

題號： 329
科目：動物生理學
節次： 7

國立臺灣大學 114 學年度碩士班招生考試試題

題號： 329
共 2 頁之第 1 頁

壹、配合題：將下列 A-N 所列賀爾蒙或神經傳導物質中的 10 項，最正確的配合到 1~10 所列的功能或特徵描述。(每題 2 分，共 20 分)

1. Hormone derived from cholesterol and synthesized in smooth endoplasmic reticulum and/or mitochondria of Leydig cells.
2. Hormone produced by endothelial cells that causes relaxation of smooth muscle cells in blood vessels.
3. Hormone that is a member of the catecholamine neurotransmitter family and regulates reward and reinforcement behavior.
4. Hormone produced in the atria that increases sodium excretion by acting on the receptor belonging to the guanylate cyclase receptor family.
5. Hormone that stimulates the growth of chondrocytes and causes epiphyseal closure.
6. Hormone that stimulates bone resorption and activates vitamin D.
7. Hormone that stimulates metabolic rate.
8. Hormone that links functions of the immune system and the brain.
9. Hormone produced in the posterior pituitary gland that increases blood pressure.
10. Hormone activated by rennin that increases blood pressure.

A: Aldosterone; B: Angiotensin II; C: ANP (atrial natriuretic hormone); D: Cortisol;
E: Dopamine; F: NO (nitric oxide); G: Estradiol; H: Growth hormone; I: Insulin;
J: Oxytocin; K: Parathyroid hormone; L: Testosterone; M: Thyroxin; N: Vasopressin.

貳、填空題：閱讀以下 2 段文，並在上、下段文末所附 a-l 與 m-v 的專有名詞或單字中，選擇適當分別填入 1-7 與 8-12 空格中，以使兩段文具完整性與正確的生理學知識。(每格 2 分，共 24 分)

Osmosis is the 1 of water molecules across the plasma membrane down its concentration gradient without the consumption of 2. The osmolality of a solution depends on the concentration of water; the higher the osmolality of a solution, the 3 the concentration of water. Therefore, water molecules move from a low osmolality solution to a high osmolality solution. Water molecules can only move effectively across the cell membrane through transmembrane proteins called 4. Active transport can move a solute across the membrane against its concentration gradient. In primary active transport, the transporter, e.g. 5, directly hydrolyzes ATP to obtain the power to transport the solute. In secondary active transport, solute across the membrane is driven by 6 move down their 7 generated by the primary active transport.

a: aquaporin; b: diffusion; c: electrochemical gradient; d: endocytosis; e: facilitated diffusion; f: glucose; g: higher; h: ions (e.g. Na^+/K^+); i: ion channels; j: lower; k: Na^+/K^+ -ATPase; l: energy;

The Na^+/K^+ pump sets an uneven distribution of Na^+ and K^+ across the cell membrane, which is important for generating and maintaining the membrane potential. In fact, the Na^+/K^+ pump contributes directly to the membrane potential because it is an 8 pump and inhibition of its function results in a rapid change in the membrane potential by 5~10 mV. The Na^+/K^+ pump moves a net positive charge out of the cell (3 Na^+ out and 2 K^+ in) in each cycle of its operation. Therefore, in a resting neuron, the membrane potential is maintained at a constant level by the inward Na^+ current exactly balanced by the outward K^+ current plus a small outward current generated by the Na^+/K^+ pump as mentioned above. Obviously, inhibition of the Na^+/K^+ pump can disrupt this balance and a net 9 current is generated, which in turn 10 the membrane potential. The change in membrane potential increases the driving force for 11 but decreases that of 12. As a result, the difference between inward and outward currents produced by the inhibition of the Na^+/K^+ pump is compromised, and a new steady-state membrane potential is established when a new balance of inward and outward currents is achieved.

m: ATP; n: depolarizing; o: electrogenic; p: hyperpolarizing; q: inward K^+ current; r: outward Na^+ current; s: potassium; t: secondary; u: sodium; v: stabilizing

見背面

參、問答題：回答以下 5 問題 (共 56 分)

1. A scientist measured the blood levels of glucose, amino acid, insulin, and glucagon in a laboratory rat before and after the animals were fed a very high protein, very low carbohydrate meal. Describe your expected changes in the blood levels of glucose, amino acid, insulin, and glucagon before and after the meal, and why? (10 分)
2. When a healthy subject first lies down and then abruptly stands up, the veins in the lower limbs would be distended and accumulate blood. What do you expect to be the changes (decrease or increase) in stroke volume, capillary filtration, arterial baroreceptor activity, and peripheral vessel diameter immediately after standing up, and why? (10 分)
3. The GHK equation well describes the membrane potential of neurons. Considering only the 2 major monovalent ions, Na⁺ and K⁺, the equation is simply written as

$$V_m = 60 \log \frac{[K^+]_o + \alpha [Na^+]_o}{[K^+]_i + \alpha [Na^+]_i} (mV)$$

[K⁺]_o, [K⁺]_i, [Na⁺]_o, and [Na⁺]_i are the intracellular (i) and extracellular (o) concentrations of K⁺ and [Na⁺], respectively. Answer questions i-iv.

- i. What is the membrane protein that determines [K⁺]_o/[K⁺]_i and [Na⁺]_o/[Na⁺]_i? (3 分)
 - ii. Do [K⁺]_o/[K⁺]_i and [Na⁺]_o/[Na⁺]_i remain constant or not during the electrical activity of neurons, why? (3 分)
 - iii. Explain the physiological significance of constant α and how it's variation generates action potential? (6 分)
 - iv. What are the membrane proteins that regulate constant α (4 分)
4. Regarding thermoregulation and thermogenesis, answer questions i-iii.
 - i. Explain the meaning of thermogenesis (3 分).
 - ii. Compared to white fat cells, what is the function and cytology (structural characteristics) of brown fat cells? (3 分)
 - iii. Draw a reflex map, including the roles of shivering thermogenesis and brown adipose tissue, to illustrate thermoregulation as the core body temperature decreases. (6 分)
 5. Explain what is the countercurrent multiplier system in the kidney and how it regulates the osmolality of excreted urine in humans with the help of which hormone control? (8 分)