Parul University
Faculty of Engineering and Technology
Department of Applied Science & Humanities Academic Year 2025-26
Subject: Quant and Reasoning (303105311)Branch: CSE/ IT

UNIT 9 - Cubes & Dice, Syllogism

CUBE

The length, breadth and height of a cube is equal. That means, the figure whose length, breadth and height are equal is called a cube.

A cube always consists of :

(A) Six faces

(B) Twelve Edges

(C) Eight corners

Cubes, on the basis of colour :

1. **Corner cube :** It is situated at each corner and three sides/faces of corner cube are coloured.
2. **Middle cube :** It is situated between each edges. Two faces of middle cube are coloured.
3. **Central cube :** It is situated at the mid place of a face and only one side of it is coloured.
4. **Inner cube :** It is situated between each central cubes. No face of inner cube is coloured.If a cube is coloured and cut into 27 equal cubes then there are :

- 6 cubes have one face coloured (Central cubes)
- 12 cubes have two faces coloured (Middle cubes)
- 8 cubes have three faces coloured (Corner cubes)
- 1 cube colourless (Inner cubes)

Cube coloured with more than one colour

Total number of one side coloured cubes which are coloured with x colours = $(n-2)^2$ □ the number of edges with which x colours are joined.

Some important formulae for the number of coloured or colourless faces:

Side of a cube :

(i) Number of cubes having no face coloured = $(n-2)^3$

(ii) Number of cubes having one coloured face = $(n-2)^2 \times 6$

(iii) Number of cubes having two coloured faces = (n – 2) ×12

(iv) Number of cubes having three coloured faces = 8

(v) Number of cubes having two colour faces coloured with two different colours, while rest are colourless = 4

(vi) Number of cubes having a colour face coloured with 1 special colour, while rest are colourless = 2

(vii) Number of cubes having 2 colour sides coloured with a special colour = 0

(viii) Number of cubes having 2 colour sides coloured with two different colours, while rest are either colouredor colourless = 12

(ix) Total numbers of cubes = n^3, where n = numbers of equal cubes in each column of each side.

Number of cubes having three colour faces coloured with 3 different colours = 8

Ex :1 Count the number of cubes in the given figure :

Solution : In the given figure, there are three columns containing 1 cube each, two columns containing 2cubes each and one column containing 3 cubes.

∴ Total number of cubes in column 1 = 3 × 1 = 3Number of cubes in column 2 = 2 × 2 = 4

Number of cubes in column 3 = 1 × 3 = 3

∴ Total number of cubes in the figure = 3 + 4 + 3 = 10

- Painting sides of cubes :

Ex 2 : Directions : The six faces of a cube are coloured black, brown, green, red, white and blue,such that

(i) Red is opposite black

(ii) Green is between red and black

(iii) Blue is adjacent to white

(iv) Brown is adjacent to blue

(v) Red is at the bottom.

Answer the following questions based on this information.

1. Which colour is opposite to brown?

a) White b) Red c) Green d) Blue

2. The four adjacent colours are?

a) Black, Blue, Brown, Red

d) Black, Blue, Brown, White

c) Black, Blue, Red, White
d) Black, Brown, Red, White

3. Which of the following can be deduced from (i) and (v)?

a) Black is on the top
b) Blue is on the top
c) Brown is on the top
d) Brown is opposite Black

Solutions : At first we draw a figure indicating colour pattern of the sides of cube.

1. As shown in the figure, side 'D' is coloured brown. Side 'B' lies opposite to side 'D'. By considering thefigure, we can say that white colour is opposite to brown.
2. By considering the figure it can be said that Black, Brown, Red, White are adjacent colours.
3. As shown in the figure Red is opposite Black and Red is at bottom. So 'Black is on the top.

Ex: 3: A large cube painted red on all six faces, is cut into 27 smaller identical cubes.

1. How many of the smaller cubes have no faces painted at all?a) 10 b) 1 c) 11 d) 21
2. How many of the smaller cubes have exactly one face painted red?
a) 4 b) 8 c) 6 d) 10
3. How many of the smaller cubes have at least one face painted red?
a) 24 b) 26 c) 27 d) 25
4. How many of the smaller cubes have exactly two faces painted red?
a) 11 b) 13 c) 15 d) 12
5. How many of the smaller cubes have at least two faces painted red?
a) 5 b) 10 c) 20 d) 15

Solutions : Cutting a large cube into 27 identical smaller cubes, gives a 3 × 3 × 3 configuration. Remove all outer cubesand remaining 1 × 1 × 1 = 1 cube will have no face painted.

1. (c) The cubes which are not along any edge are the ones that have only one face painted red. On each faceonly one middle cube will have only one face painted. So, a total of 6 cubes.
2. (b) At least one face painted means one face, two faces or three faces painted.Total number = Total cubes – cubes with no face painted

= 27 – 1 = 26 cubes

3. (d) The cubes along the edges but not at the corners will have two faces painted. So, on each edge one cubewill have two faces painted ; total number = 1 ? 12 = 12 cubes.
4. (c) Atleast two face painted means two faces or three faces painted. So, total number = 12 + 8 = 20 cubes.

Ex: 4: It was found that a large cube can be cut into certain number of identicalsmall cuboids each of dimensions 1 cm ? 2 cm ? 5 cm.

1. What is measurement of side of the smallest such cube?
   a) 5 cm b) 20 cm c) 15 cm d) 10 cm
2. How many such cuboids can be formed from a large cube?
   a) 110 b) 100 c) 150 d) 10 cm

Solutions :

1.(d) Side of the cube = LCM (1, 2, 5) = 10

2.(b) Number of cuboids = $\frac{10 \times 10 \times 10}{1 \times 2 \times 5}$ = 100

Ex 5 : If a cube of side 3 cm is cut into smaller cubes of side 1 cm, then how many cubes will be obtained?

a) 3 b) 6 c) 9 d) 27

Solution :

Ex 6 : Two adjacent faces of a solid cube are painted yel-low. The faces opposite to these are painted withred color and the remaining faces are painted black. This cube is now cut into 64 small cubes, out of these how ma ny cubes will have only 1 face painted?

Solution : From the information given,

The cubes at the center of any faces will have only one face painted.

∴ Numbers of cubes = $6(n-2)^2$

Here, n = $\sqrt[3]{64} = \sqrt[3]{4 \times 4 \times 4 = 4}$

= $4(4-2)^2 = 6 \times 4 = 24$

Ex 7 : A solid cube is painted with green color on all the faces and then it is cut into 64 equal sized small cubes.

1. How many cubes will have one face painted?

a) 12 b) 24 c) 36 d) 48

2. How many cubes will have 2 opposite faces paintedgreen?
   a) 0 b) 4 c) 8 d) 10
3. How many cubes will have only 2 adjacent facespainted green?
   a) 8 b) 12 c) 16 d) 24
4. How many cubes will have 3 faces painted?
   a) 2 b) 4 c) 6 d) 8
5. How many cubes are there which will have no face painted?
   a) 2 b) 4 c) 6 d) 8

(ANS : 1.b 2.a 3.d 4.d 5.d)

Ex 8 : A cubical block whose size is 4 × 6 × 8 cm is di-vided into cubes of size 2 cm each. How manycubes will be obtained from this arrangement?
a) 16 b) 20 c) 24 d) 48

(ANS : (C))

Ex 9 : How many cubes of side 2cm can be obtained froma cube of side 10 cm?
a) 5 b) 25 c) 125 d) 500

(ANS : (C))

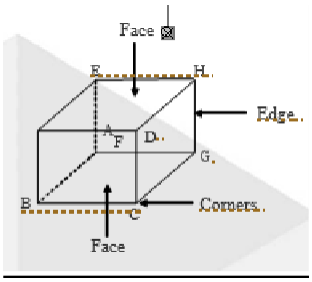
Ex 10 : A cake of size 5 cm × 30 cm × 30 cm can be cut intohow many pieces of size 5 cm × 5 cm × 10 cm?
a) 10 b) 15 c) 18 d) 30

(ANS : (C))

DICE

Dice are cubical or cuboidal shape objects containing number/figures/symbols/embedded on their surfaces.Dice are used for gambling and non-gambling purposes likes craps, ludo etc.
Different types of questions covered in this chapter are as follows:

Die/Dice is/are a three-dimentional figure with each of its six sides/faces showing different numbers/letters/colours etc. It has 8 corners and 12 edges. In a dice, length, breadth and height all are equal to each other.



In the above dice,

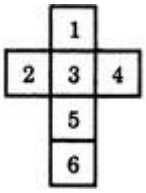
Edges  = AE, EH, HD, AD, BF, FG, GC, BC, AB, DC, HG and EF

Corners  = A, B, C, D, E, F, G and H

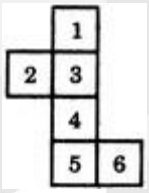
Surfaces  = AEHD, DHEG, AEFB, BCGF, ABCD and EFGH

Construction of Boxes:

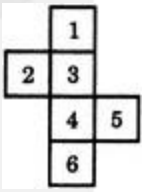
The details of the cube formed when a sheet is folded to form a box:



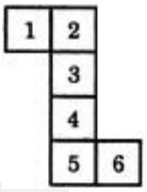
1 lies opposite 5;
2 lies opposite 4;
3 lies opposite 6.



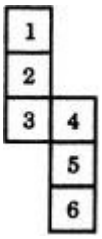
1 lies opposite 4;
2 lies opposite 6;
3 lies opposite 5.



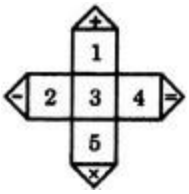
1 lies opposite 4;
2 lies opposite 5;
3 lies opposite 6.



1 lies opposite 6;
2 lies opposite 4
3 lies opposite 5.



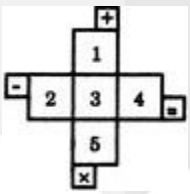
1 lies opposite 3;
2 lies opposite 5;
4 lies opposite 6.

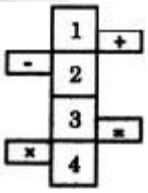


 lies opposite 3
2 lies opposite 4;
1 lies opposite 5.

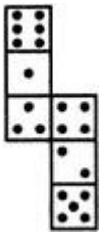
 lies opposite 3
1 lies opposite 5.
2 lies opposite 4;

 &  opp
1 lies opposite 3;
2 lies opposite 4;



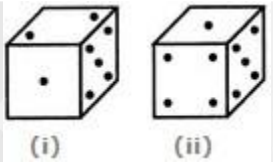


Ex 1: How many dots lie opposite to the face having three dots, when the given figure is folded to form a cube?



Solution : when this figure is folded to form a cube then the face bearing six dots will lie opposite the face bearing three dots.

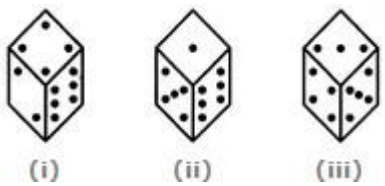
Ex 2: Observe the dots on a dice (one to six dots) in the following figures. How many dots are contained on the face opposite to that containing four dots?



Solution : We shall assume the dice in fig. (ii) to be rotated so that the 5 dots appear at the same position as in fig. (i) i.e. on RHS face (i.e. on face II as per activity 1) and 1 dot appears at the same position as in fig; (i) i.e. on Front face (i.e. on face I). Then, from the, two figures, 2 dots appear on the top face (i.e. on face V) and 4 dots appear on the Bottom face (i.e. on face VI).

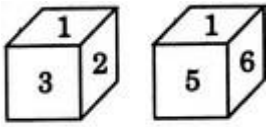
Since, these two faces are opposite to each other, therefore, two dots are contained on the face opposite to that containing four dots.

Ex 3: Three different positions of a dice are shown below. How many dots lie opposite 2 dots?



Solution : From figures (ii) and (iii), we conclude that 1, 6, 3 and 4 dots lie adjacent to 5 dots. Therefore, 2 dots must lie opposite 5 dots. Conversely, 5 dots must lie opposite 2 dots.

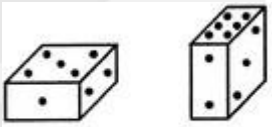
Ex 4 : Two positions of a dice are shown. When 4 is at the bottom, what number will be on the top?



(i) (ii)

Solution : From figures (i) and (ii), we conclude that 2, 3, 5 and 6 he adjacent to 1. Therefore, 4 lies opposite 1. Hence, when 4 is at the bottom, then1 must be on the top.

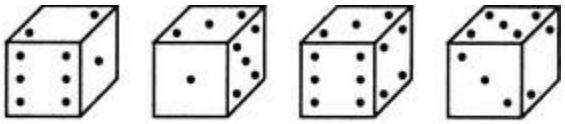
Ex 5 : Two positions of a parallelepiped are shown below. When the number 3 will be on the top side, then which number will be at the bottom?



(i) (ii)

Solution : The number 2 is common to both the figures. We assume the parallelepiped in fig. (ii) to be rotated so that 2 appears at the same position as in fig. (i) i.e. on the RHS face and the numbers 6 and 3 move to the faces hidden behind the numbers 1 and 5 respectively [in fig. (i)]. Then, the combined figure will have 1 opposite 6 and 5 opposite 3. Thus, when 3 will be on the top, then 5 will appear at the bottom.

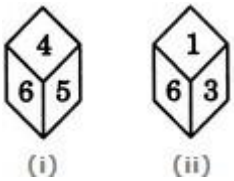
Ex 6 : If the total number of dots on opposite faces of a cubical block is always 7, find the figure which is correct.



(1) (2) (3) (4)

Solution : Since the total number of dots on opposite faces is always 7, therefore, 1 dot appears opposite 6 dots, 2 dots appear opposite 5 dots and 3 dots appear opposite 4 dots.

Ex 7 : Two positions of a dice are shown below. Identify the number at the bottom when the top is '3'?



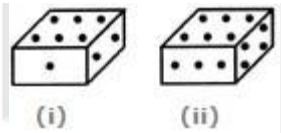
(i) (ii)

Solution : The number 6 is common to both the positions of the dice. We assume the dice in fig. (ii) to be rotated so that 6 remains on the FR-LH face (i. e. on face IV as per activity 1) and the numbers 1 and 3 move to the faces hidden behind 4 and 5 respectively [in fig. (i)]. Then, 5 lies on FR-RH face (i.e. face I), 4 lies on Top face {i.e. face V), 3 lies on RR-LH face (i.e. face III) and 1 lies on Bottom face (i.e. face VI). Thus, 3 lies opposite 5. Hence, when the top is 3, then the number at the bottom is 5.

Ex 8 : Three different positions X, Y and Z of a dice are shown in the figures given below. Which number lies at the bottom face in position X?

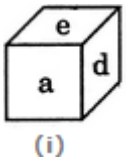
Solution : From positions X and Y we conclude that 1, 5, 6 and 3 lie adjacent to 4. Therefore, 2 must lie opposite 4. From positions Y and Z we conclude that 4, 3, 2 and 5 lie adjacent to 6. Therefore, 1 must lie opposite 6. Thus, 2 lies opposite 4, 1 lies opposite 6 and consequently 5 lies opposite 3.
As analysed above, the number on the face opposite 5 is 3. In position X, since 5 lies on the top, therefore 3 must lie at the bottom face.

Ex 9 : Two positions of a block are shown below: When six is at the bottom, what number will be at the top?



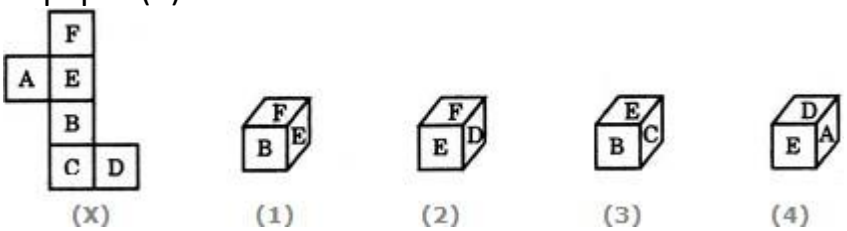
Solution : From figures (i) and (ii) we conclude that the number 1, 2, 3 and 4 appear adjacent to 6. Thus, the number 5 will appear opposite 6. Therefore, when six is at the bottom, then 5 will be at the top.

Ex 10 : In a dice a, b, c and d are written on the adjacent faces, in a clockwise order and e and f at the top and bottom. When c is at the top, what will be at the bottom?



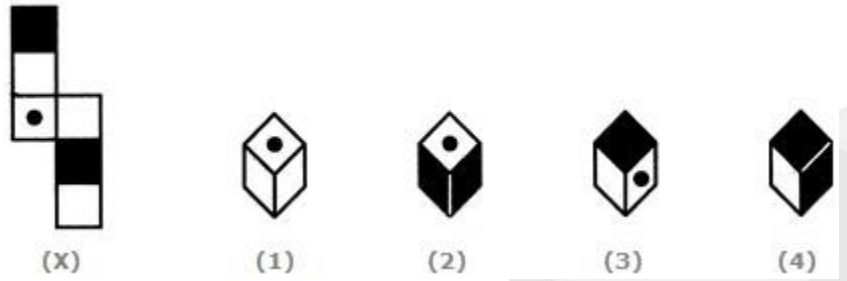
Solution : Clearly, the six faces are labelled as
Face I -> a, Face IV -> b, Face III -> c, Face II -> d, Face V -> e, Face VI -> f
Therefore 'a' appears opposite 'c'.
Hence, when 'c' is at the top, then 'a' will be at the bottom.

Ex 11 : Choose the box that is similar to the box formed from the given sheet of paper (X).



Solution : The fig. (X) is similar to the Form III. So, when the sheet in fig. (X) is folded to form a cube, then 'F' appears opposite 'B', 'E' appears opposite 'C' and 'A' appears opposite 'D' Therefore, the cube in fig. (1) which shows 'F' adjacent to 'B' the cube in fig. (3) which shows 'E' adjacent to 'C' and the cube in fig. (4) which shows 'A' adjacent to 'D' cannot be formed. Hence, only the cube in fig.(2) can be formed.

Ex 12 : Choose the box that is similar to the box formed from the given sheet of paper (X).



Solution : The fig. (X) is similar to the Form V. So, when the sheet in fig. (X) is folded to form a cube, then the face bearing a dot lies opposite to one of the shaded faces. Therefore, the cube shown in fig. (2) which has both the shaded faces adjacent to the face bearing the dot, cannot be formed. Hence, the cubes shown in figures (1), (2) and (4) can be formed.

Syllogisms

Introduction:

Syllogism is deriving hidden conclusion from already stated facts. The questions which are asked in this section contain two or more statements and these statements are followed by two or more conclusions. You have to find out which of the conclusions logically follow from the given statements. The statements have to be taken true even if they seem to be at variance from the commonly known facts.

For such questions, you can take the help of *Venn Diagrams*. On the basis of the given statements, you should draw all the possible diagrams, and then derive the solution from each of these diagrams separately. Finally, the answer common to the all the diagrams is taken**.**

Example 1:

Statements:

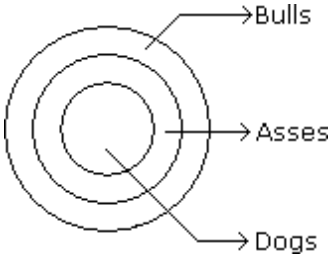
1. All dogs are asses.
2. All asses are bulls.

Conclusions:

1. Some dogs are not bulls.
2. Some bulls are dogs.
3. All bulls are dogs.
4. All dogs are bulls.

Solution:

On the basis of both statements, the following one diagram is possible.



From the diagram it is clear that (2) and (4) conclusions logically follow.

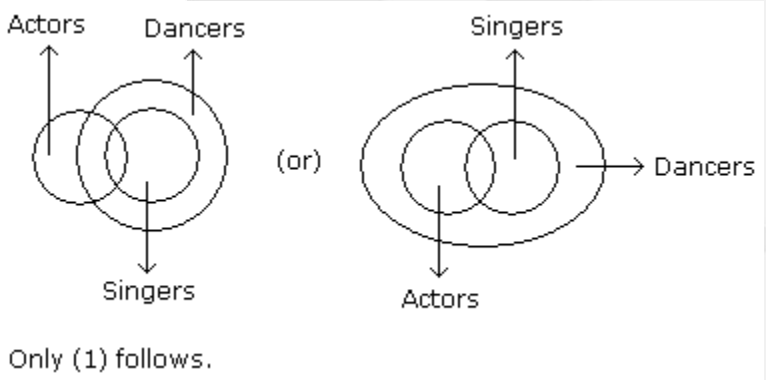
Example 2 :

Statements:

1. Some actors are singers.
2. All the singers are dancers.

Conclusions:

1. Some actors are dancers.
2. No singer is actor.



Only (1) follows.

Example 3:

Statements:

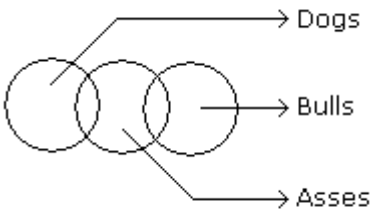
1. Some dogs are asses.
2. Some asses are bulls.

Conclusions:

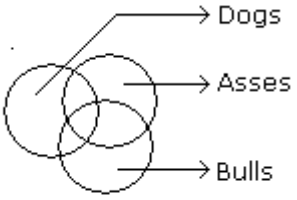
1. Some asses are not dogs.
2. Some dogs are bulls.

Solution:

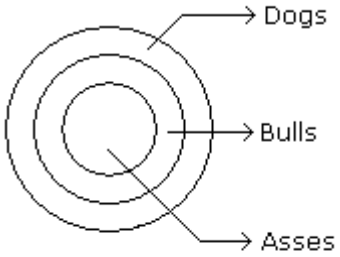
From these given statements the following diagrams are possible:



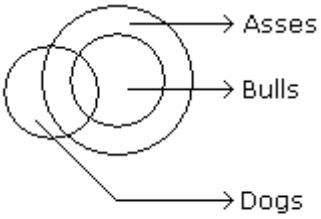
(1)



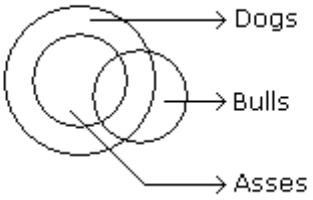
(2)



(3)



(4)



(5)

From the diagram neither (1) nor (2) conclusions follow.

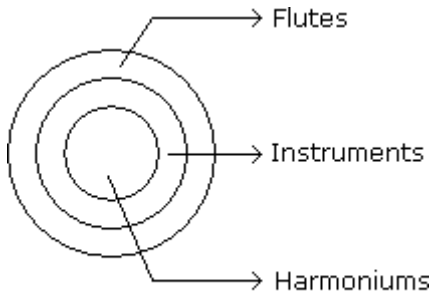
Example 4 :

Statements:

1. All the harmoniums are instruments.
2. All the instruments are flutes.

Conclusions:

1. All the flutes are instruments.
2. All the harmoniums are flutes.



Only (2) follows.

Example 5 :

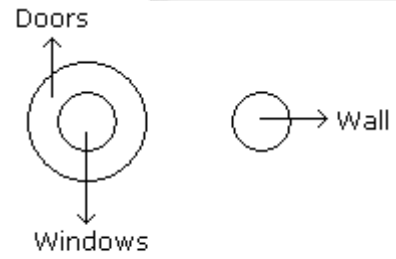
Statements:

1. All the windows are doors.
2. No door is a wall.

Conclusions:

1. Some windows are walls.
2. No wall is a door.

Solution:



Only (2) follows.

Example 6:

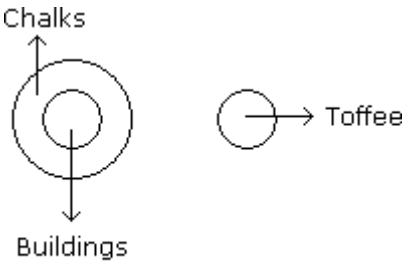
Statements:

1. All buildings are chalks.
2. No chalk is toffee.

Conclusions:

1. No building is toffee
2. All chalks are buildings.

Solution:



Only (1) follows.

Example 7 :

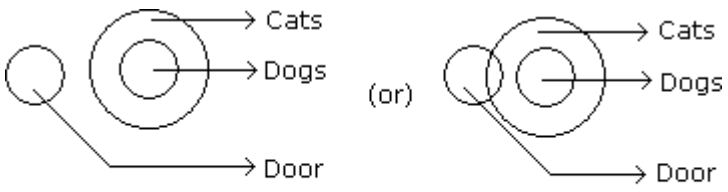
Statements:

1. No door is dog.
2. All the dogs are cats.

Conclusions:

1. No door is cat.
2. No cat is door.
3. Some cats are dogs.
4. All the cats are dogs.

Solution :



Only (3) follows.

Example 8 :

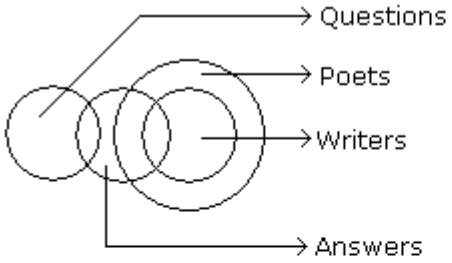
Statements:

1. Some questions are answers.
2. Some answers are writers.
3. All the writers are poets.

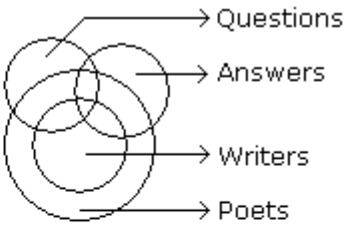
Conclusions:

1. Some writers are answers.
2. Some poets are questions.
3. All the questions are poets.
4. Some poets are answers.

Solution :

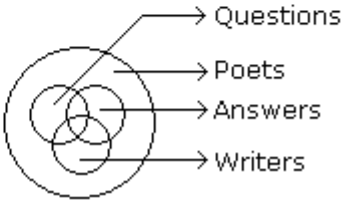


(or)



(or)

Only (1) and (4) follow.



<u>Example 9 :</u>

Statements:

1. All the papers are books.
2. All the bags are books.
3. Some purses are bags.

Conclusions:

1. Some papers are bags.
2. Some books are papers.
3. Some books are purses.

Solution :

Only (2) and (3) follows.

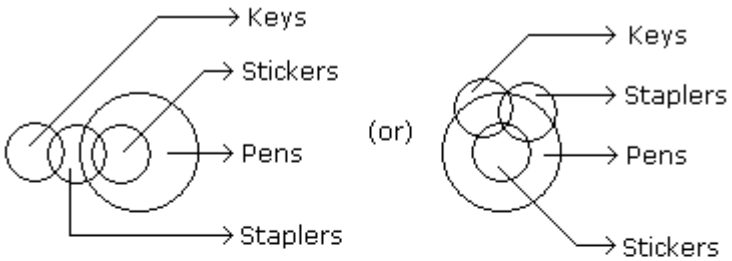
Example 10 :

Statements: Some keys are staplers. Some staplers are stickers. All the stickers are pens.

Conclusions:

1. Some pens are staplers.
2. Some stickers are keys.
3. No sticker is key.
4. Some staplers are keys.

Solution :



(or)

Only (1) and (4) follow.