



FACULTY OF SCIENCE

DEPARTMENT BOTANY AND PLANT BIOTECHNOLOGY

BIO1A1E

BIOLOGY EXTENDED 1A

APK CAMPUS

DECEMBER SSA EXAM

1 DECEMBER 2015

DATE: 6 NOVEMBER 2015

SESSION: 12H30-15H30

ASSESSOR: MS J. WILLIAMSON

INTERNAL MODERATOR: DR. A. NEL

DURATION: 3 HOURS

TOTAL MARKS: 150

NUMBER OF PAGES: 12 PAGES

Please read the following instructions carefully:

1. Answer all the questions in the question paper.
2. Answer ALL of the questions in the test book.
3. Work neatly
4. Read your questions carefully.
5. Good Luck.

QUESTION 1

[20]

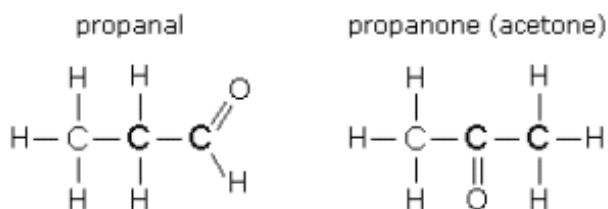
Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the question number in your answer book.

- 1.1 All of the grey squirrels that inhabit an oak forest describes a/an: _____
- A. ecosystem
 - B. biosphere
 - C. community
 - D. population
 - E. colon
- 1.2 Which of the following scientific studies would represent an example of a “systems biology” approach?
- A. measuring the effect of an invading insect that eats oak leaves on the numbers of oak trees and on any subsequent changes in the number and types of decomposer fungi in the soil.
 - B. discovering the structure of an enzyme that is important in digestion of protein comparing the microscopic structure of leaves of two different species of magnolias.
 - C. measuring the reproductive rate of emperor penguins during exceptionally warm and exceptionally cold years.
 - D. comparing the DNA sequence of two (2) closely related plants and inferring their evolutionary histories.
- 1.3 Based on the periodic table shown below, which elements will most likely form a covalent bond?

| | | | | | | | | |
|--------------|---------------------------------------|--|---|--|--|--------------------------------------|---|--------------------------------------|
| First shell | Hydrogen ${}^1_1\text{H}$ | | | | | | | Helium ${}^2_2\text{He}$ |
| Second shell | Lithium ${}^3_3\text{Li}$ | Beryllium ${}^4_4\text{Be}$ | Boron ${}^5_5\text{B}$ | Carbon ${}^6_6\text{C}$ | Nitrogen ${}^7_7\text{N}$ | Oxygen ${}^8_8\text{O}$ | Fluorine ${}^9_9\text{F}$ | Neon ${}^{10}_{10}\text{Ne}$ |
| Third shell | Sodium ${}^{11}_{11}\text{Na}$ | Magnesium ${}^{12}_{12}\text{Mg}$ | Aluminum ${}^{13}_{13}\text{Al}$ | Silicon ${}^{14}_{14}\text{Si}$ | Phosphorus ${}^{15}_{15}\text{P}$ | Sulfur ${}^{16}_{16}\text{S}$ | Chlorine ${}^{17}_{17}\text{Cl}$ | Argon ${}^{18}_{18}\text{Ar}$ |

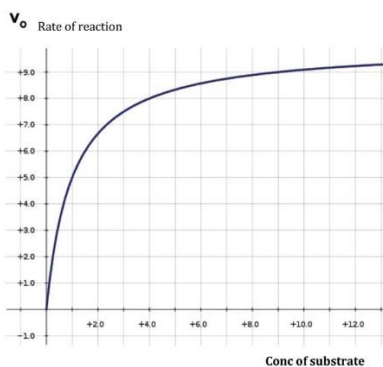
- A. Na and Cl
- B. C and O

- C. N and O
 D. Si and Cl
 E. H and H
- 1.4 H₂O can be considered _____, but H₂ can only be considered _____.
 A. an isotope and a molecule; a molecule
 B. an isotope and a molecule; an isotope
 C. a compound and an isotope; a molecule
 D. a molecule and a compound; a compound
 E. a molecule and a compound; a molecule
- 1.5 Which functional group behaves as a weak acid in organic molecules?
 A. Amino
 B. Carboxyl
 C. Carbonyl
 D. Sulfhydryl
 E. Hydroxyl
- 1.6 What type of isomer is propanal compared to acetone?



- A. cis-trans isomer
 B. structural isomer
 C. enantiomer
 D. none of the above; these are not isomers
- 1.7 Brefeldin A is a drug that disrupts transport from the ER to the Golgi apparatus. What other organelles and membranes in an animal cell are affected?
 A. lysosomes, transport vesicles, plasma membrane, nuclear membranes
 B. mitochondria, peroxisomes, plasma membrane
 C. vacuoles, mitochondria, plasma membrane
 D. lysosomes, transport vesicles, nuclear membrane
 E. all intracellular organelles and membranes

- 1.8 A typical eukaryotic nucleus has to exchange a great deal of protein and nucleic acid material with the surrounding cytosol of the cell. Which choice correctly describes a feature of most nuclei that helps promote this exchange?
- Many nuclei wait until the start of cell division, when the nuclear membrane barriers are removed, for the exchange of many needed items.
 - There are numerous nuclear pores that allow regulated passage of selected items into and out of the nuclear space.
 - Large numbers of vesicles that fuse with and bleb from the nuclear membranes are used in the movement of these items.
 - Many nuclei increase their membrane surface area relative to the nuclear volume by modifying their shape from that of a sphere.
 - The nuclear envelope membranes are selectively permeable and able to permit the passage of the needed items through their lipid phase.
- 1.9 Receptor-mediated endocytosis produces vesicles that _____
- typically deliver the items they take up to the nucleus of the cell.
 - carry macromolecules and cells for delivery to the lysosomal compartment.
 - assist in the removal of certain items from the cytosol of the cell.
 - when formed cause there to be more total surface area available in the plasma membrane.
 - have receptors which can indicate at their cytosolic side if ligands are bound or not on their extracellular/ lumen side.
- 1.10 If the reaction in the graph is an enzyme-catalyzed reaction, how can the rate of this reaction be increased beyond the maximum velocity in this figure?



- Increase the substrate concentration.
- Increase the amount of enzyme.
- Raise the temperature to be more optimal.

- D. B is the best choice, but A and C are also possible.
- E. There is no way to increase the rate of the reaction any further.
- 1.11 Which of the following statements about the citric acid cycle is true?
- A. It occurs during the movement from the cytosol through the mitochondrial membranes.
- B. It makes ATP through substrate-level phosphorylation.
- C. It makes the most ATP compared to the other steps.
- D. It occurs in the eukaryotic cytoplasm.
- E. It splits glucose.
- 1.12 During intense exercise, muscles lack sufficient oxygen, so which process will these muscles mainly use?
- A. Alcoholic fermentation.
- B. The citric acid cycle.
- C. Only glycolysis, with NAD not utilized
- D. Lactic acid fermentation.
- E. Chemiosmosis.
- 1.13 One way in which photosynthesis as done in a typical C₄ plant differs from that in a C₃ plant, is that the C₄ plant _____
- A. does not produce any oxygen gas at all.
- B. actively pumps oxygen gas away from the cells that contain rubisco.
- C. avoids the use of rubisco entirely; instead, it uses PEP carboxylase to catalyze all carbon fixation.
- D. keeps its stomata more open, so that more CO₂ can enter the plant.
- E. carries out the Calvin cycle only in the chloroplasts of bundle-sheath cells.
- 1.14 Which process is most directly driven by light energy?
- A. Creation of a pH gradient by pumping protons across the thylakoid membrane.
- B. Carbon fixation in the stroma.
- C. Reduction of NADP⁺ molecules.
- D. Removal of electrons from chlorophyll molecules.
- E. ATP synthesis.

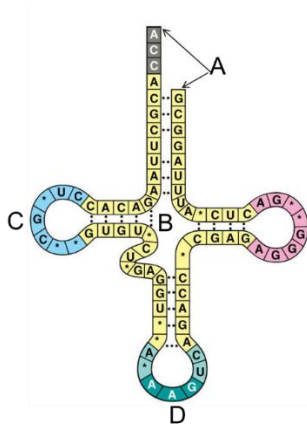
- 1.15 Which of the following does NOT need to happen during a successful mitotic cell division?
- A. Single-chromatid chromosomes must be segregated in full sets of the genome.
 - B. Exchange of DNA between homologous chromosomes must happen before metaphase.
 - C. The chromatin must condense fully so that the chromosomes are compact.
 - D. Microtubules must be assembled as part of the spindle apparatus.
 - E. Each of the chromosomes must start mitosis containing two DNA molecules.
- 1.16 Which of the following is a INCORRECT description of how cytokinesis) in animals differs from that in most plants?
- A. Animal cytokinesis separates the two new nuclei but not the cytoplasm, while plant cytokinesis separates both.
 - B. Animal cytokinesis does not involve the fusion of Golgi-derived vesicles.
 - C. Microfilaments play a role in animal cytokinesis but not in plant cytokinesis.
 - D. The new separating plasma membrane is pulled inward in animals but grows outward in plants.
 - E. Animal cytokinesis produces no new cell wall regions, while plant cytokinesis does.
- 1.17 If roan cattle (incomplete dominance) are allowed to breed, what ratio of phenotypes is expected in the offspring?
- A. 1:1 red:white
 - B. all roan
 - C. 1:2:1 red:roan:white
 - D. 3:1 red:white
 - E. 1:1:1 red:roan:white

1.18 The following offspring were observed from many crossings of the same pea plants.
What genotypes were the parents?

| | |
|--------------------------|-----------------------------|
| 465 purple axial flowers | 152 purple terminal flowers |
| 140 white axial flowers | 53 white terminal flowers |

- A. PpAa x PpAA
- B. PpAa x ppAA
- C. PPAA x ppaa
- D. PpAa x PpAa
- E. PPaa x ppAA

1.19 Which of the following is incorrectly identified in the figure below?



- A. 5C and 3C ends.
- B. Hydrogen bond.
- C. Amino acid attachment site.
- D. Anticodon loop.

1.20 From the following list, which is the first event in translation in eukaryotes?

- A. Elongation of the polypeptide.
- B. Base pairing of activated methionine-tRNA to AUG of the messenger RNA.
- C. The larger ribosomal subunit binds to smaller ribosomal subunits.

D. Covalent bonding between the first two amino acids.

E. The small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA.

QUESTION 2

[20]

Give the correct biological term for each of the following definitions. Only write down the correct term next to the appropriate question number in your answer book.

- 2.1 Prokaryotes that often live in Earth's extreme environments (most single celled and microscopic).
- 2.2 The method used by scientists to draw general conclusions from many observations.
- 2.3 The element added to municipal water and dental products to help reduce tooth decay.
- 2.4 The bond that forms between the elements of a water molecule.
- 2.5 The hydrophilic parts of a phospholipid.
- 2.6 The common component in animal cell membranes which are the starting material for making steroids, including sex hormones.
- 2.7 The structure responsible for propelling a cell by an undulating, whip like motion.
- 2.8 A rare disease characterized by recurrent infections of the respiratory tract and immotile sperm.
- 2.9 The tendency of particles to spread out evenly in an available space.
- 2.10 A solution where the solute concentration is higher outside the cell than inside the cell, causing water molecules to move out of the cell.
- 2.11 The process whereby prokaryotic organisms use an e- transport chain with an e- acceptor other than O₂, for example sulphate.
- 2.12 The enzymes necessary to oxidize glucose and other foods.
- 2.13 Structures concentrated in stacks called grana.
- 2.14 Important light-absorbing pigments in chloroplasts.

- 2.15 Human sex chromosomes.
 - 2.16 A type of cell division that produces haploid gametes in diploid organisms.
 - 2.17 An example of incomplete dominance in humans, in which dangerously high levels of cholesterol occur in the blood and heterozygotes have intermediately high cholesterol levels.
 - 2.18 The phenomenon where one (1) gene influences many characteristics.
 - 2.19 Enzyme which adds RNA nucleotides to a DNA strand during DNA replication.
 - 2.20 The enzyme which cuts out & replaces damaged stretches of DNA.
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QUESTION 3

[11]

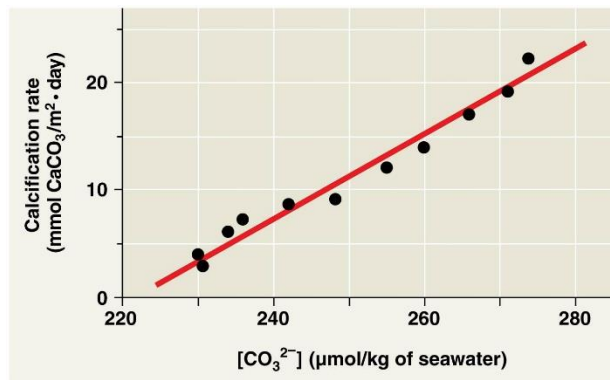
- 3.1 The dynamics of ecosystems include two (2) major processes. Name these processes and discuss the above statement. (10 x ½ = 5)
 - 3.2 Natural selection was inferred by connecting two (2) observations. Briefly describe these observations of Charles Darwin. (2)
 - 3.3 How is a theory different from a hypothesis? (3)
 - 3.4 The basic goals of science and technology differ. Discuss this statement briefly. (2 x ½ = 1)
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QUESTION 4

[11]

- 4.1. What do elements with atomic numbers 6, 14, and 22 have in common? (2)
- 4.2 In a glass of old-fashioned lemonade, which is the solvent and which is the solutes? (2)
- 4.3 What is evaporative cooling? (2)
- 4.4 Compared to an acidic solution at pH 5, a basic solution at pH 8 has more of which elements and less of which elements? (2)

- 4.5 Based on this graph, what is the relationship between carbonate ion concentration and calcification rate? (2)

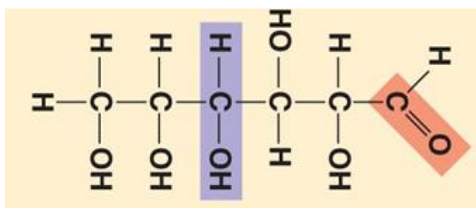


- 4.6 When astrobiologists search for signs of extraterrestrial life on distant planets, what do they search for and why? (2 x ½ = 1)

QUESTION 5

[11]

- 5.1 Explain how a nucleic acid polymer, a polynucleotide, form? (6)
- 5.2 Discuss trans-fats. (4 x ½ = 2)
- 5.3 The sugar in the diagram below can be grouped according to two (2) criteria. Name these criteria and give the possible groups of the sugar in the diagram below. (3)

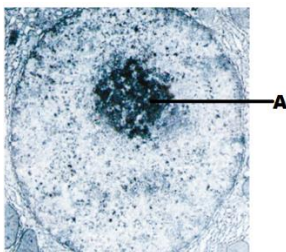


QUESTION 6

[11]

- 6.1 Why do animal cells synthesize and secrete an elaborate extracellular matrix? (3)
- 6.2 Discuss the structure and functions of the different parts of prokaryotic cells. (5)

- 6.3 The diagram below shows part of a plant cell. Name structure A and give the function of this structure. Supply the name of the organelle in which structure A is located. (3)



QUESTION 7 [11]

- 7.1 Cell membranes are fluid mosaics. Explain this statement. (11)

QUESTION 8 [11]

- 8.1 Distinguish between obligate anaerobes and facultative anaerobes. (2)
- 8.2 Discuss different ways in which cellular poisons can obstruct the process of oxidative phosphorylation in a cell and give examples of each method. (6)
- 8.3 Why do fats make better cellular fuel than carbohydrates? (3)

QUESTION 9 [11]

- 9.1 Photosynthesis may moderate global climate change. Critically discuss this statement by referring to the greenhouse effect. (22 x ½ = 11)

QUESTION 10 [11]

- 10.1 When an organism with a $2n = 6$ is ready to reproduce, which process must occur in the gonads of the organism before it can reproduce? (1)

- 10.2 Draw and label diagrams to explain the first half of the process answered in question 10.1. (20 x ½ = 10)
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QUESTION 11

[11]

- 11.1 Consider the following crosses in *Drosophila*. The two (2) traits being investigated involve eye colour and the presence or absence of wing cross veins. The outcomes of four (4) crosses are shown below:

| Parents of cross | Number of offspring of each phenotype | | | |
|--|---------------------------------------|-----------------------|-----------------|--------------------|
| | orange, crossveins | orange, crossveinless | red, crossveins | red, crossveinless |
| orange, crossveins orange, crossveins | 83 | 26 | 0 | 0 |
| red, crossveins red, crossveinless | 20 | 18 | 65 | 63 |
| red, crossveinless red, crossveins | 0 | 0 | 71 | 81 |
| red, crossveins red, crossveins | 28 | 11 | 93 | 34 |

- 11.1.1 Which eye colour is dominant and which is recessive? (2)
- 11.1.2 Which wing vein type is dominant and which is recessive? (2)
- 11.1.3 What is the most likely genotype of each parent for each of the four (4) crosses? (4)
- 11.2 Explain why human sex-linked disorders affect mostly males. (3)
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QUESTION 12

[11]

- 12.1 Explain the elongation process of translation during protein synthesis. (6)
- 12.2 Give the reproductive cycle of the mumps virus. (5)
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