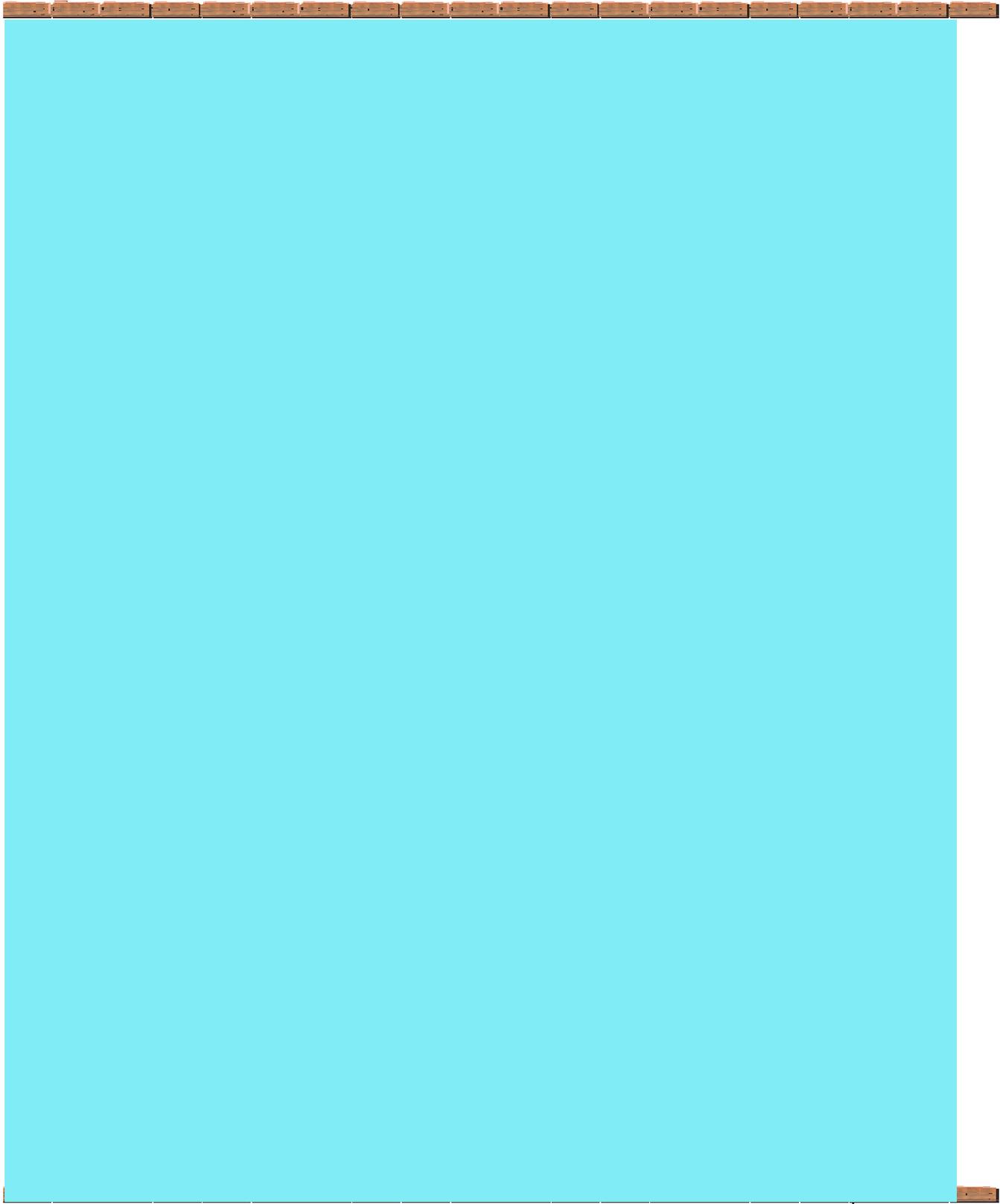


Science of thinking* series

Reasoning

Workbook -1



1. Deductive reasoning

In deductive reasoning, two premises are followed by a conclusion.

Deductive Reasoning: Venn diagrams can be used as an effective tool for reasoning.

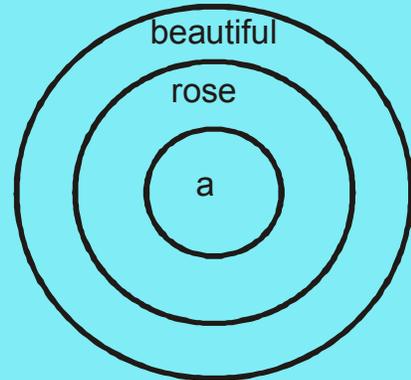
Statement 1-All roses are beautiful

Statement 2- a is a rose

Statement 3- a is beautiful

Statement 3 can be logically deduced from statements 1 and 2.

This set of 3 statements can be represented using venn diagrams



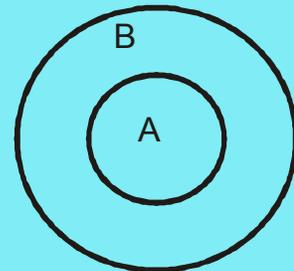
The basic axioms of reasoning

All A is B or A is B

A is a subset of B. A should be represented as a small circle within large circle B.

All A is B is not same as All B is A.

For All B is A, B is a subset of A. Hence B should be within A.



No A is B

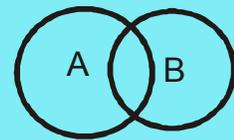
A and B are disjoint elements. This is represented as two independent circles not touching each other.



Some A is B or some A is not B

A and B are represented as two circles overlapping each other. As some A is B,

Some A is not B. Both the statements can be represented in the same manner.



To determine whether statement 3 is logically deduced from statement 1 and 2, let's take an example

Step 1: Represent the first statement using Venn diagram

Step 2: Incorporate statement 2 to the earlier diagram. Draw all the possibilities.

Step 3: Observe the existing diagram and conclude whether statement 3 can be arrived at in each of the possibility.

For example

Statement 1 -All a is b

Statement 2 -Some a is c

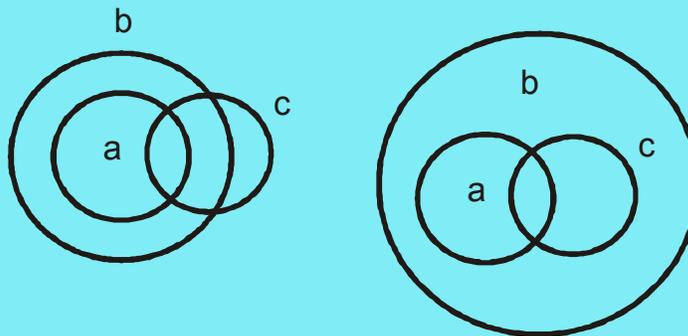
Statement 3 -All b is c

Draw statement 1 as per the axiom

When statement 2 is represented as per the existing diagram, the position of c is not defined.

i.e. Some c can be present within b or Entire c can be within b. There are two possibilities possible.

Hence all b is c cannot be concluded from either of the two possibilities.



All c is b also cannot be concluded, because in possibility 1, c is partially within b and in possibility 2: c is completely within b.

Some c is b can be concluded, because in possibility 1 and 2 some portion of c is within b.

To learn

Practice problems

Practice Exercise 1.1

Directions: Each question below consists of two statements (premises).

Add the most plausible conclusion that can be drawn from the premises.

1. All women are clever

Sania is a woman

2. All oranges are apples

All apples are pears

3. All rocks are locks

All locks are docks

4. Some men swim

All men gamble

5. Sara is a painter

No painter flies

6. All cats are white

This is white

7. No A is B

Z is A

8. Rohan is a traveler

All travelers are photographers

9. All pencils are bricks

All bricks are bottles

10. All men are prisoners

No prisoner is educated

Practice Exercise 1.2

Directions: Draw Venn diagrams for the following set of statements.

1. All animals are living things; Cat is an animal; Cat is a living thing.

2. Some flowers are green: rose is a flower: rose is green.

3. No flower is green; rose is a flower; rose is not green.

4. Some officers are engineers; No engineer is a criminal; Some officers are not criminals.

5. Seaweeds are pink; All pink things are fruits; seaweeds are fruits.

6. Most Mexicans are chefs; Some chefs are sailors; No Mexican is a sailor.

7. Some professors are swimmers; No swimmer is a typist; no typist is a professor.

8. Composers are lyricists; lyricists are directors; composers are directors.

9. Ovois is a university; some universities are not recognized; Ovois is not recognised.

10. Actors are models; Agassi is not an actor; Agassi is a model.

Practice Exercise 1.3

In each of the questions below, a set of three statements is given. Identify the sets in which the third statement can be deduced from the preceding two. If the conclusion can be drawn mark (true) if not (false). Write the answers in the bracket.

1. Doctors served in army camps.

Sam served in army camp. ()

Sam is a doctor.

2. Some painters are singers.

All composers are singers. ()

Some painters are composers.

3. All politicians are honest.

Agassi is honest. ()

Agassi is a politician.

4. All writers are singers.

Some writers are actors. ()

Some writers sing and act.

5. All sprinters run fast.

Fiama runs fast. ()

Fiama is a sprinter.

6. Vitamins are good for health.

Oranges are good for health. ()

Oranges contain vitamins.

7. All rivers are lakes.
All lakes are streams. ()
All rivers are streams.
8. Some women are not clever.
Rita is a woman. ()
Rita may be clever.
9. All who speak French know Russian.
Raju speaks Russian. ()
Raju speaks French.
10. All desks are made of wood.
Some benches are made of wood. ()
Some desks are benches.

Practice Exercise 1.4

Directions: Each question contains six statements. Write as many logical combinations as possible from the set of six. In each combination, the logical order should be

All men are clever
Sam is a man
Sam is clever

Illustration:

- A. The newt is an amphibian.
- B. Amphibians can live on land and in water.
- C. The newt is not an amphibian.
- D. The newt lives on land and in water.

- E. Amphibians can live on land.
- F. The newt cannot survive on land.

Logically valid combinations - ABD, FBC

- 2. A. Cells are the basic units of organisms.
- B. Organisms are made of cells.
- C. All organisms contain RNA.
- D. All organisms contain DNA.
- E. All cells contain DNA.
- F. DNA is similar to RNA.

Logically valid combinations - _____

- 3. A. Social behaviour is seen in colonies.
- B. Chimpanzees are known to be intelligent.
- C. Colonies require social behaviour.
- D. Intelligence is required for social behaviour.
- E. Primates are intelligent.
- F. Chimpanzees are capable of social behaviour.

Logically valid combinations - _____

- 4. A. Saffron is a colouring dye.
- B. Most foods are coloured.
- C. Saffron causes cancer.
- D. Colouring dyes are often carcinogenous.
- E. Cancer has many sources.
- F. Eating food may cause cancer.

Logically valid combinations- _____

5. A. Nectar is found in flowers.
B. The rose is not a true flower.
C. Chrysanthemum is a flower.
D. Nectar is found in roses.
E. Chrysanthemum is not a flower.
F. Nectar is found in chrysanthemum.

Logically valid combinations-_____

6. A. R and G are together taller than S.
B. R and G are of the same height.
C. S is shorter than R.
D. G is taller than S.
E. R, G and S are midgets.
F. G is taller than T.

Logically valid combinations – _____

7. A. All cars built after 1978 have seat belts.
B. Only cars built after 1978 have seat belts.
C. This car has seat belts.
D. After 1981, a new rule regarding seat belts was enforced.
E. This car must have been built after 1978.
F. This car must have been built after 1981.

Logically valid combinations – _____

8. A. In Bangalore, power is shut down for six hours every day.
B. In Madurai, power is shut down thrice a day for two hours each time.

- C. Power shutdowns affect HV users the most.
- D. Each power shutdown in Bangalore is for half an hour.
- E. The power cuts in Bangalore are as long as those in Madurai.
- F. The temperature in Madurai makes power cuts unbearable.

Logically valid combinations – _____

9. A. Today there are 2.8 persons reported per household.
B. The divorce rate has increased.
C. In 1930, on an average, there were 4.1 persons in a household.
D. The birth rate has increased.
E. Fewer people live in a household now than they did earlier.
F. The population has decreased since 1930.

Logically valid combinations – _____

10. A. Some creatures are parasites.
B. All creatures are cancer-causing
C. Some parasites are cancer-causing.
D. No parasite is a creature.
E. Some creatures are not cancer-causing.
F. Most parasites are not cancer-causing.

Logically valid combinations- _____

11. A. Japan now produces more semiconductors than the US does.
B. Semiconductors is one of the fastest growing industry segments.
C. A decade ago Japan was producing 22% and the US was producing 22% of the world's semiconductors respectively.
D. Ten years ago, Japan ranked third in terms of semiconductor production.

- E. During the last ten years, Japan's production of semiconductors has increased by 500% while that of the US has increased by 200%.
- F. Japan occupies an unassailable position in the semiconductor market today.

Logically valid combinations-_____

12. A. Bob is older than Dinku and Esther.
B. Rahul is older than Dinku.
C. Rahul is younger than Bob.
D. Rahul is older than Esther.
E. Dinku is older than Esther.
F. Bob is older than Dinku.

Logically valid combinations-_____

13. A. Inhabitants of Cyprus island speak only Konkani.
B. Some Punjabis speak only Tulu.
C. Some gypsies are inhabitants
D. Some Punjabis speak Konkani.
E. Some gypsies speak only Konkani.
F. Some Cyprus islanders speak Tulu.

Logically valid combinations-_____

14. A. In the last six months, the number of robberies at gun-point in the city has dropped by 18%.
B. Guns are necessary protection against smugglers.
C. Strict gun control laws cause a decrease in violent crime.
D. Most crimes are committed with knives and guns.
E. Six months ago, this city's council passed a gun control law.
F. Violent crimes are on the rise in most cities across the country.

Logically valid combinations-_____

15. A. Fungi are known to reproduce.
B. All living organisms reproduce.
C. The river is similar to living organisms in several ways.
D. Fungi are living organisms.
E. The river has movement like an organism.
F. The river is not a living organism.

Logically valid combinations-_____

16. A. All crows are birds.
B. All birds are black.
C. All crows are black.
D. All crows have beaks.
E. All crows lay eggs.
F. All birds have claws.

Logically valid combinations-_____

17. A. Good managers are intuitive.
B. Some managers are women.
C. Supriya is intuitive.
D. Supriya is a woman.
E. Some women are intuitive.
F. Supriya is a good manager.

Logically valid combinations-_____

18. A. Good people are educated.
B. Some girls are bad.

- C. Ram is good.
- D. Ram and Lata are friends.
- E. Ram is educated.
- F. Lata is an educated girl.

Logically valid combinations- _____

19. A. Iran and Iraq are members of the UN.
B. Not all members of the UN are friends.
C. Iran and Iraq are neighbours.
D. Some UN members are friends.
E. Iran and Iraq are not friends.
F. No neighbours are friends.

Logically valid combinations- _____

20. A. Shyam won the game.
B. Shyam lost in a chess game.
C. One need not be intelligent to win a lottery.
D. Shyam may be intelligent.
E. One need not be intelligent to win a chess game.
F. Shyam plays chess

Logically valid combinations- _____

21. A. All apples are fruits.
B. All fruits are sweet.
C. All apples are sweet.
D. All apples are priced.
E. All apples are red.
F. All fruits are available.

Logically valid combinations- _____

22. A. All rax are dax.
B. To be a dax you have to not be a sax.
C. All sax are rax.
D. All dax are rax.
E. No sax are rax.
F. All max are not sax.

Logically valid combinations-_____

23. A. Ram and Shyam are equally tall.
B. Ram is taller than Gopal.
C. Gopal is shorter than Shyam.
D. Ram and Shyam are shorter than Arvind.
E. Arvind is taller than Gopal.
F. The difference in heights between Gopal and Ram and Gopal and Shyam is the same

Logically valid combinations-_____

25. A. Tanos is 250 km east of Lagos.
B. Tertia and Lagos are cities.
C. Lagos is 300 km west of Tertia.
D. The distance from Tanos to Tertia is 550 km.
E. Tanos is between Lagos and Tertia.
F. The distance from Tanos to Tertia is 50 km.

Logically valid combinations-_____

Binary logic

Each question will have one statement with two parts. The statement is followed by four sub-statements. You have to choose a pair of statements logically consistent with the main statement. The question stems can be categorized as

A. Either... or logic Either A or B

B. Conditional logic using If, whenever, only when – If A then B or Whenever A happens, B happens ...

For 'Either ...or' questions there are two possible conclusions.

Either it rains in Chennai or it rains in Bangalore.

Possible logically consistent

Pair 1: It rains in Chennai; it doesn't rain in Bangalore.

Pair 2: It rains in Bangalore; It doesn't rain in Chennai.

Science of thinking (ScoT) tip:

If the main statement comprises two positive sub statements, you can see that in the answer one statement

Example 2:

Either I eat ice-cream or I don't get fever

Statement A – I eat ice-cream

Negated statement A – I don't eat ice-cream

Statement B – I don't get fever

Negated statement B – I get fever

Logically consistent pair 1: I ate ice-cream; I got fever

Conclusion 2: I don't get fever; I don't eat ice-cream

Science of thinking (ScoT) tip:

if the sub statements are one positive and the other negative, you can see that both statements are positive or both are negative.

Logic for conditional statements: 'If', 'whenever', 'only' questions

In questions with if, whenever, only, observe the cause and the effect.

Example 1:

Whenever it rains in Chennai, it rains in Bangalore

Cause – It rains in Chennai

Effect – It rains in Bangalore

Logically consistent pair 1: It rains in Chennai, it rains in Bangalore

Logically consistent pair 2: It doesn't rain in Bangalore, It doesn't rain in Chennai,

Inconsistent pairs:

1. It rains in Bangalore, It rains in Chennai

2. It doesn't rain in Chennai, It doesn't rain in Bangalore

Science of thinking (ScoT) tip:

If A, then B (If cause happens, effect happens)

If not B, not A (if effect doesn't happen, cause doesn't happen)

Example 2:

Ram gets a tan when he goes to Miami

Cause – Ram goes to Miami Negated cause – Ram doesn't go to Miami

Effect – Ram gets a tan Negated effect – Ram doesn't get a tan

Consistent pair 1: Ram goes to Miami, Ram gets a tan

Consistent pair 2: Ram doesn't get a tan, Ram doesn't go to Miami

Practice Exercise 1.7

Each question has a main statement followed by four statements labeled A,B,C,D.

Choose the ordered pair of statements in which the first statement implies the second and the two statements are logically consistent with the main statement.

1. Either Richard can go to school or he can go to the theatre.
 - A. Richard goes to the school.
 - B. Richard didn't go to the theatre.
 - C. Richard goes to the theatre.
 - D. Richard didn't go to the school.

Ans : AB and DC (in the actual exam you are given such 4 pairs; you choose the options that are correct)

2. If you are lucky, you can hit the jackpot.
 - A. You are lucky
 - B. You are not lucky
 - C. You can't hit the jackpot.
 - D. You can hit the jackpot.

Ans : AD & CB

3. Whenever the professor yells, we become silent.
- A. The professor is yelling.
 - B. We have become silent.
 - C. The professor is not yelling.
 - D. We are not silent.

Ans : AB & DC

Now answer the following

4. Either Peter likes to play the piano or he likes to ride his bicycle.
- A. Peter likes to ride his bicycle.
 - B. Peter likes to play the piano.
 - C. Peter doesn't like to play the piano.
 - D. Peter doesn't like to ride his bicycle.
5. Every time he cries, his eyes become red.
- A. He is crying.
 - B. He is not crying.
 - C. His eyes are not red.
 - D. His eyes became red.
6. Only when you start earning, you will know the true value of money.
- A. You started earning.
 - B. You will know the true value of money.
 - C. You do not know the true value of money.
 - D. You haven't started earning.
7. Ravi goes out with his friends only on weekends.
- A. It is a weekend.
 - B. Ravi doesn't go out with his friends.
 - C. It is not a weekend.
 - D. Ravi goes out with his friends.

8. If you don't socialize, you will become a recluse.

- A. You socialize.
- B. You will become a recluse.
- C. You will not become a recluse.
- D. You don't socialize.

9. Either Priya likes you or she is lying to you.

- A. Priya likes you.
- B. Priya is lying to you.
- C. Priya is not lying to you.
- D. Priya does not like you.

10. Whenever Rohit goes out, he takes his i-pod.

- A. Rohit takes his i-pod.
- B. Rohit doesn't go out.
- C. Rohit goes out.
- D. Rohit doesn't take his i-pod.

Illustration

When Mohan is not in the basket ball team, he is in the cricket team.

- A. Mohan is in the cricket team.
- B. Mohan is not in the basketball team.
- C. Mohan is in the basket ball team.
- D. Mohan is not in the cricket team.

Ans: BA, DC

11. You can either be a pragmatist or have no belief in the supernatural.

- A. Arun believes in the supernatural.
- B. Arun is a pragmatist.
- C. Arun is not pragmatist.
- D. Arun has no belief in the supernatural.

Ans: _____

12. If I don't go for a vacation, I gain weigh

- A. I went for a vacation.
- B. I did not gain weight.
- C. I did't go for a vacation.
- D. I gained weight.

Ans: _____

13. Ramya is either not a dishonest girl or she is a shrew.

- A. Ramya is a dishonest girl.
- B. Ramya is a shrew.
- C. Ramya is not a shrew.
- D. Ramya is not a dishonest girl.

Ans: _____

14. Corrupt politicians do not take part in anticorruption campaigns

- A. Chatterjee did not take part in the anti-corruption campaign.
- B. Chatterjee is corrupt.
- C. Chatterjee took part in the anti-corruption campaign.
- D. Chatterjee is not corrupt.

Ans: _____

15. Either the principal is not in the college or he is working out in the gym.

- A. The principal is working out in the gym.
- B. The principal is not in the college.

- C. The principal is not working out in the gym.
- D. The principal is in the college.

Ans: _____

16. Either Warne played cricket or he played snooker.
- A. Warne played snooker.
 - B. Warne played cricket.
 - C. Warne did not play cricket.
 - D. Warne did not play snooker.

Ans: _____

17. If he takes a bank loan, then he does not have to pay tax.
- A. He took a bank loan.
 - B. He does not have to pay tax.
 - C. He has to pay tax.
 - D. He did not take a bank loan.

Ans: _____

18. Either the Indian team is not fixing matches or it is playing well.
- A. The Indian team is playing well.
 - B. The Indian team is not fixing matches.
 - C. The Indian team is not playing well.
 - D. The Indian team is fixing matches.

Ans: _____

19. Whenever Nitya arrives on time, she is greeted by her colleagues.
- A. Nitya is not greeted by her colleagues.
 - B. Nitya did not arrive on time.
 - C. Nitya is greeted by her colleagues.

D. Nitya arrived on time.

Ans: _____

20. Every time Anil travels by bus, he suffers from a headache.

- A. Anil suffered from a headache.
- B. Anil did not suffer from a headache.
- C. Anil did not travel by bus.
- D. Anil travelled by bus.

Ans: _____

Answer key:

- | | | | | |
|--------------|------------|------------|------------|-----------|
| 4. AB, CD | 5. AD, CB | 6. AC, DC | 7. AD, BC | 8. CA, DB |
| 9. AC, DB. | 10. CA, BD | 11. BA, CD | 12. CD, BA | |
| 13. CD, B BA | 14. BA, CD | 15. AD, BC | 16. AC, BD | |
| 17. AB, CD | 18. AD, BC | 19. DC, AB | 20. DA, BC | |

Analytical puzzles

Each analytical puzzle contains

(i) a description of a set of 3-7 relationships between fictitious persons, places, things or events.

(ii) two or more questions to test the understanding of these relationships and implications

The questions may pertain to relationships already defined or may involve additional constraints and conditions

Each question is independent and hence the conditions and constraints defined in one question should never be used in other questions

Requisites

No special knowledge is required apart from common sense and simple computation ability. It is also required to draw up all possible alternate arrangements with the given conditions

Types of relationships

Each puzzle is based on certain conditions which establish relationships among persons, places, things or events. There are different types of relationships

(i) Time dependent-

For example 'x arrived before y'

This can be represented as $x \dots y$ or $x < y$ It is not clearly specified when x arrived. i.e. just before y, 1 hr before y, 2 hr before y....

It is also not specified how many people arrived between x and y.

One more example 'x arrived before y but after z'

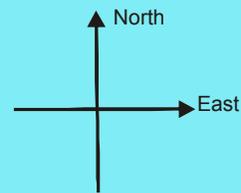
This can be represented as $z \dots x \dots y$

(ii) Space related order

X is located north west of Y.



Standard notation for directions is



(iii) Set membership

If A works then B also works

Relationship can be represented as AB

If A works then B doesn't work can be represented as $A\bar{B}$

(iv) Fixed relationships and variable relationship

A is allocated room 3 from 8 rooms numbered 1 to 8. This is a fixed relationship. This can be represented as

1	2	3	4	5	6	7	8
		A					

B is allocated room 4 or 5. This is a variable relationship. This can be represented as

1	2	3	4	5	6	7	8
			B	B			

B is not placed in the grid as B's position is not finalized

Let's attempt a problem

John has to visit 5 shops. A,B,C,D and E. He has to visit each shop in one day of the week from Monday to Friday based on the following conditions

1. C has to be visited before B
2. A has to be visited immediately after B
3. D cannot be visited on Monday
4. A has to be visited on Friday
5. E has to be visited two days before A

The above relationship can be represented as

Mon	Tue	Wed	Thur	Fri
D	E			A

C...B based on condition 1 BA from condition 2

Modifying the table

Mon	Tue	Wed	Thur	Fri
D	E		B	A

Hence D can be visited on Wednesday

Mon	Tue	Wed	Thur	Fri
C	E	D	B	A

Practice problems

1. There is an unique missing system followed in the Kimberly mines in south Africa

Tunnel 1 is linked to tunnels 2 and 3

Tunnel 4 is linked to tunnels 2, 5 and 7.

Tunnel 5 is linked to tunnels 9.

Tunnel 3 is linked to tunnels 6.

Tunnel 6 is linked to tunnels 9 and 8.

Tunnel 9 is linked to tunnels 8.

The distance between two successive tunnels is constant

1. Find the shortest distance between tunnel 4 and 8

2. A miner is in tunnel 9, find the shortest distance to reach tunnel 1.

2. Some children play with fire crackers and they decide to light the six fire crackers in a specific order. Six crackers are green, yellow, blue, red, purple & magenta.

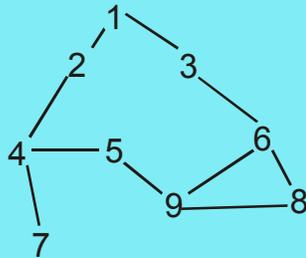
- i. Green colour should be lit at the start.
- ii. Purple colour should be lit at the last
- iii. Yellow should follow red
- iv. Blue should follow green colour immediately.

1. After what colour will the children light the magenta coloured cracker?

2. How many possible combinations are possible?

Solutions

1. 1. 4 - 5 - 9 - 8 . 2. 9 - 6 - 3 - 1.



- 2.1. Blue or yellow or Red. 2. 6

Given green is 1st & purple is at the last.

G						P
---	--	--	--	--	--	---

Blue should follow green

G	B					P
---	---	--	--	--	--	---

G	B	R	Y	M	
---	---	---	---	---	--

(or)

G	B	R	M	Y	
---	---	---	---	---	--

Now try out these problems

3. Seven different books are to be arranged in a rack. Two books are related to philosophy. Two books are related to history. Two books are related to medicine. One book is related to computer.

- (i) The two medical books should be placed together.
- (ii) The two history related books should not be placed together.
- (iii) Computer book cannot be next to a philosophy book.
- (iv) The third book should be a philosophy book.

1. If the second book is a medical book, then list all the position where the computer book can be placed.

2. If the fifth book is the philosophy book then what will be placed after it?

4. Seven children A, B, C, D, E, F, G are in 2 study groups. Group 1 has 3 members group 2 has 4 member.

- (i) A cannot be in the same group as C.
- (ii) If B is in group 1, D must be in group 1.
- (iii) If E is in group 1, C must be in group 2.
- (iv) F is in group 2.

1. If A is in group 2, who all must be in group 2?

2. If C and E are in the same group, then list all the pairs of people who must not be together?

3. If B is in group 1, then who must be in group 2 ?

5. Six chairs are placed in a meeting for A, B, C, D, E, & F.

They sit according to the following conditions.

(i) F and E in the extreme ends.

(ii) A & C Sit together.

(iii) B sits to the immediate left of E.

(iv) D and F don't sit together.

1. Who sits next to F ?

2. If another person G enters the room & sits next to B what will be his position ?

Solution

3. 1. 5,6,7 2. History

1	2	3	4	5	6	7
M	M	P	H	P	H	C

Second book is a medical book, third is philosophy book

The other medical book is first. Book in the last position is computer.

4. 1. E, A, F 2. B and G, A & C, A & F, A & E. 3. 4

5. 1. C or A 2. 5th

Given that F & E sit in the extreme ends.

E					F
---	--	--	--	--	---

(OR)

F					E
---	--	--	--	--	---

are the only possibilities.

B sits to the left of E.

F				B	E
---	--	--	--	---	---

A and C sit together.

F	C	A		B	E
---	---	---	--	---	---

(OR)

F		C	A	B	E
---	--	---	---	---	---

Place D in the remaining slot as D doesn't sit next to F

F	C	A	D	B	E
---	---	---	---	---	---

∴ Either A or C sits next to F.

If G sits next to B

F	A	C	D	G	B	E
1	2	3	4	5	6	7