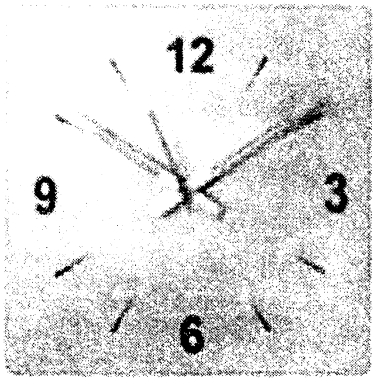
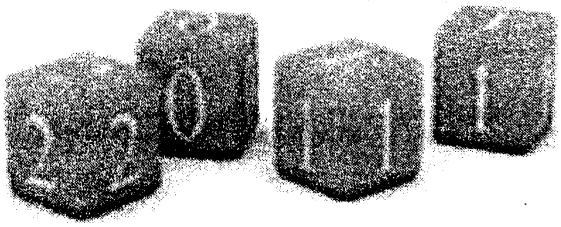
Contents

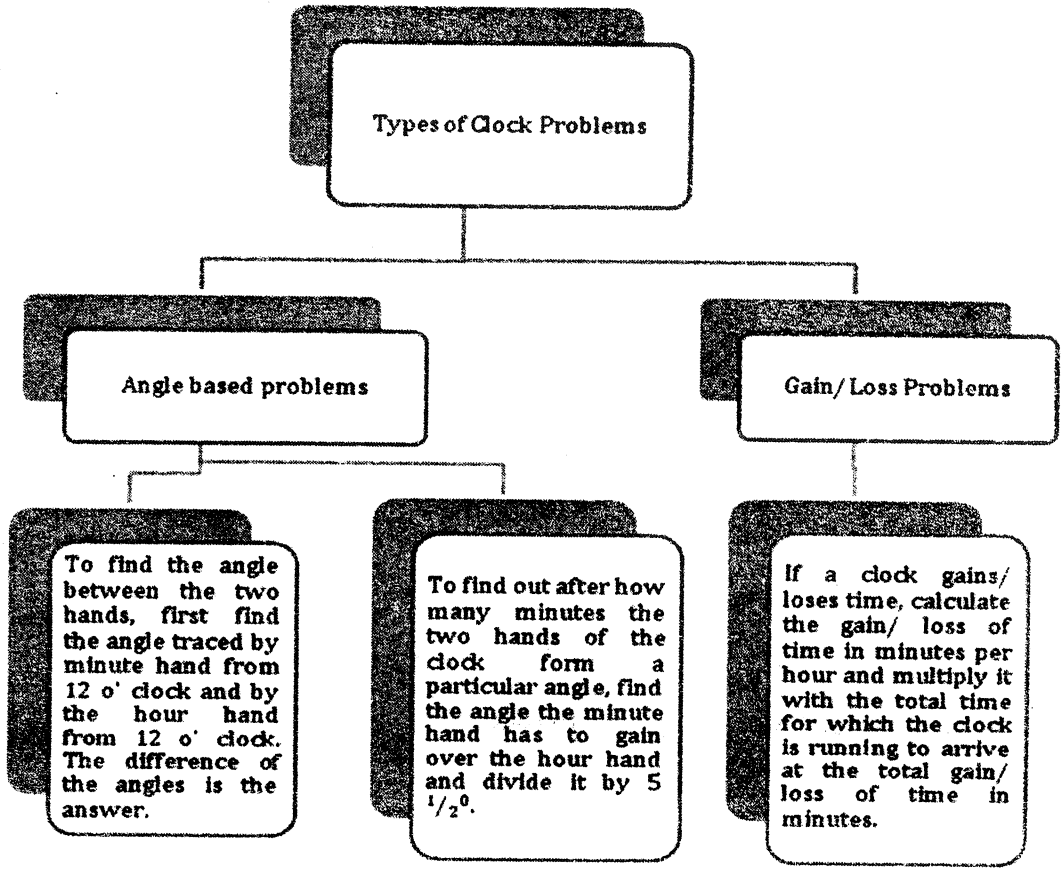


Clocks, Calendars, Direction Sense and Cubes



Problems on clocks and calendars are very common in aptitude tests. Though they seem very difficult and complicated at the outset, they can be cracked in no time with the simple concepts explained in this handout. Direction sense is a very intuitive concept and needs to be approached in an organized manner.

Concept 1: Clocks

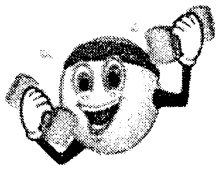


A normal clock shows 12 hours on the dial. It has two prominent hands – the minute hand and the hour hand. Hour hand takes 12 hours to complete one full rotation (360^0) while the minute hand takes 1 hour to complete one full rotation. The dial is divided into 60 divisions or 60 minutes.

Angle covered by hour hand and minute hand for various time intervals is given in the tables below.

Minute Hand	
1 Hour	360^0
1 Minute	6^0

Hour hand	
12 Hours	360^0
1 Hour	30^0
1 Minute	$1/2^0$



Drill 1

a. Find the angle between the hands of the clock.

The time shown in the clock is _____ (H) : _____ (M)

Angle traced by minute hand is ____ × _____^{0} = _____^{0}

Angle traced by hour hand is = (_____ × _____^{0}) + (_____ × _____^{0})

= _____^{0}

Angle between the hands = _____^{0}

b. What is the reflex angle between the hands of the clock at 3 o' clock?

c. If a clock gains 5 minutes every hour and it is set right at 5 a.m., then what is the exact time when it shows 10 a.m.?

Concept 2: Calendars

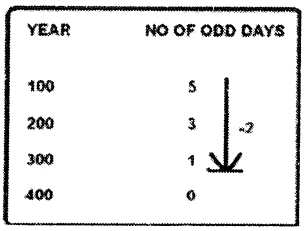
A normal year has 365 days in the Gregorian calendar that we follow and a leap year has one additional day. The days are organised into weeks with 7 days per week. A normal year has 52 weeks and one additional day. This extra day is called an 'odd day' as it is the left over and will be carried forward to the subsequent week of the next year. A leap year has 52 weeks and 2 odd days.

Codes for days of the week (the codes represent the number of odd days)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0 or 7	1	2	3	4	5	6

Example:

The year 2000 has '2' odd days. If the last day of year 2000 was a Sunday, then the last day of the year 1999 will have 5 (7-2) as the code and hence the year would have ended on a Friday.

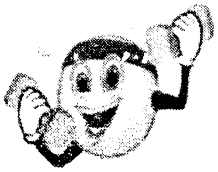


Rules to remember:

- For a year to be a leap year,
  - If the year is a century year (years ending with 00), it should be divisible by 400.
  - For all the other years, it should be divisible by 4.
- For every 100 years, there are 5 odd days; for every 200 years, there are 3 odd days; for 300 years, there is one odd day; for 400 years and multiples of 400 years, there are 0 odd days.

FACE

- A calendar repeats itself every 400 years.
- The last day of February of any year is the same as the following dates – 4th April, 6th June, 8th Aug, 10th Oct and 12th Dec (remember it as 4/4, 6/6, 8/8, 10/10 and 12/12). It also falls on the same day as 5/9, 9/5, 7/11, 11/7.



Drill 2

a. Find the number of odd days in a decade.

b. What is the number of odd days in the year 2010?

c. How many leap years and normal years are there in the 3rd century?
(Hint: Year 300 is not a leap year)

d. What day of the week is 29th July 1971?

1970 = 1600 + 300 + 70 years

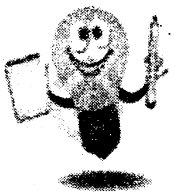
Odd days for the above expression = _____ + _____ + _____

= _____

Number of odd days from 1st Jan to 27th July = _____

Grand total of number of odd days is _____

Hence 29th July, 1971 falls on _____

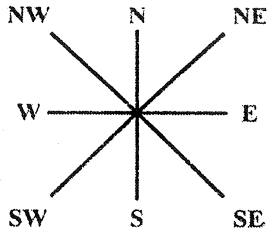


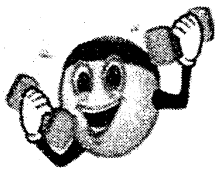
Concept 3: Direction Sense

Questions on Direction Sense typically involve a person travelling a particular distance in a specified direction and then taking several turns. The test taker is asked to find out one or more of the following,

- The current position of the person with respect to the starting point
- The direction which the person is facing
- The distance between the starting and the ending point

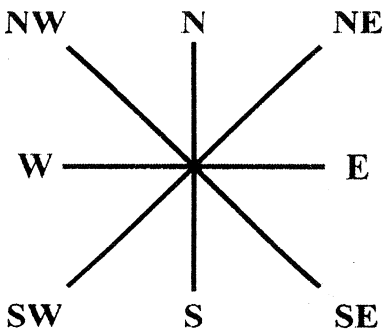
The figure shows the four main directions: North (N), South (S), East (E), West (W) and the four cardinals: North-East (NE), North-West (NW), South-East (SE), and South-West (SW).





Drill 3

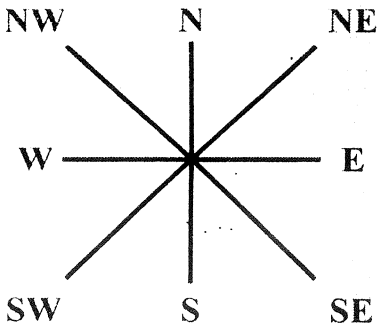
a. Deepak starts early in the morning from his house and jogs towards north for 2 km. Then he turns left and jogs for 1 km.



Now, what is his position with respect to his house? _____

Which direction is he facing? _____

He then takes a right turn and jogs 3 km and again takes a right turn and jogs 1 km.



Now his position with respect to his house is _____

The direction that he is facing is _____

The distance of his current position from his house is _____

b. A man walks 10 km towards north. From there he walks 6 km towards south and then 3 km east. How far and in which direction is he with reference to his starting point?

(Hint: Use Pythagoras theorem to find the distance)

Concept 4: Cubes

A cube is a three dimensional geometric figure. It is either solid or hollow in nature. It has 6 equal sized square faces, with each face being perpendicular to all the adjacent faces.

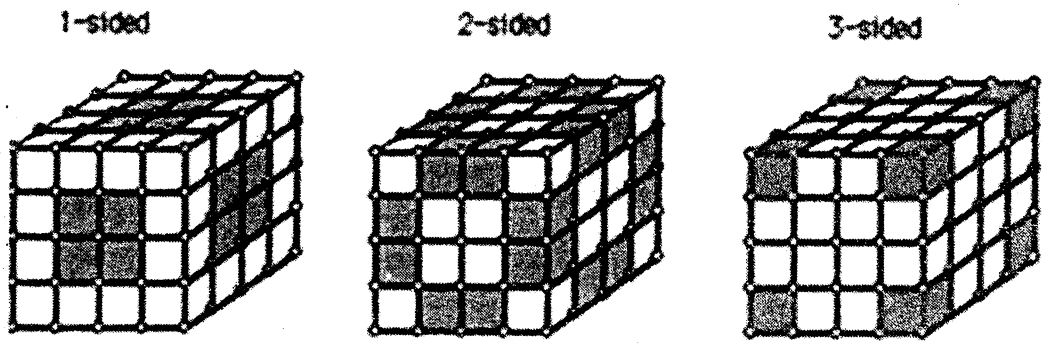
Features of a cube:

Face	A cube has 6 equal sized square faces.
Edges	The line segment formed, where two faces of the cube meet. A cube has 12 edges.
Corner (or) Vertex	A point where three edges meet. A cube has 8 vertices.

- If we make a cut (along any one of the sides of the cube), we get two pieces.
- If we make 1 cut on each dimension of the cube, (along height, length & breadth) we get $2 \times 2 \times 2 = 8$ pieces

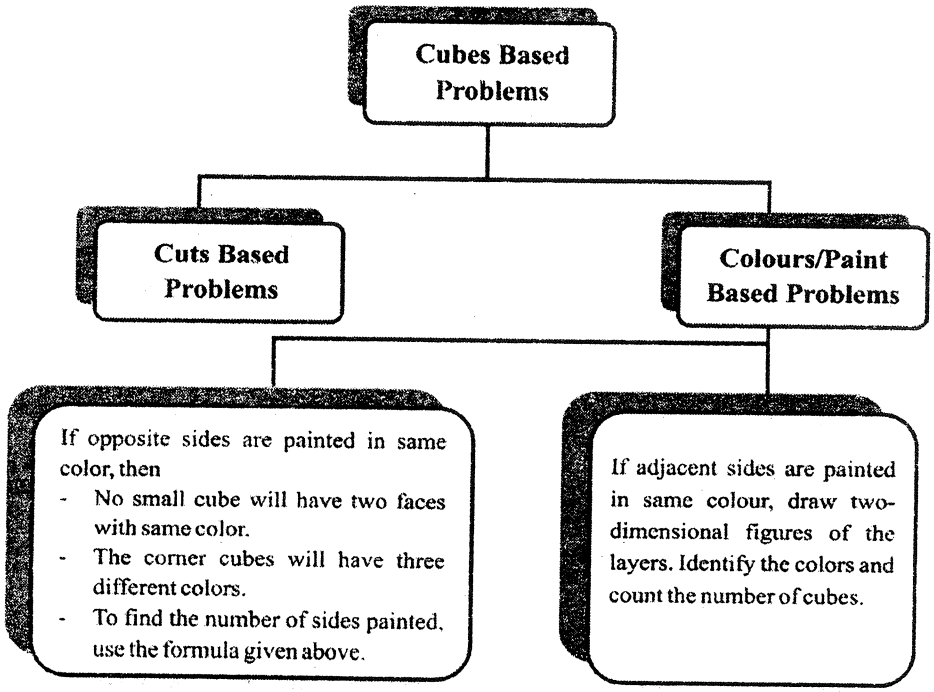
A cube is painted with red colour on all the six faces. If (n - 1) cuts are made along each of the three dimensions of a cube, then there will be n small identical cubes along each dimension of the large cube, with a total of n^3 small cubes.

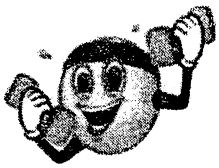
Of the smaller cubes, the number of cubes with,



- Three of its faces painted (Corner cubes) = 8
- Two of its faces painted (Edge cubes) = 12 x (n - 2)
- One face painted (Face cubes) = 6 x $(n - 2)^2$
- No face painted (Core cubes) = $(n - 2)^3$

Types of problems in cubes:





Drill 4

a. If you make 4 cuts on one side of a cake, how many pieces do you get?

_____

b. How many pieces will you get if you make 4 cuts along the length and 4 cuts along the breadth of a solid cube? _____

c. If you make 4 cuts along all the three dimensions of a cube, then how many small cubes will you get? _____

d. How many cuts should be made to get 64 small cubes out of a cube?

e. A cube of side 4 cm is cut into smaller cubes of side 1 cm.

i. How many smaller cubes are painted on two faces?

ii. How many cubes are painted on three faces?

iii. What is the maximum number of cubes that can be taken out of the bigger cube and make it a hollow one?

Googly Questions

In the following Q & A, some of the questions have been wrongly answered. Spot those questions that have been wrongly answered and also find the mistake in their answers. In the circle, mark ✓ if answer is correct and ✗ if it is not.

Q1: How many times in a day do the hands of a clock meet each other?

Answer: *The hands meet each other every hour. So, for 24 hours, they meet 24 times.*

Q2: If today is Friday, then what day of the week will it be, 1 year and 25 days from today?

Answer: *For a year 365 days + 25 days = 390. No. of odd days = remainder |390/7| = 5.*

Therefore, 5 days after Friday is Wednesday.

Q3: The fourth Prime Minister of India, Morarji Ranchhodji Desai was born on 29th February, 1896. When would his first birthday have been celebrated?

Answer: *1900*

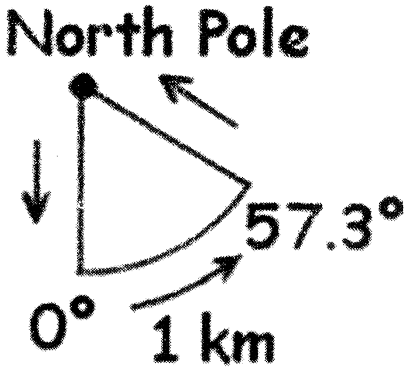
Q4: How many small pieces will I get if I make 2 cuts along each of the 3 dimensions of a cube?

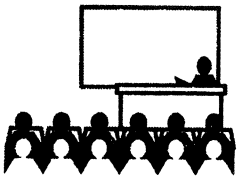
Answer: *2 cuts along the length, 2 cuts along the breadth and 2 cuts along the height.*

Therefore, the number of pieces will be = 2 × 2 × 2 = 8 small cubes.

Q5: You leave home, walk one kilometre south, then one kilometre east and finally one kilometre north. If you are home again at the end of your walk, where is your home?

Answer: *North Pole*





Concept Review Questions

1. At what time between 5 a.m. and 6 a.m. will the hands of the clock meet each other?

   a. 5:30

   b. 5:25 $\frac{5}{11}$

   c. 5:42 $\frac{5}{11}$

   d. 5:27 $\frac{3}{11}$

2. If the hands of a clock coincide every 64 minutes, then how much time does the watch gain per day?

   a. 360/11 min

   b. 365/11 min

   c. 90 min

   d. None of these

3. A clock, which gains 5 minutes every 12 hours, is set right at 5 a.m. What will be the real time, when the clock shows 5 p.m. on the following 5th day?

   a. 4:55 p.m.

   b. 4:05 p.m.

   c. 5:05 p.m.

   d. 5:55 p.m.

4. At what time between 5:30 and 6:00 will the hands of the clock be at right angles?

   a. 43 min past 5

b. $40\frac{7}{11}$ min past 5

c. $43\frac{7}{11}$ min past 5

d. 45 min past 5

5. On planet FACE, there are 10 days in a week. There are 36 hours in a day and each hour has 90 minutes while each minute has 60 seconds. As on Earth, the hour hand covers the dial twice every day. Find the approximate angle between the hands of the clock on FACE when the time is 14:40 a.m.?

a. 83

b. 74

c. 129

d. 65

6. The last day of a century cannot be a

a. Monday

b. Tuesday

c. Wednesday

d. Friday

7. Which year will have the same calendar as that of the year 2007?

a. 2014

b. 2016

c. 2018

d. 2019

8. The first Republic Day of India was celebrated on 26th January, 1950. It was on a

a. Tuesday

b. Wednesday

c. Thursday

d. Friday

Directions for questions 9 to 16: A solid cube of side 8 cm has been painted red, blue and black on pairs of opposite faces. It is then cut into cubical blocks of side 2 cm each.

9. How many cubes have no face painted?

a. 1

b. 4

c. 8

d. 27

10. How many cubes have only one face painted?

a. 8

b. 16

c. 24

d. 28

11. How many cubes have only two faces painted?

a. 8

b. 16

c. 20

d. 24

12. How many cubes have three faces painted?

a. 0

b. 4

c. 6

d. 8

13. How many cubes have three faces painted with three different colours?

a. 0

b. 4

c. 8

d. 12

14. How many cubes have two faces painted red and black and all the other faces unpainted?

a. 4

b. 8

c. 16

d. 32

15. How many cubes have one face painted red and all the other faces unpainted?

a. 4

b. 8

c. 12

d. 16

16. How many cubes have two of their faces painted black?

a. 2

b. 4

c. 8

d. None

Directions for questions 17 to 19: If you start running from a point towards north and after covering 4 km, you turn to your left and run 5 km and then again turn left and run another 6 km and before finishing you take a left turn and run for 1 km.

17. How far are you from the starting point?

a. $1\sqrt{5}$ km

b. $2\sqrt{5}$ km

c. $3\sqrt{5}$ km

d. $4\sqrt{5}$ km

18. In which direction will you be at the end (with reference to the starting point)?

a. East

b. West

c. North

d. South

19. After taking the second turn, in which direction will you be running?

a. East

b. West

c. North

d. South

20. A child is looking for his father. He went 90 m east before turning right. He then went 20 m before turning to the right again to look at his uncle's place 30 m from that point. His father was not there. From there he went 100 m north, before meeting his father in a street. How far was the father from the starting point?

a. 80

b. 100

c. 140

d. 260

Practice Exercise

1. At 3:40, the hour hand and the minute hand of a clock form an angle of

   a. 120^0

   b. 125^0

   c. 130^0

   d. 135^0

2. At what time between 6:00 and 7:00 are the hands of the clock together?

   a. 6 hours 32 $\frac{8}{11}$ min

   b. 6 hours 33 min

   c. 6 hours 34 $\frac{8}{11}$ min

   d. 6 hours 32 min

3. The angle between the hour hand and the minute hand of a clock at 8:30 is

   a. 80^0

   b. 75^0

   c. 60^0

   d. 105^0

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

   a. 4:05

   b. 4:37 $\frac{1}{11}$

   c. 4:05 $\frac{5}{11}$

   d. 4:37 $\frac{5}{11}$

5. A watch, which gains uniformly is 5 minutes slow at 5:00 a.m. on Monday and it is 5 minutes 30 seconds fast at 5:00 a.m. on the following Wednesday. When was the clock correct?

   a. 3:51 a.m.

   b. 4:41 a.m.

   c. 5:51 a.m.

   d. 3:45 a.m.

6. Which year will have the same calendar as that of the year 2005?

   a. 2010

   b. 2011

c. 2012

d. 2013

7. Which among the following is a leap year?

a. 1300

b. 1350

c. 1200

d. 1500

8. If 15th August, 2000 was on Tuesday, then on which day of the week would the Independence Day be celebrated in the year 2079?

a. Tuesday

b. Wednesday

c. Thursday

d. Friday

9. On what dates of January, 2003, did Thursdays fall?

a. 2, 9, 16, 23, 30

b. 3, 10, 17, 24, 31

c. 1, 8, 15, 22, 29

d. 4, 11, 18, 25

10. How many odd days are there from January 29, 1989 to January 18, 1990?

a. 2

b. 3

c. 4

d. 5

11. First day of 1999 is Monday. What day is the last day of the year?

a. Monday

b. Tuesday

c. Wednesday

d. Thursday

Directions for questions 12 to 15: There are two cubes having different dimensions. Two opposite faces of a cube are red and rest of it is white. Two opposite faces of the other cube are yellow and rest of it is red. These two cubes are divided separately into 64 and 27 small cubes respectively and then mixed together.

12. How many cubes have only one face painted, in red colour?

a. 10

b. 14

c. 18

d. 12

13. How many cubes will have only two faces coloured, in two different colours?

a. 24

b. 16

c. 12

d. 28

14. How many cubes will have three faces coloured, in three different colours?

a. 9

b. 6

c. 4

d. 0

15. How many cubes will have exactly two faces painted and both of them painted in the same colour?

a. 36

b. 24

c. 12

d. 18

16. A cube of side 4 cm is divided into 125 small cubes. What will be the length of the side of small cube?

a. 0.25 cm

b. 0.8 cm

c. 0.5 cm

d. 1 cm

Directions for questions 17 to 19: A solid cube of side 9 cm has been painted green, red and yellow on pairs of opposite faces. It is then cut into cubical blocks of each side 3 cm.

17. How many cubes have no face painted?

a. 1

b. 6

c. 8

d. 4

18. How many cubes have three faces painted?

a. 2

b. 4

c. 8

d. 12

19. How many cubes have four faces coloured?

a. 0

b. 1

c. 2

d. 3

Directions for questions 20 to 23: A cube has the following figures drawn on five of its faces: circle, cross, triangle, square and ellipse. The top surface is blank. The ellipse is between the cross and the triangle and the square is on the triangle's right. The ellipse and the square are opposite to each other.

20. Where is the circle?

a. Left of the triangle

b. On top

c. Bottom face

d. Opposite the triangle

21. How many arrangements are possible with the given data?

a. Only one

b. Two

c. Three

d. Four

22. If the cube is rotated such that the face having the ellipse is towards north, then which face will be towards west?

a. Square

b. Triangle

c. Circle

d. Cross

23. The cube is rolled to get the ellipse on the top face. What is on the bottom face?

a. Blank

b. Circle

c. Square

d. Triangle

24. Ganesh travels 7 km north, then turns right and walks 3 km. He again turns to his right and moves 7 km forward. How many km, is Ganesh away from the place of his starting the journey?

a. 7

b. 3

c. 6

d. 14

25. Sparsh and Rabee both start from a point towards North. Sparsh turns left after walking 10 km. Rabee turns right after

walking the same distance. Sparsh waits for some time and then walks another 5 km, whereas Rabee walks slowly for 5 km after turning right. They both turn to the South and walk 15 km forward. How far is Sparsh from Rabee?

a. 15

b. 10

c. 8

d. 12

26. The door of Adi's house faces the East. From the backside of his house, he walks 50 m towards west, then turns right and walks 50 m. Finally, he turns left and stops walking after 25 m. Now in which direction is he from the starting point?

a. South-East

b. North-East

c. South-West

d. North-West

Direction for questions 27 to 30: Rakshit walks 2 km north and turns right and walks 4 km. He then makes a second right turn and walks 4 km. He again turns right and travels 4 km. Here he meets Rashmi coming from the opposite direction and they both stop.

27. If the starting point is marked as A and the finishing point is marked as B, then what is the distance between these points?

a. 10

b. 8

c. 6

d. 2

28. Towards which direction was Rakshit coming after the third turn?

a. East

b. West

c. North

d. South

29. After taking the second turn, in what direction was Rakshit walking?

a. East

b. West

c. North

d. South

30. If Rakshit is to again reach the point from where he started, then in which direction will he have to walk?

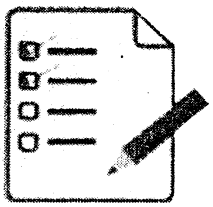
a. East

b. South-East

c. North

d. North-East

Answer key for Practice Questions									
1 c	2 a	3 b	4 c	5 a	6 b	7 c	8 a	9 a	10 c
11 a	12 d	13 a	14 d	15 c	16 b	17 a	18 c	19 a	20 c
21 a	22 d	23 c	24 b	25 b	26 d	27 d	28 b	29 d	30 c



Self-Assessment Test

Instructions:

- Duration: 15 minutes
- Marking Scheme:
  - Correct answer: 1 mark
  - Wrong answer: -1/3 mark

1. At what angle are the hands of the clocks inclined at 10 minutes to 9?

   a. 35.5^0

   b. 34^0

   c. 32.5^0

   d. 35^0

2. At what time between 2:30 and 3:30, do the hands of the clock coincide?

   a. 3 hrs 15 $\frac{8}{11}$ min

   b. 3 hrs 16 $\frac{8}{11}$ min

   c. 3 hrs 16 $\frac{4}{11}$ min

   d. 3 hrs 15 $\frac{4}{11}$ min

Directions for questions 3 to 6: A solid cube is painted red on two adjacent sides and black on the sides opposite to the red sides and green on the remaining sides. It is then cut into 64 smaller cubes of equal size.

3. How many cubes have only one side coloured?

   a. 16

b. 24

c. 28

d. 32

4. How many cubes have at least one side as red?

a. 16

b. 24

c. 28

d. 32

5. How many cubes are there with one side green and the adjacent side either red or black and painted on two sides only?

a. 8

b. 16

c. 24

d. 32

6. How many cubes are there which are red on one side and black on the opposite side?

a. 0

b. 4

c. 8

d. 16

Directions for questions 7 to 9: Answer the following questions based on the information given below.

- There are 6 check posts A, B, C, D, E and F.
- Check post F is 15 km to the north of D, which is 25 km to the North-East of B.

- Check post A is 5 km West of E and 15 km to the South - West of C.
- B, A and E are in a straight line and in the same sequence.
- The check posts B and E are 30 km apart.

7. Which check post is the farthest to the South West of D?

   a. A

   b. B

   c. C

   d. D

8. Which post is the nearest and to the North -East of E?

   a. A

   b. B

   c. C

   d. D

9. If a jeep moves from E to F via A, B and D, how much distance will it have to cover (in km)?

   a. 70

   b. 120

   c. 100

   d. 90

10. Ram celebrated his 20th birthday on 26th April, 2012. On what day will Ram celebrate his 25th birthday?

    a. Tuesday

    b. Wednesday

    c. Friday

    d. Saturday

Test Analysis

Instructions:

- Mark your answer options in the column provided for it in the table given below.
- Based on the key given below (correct answer), evaluate your test performance by awarding 1 mark for every correct answer, deducting $1/3^{rd}$ of a mark for every wrong answer and no marks for unattempted questions in the "Score Correct Attempt" column.
- If your answer matches with the close option given in the second last column, then award $1\ ^{1}/_{3}$ marks in the last column (Score close attempt). Close attempt is one, in which though the answer is wrong, you have proceeded in solving the question in the right direction but have made a small error by oversight, which could have been avoided, if you had been more careful.
- The sum of the scores that you get in the score correct attempt is your actual score.
- The sum of scores in the correct attempt and close attempts is your potential score. This score indicates the marks that could have been obtained had you avoided the errors caused due to oversight.

Question Number	Difficulty Level	Correct Answer	Your Answer	Score Correct Attempt	Close Attempt	Score Close Attempt
1	Easy	D			A	
2	Medium	C			D	
3	Easy	B			-	
4	Easy	C			-	
5	Easy	B			-	
6	Easy	A			-	
7	Medium	B			-	
8	Medium	C			-	
9	Medium	A			-	
10	Difficult	B			A	
Total					Total	

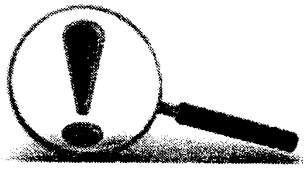
ActualScore=_____ PotentialScore=_____

Interpretation of Scores:

Score Range	Suggestion
0-4	Poor Performance. You need to start from the basics. Learn the concepts thoroughly and practise solving questions.
4-7	Average Performance. You can brush up the important concepts and practise solving more questions.
7+	Good Performance. Keep up the good performance in this section going and move on to other topics.

Strategy Analysis:

In the table, the difficulty level of questions has been mentioned. Check if you are attempting the easier questions before you solve the difficult ones. If you have attempted the difficult ones but have not solved the easy ones, be careful with the selection of questions in the next test!



Detailed Solutions

1. At 8:50, the hour hand would have travelled 265° (8 hours 50 min x 30° per hour) and the min hand would have travelled 300° (50 min x 6° per min). Hence, the angle between the two hands of the clock will be 35°.

2. The two hands of a clock coincide every $65\frac{5}{11}$ min. They will coincide for the third time (after 12 o'clock) at 3 hours $16\frac{4}{11}$ min.

3. Cubes with one side coloured = $6(n - 2)^2 = 24$ cubes

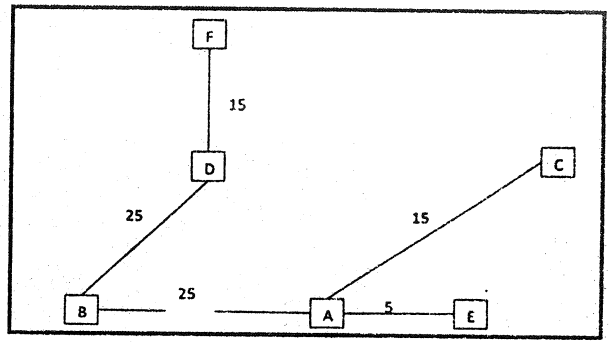
4. As there are two faces painted with red, the 32 (2 faces of 16 cubes each) cubes on these faces will have red colour. But as adjacent faces are painted in red, 4 cubes would have been double counted. Removing them, the number of cubes with red colour will be 28.

5. There are 8 edges (in the big cube), where green is painted on one side and red or black on the adjacent side. Along each edge, there are 2 cubes with the required colour combination, totaling to 16 cubes.

6. Of the smaller cubes, no cube will have paint on opposite sides.

Solution for questions 7 to 9:

From the given information, the following map can be drawn

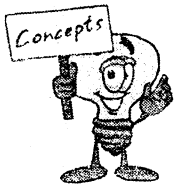


7. The only post in South-West direction from D is B.

8. The only post in the North-East direction from E is C

9. 5 + 25 + 25 + 15 = 70

10. Number of odd days for 26th April 2012 is 3 and hence will fall on a Wednesday. From 26th April 2012 to 26th April 2017, there will be 7 odd days and hence 26th April 2017 will also fall on a Wednesday.



Concepts to Remember

Clocks:

- Minute hand traces 6° in 1 minute.
- Hour hand traces 30° in 1 hour and $(1/2)^{\circ}$ in 1 minute.
- Minute hand gains 330^{0} in 60 minutes over hour hand.
- If a clock loses minutes, it will be slow and if the clock gains it will be fast.
- Minute hand and hour hand meet every $65\frac{5}{11}$ min.

Calendar:

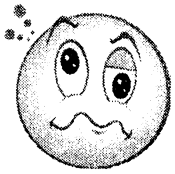
- An ordinary year has 1 one odd day, whereas a leap year has 2 odd days.
- Century years should be divisible by 400 as a check for leap year.
- For 100 years, there are 5 odd days; for 200 years, there are 3 odd days; for 300 years, there is only one odd day; for 400 years and multiples of 400 years, there are 0 odd days.

Directions:

- Position of the person with respect to some point should not be confused with the direction he is facing.

Cubes:

- Number of pieces will be one more than the number of cuts in a particular direction.
- Opposite sides and adjacent sides painted should not be confused.
- If we make a cut on each side (along height, length and breadth) we get $2 \times 2 \times 2 = 8$ pieces.



Mind Bender

There is a clock that has a special way of telling the time. It does not have any hands or numbers on it, but it has a chimer. If the time is 1 o'clock, it chimes once. If the time is 2 o'clock, it chimes twice, and so forth. The time gap between any two chimes is 4 seconds. How many seconds would it take to know the time, after the first chime is heard, if it is 4 o'clock?