

2023 年第三十八屆成大數理比賽 - 生物
38th NCKU Science and Mathematics Competition 2023 - Biology

1. 構成人類的四大元素，以下何者為非？

The four major elements in the human body *except*

- (A) 碳 C
- (B) 磷 P
- (C) 氧 O
- (D) 氫 H
- (E) 氮 N

2. 有絲分裂與減數分裂的描述，下列何者為非？

Which of the following statements is *false* regarding mitosis and meiosis?

- (A) 有絲分裂進行一次細胞分裂；減數分裂進行兩次細胞分裂

Mitosis involves one round of cell division; meiosis involves two rounds of cell division

- (B) 有絲分裂與減數分裂皆會進行一次的 DNA 複製

DNA replication occurs only once in both mitosis and meiosis

- (C) 有絲分裂產生兩個子細胞；減數分裂產生四個子細胞

Mitosis results in two daughter cells; meiosis results in four daughter cells

- (D) 有絲分裂與減數分裂產生的子細胞皆具有一模一樣的遺傳物質

The daughter cells resulting from mitosis and meiosis have the same genetic materials as the parental cells

- (E) 有絲分裂產生的子細胞 DNA 數量與母細胞相同；減數分裂產生的子細胞 DNA 數量只有母細胞的一半

The daughter cells produced from mitosis maintain the same amount of DNA as the parent cell; the daughter cells produced from meiosis have only half the amount of DNA compared to the parent cell.

3. 以下何者為酵素的作用？

Which of the following is the effect of enzyme?

- (A) 改變 pH 值 / change pH value

- (B) 破壞氫鍵 / destroy hydrogen bond

- (C) 改變產物的濃度 / change the concentration of product

- (D) 降低反應的活化能 / lower the activation energy of the reaction

- (E) 最為反應物 / acts as a reactant

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4. 光反應的產物為

The product of the light reaction

- (A) ATP, NADPH, O₂ / ATP, NADPH, 氧氣
- (B) ATP, glucose, O₂ / ATP, 葡萄糖, 氧氣
- (C) ATP, NADPH, glucose / ATP, NADPH, 葡萄糖
- (D) ATP, pyruvate, O₂ / ATP, 丙酮酸, 氧氣
- (E) Glucose, ATP, pyruvate / 葡萄糖, ATP, 丙酮酸

5. 醱解作用可以將 1 分子的葡萄糖分解成 2 分子的丙酮酸，以及幾個 ATP?

Glycolysis can decompose 1 molecule of glucose into 2 molecules of pyruvate, and how many ATP are produced?

- (A) 4 個 ATP / four ATP
- (B) 32 個 ATP / thirty-two ATP
- (C) 2 個 ATP / two ATP
- (D) 3 個 ATP / three ATP
- (E) 16 個 ATP / sixteen ATP

6. 真核生物的染色體由以下何者組成

In eukaryotic cells, chromosomes are composed of _____.

- (A) DNA 以及 RNA / DNA and RNA
- (B) 只有 DNA / DNA only
- (C) DNA 以及蛋白質 / DNA and proteins
- (D) DNA 以及磷脂質 / DNA and phospholipids
- (E) 以上皆非 / None of the above

7. 肌肉主要的功能

The major function of muscles is

- (A) 產生熱以維持生理平衡 / generate heat to maintain homeostasis
- (B) 維持外表美觀 / make you look beautiful
- (C) 把化學能轉變為動能 / convert chemical energy to mechanical energy
- (D) 固定骨骼 / hold the skeleton together
- (E) 以上皆對 / All of the above

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8. 對於限制酶的描述，何者為非

Which of the following statements is *false* regarding **restriction enzymes**?

- (A) 會辨識特定的 DNA 序列 / can recognize the specific DNA sequence
- (B) 具專一性 / have specificity
- (C) 與 DNA 連接酶合作完成 DNA 重組 / collaborate with DNA ligase in processing the DNA recombinant techniques
- (D) 與 DNA exonuclease 相同 / is the same as DNA exonuclease
- (E) 又可稱為分子剪刀 / act as molecular scissors

9. 發炎作用主要的作用為

The effect of inflammation

- (A) 產生細胞免疫 / to initiate cellular immunity
- (B) 產生體液免疫 / to initiate humoral immunity
- (C) 產生殺手細胞 / to produce killer cells
- (D) 產生巨噬細胞 / to produce macrophages
- (E) 清除受傷組織 / to clean the damaged tissues

10. 請選出**錯誤**的人體內分泌腺與代謝反應配對

Which of the following is the *false* pair for hormone with an aspect of metabolism

- (A) 雌激素 & 女性性特徵 / estrogen & female sexual characteristics
- (B) 胰島素 & 血糖濃度 / insulin & blood glucose levels
- (C) 甲狀腺素 & 血液中鈣濃度 / thyroxine & blood calcium levels
- (D) 前列腺素 & 子宮收縮 / prostaglandin & uterine contractions
- (E) 醛固酮 & 鉀離子代謝 / aldosterone & potassium levels

11. 交感神經活化會導致

Which is the outcome of the activated sympathetic nervous system (SNS)

- (A) 消化速率變快 / decreased rate of digestion
- (B) 呼吸速率的減低 / decreased rate of breathing
- (C) 支氣管收縮增加 / increased constriction of the bronchi
- (D) 心跳變慢 / decrease heart rate
- (E) 血壓的下降 / decrease blood pressure

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12. 對於維管束的描述以下何者為非?

Which of the following statements is *false* regarding the **Vascular bundle**?

- (A) 由木質部與韌皮部形成的結構 / composed of xylem and phloem
- (B) 木質部負責運輸水分 / xylem transports water
- (C) 韌皮部負責運輸葡萄糖 / phloem transports glucose
- (D) 裸子植物與被子植物均有維管束 / an important transport tissue in Gymnospermae and Angiosperms
- (E) 以上皆非 / None of the above

13. 以下何者不是人類唾液的功能

Which of the following statements is *false* regarding the human saliva

- (A) 將蛋白質分解為胜肽 / hydrolyzing proteins into peptides
- (B) 中和食物酸性 / neutralizing food acids
- (C) 控制細菌族群 / controlling bacteria population
- (D) 潤滑食物 / lubricating food
- (E) 水解食物中的澱粉 / hydrolyzing starch in food

14. 卵細胞形成過程與精子細胞形成過程相比，前者特有的現象是

Compared with the process of egg formation and sperm formation, the unique phenomenon of the former is

- (A) 染色體複製 / chromosome replication
- (B) 需要經過減數分裂 / undergo meiosis
- (C) 著絲點會分離 / centromere separate
- (D) 同源染色體分離 / homologous chromosome segregation
- (E) 細胞質不平均分配到子細胞 / cytoplasm unevenly distributes to daughter cells

15. 種子胚的組成不包括

The composition of the seed embryo does not include

- (A) 胚根 / radical
- (B) 胚芽 / plumule
- (C) 胚軸 / embryonic axis
- (D) 子葉 / cotyledons
- (E) 胚乳 / endosperm

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16. 周圍神經系統中之神經元的髓鞘是由以下何種細胞所構成?

The myelin sheath of neurons in the peripheral nervous system is composed of

- (A) 許旺細胞 / Schwann cell
- (B) 衛星細胞 / satellite cell
- (C) 寡突膠細胞 / oligodendrocyte
- (D) 星型膠細胞 / astrocyte
- (E) 以上皆是 / all of the above

17. 細菌與植物細胞的不同點，因為缺乏以下

Bacteria are different from plant cells in that they lack

- (A) DNA, 細胞壁, 葉綠體 / DNA, cell wall, chloroplasts
- (B) 核糖體, 粒線體, 細胞壁 / ribosome, mitochondria, cell wall
- (C) 葉綠體, 粒線體, 細胞核 / chloroplasts, mitochondria, nuclei
- (D) DNA, 葉綠體, 核糖體 / DNA, chloroplasts, ribosome
- (E) 粒線體, DNA, 細胞壁 / ribosome, DNA, cell wall

18. 以下何者**不是**由微小管所組成?

Which of the following is *not* composed of microtubules?

- (A) 中心體 / centrosome
- (B) 紡錘體 / mitotic spindle
- (C) 鞭毛 / cilia
- (D) 核糖體 / ribosome
- (E) 鞭毛 / flagellum

19. 植物激素與功能，以下何者為錯?

Which of the following is *false* regarding plant hormones and functions?

- (A) 植物生長素 → 果實生長 / auxin → fruit growth
- (B) 吉貝素 → 促進開花 / gibberellin → promote flowering
- (C) 離層素 → 促進細胞分裂 / abscisic acid (ABA) → promote cell division
- (D) 細胞分裂素 → 延緩葉的老化 / cytokinin → delay leaf senescence
- (E) 乙烯 → 果實熟化 / ethylene → fruit ripening

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20. 何謂生態棲位?

What is the ecological niche?

- (A) 物種所扮演的角色 / The role the species plays
- (B) 物種所吃的食物類型 / The type of food it eats
- (C) 物種所住的地方 / Where it lives
- (D) 本身與其他物種的關係 / Its relationships with other species
- (E) 以上皆對 / All of the above

21. 人類在消化過程中，食糜會在哪一個部位形成?

During the process of digestion, chyme formation occurs in which specific anatomical location?

- (A) 口腔 / oral cavity
- (B) 食道 / esophagus
- (C) 胃 / stomach
- (D) 小腸 / small intestine
- (E) 大腸 / large intestine

22. 具有吞噬外來微生物的顆粒性白血球?

The phagocytic granulocytes which can engulf foreign microorganisms are ____

- (A) 單核球 / Monocytes
- (B) 嗜中性球 / Neutrophil
- (C) 嗜酸性球 / Eosinophil
- (D) 嗜鹼性球 / Basophil
- (E) 巨噬細胞 / Macrophages

23. 新生兒自母乳獲得的抗體為_____

The antibodies acquired by newborns through breast milk are _____

- (A) IgA
- (B) IgD
- (C) IgE
- (D) IgG
- (E) All of the above

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24. 人體內 CO₂ 在血漿中以何種形式運輸?

In what form is CO₂ transported in the plasma within the human body?

- (A) H₂CO₃
- (B) CO₂
- (C) HCO₃⁻
- (D) CO₃²⁻
- (E) HCO₂⁻

25. PCR 反應的過程

Which of the following is the *correct* list of the processes for one cycle of polymerase chain reaction (PCR)?

- (A) DNA 變性成單股 → 加酵素 → 引物黏上單股 DNA 模板 → 添加 dNTPs → DNA 分子延伸
denature DNA → add fresh enzyme → anneal primers → add dNTPs → extend primers
- (B) 引物黏上單股 DNA 模板 → DNA 變性成單股 → DNA 分子延伸
anneal primers → denature DNA → extend primers
- (C) DNA 分子延伸 → 引物黏上單股 DNA 模板 → DNA 變性成單股
extend primers → anneal primers → denature DNA
- (D) DNA 變性成單股 → 引物黏上單股 DNA 模板 → DNA 分子延伸
denature DNA → anneal primers → extend primers
- (E) DNA 變性成單股 → 加酵素 → 引物黏上單股 DNA 模板 → DNA 分子延伸
denature DNA → add fresh enzyme → anneal primers → extend primers