

1.4 The Brain

Name: _____ Class: _____ Date: _____ **Total: 18 marks**

KEY WORDS fmri 功能性磁共振成像 • plasticity 可塑性 • cerebellum 小脑
• hippocampus 海马体 • hemispheric specialisation 半球特化

Objective

Build the skills to answer exam questions on **brain structures** 脑结构 and their functions.

You must be able to:

- match a brain region to a function it supports
- explain what **plasticity** 可塑性 means and when it is greatest
- describe what **hemispheric specialisation** 半球特化 does and does not imply
- state what each main imaging or recording method measures

1 Worked examples

Study these first. Each one shows the method for a task used later.

■ Regions and functions

The **brainstem** controls basic survival functions such as breathing. The **cerebellum** coordinates balance and practised movement. The **limbic system** — including the **amygdala** and **hippocampus** — supports emotion and memory formation. The **cerebral cortex** supports higher processing, divided into four lobes.

■ Plasticity

The brain reorganises in response to experience and injury. Plasticity is greatest in childhood but continues throughout life, which is why some function can be recovered after damage.

■ Hemispheric specialisation

The left hemisphere is typically more involved in language, the right in spatial processing. This is a difference of **degree**, not a division into two separate people: the hemispheres are connected and work together in almost every task.

■ What each method measures

EEG records electrical activity with excellent timing but poor location. **fMRI** infers activity from blood flow, with good location but slower timing. A **lesion** study infers function from what is lost after damage.

2 Practice

2.1 State one function of the cerebellum and one of the amygdala. [2]

2.2 Explain what is meant by plasticity. [2]

2.3 A patient recovers some speech after damage to a language area.

(a) State the property of the brain that makes this possible. [1]

(b) State one reason recovery is usually more complete in a child. [1]

3 Exam-style questions

3.1 A researcher needs millisecond timing of a brain response. The best method is [1]

- **A** fMRI
- **B** EEG
- **C** a lesion study
- **D** a case study

3.2 The claim that people are “left-brained” or “right-brained” is best described as [1]

- **A** well supported by hemispheric specialisation
- **B** an oversimplification of a difference of degree
- **C** true only for language
- **D** a finding from fMRI

3.3 A patient with hippocampal damage can hold a conversation but cannot recall it an hour later.

(a) State the memory function the hippocampus supports. [1]

(b) Explain what this case shows about how memory is organised. [2]

3.4 Applied research task. A patient recovering from a stroke can understand everything said to her and knows exactly what she wants to say, but her own speech comes out slowly and in short, effortful fragments. She is also unsteady on her feet, and she no longer forms new memories of events reliably, although she remembers her childhood clearly.

(a) Identify the brain area most likely damaged in each of the three symptoms. [3]

(b) Explain how you can tell from the description that Wernicke’s area is intact. [1]

(c) Explain why she can recall her childhood but not form new memories, naming the structure involved and the process it performs. [2]

(d) A researcher proposes using fMRI rather than a lesion study to investigate her case. State **one** advantage of fMRI here. [1]

Solutions

2.1 cerebellum: coordinates balance and practised movement; amygdala: supports emotional processing, especially fear.

2.2 the brain's capacity to reorganise its structure and connections in response to experience or injury; greatest in childhood but continuing across life.

2.3 (a) plasticity. (b) a child's brain reorganises more readily, so other regions can take over the function.

3.1 B. EEG records electrical activity directly, with excellent temporal resolution.

3.2 B. specialisation is a difference of degree between connected hemispheres.

3.3 (a) forming new long-term memories. (b) memory is not a single system: the ability to form new memories can be lost while immediate conversation and older memories remain intact.

3.4 (a) Effortful, fragmented speech with comprehension intact — **Broca's area**, in the left frontal lobe (1). Unsteadiness and loss of balance — the **cerebellum** (1). Failure to form new memories of events — the **hippocampus** (1).

(b) Wernicke's area governs the **comprehension** of language, and she understands everything said to her, so it must be undamaged (1).

(c) The hippocampus **consolidates** new information into long-term memory (1); once memories are consolidated they are stored elsewhere in the cortex, so old memories survive the damage while new ones can no longer be laid down — anterograde amnesia (1).

(d) fMRI shows activity in the **living** brain while she performs a task, so the researcher can see which areas are and are not recruited without waiting for post-mortem examination, and can compare her activity with that of healthy participants (1).