Answer the following questions. You may respond in Chinese or English. (100 points total)

1. Learning (14 points)
Pavlovian fear conditioning is a behavioral paradigm in which animals learn to predict aversive stimuli, and fear extinction is a phenomenon observed in both operantly conditioned and classically conditioned behavior.
(1) Explain fear conditioning and fear extinction behaviors. (8 points)
(2) Describe two brain regions critical for fear conditioning and fear extinction. (6 points)

2. Language (14 points)
Broca's area and Wernicke's area are well-known brain regions involved in language processing in humans.
(1). Briefly explain their roles in human language processing. (7 points)
(2). Describe what would happen if a patient has a lesion in each area. (7 points)

3. Executive functions (10 points)
Working memory is a core executive function in humans.
(1). Briefly explain what working memory is. (5 points)
(2). Give one example of working memory. (5 points)

4. Attention (12 points)
Cognitive operation of pain is a two-way street, which contains top-down and bottom-up processing. One of the key cognitive factors is attention. Please describe how top-down and bottom-up attention influences human perception of pain. (12 points)

5. In Monty Hall problem, a contestant in a game show is shown three doors and told that behind one of the doors is a car, behind the other two doors are goats. The contestant Is asked to choose one of the doors and picks door no. 1. The game show host, who knows what is behind each door opens door no. 3, which reveals a goat. The game show then asks whether the contestant wants to switch with door no. 1 or switch to door no. 2. (30 pts).

(i) State the probability that the contestant picks door no. 1 for the first choice (e.g., 1/4, 2/5, etc.). (1 pt.)
(ii) State the probability that the car is behind door no. 1 for the first choice. (1 pt.)
(iii) After the contestant picked door no. 1, state the probability that the host opens door no. 3, if the car is behind door no. 1. (3 pt.)
(iv) After the contestant picked door no. 1, state the probability that the host opens door no. 3, if the car is behind door no. 2. (3 pt.)
(v) After the contestant picked door no. 1, state the probability that the host opens door no. 3, if the car is behind door no. 3. (3 pt.)
(vi) State the name of the following theorem: $P(A|B) = \frac{P(B|A)}{P(B)} \times P(A)$. (3 pt.)

Let $P(A_i)$ be the probability that the car is behind door no. *i*. Thus, the probability that the car is behind door no. 1 is $P(A_1)$. Let $P(B_j)$ be the probability that the contestant picks door no. *j*, and let $P(C_k)$ be the probability that the host picks door no. *k*. Note that $P(C_3|A_2, B_1)$ is the probability that the host opens door no. 3 after the contestant picked door no. 1, and the car is behind door no. 2.

(vii) State the probability $P(C_3|A_1, B_1)$. (2 pt.)
(viii) State the probability $P(C_3|A_3, B_1)$. (2 pt.)
(ix) State the probability $P(C_3|B_1)$. (2 pt.)
(x) Express the probability that the car is behind door no. 2 given that the contestant picked door no. 1 and the host opened door no. 3 using the form $P(X|Y, Z)$, but replacing with A_i, B_j, and C_k, accordingly. (3 pt.)

Note that $P(X|Y, Z) = \frac{P(Y|X,Z) \times P(X) \times P(Z)}{P(Y|Z) \times P(Z)}$.

(xi) Calculate the probability described in question (x). (6 pt.)
(xii) Based on your answer in (xi), should the contestant switch doors? (1 pt.)

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6. Design an experimental study to evaluate the different roles of the striatum and the hippocampus in how humans navigate spatial environments. In your answer, briefly review what you know about the roles of the striatum and the hippocampus in spatial navigation based on past literature (provide as accurate references as you can). Then reason out your hypothesis about what cognitive processes distinguishes the roles of these two brain regions and how you might test your hypothesis. Describe your proposed experimental design, the instruments you would use, the measures you would acquire and the analyses you would do to answer your hypothesis, as well as your predicted results (20 pts).

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