



UNIVERSITY OF WESTERN ONTARIO
BIOLOGY 1222

October 25, 2008 Time: 2 1/2 Hours



Student No. _____ Test Room _____ Row _____

INSTRUCTIONS - FOLLOW THE CHECK LIST!

(√)	On your Scantron sheet		Fill the bubbles completely • Use HB pencil only • No stray marks or doodles • Make all erasures complete Yes - Calculators are permitted (non-programmable only) No – Borrowing is not allowed
	Print name	Print clearly	
	Signature	Do your best	
	Instructor	Maxwell, Haffie	
	Course	Bio 1222	
	Student number	Print clearly/ Bubble neatly	
	Exam Code	111 – Very important	
	Section	Leave it blank	
	Answer Sheet	Leave it blank	

(√)	On your Test Book		Do not write your name on the cover Your Scantron answers will be emailed to your UWO email account within a week. Review copies of this test will posted on WebCT for study purposes.
	Student number	No names please	
	Test Room	The room you're in right now	
	Row number	We will tell you this	
	Indicate your answers in the test book. Leave no questions blank		

- 1) Please place your ID prominently on your desk and sign the attendance sheet when it comes to you.
- 2) There are **50** questions in this test. Check your paper carefully.
- 3) There is only **one** fully correct answer for each question. Part marks may be awarded. **Answer all questions.** We do not subtract wrong from right.
- 4) Indicate your answers in **both** the test paper **and** on the Scantron.
- 5) It is your responsibility to transfer all answers from the test book to the Scantron sheet **within the 2 1/2 hour test period.**
- 6) When finished, **please stay seated** and raise your hand.
- 7) We will collect both your test book and your Scantron sheet

Warning The Scantron marking program has a cheating analysis feature that compares answer patterns for all papers. It alerts us to similarities. We then check seating arrangements.
Do not sit near your study partners or write the same test codes. Keep your work directly in front of you. Please help us avoid any and all misunderstandings during these tests.

Comments: Please defend your arguments **on this page only.** Comments will not be accepted after the test.

Circle the best single letter choice for each of the following questions before transferring your answers to your computer sheet.

1. In a given bacterial cell, resistance to a particular antibiotic arises because the antibiotic
- A. blocks cellular metabolism.
 - B. causes mutations in the bacterial chromosome.
 - C. stimulates resistant cells to pass their resistance plasmids horizontally.
 - D. moves the cells out of G_0 so they can grow more quickly.
 - E. None of A, B, C or D is correct.
-
2. With respect to the spread of bacterial antibiotic resistance, "vertical" transmission is achieved by
- A. cell division.
 - B. conjugation of plasmids to recipient cells.
 - C. movement of transposons onto plasmids.
 - D. killing all but the most resistant competing cells.
 - E. maintaining low levels of antibiotic in the environment.
-
3. Humans can reduce the speed at which bacteria evolve antibiotic resistance by
- 1. minimizing use of antibiotics by stopping treatment as soon as symptoms improve.
 - 2. adding antibiotics to domestic animal feed to reduce bacterial populations in food.
 - 3. taking a low dose of antibiotics every day to avoid serious infections.
 - 4. avoiding the use of antibiotics to treat viral infections.
- A. 1, 2 and 3
 - B. 1 and 3
 - C. 2 and 4
 - D. 4 only
 - E. 1, 2, 3 and 4 are correct.
-
4. One mechanism by which antibiotics stop bacterial cell division is by
- A. inhibiting mitochondrial function.
 - B. decreasing the stability of mRNAs.
 - C. inhibiting protein synthesis.
 - D. binding to the enzyme telomerase.
 - E. preventing glycolysis.
-
5. The original "Central Dogma" of molecular biology has been altered over the years as research has shown that
- A. RNA molecules can act as templates for protein synthesis.
 - B. some proteins can act as templates for the synthesis of both DNA and RNA.
 - C. RNA molecules can act as a template for the synthesis of DNA.
 - D. some proteins contain more than one peptide.
 - E. there are a number of different types of DNA molecules.
-

6. Regarding the *Chlamydomonas* mutant defective in nitrate reductase, which of the following statements is **NOT correct**?

- A. Nitrate reductase is required to convert one form of nitrogen into another.
 - B. The mutation results in the synthesis of a defective enzyme apoprotein.
 - C. The mutant may be defective in molybdenum uptake into the cell.
 - D. The mutant may be defective in the synthesis of a prosthetic group.
 - E. On ammonium (NH_4) media the mutant and the wild-type (WT) show similar growth.
-

7. Which of the following statements about a Northern Blot is **NOT correct**?

- A. It is used to assess transcript (mRNA) abundance.
 - B. It can be used to identify a gene that displays induced expression.
 - C. It requires a researcher to first isolate total RNA from a cell sample.
 - D. It relies on the very high specificity of complementary base pairing.
 - E. It requires the use of a denatured protein as a probe.
-

8. The whipping of egg whites most likely

- A. disrupts the primary structure of proteins.
 - B. results in the formation of disulfide bonds.
 - C. results in the loss of tertiary structure of proteins.
 - D. does not alter the overall conformation of proteins.
 - E. None of A, B, C or D is correct.
-

9. Unlike the protein ovalbumin, hemoglobin

- A. possesses primary structure.
 - B. cannot be denatured.
 - C. does not have binding sites for prosthetic groups.
 - D. possesses quaternary structure.
 - E. is composed of amino acids.
-

10. Based upon our current understanding of the abiotic origin of life, which of the following molecules was **not** important 4 billion years ago.

- A. H_2O
 - B. O_2
 - C. H_2S
 - D. NH_3
 - E. Amino acids
-

11. Which of the following statements about chirality is **NOT correct**?

- A. Homochirality was undoubtedly essential to the evolution of life.
 - B. Homochirality may have an extraterrestrial origin.
 - C. Chiral molecules are chemically identical and thus have identical biological effects.
 - D. The Miller-Urey experiment produced both L- and D- amino acids.
 - E. Sugar molecules are often chiral.
-



12. DNA was an evolutionary advancement over RNA because DNA

- A. carries genetic information.
 - B. can fold into three-dimensional shapes.
 - C. molecules can be far more varied and diverse.
 - D. is a more stable molecule, less prone to degradation.
 - E. None of A, B, C or D is correct.
-

13. Of the major questions concerning the origin of life, the one that remains largely unanswered is how

- A. short peptides could possibly have been synthesized without enzymes.
 - B. to know which of the molecules DNA, RNA, or PROTEIN developed first.
 - C. the building blocks of life could have been synthesized abiotically.
 - D. the first cells formed in the absence of liquid water.
 - E. macromolecules could have become organized into replicating cells.
-

14. Which of the following observations support the hypothesis of Panspermia?

- A. Humans have only existed for approximately 150,000 years.
 - B. Ribosomes contain molecules of RNA.
 - C. Deep sea vents have life that is able to exist in extreme environments.
 - D. Stromatolites contain cyanobacteria.
 - E. It takes a single sperm to fertilize an egg.
-

15. Astrometry/Doppler spectroscopy is a method used to search for extrasolar planets. This method relies on

- A. the gravitational influence of a planet on the parent star.
 - B. directly observing planets using powerful optical telescopes.
 - C. detecting regular and period shifts in apparent brightness of stars.
 - D. detecting evidence of water in the spectra of stars.
 - E. None of A, B, C or D is correct.
-

16. Which of the following statements from the Drake Equation lecture is **correct**?

1. It is estimated that the Milky Way contains between 100-400 billion stars.
 2. All planets that we know of orbit the Sun.
 3. The habitable zone is defined, in part, by the region where one would likely find liquid water.
 4. Travelling the speed of light, it would take over 1000 years to reach the nearest star beyond the Sun.
 5. The answer to the Drake Equation provides an estimate of the number of planets in the universe with life.
 6. Because we don't have a very good estimate for the last few parameters of the equation, there may be thousands of other civilizations or, we may be alone.
- A. 1, 2, 3, 4, 6
 - B. 1, 3, 5
 - C. 1, 3, 6
 - D. 2, 4, 6
 - E. 2, 4, 5
-

17. If water was not a polar molecule, it would

- A. have a very high heat capacity.
- B. not sublime.
- C. form hydrogen bonds with other molecules.
- D. be a gas at temperatures found on Earth.
- E. Both A and D are correct

18. In the Drake Equation, we set the variable f_p (the proportion of stars that have planets) at 0.5. This was done, in part, because

- A. planet formation is a natural consequence of star formation.
- B. given limited technology we have still been able to detect several extrasolar planets.
- C. planets are probably very rare in the galaxy.
- D. trick question - we actually set f_p at 0.05.
- E. Both A and B are correct.



19. In the Drake Equation, we set the variable f_l (the proportion of planets that develop life) at 1. This was done, in part, because

- A. evidence suggests that life is very rare.
- B. life requires water in a liquid state.
- C. life developed remarkably early on Earth.
- D. we have only found life on Earth and Mars.
- E. None of A, B, C or D is correct.

20. If the change in enthalpy of a reaction is negative then the

- A. reaction will be exergonic.
- B. products will have more energy than the reactants.
- C. entropy of the reactants will be greater than the products.
- D. reaction will be exothermic.
- E. reaction will be spontaneous.

21. Life does not go against the Second Law of Thermodynamics because, in part,

- A. organisms maintain high entropy by bringing in food molecules.
- B. life is not highly ordered.
- C. all the reactions that take place in a cell are exergonic.
- D. organisms give off heat that makes the surroundings more disordered.
- E. None of A, B, C or D is correct.

22. The reason a block of ice melts spontaneously at room temperature is because

- A. the melting is exothermic.
- B. heat is lost to the surroundings.
- C. the change in Gibbs free energy is positive.
- D. the melting is endergonic.
- E. the entropy of the system increases.

23. Which of the following statements about energy and thermodynamics are **correct**?

1. An isolated reaction will never reach equilibrium.
2. Substances that are stable have low free energy.
3. As temperature increases entropy increases.
4. A catabolic pathway results in an overall decrease in free energy.
5. The entropy of the universe is always increasing.
6. At chemical equilibrium the rate of the forward reaction equals the rate of the reverse reaction.

- A. 1, 2, 3
B. 1, 5, 6
C. 2, 4, 6
D. 2, 4, 5, 6
E. 2, 3, 4, 5, 6
-

24. Which of the following examples illustrates the First Law of Thermodynamics?

- A. Energy from Niagara Falls can be used as a source of electricity (Hydro).
B. The loss of that "new car smell".
C. Laptops generate a lot of heat.
D. Water is less dense when it is a solid than when it is a liquid.
E. A car only uses about 25% of the energy in gasoline.
-

25. Which of the following statements about enzymes are **correct**?

1. Enzymes increase the energy of activation (E_A) of a reaction.
2. Enzymes are encoded by genes.
3. Enzymes increase the probability that substrate molecules will occupy the transition state.
4. Enzymes alter the free energy of the reactants relative to the products of a reaction.
5. The active site of an enzyme requires the protein to fold correctly.
6. Enzymes are only required for the catalysis of endergonic reactions.

- A. 1, 5, 6
B. 2, 4, 6
C. 2, 3, 5
D. 1, 4, 5, 6
E. 1, 2, 3, 5
-

26. In enzyme kinetics,

- A. the K_m is the rate of the reaction at high substrate concentrations.
B. if an enzyme has a high V_{max} it must have a low K_m .
C. a reaction can have a very low K_m and a very high V_{max} .
D. if an enzyme has a high K_m it must have a low V_{max} .
E. the higher the K_m the greater the affinity between enzyme and substrate.
-

27. A competitive inhibitor

- A. binds to a site other than the active site.
B. results in the enzyme changing its conformation.
C. may irreversibly bind to and inactivate an enzyme molecule.
D. acts in a manner that is similar to an allosteric inhibitor.
E. None of A, B, C or D is correct.
-

28. Which of the following statements about the control of gene and protein expression is **NOT correct**?

- A. Ribozymes can function by regulating the abundance of some mRNAs.
- B. Induced gene expression is usually the result of transcription factor binding.
- C. Allosteric control of enzyme function is a type of post-translational regulation.
- D. The steady-state abundance of an mRNA is a balance between rate of synthesis and rate of decay.
- E. Housekeeping genes usually display induced expression.**

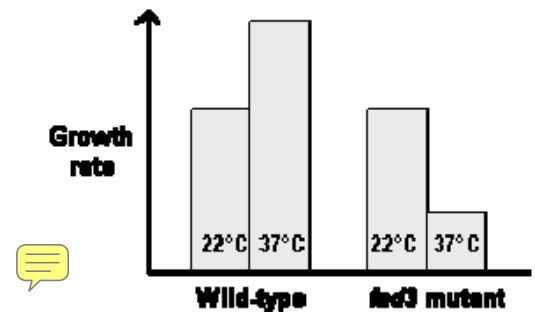
29. Penicillin

- A. kills bacteria by directly preventing protein synthesis.
- B. is a substrate analog of an enzyme.**
- C. is structurally similar to the enzyme Transpeptidase.
- D. is encoded by a gene.
- E. is an example of a reversible inhibitor.

30. Compared to normal (wild-type), the *fad3* mutant of *E. coli* displays constitutive high expression of the desaturase gene, *fad3*.

The probable reason for the mutant's poor growth at 37°C is

- A. its high levels of fatty acids containing *cis* double bonds.
- B. its abundance of fatty acids that contain *trans* single bonds.
- C. its low level of lipid unsaturation
- D. that its membrane fluidity is too high.
- E. Both A and D are correct.**



31. It has recently been shown that mice carrying one defective allele of the gene encoding the cystic fibrosis transporter (CFTR) (**Cc**) are less susceptible to Cholera than mice that do not carry the defective allele (**CC**). What is the most likely explanation for this?

- A. The Cc mice do not lose as much water.**
- B. The Cc mice are able to pump more chloride out of cells.
- C. Prior to Cholera exposure the Cc mice already displayed compromised lung function.
- D. Mice with cystic fibrosis are protected from a range of other diseases.
- E. All of A, B, C and D are correct.

32. Which of the following statements about the hydrogenation of fats is **correct**?

- A. The process converts vegetable oil into a fat that is solid at room temperature.**
- B. It introduces double bonds into saturated fats.
- C. It produces trans fats which have fewer double bonds than cis-unsaturated fats.
- D. It removes hydrogen atoms from saturated fats.
- E. One drawback is that it makes fats that are more likely to become oxidized.

33. Which of the following statements is **NOT correct** about bacterial efflux pumps?

- A. They represent a group of transmembrane proteins.
- B. They represent a major mechanism of antibiotic resistance.
- C. Their use requires a source of chemical energy such as ATP.
- D. Bacterial efflux pumps are similar to the cystic fibrosis transporter CFTR.
- E. Like an enzyme they show high specificity for their substrates.**

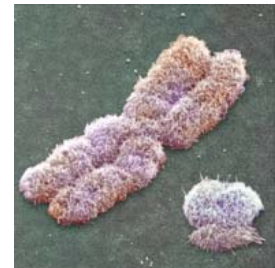
34. Both enzyme catalysis and facilitated diffusion display saturation kinetics at high substrate concentrations. This is because
- they are both governed by entropy driven processes.
 - they both display very high affinity for their respective substrates.
 - they are both energy-dependent processes.
 - the rate of each process is limited by the availability of specific proteins.
 - as substrate concentration increases the two processes show a decrease in affinity for the substrate.

35. Which of the following compounds readily diffuse across a membrane?

- Sucrose
- O₂
- K⁺
- Cl⁻
- Both C and D are correct.

36. This image shows highly condensed human X and Y chromosomes.

The X chromosome (larger of the two)



- is composed of two double-stranded DNA molecules.
- looks like this in gametes from a female.
- is from a cell that has cleared the G1 checkpoint and is in S phase.
- has two telomeres.
- has four copies of all genes carried on the X chromosome.

37. If the sequence of a particular RNA primer in *E. coli* is 5' AUUCGGGC 3', the sequence of the DNA template strand must be _____.

- 3' CGGGCUUA 5'
- 3' CGGGCTTA 5'
- 3' UAAGCCCG 5'
- 3' TAAGCCCG 5'
- 3' GCCCGAAT 5'

38. The image below shows the DNA sequence at the extreme end of a kangaroo chromosome. If telomerase were to act on this chromosome, the first base to be added would be

CGATCCGTA ACTT ... 3'
GCTTGGGCTAGCTTAGCTAGGCATTGAA ...



- U
- T
- C
- G
- impossible to know without more information.

39. In spite of differences in the shape of chromosomes, the replication of prokaryotic and eukaryotic chromosomes is remarkably similar in that both

- A. have several origins of replication on each chromosome.
- B. use telomerase to prevent loss of coding sequences.
- C. extend RNA primers by adding to the 5' end.
- D. make Okazaki fragments using DNA polymerase.
- E. replicate within the nucleus during S phase.



40. Recall that a Goldenrod plant was dissected in class to reveal an insect larva. The cells of growing Goldenrod leaves would contain DNA polymerase in

- 1. chloroplasts.
- 2. mitochondria.
- 3. nuclei.
- 4. centrosomes.

A. 1, 2 and 3

- B. 1 and 3
- C. 2 and 4
- D. 4 only
- E. 1, 2, 3 and 4 are correct



41. The fern plant, *Ophioglossum pycnostichum*, has an amazing 630 pairs of homologous chromosomes in each cell! (You have only 23 pairs.)

How many chromatids would be in the nucleus of a fern cell in G₂ phase of the cell cycle?

- A. 315
- B. 630
- C. 1260
- D. 2520
- E. 5040



42. Recall that the topic of mitotic cell division was addressed in both lecture and the microscopy lab. Slides of actively cycling root tip cells are a good illustration of

- A. meristem tissue.
- B. stem cells.
- C. external controls on cell cycling.
- D. the two types of plant growth; primary and secondary.
- E. the replication of sub-cellular organelles (e.g. chloroplasts).



43. For uni-cellular eukaryotes such as baker's yeast, the cell cycle is mainly a mechanism for

- A. DNA repair.
- B. reproduction.
- C. growth and development.
- D. tissue repair and regeneration.
- E. establishing a large population for infection.

44. With respect to DNA replication, the term "semi-conservative" refers to the fact that newly synthesized DNA contains one strand that is _____ ; the other strand is _____.

- A. new; old.
 - B. of normal length; shortened.
 - C. replicated 3' to 5'; replicated 5' to 3'.
 - D. held together by covalent bonds; held together with hydrogen bonds.
 - E. segregated to one daughter cell; segregated to the other daughter cell.
-

45. The removal of bases by DNA polymerase during proof-reading

- A. would be triggered by an G : C pairing.
 - B. is the first step in removing RNA primers.
 - C. proceeds 3' to 5' on the new strand.
 - D. is the first step of excision repair.
 - E. occurs during G₁ phase of the cell cycle.
-



46. The cytoskeleton is involved in many aspects of cell physiology, most notably maintaining cell shape and partitioning chromosomes during cell division.

If an animal cell in late anaphase was stained with a dye that bound to keratin, you would expect to see a

- A. background web of interconnected fibers throughout the cell.
 - B. collection of spindles arising from star-shaped centrosomes at each pole.
 - C. tightening band around the middle of the cell.
 - D. cluster of chromosomes near each pole.
 - E. pattern of dots, one at each centromere.
-



47. The term "karyotype" refers to a

- A. blood group antigen on a cell surface.
 - B. picture of chromosomes arranged in pairs.
 - C. particular collection of alleles on a chromosome.
 - D. diagram representing family relationships.
 - E. None of A, B, C or D is correct.
-

48. Homologous chromosomes would be expected to be different on the basis of

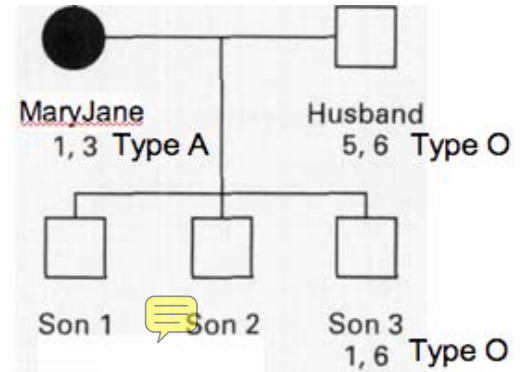
1. parent of origin
2. gene location.
3. location in daughter cells after Meiosis I.
4. time needed to replicate

- A. 1, 2 and 3
 - B. 1 and 3
 - C. 2 and 4
 - D. 4 only
 - E. 1, 2, 3 and 4 are correct.
-

49. In the case of the chimeric woman summarized in the pedigree diagram below, recall that MaryJane's blood was entirely derived from only one of the original embryos (HLA Haplotype 1,3).

Also recall that her blood type was Type **A**, while that of her husband and third son was Type **O**.

From the data shown (and your understanding of basic biology), you could conclude that MaryJane's white blood cells must have carried



- A. four different blood type alleles.
- B. two different blood type alleles.**
- C. two different blood type genes.
- D. four different HLA haplotypes.
- E. only one HLA gene.

50. If a mother and father both carry histocompatibility haplotype (HLA) 1 & 3, what proportion of their children would carry at least one HLA 3 haplotype?

- A. 0
- B. 1/4
- C. 1/2
- D. 3/4**
- E. 4/4