

## 國立中山大學100學年度碩士班招生考試試題

科目：普通生物學【生科系碩士在職專班】

選擇題：(每題1.5分) 合計30分 (單選題)

- 1) A cross between homozygous purple-flowered and homozygous white-flowered pea plants results in offspring with purple flowers. This demonstrates
- dominance.
  - true-breeding.
  - the blending model of genetics.
  - the mistakes made by Mendel.
  - a dihybrid cross.

Use Figure 1 below and the following description to answer the questions 2-4 below.

In a particular plant, leaf color is controlled by gene locus  $D$ . Plants with at least one allele  $D$  have dark green leaves, and plants with the homozygous recessive  $dd$  genotype have light green leaves. A true-breeding dark-leaved plant is crossed with a light-leaved one, and the  $F_1$  offspring is allowed to self-pollinate. The predicted outcome of the  $F_2$  is diagrammed in the Punnett square shown in Figure 1, where 1, 2, 3, and 4 represent the genotypes corresponding to each box within the square.

	$D$	$d$
$D$	1	2
$d$	3	4

Figure 1

- 2) Which of the boxes marked 1-4 correspond to plants with dark leaves?
- 2 and 3
  - 1, 2, and 3
  - 1 and 2
  - 1 only
  - 4 only
- 3) Which of the boxes correspond to plants with a heterozygous genotype?
- 2 and 3
  - 2, 3, and 4
  - 1
  - 1, 2, and 3
  - 1 and 2
- 4) Which of the plants will be true-breeding?
- 1-4
  - 1 only
  - None
  - 2 and 3
  - 1 and 4
- 5) What does transformation involve in bacteria?
- the creation of a strand of DNA from an RNA molecule
  - assimilation of external DNA into a cell
  - the type of semiconservative replication shown by DNA
  - the creation of a strand of RNA from a DNA molecule
  - the infection of cells by a phage DNA molecule

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- 6) For a science fair project, two students decided to repeat the Hershey and Chase experiment, with modifications. They decided to label the nitrogen of the DNA, rather than the phosphate. They reasoned that each nucleotide has only one phosphate and two to five nitrogens. Thus, labeling the nitrogens would provide a stronger signal than labeling the phosphates. Why won't this experiment work?
- A) There is no radioactive isotope of nitrogen.  
 B) Radioactive nitrogen has a half-life of 100,000 years, and the material would be too dangerous for too long.  
 C) Although there are more nitrogens in a nucleotide, labeled phosphates actually have 16 extra neutrons; therefore, they are more radioactive.  
 D) Amino acids (and thus proteins) also have nitrogen atoms; thus, the radioactivity would not distinguish between DNA and proteins.  
 E) Avery et al. have already concluded that this experiment showed inconclusive results.
- 7) In an experiment, DNA is allowed to replicate in an environment with all necessary enzymes, dATP, dCTP, dGTP, and radioactively labeled dTTP ( $^3\text{H}$  thymidine) for several minutes and then switched to nonradioactive medium. It is then viewed by electron microscopy and autoradiography. The Figure 2 below represents the results.

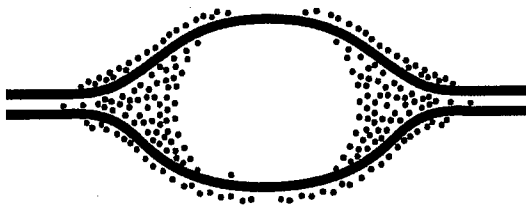


Figure 2.

Grains represent radioactive material within the replicating eye.

Which is the most likely interpretation?

- A) Thymidine is only being added where the DNA strands are furthest apart.  
 B) There are two replication forks going in opposite directions.  
 C) Thymidine is only added at the very beginning of replication.  
 D) Replication proceeds in one direction only  
 E) None of the above

The following questions 8 and 9 refer to the digestive system structures in Figure 3.

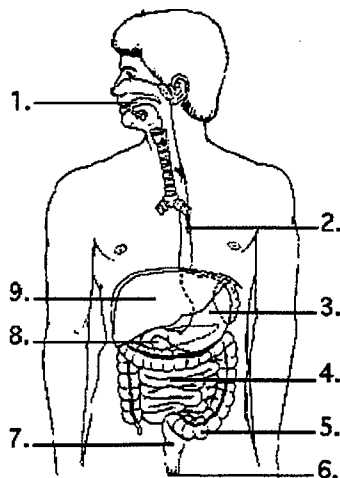


Figure 3

- 8) Where are the agents that help emulsify fat produced?

A) 8      B) 2      C) 1      D) 9      E) 3

- 9) Where does the digestion of fats mostly occur?
- A) 1, 3, and 4
  - B) 4 only
  - C) 3 and 4
  - D) 3 only
  - E) 1 and 4
- 10) What would be expected if the amount of interstitial fluid surrounding the capillary beds of the lungs were to increase significantly?
- A) The pressure would cause the capillary beds to burst.
  - B) The amount of carbon dioxide entering the lungs from the blood would increase.
  - C) The amount of oxygen entering the circulation from the lungs would increase.
  - D) The amount of oxygen entering the circulation from the lungs would decrease.
  - E) Both C and D would be expected.
- 11) If the atrioventricular node could be surgically removed from the heart without disrupting signal transmission to the Purkinje fibers, what would be the effect?
- A) Only the ventricles would contract.
  - B) No apparent effect on heart activity would be observed.
  - C) Atria and ventricles would contract at about the same time.
  - D) The heart rate would be decreased.
  - E) Only the atria would contract.
- 12) When an individual is subject to short-term starvation, most available food is used to provide energy (metabolism) rather than building blocks (growth and repair). Which hormone would be particularly active in times of food shortage?
- A) antidiuretic hormone
  - B) epinephrine
  - C) insulin
  - D) glucagon
  - E) oxytocin
- 13) Which of the following glands shows both endocrine and exocrine activity?
- A) pancreas
  - B) parathyroid
  - C) adrenal
  - D) pituitary
  - E) salivary
- 14) If a newborn were accidentally given a drug that destroyed the thymus, what would most likely happen?
- A) Genetic rearrangement of antigen receptors would not occur.
  - B) His B cells would be reduced in number and antibodies would not form.
  - C) His humoral immunity would be missing.
  - D) His cells would lack class I MHC molecules on their surface.
  - E) His T cells would not mature and differentiate appropriately.

- 15) Why does your arm feel cold when you reach inside the refrigerator to get a container of milk?
- A) The temperature of the blood circulating to the arm decreases.
  - B) Thermoreceptors in the skin undergo accommodation, which increases their sensitivity.
  - C) Thermoreceptors send signals to the posterior hypothalamus.
  - D) Circulating levels of prostaglandins increase.
  - E) Thermoreceptors send signals to the cerebral cortex where the change from room temperature to refrigerator temperature is transduced.
- 16) The perceived pitch of a sound depends on
- A) the region of the basilar membrane where the signal originated.
  - B) vibrations of the oval window creating wave formation in the fluid of the vestibular canal.
  - C) vibrations of the tympanic membrane being transmitted through the incus.
  - D) A and C only
  - E) A, B, and C
- 17) Cerebrospinal fluid can be described as all of the following except
- A) a product of the filtration of blood by the brain.
  - B) functioning in transport of nutrients and hormones through the brain.
  - C) formed from layers of connective tissue.
  - D) functioning to cushion the brain.
  - E) filling cavities in the brain called ventricles.
- 18) What controls the heart rate?
- A) medulla
  - B) neocortex
  - C) cerebellum
  - D) pituitary
  - E) thalamus
- 19) Most of the neurons in the human brain are
- A) sensory neurons.
  - B) interneurons.
  - C) motor neurons.
  - D) olfactory neurons.
  - E) auditory neurons.
- 20) The transfer of fluid from the glomerulus to Bowman's capsule
- A) results from active transport.
  - B) is mainly a consequence of blood pressure in the capillaries of the glomerulus
  - C) transfers large molecules as easily as small ones.
  - D) usually includes the transfer of red blood cells to the Bowman's capsule.
  - E) is very selective as to which subprotein sized molecules are transferred.

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問答題：合計 70 分

1. Plant photosynthesis can convert photon energy into chemical energy of organic compounds via electron transport systems. Please explain cyclic and noncyclic electron transport systems, compounds produced, and possible functions in light reaction of photosynthesis. (6 points)
2. Respiration can metabolize and convert organic compound such as glucose into the final products of  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and ATP. Several steps located in different cellular compartments are involved. Please explain the respiration process including the location, the main products produced and the metabolic pathway involved at different cellular compartment. (6 points)
3. In angiosperm, the structure of a plant can be divided into two parts: the shoot systems and root systems. (a) Please list the organs that are included in each system. (b) Different organs in cross section are all composed of three common tissue types. Please list the three common tissue types. (c) Please list the common cell types of plant. (10 points)
4. In angiosperm, the ovary is the female reproductive organ and will develop into fruit and seed after double fertilization. Please draw a simplified ovary containing those main structures and specify their fates to the corresponding tissues/organs of developed fruits and seeds after double fertilization. (6 points)
5. In lettuce, seed germination is affected by dark, far-red and red light, phytochrome ( $P_r$  and  $P_{fr}$ ), and plant growth regulators (such as ABA, GA and cytokinin). Please predict the effects (promotion or inhibition) of GA, ABA, cytokinin, dark, the flash of red or far-red light, and phytochrome ( $P_r$  and  $P_{fr}$ ) on lettuce seed germination. (7 points)
6. 請自行繪製一個台灣地圖(不含離島)，標記出(1)中山大學、(2)高屏河流域、與(3)恆春半島的位置，並再標記出何處有(4)珊瑚裙礁海岸以及(5)蘭陽平原 (10%)
7. 請翻譯以下名詞(10%)：
  - (1) fitness (註：生態學上的)
  - (2) founder effect
  - (3) kin selection
  - (4) Mammalia
  - (5) genetic drift
8. 吃喜酒真是太令人開心了，以下是五道婚宴上的常見菜色，請問其主要原料各屬於那些動物門？並請繪出這些動物門間的親緣關係為何？(15%)
  - (1) 海參燴什錦
  - (2) 龍蝦沙拉
  - (3) 鮑魚拼盤
  - (4) 花枝丸
  - (5) 豆酥鱈魚