

**2022**

**Chemical Engineering (CH)**

**Q. 1.** A sphere of radius  $r$  cm is packed in a box of cubical shape.

What should be the minimum volume (in  $\text{cm}^3$ ) of the box that can enclose the sphere?

- (a)  $\frac{r^3}{8}$                       (b)  $r^3$   
(c)  $2r^3$                       (d)  $8r^3$

**Q. 2.** Pipes P and Q can fill a storage tank full of water in 10 and 6 minutes, respectively. Pipe R draws the water out from the storage tank at a rate of 34 litres per minute. P, Q and R operate at a constant rate.

If it takes one hour to completely empty a full storage tank with all the pipes operating simultaneously, what is the capacity of the storage tank (in litres)?

- (a) 26.8                      (b) 60.0  
(c) 120.0                      (d) 127.5

**Q. 3.** Six persons P, Q, R, S, T and U are sitting around a circular table facing the center not necessarily in the same order. Consider the following statements:

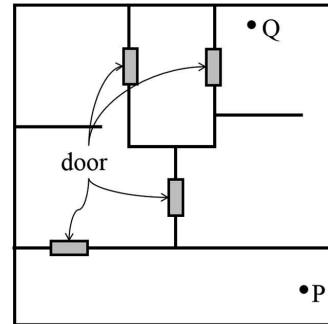
- P sits next to S and T.
- Q sits diametrically opposite to P.
- The shortest distance between S and R is equal to the shortest distance between T and U.

Based on the above statements, Q is a neighbour of

- (a) U and S                      (b) R and T  
(c) R and U                      (d) P and S

**Q. 4.** A building has several rooms and doors as shown in the top view of the building given below. The doors are closed initially.

What is the minimum number of doors that need to be opened in order to go from the point P to the point Q?



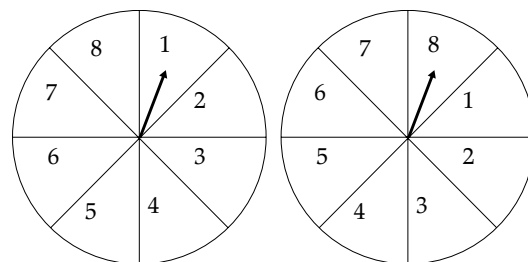
- (a) 4                      (b) 3  
(c) 2                      (d) 1

**Q. 5.** A game consists of spinning an arrow around a stationary disk as shown below.

When the arrow comes to rest, there are eight equally likely outcomes. It could come to rest in any one of the sectors numbered 1, 2, 3, 4, 5, 6, 7 or 8 as shown.

Two such disks are used in a game where their arrows are independently spun.

What is the probability that the sum of the numbers on the resulting sectors upon spinning the two disks is equal to 8 after the arrows come to rest?



- (a)  $\frac{1}{16}$                       (b)  $\frac{5}{64}$   
(c)  $\frac{3}{32}$                       (d)  $\frac{7}{64}$

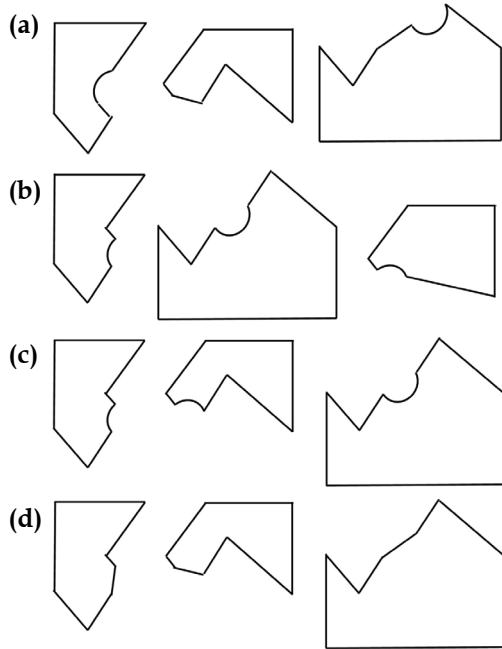
**Q. 6.** Consider the following inequalities.

- (i)  $3p - q < 4$   
(ii)  $3q - p < 12$

Which one of the following expressions below satisfies the above two inequalities?

- (a)  $p + q < 8$       (b)  $p + q = 8$   
 (c)  $8 \leq p + q < 16$       (d)  $p + q \geq 16$

**Q. 7.** Which one of the following sets of pieces can be assembled to form a square with a single round hole near the center? Pieces cannot overlap.



**CIVIL ENGINEERING (CE) P1**

**Q. 8.** Two straight lines pass through the origin  $(x_0, y_0) = (0, 0)$ . One of them passes through the point  $(x_1, y_1) = (1, 3)$  and the other passes through the point  $(x_2, y_2) = (1, 2)$ .

What is the area enclosed between the straight lines in the interval  $[0, 1]$  on the  $x$ -axis?

- (a) 0.5      (b) 1.0  
 (c) 1.5      (d) 2.0

**Q. 9.** If

$p : q = 1 : 2$   
 $q : r = 4 : 3$   
 $r : s = 4 : 5$

and  $u$  is 50% more than  $s$ , what is the ratio  $p : u$ ?

- (a) 2 : 15      (b) 16 : 15  
 (c) 1 : 5      (d) 16 : 45

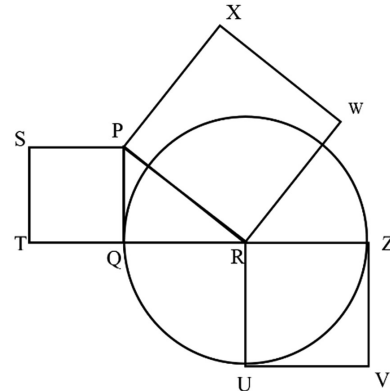
**Q. 10.** Given the statements:

- P is the sister of Q.
- Q is the husband of R.
- R is the mother of S.
- T is the husband of P.

Based on the above information, T is \_\_\_\_\_ of S.

- (a) the grandfather      (b) an uncle  
 (c) the father      (d) a brother

**Q. 11.** In the following diagram, the point R is the center of the circle. The lines PQ and ZV are tangential to the circle. The relation among the areas of the squares, PXWR, RUVZ and SPQT is



- (a) Area of SPQT = Area of RUVZ = Area of PXWR  
 (b) Area of SPQT = Area of PXWR - Area of RUVZ  
 (c) Area of PXWR = Area of SPQT - Area of RUVZ  
 (d) Area of PXWR = Area of RUVZ - Area of SPQT

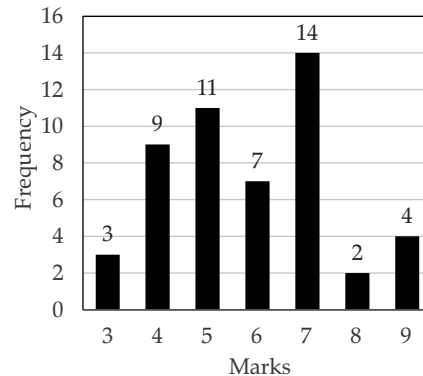
**Q. 12.** P invested ₹5000 per month for 6 months of a year and Q invested ₹  $x$  per month for 8 months of the year in a partnership business. The profit is shared in proportion to the total investment made in that year.

If at the end of that investment year, Q receives  $\frac{4}{9}$  of the total profit, what is the value

of  $x$  (in ₹)?

- (a) 2500      (b) 3000  
 (c) 4687      (d) 8437

**Q. 13.**



The above frequency chart shows the frequency distribution of marks obtained by a set of students in an exam.

From the data presented above, which one of the following is CORRECT?

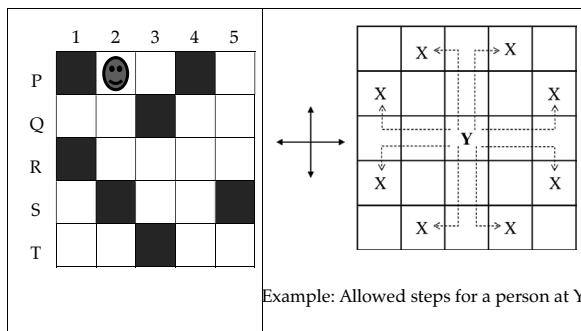
- (a) mean > mode > median
- (b) mode > median > mean
- (c) mode > mean > median
- (d) median > mode > mean

**Q. 14.** In the square grid shown on the left, a person standing at P2 position is required to move to P5 position.

The only movement allowed for a step involves, "two moves along one direction followed by one move in a perpendicular direction". The permissible directions for movement are shown as dotted arrows on the right.

For example, a person at a given position Y can move only to the positions marked X on the right.

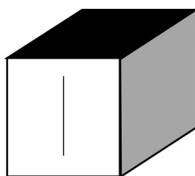
Without occupying any of the shaded squares at the end of each step, the minimum number of steps required to go from P2 to P5 is



Example: Allowed steps for a person at Y

- (a) 4
- (b) 5
- (c) 6
- (d) 7

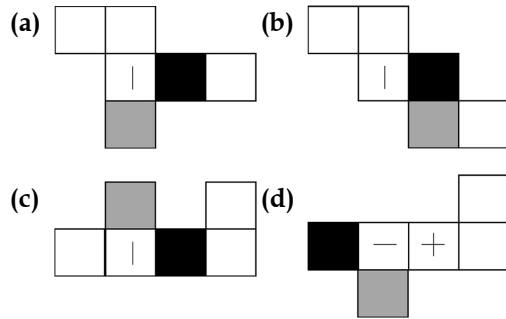
**Q. 15.**



Consider a cube made by folding a single sheet of paper of appropriate shape.

The interior faces of the cube are all blank. However, the exterior faces that are not visible in the above view may not be blank.

Which one of the following represents a possible unfolding of the cube?



**CIVIL ENGINEERING (CE) P2**

**Q. 16.**  $x : y : z = \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$ .

What is the value of  $\frac{x+z-y}{y}$ ?

- (a) 0.75
- (b) 1.25
- (c) 2.25
- (d) 3.25

**Q. 17.** Both the numerator and the denominator of  $\frac{3}{4}$  are increased by a positive integer,  $x$ ,

and those of  $\frac{15}{17}$  are decreased by the same

integer. This operation results in the same value for both the fractions.

What is the value of  $x$ ?

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

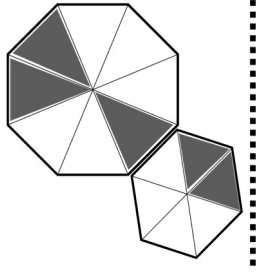
**Q. 18.** A survey of 450 students about their subjects of interest resulted in the following outcome.

- 150 students are interested in Mathematics.
- 200 students are interested in Physics.
- 175 students are interested in Chemistry.
- 50 students are interested in Mathematics and Physics.
- 60 students are interested in Physics and Chemistry.
- 40 students are interested in Mathematics and Chemistry.
- 30 students are interested in Mathematics, Physics and Chemistry.
- Remaining students are interested in Humanities.

Based on the above information, the number of students interested in Humanities is

- (a) 10
- (b) 30
- (c) 40
- (d) 45

Q. 19.



For the picture shown above, which one of the following is the correct picture representing reflection with respect to the mirror shown as the dotted line?

- (a)
- (b)
- (c)
- (d)

Q. 20. In a partnership business the monthly investment by three friends for the first six months is in the ratio of 3 : 4 : 5. After six months, they had to increase their monthly investments by 10%, 15% and 20%, respectively, of their initial monthly investment. The new investment ratio was kept constant for the next six months.

What is the ratio of their shares in the total profit (in the same order) at the end of the year such that the share is proportional to their individual total investment over the year?

- (a) 22 : 23 : 24                      (b) 22 : 33 : 50
- (c) 33 : 46 : 60                      (d) 63 : 86 : 110

Q. 21. Consider the following equations of straight lines:

- Line L1:  $2x - 3y = 5$
- Line L2:  $3x + 2y = 8$
- Line L3:  $4x - 6y = 5$
- Line L4:  $6x - 9y = 6$

Which one among the following is the correct statement?

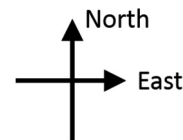
- (a) L1 is parallel to L2 and L1 is perpendicular to L3
- (b) L2 is parallel to L4 and L2 is perpendicular to L1
- (c) L3 is perpendicular to L4 and L3 is parallel to L2
- (d) L4 is perpendicular to L2 and L4 is parallel to L3

Q. 22. An ant walks in a straight line on a plane leaving behind a trace of its movement. The initial position of the ant is at point P facing east.

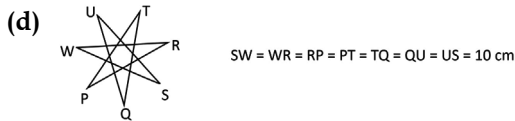
The ant first turns  $72^\circ$  anticlockwise at P, and then does the following two steps in sequence exactly FIVE times before halting.

1. moves forward for 10 cm.
2. turns  $144^\circ$  clockwise.

The pattern made by the trace left behind by the ant is



- (a)  $PQ = QR = RS = ST = TP = 10 \text{ cm}$
- (b)  $PQ = QR = RS = ST = TU = UP = 10 \text{ cm}$
- (c)  $SQ = QT = TR = RP = PS = 10 \text{ cm}$

**COMPUTER SCIENCE (CS)**

Q. 23. A function  $y(x)$  is defined in the interval  $[0, 1]$  on the  $x$ -axis as

$$y(x) = \begin{cases} 2 & \text{if } 0 \leq x < \frac{1}{3} \\ 3 & \text{if } \frac{1}{3} \leq x < \frac{3}{4} \\ 1 & \text{if } \frac{3}{4} \leq x < 1 \end{cases}$$

Which one of the following is the area under the curve for the interval  $[0, 1]$  on the  $x$ -axis?

- (a)  $\frac{5}{6}$                       (b)  $\frac{6}{5}$   
 (c)  $\frac{13}{6}$                       (d)  $\frac{6}{13}$

Q. 24. Let  $r$  be a root of the equation  $x^2 + 2x + 6 = 0$ .

Then the value of the expression  $(r + 2)(r + 3)(r + 4)(r + 5)$  is

- (a) 51                      (b) -51  
 (c) 126                      (d) -126

Q. 25. A palindrome is a word that reads the same forwards and backwards. In a game of words, a player has the following two plates painted with letters.



From the additional plates given in the options, which one of the combinations of additional plates would allow the player to construct a five-letter palindrome.

The player should use all the five plates exactly once. The plates can be rotated in their plane.

- (a) 

D
---

Q
---

J
---
- (b) 

R
---

V
---

Y
---
- (c) 

Z
---

E
---

D
---
- (d) 

I
---

7
---

Y
---

Q. 26. In a recently conducted national entrance test, boys constituted 65% of those who appeared for the test. Girls constituted the remaining candidates and they accounted for 60% of the qualified candidates.

Which one of the following is the correct logical inference based on the information provided in the above passage?

- (a) Equal number of boys and girls qualified  
 (b) Equal number of boys and girls appeared for the test  
 (c) The number of boys who appeared for the test is less than the number of girls who appeared  
 (d) The number of boys who qualified for the test is less than the number of girls who qualified

Q. 27. A box contains five balls of the same size and shape. Three of them are green coloured balls and two of them are orange coloured balls. Balls are drawn from the box one at a time. If a green ball is drawn, it is not replaced. If an orange ball is drawn, it is replaced with another orange ball.

The first ball is drawn. What is the probability of getting an orange ball in the next draw?

- (a)  $\frac{1}{2}$                       (b)  $\frac{8}{25}$   
 (c)  $\frac{19}{50}$                       (d)  $\frac{23}{50}$

Q. 28. The corners and mid-points of the sides of a triangle are named using the distinct letters P, Q, R, S, T and U, but not necessarily in the same order. Consider the following statements:

- The line joining P and R is parallel to the line joining Q and S.
- P is placed on the side opposite to the corner T.
- S and U cannot be placed on the same side.

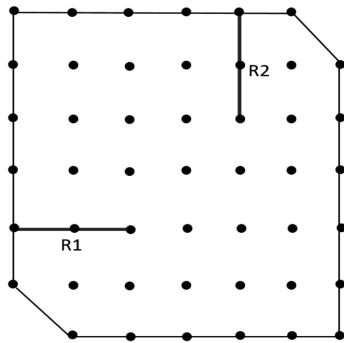
Which one of the following statements is correct based on the above information?

- (a) P cannot be placed in a corner  
 (b) S cannot be placed in a corner  
 (c) U cannot be placed at a mid-point  
 (d) R cannot be placed in a corner

Q. 29. A plot of land must be divided between four families. They want their individual plots

to be similar in shape, not necessarily equal in area. The land has equally spaced poles, marked as dots in the below figure. Two ropes, R1 and R2 are already present and cannot be moved.

What is the least number of additional straight ropes needed to create the desired plots? A single rope can pass through three poles that are aligned in a straight line.



- (a) 2
- (b) 4
- (c) 5
- (d) 3

**ELECTRICAL ENGINEERING (EE)**

**Q. 30.** In a 500 m race, P and Q have speeds in the ratio of 3 : 4. Q starts the race when P has already covered 140 m.

What is the distance between P and Q (in m) when P wins the race?

- (a) 20
- (b) 40
- (c) 60
- (d) 140

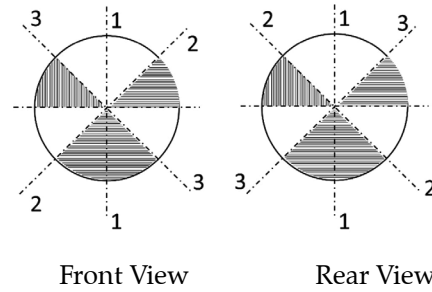
**Q. 31.** Three bells P, Q and R are rung periodically in a school. P is rung every 20 minutes; Q is rung every 30 minutes and R is rung every 50 minutes.

If all the three bells are rung at 12:00 PM, when will the three bells ring together again the next time?

- (a) 5:00 PM
- (b) 5:30 PM
- (c) 6:00 PM
- (d) 6:30 PM

**Q. 32.** The figure below shows the front and rear view of a disc, which is shaded with identical patterns. The disc is flipped once with respect to any one of the fixed axes 1-1, 2-2 or 3-3 chosen uniformly at random.

What is the probability that the disc **DOES NOT** retain the same front and rear views after the flipping operation?



- (a) 0
- (b)  $\frac{1}{3}$
- (c)  $\frac{2}{3}$
- (d) 1

**Q. 33.** There are two identical dice with a single letter on each of the faces. The following six letters: Q, R, S, T, U, and V, one on each of the faces. Any of the six outcomes are equally likely.

The two dice are thrown once independently at random.

What is the probability that the outcomes on the dice were composed only of any combination of the following possible outcomes: Q, U and V?

- (a)  $\frac{1}{4}$
- (b)  $\frac{3}{4}$
- (c)  $\frac{1}{6}$
- (d)  $\frac{5}{36}$

**Q. 34.** The price of an item is 10% cheaper in an online store S compared to the price at another online store M. Store S charges ₹150 for delivery. There are no delivery charges for orders from the store M. A person bought the item from the store S and saved ₹100.

What is the price of the item at the online store S (in ₹), if there are no other charges than what is described above?

- (a) 2500
- (b) 2250
- (c) 1750
- (d) 1500

**Q. 35.** The letters P, Q, R, S, T and U are to be placed one per vertex on a regular convex hexagon, but not necessarily in the same order.

Consider the following statements:

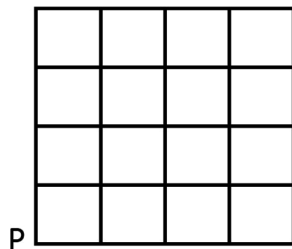
- The line segment joining R and S is longer than the line segment joining P and Q.

- The line segment joining R and S is perpendicular to the line segment joining P and Q.
- The line segment joining R and U is parallel to the line segment joining T and Q.

Based on the above statements, which one of the following option is CORRECT?

- (a) The line segment joining R and T is parallel to the line segment joining Q and S
- (b) The line segment joining T and Q is parallel to the line joining P and U
- (c) The line segment joining R and P is perpendicular to the line segment joining U and Q
- (d) The line segment joining Q and S is perpendicular to the line segment joining R and P

Q. 36.



An ant is at the bottom-left corner of a grid (point P) as shown above. It aims to move to the top-right corner of the grid. The ant moves only along the lines marked in the grid such that the current distance to the top-right corner strictly decreases.

Which one of the following is a part of a possible trajectory of the ant during the movement?

- (a)
- (b)
- (c)
- (d)

**ELECTRONICS AND COMMUNICATION (EC)**

Q. 37. A sum of money is to be distributed among P, Q, R and S in the proportion 5 : 2 : 4 : 3, respectively.

If R gets ₹1000 more than S, what is the share of Q (in ₹)?

- (a) 500
- (b) 1000
- (c) 1500
- (d) 2000

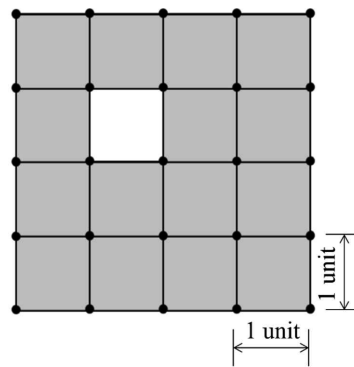
Q. 38. A trapezium has vertices marked as P, Q, R and S (in that order anticlockwise).

The side PQ is parallel to the side SR. Further, it is given that, PQ = 11 cm, QR = 4 cm, RS = 6 cm and SP = 3 cm.

What is the shortest distance between PQ and SR (in cm)?

- (a) 1.80
- (b) 2.40
- (c) 4.20
- (d) 5.76

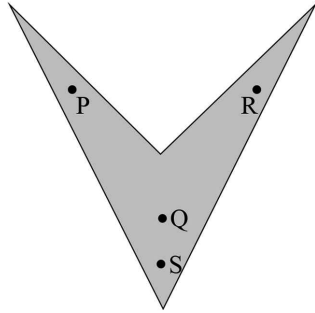
Q. 39. The figure shows a grid formed by a collection of unit squares. The unshaded unit square in the grid represents a hole.



What is the maximum number of squares without a "hole in the interior" that can be formed within the 4 × 4 grid using the unit squares as building blocks?

- (a) 15
- (b) 20
- (c) 21
- (d) 26

Q. 40. An art gallery engages a security guard to ensure that the items displayed are protected. The diagram below represents the plan of the gallery where of the boundary walls are opaque. The location of security guard posted is identified such that all the inner space (shaded region in the plan) of the gallery is within the line of sight of the security guard. If the security guard does not move around the posted location and has a 360° view, which one of the following correctly represents the set of ALL possible locations among the locations P, Q, R and S, where the security guard can be posted to watch over the entire inner space of the gallery.



- (a) P and Q                      (b) Q
- (c) Q and S                      (d) R and S

Q. 41. Consider the following inequalities.

- (i)  $2x - 1 > 7$
- (ii)  $2x - 9 < 1$

Which one of the following expressions below satisfies the above two inequalities?

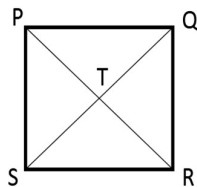
- (a)  $x \leq -4$                       (b)  $-4 < x \leq 4$
- (c)  $4 < x < 5$                       (d)  $x \geq 5$

Q. 42. Four points P(0, 1), Q(0, -3), R(-2, -1), and S(2, -1) represent the vertices of a quadrilateral.

What is the area enclosed by the quadrilateral?

- (a) 4                                      (b)  $4\sqrt{2}$
- (c) 8                                      (d)  $8\sqrt{2}$

Q. 43. Consider the following square with the four corners and the center marked as P, Q, R, S and T respectively.



Let X, Y and Z represent the following operations:

X: rotation of the square by 180 degree with respect to the S-Q axis.

Y: rotation of the square by 180 degree with respect to the P-R axis.

Z: rotation of the square by 90 degree clockwise with respect to the axis perpendicular, going into the screen and passing through the point T.

Consider the following three distinct sequences of operation (which are applied in the left to right order).

- (1) XYZZ
- (2) XY

(3) ZZZZ

Which one of the following statements is correct as per the information provided above?

- (a) The sequence of operations (1) and (2) are equivalent
- (b) The sequence of operations (1) and (3) are equivalent
- (c) The sequence of operations (2) and (3) are equivalent
- (d) The sequence of operations (1), (2) and (3) are equivalent

**MECHANICAL ENGINEERING (ME) P1**

Q. 44. The average of the monthly salaries of M, N and S is ₹4000. The average of the monthly salaries of N, S and P is ₹5000. The monthly salary of P is ₹6000.

What is the monthly salary of M as a percentage of the monthly salary of P?

- (a) 50%                                      (b) 75%
- (c) 100%                                      (d) 125%

Q. 45. A person travelled 80 km in 6 hours. If the person travelled the first part with a uniform speed of 10 kmph and the remaining part with a uniform speed of 18 kmph.

What percentage of the total distance is travelled at a uniform speed of 10 kmph?

- (a) 28.25                                      (b) 37.25
- (c) 43.75                                      (d) 50.00

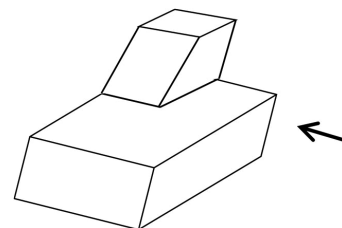
Q. 46. Four girls P, Q, R and S are studying languages at a University. P is learning French and Dutch. Q is learning Chinese and Japanese. R is learning Spanish and French. S is learning Dutch and Japanese.

Given that: French is easier than Dutch; Chinese is harder than Japanese; Dutch is easier than Japanese, and Spanish is easier than French.

Based on the above information, which girl is learning the most difficult pair of languages?

- (a) P    (b) Q
- (c) R    (d) S

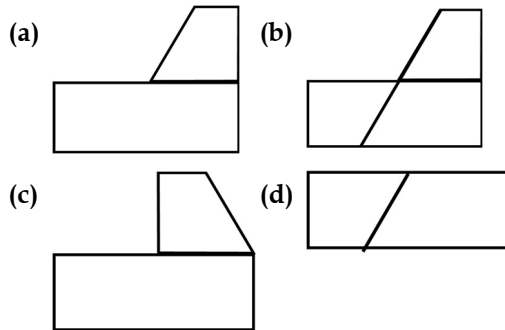
Q. 47.





A block with a trapezoidal cross-section is placed over a block with a rectangular cross-section as shown above.

Which one of the following is the correct drawing of the view of the 3D object as viewed in the direction indicated by an arrow in the above figure?



**Q. 48.** A rhombus is formed by joining the midpoints of the sides of a unit square.

What is the diameter of the largest circle that can be inscribed within the rhombus?

- (a)  $\frac{1}{\sqrt{2}}$                       (b)  $\frac{1}{2\sqrt{2}}$   
 (c)  $\sqrt{2}$                               (d)  $2\sqrt{2}$

**Q. 49.** An equilateral triangle, a square and a circle have equal areas.

What is the ratio of the perimeters of the equilateral triangle to square to circle?

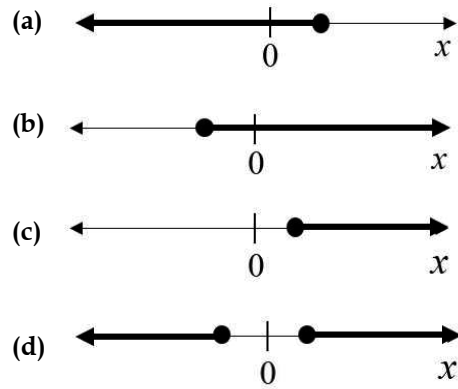
- (a)  $3\sqrt{3} : 2 : \sqrt{\pi}$   
 (b)  $\sqrt{(3\sqrt{3})} : 2 : \sqrt{\pi}$   
 (c)  $\sqrt{(3\sqrt{3})} : 4 : 2\sqrt{\pi}$   
 (d)  $\sqrt{(3\sqrt{3})} : 2 : 2\sqrt{\pi}$

**Q. 50.** In a 12-hour clock that runs correctly, how many times do the second, minute, and hour hands of the clock coincide, in a 12-hour duration from 3 PM in a day to 3 AM the next day?

- (a) 11                                      (b) 12  
 (c) 144                                    (d) 2

### MECHANICAL ENGINEERING (ME) P2

**Q. 51.** Which one of the following is a representation (not to scale and in bold) of all values of  $x$  satisfying the inequality  $2 - 5x \leq -\frac{6x - 5}{3}$  on the real number line?



**Q. 52.** If  $f(x) = 2\ln(\sqrt{e^x})$ , what is the area bounded by  $(x)$  for the interval  $[0, 2]$  on the  $x$ -axis?

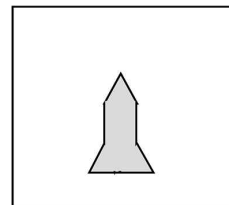
- (a)  $\frac{1}{2}$                                       (b) 1  
 (c) 2    (d) 4

**Q. 53.** A person was born on the fifth Monday of February in a particular year.

Which one of the following statements is correct based on the above information?

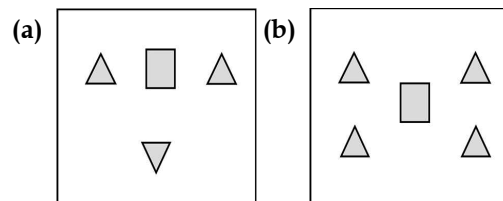
- (a) The 2nd February of that year is a Tuesday  
 (b) There will be five Sundays in the month of February in that year  
 (c) The 1st February of that year is a Sunday  
 (d) All Mondays of February in that year have even dates

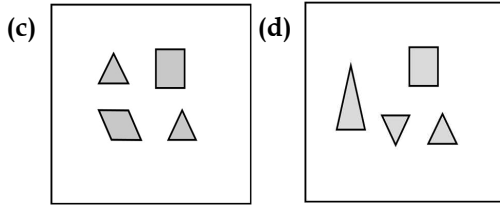
**Q. 54.**



Which one of the groups given below can be assembled to get the shape that is shown above using each piece only once without overlapping with each other?

(rotation and translation operations may be used).





**Q. 55.** For the past  $m$  days, the average daily production at a company was 100 units per day.

If today's production of 180 units changes the average to 110 units per day, what is the value of  $m$ ?

- (a) 18
- (b) 10
- (c) 7
- (d) 5

**Q. 56.** Consider the following functions for non-zero positive integers,  $p$  and  $q$ .

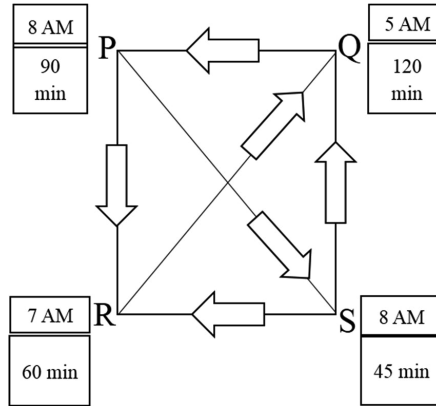
$$f(p, q) = \underbrace{p \times p \times p \times \dots \times p}_{q \text{ terms}} = p^q; \quad f(p, 1) = p$$

$$g(p, q) = p^{p^{p^{\dots}}} \text{ (up to } q \text{ terms)}; \quad g(p, 1) = p$$

Which one of the following options is correct based on the above?

- (a)  $f(2, 2) = g(2, 2)$
- (b)  $f(g(2, 2), 2) < f(2, g(2, 2))$
- (c)  $f(2, 1) \neq f(2, 1)$
- (d)  $f(3, 2) > g(3, 2)$

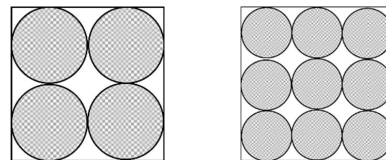
**Q. 57.** Four cities P, Q, R and S are connected through one-way routes as shown in the figure. The travel time between any two connected cities is one hour. The boxes beside each city name describe the starting time of the first train of the day and their frequency of operation. For example, from city P, the first trains of the day start at 8 AM with a frequency of 90 minutes to each of R and S. A person does not spend additional time at any city other than the waiting time for the next connecting train. If the person starts from R at 7 AM and is required to visit S and return to R, what is the minimum time required?



- (a) 6 hours 30 minutes
- (b) 3 hours 45 minutes
- (c) 4 hours 30 minutes
- (d) 5 hours 15 minutes

**Q. 58.** Equal sized circular regions are shaded in a square sheet of paper of 1 cm side length. Two cases, case M and case N, are considered as shown in the figures below. In case M, four circles are shaded in the square sheet and in case N, nine circles are shaded in the square sheet as shown.

What is the ratio of the areas of unshaded regions of case M to that of case N?



- (a) 2 : 3
- (b) 1 : 1
- (c) 3 : 2
- (d) 2 : 1

<b>Answer Key</b>			
<b>Q. No.</b>	<b>Answer</b>	<b>Topic's Name</b>	<b>Chapter's Name</b>
1	(d)	Mensuration	Geometry and Mensuration
2	(c)	Pipes and Cisterns	Arithmetic
3	(c)	Sitting Arrangement	Logical Reasoning
4	(c)	Analytical Reasoning	Logical Reasoning
5	(d)	Probability	Modern Mathematics
6	(a)	Inequalities	Algebra
7	(c)	Figure Formation	Logical Reasoning
8	(a)	Coordinate Geometry	Geometry and Mensuration
9	(d)	Ratio and Proportion	Arithmetic
10	(b)	Blood Relation	Logical Reasoning
11	(b)	Circles	Geometry and Mensuration
12	(b)	Partnership	Arithmetic
13	(b)	Line and Bar Charts	Data Interpretation
14	(b)	Analytical Reasoning	Logical Reasoning
15	(d)	Cubes and Dice	Logical Reasoning
16	(b)	Ratio and Proportion	Arithmetic
17	(c)	Equations and Polynomial	Algebra
18	(d)	Set Theory	Modern Mathematics
19	(a)	Mirror Images	Logical Reasoning
20	(d)	Partnership	Arithmetic
21	(d)	Co-Ordinate Geometry	Geometry and Mensuration
22	(c)	Direction	Logical Reasoning
23	(c)	Functions and Graphs	Algebra
24	(d)	Equations and Polynomials	Algebra
25	(b)	Word Formation	Logical Reasoning
26	(d)	Mathematical Reasoning	Logical Reasoning
27	(d)	Probability	Modern Mathematics
28	(b)	Group Arrangement	Logical Reasoning
29	(d)	Figure Puzzle	Logical Reasoning
30	(a)	Time, Speed and Distance	Arithmetic
31	(a)	LCM and HCF	Number System
32	(c)	Probability	Modern Mathematics
33	(a)	Probability	Modern Mathematics
34	(b)	Profit and Loss	Arithmetic
35	(a)	Group Arrangement	Logical Reasoning
36	(c)	Puzzle	Logical Reasoning
37	(d)	Partnership	Arithmetic
38	(b)	Quadrilaterals	Geometry and Mensuration

39	(b)	Counting of figures	Logical Reasoning
40	(c)	Analytical Reasoning	Logical Reasoning
41	(c)	Inequalities	Algebra
42	(c)	Co-Ordinate Geometry	Geometry and Mensuration
43	(b)	Spatial Aptitude	Logical Reasoning
44	(a)	Average	Arithmetic
45	(c)	Time, Speed and Distance	Arithmetic
46	(b)	Puzzle	Logical Reasoning
47	(a)	Figures	Logical Reasoning
48	(a)	Quadrilaterals	Geometry and Mensuration
49	(b)	Triangle, Square and Circle	Geometry and Mensuration
50	(a)	Clock	Arithmetic
51	(c)	Inequalities	Algebra
52	(c)	Functions And Graphs	Algebra
53	(a)	Calendar	Arithmetic
54	(b, c)	Visual Reasoning	Logical Reasoning
55	(c)	Average	Arithmetic
56	(a)	Functions And Graphs	Algebra
57	(a)	Verbal Reasoning	Logical Reasoning
58	(b)	Circles	Geometry and Mensuration

**ANSWERS WITH EXPLANATIONS**

**2022**

1. **Option (d) is correct.**

For the box to enclose the sphere,  
Diameter of sphere = side of the cube  
 $2r = a$

Since,  
Volume of a cube = (side of the cube)<sup>3</sup>  
 $= (2r)^3$   
 $= 8r^3$

2. **Option (c) is correct.**

Assume the storage tank capacity is X litres.  
Water is drawn only by pipe R in one minute

$$= \frac{x}{10} + \frac{x}{6} + \frac{x}{60}$$

$$= \frac{17x}{60}$$

Hence, the total time is taken by R to draw

$$\text{Water from the storage tank} = \frac{x}{\frac{17x}{60}}$$

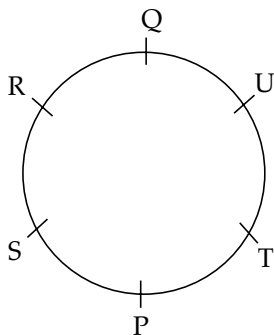
$$= \frac{60}{17} \text{ minutes}$$

$$\text{Therefore, capacity of storage tank} = \frac{60}{17} \times 34$$

$$= 120 \text{ liters.}$$

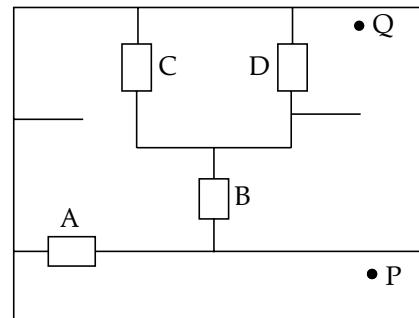
3. **Option (c) is correct.**

Based on the given information, the following figure can be drawn:



From the above figure, we can conclude that Q is a neighbour of R and U.

4. **Option (c) is correct.**



To go from point P to point Q, the minimum number of doors that are needed to be opened is two i.e., door A and door B.

5. **Option (d) is correct.**

Out of the total eight sectors,

$$\text{Probability of getting only one number} = \frac{1}{8}$$

It is given that the two spins are independent.  
Hence, probability of getting one number for each disc i.e.,  $P = \frac{1}{8} \times \frac{1}{8} = \frac{1}{64}$

Possible outcomes making the sum as 8

$$= (1, 7), (2, 6), (3, 5), (4, 4), (5, 3), (6, 2), (7, 1)$$

The total number of such possible outcomes is seven.

$$\text{Hence, the required probability} = \frac{7}{64}$$

6. **Option (a) is correct.**

$$\text{Given inequalities are : } 3p - q < 4 \quad \dots(i)$$

$$3q - p < 12 \quad \dots(ii)$$

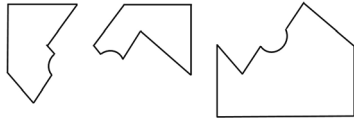
Adding (i) and (ii), we get,

$$2p + 2q < 16$$

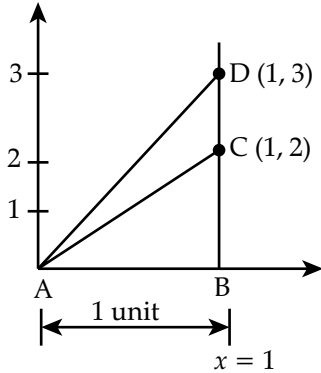
$$p + q < 8$$

7. **Option (c) is correct.**

The three pieces shown in option (c), when assembled together, form a square with a single round hole near its center.



8. Option (a) is correct.



$$\begin{aligned} \text{Area } (\Delta ADC) &= \text{Area } (\Delta ADB) - \text{Area } (\Delta ACB) \\ &= \frac{1}{2} \times 3 \times 1 - \frac{1}{2} \times 2 \times 1 \\ &= \frac{1}{2} \\ &= 0.5 \text{ square unit} \end{aligned}$$

9. Option (d) is correct.

Given,  $p : q = 1 : 2$

$$q : r = 4 : 3 \rightarrow \frac{p}{q} = \frac{1}{2}, \frac{q}{r} = \frac{4}{3}, \frac{r}{s} = \frac{4}{5}$$

$$r : s = 4 : 5$$

$$\frac{r}{s} = \frac{4 \times 3}{5 \times 3} = \frac{12}{15}$$

$$\frac{q}{r} = \frac{4 \times 4}{3 \times 4} = \frac{16}{12}$$

$$\frac{p}{q} = \frac{1 \times 8}{2 \times 8} = \frac{8}{16}$$

$$\therefore p : q : r : s = 8 : 16 : 12 : 15$$

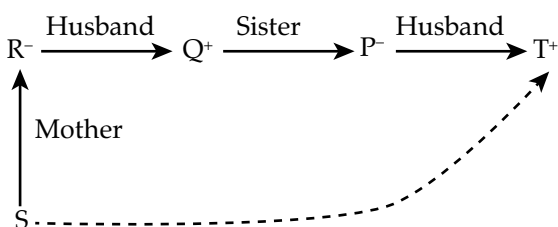
$$u = 15 \times 1.5 = 22.5$$

$$\text{Hence, } \frac{p}{u} = \frac{8}{22.5} = \frac{8 \times 2}{22.5 \times 2} = \frac{16}{45}$$

So,  $p : u = 16.45$

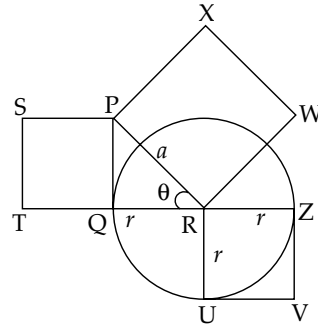
10. Option (b) is correct.

From the given information, the following tree diagram is drawn:



From the above tree diagram, it is concluded that T is an uncle of S.

11. Option (b) is correct.



$$\text{Area (PXWR)} = a^2 \quad \dots (1)$$

$$\text{In } \Delta PQR, r = a \cos \theta$$

$$\begin{aligned} \text{Area (RUVZ)} &= r^2 \\ &= a^2 \cos^2 \theta \quad \dots (2) \end{aligned}$$

From (1) and (2),

$$\begin{aligned} \text{Area (PXWR)} - \text{Area (RUVZ)} &= a^2 - a^2 \cos^2 \theta \\ &= a^2 (1 - \cos^2 \theta) \\ &= a^2 \sin^2 \theta \quad \dots (3) \end{aligned}$$

$$\text{In } \Delta PQR, PQ = a \sin \theta$$

$$\begin{aligned} \text{Area (SPQT)} &= (PQ)^2 \\ &= a^2 \sin^2 \theta \quad \dots (4) \end{aligned}$$

From (3) and (4),

$$\text{Area (SPQT)} = \text{Area (PXWR)} - \text{Area (RUVZ)}$$

12. Option (b) is correct.

Q invested ₹  $x$  per month for 8 months.

Q receives  $\frac{4}{9}$  of the total profit (given)

Hence, P receives  $1 - \frac{4}{9} = \frac{5}{9}$  of the total profit

So, the profit ratio of P and Q is

$$\frac{\text{Profit by P}}{\text{Profit by Q}} = \frac{5}{4}$$

It is given that the profit is shared in proportion to the total investment made by P and Q.

$$\therefore \frac{5}{4} = \frac{5000 \times 6}{x \times 8}$$

$$\Rightarrow x = ₹3000$$

13. Option (b) is correct.

$$\begin{aligned} \text{Mean} &= \frac{f_1x_1 + f_2x_2 + f_3x_3 + \dots + f_7x_7}{f_1 + f_2 + f_3 + \dots + f_7} \\ &= \frac{3 \times 3 + 9 \times 4 + 11 \times 5 + 7 \times 6 + 14 \times 7}{3 + 9 + 11 + 7 + 14 + 2 + 4} \\ &\quad + \frac{2 \times 8 + 4 \times 9}{3 + 9 + 11 + 7 + 14 + 2 + 4} \end{aligned}$$

$$= \frac{292}{50}$$

$$\text{Mean} = 5.84 \quad \dots(\text{i})$$

$$\text{Median} = \frac{\left(\frac{n}{2}\right)^{\text{th}} + \left(\frac{n}{2} + 1\right)^{\text{th}}}{2}$$

$$= \frac{\left(\frac{50}{2}\right)^{\text{th}} + \left(\frac{50}{2} + 1\right)^{\text{th}}}{2}$$

$$= \frac{25^{\text{th}} + 26^{\text{th}}}{2}$$

$$= \frac{6 + 6}{2}$$

$$\text{Median} = 6 \quad \dots(\text{ii})$$

Mode = Most frequently occurred observation

$$\therefore \text{Mode} = 7 \quad \dots(\text{iii})$$

From (i), (ii) and (iii),

Mode > Median > Mean

**14. Option (b) is correct.**

The minimum number of steps required are as follows:

$$\boxed{\text{P2}} \rightarrow \text{Q4} \rightarrow \text{S3} \rightarrow \text{T5} \rightarrow \text{R4} \rightarrow \text{P5}$$

Initial  
Position

Hence, the required minimum number of steps to go from P2 to P5 is five.

**15. Option (d) is possible (MTA)**

The black edge is perpendicular to the given line and the grey edge is parallel to the given line. So option (d) is the possibility.

**16. Option (b) is correct.**

$$\text{Given: } x : y : z = \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$$

$$= \frac{1}{2} \times 12 : \frac{1}{3} \times 12 : \frac{1}{4} \times 12$$

$$= 6 : 4 : 3$$

Let  $x = 6k$ ,  $y = 4k$  and  $z = 3k$

$$\frac{x + z - y}{y} = \frac{6k + 3k - 4k}{4k}$$

$$= \frac{5k}{4k}$$

$$= \frac{5}{4} = 1.25$$

**17. Option (c) is correct.**

As per the given condition,

$$\frac{3+x}{4+x} = \frac{15-x}{17-x}$$

$$\Rightarrow (3+x)(17-x) = (4+x)(15-x)$$

$$\Rightarrow 51 - 3x + 17x - x^2 = 60 - 4x + 15x - x^2$$

$$\Rightarrow 51 + 14x = 60 + 11x$$

$$\Rightarrow 3x = 9$$

$$\Rightarrow x = 3$$

**18. Option (d) is correct.**

Let Mathematics, Physics and Chemistry be denoted by M, P and C respectively.

We know that,

$$n(M \cup P \cup C) = n(M) + n(P) + n(C)$$

$$- n(M \cap P) - n(P \cap C) - n(C \cap M)$$

$$+ n(M \cap P \cap C)$$

$$= 150 + 200 + 175 - 50 - 60 - 40 + 30$$

$$= 405$$

Number of students interested in Humanities

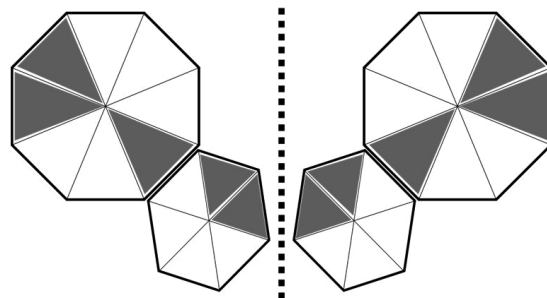
$$\text{i.e., } n(\text{Humanities}) = 450 - 405$$

$$= 45$$

**19. Option (a) is correct.**

Original Picture

Mirror image



**20. Option (d) is correct.**

Let the three friends be P, Q and R.

The ratio of will first six months of investment by P, Q and R is 3 : 4 : 5 respectively

For the next six months, P, Q and R increase the investment by 10%, 15% and 20% respectively

We know that,

Ratio of shares in the total profit by P, Q, R = Ratio of the individual investment by P, Q, R

Hence, the ratio of the shares of P, Q and R in total profit

$$= 3 + (3 \times 1.1) : 4 + (4 \times 1.15) : 5 + (5 \times 1.2)$$

$$= 6.3 : 8.6 : 11$$

$$= 63 : 86 : 110$$

**21. Option (d) is correct.**

The equation of a straight line is  $y = mx + c$

Where, 'm' is the slope of the line.

Given equation of the lines  $L_1, L_2, L_3,$  and  $L_4$  can be rewritten in the form of  $y = mx + c$  as under:

$$L_1 : y = \frac{2}{3}x - \frac{5}{3}$$

$$\therefore \text{slope of } L_1 = \frac{2}{3}$$

$$L_2 : y = -\frac{3}{2}x + 4$$

$$\therefore \text{slope of } L_2 = -\frac{3}{2}$$

$$L_3 : y = \frac{2}{3}x - \frac{5}{6}$$

$$\therefore \text{slope of } L_3 = \frac{2}{3}$$

$$L_4 : y = \frac{2}{3}x - \frac{2}{3}$$

$$\therefore \text{slope of } L_4 = \frac{2}{3}$$

$$\text{Slope of } L_4 \times \text{slope of } L_2 = \frac{2}{3} \times -\frac{3}{2} = -1$$

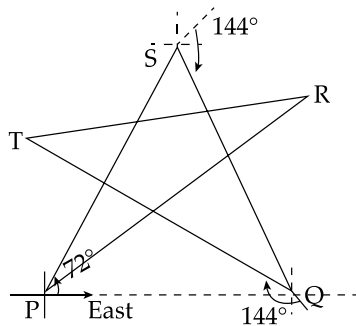
Hence,  $L_4$  is perpendicular to  $L_2$

$$\text{Slope of } L_4 = \text{slope of } L_3 = \frac{2}{3}$$

Hence,  $L_4$  is parallel to  $L_3$

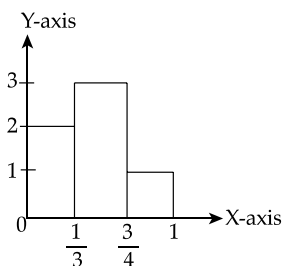
**22. Option (c) is correct.**

Pattern :



$$SQ = QT = TR = RP = PS = 10 \text{ cm}$$

**23. Option (c) is correct.**



Area under the curve

$$\begin{aligned} &= 2 \times \frac{1}{3} + 3 \times \left(\frac{3}{4} - \frac{1}{3}\right) + 1 \times \left(1 - \frac{3}{4}\right) \\ &= \frac{2}{3} + \frac{15}{12} + \frac{1}{4} \\ &= \frac{8+15+3}{12} = \frac{26}{12} = \frac{13}{6} \end{aligned}$$

**24. Option (d) is correct.**

Given :  $r$  is the root or the equation

$$x^2 + 2x + 6 = 0$$

Hence,  $r^2 + 2r + 6 = 0 \dots$  (i)

Now,  $(r + 2)(r + 3)(r + 4)(r + 5)$

$$= (r^2 + 5r + 6)(r^2 + 9r + 20)$$

$$= (r^2 + 2r + 6 + 3r)(r^2 + 2r + 6 + 7r + 14)$$

$$= (0 + 3r)(0 + 7r + 14) \dots(\text{from (i)})$$

$$= 3r(7r + 14)$$

$$= 21r^2 + 42r$$

$$= 21(r^2 + 2r)$$

$$= 21 \times (-6) \dots(\text{from (i)})$$

$$= -126$$

**25. Option (b) is correct.**

The plates in option (b) i.e.,  $\boxed{R} \boxed{A} \boxed{R}$  (by rotating the second and the third plate) can be combined with the given plates  $\boxed{A} \boxed{D}$  to form a five - letter palindrome  $\boxed{R} \boxed{A} \boxed{D} \boxed{A} \boxed{R}$ .

**26. Option (d) is correct.**

Let the total number of candidates who appeared for the test be  $x$ .

$$\text{Boys appeared} = 65\% \text{ of } x = \frac{65x}{100} = 0.65x \dots$$
 (i)

$$\text{Girls appeared} = 35\% \text{ of } x = \frac{35x}{100} = 0.35x \dots$$
 (ii)

Let the total candidates qualified for the test be  $y$ .

$$\text{Boys qualified} = 40\% \text{ of } y = \frac{40y}{100} = 0.4y \dots$$
 (iii)

$$\text{Girls qualified} = 60\% \text{ of } y = \frac{60y}{100} = 0.6y \dots$$
 (iv)

From (i), (ii), (iii) and (iv), we can conclude that the number of boys who qualified the test is less than the number of girls who qualified.

**27. Option (d) is correct.**

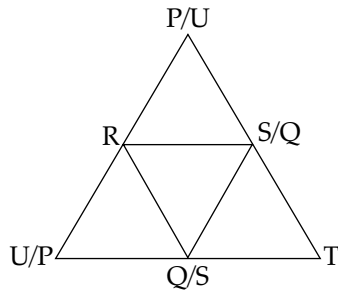
There are three green balls and two orange balls. The probability of getting the second drawn ball as orange is:



$$\begin{aligned}
 P &= P(\text{green} \cap \text{orange}) + P(\text{orange} \cap \text{orange}) \\
 &= \frac{3}{5} \times \frac{2}{4} + \frac{2}{5} \times \frac{2}{5} \\
 &= \frac{46}{100} = \frac{23}{50}
 \end{aligned}$$

28. Option (b) is correct.

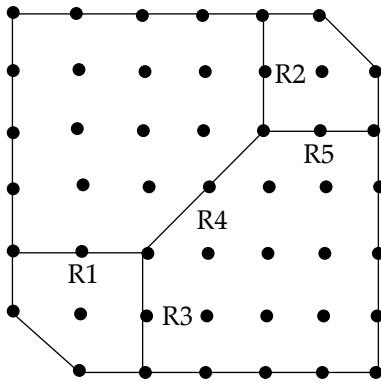
Using the given information, the following triangle is drawn:



Since it is given that PR is parallel to QS, S cannot be placed at the corners of the triangle.

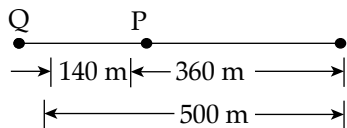
29. Option (d) is correct.

- R<sub>3</sub> – First additional rope
- R<sub>4</sub> – Second additional rope
- R<sub>5</sub> – Third additional rope



Thus, using three additional ropes, we can divide the land into four similar – shaped plots.

30. Option (a) is correct.



$$\frac{\text{Speed of P}}{\text{Speed of Q}} = \frac{3}{4}$$

∴ Speed of P = 3x and speed of Q = 4x  
 Let, P reaches the end point of race at time 't'.  
 Hence, 3x × t = 360  
 $xt = 120$  ... (i)

At time 't', distance covered by

$$\begin{aligned}
 Q &= 4x \times t \\
 &= 4xt \\
 &= 4 \times 120 \quad \text{from (i)} \\
 &= 480 \text{ m}
 \end{aligned}$$

Hence, the distance between P and Q,  
 When P wins the race = (500 – 480) m  
 = 20 m

31. Option (a) is correct.

$$\begin{aligned}
 \text{LCM of } 20, 30, 50 &= 300 \text{ min} \\
 &= 5 \text{ hours}
 \end{aligned}$$

Hence, the three bells will ring together again after 5 hours,  
*i.e.*, 12:00 pm + 5 hours = at 5:00 pm.

32. Option (c) is correct.

If the disc rotates along 1 – 1 axis, then front view = rear view

$$\text{Hence, the required probability} = \frac{2}{3}$$

33. Option (a) is correct.

$$\begin{aligned}
 \text{Total outcomes} &= n(S) = 6 \times 6 = 36 \\
 \text{Favourable outcomes} &= n(E) = (Q, Q), (Q, U), \\
 &(Q, V) \\
 &(U, Q), (U, U), (U, V) \\
 &(V, Q), (V, U), (V, V) \\
 n(E) &= 9
 \end{aligned}$$

$$\begin{aligned}
 \text{Hence, the required probability} &= \frac{n(E)}{n(S)} \\
 &= \frac{9}{36} = \frac{1}{4}
 \end{aligned}$$

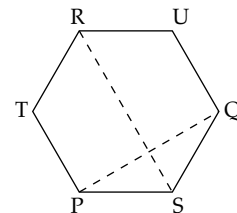
34. Option (b) is correct.

$$\begin{aligned}
 \text{Let the cost price at store M} &= ₹ 100x \\
 \text{So, the cost price at store S} &= ₹ 90x \\
 \text{Delivery charges at store S} &= ₹ 150 \\
 \therefore 100x - (90x + 150) &= 100 \\
 \Rightarrow 10x &= 250 \\
 \Rightarrow x &= 25
 \end{aligned}$$

$$\begin{aligned}
 \text{Hence, the cost price of the item at store S} \\
 &= 90 \times 25 \\
 &= ₹ 2250
 \end{aligned}$$

35. Option (a) is correct.

From the given information, the following figure is drawn:



From the above diagram, it is clear that the line segment joining R and T is parallel to the line segment joining Q and S.

36. **Option (c) is correct.**

To decrease the current distance to the top-right corner, the ant should follow the path shown in option (c).

37. **Option (d) is correct.**

$$P : Q : R : S = 5 : 2 : 4 : 3$$

$$\text{Let } P = 5x, Q = 2x, R = 4x, S = 3x$$

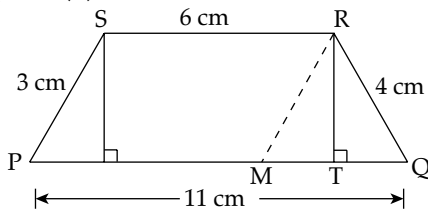
R gets rupee 1000 more than S (given)

$$\therefore 4x = 3x + 1000$$

$$\Rightarrow x = 1000$$

$$\text{Hence, share of } Q = 2x = 2 \times 1000 = ₹ 2000$$

38. **Option (b) is correct.**



PQRS is a trapezium.

RT is the shortest distance between PQ and SR.

Draw RM parallel to SP.

So, PMRS is a parallelogram, in which

$$SP = RM = 3 \text{ cm and } SR = PM = 6 \text{ cm}$$

$$MQ = PQ - PM = 11 - 6 = 5 \text{ cm}$$

In  $\Delta RMQ$ , the sides are 3 cm, 4 cm and 5 cm.

(3, 4, 5) is a Pythagorean triplet.

It means  $\Delta RMQ$  is a right - angled triangle,

where  $\angle MRQ = 90^\circ$

$$\text{Area of triangle } RMQ = \frac{1}{2} \times \text{base} \times \text{height}$$

$$= \frac{1}{2} \times RM \times RQ$$

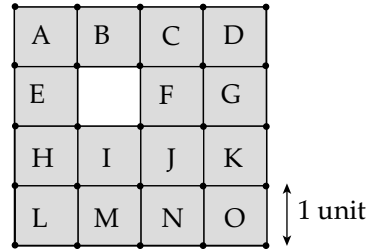
$$= \frac{1}{2} \times 3 \times 4 = 6 \text{ cm}^2$$

$$\text{Also, Area of triangle } RMQ = \frac{1}{2} \times RT \times MQ$$

$$6 = \frac{1}{2} \times RT \times 5$$

$$\Rightarrow RT = \frac{12}{5} = 2.40 \text{ cm}$$

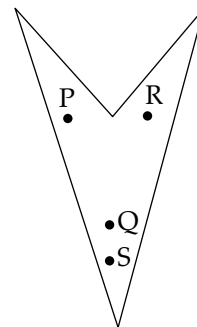
39. **Option (b) is correct.**



$$\begin{aligned} \text{Total } (1 \times 1) \text{ squares without a hole} &= 4 \times 4 - 1 \\ &= 16 - 1 \\ &= 15 \end{aligned}$$

$$\begin{aligned} \text{Total } (2 \times 2) \text{ squares without a hole} &= 5 \\ \text{Hence, the total number of squares without a hole} &= 15 + 5 \\ &= 20 \end{aligned}$$

40. **Option (c) is correct.**



If a security guard stands at point P, then he can't see the 'R' side and vice versa.

When a security guard stands at points Q and S, he can watch over the entire inner space of the gallery.

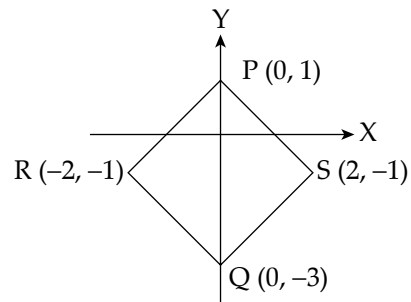
41. **Option (c) is correct.**

$$\begin{array}{l|l} 2x - 1 > 7 & 2x - 9 < 1 \\ \Rightarrow 2x > 8 & \Rightarrow 2x < 10 \\ \Rightarrow x > 4 \dots(i) & \Rightarrow x < 5 \dots(ii) \end{array}$$

Combining (i) and (ii),

$$4 < x < 5$$

42. **Option (c) is correct.**



$$PS = \sqrt{(2-0)^2 + (-1-1)^2} = \sqrt{8}$$

$$SQ = \sqrt{(2-0)^2 + (-1+3)^2} = \sqrt{8}$$

$$QR = \sqrt{(0+2)^2 + (-3+1)^2} = \sqrt{8}$$

$$PR = \sqrt{(-2-0)^2 + (1+1)^2} = \sqrt{8}$$

$$PQ = \sqrt{(0-0)^2 + (1+3)^2} = 4$$

$$RS = \sqrt{(2+2)^2 + (-1+1)^2} = 4$$

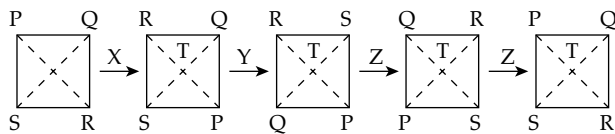
Thus, in PQRS, sides  $PS = SQ = QR = PR$   
and diagonals  $PQ = RS$   
Hence, PQRS is a square.

$$\begin{aligned} \therefore \text{Area of PQRS} &= (PS)^2 = (PS)^2 = (\sqrt{8})^2 \\ &= 8 \text{ square units.} \end{aligned}$$

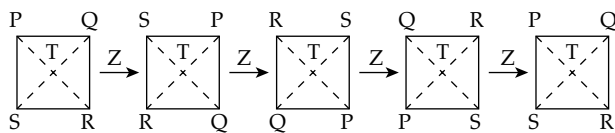
**43. Option (b) is correct.**

- (i) 'X' means rotation along S - Q by  $180^\circ$
- (ii) 'Y' means rotation along P - R by  $180^\circ$
- (iii) 'Z' means rotation along axis through point T by  $90^\circ$

Sequence of XYZZ :



Sequence of ZZZZ :



From the above two sequences, it is concluded that the sequence of operations (i) i.e., XYZZ and (iii) i.e., ZZZZ are equivalent.

**44. Option (a) is correct.**

The average of the monthly salaries of M, N and S is ₹4000.

$$\therefore 4000 = \frac{M+N+S}{3}$$

$$\Rightarrow M + N + S = 12000 \quad \dots(i)$$

The average of the monthly salaries of N, S and P is ₹ 5000.

$$\therefore 5000 = \frac{N+S+P}{3}$$

$$\Rightarrow N + S + P = 15000$$

But  $P = 6000$  (given)

$$\therefore N + S + 6000 = 15000$$

$$\Rightarrow N + S = 9000 \quad \dots(ii)$$

From (i) and (ii),

$$M + 9000 = 12000$$

$$\Rightarrow M = 3000$$

$$\frac{M}{P} (\%) = \frac{3000}{6000} \times 100 = \frac{1}{2} \times 100 = 50\%$$

**45. Option (c) is correct.**

Let the distance of  $x$  km be covered at 10 kmph.  
Therefore  $(80 - x)$  km will be covered at 18 kmph.  
Total time to cover 80 km = 6 hours (given)

$$\frac{x}{10} + \frac{80-x}{18} = 6$$

$$\Rightarrow \frac{9x + 400 - 5x}{90} = 6$$

$$\Rightarrow 4x + 400 = 540$$

$$\Rightarrow 4x = 140$$

$$\Rightarrow x = 35$$

Hence, percentage of distance covered at

$$\begin{aligned} 10 \text{ kmph} &= \frac{35}{80} \times 100 \\ &= 43.75\% \end{aligned}$$

**46. Option (b) is correct.**

P = French and Dutch

Q = Chinese and Japanese

R = Spanish and French

S = Dutch and Japanese

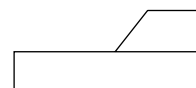
With respect to the relative difficulty level, the languages can be arranged in the descending order as under:

Chinese > Japanese > Dutch > French > Spanish

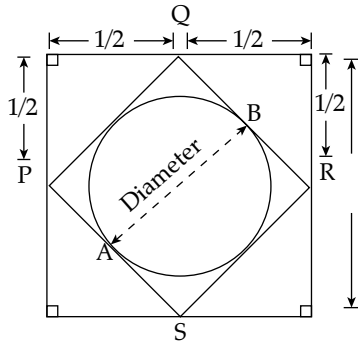
Hence, girl Q is learning the most difficult pair of languages.

**47. Option (a) is correct.**

When the given 3D object is viewed from the direction indicated by the given arrow, the view will be as under:



48. Option (a) is correct.



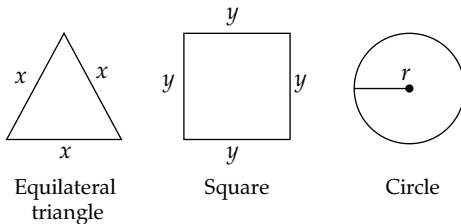
PQRS is a rhombus.

AB is the diameter of the circle.

Diameter of the circle = side of the rhombus

$$\begin{aligned} AB &= PQ \\ &= \sqrt{\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2} \\ &= \frac{\sqrt{2}}{2} \\ &= \frac{1}{\sqrt{2}} \end{aligned}$$

49. Option (b) is correct.



$$\text{Area : } \frac{\sqrt{3}}{4}x^2 = y^2 = \pi r^2$$

$$\text{Let } \frac{\sqrt{3}}{4}x^2 = y^2 = \pi r^2 = k^2$$

$$\begin{aligned} \therefore \quad x &= \sqrt{\frac{4}{\sqrt{3}}} \cdot k \\ y &= k \\ r &= \frac{1}{\sqrt{\pi}} \cdot k \end{aligned}$$

$$\text{Ratio of perimeter} \Rightarrow 3x : 4y : 2\pi r$$

$$\Rightarrow 3 \times \sqrt{\frac{4}{\sqrt{3}}} \cdot k : 4k : 2\pi \times \frac{1}{\sqrt{\pi}} \cdot k$$

$$\Rightarrow 3 \times \frac{2}{\sqrt{\sqrt{3}}} k : 4k : 2\sqrt{\pi} k$$

$$\Rightarrow \sqrt{(3\sqrt{3})} : 2 : \sqrt{\pi}$$

50. Option (a) is correct.

In every one hour, the hour hand, minute hand and the second hand coincide one time.

In 12 hours, the hands will coincide 11 times. (because in between 11:00 am to 1:00 am, the hands of a clock will meet only once).

51. Option (c) is correct.

$$\text{Given : } 2 - 5x \leq -\left(\frac{6x - 5}{3}\right)$$

$$\Rightarrow 6 - 15x \leq -6x + 5$$

$$\Rightarrow 9x \geq 1$$

$$\Rightarrow x \geq \frac{1}{9}$$

52. Option (c) is correct.

$$\text{Given : } f(x) = 2 \ln(\sqrt{e^x})$$

Area bounded by  $f(x)$  for the interval  $[0, 2]$  on

$$\text{the } x\text{-axis} = \int_0^2 f(x) dx$$

$$= \int_0^2 2 \ln(\sqrt{e^x}) dx$$

$$= \int_0^2 2 \ln(e^{x/2}) dx$$

$$= \int_0^2 x dx$$

$$= \left[\frac{x^2}{2}\right]_0^2$$

$$= \frac{2^2}{2} - \frac{0^2}{2}$$

$$= 2$$

53. Option (a) is correct.

In a year, five Mondays will come in February month only if February has 29 days.

Hence, the following dates of February will have Monday:

1<sup>st</sup> February – Monday

8<sup>th</sup> February – Monday

15<sup>th</sup> February – Monday

22<sup>nd</sup> February – Monday

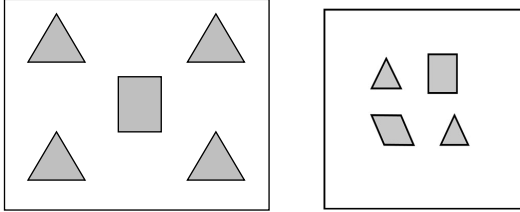
29<sup>th</sup> February – Monday

→ Option (a) is correct as 1<sup>st</sup> February is Monday. So, 2<sup>nd</sup> February will be Tuesday.

→ Option (b) is incorrect because February will have five Mondays and four Sundays.

- Option (c) is incorrect. Since, 1<sup>st</sup> February is a Monday.  
 → Option (d) is incorrect because 1<sup>st</sup>, 15<sup>th</sup> and 29<sup>th</sup> February are odd dates.

54. Option (b) or (c) is correct.



55. Option (c) is correct.

Production in 'm' days = 100 m

Adding today's day, new production in (m + 1) days = 100 (m + 1)

New average production = 110

$$\frac{100m + 180}{(m + 1)} = 100$$

$$\Rightarrow 100m + 180 = 110(m + 1)$$

$$\Rightarrow 100m + 180 = 110m + 110$$

$$\Rightarrow 10m = 70$$

$$\Rightarrow m = 7$$

56. Option (a) is correct.

$$f(p, q) = p \times p \times p \times \dots \times p = p^q;$$

$$g(p, q) = p^{p \dots \text{(upto q terms)}}$$

$$(i) \quad f(2, 2) = 2^2 = 4$$

$$g(2, 2) = 2^2 = 4$$

Hence, option (a) is correct.

$$(ii) \quad f(g(2, 2), 2) = f(4, 2) = 4^2 = 16$$

$$\text{and } f(2, g(2, 2)) = f(2, 4) = 2^4 = 16$$

$$\therefore f(g(2, 2), 2) = f(2, g(2, 2))$$

Hence, option (b) is incorrect.

$$(iii) \quad g(2, 1) = 2$$

$$f(2, 1) = 2$$

$$\therefore g(2, 1) = f(2, 1)$$

Hence, option (c) is incorrect.

$$(iv) \quad f(3, 2) = 9$$

$$g(3, 2) = 27$$

$$\therefore f(3, 2) < g(3, 2)$$

Hence, option (d) is incorrect.

57. Option (a) is correct.

The person starting from R at 7 am will visit S and return to R if the following route is followed:

$$R \rightarrow Q \rightarrow P \rightarrow S \rightarrow R$$

Now, the travel time between any two cities is one hour. Hence total travel time will be four hours.

The person reaches Q at 8 am but the next train at Q is at 9 pm.

So, waiting time at Q = 1 hr.

He starts from Q at 9 am and reaches P at 10 am but the next train at P is at 11 am.

So, waiting time at P = 1 hr.

He starts from P at 11 am and reaches S at 12 noon but the next train at S is at 12:30 pm

So, waiting time at S =  $\frac{1}{2}$  hr.

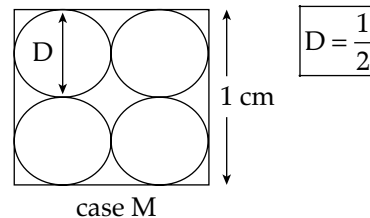
He starts from S at 12:30 pm and reaches R at 1:30 pm.

$$\text{The minimum time required} = 4 + 1 + 1 + \frac{1}{2}$$

$$= 6\frac{1}{2} \text{ hrs.}$$

$$= 6 \text{ hrs. } 30 \text{ min.}$$

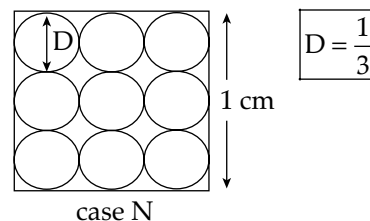
58. Option (b) is correct.



Area of unshaded regions of case M

$$= 1^2 - 4 \times \frac{\pi}{4} \times \left(\frac{1}{2}\right)^2$$

$$= \left(1 - \frac{\pi}{4}\right) \text{ cm}^2$$



Area of unshaded regions of case N

$$\begin{aligned} &= 1^2 - 9 \times \frac{\pi}{4} \times \left(\frac{1}{3}\right)^2 \\ &= \left(1 - \frac{\pi}{4}\right) \text{cm}^2 \end{aligned}$$

$$\begin{aligned} \text{The required ratio} &= \frac{\left(1 - \frac{\pi}{4}\right)}{\left(1 - \frac{\pi}{4}\right)} \\ &= 1 : 1 \end{aligned}$$