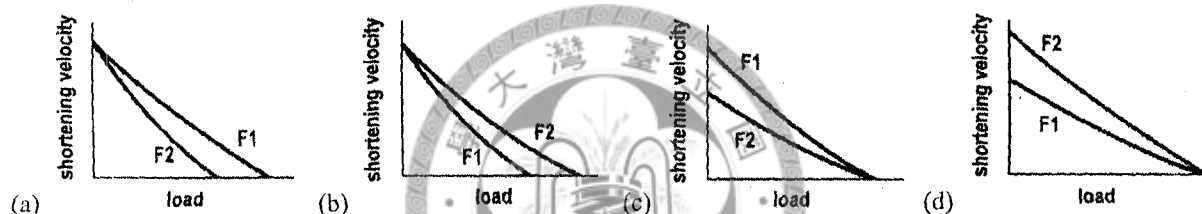


※ 注意：請於答案卷上依序作答，並應註明作答之大題及其題號。

一、 單選題 (40%)

- Which of the following best illustrates the concept of an adequate stimulus?
  - When a boxer gets punched in the eye, he perceives light.
  - Rotation of the head stimulates certain receptors in the vestibular system but not those in the visual system.
  - Information from different photoreceptors converges on a single ganglion cell that projects to the lateral geniculate nucleus.
  - Hair cells in the cochlea are stimulated by sound vibrations over a wide range of frequencies.
- Which of the following statements about autonomic nervous system is **FALSE**?
  - Activation of adrenergic receptors usually decreases airway resistance.
  - The postganglionic neurons have nicotinic cholinergic receptors.
  - Neurotransmitter is released from varicosity of a postganglionic neuron.
  - The origin of spinal preganglionic neurons is in the ventral horn of the spinal cord.
- Two muscle fibers (F1 and F2) generate the same isometric peak twitch tension, but fiber F1 contains myosin that hydrolyzes ATP at a high rate, whereas fiber F2 has myosin that hydrolyzes ATP more slowly. Properties of these fibers are consistent with which of the following sets of curves?



- When a muscle cell is relaxed and intracellular ATP levels are normal, a myosin head will remain in which of the following states?
  - bound to actin and in the low-energy form
  - bound to actin and in the high-energy form
  - in the high-energy form, with ATP bound to it
  - in the high-energy form, with ADP and  $P_i$  bound to it
- As a result of the Starling effect, stroke volume should increase following an increase in
  - mean blood pressure
  - sympathetic activity
  - preload
  - afterload
- Which of the following is **NOT** normally apparent in the ECG?
  - atrial depolarization
  - atrial repolarization
  - depolarization of Purkinje cells
  - ventricular depolarization
  - ventricular repolarization
- Left ventricular pressure and aortic pressure are virtually identical during
  - systole
  - isovolumetric contraction
  - isovolumetric relaxation
  - the ejection period
- If mean arterial pressure is constant, which of the following will **NOT** affect blood flow to a particular organ?
  - constriction of arterioles within that organ
  - constriction of arterioles in a neighboring organ
  - an increase in blood viscosity
  - a decrease in the vascular resistance of that organ

接背面

9. A person stands up abruptly after lying down. A reflex mechanism is activated that causes the heart rate to speed up. This reflex is triggered by
- (a) a fall in heart rate (c) a decrease in total peripheral resistance  
(b) a decrease in mean arterial blood pressure (d) an increase in preload
10. When all muscles of respiration are relaxed and alveolar pressure is zero, lung volume is equal to
- (a) residual volume (c) expiratory reserve volume  
(b) functional residual capacity (d) tidal volume
11. Which of the following statements about respiratory system is FALSE?
- (a) Pulmonary surfactant increases lung compliance.  
(b) Contraction of the internal intercostal muscle increases the rate of air flow during forced expiration.  
(c) Obstructive lung diseases are characterized by increased airway resistance.  
(d) During inspiration, transpulmonary pressure decreases.
12. When a person exercises, ventilation increases to meet the demands of more active tissues. This is an example of
- (a) hypoventilation (b) hyperventilation (c) hyperpnea (d) hypoxia
13. The normal fasting plasma glucose concentration is 100 mg/deciliter, and the renal threshold is 300 mg/deciliter. If the plasma concentration double to 200 mg/deciliter, then
- (a) the capacity of the renal tubule for transporting glucose will be exceeded.  
(b) the rate at which glucose is reabsorbed will double.  
(c) urinary water excretion will increase.  
(d) glucose clearance will increase.
14. Which of the following statements about urinary system is correct?
- (a) The glomerular filtration rate (GFR) tends to decrease as the concentration of plasma proteins increases.  
(b) In the proximal tubule, the  $\text{Na}^+/\text{K}^+$  pump is located on the apical membrane.  
(c) If the clearance of a substance is greater than the GFR, then the substance must have undergone reabsorption in the renal tubule.  
(d) Most water and solutes are reabsorbed in the distal and collecting duct.
15. A person has the following symptom: arterial pH = 7.48,  $\text{P}_{\text{CO}_2}$  = 44 mmHg, plasma bicarbonate concentration = 27 mM. What is the diagnosis?
- (a) respiratory acidosis (b) respiratory alkalosis (c) metabolic acidosis (d) metabolic alkalosis
16. Which of the following tends to inhibit gastric acid secretion?
- (a) Gastrin that secreted from the stomach  
(b) Entry of stomach acid into the duodenum  
(c) The arrival of food in the stomach  
(d) Vagus nerve stimulation that originated in the brain
17. In the postabsorptive state, the central nervous system uses which of the following as its primary source of energy?
- (a) fatty acids (b) amino acids (c) glucose (d) glycerol
18. During the early to mid-follicular phase of ovarian cycle, granulosa cell functions are stimulated by
- (a) progesterone (b) FSH (c) LH (d) GnRH
19. The circadian rhythm is established by what brain area?
- (a) hippocampus (b) thalamus (c) suprachiasmatic nucleus (d) basal ganglia

20. The chemoreceptors in the medulla are stimulated by
- (a) increased arterial  $\text{PCO}_2$ . (c) increased CSF pH.  
(b) decreased arterial pH. (d) decreased arterial  $\text{PO}_2$

二、請簡單說明下列三種藥物對心肌細胞之影響：(15%)

- A.  $\text{Na}^+$  channel blockers對ECG之PR interval有何影響？對QRS complex之duration有何影響？  
B.  $\text{Ca}^{++}$  channel blockers對SA node中節律點細胞之放電速率有何影響？對AV conduction有何影響？  
對心肌之contractility有何影響？  
C.  $\text{K}^+$  channel blockers對心肌細胞動作電位之duration有何影響？對ECG之QT interval有何影響？  
對不反應期有何影響？

三、請列出三種導致 renin(腎素)分泌的控制因子。(7%)

四、胃泌素(gastrin)有何作用？有哪些因子能影響它的分泌？(7%)

五、紅血球中 2,3-diphosphoglycerate (DPG)濃度的增加，對 oxygen-hemoglobin dissociation curve 有何影響？  
對氧氣的輸送有幫助嗎？(7%)

六、

With knowledge of an ion's charge and its intracellular and extracellular concentrations, we can find the *equilibrium potential* of any ion using the Nernst equation:

$$E = \frac{61}{z} \log \frac{C_o}{C_i}$$

**E** : equilibrium potential (mV)

**z** : the charge of the ion

**$C_o$**  : the concentration outside the cell

**$C_i$**  : the concentration inside the cell

The temperature is at 37°C.

The Nernst equation cannot be used, however, to calculate the membrane potential because a membrane is permeable to more than one ion, and the membrane permeability to various ions differs. The membrane potential thus depends on the concentration gradients for all ions across the plasma membrane, and on the permeability of the membrane to those ions. If the permeability is zero, an ion will not contribute to the membrane potential.

For situations in which only sodium ( $\text{Na}^+$ ) and potassium ( $\text{K}^+$ ) are permeant, the membrane potential ( $V_m$ ) can be approximated using the Goldman, Hodgkin, Katz equation, which is named after its developers, and is given below:

$$V_m = 61 \log \frac{P_{\text{Na}}[\text{Na}^+]_o + P_{\text{K}}[\text{K}^+]_o}{P_{\text{Na}}[\text{Na}^+]_i + P_{\text{K}}[\text{K}^+]_i}$$

**$V_m$**  : membrane potential (mV)

**$o$**  : the concentration outside the cell

**$i$**  : the concentration inside the cell

**$P_{\text{Na}}$**  : membrane permeability to sodium

**$P_{\text{K}}$**  : membrane permeability to potassium

The temperature is at 37°C.

接背面

請依據上述資料回答下列問題 (若計算不易，可僅列出計算式、或估算之)：(24%)

- 1) 某一大鼠之神經元細胞內外離子分布為  $[K^+]_o = 5 \text{ mM}$ ,  $[K^+]_i = 150 \text{ mM}$ ,  $[Na^+]_o = 150 \text{ mM}$ ,  $[Na^+]_i = 15 \text{ mM}$ ，假設其細胞膜只對鉀離子與鈉離子具通透性，且  $P_{Na}/P_K = 1/25$ 。
  - (a) 何謂平衡電位(equilibrium potential)？
  - (b) 試問此細胞的鉀離子平衡電位( $E_K$ )與鈉離子平衡電位( $E_{Na}$ )各為多少？  
( $\log 2 = 0.3010$ ,  $\log 3 = 0.4771$ ,  $\log 5 = 0.6990$ )
- 2) 根據上題之資料，該神經元之靜止膜電位約為多少？若  $P_{Na}/P_K = 1/1$ ，則細胞之靜止膜電位又約為多少？
- 3) 根據第一題之資料，如果膜上有新的通道突然大量打開，且該通道可以讓鈉、鉀離子通過，試問鈉、鉀離子將各往哪個方向移動(移入或移出細胞)？誰移動較多(數量)？為甚麼？膜電位將如何變化？

