

2018 年第 35 屆成大數理比賽 - 生物

1. 以下哪項通常被視為“基因改造生物”?

Which of the following is usually considered as “Genetically modified organisms (GMOs) “?

- (a) 利用細胞暴露於突變性化學品而產生的生物
Organisms that are produced by exposing cells to a mutagenic chemical
- (b) 通過兩個體細胞融合所產生的生物
Organisms that are produced by fusing of two somatic cells
- (c) 通過 DNA 重組技術將外源基因插入細胞中而產生的生物
Organisms that are produced by inserting foreign gene(s) into cells by recombinant DNA techniques
- (d) 通過將細胞暴露於 γ 射線照射而產生的生物
Organisms that are produced by exposing cells to gamma ray irradiation

2. 蛋白質的 α 螺旋(alpha helix)是

The alpha helix of proteins is

- (a) 三級結構 (tertiary structure) 之部分成分，並以雙硫橋 (disulfide bridge) 穩定結構。Part of the tertiary structure and stabilized by disulfide bridges.
- (b) 一個雙螺旋。a double helix.
- (c) 利用氫鍵 (hydrogen bonds) 穩定結構並且常發現在纖維蛋白質中 (fibrous proteins)。Stabilized by hydrogen bonds and commonly found in fibrous proteins.
- (d) 在球狀蛋白質的一些區域內發現並以疏水性相互作用 (hydrophobic interaction) 來穩定結構。found in some regions of globular proteins and stabilized by hydrophobic interactions.
- (e) 信使 RNA (messenger RNA) 的一種互補序列。a complementary sequence to messenger RNA.

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3. 下列那一项不是细胞核，叶绿体和线粒体之间的相同之处 (similarity) ?
Which of the following is *not* a similarity among the nucleus, chloroplasts, and mitochondria?
- (a) 它们都含有 DNA。They contain DNA.
 - (b) 它们被磷脂质双层细胞膜 (phospholipid bilayer) 所包围。They are bounded by two phospholipid bilayer membrane.
 - (c) 它们可以分裂去复制自己。They can self-replicate
 - (d) 它们是从内质网系统 (endoplasmic reticulum system) 演变出来。They are derived from endoplasmic reticulum system.
 - (e) 它们的膜与特定的蛋白质结合。Their membranes are associated with specific proteins.
4. 一个植物细胞放在低渗环境中(hypotonic environment)时细胞将会
A plant cell placed in a hypotonic environment will
- (a) 质壁分离 (plasmolyze)
 - (b) 萎缩 (shrivel/ shrink)
 - (c) 变成膨胀 (become turgid)
 - (d) 变得松弛 (become flaccid)
 - (e) 裂解 (lyse)
5. 以下哪一项每公克可产生最多的 ATP ?
Which of the following produces the most ATP per gram?
- (a) 葡萄糖，因为它是糖解反应 (glycolysis) 的始点位置。a glucose, because it is the starting molecule for glycolysis.
 - (b) 糖原 (glycogen) 或淀粉，因为它们是葡萄糖的聚合物。glycogen or starch, because they are polymers of glucose.
 - (c) 脂肪，因为它们是高度还原的化合物 (highly reduced compounds) 。fats, because they are highly reduced compounds.
 - (d) 蛋白质，因为能量储存在它们的三级化合物 (tertiary compounds) 中。proteins, because of the energy stored in their tertiary compounds
 - (e) 氨基酸，因为它们可以直接进入克雷布循环 (Kreb's cycle) 。amino acids, because they can be fed directly into the Kreb's cycle.

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6. 光合作用是一种氧化还原过程(redox process)，在其中
Photosynthesis is a redox process in which
- (a) 二氧化碳被还原，水被氧化。CO₂ is reduced and water is oxidized.
 - (b) NADP⁺被还原，RUBP 被氧化。NADP⁺ is reduced and RUBP is oxidized.
 - (c) CO₂，NADP⁺和水分都被还原。CO₂, NADP⁺, and water are reduced.
 - (d) O₂ 扮演氧化剂 (oxidizing agent)，水扮演还原剂 (reducing agent)。O₂ acts as an oxidizing agent and water acts as a reducing agent.
 - (e) G3P 被还原并且电子传输链 (electron transport chain) 被氧化。G3P is reduced and the electron transport chain is oxidized.
7. 同源染色体
homologous chromosomes
- (a) 有相同的基因序列。have identical genes sequence.
 - (b) 在相同基因座 (loci) 上具有相同性状 (traits) 的基因。have genes for the same traits at the same loci.
 - (c) 在配子 (gametes) 中发现。are found in gametes.
 - (d) 在减数分裂 II (meiosis II) 中分开。separate in meiosis II.
 - (e) 具有以上所有特征。have all the above characteristics.
8. 如果父母两者都是携带致命隐性基因 (lethal recessive gene) 的携带者，他们的孩子会遗传和表现这种疾病的概率 (probability) 是
If both parents are carriers of a lethal recessive gene, the probability that their child will inherit and express the disorder is
- (a) 1/8
 - (b) 1/4
 - (c) 1/2
 - (d) 1/2 x 1/2 x 1/4, or 1/16
 - (e) 2/3 x 2/3 x 1/4, or 1/9

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9. 一种有机体的 DNA 含有 20% 的碱基胸腺嘧啶 (thymine)，它的碱基鸟嘌呤 (guanine) 的百分比为何？

The DNA of an organism has thymine as 20% of its bases. What percentage of its bases would be guanine?

- (a) 20%
 - (b) 30%
 - (c) 40%
 - (d) 60%
 - (e) 80%
10. 下列全部都是由 DNA 转录的，除了
All of the following are transcribed from DNA *except*
- (a) exon
 - (b) introns
 - (c) tRNA
 - (d) rRNA
 - (e) promoter
11. 選擇正確的選項 Choose the CORRECT statement.
- (a) DNA 只能在細胞核中發現 DNA can only be found in the nucleus of a cell
 - (b) DNA 只能在植物細胞的線粒體中發現 DNA can only be found in mitochondria of a plant cell
 - (c) DNA 可以在植物細胞的細胞核，線粒體和葉綠體中發現 DNA can be found in the nucleus, mitochondria and chloroplast of a plant cell
 - (d) DNA 可以在動物細胞的細胞核，線粒體和液泡中發現 DNA can be found in the nucleus, mitochondria and vacuole of an animal cell

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12. 什么是基因组学 (genomics)?

What is genomics?

- (a) 公共伙伴 (public consortium) 对人类基因组 (human genome) 进行测序 (sequencing)。
the public consortium effort to sequence the human genome.
- (b) 塞雷拉霰弹枪定序法 (Celera shotgun) 对人类基因组进行测序。
the Celera shotgun approach to sequencing the human genome.
- (c) 全部基因组的测序和系统性的研究 (sequencing and systematic study)。
the sequencing and systematic study of whole genome.
- (d) 利用基因疗法 (gene therapy) 治疗人类疾病。
the use of gene therapy in the treatment of human diseases.
- (e) 使用核苷酸序列 (nucleotide sequence) 来确定由基因组所编码 (encoded) 的所有蛋白质功能。
the use of nucleotide sequences to determine the function of all proteins encoded by a genome

13. 自然选择 (natural selection) 的最佳描述是

The best description of natural selection is

- (a) 适者生存。the survival of the fittest.
- (b) 为生存而奋斗。the struggle for existence.
- (c) 成功繁殖最适合环境的族群成员。the reproductive success of the members of a population best adapted to the environment.
- (d) 在有限自然资源的环境中，过度产生后代。the overproduction of offspring in an environment with limited natural resources.
- (e) 在族群中，遗传变异 (inheritable variation) 比例的变化。a change in the proportion of inheritable variations within a population.

14. 什么原因阻止马和驴杂交而形成一个新物种?

What prevents horses and donkeys from hybridizing to form a new species?

- (a) 降低杂交繁殖力 reduced hybrid fertility.
- (b) 机械隔离 mechanical isolation.
- (c) 配子隔离 gametic isolation.
- (d) 行为隔离 behavioral isolation.
- (e) 以上都不是 None of the above

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15. 真核细胞 (eukaryotic cells) 的第一个化石证据是

The first fossil evidence of eukaryotic cells

- (a) 从 12 亿年前开始。dates from 1.2 billion years ago.
- (b) 出现在深海通风口 (deep-sea vents) 周围的沉积物中。appears in sediments around deep-sea vents.
- (c) 在迭层石 (stromatolites) 中发现。is found in stromatolites.
- (d) 可以追溯到 27 亿年前，氧气开始在大气层中积聚起来。dates from 2.7 billion years ago when oxygen accumulated in the atmosphere.
- (e) 出现在原核生物 (prokaryotes) 在地球上演变 15 亿年后。appears after prokaryotes had been evolving on earth for 1.5 billion years.

16. 真菌 (fungi) 和植物之间的主要差别在于真菌

The major difference between fungi and plants is that fungi

- (a) 的細胞壁主要成份為幾丁質。cell walls are mainly made of chitin
- (b) 没有细胞壁。do not have a cell wall.
- (c) 不是真核生物。are not eukaryotic.
- (d) 是多核性 (multinucleate)，但不是多细胞的 (multicellular)。are multinucleate but not multicellular.
- (e) 利用孢子繁殖。reproduce by spores.

17. 下列何种植物细胞在功能成熟 (functional maturity) 时死亡？

Which of the following cells are dead at functional maturity?

- (a) 管胞 tracheids
- (b) 软木细胞 cork cells
- (c) 容器元素 vessel elements
- (d) 厚壁细胞瘤 sclerenchyma cells
- (e) 上述皆是 all of the above

18. 种子的组成是

A seed consists of

- (a) 胚胎，种皮和营养供应部份。an embryo, a seed coat and a nutrient supply.
- (b) 一个胚囊。an embryo sac.
- (c) 配子体 (gametophyte) 和营养供应部份。a gametophyte and a nutrient supply.
- (d) 一个变大的卵巢。an enlarged ovary.
- (e) 一个胚珠 an ovule.

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19. 下列何种激素会喷洒在大麦种子上以加速酿造啤酒麦芽 (malt) 的发芽 (germination) ?

Which of the following hormones would be sprayed on barley seeds to speed germination in the production of malt for making beer?

- (a) 脱落酸 abscisic acid
- (b) 生长素 auxin
- (c) 细胞分裂素 cytokinin
- (d) 乙烯 ethylene
- (e) 赤霉素 gibberellins

20. 基础代谢率 (basal metabolic rate) 是

The basal metabolic rate

- (a) 对每个物种都是不变的。is constant for each species.
- (b) 可能会因有机体的性别或体型大小而有多不同。may vary depending on the sex or size of an organism.
- (c) 当一只动物正在运动时，它是最高的。is highest when an animal is actively exercising.
- (d) 低于外温动物 (ectotherms) 的标准代谢率。is lower than the standard metabolic rate for ectotherms.
- (e) 可以从一只动物吃的食物数量来计算。may be measured from the quantity of food eaten by an animal.

21. 以下那项陈述是错误的？

Which of the following statements is false?

- (a) 一般人都有足够的脂肪储存几周的卡路里。The average human has enough stored fat to supply calories for several weeks.
- (b) 瘦素 (leptin) 的增加引起食欲和体重的增加。An increase in leptin levels leads to an increase in appetite and weight gain
- (c) 葡萄糖和糖元的转变发生在肝脏中。Conversion of glucose and glycogen takes place in the liver.
- (d) 糖元储藏充足后，无论其原始食物来源为何，过量的卡路里都以脂肪形式储存。After glycogen stores are filled, excessive calories are stored as fat, regardless of their original food source.
- (e) 在使用蛋白质之前，碳水化合物和脂肪是优先作为燃料。Carbohydrates and fats are preferentially used in fuel before proteins are used.

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22. 动脉和静脉有何不同？

How are arteries and veins different?

- (a) 动脉比静脉有更厚的肌肉和结缔组织层 (connective tissue)。An artery has a thicker muscular and connective tissue layer than a vein.
- (b) 静脉没有瓣膜 (valves) 但动脉有。Veins do not have valves but arteries do.
- (c) 动脉血液压力低于静脉血压。Blood is under lower pressure in arteries than in veins.
- (d) 动脉将血液输送到心脏；静脉将血液送离心脏。Arteries carry blood to the heart; veins carry blood away from the heart.
- (e) 动脉血液含有多量的氧气；血液中的血液总是缺氧。Blood in arteries is oxygen rich; blood in veins is always oxygen poor.

23. 以下那项防御对病毒颗粒无效？

Which of the following is *not effective* against viral particles?

- (a) 被感染的细胞所分泌的干扰素 (interferon)。secretion of interferon by infected cells
- (b) 抗体的中和 (neutralization)。neutralization by antibodies
- (c) 溶酶体酵素 (lysozyme)。lysozyme
- (d) 继发免疫反应 a secondary immune response
- (e) 体液免疫 humoral immunity

24. 以下那一项不是内温动物 (endotherms) 的描述？

Which of the following is *not* descriptive of endotherms?

- (a) 有维持激烈活动的 ability。ability to sustain vigorous activity
- (b) 高效能的循环和气体交换系统。efficient circulatory and gas exchange systems
- (c) 高代谢率和代谢热量 (metabolic heat) 的保留。high metabolic rate and retained metabolic heat
- (d) 高效能量 (energetically efficient) 并比较不昂贵。energetically efficient and relatively inexpensive
- (e) 有解决地面温度变动的能力。ability to deal with terrestrial temperature fluctuation

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25. 下列那一个局部调节剂 (local regulators) 可以扩大疼痛的感觉 (sensation of pain)。

Which of the following local regulators amplifies the sensation of pain.

- (a) 前列腺素 prostaglandins
- (b) 组织胺 histamine
- (c) 生长因子 growth factor
- (d) 白细胞介素 interleukins
- (e) 一氧化氮 nitric oxide

26. 当怀孕在第一个三月期 (first trimester) 时，胚胎可产生何种激素来维持怀孕所必需的？

Which hormone is produced by the embryo during the first trimester and is necessary for maintaining a pregnancy?

- (a) 雌激素 estrogen
- (b) 黄体激素 progesterone
- (c) LH (黄体生成素, luteinizing hormone)
- (d) FSH (促卵泡激素, follicle-stimulating hormone)
- (e) HCG (人类绒毛膜促性腺激素, human chorionic gonadotropin)

27. 選擇不正確的選項 Choose the INCORRECT statement.

- (a) 葉綠體是一種含有葉綠素的質體，其主要作用是進行光合作用
Chloroplast is a type of plastid containing chlorophyll and its main role is to carry out photosynthesis
- (b) 澱粉體是一種專門用於植物細胞中澱粉儲存的質體 Amyloplast is a type of plastid that is specialized for starch storage in plant cells
- (c) 在植物細胞的細胞質膜中發現纖維素和半纖維素 Cellulose and hemicellulose are found in the membrane plasma of a plant cell
- (d) 植物和動物細胞能夠進行細胞呼吸 Plant and animal cells are able to carry out cellular respiration

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28. 一个种羣 (population) 是

A population is

- (a) 在特定环境中所需求的最小个体数(individuals)，以维持一个可变的基因库 (gene pool)。the minimum number of individuals required to maintain a varied gene pool in a given environment
- (b) 能够演化的最小单位。the smallest unit that can evolve
- (c) 在同一的时间中，住在相同地点的同种(species)个体组。a group of individuals of the same species living in the same place at the same time
- (d) 多个羣聚(community)的组合。a collection of communities
- (e) b 与 c 皆对。both b and c

29. 下列何者叙述有关出汗 (sweating) 是错误的?

Which of the following statements about sweating is false?

- (a) 水分丧失通常是排汗时所连带的主要问题。Water loss is usually the main problem associated with sweating.
- (b) 我们在排汗时所丧失的主要离子是钠和氯离子。The main ions we lose in sweat are sodium and chloride.
- (c) 汗水比其它身体的体液更加稀释。Sweat is much more dilute than other body fluids.
- (d) 在丧失水分前时，排汗所引起的离子丧失已经是一个问题了。Ion losses associated with sweating become a problem before water losses.
- (e) 人类甚至在一个非常冷的日子中能排汗。People can sweat even on a very cold day.

30. 温室效应(greenhouse effect)

Greenhouse effect

- (a) 被光合作用所抵消，因它将二氧化碳从大气中 (atmosphere) 除掉。is counteracted by photosynthesis, which removes carbon dioxide from the atmosphere
- (b) 因光合作用而变得更糟，因它增加大气中的二氧化碳。is made worse by photosynthesis, which adds carbon dioxide to the atmosphere
- (c) 因燃烧化石燃料(fossil fuels)而变得更糟，因它将氧气从大气中除掉。is made worse by burning of fossil fuels, which removes oxygen from the atmosphere
- (d) 因燃烧木头而改善，因为会增加大气中的二氧化碳。is improved by the burning of wood, because this adds carbon dioxide to the atmosphere

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- (e) 因增加大气中的二氧化碳而改善，因为二氧化碳能从地球表面移除多余的热量，并将热量反射回太空中。is improved by the addition of carbon dioxide to the atmosphere, since carbon dioxide removes excess heat from the earth's surface and reflects it back into space
31. 某 DNA 之三联体密码 (triplet of bases) 顺序为 AAA，与其相对 mRNA 结合之 tRNA 反密码子 (anticodon) 为何？
A particular triplet of bases in the coding sequence of DNA is AAA. The anticodon on the tRNA that binds the mRNA codon is
- (a) TTT
 - (b) UUA
 - (c) UUU
 - (d) AAA
 - (e) UAA 或 TAA，依据其第一碱基之摆动 (wobble) 决定。either UAA or TAA, depending on first base wobble
32. 这是描述什么的结构组织？“一块肌肉组织本身可以拉平和放松，以改变胸部的压力，使呼吸作用发生。”
What structure is described here? "*A sheet of muscular tissue that flattens and relaxes to alter the pressure in the thorax, allowing breathing to occur.*"
- (a) 肋间肌 Intercostal muscle
 - (b) 腹部 Abdomen
 - (c) 胸膜 Pleural membrane
 - (d) 横隔膜 Diaphragm
 - (e) 胸部 Thorax
33. 在 2 型糖尿病中
In type 2 diabetes
- (a) 胰岛素仍然产生，但细胞中的目标组织(目标组织中的细胞??)不再反应，因此血糖水平不会降低。Insulin is still produced, but cells in the target tissues no longer respond, so blood glucose levels is not brought down
 - (b) 朗格汉斯胰岛(islets of Langerhans) 中的 α 细胞不再能够产生胰高血糖素(glucagon)，因此血糖水平波动很大 The alpha cells in the islets of Langerhans are no longer able to produce glucagon, so blood glucose levels fluctuates wildly
 - (c) 肌肉无法分解糖原，导致疲劳无力和肌肉萎缩。Muscles are unable to

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breakdown glycogen, leading to fatigue weakness and muscle wasting

- (d) 胰島素不再產生，因此肌肉和肝臟不再能夠攝取葡萄糖且產生高血糖症 (hyperglycaemia)。Insulin is no longer produced, so the muscles and liver can no longer take up glucose and resulted hyperglycaemia ~~result~~
- (e) 肝臟無法產生糖原，因此身體無法儲存葡萄糖，導致血糖水平大幅波動 The liver is unable to make glycogen, so the body is unable to store glucose, leading to large swings in blood glucose levels

34. “雄性蜜蜂是沒有父親的” 這句敘述是代表甚么意思？

What is meant by the statement that “male bees are fatherless”?

- (a) 雄性蜜蜂在撫養年幼蜜蜂之事上不扮演任何角色。male bees don't play a role in rearing of young bees.
- (b) 雄性蜜蜂由卵直接發育而成。male bees develop from eggs.
- (c) 雄性蜜蜂由受精卵直接發育而成。male bees develop from fertilized eggs.
- (d) 雄性蜜蜂由非受精卵直接發育而成。male bees develop from unfertilized eggs.
- (e) 蜂後的伴侶在雄卵孵化前就死亡。the queen bee's mate dies before the male eggs hatch.

35. 單子葉植物與雙子葉植物的區別在於: Monocots differ from dicots in terms of:

- (a) 通常在單子葉植物中觀察得到直根，而在雙子葉植物中觀察不到 Taproot is usually observed in monocots but not in dicots
- (b) 單子葉植物的維管束通常以環狀排列 Vascular bundles of a monocot is usually arranged in ring
- (c) 雙子葉的葉脈通常平行排列，但單子葉植物中沒有 Veins of dicot leaves is usually arranged in parallel but not in monocots
- (d) 單子葉植物的花通常是三的倍數 Floral parts of monocots are usually in multiples of three