

2022 年第三十七屆成大數理比賽 - 生物
37th NCKU Science and Mathematics Competition 2022 - Biology

1. 關於真核細胞和原核細胞，以下哪項是錯誤的？
Which of the following is incorrect about eukaryotic cells and prokaryotic cells?
- (A) 真核細胞含有膜結合的細胞器，而原核細胞沒有。
Eukaryotic cells contain membrane-bound organelles while prokaryotic cells do not.
 - (B) 葉綠體可以在所有的真核細胞中找到，但是在原核細胞中卻沒有。
Chloroplast can be found in all eukaryotic cells but absent in prokaryotic cells.
 - (C) 線粒體可以在真核細胞中找到，但在原核細胞中不存在。
Mitochondria can be found in eukaryotic cells but absent in prokaryotic cells.
 - (D) 真菌是真核細胞的一個例子。
Fungus is an example of eukaryotic cells.
 - (E) 高爾基體存在於真核細胞中，但不存在於原核細胞中。
Golgi apparatus is present in eukaryotic cells but absent in prokaryotic cells.
2. 食物進入小腸消化後，其中的葡萄糖如何進入小腸上皮細胞？
How is glucose of the digested food absorbed by intestine epithelial cells?
- (A) 主動運輸
active transport
 - (B) 胞吞作用
endocytosis
 - (C) 自由擴散
free diffusion
 - (D) 與脂肪酸共同運輸
cotransport with fatty acid
 - (E) 協助擴散
facilitated diffusion
3. 以人的胃蛋白酶放在試管內加入受質測試活性，發現在室溫 25°C、pH7.0 的溶液中活性很低。如何改變實驗條件以提升胃蛋白酶的活性？
A scientist tested the human stomach proteinase and found its activity in a pH7.0 solution was low at room temperature 25°C. How can the scientist elevate the enzyme activity?
- (A) 降低 pH 值並降溫
lower both pH and temperature
 - (B) 降低 pH 值並保持 25°C
lower pH and keep at 25°C
 - (C) 降低 pH 值並升溫
lower pH and raise temperature
 - (D) 升高 pH 值並升溫
raise both pH and temperature
 - (E) 升高 pH 值並降溫
raise pH and lower temperature

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4. 下列關於人類胚胎發育的過程, 何者錯誤?
Which of the following description about human embryonic development is incorrect?
- (A) 受精卵發育成囊胚
Fertilized egg develops into blastula.
 - (B) 有二個胚層形成
There are two germ layers formed.
 - (C) 外胚層形成皮膚與神經等器官
Ectoderm develops into skin, nerve, etc.
 - (D) 內胚層形成肺、胃、腸等器官
Endoderm develops into lung, stomach, intestine, etc.
 - (E) 細胞分裂產生多個細胞
Cell division increases cell number.
5. 下列有關消化系統的敘述, 何者正確?
Which of the following description about human digestive system is correct?
- (A) 小腸內壁十分平滑, 以提供高效率的養分吸收。
The inner wall of intestine is smooth, and functions in absorbing nutrient efficiently.
 - (B) 膽囊所分泌的膽汁含有分解脂質的酵素。
The gall bladder-secreted bile contains enzymes to catalyze fat.
 - (C) 小腸能調節胃液的分泌。
The intestine can regulate the secretion of stomach juice.
 - (D) 唾液澱粉酶在中性 pH 環境下活性最佳。
The salivary amylase works best in neutral pH environment.
 - (E) 脂肪酸被小腸吸收到微血管後, 可直接進入淋巴循環系統。
Fatty acid goes directly into the lymphatic system after being absorbed by the intestine.
6. 下列哪一個構造決定了心臟中的血液只朝一個方向流動?
What structure determines the unidirectional flow of the blood in the heart?
- (A) 瓣膜
valve
 - (B) 左心室壁
left ventricle wall
 - (C) 右心房壁
right atrium wall
 - (D) 房室束
atrioventricular bundle
 - (E) 房室結
atrioventricular node

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7. 光合作用製造的有機物如何在植物體內運輸？

How are organic matters produced by photosynthesis transported in plant?

- (A) 經由木質部往上運送
upward transport through xylem
- (B) 經由韌皮部往上運送
upward transport through phloem
- (C) 經由木質部往上和下運送
upward and downward transport through xylem
- (D) 經由韌皮部往下運送
downward transport through phloem
- (E) 經由韌皮部往上和下運送
upward and downward transport through phloem

8. 膝跳反射路徑中神經衝動的傳遞方向是？

How is the nerve impulse transmitted in stretch reflex arc?

- (A) 股四頭肌肌腱 → 脊髓神經節內的運動神經元 → 脊髓神經節內中間神經元
→ 脊髓神經節內感覺神經元 → 股四頭肌
tendon of quadriceps → motor neurons in the spinal cord → interneurons in the spinal cord
→ sensory neurons in the spinal cord → quadriceps
- (B) 股四頭肌 → 脊髓神經節內的感觉神經元 → 脊髓神經節內中間神經元
→ 脊髓神經節內運動神經元 → 股四頭肌肌腱
quadriceps → sensory neurons in the spinal cord → interneurons in the spinal cord
→ motor neurons in the spinal cord → tendon of quadriceps
- (C) 股四頭肌肌腱 → 脊髓神經節內的感觉神經元 → 脊髓神經節內中間神經元
→ 脊髓神經節內運動神經元 → 股四頭肌
tendon of quadriceps → sensory neurons in the spinal cord → interneurons in the spinal cord
→ motor neurons in the spinal cord → quadriceps
- (D) 股四頭肌肌腱 → 大腦皮質的感觉神經元 → 大腦皮質的中間神經元
→ 脊大腦皮質的運動神經元 → 股四頭肌
tendon of quadriceps → sensory neurons in the brain cortex → interneurons in the brain cortex
→ motor neurons in the brain cortex → quadriceps
- (E) 股四頭肌肌腱 → 脊髓神經節內的感觉神經元 → 大腦皮質的中間神經元
→ 脊髓神經節內運動神經元 → 股四頭肌
tendon of quadriceps → sensory neurons in the spinal cord → interneurons in the brain cortex
→ motor neurons in the spinal cord → quadriceps

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9. 下列有關尿液形成過程的敘述，何者正確？

Which of the following description about the process of urine generated in the human kidney is correct?

- (A) 經由腎小球→亨耳環管→近曲小管→遠曲小管→集尿管
From glomerulus → loop of Henle → proximal convoluted tubule → distal convoluted tubule → collecting duct
- (B) 經由腎小球→近曲小管→遠曲小管→亨耳環管→集尿管
From glomerulus → proximal convoluted tubule → distal convoluted tubule → loop of Henle → collecting duct
- (C) 腎小管會以主動運輸的方式回收濾液中所有的離子
Renal tubule reabsorbs all ions from filtrate by active transport.
- (D) 過濾作用在絲球體與鮑氏囊間進行
The Bowman's capsule is the filtration unit of the glomerulus.
- (E) 集尿管受抗利尿激素刺激可再吸收尿液中的鉀離子
The act of vasopressin on collecting duct stimulates reabsorption of potassium ion from urine.

10. 下列有關人體免疫系統與功能的敘述，何者錯誤？

Which of the following description about the human immune system and its function is incorrect?

- (A) 沒有輔助性 T 細胞存在，就不會發生免疫反應。
The helper T cell is necessary for stimulating immune response.
- (B) B 細胞分化為漿細胞後製造並釋放抗體。
B cells differentiate into plasma cells which secrete antibody.
- (C) B 細胞和 T 細胞表面都具有能辨識抗原的專一性受體分子。
The surface of both B and T cells exhibits specific receptors for antigens.
- (D) B 細胞和 T 細胞都能被輔助 T 細胞產生的細胞激素刺激而增強活性。
The activity of both B and T cells increases after receiving cytokines.
- (E) 組織胺參與發炎和過敏反應發生的過程。
Histamine is involved in inflammation and allergy.

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11. 下列哪些過程，在動物和植物細胞的有絲分裂中皆會發生？
Which of the following process is common to mitosis of both animal and plant cells?
- (A) 紡錘絲的形成、中心粒的形成
the formation of spindle fiber and centriole
 - (B) 中心粒的形成、分裂末期細胞膜凹陷
the formation of centriole and cleavage furrow at telophase
 - (C) 紡錘絲的形成、染色體的形成
the formation of spindle fiber and chromosome
 - (D) 紡錘絲的形成、分裂末期細胞膜凹陷
the formation of spindle fiber and cleavage furrow at telophase
 - (E) 中心粒的形成、細胞板的形成
the formation of centriole and cell plate
12. 下列何者不是癌細胞的特性？
Which of the following is not a feature of cancer cells?
- (A) 不會啟動細胞凋亡，並且會無限制持續分裂
no apoptosis, unlimited cell division
 - (B) 會無限制持續分裂，並轉移至其他組織
unlimited cell division, metastasis
 - (C) 不會啟動細胞凋亡，並且會轉移至其他組織
no apoptosis, metastasis
 - (D) 會無限制持續分裂，並且無接觸抑制
unlimited cell division, no contact inhibition
 - (E) 不會啟動細胞凋亡，並且有接觸抑制
no apoptosis, exhibiting contact inhibition
13. 下列有關真核細胞基因轉錄和轉譯的敘述，何者正確？
Which of the following description about transcription and translation in eukaryotic cells is correct?
- (A) 只有信使 RNA 的轉譯發生在細胞核中
Only the translation of mRNA occurs in the nucleus.
 - (B) RNA 聚合酶結合到啟動子序列上開啟了轉錄
Transcription initiates when RNA polymerase binds to the promoter.
 - (C) 轉錄發生在細胞質中
Transcription occurs in the cytoplasm.
 - (D) 核糖體 RNA 的功能是在轉錄過程中協助運送各種氨基酸
rRNA functions in transporting amino acids during transcription.
 - (E) 轉運 RNA 會和蛋白質以及信使 RNA 結合以協助轉錄進行
tRNA functions in transcription by binding to proteins and mRNA.

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14. 科學家發現某一人類遺傳疾病大多發生於男性，這個疾病基因很可能是
Scientists found that some human genetic disease mostly occurs in males. It is highly possible that the disease gene is
- (A) 隱性基因位於 Y 染色體上
recessive gene on Y chromosome
 - (B) 顯性基因位於 Y 染色體上
dominant gene on Y chromosome
 - (C) 隱性基因位於 X 染色體上
recessive gene on X chromosome
 - (D) 顯性基因位於 X 染色體上
dominant gene on X chromosome
 - (E) 隱性基因位於體染色體上 recessive gene on an autosome
15. 下列有關聚合酶連鎖反應的敘述，何者正確？
Which of the following description about polymerase chain reaction is correct?
- (A) 會加入限制酶來降低反應所需活化能
Restriction enzyme can be added to lower the activation energy.
 - (B) 升溫到 95 度來使雙股 DNA 模板分開為單股
The elevation of temperature to 95 °C is to melt double strand DNA into single strand DNA.
 - (C) 加入引子 DNA 來引導單股 DNA 合為雙股
The addition of primer is to synthesize double strand DNA from single strand DNA.
 - (D) 加入核苷酸是為了提高反應速率
The addition of nucleotides is to increase the reaction rate.
 - (E) 降溫到 50-60 度是為了讓 DNA 聚合酶發揮最大活性
The temperature between 50 and 60°C is optimal for the activity of DNA polymerase.
16. 下列何者不是黃體成長激素的功能？
Which of the following is not the function of luteinizing hormone (LH)?
- (A) 高濃度情況下能誘發排卵
LH surge (i.e. an acute rise of LH) triggers ovulation.
 - (B) 在月經週期的最後兩週維持黃體功能
To maintain the luteal function through the last two weeks of a menstrual cycle.
 - (C) 促使睪丸釋放睪酮
To signal testis to release testosterone.
 - (D) 促使卵巢內的卵泡成長
To stimulate the growth of ovarian follicles in the ovary.
 - (E) 促使黃體釋放孕酮和雌性激素
To stimulate the corpus luteum to secrete progesterone and estrogen.

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17. 以下對於人類絨毛膜性腺激素的描述何者為非？
Which one of the following descriptions of human chorionic gonadotropin (hCG) is incorrect?
- (A) hCG 最早是由胎盤的滋養層細胞分泌
It is firstly secreted by the trophoblast cells of the placenta.
- (B) 整個懷孕過程中，hCG 都維持在高濃度
The concentration of hCG is maintained at high level throughout the pregnancy duration.
- (C) hCG 的主要功能為維持動情素和黃體素的分泌
Its main functions are maintaining the secretion of estrogen and progesterone.
- (D) hCG 是用於驗孕的主要激素
It is the main factor used in pregnancy test.
- (E) hCG 只在懷孕婦女體內才會分泌
hCG is released only in pregnant women.
18. 相較於有性生殖，採用無性生殖具有哪些優勢？
What are the benefits of asexual reproduction comparing to sexual reproduction?
- (A) 繁殖速度較快
Increasing the speed of reproduction.
- (B) 增加後代變異性
Increasing offspring diversity.
- (C) 促進基因重組
Increasing the opportunity of gene recombination.
- (D) 較容易受到單一疾病侵擾整個族群
The whole population is more likely to be affected by the same disease.
- (E) 同一物種可能只適應於單一環境
The species may only be adapted to only one habitat type.
19. 以下生態組織中的哪個階層包含了非生物因子？
Which of the following levels of ecological organization includes abiotic factors?
- (A) 族群
population
- (B) 物種
species
- (C) 生態系統
ecosystem
- (D) 寄生
parasitism
- (E) 群聚
community

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20. 根據達爾文的自然選擇學說，以下何者不是演化的成因？
According to Darwin's natural selection, which one of the following is not the causes of evolution?

- (A) 地理隔離
geographical isolation
- (B) 遺傳變異
genetic variation
- (C) 環境變異
environmental variation
- (D) 被捕食壓力
predation risk
- (E) 用進廢退
use and disuse

21. 假設在一個食物鏈的組成中，包含：

浮游植物 → 浮游動物 → 魚 → 魚鷹 → 獵鷹人 → 細菌

其中細菌為？

Assuming a food chain is composed by

phytoplankton → zooplankton → fish → osprey → eagle-hunter → bacteria
then the bacteria is the _____ in this food chain.

- (A) 初級生產者
primary producer
- (B) 次級生產者
secondary producer
- (C) 初級消費者
primary consumer
- (D) 四級消費者
tertiary consumer
- (E) 分解者
decomposer

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22. 以下何者不是物種演化的機制？

Which one of the following is not an evolutionary mechanism?

- (A) 性擇
sexual selection
- (B) 天擇
natural selection
- (C) 基因突變
genetic mutation
- (D) 基因改造
genetic modification
- (E) 雜交
hybridization

23. 具有以下哪種特色的物種較不容易滅絕？

Species with which of the following features is the least likely to extinct comparing to the other four?

- (A) 族群量小
small population size
- (B) 世代間隔長
long generation time
- (C) 族群密度高
high population density
- (D) 易受人類活動驚擾
vulnerable to human disturbance
- (E) 每次繁殖的子代數量少
small number of offspring produced per mating

24. 以下類群中，何者具有最多物種數量？

Which of the following taxa has the greatest number of species?

- (A) 節肢動物
Arthropod
- (B) 哺乳類
Mammals
- (C) 脊椎動物
Vertebrates
- (D) 細菌
Bacteria
- (E) 裸子植物
Gymnosperm

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25. 一個生態系統中的最小單位是？
What is the smallest unit in an ecosystem?
- (A) 生物個體
organism
 - (B) 群聚
community
 - (C) 族群
population
 - (D) 物種
species
 - (E) 基因
gene