

**UNIVERSITY OF BOTSWANA**

**2005/2006 SEMESTER ONE EXAMS**

**FRONT PAGE**

Course No	: <b>BIO 111</b>	Duration	: <b>2 hours</b>
	Date	: <b>November/December 2005</b>	
Title of Paper	: <b>PRINCIPLES OF BIOLOGY</b>		
Subject	: <b>BIOLOGICAL SCIENCES</b>		
Morning/ Afternoon			

**INSTRUCTIONS:**

**Answer ALL questions in sections A and B and ONE question from Section C.**

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**NO. OF PAGES INCLUDING THIS ONE [ 12 ]**

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**DEPARTMENT OF BIOLOGICAL SCIENCES**

**2005/2006 SEMESTER ONE EXAMINATIONS**

**Course Code: BIO 111**

**Course Name: PRINCIPLES OF BIOLOGY**

**November/December 2005**

**Duration: 2 hours**

**Answer ALL questions in sections A and B and ONE question from Section C.**

**Total marks available = 80**

**ID Number:.....**

**Tutorial Group: .....**

**SECTION A: Multiple choice (40 marks available, one mark per question. Allow 60 minutes for this section). Circle the letter that you think is the correct answer.**

1. Mendel's First Law holds because:
  - a. crossing-over occurs in metaphase I,
  - b. non-homologous chromosomes assort independently,
  - c. recessive alleles are hidden in the  $F_1$  generation,
  - d. chromosomes and chromatids segregate at random during meiosis
  - e. fertilization is non-random.
  
2. In sweet peas, red shows incomplete dominance over white. In a parental cross between a pure-breeding red flower and a white flower, what would be the expected phenotype ratio in the  $F_2$  generation?
  - a. 3 red 1 white
  - b. 1 red 1 pink 1 white
  - c. 1 red 2 pink 1 white
  - d. 2 red 1 pink 1 white
  - e. 9 red 3 dark pink 3 light pink 1 white.
  
3. In a family with three children, what is the probability that they will be all boys or all girls?
  - a.  $1/2$
  - b.  $1/3$
  - c.  $1/4$
  - d.  $1/8$
  - e.  $1/16$

4. In Avery et al.'s proof that DNA was the genetic material, they used a nuclease to i. \_\_\_\_\_ and a protease to ii. \_\_\_\_\_.
- i. heat-kill S-strain bacteria    ii. transform R-type bacteria
  - i. break up DNA    ii. break up protein
  - i. label protein    ii. label DNA
  - i. break up protein    ii. break up DNA
  - i. separate phage ghosts    ii. lyse infected bacteria
5. How does RNA differ from DNA?
- uracil instead of thymine
  - ribose sugar instead of deoxyribose sugar
  - single-stranded instead of double-stranded
  - can perform enzyme-like functions
  - all of the above
6. In Meselson-Stahl's proof of semi-conservative replication, after one generation (c. 20 minutes) the following band(s) appeared in the centrifuge tube:
- a single  $N_{14}$  band
  - a single  $N_{15}$  band
  - a single  $N_{14/15}$  hybrid band
  - an  $N_{14}$  band and an  $N_{14/15}$  hybrid band
  - an  $N_{14}$  band and an  $N_{15}$  band
7. Which of the following enzymes catalyses transcription?
- DNA polymerase
  - RNA polymerase
  - DNA ligase
  - exonuclease
  - amino-acyl tRNA synthetase
8. Which of the following best describes the genetic code?
- Triplet, universal, non-overlapping, analogous & highly specific.
  - Triplet, overlapping, arbitrary & highly redundant.
  - Doublet, species-specific, dispersive, arbitrary & highly repetitive
  - Triplet, universal, non-overlapping, arbitrary & highly redundant.
  - Triplet, hypothetical, encrypted, arbitrary & highly redundant.
9. Homologies are recognised by:
- structural equivalence, functional diversity.
  - structural diversity, functional equivalence
  - convergent evolution
  - perfection of design
  - density gradient equilibrium sedimentation

10. What was the Cambrian explosion?
- Big Bang
  - Rapid appearance of all major phyla about 550 mya.
  - First mass extinction
  - Asteroid impact that destroyed the dinosaurs
  - Adaptive radiation following the extinction of the dinosaurs
11. Which of the following states of development is defined by the three embryonic tissue layers (ectoderm, mesoderm, and endoderm)?
- The gastrula
  - The zygote
  - The embryo
  - The blastula
  - The ovum
12. What is happening to a cell during differentiation?
- It is taking on its specialized function by becoming a specific cell type.
  - It is dividing to produce a cell with one-half the number of original chromosomes
  - It is dividing to produce a cell with the same number of chromosomes.
  - Material is moving across the cell's membrane as it goes from a region of high concentration to a region of low concentration.
  - It is mutating.
13. Carrots belong to the genus "daucus" Species " carota". what is the correct binomial nomenclature for the carrot?
- Daucus carota
  - Carota daucus
  - Daucus Carota
  - daucus carota
  - carota Daucus*
14. Prokaryotes differ from eukaryotes by absence of:
- Mitochondria
  - Chloroplasts
  - Golgi apparatus.
  - Endoplasmic reticulum
  - All the above.
15. In bacteriology, the most common method of achieving isolated colonies is the:
- Broth dilution.
  - Agar slant.
  - Streak plate.
  - Agar deep.
  - Gram staining

16. Which of the following represent the correct order in stages of development?
- Fertilization → growth → determination → differentiation → morphogenesis
  - Fertilization → growth → differentiation → determination → morphogenesis
  - Fertilization → differentiation → growth → differentiation → morphogenesis
  - Fertilization → determination → differentiation → growth → morphogenesis
  - Fertilization → gastrulation → differentiation → growth → oogenesis
17. Which of the following can lead to contamination?
- Forgetting to flame the loop between inoculations.
  - Allowing the broth to reach the top of the tube.
  - Allowing moisture from the cover of an agar plate to leak onto the agar.
  - a. and b. only
  - All of these.
18. What is the first step in transcription?
- Recognition of start codon.
  - Denaturation of DNA at *Ori* site.
  - Promoter recognition
  - Formation of primary transcript
  - RNA processing
19. What is the most abundant polysaccharide on Earth?
- Starch
  - Peptidoglycan
  - Glycogen
  - Sucrose
  - Cellulose
20. Cells are small in order to:
- maintain osmotic balance
  - maximize surface area-volume ratio
  - maximize volume-surface area ratio
  - minimize surface area-volume ratio
  - reduce gas exchange
21. Which of the following statements best describes the logic of the scientific method?
- If I generate a testable hypothesis, tests and observations will support it.
  - If my prediction is correct, it will lead to a testable hypothesis.
  - If my observations are accurate, they will support my hypothesis.
  - If my hypothesis is correct, I can expect certain test results.
  - If my controlled experiments are set up right, I will be able to generate a testable hypothesis.

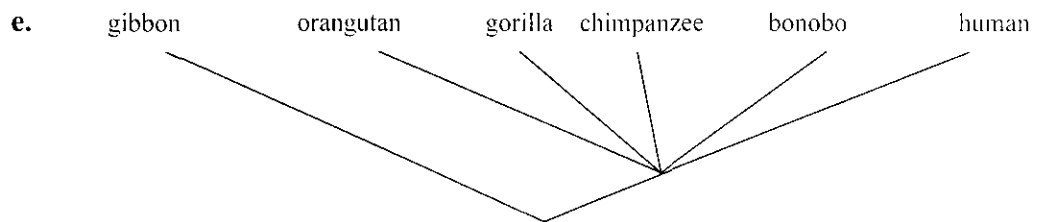
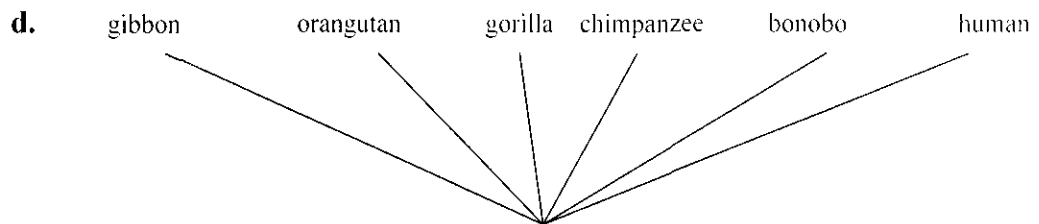
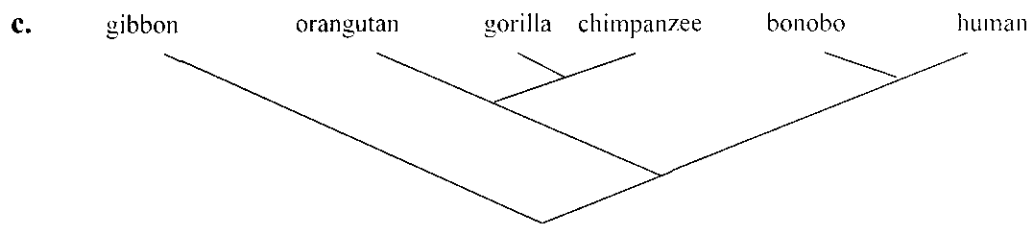
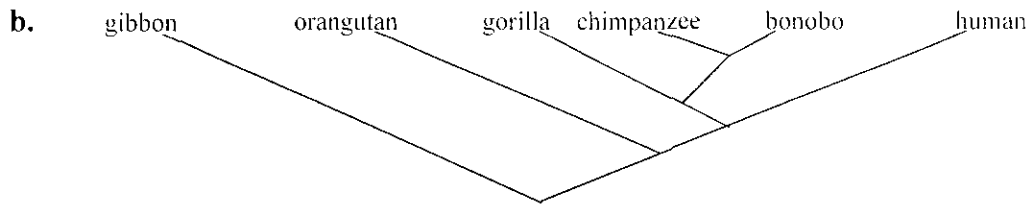
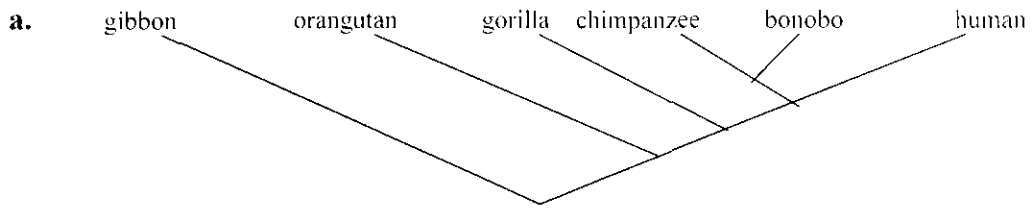
22. Anabolic reactions:
- generate free energy
  - break down complex molecules
  - convert nucleotides to amino acids
  - are energy-demanding
  - violate the Second Law of Thermodynamics.
23. Which of the following is *not* a function of polysaccharides in organisms:
- energy storage
  - storage of hereditary material
  - formation of cells walls
  - structural support
  - formation of exoskeletons
24. Proteins differ from one another because:
- the peptide bonds linking amino acids differ from protein to protein
  - the sequence of amino acids in the polypeptide chain differs from protein to protein
  - each protein molecule contains its own unique sequence of sugars
  - the number of nucleotides in each protein varies from molecule to molecule
  - the number of nitrogen atoms in each amino acid differs from the number on all the others
25. Which of the following information can we not derive from fossils?
- Radioisotope dating of major evolutionary events.
  - Changes in biodiversity with time.
  - Paleoenvironments.
  - Interbreeding potential of the species.
  - a. and d.
26. The biological species concept is defined in terms of:
- morphology
  - binomial nomenclature
  - reproductive isolation
  - cladistic divergence
  - mode of speciation
27. Which one of the following statements is true regarding species concepts?
- The cladistic species concept emphasizes evolutionary and potential interbreeding ability of species.
  - According to the biological species concept, a natural population consists of interbreeding species.
  - The Biological species emphasizes the actual evolutionary relationships.
  - The phenetic species concept is based on morphological similarities.
  - The species concept allows interchanging of genes between species.

28. Viruses are:
- the smallest prokaryotes
  - obligatory cellular parasites
  - a group of pathogenic bacteria
  - free-living acellular organisms
  - composed of a polynucleotide capsid surrounding a polypeptide genome
29. Biodiversity is highest in ecosystems:
- with deep fertile soils
  - with marked seasonality
  - with few predators
  - on the equator
  - at higher latitudes
30. Which of the following habitats has the highest species richness?
- Mid-oceanic ridge
  - Temperate broad-leaved forest
  - Desert
  - Savanna
  - Tropical rainforest
31. Why would you expect there to be a smaller biomass of big predators than grazing mammals in the Central Kalahari Game Reserve?
- Too little cover for predators to hide
  - The inefficiency of energy transfer between trophic levels
  - Large predators are more susceptible to diseases
  - Many predators live in very structured social groups which limits their numbers
  - Grazers are better adapted for moving long distances and can better follow the rains
32. Which of these biomes has been increased in area by human activities?
- Temperate rain forests
  - Tropical rain forests
  - Grasslands
  - Deserts
  - Savannah
33. Consider the food chain: Grass → insects → lizards → snakes → hawks.  
What trophic level do the insects occupy?
- primary producers
  - insectivores
  - carnivores
  - primary consumers
  - secondary consumers

34. A group of interbreeding individuals that are reproductively isolated from all other individuals and groups is called a:
- biome
  - habitat
  - population
  - community
  - ecosystem
35. All the populations that share a habitat are called a:
- species
  - niche
  - community
  - biome
  - ecosystem
36. The maximum number of individuals of a species that a habitat can sustain is called:
- climax community
  - ecological succession
  - biotic potential
  - carrying capacity
  - population density
37. Which of the following are true?
- Heterotrophs are organisms which require preformed inorganic compounds as a source of carbon
  - Heterotrophs are organisms which require preformed organic compounds as a source of carbon and light as a source of energy
  - Heterotrophs are organisms which require preformed organic compounds as a source of energy
  - Heterotrophs are organisms which require preformed organic compounds as a source of carbon but not energy
  - a. and b.
38. Deletions and duplications in chromosome structure are usually caused by:
- Nondisjunction
  - Segregation distortion
  - Linkage
  - Errors during crossing over
  - Frameshift mutations
39. The function of an amino-acyl tRNA synthetase is:
- to catalyze the synthesis of tRNA
  - to catalyze the synthesis of amino acids
  - to catalyze the formation of tRNA-amino acid complexes
  - to translate the codons on the mRNA
  - to recognize the start and stop codons



40. Which of the following is the most probable phylogeny for living apes?



**SECTION B: Short questions (20 marks available. Allow 30 minutes for this section)**

41. A virion consists of a central core of either DNA or RNA surrounded by a ..... (1 mark)

42. The enzyme RNA polymerase uses a single-stranded ..... template to synthesize a complementary strand of ..... (1 mark)

43. .... is an ecological interaction in which both participants benefit.  
**(1 mark)**
44. Some autotrophs can derive energy from the sun; these are  
termed .....  
**(1 mark)**
45. The end products of meiosis are ....., ....., .....  
.....  
**(1 mark)**
46. Distinguish between the lytic and lysogenic cycles in bacteriophages.  
  
  
**(2 marks)**
47. What is totipotency?  
**(1 mark)**
48. What type of virus is HIV and how does it integrate its genome into its host's  
DNA?  
  
  
**(3 marks)**
49. What is the advantage of aerobic respiration over anaerobic or fermentative  
respiration?  
**(2 marks)**
50. a. Suggest a hypothesis to explain the observation that female long-tailed  
widow-birds prefer to mate with the males that have the longest tails.  
**(2 marks)**

b. How could you test the above hypothesis? (2 marks)

51. In what ways is a Gram positive cell wall different from a Gram negative cell wall? (2 marks)

52. What are the 3 most common shapes bacteria display? (1 mark)

**SECTION C: Essay questions: Answer ONE of the following (20 marks available. Allow 30 minutes for this section)**

53. Write a comparative account of DNA replication and gene expression.

54. Discuss the implications of the size of organisms on their organization, metabolism, growth and development.

55. Discuss the major events in the history of life.

56. Write a comparative account of recombination and its implications in prokaryotes and eukaryotes.

Use the following page for your answer.

**END OF EXAMINATION**