CHAPTER 11

Clock and Calendar

CLOCK

Introduction

- A clock has two hands : Hour hand and Minute hand.
- The minute hand (M.H.) is also called the long hand and the hour hand (H.H.) is also called the short hand.
- The clock has 12 hours numbered from 1 to 12.

Also, the clock is divided into 60 equal minute divisions. Therefore, each hour number is separated by five minute divisions. Therefore,

Shortcut Approach

- One minute division $= \frac{360}{60} = 6°$ apart. ie. In one minute, the minute hand moves 6°.
- One hour division $= 6° \times 5 = 30°$ apart. ie. In one hour, the hour hand moves 30° apart.

  Also, in one minute, the hour hand moves $= \frac{30°}{60°} = \frac{1°}{2}$ apart.
- Since, in one minute, minute hand moves 6° and hour hand moves $\frac{1°}{2}$, therefore, in one minute, the minute hand gains $5\frac{1°}{2}$ more than hour hand.
- In one hour, the minute hand gains $5\frac{1°}{2} \times 60 = 330°$ over the hour hand. i.e. the minute hand gains 55 minutes divisions over the hour hand.

Relative position of the hands

The position of the M.H. relative to the H.H. is said to be the same, whenever the M.H. is separated from the H.H. by the same number of minute divisions and is on same side (clockwise or anticlockwise) of the H.H.

Any relative position of the hands of a clock is repeated 11 times in every 12 hours.

(a) When both hands are 15 minute spaces apart, they are at right angle.

(b) When they are 30 minute spaces apart, they point in opposite directions.

(c) The hands are in the same straight line when they are coincident or opposite to each other.
- In every hour, both the hand coincide once.
- In a day, the hands are coinciding 22 times.
- In every 12 hours, the hands of clock coincide 11 times.
- In every 12 hours, the hands of clock are in opposite direction 11 times.
- In every 12 hours, the hands of clock are at right angles 22 times.
- In every hour, the two hands are at right angles 2 times.
- In every hour, the two hands are in opposite direction once.
- In a day, the two hands are at right angles 44 times.
- If both the hands coincide, then they will again coincide after $65\frac{5}{11}$ minutes. i.e. in correct clock, both hand coincide at an interval of $65\frac{5}{11}$ minutes.
- If the two hands coincide in time less than $65\frac{5}{11}$ minutes, then clock is too fast and if the two hands coincides in time more than $65\frac{5}{11}$ minutes, then the clock is too slow.

Shortcut Approach

- **Shortcut Approach for finding degrees minutes and hours is**

  $\theta = \left(\frac{11}{2}M - 30H\right)$

  Where, M = minutes
  and, H = Hours
- When value of θ becomes more than 360, subtract 360 from the value of θ and complete the calculation.

EXAMPLE 1. The angle between the minute hand and the other hour hand of a clock when the time is 8:30 is

(a) 80 degrees **(b) 75 degrees**
(c) 60 degrees **(d) 105 degrees**

Sol. Degree required $(\theta) = \left[\frac{11}{2}M - 30H\right]$

$$= \frac{11}{2} \times 30 - 30 \times 8 = 165 - 240 = 75 \text{ degree}$$

EXAMPLE 2. At what time between 4 and 5 will the hands of a watch
(i) coincide, and
(ii) point in opposite directions.

Sol. (i) At 4 O' clock, the hands are 20 minutes apart. Clearly the minute hand must gain 20 minutes before two hands can be coincident.
But the minute-hand gains 55 minutes in 60 minutes.
Let minute hand will gain x minute in 20 minutes.

So, $\frac{55}{20} = \frac{60}{x}$

$\Rightarrow \quad x = \frac{20 \times 60}{55} = \frac{240}{11} = 21\frac{9}{11}$ min.

$\therefore$ The hands will be together at $21\frac{9}{11}$ min past 4.

(ii) Hands will be opposite to each other when there is a space of 30 minutes between them. This will happen when the minute hand gains $(20 + 30) = 50$ minutes.

Now, the minute hand gains 50 min in $\frac{50 \times 60}{55}$ or $54\frac{6}{11}$ min.

$\therefore$ The hands are opposite to each other at $54\frac{6}{11}$ min past 4.

EXAMPLE 3. What is the angle between the hour hand and minute hand when it was 5 : 05 pm.

Sol. 5.05 pm means hour hand was on 5 and minute hand was on 1, i.e. there will be 20 minutes gap.
$\therefore$ Angle $= 20 \times 6° = 120°$ [$\because$ 1 minute $= 6°$]

INCORRECT CLOCK

If a clock indicates 6 : 10, when the correct time is 6 : 00, it is said to be 10 minute too fast and if it indicates 5 : 50 when the correct time is 6 : 00, it is said to be 10 minute too slow.

- Also, if both hands coincide at an interval x minutes and $x < 65\frac{5}{11}$, then total time gained $= \left(\frac{65\frac{5}{11} - x}{x}\right)$ minutes and clock is said to be 'fast'.
- If both hands coincide at an interval x minutes and $x > 65\frac{5}{11}$, then total time lost $= \left(\frac{x - 65\frac{5}{11}}{x}\right)$ minutes and clock is said to be 'slow'.

EXAMPLE 4. My watch, which gains uniformly, is 2 min slow at noon on Sunday, and is 4 minutes 48 seconds fast at 2 pm on the following Sunday. When was it correct.

Sol. From Sunday noon to the following Sunday at 2 pm = 7 days 2 hours = 170 hours.

The watch gains $\left(2 + 4\frac{48}{60}\right) = 6\frac{4}{5}$ minutes in 170 hours.

$\therefore$ The watch gains 2 minutes in $\frac{2}{6\frac{4}{5}} \times 170 = 50$ hours

Now, 50 hours = 2 days 2 hours
2 days 2 hours from Sunday noon = 2 pm on Tuesday.

EXAMPLE 5. 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?

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

But, they are together after 65 min.

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

Gain in 24 hours $= \left(\frac{5}{11} \times \frac{60 \times 24}{65}\right)$ min. $= 10\frac{10}{143}$ min.

$\therefore$ The clock gains $10\frac{10}{143}$ minutes in 24 hours.

EXAMPLE 6. A man who went out between 5 or 6 and returned between 6 and 7 found that the hands of the watch had exactly changed place. When did he go out?

Sol. Between 5 and 6 to 6 and 7, hands will change place after crossing each other one time. ie. they together will make 1 + 1 = 2 complete revolutions.

H.H. will move through $2 \times \frac{60}{13}$ or $\frac{120}{13}$ minute divisions.

Between 5 and 6 $\rightarrow \frac{120}{13}$ minute divisions.

At 5, minute hand is 25 minute divisions behind the hour-hand.

Hence it will have to gain $25 + \frac{120}{13}$ minute divisions on the hour-hand $= \frac{445}{13}$ minute divisions on the hour hand.

The minute hand gains $\frac{445}{13}$ minute divisions in $\frac{445}{13} \times \frac{12}{11}$ minutes $= \frac{5340}{143} = 37\frac{49}{143}$ minutes

$\therefore$ The required time of departure is $37\frac{49}{143}$ min past 5.

CALENDAR

INTRODUCTION

An ordinary year has 365 days. Every year which is divisible by 4, is a leap year and has 366 days, But century year has 365 days except for year divisible by 400 which has 366 days.

An ordinary year contains 365 days i.e., 52 weeks + 1 day i.e. 1 odd day.

A leap year contains 366 days i.e. 52 weeks + 2 days i.e. 2 odd days.

A century (100 years) contains = 24 leap years + 76 ordinary years = 24 × 2 + 76 = 124 odd days = 17 weeks + 5 odd days

Similarly,

200 years contains 2 × 5 – 7 = 3 odd days

300 years contains 3 × 5 – 14 = 1 odd day

400 years contains 4 × 5 + 1 – 21 = 0 odd days

First January, 1 A.D. was Monday.

A solar year contains 365 days 5 hours 48 minutes 48 seconds.

The first day of a century must either be Monday, Tuesday, Thursday or Saturday.

Months	Odd days
January	3
February	0/1 (ordinary/leap)
March	3
April	2
May	3
June	2
July	3
August	3
September	2
October	3
November	2
December	3

To find a particular day witihout given date and day

Following steps are taken into consideration to solve such questions

Step I Firstly, you have to find the number of odd upto the date for which the day is to be determined.

Step II Your required day will be according to the following conditions

(a) If the number of odd days = 0, then required day is Sunday.

(b) If the number of odd days = 1, then required day is Monday.

(c) If the number of odd days = 2, then required day is Tuesday.

(d) If the number of odd days = 3, then required day is Wednesday.

(e) If the number of odd days = 4, then required day is Thursday.

(f) If the number of odd days = 5, then required day is Friday.

(g) If the number of odd days = 6, then required day is Saturday.

NOTE : *February in an ordinary year gives no odd days, but in a leap year gives one odd day.*

EXAMPLE 7. What day of the week was 15th August 1949?

Sol. 15th August 1949 means

1948 complete years + first 7 months of the year 1949 + 15 days of August.

1600 years give no odd days.

300 years give 1 odd day.

48 years give {48 + 12} = 60 = 4 odd days.

[∵ For ordinary years → 48 odd days and for leap year 1 more day (48 ÷ 4) = 12 odd days; 60 = 7 × 8 + 4]

From 1st January to 15th August 1949

Odd days :

January – 3

February – 0

March – 3

April – 2

May – 3

June – 2

July – 3

August – 1

17 ⇒ 3 odd days.

∴ 15th August 1949 → 1 + 4 + 3 = 8 = 1 odd day.

This means that 15th Aug. fell on 1st day. Therefore, the required day was Monday.

EXAMPLE 8. How many times does the 29th day of the month occur in 400 consecutive years?

Sol. In 400 consecutive years, there are 97 leap years. Hence, in 400 consecutive years, February has the 29th day 97 times and the remaining eleven months have the 29th day 400 × 1100 = 4400 times

∴ The 29th day of the month occurs (4400 + 97) or 4497 times.

EXAMPLE 9. Today is 5th February. The day of the week is Tuesday. This is a leap year. What will be the day of the week on this date after 5 years?

Sol. This is a leap year. So, next 3 years will give one odd day each. Then leap year gives 2 odd days and then again next year give 1 odd day.

Therefore (3 + 2 + 1) = 6 odd days will be there.

Hence the day of the week will be 6 odd days beyond Tuesday, i.e., it will be Monday.

EXAMPLE 10. What day of the week was 20th June 1837 ?

Sol. 20th June 1837 means 1836 complete years + first 5 months of the year 1837 + 20 days of June.

1600 years give no odd days.

200 years give 3 odd days.

36 years give (36 + 9) or 3 odd days.

1836 years give 6 odd days.

From 1st January to 20th June there are 3 odd days.

Odd days :

January	: 3
February	: 0
March	: 3
April	: 2
May	: 3
June	: 6

	17

Therefore, the total number of odd days = (6 + 3) or 2 odd days.

This means that the 20th of June fell on the 2nd day commencing from Monday. Therefore, the required day was Tuesday.

EXERCISE

1. If the two hands in a clock are 3 minutes divisions apart, then the angle between them is
   (a) 3° (b) 18°
   (c) 24° (d) 60°
   (e) None of these
2. At what approximate time between 4 and 5 am will the hands of a clock be at right angle?
   (a) 4 : 40 am (b) 4 : 38 am
   (c) 4 : 35 am (d) 4 : 39 am
   (e) None of these
3. What will be the acute angle between hands of a clock at 2 : 30?
   (a) 105° (b) 115°
   (c) 95° (d) 135°
   (e) None of these
4. In 16 minutes, the minute hand gains over the hour hand by
   (a) 16° (b) 80°
   (c) 88° (d) 96°
   (e) None of these
5. A clock is set right at 1 p.m. If it gains one minute in an hour, then what is the true time when the clock indicates 6 p.m. in the same day?
   (a) $55\frac{5}{61}$ minutes past 5 (b) 5 minutes past 6
   (c) 5 minutes to 6 (d) $59\frac{1}{64}$ minutes past 5
   (e) None of these
6. At what time between 9'o clock and 10'o clock will the hands of a clock point in the opposite directions?
   (a) $16\frac{4}{11}$ minutes past 9 (b) $16\frac{4}{11}$ minutes past 8
   (c) $55\frac{5}{61}$ minutes past 7 (d) $55\frac{5}{61}$ minutes to 8
   (e) None of these
7. A clock gains 15 minutes per day. It is set right at 12 noon. What time will it show at 4.00 am, the next day?
   (a) 4 : 10 am (b) 4 : 45 am
   (c) 4 : 20 am (d) 5 : 00 am
   (e) None of these
8. What is the angle between the 2 hands of the clock at 8:24 pm?
   (a) 100° (b) 107°
   (c) 106° (d) 108°
   (e) None of these
9. In a watch, the minute hand crosses the hour hand for the third time exactly after every 3 hrs., 18 min., 15 seconds of watch time. What is the time gained or lost by this watch in one day?
   (a) 14 min. 10 seconds lost
   (b) 13 min. 50 seconds lost
   (c) 13min. 20 seconds gained
   (d) 14 min. 40 seconds gained
   (e) None of these
10. At what time between 3 and 4 o'clock, the hands of a clock coincide?
    (a) $16\frac{4}{11}$ minutes past 3 (b) $15\frac{5}{61}$ minutes past 3
    (c) $15\frac{5}{60}$ minutes to 2 (d) $16\frac{4}{11}$ minutes to 4
    (e) None of these
11. 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
    (e) None of these
12. If a clock strikes 12 in 33 seconds, it will strike 6 in how many seconds?
    (a) $\frac{33}{2}$ (b) 15
    (c) 12 (d) 22
    (e) None of these
13. 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) 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
    (e) None of these
14. At what time between 8 and 9 o'clock will the hands of a watch be in straight line but not together?
    (a) $10\frac{11}{10}$ min. past 8 (b) $10\frac{10}{11}$ min. past 8
    (c) $11\frac{10}{11}$ min. past 8 (d) $12\frac{10}{11}$ min. past 8
    (e) None of these
15. 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
    (e) None of these

16. Find the angle between the hour hand and the minute hand of a clock when the time is 3.25.
(a) 45° (b) $37\frac{1}{2}^\circ$
(c) $47\frac{1}{2}^\circ$ (d) 46°
(e) None of these

17. How much does a watch lose per day, if its hands coincide every 64 minutes?
(a) $32\frac{8}{11}$ min. (b) $36\frac{5}{11}$ min.
(c) 90 min. (d) 96 min.
(e) None of these

18. 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°
(e) None of these

19. The first Republic Day of India was celebrated on 26th January, 1950. It was :
(a) Tuesday (b) Wednesday
(c) Thursday (d) Friday
(e) None of these

20. What will be the day of the week on 1st January, 2010 ?
(a) Friday (b) Saturday
(c) Sunday (d) Monday
(e) None of these

21. The calendar for the year 2005 is the same as for the year :
(a) 2010 (b) 2011
(c) 2012 (d) 2013
(e) None of these

22. If 09/12/2001 happens to be Sunday, then 09/12/1971 would have been at
(a) Wednesday (b) Tuesday
(c) Saturday (d) Thursday
(e) None of these

23. What was the day of the week on 15th August, 1947 ?
(a) Wednesday (b) Tuesday
(c) Friday (d) Thursday
(e) None of these

24. The last day of a century cannot be :
(a) Monday (b) Wednesday
(c) Friday (d) Tuesday
(e) None of these

25. The reflex angle between the hands of a clock at 10:25 is?
(a) 180° (b) $192\frac{1}{2}^\circ$
(c) 195° (d) $197\frac{1}{2}^\circ$
(e) None of these

26. A clock gains 5 minutes. in 24 hours. It was set right at 10 a.m. on Monday. What will be the true time when the clock indicates 10:30 a.m. on the next Sunday ?
(a) 10 a.m. (b) 11 a.m.
(c) 25 minutes past 10 a.m. (d) 5 minutes to 11 a.m.
(e) None of these

27. At what angle the hands of a clock are inclined at 15 minutes past 5 ?
(a) $72\frac{1}{2}^\circ$ (b) 64°
(c) $58\frac{1}{2}^\circ$ (d) $67\frac{1}{2}^\circ$
(e) None of these

28. Find the day of the week on 16th July, 1776.
(a) Tuesday (b) Wednesday
(c) Monday (d) Thursday
(e) None of these

29. On January 12, 1980, it was Saturday. The day of the week on January 12, 1979 was –
(a) Saturday (b) Friday
(c) Sunday (d) Thursday
(e) None of these

30. The year next to 1991 having the same calendar as that of 1990 is –
(a) 1998 (b) 2001
(c) 2002 (d) 2003
(e) None of these

31. A clock is set right at 5 a.m. The clock loses 16 min. in 24 hours. What will be the true time when the clock indicates 10 p.m. on the 4th day ?
(a) 11 p.m. (b) 10 p.m.
(c) 9 p.m. (d) 8 p.m.
(e) None of these

32. Find the exact time between 7 am and 8 am when the two hands of a watch meet ?
(a) 7 hrs 35 min (b) 7 hrs 36.99 min
(c) 7 hrs 38.18 min (d) 7 hrs 42.6 min
(e) None of these

33. 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) 4 p.m. (b) $59\frac{7}{12}$ minutes past 3
(c) $58\frac{7}{11}$ minutes past 3 (d) $2\frac{3}{11}$ minutes past 4
(e) None of these

ANSWER KEY

1	(b)	5	(a)	9	(b)	13	(d)	17	(a)	21	(c)	25	(d)	29	(b)	33	(a)
2	(b)	6	(a)	10	(a)	14	(b)	18	(d)	22	(d)	26	(a)	30	(c)		
3	(a)	7	(a)	11	(b)	15	(b)	19	(c)	23	(c)	27	(d)	31	(a)		
4	(c)	8	(d)	12	(b)	16	(c)	20	(c)	24	(d)	28	(a)	32	(c)		

Hints & Explanations

1. (b) In a clock, each minute makes 6º

$\therefore$ 3 minutes will make $6 \times 3 = 18^\circ$

2. (b) Here $H \times 30 = 4 \times 30 = 120^0$.

(Since initially the hour hand is at 4. $\therefore$ H = 4).

Required angle $A = 90^0$ and since, $H \times 30 > A°$ so, there will be two timings.

Required time $T = \frac{2}{11}(H \times 30 \pm A)$ minutes past H.

$\therefore$ One timing $= \frac{2}{11}(4 \times 30 + 90)$ minutes past 4

$= 38\frac{2}{11}$ minutes past 4.

Or 4 : 38 approx.

3. (a) At 2'O Clock, Minute Hand will be $10 \times 6 = 60°$ behind the Hour Hand.

In 30 minutes, Minute Hand will gain $\left(5\frac{1}{2}\right)^\circ \times 30$

$= 150 + 15 = 165°$

$\therefore$ Angle between Hour Hand and Minute Hand

$= 165 - 60 = 105°$

4. (c) In 1 hour, the minute hand gains 330º over the hour hand.

i.e. in 60 minute, the minute hand gains 330º over the hour hand.

$\therefore$ In 16 minutes, the minute hand gains over the hour hand by $\frac{330^\circ}{60} \times 16^\circ = 88^\circ$

5. (a) Time interval indicated by incorrect clock

$= 6$ p.m $- 1$ p.m $= 5$ hrs.

Time gained by incorrect clock in one hour

$= +1$ min.$= +\frac{1}{60}$ hr.

Using the formula, $\frac{\text{True time interval}}{\text{Time interval in incorrect clock}}$

$= \frac{1}{1 + \text{hour gained in 1 hour by incorrect clock}}$

$\Rightarrow \frac{\text{True time interval}}{5} = \frac{1}{1+\frac{1}{60}}$

$\Rightarrow$ True time interval $= \frac{5 \times 60}{61} = 4\frac{56}{61}$

$\therefore$ True time $= 1$ p.m. $+ 4\frac{56}{61}$ hrs.

$= 5$ p.m. $+ \frac{56}{61}$ hrs. $= 5$ p.m. $+ \frac{56}{61} \times 60$ min.

$= 55\frac{5}{61}$ minutes past 5.

6. (a) Minute and hour hand of a clock are opposite to each other when they are at an angle of 180° or they are 30 minutes apart to each other.

At 9'o clock, minute hand is 15 minutes ahead of hour hand. Therefore, minute hand must be ahead 15 minute more to become opposite to hour hand,

Now, minute hand ahead 55 minutes in 60 minutes

$\Rightarrow$ minute hand ahead 1 minutes in $\frac{60}{55}$ minutes

$\Rightarrow$ minute hand ahead 15 minutes in $\frac{60}{55} \times 15$ minutes

$= \frac{180}{11}$ minutes

Hence, between, 9 and 10 o' clock, minutes and hour hand are opposite to each other at $16\frac{4}{11}$ minutes past 9.

7. (a) The clock gains 15 min in 24 hours.

Therefore, in 16 hours, it will gain 10 minutes.

Hence, the time shown by the clock will be 4.10 am.

8. (d) Required angle = 240 – 24 × (11/2)

$= 240 - 132 = 108°.$

9. (b) In a watch than is running correct the minute hand should cross the hour hand once in every $65 + \frac{5}{11}$ min.

So they should ideally cross 3 times once in

$$3 \times \left(\frac{720}{11}\right) = \frac{2160}{11}\text{ min} = 196.36\text{ minutes.}$$

But in the watch under consideration, they meet after every 3hr, 18 min and 15 seconds,

i.e. $\left(3 \times 60 + 18 + \frac{15}{60}\right) = \frac{793}{4}$ min. = 198.25 min

Thus, our watch is actually losing time (as it is slower than the normal watch). Hence when our watch elapsed

$$\left(1440 \times \frac{196.36}{198.25}\right) = 1426.27.$$

Hence the amount of time lost by our watch in one day $= (1440 - 1426.27) = 13.73$ ie 13 min and 50s (approx).

10. (a) At 3 o' clock, minutes hand big behind 15 minutes from hour hand.

Now, minute hand head 55 minutes in 60 minutes

$\Rightarrow$ minute hand head 1 minutes in $\frac{60}{55}$ minutes

$\Rightarrow$ minute hand head 15 minutes in $\frac{60}{55} \times 15$ minutes

$= 16\frac{4}{11}$ minutes

Hence minute hand concides with hour hand at $16\frac{4}{11}$ minutes past 3 o' clock.

11. (b) Time from 12 p.m. on Monday to 2 p.m. on the following Monday = 7 days 2 hours = 170 hours.

$\therefore$ The watch gains $\left(2 + 4\frac{4}{5}\right)$ min.

or $\frac{34}{5}$ min. in 170 hrs.

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

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

$\therefore$ 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.

12. (b) In order to strike 12, there are 11 intervals of equal time

$= \frac{33}{11} = 3$ seconds each

Therefore, to strike 6 it has 5 equal intervals, it requires 5 × 3 = 15 sec.

13. (d) 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 in. spaces.

55 min. spaces are gained in 60 min.

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

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

14. (b) At 8 o'clock, the hands of the watch are 20 min. spaces apart.

To be in straight line but not together they will be 30 min. space apart.

$\therefore$ Minute hand will have to gain 10 min. spaces

55 min. spaces are gained in 60 min.

10 min. spaces will be gained in $\left(\frac{60}{55} \times 50\right)$ min or $10\frac{10}{11}$ min

$\therefore$ Required time $= 10\frac{10}{11}$ min. past 8

15. (b) 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 $\left(\frac{60}{55} \times 40\right)$ min. $= 43\frac{7}{11}$ min.

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

16. (c) Angle traced by the hour hand in 12 hours = 360°

Angle traced by it in 3 hrs 25 min. i.e. $\frac{41}{12}$ hrs

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

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

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

17. (a) 55 min. spaces are covered in 60 min.

60 min. spaces are covered in $\left(\frac{60}{55}\times 60\right)$ min.

$=65\frac{5}{11}$ min.

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

Loss in 24 hrs. $=\left(\frac{16}{11}\times\frac{1}{64}\times 24\times 60\right)$ min $=32\frac{8}{11}$ min.

18. (d) Angle traced by the hour hand in 6 hours

$=\left(\frac{360}{12}\times 6\right)^{\circ}=180^{\circ}$

19. (c) 26th Jan., 1950 = (1949 years + Period from 1st Jan., 1950 to 26th Jan., 1950)

1600 years have 0 odd day. 300 years have 1 odd day.

49 years = (12 leap years + 37 ordinary years)

= [(12 × 2) + (37 × 1)] odd days = 61 odd days

= 5 odd days.

Number of days from 1st Jan. to 26th Jan. = 26

= 5 odd days

Total number of odd days = (0 + 1 + 5 + 5) = 11

= 4 odd days

∴ The required days was 'Thursday'

20. (c) 2000 years have 2 odd days.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Odd days	1	1	1	2	1	1	1	2	1

= 11 odd days = 4 odd days.

1st January, 2010 has 1 odd day. Total number of odd days = (2 + 4 + 1) = 7 = 0.

∴ 1st January, 2010 will be Sunday.

21. (c) Count the number of days from 2005 onwards to get 0 odd day.

Year	2005	2006	2007	2008	2010	2011
Odd days	1	1	1	2	1	1

= 7 or 0 odd day.

∴ Calender for the year 2005 is the same as that for the year 2012.

22. (d) 09/12/2001——Sunday

No. of days between 9/ 12/ 71 & 9 / 12/ 2001

we know every year has 1 odd days

we know leap year has 2 odd days

Here, No. of normal years = 22

And no. of leap years = 8

So odd days = 22 + 16 = 38 i.e 3odd days

(remainder when 38 is divided by 7, i.e. 3)

Hence it was a Thursday

23. (c) 15th August, 1947 = (1946 years + Period from 1st Jan., 1947 to 15th Aug., 1947)

Counting of odd days :

1600 years have 0 odd day. 300 years have 1 odd day.

47 years = (11 leap years + 36 ordinary years)

= [(11 × 2) + (36 × 1)] odd days = 58 odd days

⇒ 2 odd days.

Jan.	Feb.	March	April	May	June	July	Aug.
31	28	31	30	31	30	31	15

= 227 days = (32 weeks + 3 days) = 3 odd days.

Total number of odd days = (0 + 1 + 2 + 3) odd days = 6 odd days.

Hence, the required day was 'Friday'.

24. (d) 100 years contain 5 odd days. So, last day of 1st century is 'Friday'

200 years contain (5 × 2) = 10 odd days = 3 odd days.

So, last day of 2nd century is 'Wednesday'.

300 years contain (5 × 3) = 15 odd days = 1 odd day.

∴ Last day of 3rd century is 'Monday'.

400 years contain 0 odd day.

∴ Last day of 4th century is 'Sunday'

Since the order is continually kept in successive cycles, we see that the last day of a century cannot be Tuesday, Thursday or Saturday.

25. (d) Angle traced by hour hand in $\frac{125}{12}$ hrs.

$=\left(\frac{360}{12}\times\frac{125}{12}\right)^{o}=312\frac{1}{2}^{o}$

Angle traced by minute hand in 25 min.

$=\left(\frac{360}{12}\times 25\right)^{o}=150^{o}$

∴ Reflex angle $=360-\left(312\frac{1}{2}-150\right)^{o}=197\frac{1}{2}^{o}$

26. (a) Time between 10 a.m. on Monday to 10:30 a.m. on Sunday $=144\frac{1}{2}$ hours.

$24\frac{1}{2}$ hours of incorrect clock = 24 hours of correct time.

∴ $144\frac{1}{2}$ hours of incorrect clock = x hours of correct time.

∴ $x = \frac{144\frac{1}{2}\times 24}{24\frac{1}{2}} = 144$ hours i.e.,

The true time is 10 a.m. on Sunday.

27. (d) At 15 minutes past 5, the minute hand is at 3 and hour hand slightly advanced from 5. Angle between their 3rd and 5th position.

Angle through which hour hand shifts in 15 minutes is

$\left(15\times\frac{1}{2}\right)^\circ = 7\frac{1}{2}^\circ$

∴ Required angle = $\left(60+7\frac{1}{2}\right) = 67\frac{1}{2}^\circ$

28. (a) 16th July, 1776 mean (1775 years + 6 months + 16 days)

Now, 1600 years have 0 odd days.

100 years have 5 odd days

75 years contain 18 leap years and 57 ordinary years and therefore (36 + 57) or 93 or 2 odd days.

∴ 1775 years given 0 + 5 + 2 = 7 and so 0 odd days.

Also number of days from 1st Jan. 1776 to 16th July, 1776

Jan. Feb. March April May June July

31 + 29 + 31 + 30 + 31 + 30 + 16

= 198 days = 28 weeks + 2 days = 2 odd days

∴ Total number of odd days = 0 + 2 = 2.

Hence the day on 16th July, 1776 was 'Tuesday'.

29. (b) The year 1979 being an ordinary year, it has 1 odd day.

So, the day on 12th January 1980 is one day beyond on the day on 12th January, 1979.

But, January 12, 1980 being Saturday.

∴ January 12, 1979 was Friday.

30. (c) We go on counting the odd days from 1991 onwards till the sum is divisible by 7. The number of such days are 14 upto the year 2001. So, the calender for 1991 will be repeated in the year 2002.

31. (a) Time from 5 a.m. on a day to 10 p.m. on 4th day is 89 hours.

Now, 23 hrs. 44 min. of this clock are the same as 24 hours of the correct clock.

i.e., $\frac{356}{15}$ hrs. of this clock = 24 hrs. of correct clock.

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

So, the correct time is 11 p.m.

32. (c) 55 min spaces are gained in 60 min

⇒ 35 min spaces will be gained in 38.18 min.

⇒ Answer = 7 hrs + 38.18 min.

33. (a) Time from 7 a.m. to quarter pas 4

= 9 hours 15 min.=555 min.

Now, $\frac{37}{12}$ min. of this watch = 3 min. of the correct watch.

555 min. of this watch = $\left(\frac{3\times 12}{37}\times 555\right)$ min.

= $\left(\frac{3\times 12}{37}\times\frac{555}{60}\right)$ hrs. = 9 hrs. of the correct watch.

Correct time is 9 hours after 7 a.m. i.e., 4 p.m.