GS FOUNDATION (2023-24) BOOKLET 24
&
CSAT FOUNDATION 2.0 (2023-24) BOOKLET 13
Clocks

Contents

1) INTRODUCTION

We use clock every day and our lives are virtually tied to it. Yet, the questions on this topic are not as easy as they seem.

This topic requires basic knowledge of Mathematics like concepts of circle, angles, speed and distance. It also involves few more calculations when compared with other topics.

2) BASICS OF CLOCKS:

A clock is basically a circle. It thus has 360 degrees.

It is divided into 12 equal divisions denoted from 1 to 12. Each of these divisions is called an hour.

The angle between the consecutive divisions is obtained by dividing the total angle of clock 360° by the number of divisions i.e. 12.

The angle between any two consecutive divisions = (360°)/12= 30°

There are two hands of a clock.

First, there's an hour hand. It travels one division in an hour.

An angular space between any two consecutive divisions has further five more divisions – called minutes. The area between the two divisions corresponds to a value of 5 minutes. Hence, dividing the 30° by five will result in the angular value of a minute.

Angular value of a minute = (30°)/5= 6°

1 minute = 6°

2 minutes = 12°

5 minutes = 30°

10 minutes = 60° and so on

i.e A minute hand travels 6 degrees in a minute

i.e. at the **speed of 6 degrees/minute**

An hour hand on the other hand travels 30° in 60 minutes i.e. **½ or 0.5°/minutes is the speed of hour hand**

So, **difference between speed of hour hand and minute hand is 5.5°/minute**

3) TYPES OF QUESTIONS:

<u>Coincidence of hour and minute hands:</u>

In this type of questions, how many times do two hands coincide within given time frame is to be determined.

Here, only thing we need to remember is that, every hour two hands meet once except between 11-12 and 12-1.

The question is: how many times do two hands meet in a day or between given time?

- First coincidence is clearly at 12 midnight.
- Note that between 12 to 1 two hands do not meet
- Between 1 and 2 they meet once; 2 and 3 they meet once and so on
- Also note that, between 11 and 12 two hands do not meet
- In 12 hours – there shall be 11 coincidences
- In 24 hours – there shall be 22 coincidences

Frequency of coincidence = 12 hours/11 = 720 minutes/11 = $65\frac{5}{11}$ minutes

So, every $65\frac{5}{11}$ minutes two hands coincide.

Shortcut in exam: If question asks to find how many times hands of clock meet between say 2pm to 4pm – you can simply check it on the watch.

Q. At what time between 3 and 4 do two hands coincide?

- Initially, there's 3 divisions or 90° gap between both hands. We want to know when will that be 0
- Minute hand gains 5.5°/minute over hour hand
- So, to cover 90° gap, it'll take 90/5.5 = $16\frac{4}{11}$ minutes
- So, the required time is 3: $16\frac{4}{11}$

<u>180° angle between two hands</u>

This type is very similar to above wherein almost every hour except 5-6 and 6-7, two hands make angle of 180° once an hour.

Q. How many times in a day do the minute and hour hands of clock form a 180° straight line in a day?

- Note that, at exactly 6, there's an angle of 180 between two hands
- Consequently, between 5-6 and 6-7, there's no other coincidence
- In 12 hours, there shall be 11 coincidences
- In 24 hours, there shall be 22 coincidences

Q. Find at what time between 9 and 10 o'clock will the hands of a clock be in the same straight line but not together?

- At 9 o'clock hour hand 15 minutes space apart from minute hand.
- This difference has to be 30 mins to be in a straight line.
- Thus, Min hand needs to gain 15 more minutes over Hour hand to be in straight line
- 15-minute space is equivalent to 90°
- 5.5° are gained per minutes min hand
- So, 90° will be gained in = 90/5.5 = $16\frac{4}{11}$ minutes
- Thus, time = 9:16 4/11 hours

Finding angle between two hands when time is known

Here, we're given exact time and we've to find angle between two hands of a clock.

Firstly, we simply draw the clock and look for range within which angle will lie using one division is 30°. If the answer can be found in the options with just this information, well and good. If not, we proceed as below to calculate precise angle.

Q. Find the angle between the hour hand and the minute hand of a clock when the time 2:45

- Hour hand travels 0.5°/minute
- So, in 2 hours 45 minutes, it'll travel 165/2° from 12-mark
- Minute hand is at 45-minute mark or 270° from 12-mark
- So, angle between them is 270 – 165/2 = 187.5°

OR

- We know that minute hand gains 5.5°/minute over hour hand
- So, in 45 minutes, it'll gain 45*5.5 = 247.5°
- However, hour hand was already at 2 i.e. 60° mark
- So, angle between two hands = 247.5 – 60 = 187.5°

Q. Find exact angle between the two hands when clock reads 3:30

- Hour hand is exactly between 3 and 4
- Minute hand is at 30-minute mark i.e. 6
- Angle = 30 + 30 + 15 = 75 degrees

Q. Find angle when clock reads 4:40

Q. Find angle when clock reads 7:50

Finding time when angle is known:

In this type of question, we're asked to find exact time when angle between two hands is given.

Q. At what time between 8 and 9 o'clock will the hands of a clock be at right angle?

- At exactly 8, the angle in 120° and 240° from the other side
- At exactly 9, angle from 120° becomes 90° - which is not between 8-9
- From other side angle 240° keeps reducing at the rate of 5.5°/min
- So, for this angle to reduce to 90°, (240-90)/5.5 minutes should lapse
- Thus, after 150/5.5 = $27\frac{3}{11}$ minutes post 8 o'clock angle will be 90°
- I.e. at time 8: $27\frac{3}{11}$ hours

Correct and incorrect clock

Here, the given clock is either slow or fast compared to correct clock. The wrong clock can either be fast or delayed by a few seconds/minutes/ hours or sometimes by a few days and weeks.

Q. A clock gains 10 seconds for every 5 minutes. If the clock started working at 7 a.m. in the morning, then what will be the time in the wrong clock at 4 p.m. on the same day?

- Clock gains 10 seconds in 5 minutes – 120 seconds in 60 minutes
- Between 7am and 4pm, 9 hours have elapsed.
- Clock gains 9*120 = 1080 seconds = 18 minutes
- Time in wrong clock: 4:18

Q. A clock is set right at 8 a.m. The clock loses 15 minutes in 24 hours. What will be time shown in the clock when some other accurate clock indicates 8 p.m. on the third day?

- 15 min loss in 24 hours
- Thus, in 60 hours (when accurate clock indicates 8pm), there shall be 37.5 minutes loss
- Time shown will be 7:22:30

Q. A clock is set right at 8 a.m. The clock loses 15 minutes in 24 hours. What will be true time when clock indicates 8 p.m. on the third day?
(Are the above two questions same? If not, what is the difference? Will the answer change?)

- NOTE: this faulty clock is showing 8pm
- In 24 hours, faulty clock loses 15 min thus ends up showing 23 hours 15 min or $23\frac{1}{4}$= 95/4 hours
- Thus, we need to find actual time lapsed when this clock ends up showing 60 hours elapsed
- Actual time = $\frac{60}{95/4} \times 24 = \frac{4\times60\times24}{95} = 60\frac{96}{95} = 60.632$ hours = 60 hours + 0.632*60minutes = 60 hours + 38 minutes
- Thus, correct clock shows 8:38 (approx.)

4) PYQS

CSE 2022: How many seconds in total are there in x weeks, x days, x hours, x minutes and X seconds?
(a) 11580x
(b) 11581x
(c) 694860x
(d) 694861x

CSE 2022: Consider the following statements:
1. Between 3:16 p.m. and 3:17 p.m., both hour hand and minute hand coincide.
2. Between 4:58 p.m. and 4:59 p.m. both minute hand and second hand coincide.
Which of the above statements is/are correct?
(a) 1 only
(b) 2 only

(c) Both 1 and 2
(d) Neither 1 nor 2

CSE 2021: At which one of the following times, do the hour hand the minute hand of the clock make an angle of 180° with each other?
(a) At 7:00 hours
(b) Between 7:00 hours and 7:05 hours
(c) At 7:05 hours
(d) Between 7:05 hours and 7:10 hours

CSE 2019: A wall clock moves 10 minutes fast in every 24 hours. The clock was set right to show the correct time at 8:00 am. on Monday. When the clock shows the time 6:00 p.m. on Wednesday, what is the correct time?
a. 5:36 p.m.
b. 5:30 p.m.
c. 5:24 p.m.
d. 5:18 p.m

CSE 2017: A watch loses 2 minutes in every 24 hours while another watch gains 2 minutes, in 24 hours. At a particular instant, the two watches showed an identical time. Which of the following statements is correct if 24hour clock is
(a) The two watches show the identical time again on completion of 30 days.
(b) The two watches show the identical time again on completion of 90 days.
(c) The two watches show the identical time again on completion of 120days.
(d) None of the above statements correct

CSE 2017: A clock strikes once at 1 o'clock, twice at 2 o'clock and thrice at 3 o'clock, and so on. If it takes 12 seconds to strike at 5 o'clock, what is the time taken by it to strike at 10 o'clock?
(a) 20 seconds
(b) 24 seconds
(c) 28 seconds
(d) 30 seconds

CSE 2016: A class starts at 11:00 am and lasts till 2:27 pm. Four periods of equal duration are held during this interval. After every period, a rest of 5 minutes is given to the students. The exact duration of each period is:
(a) 48 minutes
(b) 50 minutes
(c) 51 minutes
(d) 53 minutes

CSE 2015: Between 6 PM and 7 PM the minute hand of a clock will be ahead of the hour hand by 3 minutes at

(a) 6: 15 PM

(b) 6: 18 PM

(c) 6: 36 PM

(d) 6: 48 PM

CSE 2014: Assume that

1. The hour and minute hands of a clock move without jerking.
2. The clock shows a time between 8 o'clock and 9 o'clock.
3. The two hands of the clock are one above the other.

After how many minutes (nearest integer) with the two hands will be again lying one above the other?

(a) 60

(b) 62

(c) 65

(d) 67

5) COMPREHENSION

Our urban bodies cannot possibly ensure sustainable delivery of water in our cities unless financing mechanisms are put in place. Water delivery requires heavy investment in collecting it from a natural source, treating it to make it potable, and laying a distribution network of pipes for delivery to the users. It also requires investments in sewerage infrastructure and sewage treatment plants so that the sewers can carry the wastewater to these plants to ensure that no untreated sewage is discharged back into natural water bodies. If our cities were rich enough to meet the entire cost, water could be delivered free. They are not.

Q. What is the most logical and crucial message conveyed by the passage?

(a) Urban local bodies must recover costs through user charges.

(b) Urban local bodies are not efficient enough to meet the water requirements of our cities.

(c) Water shortage in our cities is a perennial problem that cannot be solved.

(d) In view of the water crisis in our cities, there is an urgent need to limit the population of cities by adopting an upper limit of population size.

Q. With reference to the above passage, the following assumptions have been made:

1. Rich cities only can ensure sustainable delivery of water.
2. Sustainable delivery of water in cities means much more than supplying water to households.

Which of the above assumptions is/are valid?

(a) 1 only

(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

These are polarising times and one hears some arguing that the Indian economy is doing dismally, and others chanting that it is a blazing success. The truth lies somewhere in between. It is true that the Indian rupee has been doing very poorly (especially in comparison to the stated target of our political leaders to strengthen it) and inflation, at 7.41%, is high, but these are global problems. Virtually all currencies are losing out against the U.S. dollar, and inflation right now is a global phenomenon. Where India is doing especially poorly is in employment generation. India's unemployment rate is high. In October, it stood at 7.8%. However, what is really worrying is youth unemployment. According to International Labour Organization (ILO) data, collated and presented by the World Bank, India's youth unemployment, that is, from among people aged 15 to 24 years who are looking for work, the percent that does not find any, stands at 28.3%.

Q. Which of the following inference cannot be drawn from the passage?
(a) State of Indian economy is not black or white but like most things – grey
(b) India's unemployment rate is unusual decoupled from global trend
(c) High inflation of 7.8% in India is part of a global trend
(d) Rupee like most currencies is losing in a big way against dollar

Q. In India, agriculture still engages about half of its workforce, and about 85 per cent of its farms are small and marginal. Compared to China and Vietnam, which have experienced fast structural and rural transformation, India's story is of slow transformation. As a result, poverty reduction in India was at much slower pace during 1988-2014, compared to China and Vietnam. India's poverty reduction was slow during 1988-2005, but during 2005-2012, it accelerated dramatically–almost three times faster than during the earlier period. What did India do during this period? Research reveals that the relative price scenario changed significantly (by more than 50%) in favour of agriculture in the wake of rising global prices. This boosted private investments in agriculture by more than 50%. As a result, agri-GDP growth touched 4.1% during 2007-2012 as against 2.4% during 2002-2007. The net surplus of agri-trade touched $25 billion in 2013-2014; real farm wages rose by 7% per annum. All this led to unprecedented fall in poverty.
Q. With reference to the above passage, the following assumptions have been made:
1. Structural and rural transformation is impossible when farms are mainly small and marginal.
2. A good price incentive can trigger investments in agriculture.
3. India needs to build value chains for high-value agri-products like livestock and horticulture.
4. Higher global prices of agricultural commodities are essential for India's poverty reduction.

Which of the above assumptions are valid?

(a) 1 and 3
(b) 2 and 4
(c) 2 and 3
(d) 3 and 4

In UK, royal assent is necessary for a Bill to be passed by Parliament to become law and the crown has the power to withhold assent. But it is a dead letter. By practice and usage there is no power of veto exercised by the crown in England now. Moreover, refusal of royal assent on the ground that the monarchy strongly disapproves of the Bill or that the Bill is very controversial is treated as unconstitutional. In the United States, the President is empowered by the Constitution to refuse assent and return a Bill to the House but if the Houses again pass it with two thirds of each House the Bill becomes law. The lesson to be drawn from these practices is that refusal of assent is a practice which is not followed in other democratic countries. And in some contexts, it is unconstitutional or the Constitution itself provides a remedy so that the Bill passed by the legislature could become law even after the refusal of assent. The Indian Constitution, however, does not provide any such remedy. The courts too have more or less accepted the position that if the Governor withholds assent, the Bill will go. Thus, the whole legislative exercise will become fruitless. It does not square with the best practices in old and mature democracies.

Q. Which of the following inferences may not be drawn from the passage?

(a) India should follow UK and USA in democratic practices as they are matured democracies
(b) Governors in general should not harm legislative process
(c) There is no constitutional or judicial remedy in India in cases where governor withholds assent
(d) Powers of governor office needs to be reduced drastically as they work against elected legislature