6 Clocks and Calendars

Clocks

A clock is a mechanical or electronic device that is a periodic system to indicate time. Calendars indicate dates in terms of days, months, and years. In management entrance exams, one can expect a few questions from this topic.

Points to Remember

- The hands of a clock are at 90° for 22 times in 12 hours.
- The hands of a clock are at 180° for 11 times in 12 hours.
- The two hands coincide 11 times in 12 hours.
- Relative speed of minute hand and hour hand = 5.5° per minute.
- The minute hand overtakes the hour hand after every 720/11 minutes.

Formula for calculating the angle between the hands of a clock

i) $\text{Angle} = \frac{11}{2}m - 30h$ (when, $\frac{11}{2}m > 30h$)

ii) $\text{Angle} = 30h - \frac{11}{2}m$ (when, $30h > \frac{11}{2}m$)

(where, m = minutes and h = hours)

Keynote

Clock questions are mostly based on the analogue clocks.

Example 1:

What is the angle between the hands of the clock at 9:38 am?
(A) 61°
(B) 59°
(C) 61.5°
(D) 60°

Solution: (A)

Formula method

Since, 30 × H > 11 × M/2,

$$\text{Angle} = 30h - \frac{11}{2}m \text{ (when, } 30h > \frac{11}{2}m)$$

So, $\text{angle} = 30 \times 9 - \frac{11}{2} \times 38$ i.e., 61°.

OMET Mantra

The minute hand covers 6° in a minute.

The hour hand covers 1/2° in a minute.

Alternative solution

At 9 o'clock, the angle between the hour hand and minute hand is 270°.

The degrees turned by the hour hand in 12 hours = 360°.

The degrees turned by the hour hand in 1 hour = 30°.

The degrees turned by the hour hand in 1 min = 30/60 = 0.5°.

Similarly, the degrees turned by the minute hand in 60 min = 360°.

The degrees turned by the minute hand in 1 min = 360/60 = 6°.

In 38 minutes, The hour hand will move = 38 × 0.5 = 19° further or 270 + 19 = 289° from the vertical line.

The minute hand will move = 38 × 6 = 228°.

The angle between the two hands at 9:38 am = 289 – 228 = 61°.

Hence, option (A) is correct.

Example 2:

A watch gains uniformly and was observed to be three minutes slow at 8 a.m. on a particular day. At 8.00 p.m. on the same day, it was three minutes fast. At which time did the watch show the correct time?

(A) 1 p.m.

(B) 3 p.m.

(C) 2 p.m.

(D) 6 p.m.

Solution: (C)

The duration from 8 am to 8 p.m. is 12 hours. The total number of minutes gained by the clock in these 12 hours is given as 6 minutes. If the clock gains three minutes, then it shows the correct time, the time taken by the clock to gain three minutes is 6 hours after 8 a.m., i.e., at 2.00 p.m. the clock shows the correct time.

Hence, option (C) is correct.

Example 3

At what time between 7 o'clock and 8 o'clock are two hands of a clock 80° apart?

(A) 7 hours $52\frac{8}{11}$ min

(B) 7 hours $38\frac{8}{11}$ min

(C) 7 hours $23\frac{7}{11}$ min

(D) Both (A) and (C)

Keynote

The angle between two hands at 3:15 p.m. is 7.5° (not 0°).

Solution: (D)

At 7.00 the minute hand of a watch is at the 12 mark and hour hand at the 7 mark.

The angle between them is 210°.

Assuming that the hour hand stays fixed at 7, to make 80 degree angle to it, the minute hand has to travel either

a) 210 – 80 = 130° or,

b) 210 + 80 = 290°,

but at a relative speed compared to the hour hand, i.e., (6 – 0.5) deg/min = 5.5 deg/min.

Time taken to do so is:

a) (130/5.5) min = 23 and 7/11 min, or,

b) (290/5.5) min = 52 and 8/11 min.

Hence, at 23 and 7/11 past 7, and 52 and 8/11 past 7 the phenomenon will happen.

Hence, option (D) is correct.

Example 4:

At a particular point in time, the number of hours to 12:00 p.m. from that time is twice the number of hours to 12:00 p.m. after 5 hours from that particular time. Find the time.

(A) 2:30 p.m.

(B) 4 o'clock

(C) 2 o'clock

(D) None of these

Solution: (C)

Let the present time be *x* o'clock.

$\therefore 2(12 - (x + 5)) = 12 - x$

$\Rightarrow 2(7 - x) = 12 - x$

So, $x = 2$, i.e., the present time is 2 o'clock

Hence, option (C) is correct.

Rack Your Brain

1. At what angle are the hands of a clock inclined at 20 minutes past 7?

   How many degrees does an hour hand make in 10 minutes?

   A clock is set to the correct time at 10 am. The clock loses 12 minutes in a day. What will be the appropriate time when the watch indicates 5 p.m. on the next day?

Example 5:

For how many times, the minute hand of a clock is opposite the hour hand from 8 p.m. on the sixth of a month to 6:00 am on the 10th of the same month?

(A) 93

(B) 76

(C) 56

(D) 86

Solution: (B)

From 8:00 p.m. on the sixth of a month to 8:00 p.m. on the 9th of the same month, it occurs 66 times.

From 8:00 p.m. to 6:00 am, they are opposite each other for 10 times. Therefore, they are opposite for 66 + 10 = 76 times.

Hence, option (B) is correct.

Example 6:

What is the angle between the hands of the clock when it shows 50 minutes past 5 o'clock?

(A) 125°

(B) 96°

(C) 170°

(D) 120°

Solution: (A)

At 5 o'clock, the hour hand makes an angle of 150° from the vertical and the minute hand makes an angle of 0° from the vertical.

Speed of the hour hand = 0.5 deg/min and speed of the minute hand = 6 deg/min.

In 50 minutes, the hour hand will move = 50 × 0.5 = 25° further or 150 + 25 = 175° from the vertical.

The minute hand will move = 50 × 6 = 300°.

The angle between the two hands at 5:50 = 300 – 175 = 125°.

Hence, option (A) is correct.

Calendars

A calendar is a tabular representation of dates, days, months, and years.

Leap Years and Non-Leap Years

A leap year has 29 days in February whereas an ordinary/non-leap year has only 28 days in February.

Number of Odd Days/Extra Days

It is equal to the remainder obtained when a particular period (of days) is divided by 7. For example, the number of odd days in a period of 60 days is '4'.

because 60 ÷ 7 → Remainder = 4

Important points

- 1st January 0001 was a Monday.
- **Odd days:** remainder obtained when no. of days of a period is divided by 7.
- A normal year has 1 odd day and a leap year has 2 odd days.
- A century has 5 odd days and a leap century has 6 odd days.
- The calendar *moves ahead* by the number of *odd days*.
- Calendar repeats after every 400 years.
- **Leap year:** It is always divisible by 4, but a *century year* (the year where a century

ends) is not leap year unless it is divisible by 400.

- While checking leap year, just analyze whether *February* falls in that period or not.
- In a *normal year*, 1st January, 2nd July, and 1st October fall on the same day.
- In a *leap year*, 1st January, 1st July, and 30th September fall on the same day.
- 1st January 1901 was *Tuesday*.

Example 7:

Which day of the week was 19th April 1901?

(A) Monday

(B) Tuesday

(C) Wednesday

(D) Friday

Solution: (D)

We know that (or rather need to remember that) 1st January 1901 was *Tuesday*.

Now, to find the day on the 19th of April, we will count the days till the 18th of April (see Period Calculation).

The number of days from 1st January 1901 to 19th April 1901

= (31 + 28 + 31 + 18) days = 108 days

= 15 weeks + 3 odd days

Total odd days = 3

Hence, 19th April 1901 is Friday. (i.e., 3 days ahead of Tuesday).

Hence, option (D) is correct.

OMET Mantra

Calendar moves forward by number of odd days.

Period calculation

While calculating the number of days in a period (in order to find the number of odd days), always exclude the last day, if you include the first day of that period (i.e., the day which is known).

For a period in a month, the calculation is very simple, higher value – lower value. But for the period spreading across months, the above-mentioned point should be considered.

For example, if 1st January is Monday, and you wish to find out the day on 28th February in the same year. So, you will consider it a period of 31 + 27 = 58 days. (Note that we have excluded 28th February here).

Since, $\frac{58}{7}$ gives a remainder of 2, 28th February will be Wednesday (i.e., 2 days ahead of Monday).

Example 8:

If the first day of the years 2012 and 2023 are Mondays, which day of the week will the last days of these years be, respectively?

(A) Thursday, Tuesday

(B) Tuesday, Monday

(C) Monday, Tuesday

(D) Sunday, Monday

Solution: (B)

2012 is a leap year, so it will have two odd days.

Hence, 1st January 2013 is two days after Monday to Wednesday.

So, 31st December 2012 is a Tuesday, 2023 is a non-leap year and has 1 odd day.

So, 1st January 2024 is Tuesday and 31st December 2023 is a Monday.

Hence, option (B) is correct.

OMET Mantra

Any century year (i.e., the last year of a century) would be a leap year only if it is divisible by 400.

Example 9:

If in a calendar year there are 541 days and 10 days a week, then how many odd days will be there in that year?

(A) One

(B) Two

(C) Three

(D) Four

Solution: (A)

To find the number of odd days, we have to find the final remainder of 541/10.

The remainder is one.

Hence, there is one odd day.

Hence, option (A) is correct.

Rack Your Brain

2. If a year starts and ends with Sunday, then how many Sundays are there in that year?

Which among the following is a leap year?

(A) 2,600 (C) 2,700

(B) 2,800 (D) 3,000

Example 10:

If 1st January 2012 is a Sunday, then on which day of the week will the New Year be celebrated in 2016?

(A) Friday (B) Sunday

(C) Wednesday (D) Saturday

Solution: (A)

The total number of years from 2012 to 2016 is four, out of which 2013, 2014, and 2015 are non-leap years, hence there is 1 odd day in each of these years, 2012 is a leap year; hence, it has 2 odd days.

The total number of odd days in these four years is 5.

1st January 2016 is five days to Sunday, i.e., Friday.

Hence, option (A) is correct.

Example 11:

If 12th December 2005 is a Monday, then 12th December 2605 is:

(A) Monday (B) Saturday

(C) Tuesday (D) Thursday

Solution: (D)

The number of years from 2005 to 2605 is 600 years.

600 years = 400 years + 200 years = 0 odd days + 3 odd days.

Three days after Monday, it will be Thursday.

Therefore, 12th December 2605 is Thursday.

Hence, option (D) is correct.

Example 12:

If 21st February 2005 was a Monday, then what day of the week will be 21st February 2105 (i.e., after the century)?

(A) Sunday (B) Saturday

(C) Monday (D) Friday

Solution: (B)

The number of odd days in 100 years (i.e., century) is 5.

Hence, 21st February 2105 is five days after Monday i.e., on Saturday.

Hence, option (B) is correct.

Practice Exercise

Level of Difficulty – 1

1. Which month will have the same calendar as January in a leap year?
(A) April
(B) July
(C) October
(D) March

2. At what time (approx.) between 3:00 am and 4:00 am do the hands of a clock form an angle of 180°?
(A) 3:49
(B) 3:45
(C) 3:46
(D) 3:50

3. A faulty watch loses 7 minutes every hour. It was set right at 6 am on Monday. Approximately when will it show the correct time again?
(A) 12:51 am on Thursday
(B) 12:50 p.m. on Friday
(C) 12:51 am on Friday
(D) 12:51 p.m. on Friday

4. If 24th March 2010 was Wednesday, what day was it on 24th June 2010?
(A) Friday
(B) Wednesday
(C) Tuesday
(D) Thursday

5. When a watch shows 3:15, then the minute hand points towards the east, in which direction will the hour hand point at 9 p.m.?
(A) West
(B) North
(C) South-West
(D) North-West

6. In 2001, India celebrated its independence day on Wednesday. In which of the following years did India celebrate its republic day on Sunday?
(A) 2001
(B) 2002
(C) 2003
(D) 2004

7. A clock is kept horizontally on a table in such a way that at 6:12 am, its minute hand points towards South-East. At what time will the hour hand point exactly towards North?
(A) 9:48 AM
(B) 9:54 AM
(C) 11:06 AM
(D) 1:48 p.m.

8. What is the angle between the hands of the clock at 7:14?
(A) 135°
(B) 129°
(C) 131°
(D) None of these

Directions for Questions 9 to 12

The time on the clock is between 2 p.m. and 3 p.m.. You need to find the exact time when the two hands of the clock meet the condition/s given in each of the questions below.

9. The hands make an angle of 60° with each other.

10. The hands overlap with each other.

11. The hands are perpendicular to each other.

12. The hands are on the same straight line but are facing the opposite direction.

13. If you were born on the 14th of April 1992, which was a Sunday, then on which day of the week does your birthday fall in 1993?
(A) Monday
(B) Tuesday
(C) Wednesday
(D) Friday

14. If 1st January 1992 is a Tuesday then on which day of the week will 1st January 1993, fall?

(A) Wednesday
(B) Thursday
(C) Friday
(D) Saturday

15. If 1st April 2003 was Monday, then which day of the week will 25th December of the same year be?

(A) Tuesday
(B) Wednesday
(C) Thursday
(D) Friday

Level of Difficulty – 2

1. Find the angle between the minute hand and the hour hand at 3:20 p.m.
(A) 10°
(B) 20°
(C) 30°
(D) 40°

2. Find the time between 1 and 2 o'clock at which the minute hand and hour hand make an angle of 60° with each other.
(A) 1 hour 20 minute
(B) 1 hour $15\frac{3}{11}$ minute
(C) 1 hour $16\frac{4}{11}$ minute
(D) None of these

3. The reflection of a wall clock in a mirror shows the time as 2 hours 40 minutes. What is the actual time?
(A) 8 hours 15 minutes
(B) 8 hour 20 minutes
(C) 9 hours 20 minutes
(D) 8 hours 35 minutes

4. By how many degrees does an hour hand move in three-quarters of an hour?
(A) 7.5°
(B) 22.5°
(C) 21.5°
(D) 15°

5. A clock strikes at 1 o'clock twice at 2 o'clock, three times at 3 o'clock, and so on. If it takes 10 seconds to strike at 6 o'clock find the time taken by it to strike at 12 o'clock.
(A) 18 seconds
(B) 22 seconds
(C) 24 seconds
(D) 26 seconds

6. The minute hand of a clock coincides with the hour hand at an interval of 60 minutes of correct time. How much time does the clock gain or lose in 1 hour of the correct time?
(A) Gains $5\frac{5}{11}$ minutes
(B) Loses $5\frac{5}{11}$ minutes
(C) Gains $\frac{5}{11}$ minutes
(D) Loses $\frac{5}{11}$ minutes

7. In a particular period, there are exactly 25 leap years.
Which of the following is/are true about that period?
I. There should be at least one 'century year' in that period.
II. There should be at least two 'century years' in that period.
III. There can be at most one century years in that period.
IV. There can be at most two centuries years in that period.
(A) II and IV only
(B) I and III only
(C) I and IV only
(D) I, II, and III only

8. If 28th August 1946 was a Wednesday, what day of the week was on 31st August 1961?
(A) Tuesday
(B) Thursday
(C) Monday
(D) Wednesday

9. If 1st May of a particular year is a Saturday, then how many Fridays will fall on the prime numbered days of the December month of the same year?
(A) 0
(B) 1
(C) 2
(D) 3

10. In 2016, Mahesh celebrated his birthday on Friday. When will be the first year after 2016 when Mahesh will celebrate his birthday on a Wednesday? (He was not born in January or February).
(A) 2021
(B) 2023
(C) 2020
(D) 2025

11. If you were born on 14th April 1992, which was a Sunday, then on which day of the week does your birthday fall in 1993?
(A) Monday
(B) Tuesday
(C) Wednesday
(D) Friday

12. It was Monday on 31st December 2007. What was the day on 31st December 2014?
(A) Monday
(B) Tuesday
(C) Wednesday
(D) Thursday

13. If 28th February 2012 was Tuesday, then what day of the week was 28th February 2015?
(A) Monday
(B) Saturday
(C) Thursday
(D) Sunday

14. Which year will have the same calendar as that of 2005?
(A) 2006
(B) 2007
(C) 2008
(D) 2011

15. Arjun's grandfather was born on 14th April 1992, then on which day did his grandfather celebrate his first birthday if it is known that he was born on a Sunday?
(A) Saturday
(B) Sunday
(C) Monday
(D) Friday

Level of Difficulty – 3

1. Rishi went out from his home between 3 p.m. and 4 p.m. and, came back between 9 p.m. and 10 p.m.. He observed that the hour hand and minute hand have inter-changed their positions. Find the angle between the hour hand and the minute hand when he left his home?

(A) $\frac{1,930}{17}$

(B) $\frac{2,160}{11}$

(C) $\frac{2,160}{13}$

(D) $\frac{1,940}{13}$

2. At what time after 3 p.m. and before 4 p.m. the angle between the hour hand and the minute hand is 90°?
(A) 32 minutes 43 seconds
(B) 34 minutes 56 seconds
(C) 30 minutes
(D) 34 minute 43 seconds

3. What was the day of the week on 15th July 1998?
(A) Wednesday
(B) Tuesday
(C) Thursday
(D) Friday

4. Azad was born in 1898 on Sunday. Which day of the week did he celebrate his birthday in 1905?
(A) Saturday
(B) Sunday
(C) Monday
(D) Tuesday

5. A watch showed 10 minutes past 6 o'clock on Thursday morning when the correct time was 6 o'clock. It loses time uniformly and was observed to be 15 minutes slow at 8 o'clock on Saturday morning. When did the watch show the correct time?
(A) 1 o'clock on Friday afternoon
(B) 12 noon on Friday
(C) 4 o'clock on Friday evening
(D) 2 o'clock on Friday morning

6. A clock shows 2 o'clock in the morning. By how many angles will the hour hand rotate when the clock shows 4 o'clock in the morning on the same day?
(A) 30°
(B) 45°
(C) 60°
(D) 90°

7. The minute hand of a clock crosses the hour hand after every 70 minutes of correct time. How much time (rounded to the nearest minute) does the clock gain or lose time every 24 hours?
(A) 36 min gain
(B) 94 min loss
(C) 42 min gain
(D) 36 min loss

8. A Marathon starts between 5 p.m. and 6 p.m.. The referee realizes that the hands of a clock are interchanged when the marathon ends between 8 p.m. and 9 p.m.. What was the appropriate start time for the marathon?
(A) 5:23 p.m.
(B) 5:42 p.m.
(C) 5:44 p.m.
(D) 5:49 p.m.

Directions for Questions 9 and 10

Following details are available about the birthdays of four friends—A, B, C, and D, who were born in the same year on four consecutive days.

i) Only A was born in the month in which B was born.

ii) The youngest one was born on an even day of the month.

iii) A is neither the youngest nor the oldest. D is older than C.

iv) C and A were not born on consecutive days.

v) The day of the month on which B was born, is represented by a prime number.

9. Which of the following is a possible day on which C celebrates his birthday?
(A) 2nd March 2008
(B) 2nd March 2010
(C) 2nd December 2010
(D) 31st November 2008

10. Who among the following was born on the last day of the month?
(A) A
(B) B
(C) C
(D) D

11. Mike was born in 1969 on Wednesday. How many years old was he, when he first celebrated his birthday on Tuesday?
(A) 5
(B) 7
(C) 6
(D) 8

12. If 29th December of a particular year was Wednesday, what day was it on 29th January of the same year?
(A) Friday
(B) Thursday
(C) Saturday
(D) Cannot be determined

13. At what time (approximate to the nearest minute) between 5:00 am and 6:00 am do the hands of a clock form an angle of 60°?
(A) 5:16 am and 5:32 am
(B) 5:38 am and 5:42 am
(C) 5:38 am and 5:19 am
(D) None of these

14. If the 29th March of a particular year was Wednesday, what day was it on 28th December of the same year?
(A) Friday
(B) Wednesday
(C) Tuesday
(D) Thursday

15. Golu eats a burger each time the hands (hour and minute) of his clock make an angle of 90°. How many burgers will he eat in a day?
(A) 48
(B) 22
(C) 24
(D) None of these

Solutions

Level of Difficulty – 1

1. (B)

The month, whose 1st day is exactly 7x days away from 31st January, will have the same calendar as that of January.
(Note: There is '0' day gap between 1st February and 31st January).
So, 1st February is 0 day away
1st March is 29 days away (as per the question, February has 29 days).
1st April is 60 days away... and so on.
So, July is 182 days away, which is a multiple of 7.
Hence, July is the answer.

Alternate solution

Summation of number of the odd days, month-wise, from 1st January onwards
= 3 (January) + 1 (leap year February) + 3 (March) + 2 (April) + 3 (May) + 2 (June) = 14 odd days, which is divisible by 7 (the number of days in a week).
Hence July will have an identical calendar to that of January in a leap year.
Hence, option (B) is correct.

2. (A)

Let us assume that the hands of the clock form an angle of 180°, at
x minutes past 3:00 am.
At 3 am, the hour hand is at 90° from the 12 o'clock position.
The degrees turned by the hour hand in 12 hours = 360°.
The degrees turned by the hour hand in 1 hour = 30°.
The degrees turned by the hour hand in 1 min = 30/60 = 0.5°.
In 'x' minutes, The hour hand will make an angle of $90 + 0.5x$ degrees from the 12 o'clock position.
Similarly,
The degrees turned by the minute hand in 60 min = 360°.
The degrees turned by the minute hand in 1 min = 360/60 = 6°.
In 'x' minutes,
The minute hand will make an angle of 6x degree with the vertical.
According to the question,
$6x - (90 + 0.5x) = 180°$
$5.5\,x = 270°$
$x = 540/11$

$x = 49\ \frac{1}{11}$ minutes

Alternate solution

At 3.00 am the minute hand of a watch is at the 12 mark and hour hand at the 3 mark.
The angle between them is 90 degrees.
Assuming that the hour hand stays fixed at 3, to make 180 degree angle, the minute hand has to travel 90 + 180 = 270 degrees, but at a relative speed compared to the hour hand, i.e., (6 – 0.5) deg/min = 5.5 deg/min.
Time taken to do so = (270/5.5) mins = 49 mins (approx).
Hence, at 3.49 am the phenomenon will happen.
Hence, option (A) is correct.

3. (D)

The watch will show the correct time again after losing 12 hours.
Time taken to lose 7 minutes = 60 minutes (1 hour).
Time taken to lose 1 hour (60 minutes) = 60/7 × 60 = 3,600/7 minutes.
Time taken to lose 12 hour = 3,600/7 × 12.

minutes = 30/7 days = $4\ \frac{2}{7}$ days = 4 days 6 hours 51 minutes (approx.)
So, it will show the correct time at = 12:51 p.m. on Friday.
Hence, option (D) is correct.

4. (D)

According to the question,
The number of days between 24th March and 24th June = 7 (March) + 30 (April) + 31 (May) + 24 (June) = 92
On dividing 92 by 7, we get 1 as a remainder. It means that 24th June was Wednesday + 1 = Thursday.
Hence, option (D) is correct.

5. (A)

At 3:15, minute hand will be at the third hour. If that is east, then clearly 9 p.m. will be west as 9 is just opposite to 3.
Hence, option (A) is correct.

6. (C)

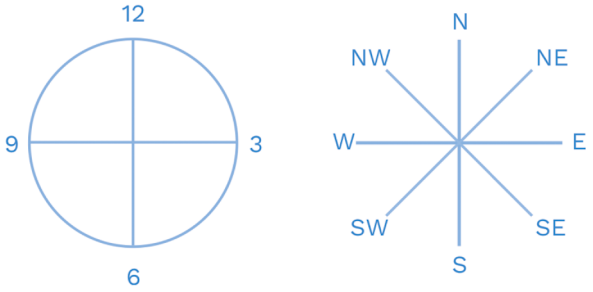
According to the question,
15th August 2001 = Wednesday
So, Number of days since 26th January
= 5 + 28 + 31 + 30 + 31 + 30 + 31 + 15
= 201 = (28 × 7 + 5) days
= 28 weeks + 5 days.
So, 28 weeks before 15th August 2001 was also Wednesday.
5 days before Wednesday, i.e., 26th January was Friday (Wednesday – 5).
Also, in an ordinary year, there is 1 odd (extra) day.
This means that 26th January 2002 was Saturday (Friday + 1).
Similarly, 26th January 2003 will be Sunday (Saturday + 1).

Alternate solution:

Number of odd days from 26th January 2001 (Republic Day) till 15th August 2001 = odd days from (27th January to 26th February) + (27th February to 26th March) + ... + (27th July to 26th August) – (16th August to 26th August)
= (3 + 0 + 3 + 2 + 3 + 2 + 3) – 4 = 5 odd days
So, 26th January 2001 is a (Wednesday – 5) = Friday.
Now 26th January 2002 will be a Saturday (non-leap year, i.e., odd days = 1) and 26th January 2003 will be a Sunday (non-leap year, i.e., odd days = 1)
Hence, option (C) is correct.

7. (B)

Let us assume a case when the clock is kept horizontally in such a manner that at 6:00 am, the minute hand point towards north.



At 6:12 am, its minute hand will turn by 12 × 6 = 72° (because 60 minutes = 360°)
In order to point towards the south-east, it must turn by 90 + 45 = 135°.
So, we can say that the clock is tilted at an angle of (135 - 72 = 63°) in the clockwise direction. At 12 o'clock, its hour hand will be making an angle of 63° with the vertical line.
1° of hour hand represents 2 minutes.
So, 63° = 126 minutes = 2 hours and 6 minutes.
It means that 2 hours and 6 minutes (63 degrees) before 12:00 p.m., i.e., at 9:54 am, its hour hand must have been pointing towards North.

Alternate solution:

The above diagram represents the original scenario.
Angle between the minute and hour hand at 6.12 am = {180 + (12 × 0.5)} – (12 × 6) = 114°.
For hour hand to point North, it has to move (180 + 45) – 114 = 111°.

Time taken to do so = 111/0.5 = 222 min = 3 hours 42 minutes.
So, the hour hand will point North at 6.12 am + 3 hours 42 min = 9.54 am.
Hence, option (B) is correct.

8. (D)
By using the angle formula,

$$\text{Angle} = 30h - \frac{11}{2}m \text{ (when, } 30h > \frac{11}{2}m\text{)}$$

$$\text{Angle} = 30 \times 7 - \frac{11}{2} \times 14$$

= 133°
So, the angle between the two hands at 7:14 is 133°.
Hence, option (D) is correct.

9. 2:00 p.m. and at **2:22** p.m.
At 2:00 p.m. the minute hand of a watch is at the 12 mark and hour hand at the 2 mark.
The angle between them is 60°.
Assuming that the hour hand stays fixed at 2, to make 60 degree angle, the minute hand has to travel 60 + 60 = 120°, but at a relative speed compared to the hour hand, i.e., (6 – 0.5) deg/min = 5.5 deg/min.
Time taken to do so = (120/5.5) mins = 22 mins (approx).
Hence, at 2:00 p.m. and at 2:22 p.m. the phenomenon will happen.
Hence answer is 2:00 p.m. and at 2:22 p.m.

10. $10\frac{10}{11}$ minutes past 2
When the two hands overlap, the angle between them is 0°.

$$\theta = \left|\frac{11}{2}m - 30h\right|$$

Hence, θ = 0° and h = 2

$$\frac{11}{2}m = 30 \times 2$$

$$m = \frac{120}{11} = 10\frac{10}{11} \text{ minutes past 2}$$

11. 2:27 p.m. and at **3:00** p.m.
At 2:00 p.m., the minute hand of a watch is at the 12 mark and hour hand at the 2 mark.
The angle between them is 60°. Assuming that the hour hand stays fixed at 2, to make 90 degree angle the minute hand has to travel 90 + 60 = 150°, but at a relative speed compared to the hour hand, i.e., (6 – 0.5) deg/min = 5.5 deg/min.
Time taken to do so = (150/5.5) mins = 27 mins (approx).
Hence at 2:27 p.m. and at 3:00 p.m. the phenomenon will happen.
Hence answer is 2:27 p.m. and at 3:00 p.m.

12. $43\frac{7}{11}$ minutes past 2 o'clock
When two hands are pointing in opposite directions and are on a straight line the angle between them would be 180°, i.e., θ = 180° and h = 2.

$$180 = \frac{11}{2}m - 30h$$

$$\frac{11}{2}m = 180 + 60 = 240$$

$$m = \frac{480}{11} = 43\frac{7}{11}$$

So, at $43\frac{7}{11}$ minutes past 2 o'clock the hands will be 180°.

13. (A)
14th April 1992 to 14th April 1993 is a complete year, which has 365 days. Hence, the number of odd days from 14th April 1992 to 14th April 1993 is 1. Hence, 14th April 1993 is one day after Sunday, i.e., Monday.
Hence, option (A) is correct.

14. (B)
Since 1992 is a leap year there are 2 odd days.
Hence, 1st January 1993 is two days after Tuesday i.e., Thursday.
Hence, option (B) is correct.

15. (B)

The number of days from 1st April to 25th December

(29 + 31 + 30 + 31 + 31 + 30 + 31 + 30 + 25)

days = 268 days $= \frac{268}{7} = 38 + 2$ odd days

Hence, 25th December is 2 days after Monday, i.e., Wednesday.

Alternate solution

Number of odd days from 1st April 2003 till 25th December 2003

= odd days from (2nd April to 1st May) + (2nd May to 1st June) + ... + (2nd November to 1st December) + (2nd December to 25th December)

= (2 + 3 + 2 + 3 + 3 + 2 + 3 + 2) + 3 = 23 odd days = 2 odd days

So 25th December 2003 is a (Monday + 2) = Wednesday.

Hence, option (B) is correct.

Level of Difficulty – 2

1. (B)

At 3 p.m., the hour hand makes an angle of 90° from the vertical and the minute hand makes an angle of 0° from the vertical.
Speed of the hour hand = 0.5 deg/min and speed of the minute hand = 6 deg/min.
In 20 minutes, the hour hand will move = 20 × 0.5 = 10° further or 90 + 10 = 100 degrees from the vertical.
The minute hand will move = 20 × 6 = 120°.
The angle between the two hands at 3:20 p.m. = 120 – 100 = 20°.
Hence, option (B) is correct.

2. (C)

By using the formula

$$\theta = \frac{11}{2}m - 30h \left(\text{when } \frac{11}{2}m > 30h \right)$$

$$\theta = 30h - \frac{11}{2}m \left(\text{when } 30h > \frac{11}{2}m \right)$$

So, between 1 and 2 o'clock

$$\theta = \frac{11}{2}m - 30h$$

$$60 = \frac{11}{2}m - 30 \times 1$$

$$\Rightarrow 90 = \frac{11}{2}m$$

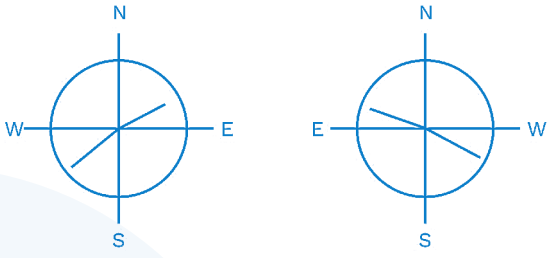
$$\Rightarrow \frac{180}{11} = m \Rightarrow 16\frac{4}{11} = m$$

Hence, option (C) is correct.

3. (C)

It is known that the reflection of a wall clock in a mirror is always refuted as the actual time = 12:00 – mirror time.

Here, mirror time = 2h 40 minutes
Therefore, the actual time:
12:00 – 2h 40 minutes = 9h 20 minutes



Original 2:40 As seen in Mirror

Alternate method:
By mere observation, and also because the options being far enough from each other, we can understand that it has got to be 9:20.
Hence, option (C) is correct.

4. (B)

Hour hand covers 30° per hour, i.e., hour hand moves,

$30° \times \frac{3}{4} = 22.5°$ in three-quarters of an hour.

($\therefore$ 3 quarters of an hour = $\frac{45}{60} = \frac{3}{4}$).

Alternatively:

Speed of an hour hand = 0.5 degree/min
Degrees covered in 3/4th of an hour, i.e., 45 mins = 45 × 0.5 = 22.5°
Hence, option (B) is correct.

5. (B)

The clock strikes 6 times at 6:00 o'clock. Let the gap between two consecutive strikes be x.

Now the total gap between 1st strike and the 6th strike is $5x$.

Now, $5x = 10 \quad \Rightarrow \quad x = 2$

Now, the gap between 1st strike and 12th strike at 12:00 o'clock is $11x$ i.e., 22 seconds.

Hence, option (B) is correct.

6. (A)

It is known that the hour hand and minute hand coincide after every $65\frac{5}{11}$ minutes in a correct clock.

Therefore, if a clock coincides after every 60 minutes, then the clock must be gaining time.

We can conclude that in 60 minutes the

difference $= 65\frac{5}{11} - 60$

$$= \frac{720}{11} - 60 = \frac{720 - 660}{11} = \frac{60}{11} = 5\frac{5}{11}\text{min.}$$

= (65 – 60) + 5/11 = 5 and 5/11 minutes.

Hence, option (A) is correct.

7 (C)

This is a tricky question and requires a slightly more details analysis of the period.

Also, you should know that a century year will be a leap year only if it is divisible by 400 (and not just by '4').

If you take a period of 1901 to 2000, there are 25 leap years but only 1 century year (i.e., year 2000).

If you take a period of 1798 to 1904, there are 25 leap years but 2 century years (i.e., years 1800 and 1900).

Hence, there have to be at least 1 century year and at most two century years.

So, option (C) is correct.

8. (B)

It is because that 28th August 1946 was Wednesday. From 28th August 1946 to 28th August 1961, we have 4 leap years and 11 normal years. So, the number of odd days would be:

11 × 1 + 4 × 2 = 19

Now the date which is asked is 31 August 1961. So, if we move from 28th August to 31st August, we will have 3 more odd days.

So, the total number of odd days = 19 + 3 = 22.

Now, 22 odd days is equivalent to 1 odd day.

So, 31st August 1961 would be Wednesday + 1 = Thursday.

Hence, option (B) is correct.

9. (D)

Number of odd days from 1st May till 1st December

= odd days from (1st May to 31st May) + (1st June to 30th June) + ... + (1st November to 30th November)

= (3 + 2 + 3 + 3 + 2 + 3 + 2) = 18 odd days = 4 odd days

So, 1st December will be (Saturday + 4) i.e Wednesday.

So, 3rd December will be Friday.

So, the other Fridays of that month will be 10, 17, 24, and 31.

Hence, there will be three such days i.e., 3, 17, and 31.

Hence, option (D) is correct.

10. (C)

Since it has been mentioned that Mahesh was not born in February, we will celebrate his next birthday on a Wednesday in the year for which the sum of the odd days becomes 5 or a multiple of 5.

By his birthday in 2017, there will be 1 odd day.

By his birthday in 2018, there will be 2 odd days.

By his birthday in 2019, there will be 3 odd days.

By his birthday in 2020, there will be 5 odd days, as 2020 is a leap year.

So, in 2020, he will celebrate his birthday on Wednesday.
Hence, option (B) is correct.

11. (A)
14th April 1992 to 14th April 1993 is a complete year with 365 days.
Hence, the number of odd days from 14th April 1992 to 14th April 1993 is 1.
Hence, 14th April 1993 is one day after Sunday, i.e., Monday.
Hence, option (A) is correct.

12. (C)
Number of odd days from 31st December 2007 till 31st December 2014
= 2 + 1 + 1 + 1 + 2 + 1 + 1 = 9 odd days = 2 odd days
So 31st December 2014 is a (Monday + 2) = Wednesday
Hence, option (C) is correct.

13. (B)
Number of odd days from 28th February 2012 to 28th February 2015
= 2 + 1 + 1 = 4
Hence, 28th February 2015 is Tuesday + 4 = Saturday.
Hence, option (B) is correct.

14. (D)
Year 2005 + 2006 + 2007 + 2008 + 2009 + 2010.
Odd days: 1 + 1 + 1 + 2 + 1 + 1
The total number of odd days from 2005 to 2010 is 7 = 0 odd days.
Hence, 2011 will have the same calendar as that of 2005.
Hence, option (D) is correct.

15. (C)
14th April 1992 to 14th April 1993 is one full year which has 365 days. Hence, the number of odd days between (52 weeks and 1 extra day) from 14th April 1992 to 14th April 1993 is 1. Hence it is Monday.
Hence, option (C) is correct.

Level of Difficulty – 3

1. (C)

Let the recorded angle be x.
Hour hand covers x degrees while minute hand covers $(360 \times 5 + 360 - x) = 2{,}160 - x$ degrees in that time.

Now, the time taken to cover these angles is the same.

$$\frac{2{,}160 - x}{6} = \frac{x}{1/2}$$

$$\Rightarrow 2x = \frac{(2{,}160 - x)}{6}$$

$$\Rightarrow x = \frac{2{,}160}{13}$$

Hence, option (C) is the right answer.

2. (A)

$$\text{Angle} = \frac{11}{2}M - 30h$$

$$\left(\text{if } \frac{11}{2}m > 30h\right)$$

So, $90 = \frac{11}{2}m - 30 \times 3$

$$180 = \frac{11M}{2}$$

$\frac{360}{11}$ = 32 minutes 43 seconds.
Hence, option (A) is correct.

3. (A)

15th July, 1998 = (1997 years + Period from 1.1.1998 to 15.7.1998)
1997 = 1600 + 300 + 97
Odd days in 1,600 years = 0
Odd days in 300 years = 1
97 years have 24 leap years + 73 ordinary years.
Number of odd days in 97 years (24 × 2 + 73) = 121 = 2 odd days.
Jan. Feb. March. April. May. June. July (31 + 28 + 31 + 30 + 31 + 30 + 15) = 196 odd days = 0 odd days.
Total number of odd days
= (0 + 1 + 2 + 0) = 3.
The given day is Wednesday.
Hence, option (A) is correct.

4. (C)

In each year we get 1 odd (extra day) and in a leap year, we will get 2 odd days.
So, the total number of odd days = 1(1899) + 1(1900) + 1(1901) + 1(1902) + 1(1903) + 2(1904) + 1(1905) = 7 + 1
Note: 1900 is not a leap year as it is divisible by 100.
So, it was Monday (Sunday + 1) when Azad celebrated his birthday in 1905.
Hence, option (C) is correct.

5. (D)

The watch lost 25 minutes in 50 hours, i.e., 6 am on Thursday to 8 am on Saturday.
So, it will lose 10 minutes in 20 hours. So, it will show the correct time at 2 o'clock on Friday morning.
Hence, option (D) is correct.

6. (C)

In 12 hours, the hour hand turns 360°.
Here, the difference between time = 2 hours
Thus, the required angle $= \frac{360}{12} \times 2 = 60°$
Hence, option (C) is correct.

7. (B)

The hands of a clock coincide with each other for 11 times every 12 hours.
So, when the time of the watch is correct, the interval for each coincidence is $(12 \times 60) / 11 = 65\frac{5}{11}$ min.

But in the given watch, they are coinciding after every 70 min.
So, the watch is losing time.

Loss for every 70 min = (70 – 65 & $\frac{5}{11}$)
= $4\frac{6}{11}$ min

Hence loss every 24 hours = $4\frac{6}{11}\times\frac{1}{70}\times 24\times 60$
= 93.5 min ≈ 94 min.

Hence, option (B) is correct.

8. (B)

Suppose the Marathon started at 5 hours x minutes and ended at 8 hours y minutes. Angle made by an hour in the first case will be $150+\frac{1}{2}x$ and the angle made by minute hand will be 6x. In the second case, the angle made by the hour hand will be 6x. In the second case, the angle made by the hour hand will be $240+\frac{1}{2}y$ and the minute hand will be 6y.

We have been given that

$$150+\frac{x}{2}=6y \text{ and } 240+\frac{y}{2}=6x$$

Solving both the equations we get x = 42.37 minutes. Start time is 5:42 p.m.

Hence, option (B) is the right answer.

9. (C)

According to the question,

Only A was born in the month in which B was born. It means A and B were born in the same month. While C and D were born in another month. The youngest one was born on an even day of the month. So, there can be four possible cases.

Case 1 (Possible Birthdays)	Case 2	Case 3 (Ordinary Year)	Case 4 (Leap Year)
30	29	27 February	28 February
31	30	28 February	29 February
1	1	1 March	1 March
2 (Youngest one)	2	2 March	2 March

A is neither the youngest nor the oldest.

D is older than C. So,

Case 1	Case 1a	Case 2	Case 2a	Case 3	Case 3a	Case 4	Case 4a
30-D	30-B	29-D	29-B	27 Feb-B	27 Feb-D	28 Feb-D	28 Feb-B
31-C	31-A	30-C	30-A	28 Feb-A	28 Feb-C	29 Feb-C	29 Feb-A
1-A	1-D	1-A	1-D	1 March-D	1 March-A	1 March-A	1 March-D
2-B	2-C	2-B	2-C	2 March-C	2 March-B	2 March-B	2 March-C

C and A were not born on consecutive days. So, cases 1, 2, 3a, and 4 will be eliminated.

Case 1a	Case 2a	Case 3	Case 4a
30-B	29-B	27 February-B	28 Feb-B
31-A	30-A	28 February-A	29 Feb-A
1-D	1-D	1 March-D	1 March-D
2-C	2-C	2 March-C	2 March-C

The day of the month on which B was born, is represented by a prime number. So, cases 1a, 3, and 4a will be eliminated.

Case 2a
29-B
30-A
1-D
2-C

Out of the four given options, the above conditions are met only in option (C), i.e., when C celebrates his birthday on 2nd December.

10. (A)

As explained earlier, A was born on the last day of the month.
Hence, option (A) is correct.

11. (A)

Each year, we get
1 odd (extra day).
It means Mike will celebrate his first birthday (in 1970) on Thursday (Wednesday + 1).
Similarly,
1971 = Friday (Mike's second birthday)
1972 is a leap year, hence there will be two odd days
1972 = Sunday (Mike's third birthday)
1973 = Monday (Mike's fourth birthday)
1974 = Tuesday (Mike's fifth birthday)
Hence, Mike was be 5 years old, when his first celebrated his birthday on Tuesday
Hence, option (A) is correct.

12. (D)

The answer cannot be determined as we do not know if that was a leap year or an ordinary year.
Hence, option (D) is correct.

13. (D)

At 5.00 am the minute hand of a watch is at the 12 mark and hour hand at the 5 mark.
The angle between them is 150°. Assuming that the hour hand stays fixed at 5, to make 60° angle the minute hand has to travel either
a) 150 – 60 = 90° or,
b) 150 + 60 = 210°,
but at a relative speed compared to the hour hand, i.e., (6 – 0.5) deg/min = 5.5 deg/min.
Time taken to do so is:
a) (90/5.5) mins = 16 mins (approx), or,
b) (210/5.5) mins = 38 mins (approx)

Hence, option (D) is correct.

14. (D)

Since we do not cross February, we need not be concerned about which type of year it is.
Hence total number of odd days between 29th March and 29th December = 2 (March).
+ 30 (April) + 31 + 30 + 31 + 31 + 30 + 31 + 30 + 28 (December) = 274 days.

On dividing 274 by 7, 1 is left as a remainder. So, it was Thursday (Wednesday + 1) on 28th December of that year.

Hence option (D) is correct.

15. (D)

We all know that in 12 hours the hands of a clock make an angle of 90° with each other 22 times.
Hence in 24 hours, they would make such 44 times.
So, Golu could eat 44 burgers in one day.

Hence, option (D) is correct.

Rack Your Brain

1. (A)

At 7 o'clock, the angle between the two hands is 210°.

Speed of the hour hand = 0.5 deg/min

Speed of the minute hand = 6 deg/min

In 20 minutes,

The hour hand will move = 20 × 0.5 = 10° further or 210 + 10 = 220° from the vertical.

The minute hand will move = 20 × 6 = 120°

The angle between the two hands at 7:20 = 220 – 120 = 100°.

Hence, the answer is 100°.

(B) Speed of the hour hand = 0.5 deg/min

So in 10 minutes the hour hand makes =10 × 0.5 = 5°

Hence, the answer is 5°.

(C) Clock loses 12 mins in a day, i.e., 12 minutes in 24 hours.

Hence, it loses 12/24 = 0.5 min every hour.

10 am to 5 p.m. is 7 hours.

So in 7 hours the time lost = 7 × 0.5 = 3.5 min

Watch shows 5 p.m..

So the correct (appropriate) time is 3 min 30 secs past 5 p.m.

Hence, the answer is 3 min 30 secs past 5 p.m.

Rack Your Brain

2. (A) If a normal year starts and ends on the same day of the week, it means that the first day of the next year starts after advancing by a day compared to the previous year.

That indicates that the number of odd days is 1, i.e., a year of 365 days.

Hence, the number of Sundays = quotient of (365/7) + 1 = 16.

Hence, the answer is 16 Sundays.

(B) If it is a century year, then to be a leap year it has to be divided by 400 as well.

Only 2,800 satisfies this condition and hence is the leap year.
Hence, the answer is 2,800.