

※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

**1. Social brain (18 points).** The ability to understand the emotions of another person, or emotional empathy, facilitates interpersonal relationships. When we see another person suffering, there are increased responses in the anterior insula and anterior cingulate cortex in the human brain. In addition, activations within the mirror-neuron network and mentalizing (or Theory of Mind) network also show increased activation in many human studies.

(a). What is a mirror neuron? (3 points) According to previous literature, which brain regions have been reported to contain mirror neurons in primates or humans? (3 points) What are the proposed functions of mirror neurons? (3 points)

(b). What is mentalizing? (3 points) Can you make an example of mentalizing? (3 points) Which brain regions play an important role in mentalizing? (3 points)

**2. Sensation and perception (18 points).** The perception of touch depends on the integrative processing between the peripheral and central nervous systems.

(a). Describe the somatosensory pathway (from peripheral receptors to cerebral cortex) associated with the transmission of tactile stimulation (6 points).

(b). Mapping of specific parts of the body to areas of the cortex is known as somatotopy. In a sketch of coronal section of the human brain, please mark the approximate mapping locations in the primary somatosensory cortex for the left face, left hand, and left foot. (3 points)

(c). Ample evidence has indicated hemispheric lateralization during processing tactile information in humans. What is hemispheric lateralization? (3 points)

(d). Briefly describe one experimental design to demonstrate that some brain regions responsive to tactile stimulation are lateralized. (6 points)

**3. Methodology (14 points).** Electroencephalography (EEG), Magnetoencephalography (MEG), positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) are methodologies commonly used in cognitive neuroscience research.

(a). Briefly explain how each of them measures neural activity. (8 points)

(b). Compare the spatial and temporal resolution among these four tools. (6 points)

**4. Statistics (30 points).** A scientist acquired the following memory scores of 10 participants on Day 1:

2, 5, 7, 1, 4

The same participants then underwent a memory training program and their scores on Day 2 after training, in the same participant order, were:

7, 9, 10, 0, 2

(a). Calculate the following for Day 1 and 2 scores: Means, standard deviations, standard error of the means. For each, state your formula and show your working as clearly as possible. *Note:*  $\sqrt{5} = 2.24$ ;  $\sqrt{5.70} = 2.39$ ;  $\sqrt{19.3} = 4.39$ . (20 points).

(b). State the appropriate t-test and formula to determine whether training led to memory score changes or not. Calculate the t-value and state your conclusion. *Note:* Use a two-tailed test and critical t-value of 1.50.  $\sqrt{9.70} = 3.11$ . (10 points).

**5. General (20 points).** Many studies have demonstrated that people tend to have better memory when items are encoded using the method-of-loci. Outline plausible neural mechanism(s) for this phenomenon. In your answer, detail what is the method-of-loci, provide in detail an example of an experimental context in which you might assess it behaviorally, and provide convincing argument what neural processes you think are involved to produce memory behavior in this experimental context you describe and why method-of-loci enhances these neural processes.