

CLOCK

- A clock is a complete circle having 360 degrees. It is divided into 12 equal parts i.e. each part is $360/12 = 30^\circ$.
- As the minute hand takes a complete round in one hour, it covers 360° in 60 minutes.
- In 1 minute it covers $360/60 = 6^\circ$ / minute.
- Also, as the hour hand covers just one part out of the given 12 parts in one hour. This implies it covers 30° in 60 minutes i.e. $\frac{1}{2}^\circ$ per minute.
- This implies that the relative speed of the minute hand is $6 - \frac{1}{2} = 5\frac{1}{2}$ degrees.

Here, 60 minute spaces	$=360^\circ$
1 minute space	$=6^\circ$
Similarly, 12 hour space	$=360^\circ$
1 hour space	$=30^\circ$
Similarly, 60 second space	$=360^\circ$
1 second space	$=6^\circ$

Some facts about clocks:

- Coincide means 0 degree angle between 2 hands or when the hands are together. There is one coincide per hour except between 11 to 1 AM/PM. Between 11 and 1 am/pm, the two hands coincide only once i.e. at 12. Therefore, there are 11 coincides in 12 hours and 22 coincides in 24 hours.
- The two hands make a same straight line when they are together or opposite to each other.
- When the two hands are at a right angle, they are 15-minute spaces apart. In one hour, they will form two right angles and in 12 hours there are only 22 right angles. Example - It happens due to right angles formed by the minute and hour hand at 3'o clock and 9'o clock.
- When the hands are in opposite directions, they are 30-minute spaces apart.
- If both the hour hand and minute hand move at their normal speeds, then both the hands meet after $65\frac{5}{11}$ minutes.
- The minute hand moves around the whole circumference of the clock once in 1 hour.
- The hour hand moves around the whole

circumference of the clock once in 12 hours. That shows minute hand is twelve times faster than the hour hand.

- As already we knew that in an hour, the hour hand crosses 5 minute spaces while the minute hand crosses 60 min spaces.

In 60 min, the minute hand gains $(60 - 5) = 55$ min over hour hand

1 min is gained by minute hand over hour hand in $60/55 = 12/11$ min.

Minute and Hour Hands	Angle in Degree	Happened in 12 hrs
Coincident	0	11
Right Angle	90	22
Opposite	180	11
Straight Line	0 or 180	22

Elementary formula on Clocks

- Two hands of the Clock will be together between n and (n+1) O' clock at $(60n/11)$ min past n O' clock.
- Two hands of the clock will be right angles between n and (n+1) O' clock at $(5n \pm 15)/12/11$ min past n O'clock.
- Angle between hour and minute hands

The angle between the hands of the clock at a particular time is given by:

$\theta = [30(H - M/5) \pm M/2]$ degrees. where, θ is angle between the hour hand and minute hand. H is the no. of hours. M is in minutes.

Faulty Clock

A clock which shows incorrect time is a faulty or defective clock. For example, if a clock indicates 3 hours 10 minutes when the correct time is 3, then the clock is gaining, whereas if it indicates 5:50 when the correct time is 6, then the clock is losing.

The minute hand of a clock overtakes the hour hand at an interval of M minutes of correct time.

And so, the clock gains or losses in a day is given by $(720/11 - M) * (60 * 24/M)$ min.

Solved examples

Q 1. 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

Answer: Option D

Explanation:

In 1 hour, hour hand traces 30 degrees.

In 6 hours, hour hand will trace = $30 \times 6 = 180$ degrees.

Q 2. 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

Answer: Option C

Explanation:

Angle traced by hour hand in 12 hrs = 360.

In 1 hour, hour hand traces 30 degrees.

Angle traced by hour hand in 5 hrs 10 min = $5 \times 30 + 10/60 \times 30 = 155$ degrees.

Q 3. The angle between the minute hand and the hour hand of a clock when the time is 8.30, is:

- (a) 80
- (b) 75
- (c) 60
- (d) 105

Answer: B

Explanation:

Angle traced by hour hand = $8 \times 30 + 30/60 \times 30 = 255$ degrees.

Angle traced by minute hand = $30 \times 6 = 180$ degrees.

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

Q 4. How many times are the hands of a clock at right angle in a day?

- (a) 22
- (b) 24
- (c) 44
- (d) 48

Answer: C

In 12 hours, they are right angles 22 times.

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

Q 5. A clock becomes 12 s fast in every 3 h. If it is made correct at 3 O' clock in the afternoon of Sunday, then what time will it show at 10 O' clock Tuesday morning?

- (a) 2 min 52 s past 10
- (b) 2 min 54 s past 10
- (c) 2 min 50 s past 10
- (d) 2 min 48 s past 20

Answer: A

Total time from 3 O' clock Sunday afternoon to 10 O' clock Tuesday morning = 43 h

Total increased time = $(12/3) \times 43 = 172\text{s} = 2$ min 52s

Therefore, Time at 10 O' clock Tuesday morning = 2 min 52 s past 10

Q 6. A clock becomes 10 min fast in every 6 h. If it is made correct at 6 O' clock in the evening of Sunday, then what time will it show at 6 O' clock Tuesday morning?

- (a) 7 am
- (b) 8 am
- (c) 9 am
- (d) 10 am

Answer: A

Total time from 6 O' clock Sunday afternoon to 6 O' clock Tuesday morning = 36 h

Total increased time = $(10/6) \times 36 = 60$ min

Therefore, Time at 6 O' clock Tuesday morning = 7am.

Q 7. A clock is set right at 5 am. The clock loses 16 min in 24 h. What will be the right time when the clock indicates 10 pm on the 3rd day ?

- (a) 11 : 15 pm
- (b) 11 pm
- (c) 12 pm
- (d) 12 : 30 pm

Answer: B

Time from 5 am of a particular day to 10 pm on the 3rd day is 89 h.

Now, the clock loses 16 min in 24 h or in other words,

we can say that 23 h 44 min of this clock is equal to 24 h of the correct clock.

$(23 + 44/60) = 356/15$ hr of this clock = 24h of the correct clock

Therefore, 89 h of this clock = $(24 \times 15/356 \times 89)$ hour

the correct clock = 90 h of the correct clock or 89 h of this clock = 90 h of the correct clock.

Therefore, it is clear that in 90 h this clock loses 1 h and hence, the correct time is 11 pm when this clock shows 10 pm.

Q 8. A clock, which loses uniformly, is 15 min fast at 9 am on 3rd of the December and is 25 min less than the correct time at 3 pm on 6th of the same month. At what time it was correct ?

- (a) 2 : 15 am on 3rd
- (b) 2 : 15pm on 4th
- (c) 2 : 15 pm on 3rd
- (d) 2 : 15 am on 4th

Answer: B

Total time from 9 am on 3rd of the December to 3 pm on 6th of the December = 3 days 6 hours = 78 hours.

Also, the clock loses in 78 hours = $(15 + 25) = 40$ minutes. So, the clock loses 15 minutes in = $78/40 \times 15 = 29$ hours 15 minutes.

Therefore, the clock is correct after 29 hours 15 minutes from 9 am on 3rd December = 2.15 pm on 4th December.

Q 9. Two clocks are set correctly at 10 am on Sunday. One clock loses 3 min in an hour while the other gains 2 min in an hour. By how many minutes do the two clocks differ at 4 pm on the same day ?

- (a) 25 min
- (b) 20 min
- (c) 35 min
- (d) 30 min

Answer: D

Total number of hours between 10 am and 4pm = 6 hours.

Time lost by 1st clock = $3 \times 6 = 18$ minutes.

Time gained by 2nd clock = $2 \times 6 = 12$ minutes.

Hence, difference between time in both clocks will be: $12 - (-18) = 30$ minutes.

Q 10. 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 ?

- (a) 5.15 a.m.
- (b) 5.30 a.m.
- (c) 6 a.m.
- (d) 6.30 a.m.

Answer: B

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.

Q 11. A mechanical grandfather's old 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?

- (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

Answer: B

Time lost in $6\frac{1}{2}$ hrs = $(4 \times \frac{1}{2} \times 6)$ sec = 26 sec.

Correct time after $6\frac{1}{2}$ hrs = 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.

Q 12. 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?

- (a) 126 minutes
- (b) 136 minutes
- (c) 96 minutes
- (d) 106 minutes

Answer: A

One clock shows 10 pm.

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 = $(2 \times 18 + 5 \times 18)$ minutes = 126 minutes

Q 13. 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

- (a) 12:30 at night, after 130 days
- (b) 12 noon, after 135 days
- (c) 12 midnight after 135 days
- (d) 1:30 at nights, after 130 days

Answer: B

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

After 12 days, i.e., after 12×24 hours clock B will lose 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 lose 180 minutes in 135 days Total 720 minutes.

Q 14. The priest told the devotes, "the bell is rung at regular intervals of 45 min. The last bell was rung 5 min ago. The next bell is due to the rung at 7:45 am. At what time did the priest give the information to be devotes?"

- (a) 7:40 AM
- (b) 7:00 AM
- (c) 7:05 AM
- (d) 6:55 AM

Answer: C

Time of ringing last bell = $(7:45 - 0:45) = 7:00$ am.

But it happened 5 min before the priest gave the information to the devotes.

Therefore, Time of giving information = $7:00 + 0:05 = 7:05$ am.

Practice Questions

- Q 1.** What angle will be difference in angle traced by the minute and hour hands of a clock at 12:55?
- (a) 300
 - (b) 301
 - (c) 302
 - (d) 302.5

Q 2. At what angle (in degrees) the hands of a clock are inclined at 15 minutes past 5 ?

- (a) 58 degrees
- (b) 64 degrees
- (c) 67.5 degrees
- (d) 72 degrees

Q 3. 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

Q 4. From 1 O' clock afternoon up-to 10 O' clock in the night, the hands of a clock will be at right angle _____ Times.

- (a) 9
- (b) 10
- (c) 16
- (d) 20

Q 5. How many times in 24 h the hands of a clock are in straight line but opposition in directions ?

- (a) 20
- (b) 22
- (c) 24
- (d) 48

Q 6. At what time between 4 O' clock and 5 O' clock will hands of a clock be together ?

- (a) 24 min past 4
- (b) 23 min past 4
- (c) 21 $\frac{9}{11}$ min past 4
- (d) 54 min past 4

Q 7. 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

- (a) 4552.67 cm
- (b) 4555.67 cm
- (c) 4557.67 cm
- (d) 4559.67 cm

Q 8. How much does a watch gains 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.

Q 9. A faulty wall clock is known to gain 15 minutes every 24 hours. It is synchronized to the correct time at 9 AM on 11th July. What will be the nearest time to the nearest minute when the clock shows 2 PM on 15th July of the same year ?

- (a) 12:45 PM
- (b) 12:58 PM
- (c) 1:00 PM
- (d) 2:00 PM

Q 10. The minute hand of a clock overtakes the hour hand at intervals of 88 min of the correct time. How much does a clock gain or lose in a day ?

- (a) $368 (112/121)$ min (loss)
- (b) 369 min (loss)
- (c) 368 min (gain)
- (d) 369 min (gain)

Q 11. I have two watches with a 12 hours cycle. One of them gains one minute a day and the other loses 1 min 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) 720 days
- (b) 300 days
- (c) 480 days
- (d) 1440 days

Q 12. The reflex angle between the hands of a clock at 10:25 is

- (a) 180
- (b) 192.5
- (c) 195
- (d) 197.5 degrees

Solution

Q 1. Answer: D

Angle traced by hour hand = $55/60 \times 30 = 27.5$ degrees
And angle traced by minute hand = $55 \times 6 = 330$ degrees
Required angle = $330 - 27.5 = 302.5$ degrees

Q 2. Answer: C

Angle made by hour hand = $5 \times 30 + 15/60 \times 30$
 $= 150 + 7.5 = 157.5$
Angle made by minute hand = $15 \times 6 = 90$
Angle between minute and hour hand = $157.5 - 90 = 67.5$ degrees.

Q 3. Answer: B

Explanation: Clearly, the minute hand traverses 65 minutes in 1 hour.
 \therefore Required angle = $(360/60 \times 65) = 390$ degrees

Q 4. Answer: C

Time period from 1 O' clock afternoon to 10 O' clock night = $(10 - 1)h = 9h$
As we know, hands are at right angle 2 times in an hour.
Hence, in 9 h they will be at right angle $9 \times 2 = 18$ times.
But, at 3pm and 9pm there will be only one right angle.
Hence, total right angle will be $18 - 2 = 16$ right angles.

Q 5. Answer: B

The hands of a clock are in the same straight line (but opposite in direction) 11 times in every 12 h, because between 5 and 7 they point in opposite direction at 6 O' clock only.
Therefore, in a day (24 h) the hands point in the opposite direction $(2 \times 11) = 22$ times.

Q 6. Answer: C

Explanation:

At 4 O' clock, hour hand is at 4 and minute hand is at 12.

To be together with hour hand minute hand will have to gain 20 min. As 55 min are gained by minute hand in 60 min.

Therefore, 20 min will be gained in $(60/55 \times 20)$ min = $(60 \times 4/11)$ min = $240/11$ min = $21 (9/11)$ min past 4

Hence, the hands will be together at 21 (9/11) min past 4.

Q 7. Answer: C

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

Number of rounds completed by the hour hand in 3 days 5 hrs
 $= (3 \times 2 + 5/12) = 6 (5/12)$

Therefore, Difference between the distance traversed = $[77 \times (2 \times 22/7 \times 10) - 6(5/12) \times (2 \times 22/7 \times 7)]$ cm = $(4840 - 282.33)$ cm = 4557.67 cm.

Q 8. Answer: A

Therefore, required result = $(720/11 - x)(60 \times 24/76)$ min
Here, $x = 64$ Therefore, required result = $(720/11 - 64)(60 \times 24/76)$ min
 $= 32 (8/11)$ min.

Q 9. Answer: B

9 AM of 11 July of 2 PM on 15th July = 101 hours

In 24 hour clock gains hours $(15/60)$ min

In 1 hour clock will gain $1/96$ hours.

Let's assume, the correct clock has travelled X hours.

Then, time gained will be $X \times 1/96$ hours.

Total time = $X + X/96$, and this will be equal to 101 hours.

Hence, $X = 99.96$ hours. So, the nearest time will be 12:58pm.

Q 10. Answer: A

Required result = $(720/11 - x)(60 \times 24/x)$ min

Here, $x = 88$

Therefore, required result = $(720/11 - 88)(60 \times 24/88)$ min = $-368 112/121$ min (loss as sign in negative)

Q 11. Answer: D

Clearly, the first watch will show the correct time when it has gained 12 hours i.e., $(12 \times 60) = 720$ min and the second 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 = $(720 \div 1\frac{1}{2})$ days = $(720 \times \frac{2}{3})$ days = 480 days.

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

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

Q 12. Answer: D

Angle traced by hour hand in 10 hrs and 25 min = $10 \times 30 + \frac{25}{60} \times 30 = 312.5$ degrees.

Angle traced by minute hand in 25 min = $25 \times 6 = 150$ degrees.

\therefore Reflex angle = $360(312.5 - 150) = 197.5$ degrees.