angle between hour hand and minute hand of a clock)	
A.	1.10 p.m.	1.	20°
B.	2.15 p.m.	2.	$22\frac{1}{2}°$
C.	8.40 p.m.	3.	24°
		4.	25°
		5.	30°

	A	B	C
(a)	4	2	1
(c)	5	2	1

	A	B	C
(b)	4	3	2
(d)	4	3	2

15. An accurate clock shows the time as 3.00. After the hour hand has moved 135°, the time would be
(a) 6.30 (b) 7.30
(c) 8.00 (d) 9.30

16. What is the area of the face of a clock described by its minute hand between 9 a.m. and 9.35 a.m; if the minute hand is 10 cm long? **(M.B.A., 2004)**
(a) $36\frac{2}{3}$ cm^2 (b) $157\frac{1}{7}$ cm^2
(c) $183\frac{1}{3}$ cm^2 (d) None of these

17. The hands of a clock are 10 cm and 7 cm respectively. The difference between the distance traversed by their extremities in 3 days 5 hours is **(M.A.T., 2006)**
(a) 4552.67 cm (b) 4555.67 cm
(c) 4557.67 cm (d) 4559.67 cm

18. The minute arm of a clock is 10 cm long. The number of minutes taken by the tip of the arm to travel a length of 10 cm is nearly equal to
(a) 5 (b) 10
(c) 15 (d) 20

19. At which time number of minutes elapsed since midnight is nine times the number of minutes before noon? **(R.R.B., 2006)**
(a) 8.30 a.m. (b) 6.56 a.m.
(c) 9.46 a.m. (d) 10.48 a.m.

20. How many times do the hands of a clock coincide in a day?
(a) 20 (b) 21
(c) 22 (d) 24

21. How many times in a day, the hands of a clock are straight? **(I.I.F.T., 2005)**
(a) 22 (b) 24
(c) 44 (d) 48

22. How many times are the hands of a clock at right angle in a day?
(a) 22 (b) 24
(c) 44 (d) 48

23. How many times in a day, are the hands of a clock in straight line but opposite in direction? **(R.R.B., 2003)**
(a) 20 (b) 22
(c) 24 (d) 48

24. How many times are the hour hand and the minute hand of a clock at right angles during their motion from 1.00 p.m. to 10.00 p.m.? **(I.A.S., 2009)**
(a) 9 (b) 10
(c) 18 (d) 20

25. A clock gains 5 minutes in one hour. Therefore, the angle traversed by the minute hand in 1 hour is
(a) 360° (b) 390°
(c) 390.5° (d) None of these

26. A clock strikes once at 1O′ clock, twice at 2O′ clock, thrice at 3O′ clock and soon. What is the total number of strikings in a day? **(R.R.B., 2006)**
(a) 136 (b) 146
(c) 156 (d) 166

27. A wall-clock takes 9 seconds in tringing at 9O′ clock. The time, it will take in tringing at 11O′ clock, is **(C.P.O., 2004)**
(a) 10 seconds (b) 10.80 seconds
(c) 11 seconds (d) 11.25 seconds

28. If a clock strikes six times in 5 seconds, the number of strikes in 10 seconds is
(a) 8 (b) 9
(c) 10 (d) 11

29. In every 30 minutes the time of a watch increases by 3 minutes. After showing the correct time at 5 a.m; what time will the watch show after 6 hours?
(a) 10 : 54 a.m. (b) 11 : 30 a.m.
(c) 11 : 36 a.m. (d) 11 : 42 a.m.
(e) 11 : 38 p.m. **(Bank P.O., 2009)**

30. A watch becomes fast by 5 minutes everyday. By what percent does it become fast? **(R.R.B., 2006)**
(a) $\frac{5}{24}\%$ (b) $\frac{1}{12}\%$
(c) 5% (d) $\frac{50}{144}\%$

31. A clock goes slow from midnight by 5 minutes at the end of the first hour, by 10 minutes at the end of the second hour, by 15 minutes at the end of the third hour and so on. What will be the time by this clock after 6 hours? **(S.S.C., 2002)**
(a) 5.15 a.m. (b) 5.30 a.m.
(c) 6 a.m. (d) 6.30 a.m.

32. A watch goes fast by 15 minutes compared to the right time everyday. If it is corrected and set to the standard time at 120' clock at noon, which of the following will be the time shown by it at 4 : 00 a.m. in the morning?
(a) 3 : 45 a.m. (b) 4 : 10 a.m.
(c) 4 : 15 a.m. (d) 4 : 30 a.m.

33. It is between 3 P.M. and 4 P.M. and the distance between the hour and the minute hand of clock is 18 minute spaces. What time does the clock show? **(R.R.B., 2006)**

(*a*) 3.12 P.M. (*b*) 3.27 P.M.
(*c*) 3.31 P.M. (*d*) 3.36 P.M.

34. At what time between 9 and 10 o'clock are the hands of a clock 23 minute spaces apart?

(*a*) 9 : 18 (*b*) 9 : 23
(*c*) 9 : 24 (*d*) 9 : 26

35. How much does a watch lose per day, if its hands coincide every 64 minutes? **(M.B.A. 2004, 05, 06; G.B.O., 2007; Campus Recruitment, 2008, 2010)**

(*a*) $32\frac{8}{11}$ min. (*b*) $36\frac{5}{11}$ min.
(*c*) 90 min. (*d*) 96 min.

36. At what time, in minutes, between 3 o'clock and 4 o'clock, both the needles will coincide each other? **(R.R.B., 2002)**

(*a*) $5\frac{1}{11}''$ past (*b*) $12\frac{4}{11}''$ past
(*c*) $13\frac{4}{11}''$ past (*d*) $16\frac{4}{11}''$ past

37. At what time between 9 and 10 o'clock will the hands of a watch be together?

(*a*) 45 min. past 9 (*b*) 50 min. past 9
(*c*) $49\frac{1}{11}$ min. past 9 (*d*) $48\frac{2}{11}$ min. past 9

38. At what time between 7 and 8 o'clock will the hands of a clock be in the same straight line but, not together? **(A.A.O. Exam., 2003)**

(*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

39. At what time between 4 and 5 o'clock will the hands of a watch point in opposite directions?

(*a*) 45 min. past 4 (*b*) 40 min. past 4
(*c*) $50\frac{4}{11}$ min. past 4 (*d*) $54\frac{6}{11}$ min. past 4

40. At what time between 5.30 and 6 will the hands of a clock be at right angles?

(*a*) $43\frac{5}{11}$ min. past 5 (*b*) $43\frac{7}{11}$ min. past 5
(*c*) 40 min. past 5 (*d*) 45 min. past 5

41. Henry started a trip into the country between 8 A.M. and 9 A.M. when the hands of clock were together. He arrived at his destination between 2 P.M. and 3 P.M. when the hands of the clock were exactly 180° apart. How long did he travel? **(SNAP, 2004)**

(*a*) 6 hours (*b*) 7 hours
(*c*) 9 hours (*d*) 11 hours

42. Imagine that your watch was correct at noon, but then it began to lose 30 minutes each hour. It now shows 4 p.m. but it stopped 5 hours ago. What is the correct time now? **(M.B.A. 2004)**

(*a*) 9.30 p.m. (*b*) 11 p.m.
(*c*) 1 a.m. (*d*) 1.30 a.m.

43. A mechanical grandfather clock is at present showing 7 hr 40 min 6 sec. Assuming that it loses 4 seconds in every hour, what time will it show after exactly $6\frac{1}{2}$ hours? **(M.B.A. 2004)**

(*a*) 14 hr 9 min 34 sec (*b*) 14 hr 9 min 40 sec
(*c*) 14 hr 10 min 6 sec (*d*) 14 hr 10 min 32 sec

44. I have two watches with a 12 hour cycle. One of them gains one minute a day and the other loses $1\frac{1}{2}$ minutes per day. If I set them both at the correct time, how long will it be before they again tell the correct time together?

(*a*) 288 days (*b*) 480 days
(*c*) 720 days (*d*) 1440 days

45. A watch is 1 minute slow at 1 p.m. on Tuesday and 2 minutes fast at 1 p.m. on Thursday. When did it show the correct time? **(M.A.T. 2004)**

(*a*) 1.00 a.m. on Wednesday
(*b*) 5.00 a.m. on Wednesday
(*c*) 1.00 p.m. on Wednesday
(*d*) 5.00 p.m. on Wednesday

46. A watch which gains uniformly is 2 minutes low at noon on Monday and is 4 min. 48 sec fast at 2 p.m. on the following Monday. When was it correct?

(*a*) 2 p.m. on Tuesday (*b*) 2 p.m. on Wednesday
(*c*) 3 p.m. on Thursday (*d*) 1 p.m. on Friday

47. A watch which gains 5 seconds in 3 minutes was set right at 7 a.m. In the afternoon of the same day, when the watch indicated quarter past 4 o'clock, the true time is

(*a*) $59\frac{7}{12}$ min. past 3 (*b*) 4 p.m.
(*c*) $58\frac{7}{11}$ min. past 3 (*d*) $2\frac{3}{11}$ min. past 4

48. Between 5 and 6, a lady looked at her watch and mistaking the hour hand for the minute hand, she thought that the time was 57 minutes earlier than the correct time. The correct time was **(M.B.A. 2003)**

(*a*) 12 minutes past 5 (*b*) 24 minutes past 5
(*c*) 36 minutes past 5 (*d*) 48 minutes past 5

49. How much does a watch losse per day if its hands coincide every 64 minutes?
[IDBI Bank Executive Officers Exam, 2012]

(*a*) 37 minutes (*b*) $32\frac{8}{11}$ minutes

(*c*) 31 minutes (*d*) None of these

50. Wall clock gains 2 minutes in 12 hours, while a table clock loses 2 minutes every 36 hours. Both are set right at 12 noon on Tuesday. The correct time when both show the same time next would be
[SSC—FCI Gr. III Exam, 2012]

(*a*) 12:30 at night, after 130 days

(*b*) 12 noon, after 135 days

(*c*) 1:30 at nights, after 130 days

(*d*) 12 midnight after 135 days

51. The angle between the hands of a clock when the time is 4 : 25 am is [CLAT, 2016]

(*a*) $13\frac{1}{2}°$ (*b*) $17\frac{1}{2}°$

(*c*) $14\frac{1}{2}°$ (*d*) $12\frac{1}{2}°$

52. At 8:30, the hour hand and the minute hand of clock form an angle of [CDS Exam, 2016]

(*a*) 80° (*b*) 75°

(*c*) 70° (*d*) 60°

53. A clock is displaying correct time at 9am on Monday. If the clock loses 12 minutes in 24 hours, then the actual time when the clock indicates 8:30pm on Wednesday of the same week is
[DMRC—Customer Relationship Assistant (CRA) Exam, 2016]

(*a*) 8 pm (*b*) 7 pm

(*c*) 9 pm (*d*) 8: 59 : 45 pm

54. There are two clocks, both set to show 10 pm on 21st January 2010. One clock gains 2 minutes in an hour and the other clock loses 5 minutes in an hour. Then by how many minutes do the two clocks differ at 4 pm on 22nd January 2010?
[DMRC—Customer Relationship Assistant (CRA) Exam, 2016]

(*a*) 126 minutes (*b*) 136 minutes

(*c*) 96 minutes (*d*) 106 minutes

ANSWERS

1. (*c*)	**2.** (*a*)	**3.** (*d*)	**4.** (*b*)	**5.** (*a*)	**6.** (*d*)	**7.** (*c*)	**8.** (*d*)	**9.** (*c*)	**10.** (*b*)
11. (*b*)	**12.** (*c*)	**13.** (*d*)	**14.** (*a*)	**15.** (*b*)	**16.** (*c*)	**17.** (*c*)	**18.** (*b*)	**19.** (*d*)	**20.** (*c*)
21. (*c*)	**22.** (*c*)	**23.** (*b*)	**24.** (*c*)	**25.** (*b*)	**26.** (*c*)	**27.** (*d*)	**28.** (*d*)	**29.** (*c*)	**30.** (*d*)
31. (*b*)	**32.** (*b*)	**33.** (*d*)	**34.** (*c*)	**35.** (*a*)	**36.** (*d*)	**37.** (*c*)	**38.** (*d*)	**39.** (*d*)	**40.** (*b*)
41. (*a*)	**42.** (*c*)	**43.** (*b*)	**44.** (*d*)	**45.** (*b*)	**46.** (*b*)	**47.** (*b*)	**48.** (*b*)	**49.** (*b*)	**50.** (*b*)
51. (*b*)	**52.** (*b*)	**53.** (*c*)	**54.** (*a*)						

SOLUTIONS

1. Clealy, time in London is 5 hrs 30 minutes behnd 2.35 a.m. which is 9.05 p.m. or 21.05 hrs.

2. Duration of the journey
= (Duration form 12.25 noon to midnight)
+ (Duration from 12.00 midnight to 10.45 a.m.)
= 11 hrs 35 min + 10 hrs 45 min = 22 hrs 20 min.

3. Angle traced by the hour hand in 6 hours
$= \left(\frac{360}{12}\times 6\right)° = 180°.$

4. Number of rotations $= \frac{72}{12} = 6.$

5. Angle traced by the minute hand in 5 minutes
$= \left(\frac{360}{60}\times 5\right)° = 30°.$

6. Angle traced by the minute hand in 2 hrs 20 min, i.e., 140 min $= \left(\frac{360}{60}\times 140\right)° = 840°.$

7. Angle traced by the hour hand in 12 hrs = 360°.
Angle traced by the hour hand in 5 hrs 10 min, i.e., $\frac{31}{6}\text{ hrs} = \left(\frac{360}{12}\times\frac{31}{6}\right) = 155°.$

8. Time from 12 noon to 9 : 38 A.M. = 12 hrs + 9 hrs 38 min = 21 hrs 38 min.
$= 21\frac{38}{60}\text{ hrs} = 21\frac{19}{30}\text{ hrs} = \frac{649}{30}\text{ hrs}.$
Angle traced by the hour hand in 12 hrs = 360°.
Angle traced by the hour hand in
$\frac{649}{30}\text{ hrs} = \left(\frac{360}{12}\times\frac{649}{30}\right)° = 649°.$

9. Angle traced by hour hand in 12 hrs. = 360°.
Angle traced by it in $\frac{11}{3}\text{ hrs} = \left(\frac{360}{12}\times\frac{11}{3}\right)° = 110°.$
Angle traced by minute hand in 60 min. = 360°.
Angle traced by it in 40 min. $= \left(\frac{360}{60}\times 40\right)° = 240°.$
∴ Required angle = (240 – 110)° = 130°.

10. Angle traced by hour hand in $\frac{17}{2}$ hrs $= \left(\frac{360}{12} \times \frac{17}{2}\right)^\circ = 255^\circ$.

Angle traced by min. hand in 30 min. $= \left(\frac{360}{60} \times 30\right)^\circ = 180^\circ$.

$\therefore$ Required angle $= (255 - 180)^\circ = 75^\circ$.

11. Angle traced by hour hand in $\frac{13}{3}$ hrs $= \left(\frac{360}{12} \times \frac{13}{3}\right)^\circ = 130^\circ$.

Angle traced by min. hand in 20 min. $= \left(\frac{360}{60} \times 20\right)^\circ = 120^\circ$.

$\therefore$ Required angle $= (130 - 120)^\circ = 10^\circ$.

12. Angle traced by hour hand in $\frac{21}{4}$ hrs $= \left(\frac{360}{12} \times \frac{21}{4}\right)^\circ = 157\frac{1}{2}^\circ$.

Angle traced by min. hand in 15 min. $= \left(\frac{360}{12} \times 15\right)^\circ = 90^\circ$.

$\therefore$ Required angle $= \left(157\frac{1}{2}\right)^\circ - 90^\circ = 67\frac{1}{2}^\circ$.

13. Angle traced by hour hand in $\frac{125}{12}$ hrs $= \left(\frac{360}{12} \times \frac{125}{12}\right)^\circ = 312\frac{1}{2}^\circ$.

Angle traced by minute hand in 25 min $= \left(\frac{360}{60} \times 25^\circ\right) = 150^\circ$.

$\therefore$ Reflex angle $= 360^\circ - \left(312\frac{1}{2} - 150\right)^\circ = 360^\circ - 162\frac{1}{2}^\circ$

$= 197\frac{1}{2}^\circ$.

14. (A) Angle traced by hour hand in $\frac{7}{6}$ hrs $= \left(\frac{360}{12} \times \frac{7}{6}\right)^\circ = 35^\circ$.

Angle traced by minute hand in 10 min $= \left(\frac{360}{60} \times 10\right)^\circ = 60^\circ$.

$\therefore$ Required angle $= (60^\circ - 35^\circ) = 25^\circ$.

(B) Angle traced by hour hand in $\frac{9}{4}$ hrs $= \left(\frac{360}{12} \times \frac{9}{4}\right)^\circ = 67\frac{1}{2}^\circ$.

Angle traced by minute hand in 15 min $= \left(\frac{360}{60} \times 15\right)^\circ = 90^\circ$.

$\therefore$ Required angle $= \left(90^\circ - 67\frac{1}{2}^\circ\right) = 22\frac{1}{2}^\circ$.

(C) Angle traced by hour hand in $\frac{26}{3}$ hrs $= \left(\frac{360}{12} \times \frac{26}{3}\right)^\circ = 260^\circ$.

Angle traced by minute hand in 40 min $= \left(\frac{360}{60} \times 40\right)^\circ = 240^\circ$.

$\therefore$ Required angle $= (260^\circ - 240^\circ) = 20^\circ$

15. Time taken by the hour hand to move 360° = 12 hours.

Time taken by the hour hand to move 135°

$= \left(\frac{12}{360} \times 135\right)$ hrs $= 4\frac{1}{2}$ hrs.

$\therefore$ Required time is $4\frac{1}{2}$ hrs ahead of 3.00, i.e., 7.30.

16. Angle swept by the minute hand in 35 min

$= \left(\frac{360}{60} \times 35\right)^\circ = 210^\circ$.

$\therefore$ Required area = Area of a sector of a circle with radius 10 cm and central angle 210°

$= \frac{\pi r^2 \theta}{360} = \left(\frac{22}{7} \times 10 \times 10 \times \frac{210}{360}\right)\text{cm}^2 = \frac{550}{3}\text{cm}^2 = 183\frac{1}{3}\text{cm}^2$.

17. Number of rounds completed by the minute hand in 3 days 5 hrs = (3 × 24 + 5) = 77.

Number of rounds completed by the hour hand in 3 days 5 hrs $= \left(3 \times 2 + \frac{5}{12}\right) = 6\frac{5}{12}$.

$\therefore$ Difference between the distance traversed

$= \left[77 \times \left(2 \times \frac{22}{7} \times 10\right) - 6\frac{5}{12} \times \left(2 \times \frac{22}{7} \times 7\right)\right]$ cm

= (4840 − 282.33) cm = 4557.67 cm.

18. Distance covered by the arm tip in 1 round

$= \left(2 \times \frac{22}{7} \times 10\right)\text{cm} = \frac{440}{7}$ cm.

Now, $\frac{440}{7}$ cm is covered in 60 min.

$\therefore$ 10 cm is covered in $\left(60 \times \frac{7}{440} \times 10\right)$ min

= 9.54 min ≈ 10 min.

19. Let the required time be x minutes after midnight.

Duration from 12 midnight to 12 noon

= 12 hrs = (12 × 60) min = 720 min.

So, $x = 9\ (720 - x) \Rightarrow 10x = 6480 \Rightarrow x = 648$.

Hence, required time = 648 min after midnight = 10 hrs 48 min after midnight = 10.48 a.m.

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

$\therefore$ The hands coincide 22 times in a day.

21. In 12 hours, the hands coincide or are in opposite direction 22 times.

$\therefore$ In 24 hours, the hands coincide or are in opposite direction 44 times a day.

22. In 12 hours, they are at right angles 22 times.

$\therefore$ In 24 hours, they are at right angles 44 times.

23. The hands of a clock point in opposite directions (in the same straight line) 11 times in every 12 hours (Because between 5 and 7 they point in opposite directions at 6 o'clock only). So, in a day, the hands point in the opposite directions 22 times.

24. The duration from 1.00 p.m. to 10.00 p.m. is 9 hours and during each of these 9 hours the hands of the clock are at right angles twice.

So, required number = 9 × 2 = 18.

25. Clearly, the minute hand traverses 65 minutes in 1 hour.

$\therefore$ Required angle $= \left(\frac{360}{60} \times 65\right)^\circ = 390^\circ$.

26. Total number of strikings = 2 (1 + 2 + 3 + ... + 12)

$$= 2\times\frac{12\times13}{2}=156.$$

27. There are 8 intervals in 9 trings and 10 intervals in 11 trings.

Time duration of 8 intervals = 9 sec.

$\therefore$ Required time = Duration of 10 intervals

$$=\left(\frac{9}{8}\times10\right)\text{sec} = 11.25 \text{ sec.}$$

28. There are 5 intervals in 6 strikes.

Number of intervals in 5 seconds = 5. Number of intervals in 10 seconds = 10.

So, the clock will strike 11 times in 10 seconds.

29. Time gained in 1 hour = 6 min.

Time gained in 6 hours = (6 × 6) min = 36 min.

After 6 hours, the correct time is 11:00 a.m. and the watch will show 11:36 a.m.

30. Number of minutes in a day = (24 × 60) = 1440.

$\therefore$ Required percentage = $\left(\frac{5}{1440}\times100\right)\%=\frac{50}{144}\%$.

31. Time lost in 1 hour = 5 min.

Time lost in 6 hours = (5 × 6) min = 30 min.

After 6 hours, the correct time will be 6 a.m. and the clock will show 5.30 a.m.

32. Duration from 12 noon to 4:00 a.m. = 16 hours.

Time gained in 24 hours = 15 min.

Time gained in 16 hours = $\left(\frac{5}{24}\times16\right)\text{min}$ = 10 min.

Hence, time shown by the watch at 4 a.m. = 4:10 a.m.

33. At 3 o' clock, the minute hand is 15 min spaces behind the hour hand.

Thus, the minute hand has to gain (15 + 18) = 33 minute spaces.

55 min are gained in 60 min.

33 min are gained in $\left(\frac{60}{55}\times33\right)=24\text{ min.}$

$\therefore$ The hands will be 18 min spaces apart at 3:36 P.M.

34. At 9O' clock, the minute hand is 4 min. spaces behind the hour hand.

Thus, the minute hand has to gain (45 – 23)

= 22 min sapces.

5 min are gained in 60 min.

22 min are gained in $\left(\frac{60}{55}\times22\right)=24\text{ min.}$

$\therefore$ The hands will be 23 min spaces apart at 9:24.

35. 55 min. spaces are covered in 60 min.

60 min. spaces are covered in

$\left(\frac{60}{55}\times60\right)\text{min.}=65\frac{5}{11}\text{min.}$

Loss in 64 min. = $\left(65\frac{5}{11}-64\right)=\frac{16}{11}\text{min.}$

Loss in 24 hrs = $\left(\frac{16}{11}\times\frac{1}{64}\times24\times60\right)\text{min.}=32\frac{8}{11}\text{min.}$

36. At 3 o'clock, the minute hand is 15 min. spaces apart from the hour hand.

To be coincident, it must gain 15 min. spaces.

55 min. are gained in 60 min.

15 min. are gained in $\left(\frac{60}{55}\times15\right)\text{min.}=16\frac{4}{11}\text{min.}$

$\therefore$ The hands are coincident at $16\frac{4}{11}\text{min. past 3.}$

37. To be together between 9 and 10 o'clock, the minute hand has to gain 45 min. spaces.

55 min. spaces are gained in 60 min.

45 min. spaces are gained in $\left(\frac{60}{55}\times45\right)\text{min. or }49\frac{1}{11}\text{min.}$

$\therefore$ The hands are together at $49\frac{1}{11}\text{min. past 9.}$

38. When the hands of the clock are in the same straight line but not together, they are 30 minute spaces apart.

At 7 o'clock, they are 25 min. spaces apart.

$\therefore$ Minute hand will have to gain only 5 min. spaces.

55 min. spaces are gained in 60 min.

5 min. spaces are gained in $\left(\frac{60}{55}\times5\right)\text{min}=5\frac{5}{11}\text{min.}$

$\therefore$ Required time = $5\frac{5}{11}\text{min. past 7.}$

39. At 4 o'clock, the hands of the watch are 20 min. spaces apart.

To be in opposite directions, they must be 30 min. spaces apart.

$\therefore$ Minute hand will have to gain 50 min. spaces.

55 min. spaces are gained in 60 min.

50 min. spaces are gained in $\left(\frac{60}{55}\times50\right)\text{min. or }54\frac{6}{11}\text{min.}$

$\therefore$ Required time = $54\frac{6}{11}\text{min. past 4.}$

40. At 5 o'clock, the hands are 25 min. spaces apart.

To be at right angles and that too between 5.30 and 6, the minute hand has to gain (25 + 15) = 40 min. spaces.

55 min. spaces are gained in 60 min.

40 min. spaces are gained in $\left(\frac{60}{55}\times40\right)\text{min.}=43\frac{7}{11}\text{min.}$

$\therefore$ Required time = $43\frac{7}{11}\text{min. past 5.}$

41. To be together between 8 A.M. and 9 A.M, the minute hand has to gain 40 min spaces.

55 min. spaces are gained in 60 min.

40 min. spaces are gained in $\left(\frac{60}{55}\times40\right)\text{min}=43\frac{7}{11}\text{min.}$

So, Henry started his trip at $43\frac{7}{11}$ min past 8 A.M.

Now, to be 180° apart, the hands must be 30 min spaces apart.

At 2 P.M, they are 10 min spaces apart.

∴ The minute hand will have to gain (10 + 30) = 40 min spaces.

As calculated above, 40 min. spaces are gained in $43\frac{7}{11}$ min.

So, Henry's trip ended at $43\frac{7}{11}$ min past 2 P.M.

∴ Duration of travel = Duration from $43\frac{7}{11}$ min past 8 A.M. to $43\frac{7}{11}$ min past 2 P.M. = 6 hours.

42. The watch loses $\frac{1}{2}$ hour each hour. So, it must have taken 8 hours to show 4 p.m. from 12 noon. Thus, it stopped at 8 p.m.

So, the correct time is 5 hours ahead of 8 p.m., i.e., 1 a.m.

43. Time lost in $6\frac{1}{2}\text{hours} = \left(6\frac{1}{2}\times 4\right)\text{sec}$ = 26 sec.

Correct time after $6\frac{1}{2}$ hours = 7 hr 40 min 6 sec + 6 hr 30 min = 14 hr 10 min 6 sec.

Time shown by the clock = 14 hr 10 min 6 sec – 26 sec
= 14 hr 9 min 40 sec.

44. Clearly, the first watch will show the correct time when it has gained 12 hours i.e., (12 × 60) = 720 min and the secon watch will show the correct time when it has lost 720 min.

Time taken by first watch to gain 720 min = 720 days.

Time taken by second watch to gain 720 min $= \left(720 \div 1\frac{1}{2}\right)\text{days} = \left(720\times\frac{2}{3}\text{ days}\right) =$ 480 days.

So the first watch shows correct time after every 720 days and the second wach after every 480 days.

∴ Time after which both the clocks will together tell the correct time = L.C.M. of 720 and 480 = 1440 days.

45. Time from 1 p.m. on Tuesday to 1 p.m. on Thursday = 48 hours.

So, the watch gains (1 + 2) min or 3 min in 48 hrs.

Now, 3 min are gained in 48 hrs.

So, 1 min is gained in $\left(\frac{48}{3}\right)$ = 16 hrs.

Thus, the watch showed the correct time 16 hrs. after 1 p.m. on Tuesday, i.e. 5 a.m. on Wednesday.

46. Time from 12 p.m. on Monday to 2 p.m. on the following Monday = 7 days 2 hours
= 170 hours.

∴ The watch gains $\left(2+4\frac{4}{5}\right)\text{min.}$ or $\frac{34}{5}\text{ min. in 170 hrs.}$

Now, $\frac{34}{5}$ min. are gained in 170 hrs.

∴ 2 min. are gained in $\left(170\times\frac{5}{34}\times 2\right)\text{hrs} = 50\text{ hrs.}$

∴ Watch is correct 2 days 2 hrs. after 12 p.m. on Monday *i.e.* it will be correct at 2 p.m. on Wednesday.

47. Time from 7 a.m. to 4.15 p.m. = 9 hrs 15 min. = $\frac{37}{4}$ hrs.

3 min. 5 sec. of this clock = 3 min. of the correct clock.

$\Rightarrow \frac{37}{720}$ hrs of this clock = $\frac{1}{20}$ hrs of the correct clock

$\Rightarrow \frac{37}{4}$ hrs of this clock

$= \left(\frac{1}{20}\times\frac{720}{37}\times\frac{37}{4}\right)$ hrs of the correct clock

= 9 hrs of the correct clock

∴ The correct time is 9 hrs after 7 a.m., i.e. 4 p.m.

48. Since the time read by the lady was 57 minutes earlier than the correct time, so the minute hand is (60 – 57) = 3 minute spaces behind the hour hand.

Now, at 5 o'clock, the minute hand is 25 minute spaces behind the hour hand.

To be 3 minute spaces behind, it must gain (25 – 3) = 22 minute spaces.

55 min spaces are gained in 60 min.

22 min spaces are gained in $\left(\frac{60}{55}\times 22\right)$ = 24 min.

Hence, the correct time was 24 minutes past 5.

49. 55 minutes spaces are covered in 60 minutes

60 minutes spaces are covered in $\left[\frac{60}{55}\times 60\right]$ minutes

$= 65\frac{5}{11}$ minutes

Loss in 64 minute = $65\frac{5}{11} - 64 = \frac{16}{11}$ minutes

Loss in 24 hours = $\left(\frac{16}{11}\times\frac{1}{64}\times 24\times 60\right)$ minutes

$= 32\frac{8}{11}$ minutes

50. After 12 days, i.e., after 12 × 24 hours clock A will gain 48 minutes and will slow 12:48 noon.

After 12 days, i.e., after 12 × 24 hours clock B will loose 16 minutes and will show 11:44 am.

The two clocks will show the same time after 135 days

The time difference has to be 12 hours between then
= 720 minutes.

A will gain 540 minutes in 135 days.

B will loose 180 minutes in 135 days Total 720 minutes.

Further if we consider only time then the problem becomes simpler

Total difference of minutes between the times shown by the clocks after 36 hours

$\Rightarrow \frac{16}{3}$ minutes difference in 1 day

$\Rightarrow$ 12 × 60 minutes difference in $\frac{3}{16}\times 12\times 60 = 135$ days

51. Let angle between the hands of clock be x°.
When the time is 4 : 25 a.m.
{Where M = minutes and H = hours}

Required angle = $30\left(\frac{M}{5}-H\right)-\frac{M}{2}$

$=30\left(\frac{25}{5}-4\right)-\frac{25}{2}=30\left(\frac{25-20}{5}\right)-\frac{25}{2}=30\left(\frac{5}{5}\right)-\frac{25}{2}=30-\frac{25}{2}$

$=\frac{60-25}{2}=\frac{35}{2}=17\frac{1}{2}^\circ$

52. In 1 hour, the hour hand's make the angle of 30°.

The hour hand make the angle of x° in $8\frac{30}{60}$ hours.

$\Rightarrow x=\left(30\times 8\frac{1}{2}\right)^\circ$

$=\left(30\times\frac{17}{2}\right)=225^\circ$

The minute hand make the angle in 1 minute = 6°
Minute hand makes the angle in 30 minutes
= (6 × 30)° = 180°
Required angle = 255°–180° = 75°

53. Time interval from 9 am on Monday to 8 : 30 pm on Wednesday

$=(24\times 2.5)-0:30$ hours

= 60 – 0 : 30 hours
= 59 hours 30 minutes

$=59\frac{30}{60}=59\frac{1}{2}$

$=\frac{119}{2}$ hours

Also 24 hours – 12 minutes
= 23 hours 48 minutes

$=23+\frac{48}{60}=23\frac{4}{5}$ hours $=\frac{119}{5}$ hours

$\frac{119}{5}$ hours of this clock = 24 hours of the correct clock

$\therefore\ \frac{119}{2}$ hours of this clock $=\frac{24\times 5}{119}\times\frac{119}{2}=60$ hours

$\left(60-\frac{119}{2}\right)$hours

$=\frac{120-119}{2}$ hours $=\frac{1}{2}$ hours = 30 minutes

Hence, the correct time is 30 minutes after 8 : 30 pm. i.e. 9 pm.

54. One clock show 10pm. On 21st January 2010
One clock gains = 2 minutes
Other clock loses = 5 minutes
Time period between 10 pm and 4 pm = 18 hours
$\therefore$ Required difference = (2 × 18 + 5 × 18) minutes
= 126 minutes