COGNITIVE PSYCHOLOGY, LEARNING AND MEMORY (MPC-001)

TUTOR MARKED ASSIGNMENT (TMA)

Course Code: MPC-001
Assignment Code: MPC-001/ASST/TMA/2021-22
Marks: 100

NOTE: All questions are compulsory.

SECTION – A

Answer the following questions in 1000 words each. 3 x 15 = 45 marks

1. Define cognitive psychology and describe the domains of cognitive psychology.

2. Critically discuss Sternberg's Information processing approach.

3. Explain the concept of IQ. Describe the history of measurement of intelligence.

SECTION – B

Answer the following questions in 400 words each. 5 x 5 = 25 marks

4. Describe the principles of information processing.

5. Explain the cellular bases of learning and memory.

6. Discuss Spearman's Two-factor theory of intelligence.
7. Define creativity. Discuss the measurement of creativity.
8. Explain the basic concepts of multilingualism.

SECTION – C

Answer the following questions in 50 words each. 10 x 3 = 30 marks

9. Nature vs. Nurture
10. Neuroscience and cognitive psychology
11. Miller's magic number
12. Encoding, Storage and Retrieval
13. Knowledge base in PASS theory
14. Spatial intelligence
15. Algorithms
16. Problem space
17. Functional fixedness
18. Backward search

ASSIGNMENT SOLUTIONS GUIDE (2021-22)

MPC-001: Cognitive Psychology, Learning and Memory

SECTION – A

Answer the following questions in 1000 words each.

Q1. Define cognitive psychology and describe the domains of cognitive psychology.

Ans. Cognitive psychology is the study of how people perceive, learn, remember, and think about information. A cognitive psychologist might study how people perceive various shapes, why they remember some facts but forget others, or how they learn language. Consider some examples of everyday experiences that are also of theoretical interest to cognitive psychologists: How many times have you carefully proofread written work, only to be embarrassed later by an obvious error you overlooked? Many times what we see is determined as much by the context in which it occurs as by what is actually there, an issue of pattern recognition. Have you noticed the difficulty of simultaneously taking notes in class and understanding a lecture?

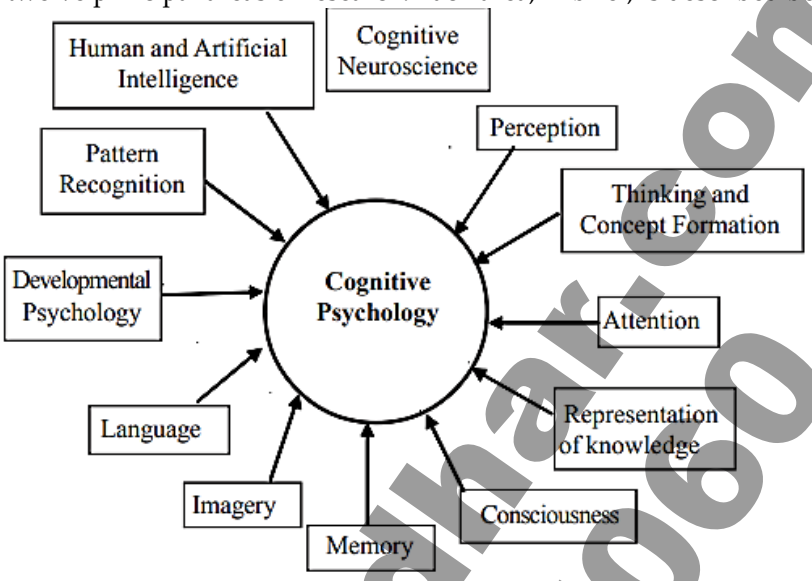
Explanations of this kind of difficulties are found in the discussion of attention. When you dial the telephone directory assistance for a telephone number and do not have a pen to note it down, why do you have to repeat the number until you have dialled it? And why you have to make your call again to enquire the number if someone talks to you before you dial the number? These are problems associated with the short term memory. Do you remember the experience of working on a problem or a puzzle that you were unable to solve, but after taking a break from the problem, you subsequently obtained a solution? This phenomenon, known as incubation effect, along with other commonly experienced events is an aspect of problem solving. Why do objects look farther away on foggy days than they really are? This discrepancy of perception can be dangerous, even deceiving drivers into having accidents.

These are just a few of the many examples of everyday experiences which are discussed and explored by the experiments and theory of cognitive psychology. Two points about these examples should be considered as we attempt to gain an overview of cognitive psychology.

- All represent instances of difficulty or failure of mental processes. We rarely Cognitive Psychology think of them unless they fail to work. Failure of mental processes are immediately noticed because they can be frustrating, embarrassing, and sometimes even dangerous and, consequently, such failures become useful tools for the psychological analysis of mental phenomena.
- Cognitive psychology is interested in what is generally called mental phenomena. In this sense, the examples just discussed are consistent with the dictionary definition of cognitive psychology: "the scientific study of the mind".

While it is hoped that examples help clarify the definition, questions undoubtedly remain concerning how one goes about this 'scientific study of mind'. To address these questions, here's a brief discussion of the scientific methods, followed by an extensive description of the important historical events leading up to modern cognitive psychology.

Domains of Cognitive Psychology: Modern cognitive psychology freely, draws theories and techniques; from twelve principal areas of research. Each area, in brief, is described below:



Cognitive Neuroscience: Only within the past few years have cognitive psychologists and cognitive neuroscientists formed a close working relationship. Thus far, this union has produced some of the most provocative developments in the study of our mental character. Cognitive psychologists are seeking neurological explanations for their findings, and neuroscientists are turning to cognitive psychologists to explain observations made in their laboratories. Every part of the cognitive process from sensation to memory is supported by basic electrochemical processes taking place in the brain and nervous system.

Perception: The branch of psychology directly involved with the detection and interpretation of sensory stimuli is perception. From experiments in perception, we have a good understanding of the sensitivity of the human organism to sensory signals and more important to cognitive psychology of the way we interpret sensory signals. The experimental study of perception has helped identify many of the parts of this process. However, the study of perception alone does not adequately account for the expected performance; other cognitive systems are involved, including pattern recognition, attention, consciousness, and memory.

Pattern Recognition: Environmental stimuli rarely are perceived as single sensory events; they usually are perceived as part of a more meaningful pattern. The things we sense – see, hear, feel, taste, or smell—are almost always part of a complex pattern of sensory stimuli. Think about the problem of reading. Reading is a complex effort in which the reader is required to form a meaningful pattern from an otherwise meaningless array of lines and curves. By organising the stimuli that make up letters and words, the reader may then access meaning from his or her memory. The entire process takes place in a fraction of a second, and considering all the neuroanatomical and cognitive systems involved, this feat – performed daily by all sorts of people – is wondrous.

Attention: Although we are information-gathering creatures, it is evident that under normal circumstances we are also highly selective in the amount and type of information to which we attend. Our capacity to process information seems to be limited to two levels – sensory and cognitive. If too many sensory clues are imposed upon us at any given time, we can become overloaded; if we try to process too many events in memory, we can become overloaded, which may cause a breakdown in performance. All of us have felt the same way at one time or another.

Consciousness: Consciousness is defined as "the current awareness, of external or internal circumstances." Rejected as being "unscientific" by the behaviourists, the word consciousness and the concept it represents simply did not fade away. For most people, consciousness and unconscious thoughts (such as you might have on a first date) are very real. For example, when you glance at your watch while studying and it reads "10:42 (P.M.)," you are conscious, or, aware, of that external signal. However, your reading of the time also brings up another conscious thought, one that was initially activated by reading the time but is from "inside." That conscious thought might be, "It's getting late: I'd better finish this chapter and go to bed". Consciousness has gained new respectability recently and now is a concept studied seriously in modern cognitive psychology.

Memory: Memory and perception work together. The information available to us comes from our perception, short-term memory, and long-term memory. Most obvious long-term storage is the knowledge of the language. We draw words from LTM and more or less use them correctly. In a fleeting second, we are able to recall information about an event of years before. Such information does not come from an immediate perceptual experience; it is stored along with a vast number of other facts in the LTM.

Representation of Knowledge: Fundamental of all human cognition is the representation of knowledge: how information is symbolised and combined with the things stored in the brain. This part of cognition has two aspects: the conceptual representation of knowledge in mind and the way the brain stores and process information. The conceptual representation in different individuals can be considerably different. In spite of these inherent dissimilarities between representations of knowledge, most humans do experience and depict experience in similar enough ways to get along well in the world. The content of this information is also hugely different. But our neurological web entraps information and experiences and holds them in structures that are similar in all human brains.

Imagery: Cognitive psychologists are especially interested in the topic of internal representations of knowledge. The mental images of the environment are formed in the form of a cognitive map, a type of internal representation of the juxtaposed buildings, streets, street signs, spotlights, and so on. From the cognitive maps, we are able to draw out significant cues. Although the experimental study of mental imagery is relatively new to psychology, some significant research has recently been reported.

Language: One form of knowledge shared by all human societies is the knowledge of language. Language is the principal means by which we acquire and express knowledge; thus, the study of how language is used is a central concern of cognitive psychology. Human language development represents a unique kind of abstraction, which is basic to cognition. Language processing is an important component of information processing and storage. Language also influences perception, a fundamental aspect of cognition.

Developmental Psychology: Developmental psychology is another important area of cognitive psychology that has been intensely studied. Recent studies and theories in developmental cognitive psychology have greatly expanded our understanding of how cognitive structures develop. As adults, we have all lived through childhood and adolescence and we share maturational experiences with all members of our species.

Thinking and Concept Formation: Thinking is the crown jewel of cognition. Thinking is the process by which a new mental representation is formed through the transformation of information. Advances in cognitive psychology have led to a formidable arsenal of research techniques and theoretical models. An ability to think and form concepts is an important aspect of cognition. Similar concepts help in the understanding and processing of information. There is a considerable body of knowledge about the laws and processes of concept formation.

Human and Artificial Intelligence: Human intelligence includes the ability to acquire, recall, and use knowledge to understand concrete and abstract concepts and the relationships among objects and ideas, to understand a language, to follow instructions, to convert verbal descriptions into actions, and to behave according to the rules, and to use knowledge in a meaningful way.

The specialty within the computer science called artificial intelligence has had a major influence on the development of cognitive science, especially since the design of programs requires knowledge of how we process information. Cognitive psychology also addresses to find out whether a perfect robot can simulate human behaviour.

Q2. Critically discuss Sternberg's Information processing approach.

Ans. Information processing is the change (processing) of information in any manner detectable by an observer. Within the field of cognitive psychology, information processing is an approach to the goal of understanding human thinking. It began in the 1940s and 1950s. Educators are very interested in the study of how humans learn. This is because how one learns, acquires new information, and retains previous information guides selection of long-term learning objectives and methods of effective instruction. To this end, cognition as a psychological area of study goes far beyond simply the taking in and retrieving information. It is a broad field dedicated to the study of the mind holistically. Neisser (1967), one of the most influential researchers in cognition, defined it as the study of how people encode, structure, store, retrieve, use or otherwise learn knowledge. Cognitive psychologists hypothesise an intervening variable or set of variables between environment and behaviour—which contrasts it with behavioural theories.

Sternberg's Information Processing Approach: Another theorist firmly grounded in the information processing approach is Sternberg (1988). Sternberg's theory suggests that development is skills-based and continuous rather than staged and discontinuous as stage theorists believe, and his focus is on intelligence. This focus on intelligence separates his ideas from stage theorists because it rejects the idea of incremental stages, but rather suggests that development occurs in the same way throughout life differentiated only by the expertise of the learner to process new information. First, and very importantly, Sternberg's model does not differentiate between child and adult learning. Also, he deals solely with information processing aspects of development and does not incorporate any facets of biological development into his theory. Cognitive development is viewed as a novice to expert progression; as one becomes better at interaction and learning, one is able to learn more and at higher levels. Development changes as a result of feedback, self-monitoring, and automatization. In this theory, intelligence is comprised of three kinds of information processing components: meta-components, performance components, and knowledge-acquisition components.

In Sternberg's (1988) model, each of these three components works together to facilitate learning and cognitive development. Meta-components are executive in nature. They guide the planning and decision making in reference to problem solving situations; they serve to identify the problem and connect it with experiences from the past. There is, however, no action directly related to meta-components, they simply direct what actions will follow. Performance components are the actions taken in the completion of a problem-solving task. Performance components go beyond meta-components in that they perform the function also of weighing the merit and or consequences of actions in comparison to other options rather than simply identifying options. Sternberg's third proposed type of intelligence is the knowledge-acquisition component. This type is characterised by the ability to learn new information in order to solve a potential problem. This type is much more abstract and may or may not be directly related to a current problem-solving task (Driscoll, 2001). This three-leveled view of intelligence comprises the componential aspect of Sternberg's theory, but this is only one of three parts to his larger triarchic theory of intelligence (Kearsley, 2001).

Sternberg's (1988) theory adds the components of feedback to theories of cognitive development; this suggests that an individual's social interaction has some impact on cognitive development. In fact, one of the three parts of his theory is based on the context in which learning takes place; this subpart of the theory "specifies that intelligent behaviour is defined by the sociocultural context in which it takes place and involves adaptation to the environment, selection of better environments, and shaping of the present environment" (Kearsley, 2001). The addition of social context as a factor in cognitive development links Sternberg to the interactional theories of development of Bruner (1977, 1986) and Vygotsky (1978). These theories, and others of this type, are premised on the assumption

that learning does not occur in a vacuum. Therefore, one must discuss the social and cultural contexts of learning. Driscoll (2001) says, "Of central importance is viewing education as more than curriculum and instructional strategies. Rather, one must consider the broader context in how culture shapes the mind and provides the toolkit by which individuals construct worlds and their conceptions of themselves and their powers".

These theories all work under the assumption that new information can most effectively be learned if the material can be matched to memory structures already in place (Winn and Snyder, 2001). Most theories hold that the mind contains some type of framework into which new information is placed. This structure is multi-leveled and has varying degrees of specificity. New information can be matched with, compared to, contrasted to, joined with, or modified to fit with existing structures. This in-place structural system allows for differing levels of complexity of information processing. The formation of and continual building of these structures, then, is critical in order for learners to process information in various ways and at higher levels.

Q3. Explain the concept of IQ. Describe the history of measurement of intelligence.

Ans. The Concept of IQ: The most important development in the area of intelligence testing was adaptation of Stern's (1912) concept of an intelligence quotient in the Stanford-Binet Intelligence Scale. Stern put forth the notion that to derive an intelligence quotient (IQ) and Terman incorporated this concept into the 1916 version of StanfordBinet Scale. To obtain the IQ a person's mental age is divided by his/her chronological or real age. This product is further multiplied by hundred to avoid decimal fractions.

$$IQ = \frac{\text{Mental Age}}{\text{Chronological Age}} \times 100$$

History of Measurement of Intelligence: At the time of early development of discipline psychologists were much more interested in searching of generalised principles of human behaviour and subsequently formulating universal theories. Measurement of individual differences received attention very late in the nineteenth century.

Galton and Cattell: The first institutional effort to measure individual differences came from the British biologist Sir Francis Galton who administered simple tests of visual discrimination, determining highest audible pitch and kinaesthetic discrimination. He thought that intelligence could be measured by the tests of sensory discrimination. He believed that the ability to discriminate among heat, cold and pain could discriminate the intelligent persons from the mentally retarded ones. The term 'mental test' was used first time in the psychological literature by the American psychologist James McKeen Cattell in 1890. He described a number of tests to measure intellectual level of persons which included measures of muscular strength, speed of movement, sensitivity to pain, keenness of vision and of hearing, weight discrimination, reaction time, memory etc.

Contribution of Alfred Binet: Alfred Binet (1857-1911) set out to develop a series of tasks designed to measure individual differences on the request of the French government due to the need for a reliable diagnostic system to identify children with mental retardation. The differences that he intended to delineate included a number of complex mental facilities, such as memory, imagery, imagination, attention, comprehension, aesthetic sentiment, moral sentiment, muscular strength, motor ability, and handeye coordination. Together with physician Theodore Simon, Binet created the Binet-Simon scale, which was published in 1905. The 1905 Binet-Simon scale differed greatly from the scale that we use today. The original scale consisted of 30 pass/fail items. The tasks were also different from today's items and required a combination of mental and physical strategies to complete each task.

The major breakthrough of the Binet-Simon scale was the complexity of the tasks and the breadth of mental abilities measured. Furthermore, intelligence was finally able to be measured during a clinical interview, as opposed to in laboratories or by using physical measurements. Although the Binet-Simon scale is quite antiquated with regard to today's intelligence scale standards, many current day innovations were derived from this scale. The concepts of strict administration, age-graded norms,

and a rank order of items ranging from least to most difficult, are but a few. Furthermore, the inclusion of age-graded norms provided for the first estimate of mental age.

The first revision of the Binet scale was in 1908; however, the majority of the scale was left unchanged. By 1911, the scale was in its second revision and the age range had been extended through adulthood, as opposed to its previous use for the diagnosis of mental retardation in children. With the inclusion of adults, the scales needed to be rebalanced, which Binet did by including five items for each age level. The abilities targeted by the 1911 edition were language, auditory processing, visual processing, learning and memory, and problem solving. By 1912, Lewis M. Terman of Stanford University began revisions on the 1911 Binet scale which was published in 1916 and was entitled the Stanford-Binet Intelligence Scale. The advantages that the Stanford-Binet had over other intelligence scales of the time were many. The first, and seemingly most simplistic, was that the 1916 version was the most comprehensive revision of Binet's original scale. The second, and perhaps the most important, was that the standardisation procedure used by Terman was the most rigorous of the time. The third advantage was the inclusion of an extensive manual, both for administration of the test as well as for use as a teaching aide for understanding the test.

World War I and Army Personnel Selection: During World War I in 1917 a committee of American Psychological Association, under leadership of Robert M. Yerkes, prescribed the use of intelligence tests for rapid classification of army personnel. In view of this, American Army psychologists developed two tests: (i) Army Alpha and (ii) Army Beta. Both the tests were group tests in which the first was a language test, while the second was a non-language-performance test.

SECTION – B

Answer the following questions in 400 words each.

Q4. Describe the principles of information processing.

Ans. Information processing is the change (processing) of information in any manner detectable by an observer. Within the field of cognitive psychology, information processing is an approach to the goal of understanding human thinking. It began in the 1940s and 1950s. Educators are very interested in the study of how humans learn. This is because how one learns, acquires new information, and retains previous information guides selection of long-term learning objectives and methods of effective instruction. To this end, cognition as a psychological area of study goes far beyond simply the taking in and retrieving information. It is a broad field dedicated to the study of the mind holistically. Neisser (1967), one of the most influential researchers in cognition, defined it as the study of how people encode, structure, store, retrieve, use or otherwise learn knowledge. Cognitive psychologists hypothesise an intervening variable or set of variables between environment and behaviour—which contrasts it with behavioural theories.

Principles of the Information Processing: Even though there are widely varying views within cognitive psychology, there is general agreement among most cognitive psychologists on some basic principles of the information processing system.

The first is the assumption of a limited capacity of the mental system. This means that the amount of information that can be processed by the system is constrained in some very important ways. Bottlenecks, or restrictions in the flow and processing of information, occur at very specific points.

A second principle is that a control mechanism is required to oversee the encoding, transformation, processing, storage, retrieval and utilisation of information. That is, not all of the processing capacity of the system is available; an executive function that oversees this process will use up some of this capability. When one is learning a new task or is confronted with a new environment, the executive function requires more processing power than when one is doing a routine task or is in a familiar environment.

A third principle is that there is a two-way flow of information as we try to make sense of the world around us. We constantly use information that we gather through the senses (often referred to as bottom-up processing) and information we have stored in memory (often called top-down processing) in a dynamic process as we construct meaning about our environment and our relations

to it. This is somewhat analogous to the difference between inductive reasoning (going from specific instances to a general conclusion) and deductive reasoning (going from a general principle to specific examples.) A similar distinction can be made between using information we derive from the senses and that generated by our imaginations.

A fourth principle generally accepted by cognitive psychologists is that the human organism has been genetically prepared to process and organise information in specific ways. For example, a human infant is more likely to look at a human face than any other stimulus. Other research has discovered additional biological predispositions to process information. For example, language development is similar in all human infants regardless of language spoken by adults or the area in which they live (e.g., rural versus urban, Asia versus Europe.) All human infants with normal hearing babble and coo, generate first words, begin the use of telegraphic speech (example, ball gone), and overgeneralise (e.g., using "goed to the store" when they learn the verbs) at approximately the same ages.

Q5. Explain the cellular bases of learning and memory.

Ans. Most models of the cellular bases of memory hold that it is the result of changes in the strength of synaptic interactions among neurons in neural networks. How would synaptic strength be altered to enable learning and memory? Neil Carlson (1994) described some basic physiological mechanisms for learning new information.

One basic mechanism is Hebb's law, named after the man who posited it, Canadian psychologist Donald Hebb, in 1949. Hebb's rule states that if a synapse between two neurons is repeatedly activated at about the same time the postsynaptic neuron fires, the structure or the chemistry of neuron changes and the synapse will be strengthened—this is known as Hebbian learning. A more general, and more complex, mechanism is called long-term potentiation (LTP). In this process, neural circuits in the hippocampus that are subjected to repeated and intense electrical stimulation develop hippocampal cells that become more sensitive to stimuli.

That an excitatory input and postsynaptic depolarisation are needed to produce LTP is explained by the properties of the doubly gated N-methyl-D-aspartate (NMDA) receptor located on the dendritic spines of postsynaptic neurons that show LTP. Glutamate is the major excitatory transmitter in the hippocampus, and it can bind with NMDA and non-NMDA receptors. When 2-amino-5-phosphonopentanoate (AP5) is introduced to neurons, NMDA receptors are chemically blocked and LTP induction is prevented. But the AP5 treatment does not produce any effect on previously established LTP in these cells.

Therefore, NMDA receptors are central to producing LTP but not maintaining it. It turns out that maintenance of LTP may depend on the non-NMDA receptors.

Long-Term Potentiation and Memory Performance - This effect of enhanced response can last for weeks or even longer, suggesting to many that this could be a mechanism for long-term learning and retention (Baddeley, 1993).

Disrupting the process of long-term potentiation (say, through different drugs) also disrupts learning and remembering. Chemically blocking LTP in the hippocampus of normal mice impairs their ability to demonstrate normal place learning; thus, blocking LTP prevents normal spatial memory. In a similar way, genetic manipulations that block the cascade of molecular triggers for LTP also impair spatial learning.

These experiments provide strong evidence of impairing spatial memory by blocking NMDA receptors and preventing LTP. Moreover, we are rapidly developing a very clear understanding of the molecular processes that support synaptic plasticity, and thus learning and memory in the brain.

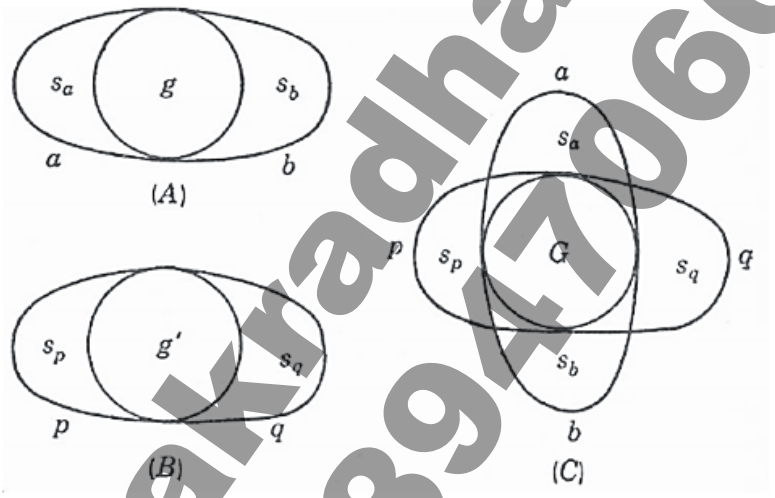
Q6. Discuss Spearman's Two-factor theory of intelligence.

Ans. Charles Spearman published an epoch-making study in 1904, which indeed proved to be the crucial step toward quantitative testing of theories, as opposed to simple quantification or measurement. He used the techniques of correlational analysis and factor analysis, both of which had been developed earlier by Karl Pearson, in relation to the scores obtained by groups of children on

various intelligence tests. His historical significance can be seen in the development of the factor analytical method and in its explicit use for the first time. It is with regard to such importance that Guilford (1954, p. 472) has stated: "No single event in the history of mental testing has proved to be of such momentous importance as Spearman's proposal of his famous two-factor theory in 1904."

Spearman was critical of Binet and Simon's (1905) practice of assembling a hodgepodge of problems for testing intelligence without first testing for the presence of a general factor or without weighing the problems in terms of their loadings on the general factor. He was concerned to test the theory that the obtained inter-correlations between various tests of intelligence were due entirely to a general intellective factor "g". In addition to that, he also recognised specific factors, "s" factors, which were specific to particular tests. Eysenck has contended that "essentially his point was that under these conditions matrices of inter-correlations between tests should be of rank one; he did not use matrix algebra himself, but his formulas are the equivalent of more modern versions." Spearman (1927) elaborated and revised his work in "The abilities of man."

To understand his theory, let us assume that any correlation between two tests used by Spearman implies a factor common to both, plus two specific factors. Let the two tests be called a and b, the common factor "g", and the two specific factors sa and sb, as shown in the diagram drawn by Guilford (1953), which are reproduced below:



In terms of the two-factor theory, we may regard that tests a and b are two measures of the common element "g", with the two remainders sa and sb. Similarly, let p and q be two other tests with "g" as the common element as shown in the Figure above. For some experiments, Spearman (1904) reported the correlations between "g" and "g" to approximate a value of 1.00. This meant that "g" and "g" were practically identical. Spearman believed that all intellectual activity contained some element or factor in common. This "g", or general factor, was postulated to be important in every mental act, although some acts were thought to depend upon it more than others. The difference between people in intelligence was a matter of how much "g" they possessed. Spearman called this general factor as "mental energy."

Q7. Define creativity. Discuss the measurement of creativity.

Ans. Creativity: The most advanced thought process, creativity, involves production of uncommon and novel ideas that are highly relevant to the situation. Creativity is defined as something different from intelligence and as a parallel construct to intelligence, but it differs from intelligence in that it is not restricted to cognitive or intellectual functioning or behaviour. Instead, it is concerned with a complex mix of motivational conditions, personality factors, environmental conditions, chance factors, and even products.

Measurement of Creativity: Houtz and Krug (1995) provide a review of several tests developed for the assessment of creativity. The review reveals that most of the tests of creativity intend to measure divergent thinking. Within the category of divergent thinking, Houtz and Krug (1995) present the

Torrance Test of Creative Thinking (TTCT) (Torrance 1966), The Wallach and Kogan Tests, The Guilford Battery.

The most widely used test on creativity is the Torrance Test of Creative Thinking (TTCT). It is also the one that has the most extended research on their reliability and validity (Kim 2006). This test has been translated into more than 30 languages and it is used in different places as a tool to assess creative potential. It is based on Guilford's Structure of the Intellect (SOI) battery that included some measures of divergent thinking. Thus, it measures creativity through divergent thinking.

The TTCT was developed in 1966, and it has been re-normed four times: 1974, 1984, 1990 and 1998. There are two forms, TTCT-Verbal and Figural with two parallel tests (form A and B). Each test is expected to measure:

- Fluency: The number of ideas: Total number of relevant responses.
- Originality: The rarity of ideas: Number of statistically infrequent ideas. The score is 0 if the idea is common, and 1 if it is unique.
- Elaboration: The number of added ideas.
- Flexibility: Number of categories of the relevant responses

In 1990 Torrance deleted the flexibility scale, since it correlated highly with fluency and added two measures of creative potential, viz., (i) abstractness of titles and (ii) resistance to premature closure. While (i) abstractness of title refers to the degree a title moves beyond concrete labelling of pictures drawn, (ii) resistance to premature closure pertains to measure the degree of psychological openness. The test can be administered in around 30 minutes, but the process of scoring requires some training and specific country norms.

The 1998 manual provides norms for the United States and includes both grade related and age related norms. Thus, there is some country specificity in the measurement of creativity. Kim (2006) reported some normative measures in other countries. These norms have usually been developed for research activities.

Criticisms against TTCT

There are 4 main criticisms against this test and these are:

- The response set might influence the results. Thus, different order in the presentation of the items leads to different results.
- Creativity tests administered under different conditions lead to differences in performance.
- Raters of the TTCT might differ considerably in their scores to a similar person.
- The structure of the test itself is inadequate.

Q8. Explain the basic concepts of multilingualism.

Ans. Multilingualism is the knowledge of more than one language by a person or within a social group; it assumes the ability to switch from one language to another in speech, in writing, or in reading. Other terms describing this phenomenon include bilingualism, polylingualism, plurilingualism, diglossia, and languages-in-contact. Multilingualism may be personal, social, or intersubjective. A generic term for multilingual persons is polyglot. Poly (Greek word) means "many", glot (Greek) means "language"; and for the monolinguals is monoglot. Personal multilingualism refers to the knowledge and verbal behaviour of an individual, not necessarily shared by the whole community. Social multilingualism refers to the communicative practices of a nation, tribe, or other social group that sustains two or more languages. As in India, nearly 200 languages are spoken by its natives.

The Structure of Multilingualism: For many years, the popular belief was that a multilingual person should have learnt all of his or her languages simultaneously in early childhood and that he or she should have a native — like oral and written competence in all of them.

Today, a broader definition is more common. Accordingly, a person may be called multilingual if s/he uses his or her languages on a regular base and is able to switch from one to another where ever it is necessary, independently from the symmetry of his/her command of the languages, of the modalities of acquisition and of the distance between the varieties (Haugen 1953, Oksaar 1980 & Grosjean 1982).

Thus, an Indian guest worker who learnt enough Swiss German dialect for his struggle for life in Switzerland may be considered bilingual with the same right (but not, of course, in the same way) as an interpreter working at the European Union and having systematically extended his or her 'native' French-English bilingualism.

Generally speaking, multilingualism is of two kinds: Elite – Language learned in a formal setting through planned and regular instruction as in a school system. Neighborhood – Here the language is acquired in a natural setting, acquired through the interaction with people speaking different languages. Theoretically bilingualism is referred to as — additive and subtractive bilingualism. In additive bilingualism, a second language is acquired in addition to a relatively welldeveloped first language. In subtractive bilingualism, elements of a second language replace elements of the first language.

Researchers also distinguish between simultaneous bilingualism, which occurs when a child learns two languages from birth, and sequential bilingualism, which occurs when an individual first learns one language and then another (Bhatia & Ritchie, 1999). Either form of language learning can contribute to fluency. It depends on the particular circumstances in which the languages are learned.

It is known, however, that infants begin babbling at roughly the same age. This happens regardless of whether they consistently are exposed to one or two languages (Oller & associates, 1997). In the United States, many people make a big deal of bilingualism, perhaps because relatively few Americans born in the United States of nonimmigrant parents learn a second language to a high degree of fluency. In other cultures, however, the learning of multiple languages is taken for granted. For example, in parts of India, people routinely may learn as many as four languages (Khubchandani, 1997). In Flemish-speaking Belgium, many people learn at least some French, English, and/or German. Often, they learn one or more of these other languages to a high degree of fluency.

Multilingualism in India: India is said to be a socio-linguistic giant and the nerve system of this giant is multilingualism. "Indian multilingualism is huge in size, having 1620 mother tongues reduced to 200 languages….With the population of many of minorities larger than European countries". This multilingual character of India is represented by its metropolitan cities like Mumbai and New Delhi, where people from all over come and settle down. For example, in Mumbai every child is exposed to at least four languages right from its infancy (Pai, 2005). Government of India has introduced the Three Language Formula in its educational system, which means every child has to study two more languages other than their first language. The two languages are introduced simultaneously at upper primary level.

SECTION – C

Answer the following questions in 50 words each.

Q9. Nature vs. Nurture

Ans. Nature versus Nurture – Which is more influential in human cognition – nature or nurture? If we believe that innate characteristics of human cognition are more important, we might focus our research on studying innate characteristics of cognition. If we believe that the environment plays an important role in cognition, we might conduct research exploring how distinctive characteristics of environment seem to influence cognition.

Q10. Neuroscience and cognitive psychology

Ans. During the early stages of cognitive psychology, little attention was given to physiological psychology or neuroanatomy. Much of the early information on the brain and its functions resulted from head traumas incurred during wars and accidents. The central issue neurologists struggled with was whether the brain was a holistic organ, with operations distributed throughout its infrastructure, or whether activities were localised and tied to specific regions. For example, did learning a specific act take place in a localised area of the brain, or was learning distributed throughout many parts of the brain? Among the most prominent of the scientists who wrestled with these issues was Karl

Lashley (1929). Recently, progress has been made in the field of neuroscience, which comprises both the Cognitive Psychology structural aspects of the brain and its peripheral components, as well as the functional aspects.

Q11. Miller's magic number

Ans. George Miller's classic 1956 study found that the amount of information which can be remembered on one exposure is between five and nine items, depending on the information. Applying a range of +2 or -2, the number 7 became known as Miller's Magic Number, the number of items which can be held in Short-Term Memory at any one time. Miller himself stated that his magic number was for items with one aspect. His work is based on subjects listening to a number of auditory tones that varied only in pitch. Each tone was presented separately, and the subject was asked to identify each tone relative to the others s/he had already heard, by assigning it a number. After about five or six tones, subjects began to get confused, and their capacity for making further tone judgments broke down. He found this to be true of a number of other tasks. But if more aspects are included, then we can remember more, depending upon our familiarity and the complexity of the subject (in Miller's research, there was only one aspect — the tone). For example, we can remember way more human faces as there are a number of aspects, such as hair color, hair style, shape of face, facial hair, etc. We remember phone numbers by their aspects of 2 or more groupings, i.e. chunking. We don't really remember "seven" numbers. We remember the first group of three and then the other grouping of four numbers. If it is long distance, then we add an area code.

Q12. Encoding, Storage and Retrieval

Ans. Encoding - Encoding occurs during the initial processing of a stimulus or event. Maturation and experience influence this process. In terms of maturation, Dempster (1981) suggests that the adult capacity for short-term memory of 5 + 2 digits might be as much as 2 digits lower for children aged 5 and 1 digit lower for children aged 9. As for experience, in a series of well-known studies of expertise, novices remember new information less well than experts (e.g., Chi, 1978; Schneider, Korkel, & Winert, 1989). One of the most important differences between novices and experts is the structure and organisation of domain-specific knowledge.

Storage and Retrieval - How much information can be stored and retrieved relative to a stimulus or event also changes over time. For example, prior to about age 7 months an infant will not seek an object that has been shown and then removed from view. The infant has encoded the object (such as a rattle) and will reach for it, but seems to lose interest as soon as it is no longer in view. At about 7 months attains what is called "object permanence" and will begin to seek the object if it is removed from view.

A series of studies by Bauer, Mandler and associates (as cited in Flavell et al., 2002) demonstrates a child's increasing ability to perform simple multiple-act sequences. By age 13 months infants can reproduce three-act sequences; by age 24 months this has increased to five-act sequences; and by age 30 months to eight separate actions. As children gain language skills, their ability to store and recall more complex events increases. This is shown first in autobiographical accounts of daily activities and then to events they may have witnessed or heard about.

Q13. Knowledge base in PASS theory

Ans. Knowledge base is an integral component of the PASS model and therefore all processes are embedded within this dimension. The base of knowledge included in the PASS model is intended to represent all information obtained from the cultural and social background of the individual, because this determines the form of mental activity. Children's use of language to analyse, generalise, and encode experience is a critical determinant of the base of knowledge, because mental processes cannot develop apart from the appropriate forms of social life.

Cognition is a dynamic process that works within the context of the individual's knowledge base, responds to his experiences, and is subject to developmental variations. When considering the

measurement of cognitive processes, it must be noted that the effective processing is accomplished through the integration of knowledge with planning, attention, simultaneous, and successive processes as demanded by the particular task. Although these processes are interrelated and nonstop, they are not equally involved in all tasks. For that reason, cognitive assessment tasks for planning, attention, simultaneous, and successive processing were developed to adhere to PASS theory and predominantly require a specific cognitive process.

Q14. Spatial intelligence

Ans. Spatial intelligence involves the potential for recognising and manipulating the patterns of both wide spaces such as those negotiated by pilots or navigators, and confined spaces such as those encountered by sculptors, architects or championship chess players. This area deals with spatial judgment and the ability to visualise with the mind's eye. Careers which suit those with this type of intelligence include artists, designers and architects. A spatial person is also good with puzzles.

Q15. Algorithms

Ans. An algorithm is a strategy that ensures the correct solution of the problem, if the well-defined rule of the solution is properly followed. In an anagram problem, an algorithm would be attempting all the possible letter sequences until the correct and meaningful word is found. There are four essential properties of an algorithm:

- Each step of an algorithm must be exact. An algorithm must be precisely and unambiguously described, so that there remains no uncertainty.
- An algorithm must terminate. The ultimate purpose of an algorithm is to solve a problem. If the process does not stop when executed, one will not be able to get any result from it. Therefore, an algorithm must contain a finite number of steps in its execution.
- An algorithm must be effective. It must provide the correct answer to the problem.
- An algorithm must be general. This means that it must solve every instance of the problem. For example, a program that computes the area of a rectangle should work on all possible dimensions of the rectangle, within the limits of the programming language and the machine.

Q16. Problem space

Ans. Initial state, goal state and operator combine to form the problem space. The problem space includes a number of elements in it that are required to be organised in a particular manner. A successful understanding of the problem space would require: coherence, correspondence and relationship to background knowledge. Coherent understanding of the problem space refers to connecting the elements in a meaningful manner. A successful understanding also requires a close correspondence between the internal representation and the elements of the problem space. None of the elements should be left unmatched and also none of them should be mismatched. Therefore, proper matched connections should be made among all the elements.

Q17. Functional fixedness

Ans. Functional fixedness discovered by Duncker (1935) refers to the tendency to see objects as having only a single, typical use. A hammer is for pounding nails and other things for instance. We categorise objects based on their functional features as well as their features. Generally the prototypical function dominates the way we think.

Duncker in his experiment led an individual into a room with a table holding several small objects. They included three cardboard boxes filled with candles, tacks and matches, respectively and an ashtray, paper, paper clips, string, pencils, and tinfoil. The individual was instructed to mount the candles at eye level on the wall, ostensibly to prepare the room for a vision experiment.

Duncker found that only 43% of his participants could develop a solution to the problem. He hypothesised that they fixated on the common function of a box, namely, to serve as a container. To help break their functional fixedness, he repeated the experiment but this time emptied the candles,

tacks, and matches on the table, leaving the boxes empty. Under these circumstances, all participants solved the problem by first mounting the boxes on the wall using the tacks, which then served as platforms for the candles.

Q18. Backward search

Ans. With the backward search heuristic, the problem solver starts at the goal state. Sometimes it is useful to start at the goal state of a problem and attempt to work backward to the initial state. In solving a paper-pencil maze, it may be easier to see the correct path by starting at the end. Working backwards can be a very useful heuristic, particularly for problems that contain a uniquely specified goal state. For example, a backward search would be ideal for a maze with many paths out of the beginning point yet only one path leading form the goal.

The reason working backward helps lies in the sub-goals that one begins to see Stages of Problem Solving by starting with the final goal. Once the problem solver can envision a string of sub-goals projecting backward from the goal state, then going about solving the sub-goals in a forward direction can be readily accomplished. Working backward is only viable when the goal state is uniquely well defined.