14 Venn Diagram

Venn diagrams are used to solve syllogisms and are considered the standard way. A syllogism is a kind of logical argument in which one proposition (the conclusion) is inferred from two or more others (the premises).

Example:

- Premise 1: All women are mothers.
- Premise 2: All mothers are caring.

Conclusion: All women are caring.

Shortcut rules (if Venn Diagrams are confusing you) between Statement 1 and Statement 2 in that order

- All + All = All
- All + No = No
- All + Some = No Conclusion
- Some + All = Some
- Some + Some = No Conclusion
- Some + No = Some, Not
- No + No = No Conclusion
- No + All = Some not reversed
- No + Some = Some not reversed

Note

Using Venn diagrams to explore direct, indirect, and transitive reasoning; today's mostly used method for solving syllogisms based on Venn diagrams. With some practice we can be drawn fairly quickly making them a valuable tool in solving syllogisms in timed aptitude tests.

To solve problems based on Venn diagrams we should learn first set theory and the definitions of Universal set (all elements), sub sets (all elements of this set contains the main set), set intersection (common elements) and union set (set forms by more than two sets elements).

Here are a few different types of Venn diagrams with their implication made clear.

Suppose you are given a group of three items. Then,

1. If the items evidently belong to three different groups, then the Venn diagram representing it would be as shown alongside.

   Example: Doctors, Engineers, Lawyers

   These three items bear no relationship to each other. So, they are represented as above, by 3 disjoint figures as P representing Doctors, Q representing Engineers and R representing Lawyers.

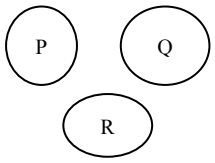


Figure 1

2. If one item belongs to the class of the second and the second belongs to the class of third, then the representation is in the form of three concentric circles, as shown below.

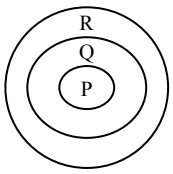


Figure 2

Example: Seconds, Minutes, Hours

Clearly, seconds are a part of minutes and minutes are a part of hours. The Venn diagram would be as shown in the adjoining figure with circle P representing *Seconds*, Q representing *Minutes* and R representing *Hours*.

3. Ff two separate items belong to the class of the third, they are represented by two disjoint circles inside a bigger circle.

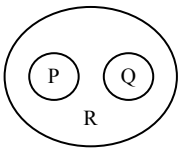


Figure 3

Example: Table, Chair, Furniture

Clearly, table and chair are separate items but both are items of furniture.

So, they would be represented as in the adjoining figure with circle P representing *table,* circle Q representing *chair* and circle R representing *furniture.*

4. If two items belong to the class of the third such that some items of each of these two groups are common in relationship, then they are represented by two intersecting circles enclosed within a bigger circle.

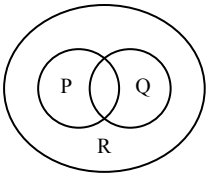


Figure: 4

Example: Males, Fathers, Brothers

Clearly, some fathers may be brothers. So, fathers and brothers would be represented by two intersecting circles. Also, both fathers and brothers are males. So, the diagrammatic representation would be as shown in figure 4, with circle P representing *Fathers,* circle Q representing *Brothers* and circle R representing *Males*.

5. If two terms items are partly related to the third, and are themselves independent of each other they are represented by three intersecting circles in a line.

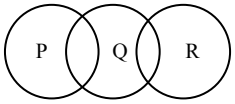


Figure 5

Example: Dogs, Pets, Cats

Clearly; some dogs and some cats are pets. But, all the pets are not dogs or cats, Also, dogs and cats are not related to each other. So, the given items would be represented as shown in figure 5 with circle P representing *Dogs,* circle Q representing *Pets* and circle R representing *Cats*.

6. If the three items are partly related to each other, they are represented as shown in the adjoining figure.

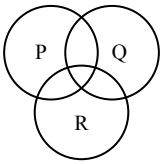


Figure 6

Example: Clerks, Government Employees, Educated Persons

Clearly, some clerks may be government employees and some may be educated. Similarly, some government employees may be clerks and some may be educated. Also, some educated persons may be clerks and some may be government employees.

So, the given items may be represented as shown in figure 6 with three different circles denoting the three classes.

7. If one item belongs to the class of second while third item is entirely different from the two, then they may be represented by the adjoining diagram.

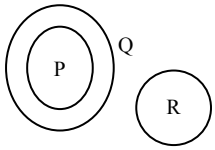


Figure 7

Example: Engineers, Human Beings, Rats

Clearly, all engineers are human beings. This would be represented by two concentric circles. But the class of rats is entirely different from these two. Thus, these items would be represented as shown in figure 7 with circle P representing *Engineers,* circle Q representing *Human Beings* and circle R representing *Rats*.

8. If one items belongs to the class of second and the third item is partly related to these two, they are represented as shown alongside.

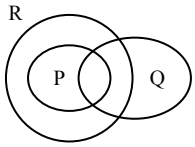


Figure 8

Example: Females, Mothers, Doctors

Clearly, all mothers are females. This would be represented by two concentric circles. But, some females and some mothers can be doctors. So, the circle representing doctors would intersect the two concentric circles. Thus, the diagram becomes as shown in figure 8 with circle P representing *Mothers,* circle R representing *Females* and circle Q representing *Doctors*.

9. If one items belongs to the class of second and the third item is partly related to the second, they are represented as shown alongside.

Figure 9

Example: Grass-eating Animals, Cows, Flesh-eating Animals

Clearly, cows are grass-eating animals. So, they would be represented by two concentric circles. But some grass-eating animals are flesh-eating also. Thus, the Venn diagram is as shown above with circle P representing *Cows*, circle Q representing *Grass-eating Animals* and circle R representing *Flesh eating Animals.*

Example:

- All Canadians are right handed.
- All right handed are opticians.
- Conclusion: Some opticians are Canadian.

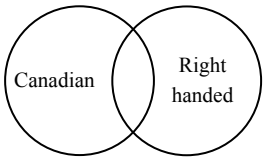
To check the validity of this statement first the different terms are appointed.

Subject: Canadian

Predicate: Optician

Middle term: Right handed

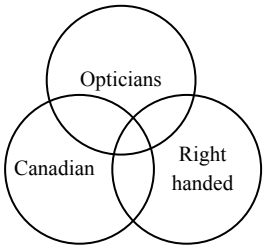
We will start with the first out of the two given statements from above. The first thing to do is draw two circles and write the terms Canadian and Right handed in them. The circle with the word Canadian without the overlap represents only Canadian people, while the part within the overlap with the right handed circle represents all Right handed Canadian people. Everything outside these two circles represents everything not connected to these two terms. With this one can think of plants, animals, cars but even you and me.



1st Statement: All Canadians are right handed. Thus this means that all Canadian people outside the overlap of the two circles are not involved in this statement, since they are not connected to the term right handed.

2nd Statement: Subsequently the 2nd statement is reviewed. According to this statement all right handed are opticians. This statement can be solved by drawing two circles; except the overlap in the right handed circle, just as was done with the first statement.

Linking Statements: Linking the two statements and the circles together results in the Venn Diagram. Here both the first as well as the second statement are displayed. The overlap between Right handed and Optician is clearly shown, even as the absence of one between Canadian and Opticians. Further it can be noticed that there is a small area where all three term are overlapping, a part which is still present.

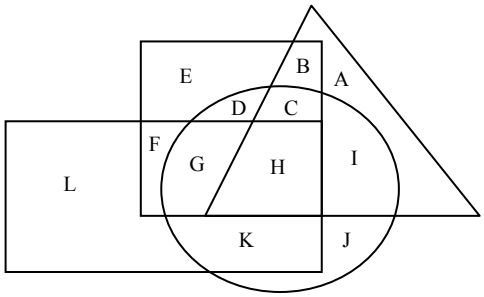


Now that the Venn diagram is completed, the validity of the conclusion can be checked. The conclusion states: some Opticians are Canadian. The Venn diagram clearly shows the correctness of this conclusion. Although the overlap area between both circle, there is still a small area in the middle where all three terms are present. It is this area that results in the correctness of the conclusion.

This case is characterised as a valid reasoning, since the conclusion can be drawn directly using the Venn diagram. It is however also possible that additional information is needed in order to check the validity of the conclusion. In that case the reasoning is invalid.

Examples:

Directions (1 to 4): In the following diagram, the square represents girls, the circle tall persons, the triangle is for tennis players and the rectangle stands for the swimmers.



On the basis of the above diagram, answer the questions given below.

1. Which letter represents tall girls who are swimmers but don't play tennis?

a. C **b.** D **c.** G **d.** H

Sol: (c) Tall girls, who are swimmers are represented by the region common to the square, circle and the rectangle i.e. G and H. But, according to the given conditions, the girls shouldn't be tennis players. So, the required region should not be a part of the triangle i.e. H should be excluded. Thus, the region representing the persons satisfying the given conditions is G. Hence, the answer is (c).

2. Which letter represents girls who are swimmers, play tennis but are not tall?

a. B **b.** E **c.** F **d.** None

Sol: (d) Girls who are swimmers and play tennis are represented by the region common to the square, triangle and rectangle i.e., H. But, it is given that the girls shouldn't be tall. So, the required region should not be a part of the circle. Since H is a part of the circle, so the answer is (d).

3. Which letter represents tall girls who do not play tennis and are not swimmers?

a. C **b.** D **c.** E **d.** G

Sol: (b) Tall girls are represented by the region common to the square and the circle i.e. D, C, G and H. But according to

the given conditions, the girls are neither tennis players nor swimmers. So, the required region should be neither a part of the rectangle nor the triangle. G lies inside the rectangle, C inside the triangle and H is common to both. So, the answer is (b).

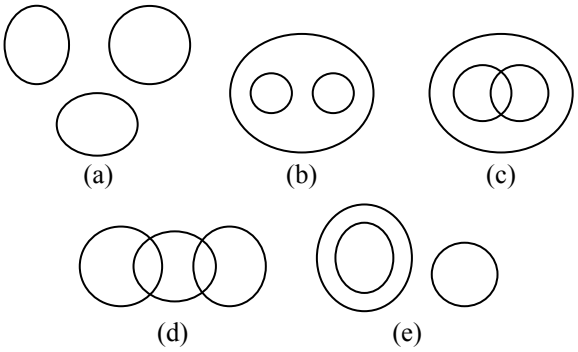
4. Which letter represent tall persons who are gents and swimmers but do not play tennis?

a. I **b.** J **c.** K **d.** L

Sol: **(c)** The tall persons are represented by regions inside the circle i.e. C, D. G, H, I, J and K. Since the persons are not girls and do not play tennis, so the region should not be a part of either the square or the triangle. Thus, C, D, G, H should be excluded. Also, according to the given conditions, the persons should be swimmers. So, the required region should be a part of the rectangle and such a region is K. Hence, the answer is (c).

Multiple Choice Questions

Direction (1 to 13): In each one of the following questions contains three items using the relationship between these items, match each question with the most suitable diagram. Your answer is the letter denoting that diagram.



1. Deer, Rabbit, Mammal

a. a **b.** b **c.** c **d.** d **e.** e

2. Human beings, Teachers, Graduates

a. a **b.** b **c.** c **d.** d **e.** e

3. Whales, Fishes, Crocodiles

a. a **b.** b **c.** c **d.** d **e.** e

4. Plums, Tomatoes, Fruits

a. a **b.** b **c.** c **d.** e **e.** e

5. Mountains, Forests, Earth

a. a **b.** b **c.** c **d.** d **e.** e

6. Tiger, Fox, Carnivores

a. a **b.** b **c.** c **d.** d **e.** e

7. Grams, Beans, Legumes

a. a **b.** b **c.** c **d.** d **e.** e

8. Flowers, Clothes, White

a. a **b.** b **c.** c **d.** d **e.** e

9. Uncles, Parents, Friends

a. a **b.** b **c.** c **d.** d **e.** e

10. Rohtak, Haryana, Punjab

a. a **b.** b **c.** c **d.** d **e.** e

11. Engineer, Doctor, People

a. a **b.** b **c.** c **d.** d **e.** e

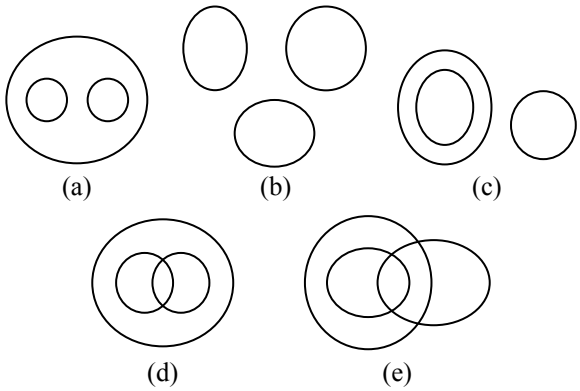
12. Thieves, Lawyers, Criminals

a. a **b.** b **c.** c **d.** d **e.** e

13. Sea, Island, Mountain

a. a **b.** b **c.** c **d.** d **e.** e

Direction (14 to 19): In each one of the following questions choose the Venn diagram which best illustrates the relationship among three given circles.



14. Diseases, Leprosy, Scurvy

a. a **b.** b **c.** c **d.** d **e.** e

15. Hockey, Cricket, Games

a. a **b.** b **c.** c **d.** d **e.** e

16. Yak, Zebra, Bear

a. a **b.** b **c.** c **d.** d **e.** e

17. Sun, Moon, Stars

a. a **b.** b **c.** c **d.** d **e.** e

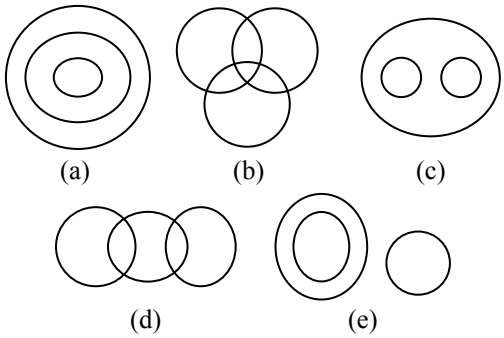
18. Animals, Men, Plants

a. a **b.** b **c.** c **d.** d **e.** e

19. Mercury, Mars, Planets

a. a **b.** b **c.** c **d.** d **e.** e

Direction (20 to 29): Of the four alternatives in each of the following questions, three alternatives are such that the three words in each are related among themselves in one of the five ways represented by (a), (b), (c), (d) and (e) below while none of these relationships is applicable to the remaining alternative. That is your answer.



20. **a.** Army, General, Colonel **b.** Boy, Student, Player
c. Painter, Scholar, Table **d.** Man, Typist, Peon

21. **a.** Hen, Dog, Cat
b. Body, Ear, Mouth
c. Bed, Ward, Nurse
d. Tiger, Animal, Carnivorous

22. **a.** Atmosphere, Air, Oxygen **b.** Boy, Girl, Student
c. Man, Worker, Garden **d.** Animal, Dog, Cat

23. **a.** Animal, Mammal, Cow
b. Colour, Cloth, Merchant
c. Colour, Red, Blue
d. Male, Horse, Mare

24. **a.** Bed, Hand, Finger
b. Mammal, Nurse, Woman
c. Cereal, Wheat, Rice
d. Males, Cousins, Nephews

25. **a.** Bed, Ward, Hospital **b.** Boy, Girl, Player
c. Copper, Zinc, Iron **d.** Book, Girl, Player

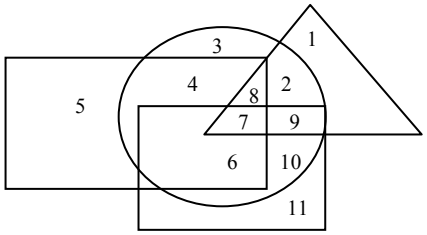
26. **a.** Star, Moon, Mars
b. Professor, Scholar, Politician
c. Nurse, Doctor, Woman
d. Swimmer, Carpenter, Singer

27. **a.** Periodical, Weekly, Book
b. Swimmer, Carpenter, Singer
c. Doctors, Human beings, Married people
d. Army, Doctor, Engineer

28. **a.** Director, Engineer, Musician
b. Apple, Orange, Mango
c. Fruit, Mango, Grass
d. Oxygen, Air, Water

29. **a.** Mineral, Iron, Copper
b. Dean, Painter, Singer
c. Seed, Leaf, Root
d. Piston, Engine, Wheel

Directions (30 to 34): In the following figure, rectangle, square, circle and the triangle represent the regions of wheat, gram, maize and rice cultivation respectively. On the basis of the above figure, answer the following questions.



30. Which area is cultivated by all the four commodities?
a. 7 **b.** 8 **c.** 9 **d.** 2

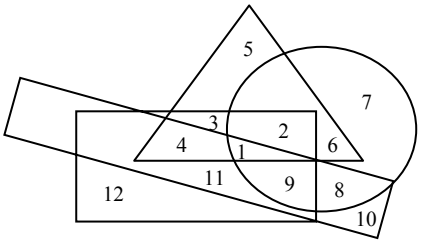
31. Which area is cultivated by wheat and maize only?
a. 8 **b.** 6 **c.** 5 **d.** 4

32. Which area is cultivated by rice only?
a. 5 **b.** 1 **c.** 2 **d.** 011

33. Which area is cultivated by maize only?
a. 10 **b.** 2 **c.** 3 **d.** 4

34. Which area is cultivated by rice and maize and nothing else?
a. 9 **b.** 8 **c.** 2 **d.** 7

Directions (35 to 40): In the following figure, the circle stands for employed, the square stands for hard-working, the triangle stands for rural and the rectangle stands for intelligent. Study the figure carefully and answer the questions that follow.



35. Non-rural, employed, hard-working and intelligent people are indicated by region.
a. 8 **b.** 9 **c.** 10 **d.** 11 **e.** 12

36. Non-rural, employed people who are neither intelligent nor hard-working are represented by region.
a. 12 **b.** 11 **c.** 10 **d.** 7 **e.** 05

37. Intelligent, employed and hard-working non-rural people are indicated by region.

a. 11 **b.** 6 **c.** 9 **d.** 4 **e.** 3

38. Hard-working non-rural people who are neither employed nor intelligent are shown by region.

a. 8 **b.** 7 **c.** 6 **d.** 10 **e.** 12

39. Employed, hard-working and intelligent rural people are indicated by region.

a. 1 **b.** 2 **c.** 3 **d.** 4 **e.** 5

40. Rural hard-working people who are neither employed nor intelligent are indicated by region.

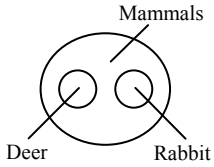
a. 6 **b.** 5 **c.** 4 **d.** 3 **e.** 2

ANSWERS

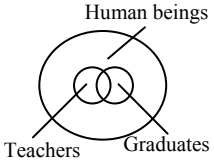
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
b	c	a	e	c	b	b	d	a	e
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
b	e	e	a	a	b	c	c	a	c
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
a	c	b	d	c	c	c	b	c	a
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
d	b	c	c	b	d	c	e	a	d

SOLUTIONS

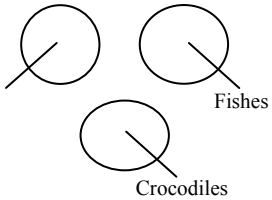
1. **(b)** Deer and Rabbit are unrelated items. But, both are mammals.



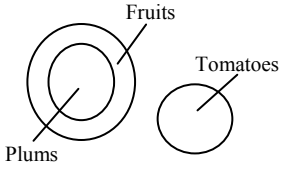
2. **(c)** All teachers and graduates are human beings. But, some teachers can be graduates and some graduates can be teachers.



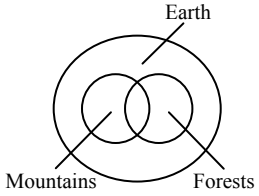
3. **(a)** Whales, Fishes and Crocodiles are all separate items, entirely different from each other. So they would be represented by three disjoint circles.



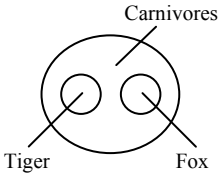
4. **(e)** All plums are fruits. But, tomatoes are entirely different.



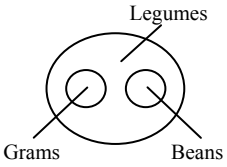
5. **(c)** Mountains and Forests are parts of earth. But, some mountains are forested and some forests are mountainous.



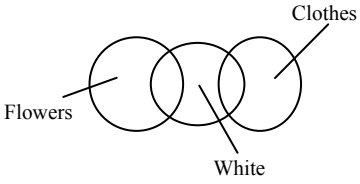
6. **(b)** Tiger and Fox are unrelated and entirely different. But both are carnivores or flesh eating animals.



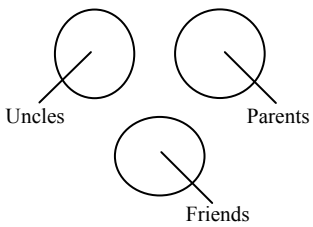
7. **(b)** Grams and Beans are entirely different from each other. But both are legumes.



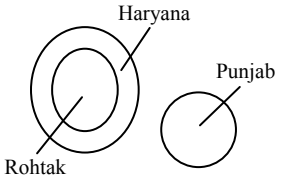
8. **(d)** Some flowers are white. Some clothes are white. But, all white things are not flowers or clothes.



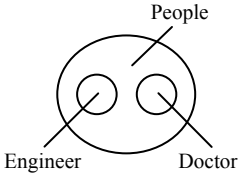
9. **(a)** Uncles, Parents and Friends are entirely different iron each other.



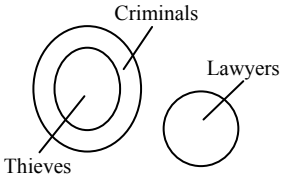
10. **(e)** Rohtak is a part of Haryana, Punjab is a separate state.



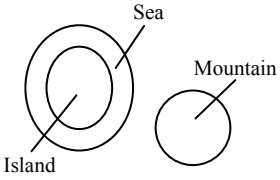
11. **(b)** Both Engineer and Doctor are people. But both of them are different from each other.



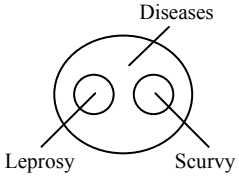
12. **(e)** All thieves are criminals. But lawyers are entirely different.



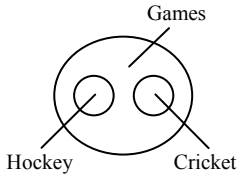
13. **(e)** Island is a part of sea. But, Mountain is entirely different.



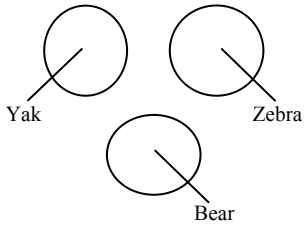
14. **(a)** Both Leprosy and Scurvy are diseases. But, both are entirely different from each other.



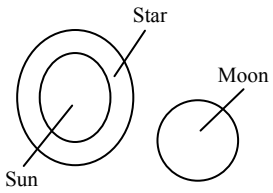
15. **(a)** Both Hockey and Cricket are games. But both are entirely different from each other.



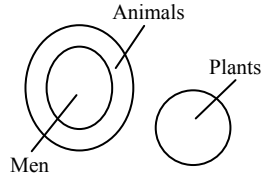
16. **(b)** Yak, Zebra and Bear are all Hockey different from each other.



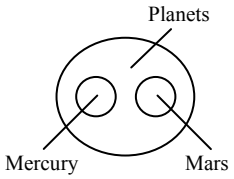
17. **(c)** Sun is a star. Moon is entirely different from the two.



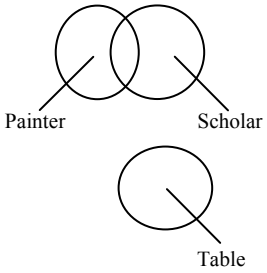
18. **(c)** Sun is a star. Moon is entirely different from the two.



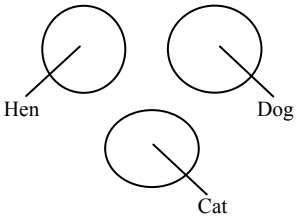
19. **(a)** Mercury and Mars are entirely different from each other.



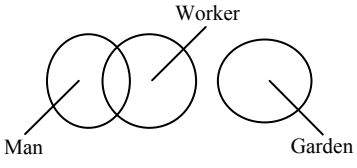
20. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



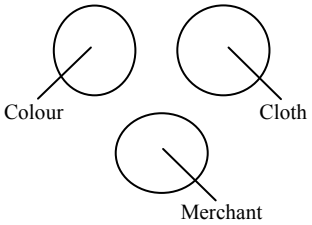
21. **(a)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (a) is the answer.



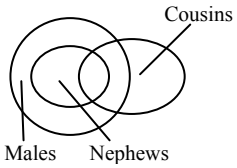
22. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



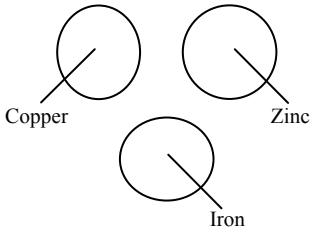
23. **(b)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (b) is the answer.



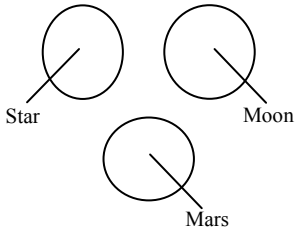
24. **(d)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (d) is the answer.



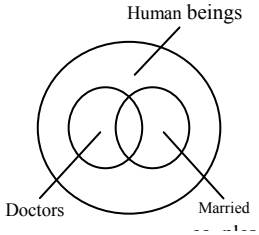
25. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



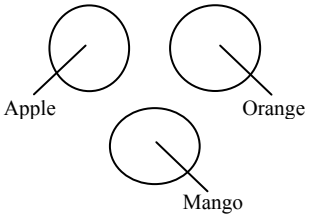
26. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



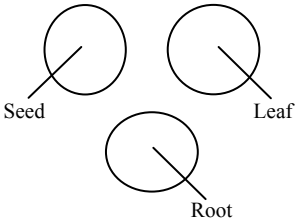
27. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



28. **(b)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (b) is the answer.



29. **(c)** This group of items can be represented as shown in Figure. Since there is no such diagram in the question, so (c) is the answer.



30. **(a)** The required region is the one common to the rectangle, square, circle and the triangle i.e. 7.

31. **(d)** The required region is the one which is common to only the rectangle and the circle and is not a part of either the triangle i.e. 4.

32. **(b)** The required region is the one which lies inside the triangle and outside the rectangle, square and circle i.e. 1.

33. **(c)** The required region is the one which lies inside the circle but outside the rectangle, square and triangle i.e. 8

34. **(c)** The required region is the one which is common to only the triangle and the circle i.e. 2.

35. **(b)** The required set of people is represented by the region which lies outside the triangle and is common to the circle, square and rectangle i.e. 9.

36. **(d)** The required set of people is represented by the region which lies outside the triangle, inside the circle but outside the rectangle and the square i.e. 7.

37. **(c)** The required set of people is represented by the region which is common to the rectangle, circle and square but lies outside the triangle i.e. 9.

38. **(e)** The required set of people is denoted by the region which lies inside the square but outside the triangle, circle and rectangle i.e. 12.

39. **(a)** The required set of people is denoted by the region common to the circle, square, rectangle and triangle i.e. 1.

40. **(d)** The required set of people is represented by the region which is common to the triangle and the square but lies outside the circle and rectangle i.e. 3.

□ □ □