Question 1: What are brain ventricles, and what functions have been ascribed to them over the ages?

Answer: Brain ventricles are hollow, fluid filled spaces within the brain. The Greek physician and writer Galen (A.D. 130–200) suggested that the body functioned according to a balance of four vital fluids or humors. Sensations were registered and movements were initiated by the movement of humors to or from the brain ventricles via the nerves. He thought that the brain ventricles helped the brain register sensations and control the limb movements. In the early seventeenth century, French inventors supported the fluid-mechanical theory of brain function. This theory stated that the fluid forced out of the ventricles through the nerves cause the movement of the limbs by inflating the muscles. The chief advocate of this theory was the French mathematician and philosopher Rene Descartes.

Question 2: What experiment did Bell perform to show that the nerves of the body contain a mixture of sensory and motor fibers?

Answer: Bell tested the possibility that the two spinal roots, which are formed by the division of spinal nerves just before they join the spinal cord, carry information in opposite directions. The dorsal root enters toward the back of the spinal cord while the ventral root enters toward the front. He cut each root separately and observed the consequences in experimental animals. He found that cutting only the ventral roots caused muscular paralysis. Later, Magendie was able to show that the dorsal roots carry sensory information into the spinal cord. Bell and Magendie concluded that each spinal nerve contains a mixture of many wires, some of which bring information into the spinal cord and others that send information out to the muscles.

Question 3: What did Flourens' experiments suggest about the functions of the cerebrum and the cerebellum?

Answer: Flourens used the *experimental ablation method* in a variety of animals and birds to test the functions of the cerebrum and cerebellum. In this approach, parts of the brain are systematically destroyed to determine their function. He showed that the function of the cerebellum is coordination of movements and the function of the cerebrum is sensation.

Question 4: What is the meaning of the term animal model?

Answer: Many neuroscientists use *animal models* to examine the process that they wish to study in humans. Animal models can be experimented upon for the purpose of relating experimental results to humans. The theory that the nervous systems of different species evolved from common ancestors and utilize many common mechanisms is the rationale for relating the results of animal experiments to humans. For example, rats show clear signs of addiction if they are given the chance to self-administer cocaine repeatedly. Consequently, rats are a valuable animal model for research focused on understanding how psychoactive drugs exert their effects on the nervous system.

Question 5: A region of the cerebrum is now called Broca's area. What function do you think this region performs and why?

Answer: Broca's area is a portion of the left frontal lobe of the human cerebrum. Paul Broca is the person credited with tilting the scales of scientific opinion firmly toward localization of function in the cerebrum, specifically, language. Broca was presented with a patient who could understand language but could not speak. Following the man's death in 1861, Broca examined the brain and found a circumscribed lesion in the left frontal lobe. Based on this

case and several others like it, Broca concluded that this region of the human cerebrum was specifically responsible for the production of speech.

Question 6: What are the different levels of analysis in neuroscience research? What types of questions do researchers ask at each level?

Answer: In ascending order of complexity, the levels of analysis in neuroscience research are molecular, cellular, systems, behavioral, and cognitive. The questions asked at each level are:

i) Molecular science level

(1) Identify the molecules that are crucial for brain function and act as:

(a) Messengers that allow neurons to communicate with one another

(b) Sentries that control what materials can enter or leave neurons

(c) Conductors that orchestrate growth

(d) Archivists of past experiences

ii) Cellular neuroscience level

(1) How many different types of neurons are there?

(2) How do the different types of neuron differ in their functions?

(3) How do neurons influence other neurons?

(4) How do neurons become “wired together” during fetal development?

(5) How do neurons perform computations?

iii) Systems neuroscience level

(1) How do different neural circuits analyze sensory information?

(2) How do they form perceptions of the external world, make decisions, and execute movements?

iv) Behavioral neuroscience level

(1) How do neural systems work together to produce integrated behaviors?

(2) How are different forms of memory accounted for by different systems?

(3) Where in the brain do "mind-altering" drugs act?

(4) What is the normal contribution of these systems to the regulation of mood and behavior?

(5) What neural systems account for gender-specific behaviors?

(6) Where in the brain do dreams come from?

v) Cognitive neuroscience level

(1) Identify the neural mechanisms that are responsible for the higher levels of human mental activity such as:

(a) Self-awareness

(b) Mental imagery

(c) Language

Question 7: What are the steps in the scientific process? Describe each one of them.

Answer: The steps in the scientific process are observation, replication, interpretation, and definition.

i) **Observation –** The first step in the scientific process is observation. Observations are typically made during experiments designed to test a particular hypothesis. Observations can also be made by carefully watching the world around us, from introspection, or from human clinical cases.

ii) **Replication –** The second step is replication. Experimental or clinical observation needs to be replicated before it can be accepted by scientists as fact. Replication simply means repeating the experiment on different subjects or making similar observations in different subjects, as many times as necessary to rule out the possibility that the observation occurred by chance.

iii) **Interpretation –** The third step is interpretation. After the scientist believes the observation is correct, he or she makes an interpretation. Interpretations depend on the state of knowledge (or ignorance) at the time the observation was made and on the preconceived notions (the "mind set") of the scientist who made it and do not always withstand the test of time.

iv) **Verification -** The final step in the scientific process is verification. Verification means that the observation is sufficiently robust and can be reproduced by any competent scientist who precisely follows the protocols of the original observer. Therefore, the process of verification, if affirmative, establishes new scientific facts.