# 8 Memory



## Learning objectives

This chapter aims at facilitating students to

1. understand the process and nature of memory.
2. understand various methods of measuring memory.
3. understand various causes of forgetting.
4. understand the strategies of improving memory and relate the same to day to day experiences.

## 8.1 Introduction : What is memory?

We have looked at the different parts of the brain as well as the mechanism of how signals are transferred to and fro from the brain and various parts of the body. In this chapter, let us now look at how information and experiences are stored and recalled in the brain.

**Activity 1 :**

Do you remember your first picnic from your school? Do you remember your primary school teacher? Now can you remember what food you ate last Monday? Why you can remember some incidents from the past clearly while you cannot remember some things which happened yesterday?

**Activity 2 : Why this happens?**

25 workers used to work in Thomas Edison's Bulb and Phonogram unit of industries. There was a huge tree near his company. After 6 months, Edison asked his workers about the huge tree but not a single worker could give information about that tree. Why do you think this happened despite seeing the tree everyday?

All of us are aware of the tricks that memory plays with us throughout our lives. Have you ever felt embarrassed because you could not remember the name of a known person you were talking to?

Memory is indeed a very fascinating, intriguing human ability. It functions to preserve our sense of identity, interpersonal relationships, solving problems and making decisions.

Memory has been a theme of research in Psychology over a hundred years.

## What is Memory?

Memory is an ability by which information is encoded, stored and retrieved when needed. It is the retention of information over time for the purpose of future action. In the last chapter, we've seen that hippocampus plays an important role in storage of memory.

According to Tulving (2000) "Memory is the means by which we draw on our past experiences in order to use that information in the present". Memory is the term given to the structure and processes involved in the storage and subsequent retrieval of information.

### 8.1.1 Basic processes in memory

- Encoding / Acquisition
- Storage
- Retrieval


**Fig. 8.1 Basic processes in memory**

We can think of these processes as analogous to the functions of computer.

### 1. Acquisition / Encoding

Acquisition is the process of acquiring information from our sense organs. The process of transforming the information received through our sense organs into suitable symbols like pictures, figures, words & numbers.

### 2. Storage

The information acquired and encoded is preserved over a period of time. The process of storage is essential for using that information in future.

### 3. Retrieval

We can sometimes remember the poem which we had learned in first or second standard and we can recall it after our school days also. The process of recalling the stored information for the purpose of its actual use is known as Retrieval. We tend to retrieve mobile numbers, names etc. in our daily life.

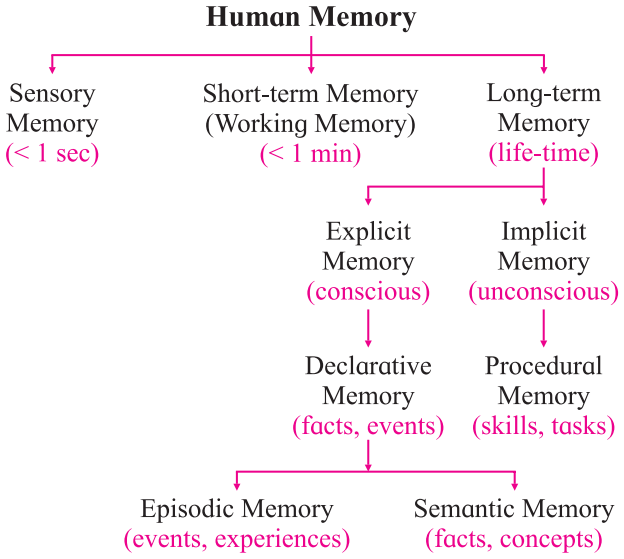


**Fig. 8.2 Types of Human Memory**

### 8.1.2 Stages of memory

The environmental stimulus is received with the help of our sense organs which is called as sensory memory. When we pay attention to the sensations coming in, they are transferred to STM. If the information is not rehearsed in STM, it is not retained. If it is rehearsed or appears frequently, then it is transferred to the LTM. When we encounter any problem, we bring the information from our LTM to STM so that it's available to us for solving that problem.

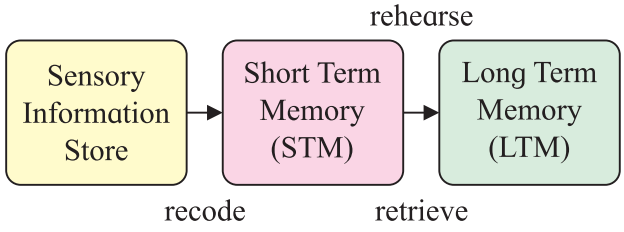


**Fig. 8.3 Stages of memory**

### 1. Sensory memory

Sensory memory is the shortest element of memory. It is the ability to retain impressions of sensory information after the original stimulus has ended. Sensory memory retains information received through the five senses of sight, hearing, smell, taste and touch for a brief period of time.

### 2. Short term memory

We are constantly bombarded with sensory inputs, however, only if they are significant they enter the Short Term Memory (STM). To retain the information in STM, maintenance rehearsal is required. STM holds the information between 15 to 30 seconds and the capacity of STM is about 7 items at a time.

The magical number 7 +/- 2 provides the evidence for the limited capacity of the STM. Most adults can store between 5 and 9 items in the STM. This idea was put forward by George Miller in 1956 and called as magical number 7.

### Working Memory

Baddeley called STM as working bench of memory, because according to him STM is the most important stage of our memory which is used most of the time for problem solving.

Working memory term was coined by Miller, Galanter and Pribram around 1960.

It was formerly known as “short term store”.

Short term memory is also known as -

primary memory.

immediate memory.

operant memory.

provisional memory.

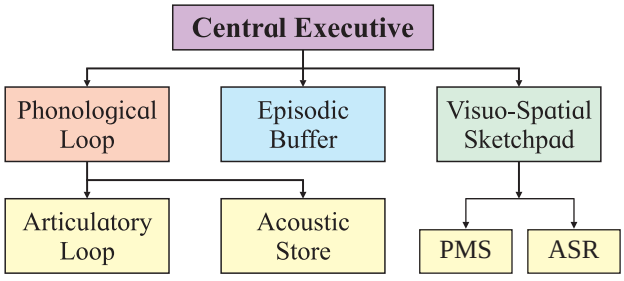


**Fig. 8.4 Working Memory Model**

The working memory model given by Baddeley can be explained as follows :

### Central Executive

Central executive is a supervisor responsible for the co-ordination of the subsystems and the selection of reasoning and storage strategies.

### Phonological loop (PL)

Phonological loop is responsible for verbal information. It has two subsystems, namely, phonological / acoustic store and articulatory loop.

### Phonological / acoustic store

It is passive component of phonological loop. It holds on verbal information. This information is forgotten if it is not rehearsed.

### Articulatory loop

It involves rehearsing and refreshing the information, just like our inner voice.

### Episodic buffer

It holds information that is not covered by all other slave systems. It is link between working memory and long term memory.

**Visuo-spatial sketch pad (VSSP) - handles visual and spatial information.**

Is one of the two passive systems. It is responsible for storing speech based information.

It has 2 components -

**1) Phonological memory store :**

That can hold traces of acoustic or speech based information.

**2) Articulatory Subvocal Rehearsal :**

Material in short term store is maintained through this component. Prevention of articulatory rehearsal leads to rapid forgetting.

### 3. Long term memory

Some items enter the Long Term Memory (LTM) after rehearsal. Elaborative rehearsal is making that information meaningful and connecting the same with the information that already exists in the LTM. Once entered, the information is retained for more or less permanently. It is an organized system and a store house of encoded experiences. The amount of information stored here is unlimited.

**Activity 3 :**

**Think about this -**

How many people do you recognize? How many flowers you can name? How many places do you know? It is amazing that we can store an enormous amount of information, thanks to our Long Term Memory.

**Types of Long Term Memory.**

**Explicit Memory**

Conscious memories of facts and events are called as explicit memory. It is also known as Declarative memory.

**Episodic memory** is a memory of experiences and specific events which we recall step by step where we can reconstruct the actual events. It is the memory of autobiographical events with times, places and associated emotions.

**Semantic memory** is a more structured record of facts, meanings, concepts and knowledge. Semantic memories have personal context. It includes vocabulary, mathematics, rules of logic etc.

A type of declarative memory is **auto-biographical memory**. Autobiographical memory refers to episodes recollected from an individual's own life.

One type of autobiographical memory is known as **flashbulb memory**, which is a highly detailed, exceptionally clear "snapshot" of mostly a traumatic moment.

**Implicit Memory**

It is also known as procedural memory. Procedural memory is the unconscious memory of skills and how we do things, regarding the use of objects or movements of the body, such as tying a shoelace, playing harmonium or riding a bicycle. These memories are developed through repetition and practice.

## 8.2 Measurement of memory

As we've seen various stages of memory, let's see now how our memories can be measured. These are major ways of measuring memory - Recall,

Recognition,

Relearning.

Recall can be in the written form or it can be oral. Again recall can be free recall or serial recall.

### 8.2.1 Recall

Recall is retrieval of information from our LTM with few / no cues. The essay type questions which appear in your exams is the example of recall. Recall involves remembering a fact, event or object that is not currently physically present and require the direct uncovering of information from memory. Murdock (1962) did one experiment to check the recall of the subjects. He asked subjects to learn a list of words. Later their recall was tested by a free recall method. Murdock (1962) found that subjects could recall first few (primacy effect) and last few (recency effect) words prominently, but they got confused with the words in the middle part (serial position effect).

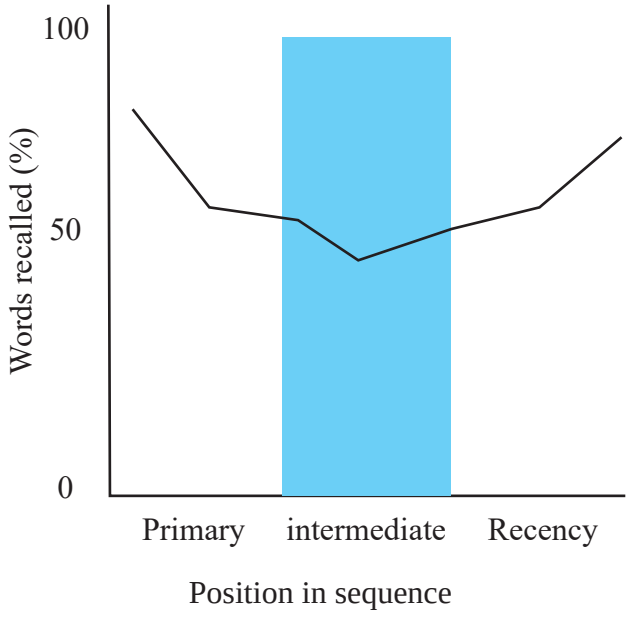


**Fig. 8.5 Serial Position Effect**

**Activity 4 :**

Note down the problems you face while learning a long answer.

Try linking your points to one another while learning in order to reduce the effect of serial position.

Recall is of two types.

**Free recall :**

It is recollection of the items in the list without its serial order. Memory for free recall is always better than if the subjects are asked to recall in a serial order. Free recall is effective in studying primacy effect and recency effect. Primacy effect occurs when the subject is able to recall items which are presented at the starting point of the list and recency effect occurs when the subject is able to recall the items which are presented at the end. Example of free recall is : we may listen to a lecture and afterwords recall few important points irrespective of the order in which they were presented.

**Serial recall :**

Here, material is recalled in the exact order in which it was presented. For example : if you are watching a dance show and if you are asked about who presented first and who was second performer and so on. Here, your answer will be in serial order. When you solve a mathematical problem, like 2+2= 4* 4= 16 you are doing steps one after the other so it is serial recall.

Recall is greatly affected by emotions and motivation at the time of learning and subsequently at the time of retrieval also.

### 8.2.2 Recognition

In this method the individual has to point out or recognise previously learnt material which is presented to him in a different context. The already learned material is present and the learner has to recognise it. It becomes relatively easier than the recall method. Usually score of memory by recognition method is more than recall method. Example : Multiple choice questions or match the columns.

### 8.2.3 Relearning

It measures retention by measuring how much faster one learns a previously learnt material after an interval of time. The comparison of retention scores at the time of first learning and the second learning shows that there is improvement in terms of time (no. of trials taken). Thus by relearning; there is saving of time taken to learn the same material.

This method is also known as saving method. The same material is learned by the same subject up to same learning criterion on two different occasions separated by some time interval.

It measures memory by comparing which includes performance on the same task on two different occasions.

## 8.3. Some phenomena related to memory

### 8.3.1 Flashbulb memory

Can you remember where you were and what you were doing when you first learned about an earthquake or tsunami taking place? If you can, you now have flash bulb memories – a term coined by Brown and Kulik.

Flash bulb memories are vivid memories of what we were doing at the time of an emotion provoking event because they seem to be preserved in autobiographical memory in considerable detail, almost like a photograph. Flashbulb memories illustrate a more general phenomenon about memory. Exceptional memories are easily retrieved.

### 8.3.2 Tip of the tongue phenomenon

One way to study organisation of information in long term memory is to see what happens when we search through our library of experiences to retrieve a memory. Suppose you are trying to retrieve a person's name but you cannot remember it. The name is on the tip of the tongue, but you cannot recall it. For example if you want to recall a name XYZ. Instead of this name you may utter similar names starting with the same letter and having nearly similar names, So tip of the tongue phenomenon is the evidence for the organisation of long term memory.

## 8.4 Forgetting

**Activity 5 :**

Think of the following situations...

Have you ever experienced the feeling that you had studied well before the exam but you did not remember the answers in the exam?

After a long time you meet your old school mate but you don't remember his name.

You hear your favourite song tune but you don't remember the words.

All these are the experiences of forgetting. Let's understand now what is forgetting...

Forgetting is simply the inability to remember the things which we want to remember at that moment. In other words, Forgetting is the failure to retrieve the material from our long term memory which we had already stored.

The pioneer of experiments on forgetting was Hermann Ebbinghaus. He created several lists of "nonsense syllables". Nonsense syllable is set of three alphabets two on both the sides are consonants and middle one is vowel like GEX, WOL, MUV etc and learnt it. He checked his own recall at various periods of time. He found out that he forgot most of whatever he had learnt in the first 20 minutes (40%). Following that after 1 hour (20%) till 9 hours (10%) again he forgot further and after one day he could recall only around 30% of the material he had learnt. After that his recall was steady for a long period of time. This experiment proved that we forget most of the things we learn in a short span. Therefore you should revise the study material on the same day again when you finish studying it to avoid forgetting.

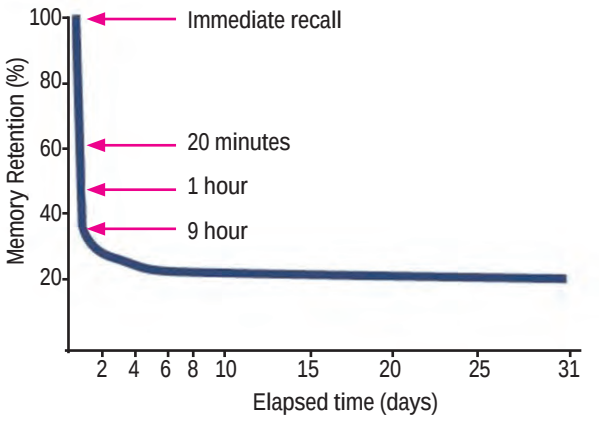


**Fig. 8.6 Forgetting curve**

Now let's see various causes of forgetting and how we can use some memory improvement techniques to reduce the forgetting.

## Causes

1) If you keep a book on a shelf for over 6 months without touching it, what will happen to that book? How will it start looking? You will realize that after 6 months period, there will be dust on that book. Similarly our memories fade out when we don't use them for longer period. These traces get decayed over a period of time if they are not used and so we forget.

2) Have you ever played the game Chinese whispers? What happens in that game? Does the message remains the same as it was told by the first person who started the message? You can try it in the class or with your friends. You will see that the message in the beginning and message which is given by the last person is not the same. What do you think why does this happen? It is because we have a tendency to distort our memories. The game Chinese Whispers is the crude example of this type of forgetting. Some researchers believe that our memory traces are not decayed but they are distorted over a period of time and forgetting occurs.

3) Have you gone through some similar situations in your day to day life, think. You studied Psychology yesterday and you studied Sociology today. Now you end up forgetting either Psychology or Sociology. This kind of forgetting is due to interference of material. Some researchers believe that we forget due to the interference of the materials with each other which we learn one after the other. There are two type of interference namely retroactive interference and proactive interference.

### a) Retroactive interference :

As the name suggests Retro means backward interference. It is the partial or complete forgetting of the previously learnt material due to the new memories which get mixed up with the older ones. So in the earlier example if we forget Psychology due to the study of Sociology, it will be due to retroactive interference.

### b) Proactive interference :

As the name suggests Pro means forward interference. It is the partial or complete forgetting of the newly learnt material due to the old material. So in the example given, if we forget Sociology due to the study of Psychology, it will be proactive interference.

**Retroactive and Proactive interference**

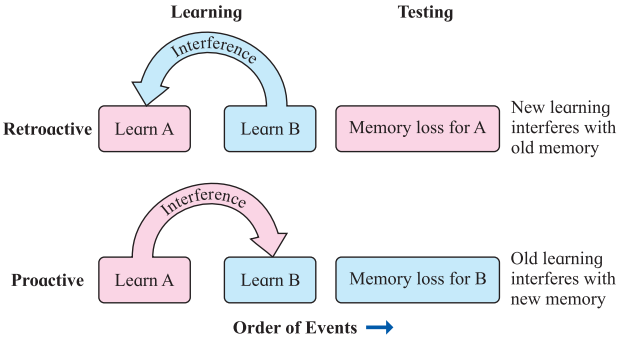


**Fig. 8.7 Forgetting due to interference**

### 4) Motivated Forgetting :

It is a behaviour in which people may forget unwanted memories either consciously or unconsciously. It is also called as a conscious coping strategy but it should not be confused with defense mechanisms.

There are two levels of motivated forgetting :

### a) Repression :

Sigmund Freud's Psychoanalytic model states that we subconsciously push unwanted thoughts and memories into our unconsciousness. Person thinks that such repressed memories are completely forgotten. For example a girl who had experienced sexual abuse during childhood may completely forget about it but she may have difficulty while forming romantic relationship.

### b) Thought suppression :

It is a conscious effort where we forget the memories of unwanted incidents and experiences of our lives. For example : if your friend has experienced a break up recently he may change the topic if you want to discuss about it. Thought suppression can be time consuming and quite difficult also, because such suppressed thoughts will reoccur. So your friend may try to suppress the thoughts about his ex-girlfriend but he may not be successful as she is your classmate.

## 8.5 Techniques of improving memory

After knowing the reasons of forgetting, now let us move ahead with how we can improve our memory.

### 1) The Keyword Method :

The Keyword Method is an effective method for remembering definitions, learning foreign language vocabulary with their meaning etc. Any two different pieces of information can be linked together by using this method. e.g. In Japanese "ki" means tree. A person can remember similar sounding word like "key" from English and can remember as "there is a key on the tree".

### 2) Encoding Specificity :

The encoding specificity of memory (Tulving & Thomson, 1973) provides information about how context can affect memory. According to this principle, memory is improved when information available while learning is also available at the time to recall.

### 3) Method of Loci :

It is creating imaginary route so that things can be remembered in better way. e.g. things to be picked up while going home or steps to solve mathematical problem. By using this method, a person with average intelligence also can form a route, club things in such a way that person can remember associated images for long period.

### 4) Mnemonic Devices :

These are the memory tools which help you to remember words, information or concepts. 'Mnemonic' in Greek means "of memory or related to memory". Mnemonics will include acronyms or first letter technique such as VIBGYOR which includes colours of rainbow. It will also include visualization like imagining face of a friend to remember your meeting

with him or her. Another example is, you don't repeat the same mistake if you remember the punishment you got before. Another technique is chunking where you can place large information into small chunks. For example "Vina's Nervous Mother was running slowly and peacefully'. this could be divided into chunks for 7 primary mental abilities given by Thrustone. The sentence includes verbal, numerical, memory, word fluency, reasoning, spatial and perceptual speed as factors of intelligence.

### 5) Practice and rehearsal :

Relearning the same material for a number of times will lead to better retention and better recall. For small size of material like definitions or easy material, if we use our time fully and learn the entire material, it will be more effective. For large size of material or difficult material we must take breaks in between and also learn the material in parts.

### 6) Minimizing interference :

We have already learnt about retroactive and proactive interference. Therefore we must not learn similar subjects together as they might interfere with each other. Also rest is necessary for minimizing interference.

### 7) One can also use POWER method for improving memory.

### a) Prepare :

Before starting our studies, we must prepare ourselves for it by setting our goals i.e. why are we studying that particular topic. We should be aware of the reason.

### b) Organize :

While reading we must organize the material appropriately and plan for the time we will require to learn it. If the material is easy and familiar, we can dedicate less time for it and if the material is unfamiliar, complicated or technical, we have to devote more time to it. We must learn difficult and technical material when we are fresh and when are tried we must go for the subject we enjoy.

### c) Work :

You have to work towards your goal, put efforts while learning so to achieve the goal. You must associate new information with something which you have already learnt. Learn with motive to remember. Form chunks, form new associations so that you can remember the material.

### d) Evaluate :

Try to evaluate quality of your learning by solving questions and find out the quality of your knowledge. Here, you will come to know about how much you have gained.

### e) Rethink :

This final stage involves reanalyzing, reviewing, questioning and challenging our assumption. Here you can associate new material with whatever you already know.

This chapter must have provided you enough insight into the working and organisation of your memory as well as some hands on tips to improve your retention which could aid you in your academic performance. Make sure you apply the methods mentioned in this chapter while studying next time!

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## Summary :

- Memory is a process of receiving, storage and retrieval of information when required.
- The basic processes of memory include acquisition (encoding), storage and retrieval.
- The stages of memory include : Sensory memory : retention of sensation (sensory impression) for a very brief time, Short Term Memory: the working memory that has limited capacity and retains information for limited time, Long Term Memory: After elaborative rehearsal the information from STM enter the LTM which is a highly organized system. Information retained almost permanently. LTM can be Explicit (Declarative) or Non declarative. Declarative memory can be episodic i.e. relating to life experiences OR semantic--for information encoded in signs and symbols. Non declarative is implicit or procedural i. e. for skills like riding a bike.
- Methods of Measurement of memory : Recall, Recognition and Relearning.
- Forgetting is inability to retrieve the stored information due to : Trace Decay, Trace Distortion, Interference or Retrieval failure.
- Memory can be improved by certain techniques. These techniques are called Mnemonic devices.

## Key Terms :

- Memory
- Sensory memory
- Short term memory
- Working memory
- Elaborative rehearsal
- Long term Memory
- Explicit Memory
- Implicit Memory
- Episodic Memory
- Semantic Memory
- Flashbulb Memory
- Recall
- Recognition
- Relearning
- Trace Distortion
- Trace Decay
- Interference
- Retroactive Interference
- Proactive Interference
- Mnemonic device
- Method of Loci

## Key Psychologists :

**Hermann Ebbinghaus :**

From 1880 to 1885, he conducted a limited, incomplete study on himself and published his hypothesis in 1885 as Über das Gedächtnis (later translated into English as Memory: A Contribution to Experimental Psychology). Ebbinghaus studied the memorization of nonsense syllables, such as "WID" and "ZOF".

## Exercise

**Q. 1. (A) Complete the following statements**

1. One of the important processes for storage of information in the LTM is .....

   *a. Perception* *b. Elaborative rehearsal*

   *c. Encoding*

2. Memory is a/an .....

   *a. Activity* *b. Process*

   *c. Performance*

3. ..... memory has the shortest duration.

   *a. Sensory* *b. Short Term*

   *c. Long Term*

4. ..... memory is also known as Working Memory.

   *a. Long Term* *b. Accidental*

   *c. Short Term*

5. ..... memory has unlimited capacity.

   *a. Sensory* *b. Short Term*

   *c. Long Term*

6. The span of Short Term Memory is .....

   *a. 5+/- 2* *b. 7+/-2* *c. 9+/-2*

**(B) State whether the following statements are True or False. If False, correct them. If True, explain why.**

1. Our sense organs also have memory.
2. Short term memory has an unlimited capacity.
3. Conscious memory of facts and events is called explicit memory.
4. Implicit memory is memory of skills.
5. When we memorise meanings, concepts and principles, it is called episodic memory.
6. The method of relearning is also known as saving method.
7. The most vivid memory is flashbulb memory.
8. Very often forgetting is due to unconscious processes like repression.

**(C) Identify the odd item from the following.**

1. Encoding, storage, Tip of the tongue (TOT), retrieval
2. Keyword method, method of Loci, Chunking, Rote learning, First letter technique
3. Sensory register, STM, Flashbulb memory, LTM
4. Recall, recognition, relearning, trace decay

## (D) Match the following pairs.

| A | B |
|---|---|
| 1. A technique to improve memory | a. Short Term Memory |
| 2. The most vivid memory | b. Declarative Memory |
| 3. Working memory | c. Implicit Memory |
| 4. Most organized memory | d. Flash Bulb Memory |
| 5. Playing a harmonium after a long time | e. Method of Loci |
| 6. Writing an essay on perceptual process | f. LTM |
| | g. recall method |
| | h. relearning method |

## Q. 2. Answer the following questions in around 35-40 words each.

1. Explain any one example of Flashbulb memory from your life.
2. Explain the model of working memory proposed by Baddeley.
3. Explain the Tip of the tongue (TOT) phenomenon with an example.
4. Give an example of Episodic memory.
5. What is motivated forgetting?

## Q. 3. Compare and contrast

1. STM - LTM
2. Implicit Memory - Explicit Memory
3. Semantic memory - Episodic memory
4. Storage failure - Retrieval failure
5. Recall method - Recognition method

## Q. 4. What will you do if...

1. You have to prepare a long speech covering all the activities in your college and present at the annual function.
2. How will you apply "POWER" to prepare for the final exam of Psychology.

## Q. 5. Short Notes.

1. Characteristics of Memory
2. Techniques to improve memory
3. Motivated forgetting
4. Causes of forgetting

## Q. 6. Answer the following question in 150 to 200 words.

1. Explain the process of human memory in detail.
2. Explain the theories of forgetting in detail.

## Q. 7. Arrange the following elements in concepts of memory in ascending order.

1. Elaborative rehearsal, Short Term Memory, receiving information from the environment, Long Term Memory, Retrieval.