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BIOL 230: Cell & Molecular Biology *PRACTICE FINAL EXAM* Dr. Nathan Staples

Scantron Instructions:
1. Make sure you have a **200-** question, **RED/ORANGE form!!**
2. Use a #2 or HB pencil to complete the form.
3. Write in your **name, date, and I.D. #** on BOTH the **scantron** & **each page of the examination**.
4. Fill-in on Scantron: **G# ("G"= "0"+ 8 digits)**, exam #: **234**, Form: **A**.
5. ***Darkly* Fill-in** the ***entire rectangle*** for the answer you choose.

M/C = _______/100

Essays = _______/ 60

Total = ______/150

READ ALL QUESTIONS THOROUGHLY. ***FOR ALL M/C questions, PICK THE BEST ANSWER.***

55 QUESTIONS, 2 or 20 POINTS EACH; **150 points total.** (4 total pages = 2, double-sided sheets)

RELAX, CONCENTRATE, AND GOOD LUCK!!

****** IMPORTANT: Turn-in BOTH your signed Scantron and your signed copy of the Exam.***

Multiple Choice: *Identify the letter of the choice that best completes the statement or answers the question.*

CUMULATIVE M/C (1-18):

1. The part of the atom of greatest biological interest is the
- a. Proton
- b. Electron
- c. Neutron
- d. Innermost shell
- e. Just-Gimme-an-"A"-tron! ☺

2. Polymerization reactions in which proteins are synthesized from amino acids
- a. Require energy
- b. Result in the formation of water
- c. Are condensation reactions
- d. Are dehydration reactions
- e. All of the above

3. The portion of a phospholipid that contains the phosphorus group has one or more electric charges. That makes this region of the molecule
- a. Hydrophobic
- b. Hydrophilic
- c. Nonpolar
- d. Unsaturated
- e. Saturated

4. In DNA molecules
- a. Purines pair with pyrimidines
- b. A pairs with C
- c. G pairs with A
- d. Purines pair with purines
- e. C pairs with T

5. Which is present in both prokaryotic and eukaryotic animal cells?
- a. Chloroplast
- b. Mitochondrion
- c. ER
- d. Nucleus
- e. Ribosomes

6. The LDL receptor is an integral protein that crosses the plasma membrane, with portions of the protein extending both outside and into the interior of the cell. The amino acid side chains in the region of the protein that crosses the membrane are most likely to be
- a. Charged
- b. Hydrophilic
- c. Hydrophobic
- d. Carbohydrates
- e. Lipids

7. Which of the following is NOT a function that can be performed by an enzyme catalyzing a chemical reaction.
- a. Reduction of the activation energy of the reaction.
- b. Shifting the point of equilibrium to favor production of more product than the uncatalyzed reaction.
- c. Coupling of an energy-releasing reaction to an energy-absorbing reaction.
- d. Specific binding of the reactants at the active site to bring them closer to the transition state.
- e. Increasing the speed at which the reaction reaches equilibrium.

8. The end product of glycolysis is
- a. Pyruvate
- b. The starting point before entry into oxidation and the citric acid cycle
- c. The starting point before entry into the fermentation pathway
- d. A, B and C
- e. Really bad muscle aches the "morning after". ☺

9. Which of the following two processes in the metabolism of glucose, when combined, release the equivalent of all six carbons of a glucose molecule as CO_2?
- a. pyruvate oxidation and the citric acid cycle.
- b. glycolysis and pyruvate oxidation.
- c. glycolysis and the citric acid cycle.
- d. the citric acid cycle and the electron transport chain.
- e. glycolysis and the electron transport chain.

10. During aerobic respiration, $NADH_2$ donates two electrons to ubiquinone (coenzyme Q). When this happens, Q is
- a. Reduced
- b. Oxidized
- c. Phosphorylated
- d. Aerobic
- e. Hydrolyzed

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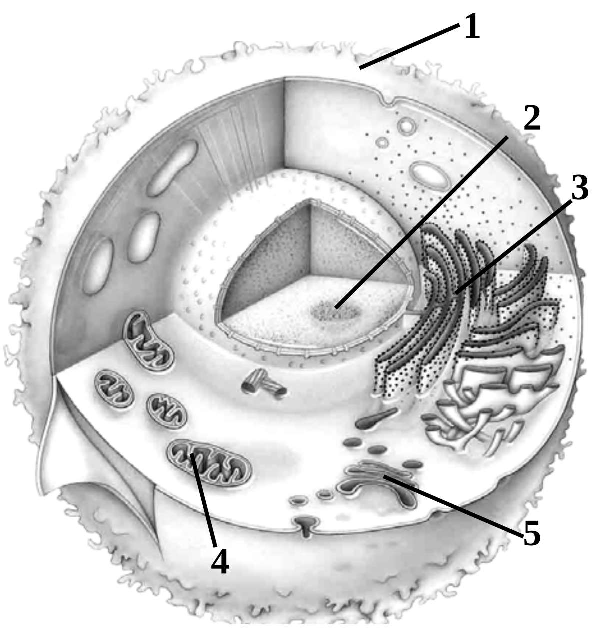
11. The chemiosmotic generation of ATP is driven by
- a. Osmotic movement of water into an area of high solute concentration
- b. The addition of protons to ADP and phosphate via enzymes
- c. Passage of phosphates between electron carriers.
- d. A difference in H+ concentration on both sides of a membrane
- e. A new Brita Water Purification System. ☺

For *questions 12-13*, choose the letter of the subcellular structure (organelle) indicated by each number on the diagram of an Animal Cell below.

- a. Nucleolus
- b. Nucleus
- c. Endoplasmic Reticulum
- d. Golgi apparatus
- e. Mitochondrion



12. Which cellular structure is illustrated by #3 in the diagram?

13. Which cellular structure is illustrated by #5 in the diagram above?

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14. What would you expect would happen if you removed a plant cell's wall and placed the wall-less cell in a drop of pure water?
- a. The cell would begin to divide
- b. The cell would shrink in size
- c. The cell would swell and burst
- d. The cell would first swell and then shrink
- e. The cell would first shrink and then swell

15. In the genetic code, the "codons" are found on the
- a. DNA molecules
- b. Transfer RNA molecules
- c. Messenger RNA molecules
- d. Ribosomal RNA molecules
- e. Ribosomes

16. The "repressor" regulates the synthesis of enzymes of the lactose operon at the level of:
- a. replication
- b. translation
- c. degradation
- d. transduction
- e. transcription

17. Which statement about DNA replication is INCORRECT?
- a. Replication of DNA starts at RNA primers.
- b. Replication of DNA depends on two different DNA polymerases.
- c. Replication of DNA proceeds in opposite directions on the two strands of a replication fork.
- d. Replication of DNA is discontinuous on both strands of a single replication fork.
- e. An RNA polymerase initiates replication of DNA.

18. RNA processing that must be completed before translation in eukaryotes involves
- a. The addition of a G cap
- b. Polyadenylation
- c. Removal of introns
- d. Splicing together of exons
- e. All of the above

Part IV M/C (19-50):

19. Allosteric regulation of proteins is involved in which of the following cellular processes?
- a. Inactivation of an operon Repressor by an inducer.
- b. Activation of the CRP protein by cyclic AMP.
- c. Feedback inhibition of branchpoint enzymes by end product of an anabolic biochemical pathway.
- d. Binding of cyclin to CDK to activate the cell cycle.
- e. All of the above.

20. Bacteria typically have __________ while eukaryotes have __________.
- a. One chromosome that is circular, many that are linear
- b. Several chromosomes that are circular, many that are linear
- c. One chromosome that is linear, many that are circular
- d. Two chromosomes that are circular, eight that are linear
- e. None of the above

21. The appropriate decisions to enter the S phase and the M phase of the cell cycle depend on a pair of biochemicals called
- a. Actin and mysosin
- b. CDK's and cyclin
- c. Ligand and receptor
- d. ATP and ATPase
- e. "RED LIGHT" and "GREEN LIGHT"! ☺

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22. In plant cells, cytokinesis is accomplished by the formation of a(n)
a. Aster
b. Membrane furrow
c. Equatorial plate
d. Cell plate
e. Spindle

23. During meiosis, the sister chromatids separate during
a. Anaphase II
b. Anaphase I
c. The S phase
d. Synapsis
e. Telophase II

24. The exchange of genetic material between chromatids on homologous chromosomes occurs during
a. Interphase
b. Mitosis and meiosis
c. Prophase I
d. Anaphase I
e. Anaphase II

25. At the end of the <u>first</u> <u>meiotic</u> division, each chromosome consists of
a. chiasmata.
b. a homologous chromosome pair.
c. four copies of each DNA molecule.
d. two sister chromatids
e. a single DNA molecule.

26. The process of "programmed cell death" is called
a. Necrosis
b. Apoptosis
c. Lysis
d. Cellular suicide
e. Mission Impossible Syndrome ☺

27. Incomplete dominance occurs when
a. Chromosomes are deleted
b. Heterozygotes synthesize a reduced amount of an enzyme, producing an intermediate phenotype
c. The genes fail to segregate
d. The law of independent assortment is upheld
e. One gene is epistatic to the other

28. When a given trait is the result of multigene action, one of the genes may mask the expression of one or all other genes. This phenomenon is termed
a. Epistasis
b. Epigenesis
c. Codominance
d. Incomplete dominance
e. None of the above

29. If surviving, an adult human with XO sex chromosomes will be phenotypically _____________, and an adult fruit fly with XO sex chromosomes will be phenotypically _______________.
a. Male; Male
b. Male; Female
c. Female; Male
d. Female; Hermaphroditic
e. Female; Female

30. The event in the cell division process that clearly involves **actin microfilaments** is
a. chromosome separation during anaphase.
b. movement of chromosomes to the metaphase plate.
c. chromosome condensation during prophase.
d. disappearance of the nuclear envelope during prophase.
e. Cytokinesis in animal cells.

31. Heterochromatin regions of eukaryotic chromosomes are
a. Transcriptionally inactive
b. Densely-staining with nuclear dyes
c. Silent for gene expression
d. Tightly bound by histone proteins
e. All of the above

32. The <u>direct</u> products of <u>mitosis</u> are
a. one nucleus containing twice as much DNA as the parent nucleus.
b. four nuclei containing half as much DNA as the parent nucleus.
c. two genetically identical cells.
d. two genetically identical nuclei.
e. four genetically identical nuclei.

33. The four haploid nuclei found at the end of meiosis differ from one another in their exact genetic composition. Some of this difference is the result of
a. cytokinesis.
b. crossing over during prophase I.
c. replication of DNA during the S phase.
d. separation of sister chromatids at anaphase II.
e. spindle formation.

34. During Meiosis I in humans, each one of the daughter nuclei/cells receives
a. only maternal chromosomes.
b. a mixture of maternal and paternal chromosomes.
c. the same number of chromosomes as a diploid cell.
d. a sister chromatid from each chromosome.
e. Mom's pearl earrings to keep in her Hope chest. ☺

35. A key factor that allowed Mendel to clearly interpret the results of his breeding experiments was that
a. the varieties of peas he used were "true-breeding."
b. peas naturally self-pollinate
c. peas can reproduce asexually
d. pollination could be controlled.
e. Both A and D

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36. When reciprocal crosses produce NON-identical results, the trait is
a. sex-linked.
b. not sex-linked.
c. autosomally inherited.
d. Both a and c
e. Both b and c

37. True or False? Two parents with type A and type AB blood types, respectively, can have a child with Type B blood.
a. True
b. False

38. A woman's father has male-pattern baldness (MPB), a recessive sex-linked (X-linked) trait. She marries a man who also has MPB. Which of the following is true about their offspring?
a. All sons, and no daughters will likely have MPB
b. All daughters, and no sons will likely have MPB
c. Half of the daughters and no sons will have MPB
d. Half of the sons and half of the daughters will have MPB
e. All of their children, sons and daughters, will have MPB

39. A recessive allele causes classical albinism. Which of the following is the expected ratio for the progeny when a normally pigmented male with an albino father has children with an albino woman? *(Hint: begin by deciding the genotypes of the recessive family members – it should be obvious!)*
a. 3/4 normal; 1/4 albino
b. 3/4 albino; 1/4 normal
c. 1/2 normal; 1/2 albino
d. All normal
e. All albino

For questions 40-41: Imaginary Schmoos live in geographically separated groups and rarely interbreed. On one occasion, two from the different groups did mate. A big-footed white schmoo mated with a small-footed brown schmoo. Three offspring resulted: one big-footed brown schmoo and two small-footed brown schmoos.

40. Which statement about the inheritance of color in schmoos is most likely correct?
a. Brown is dominant to white
b. White is dominant to brown
c. White and brown are codominant
d. You cannot reach any conclusions
e. We will never find out, since that Hanna-Barbera cartoon was thankfully cancelled. ☺

41. If big feet (*B*) in schmoos is dominant to small feet (*b*), what is the genotype of the big-footed white parent schmoo with respect to the foot gene?
a. bb
b. BB
c. Bb
d. A and B
e. A and C

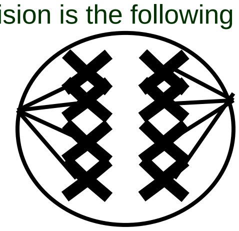
42. In humans, a widow's peak is caused by a dominant allele, *W* and a continuous hairline, by a recessive allele *w*. Short fingers are caused by a dominant allele *S* and long fingers, by a recessive allele *s*. Suppose a woman with a continuous hairline and short fingers and a man with a widow's peak and long fingers have three children. One child has short fingers and a widow's peak, one has long fingers and a widow's peak, and one has long fingers and a continuous hairline. What are the genotypes of the parents?
a. Female was *wwSS*; male *WWss*
b. Female was *wwSs*; male *Wwss*
c. Female was *wwSs*; male *WWss*
d. Female was *WwSs*; male *WsSs*
e. None of the above

43. In cocker spaniels, black color (*B*) is dominant over red (*b*), and solid color (*S*) is dominant over spotted (*s*). If the offspring from crossing *BBss* and *bbss* individuals (F1 progeny) are then mated with each other, what fraction of their offspring (F2) will be expected to be black and spotted? Assume the genes are unlinked. *(Hint: do BOTH crosses)*
a. 1/16
b. 9/16
c. 1/9
d. 3/16
e. 3/4

44. In tomatoes, tall is dominant to short, and smooth fruits are dominant to hairy fruits. A plant homozygous for both dominant traits is crossed with a plant homozygous for both recessive traits. The F_1 progeny are test-crossed with the following results: 68 tall, smooth fruits; 72 dwarf hairy fruits; 33 tall, hairy fruits; and 27 dwarf smooth fruits. These data indicate that the genes are
a. On different chromosomes
b. Linked, but do not cross over
c. Linked, and show 15% recombination
d. Linked, and show 30% recombination
e. Linked, and show 60% recombination

45. Remembering that white eyes is a recessive, sex-linked trait, if a white-eyed female fruit fly is mated with a red-eyed male, their offspring should be
a. 50% red-eyed, 50% white-eyed for both sexes
b. all white eyed for both sexes
c. all white-eyed males, all red-eyed females
d. all white-eyed females, all red-eyed males
e. 50% red-eyed males, 50% while-eyed males, all red-eyed females

46. During interphase, the following cell has a diploid number of eight chromosomes (4 homologous pairs). At which stage of nuclear division is the following cell?
a. Mitotic Anaphase
b. Mitotic Telophase
c. Meiotic Anaphase I
d. Meiotic Metaphase II
e. Meiotic Anaphase II



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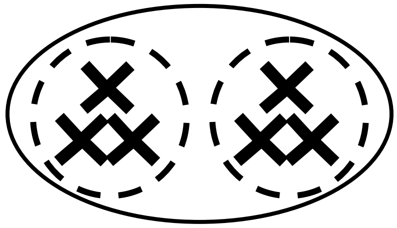
47. During interphase, the following cell has a diploid number of six chromosomes (three homologous pairs). At which stage of nuclear division is the following cell?

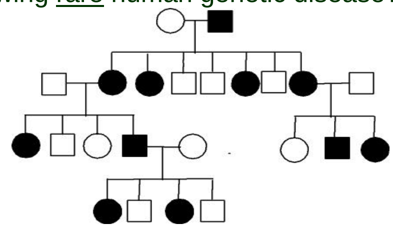
a. Mitotic Prophase
b. Mitotic Anaphase
c. Meiotic Anaphase I
d. Meiotic Telophase I
e. Meiotic Telophase II



48. The Achoo Syndrome, reflexively sneezing when suddenly exposed to sunlight, is an X-linked dominant trait ***[for the sake of this test question]***. A sunlight-sneezing man marries a non-sunlight-sneezing woman. What proportion of the male progeny will show the sunlight-sneezing trait (Achoo Syndrome)?

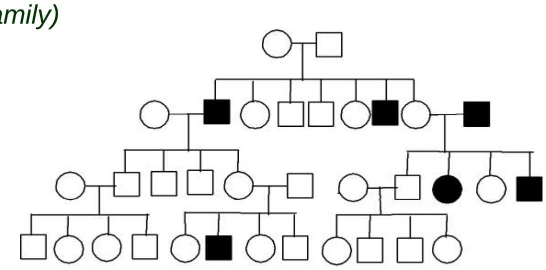
a. None (0%)
b. 1/4 (25%)
c. 1/2 (50%)
d. 3/4 (75%)
e. all (100%)

49. What is the *most likely* mode (pattern) of inheritance of the following rare human genetic disease?



a. Autosomal Recessive
b. Autosomal Dominant
c. X-linked Recessive
d. X-linked Dominant
e. Y-linked Dominant

50. What is the *most likely* mode (pattern) of inheritance of the following human genetic trait? ***(hint**: think carefully about the impact of genotypes marrying into the family)*



a. Y-linked Dominant
b. Y-Linked Recessive
c. X-linked Dominant
d. X-linked Recessive
e. Autosomal Dominant

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CUMULATIVE Portion: Short Essays (20 pts total): Circle and Answer ONLY ONE of the following TWO questions BRIEFLY but COMPLETELY. Use DIAGRAMS!!.

51. (20 pts) Compare and contrast **AT LEAST 10 characteristics** that distinguish between **"Prokaryotic" and Eukaryotic cells**, *including* ***genomic structure and gene regulation*****.**

- ***OR:***

52. (20 pts) Diagram and describe **how ATP synthesis is coupled to electron transport** in mitochondria and/or chloroplasts. Define ***energetic coupling*****,** and identify what cellular molecules perform the coupling process in each case of energy conversion**.**

Part IV Portion: Short Essays (40 pts total): Answer #53 and ONLY ONE of the last two questions BRIEFLY but COMPLETELY. Use diagrams to illustrate your answers!!

53. (20 pts) ***MANDATORY QUESTION:*** Diagram and compare the differences between **Mitosis and Meiosis (especially Meiosis I)**. How do these differences serve the biological purpose of each process? *(What is the biological purpose of Mitosis, and of Meiosis?)*.

- ***[*** Answer ONLY on the FOLLOWING PAGE!!!]***

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53. (*MANDATORY!*):

54. (20 pts) Describe the **two major components** in **Eukaryotic Cell Cycle regulation**, and how such proteins can serve as effective, but transient, controls on the progression of the cell cycle. How is cell cycle progression induced by these proteins, and then halted (what regulates the regulators)? *Be sure to mention the main phases of the whole Cell Cycle!!*

- ***OR:***

55. (20 pts) Describe the differences between ***Particulate Inheritance*** and ***Blending Inheritance***? Use diagrams to Demonstrate how Mendel's experiments specifically disproved one of these theories, and proved the other. *Be sure to mention both his experimental setup, and his observed results and data!!*

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BIOL230 AA/AB PRACTICE FINAL EXAM

Answer Key -- Fall Semester

Only look here AFTER you have thoughtfully and thoroughly completed the Practice Exam!!! NO CHEATING!! ☺

1.	B
2.	E
3.	B
4.	A
5.	E
6.	C
7.	B
8.	D
9.	A
10.	A
11.	D
12.	C
13.	D
14.	C
15.	C
16.	E
17.	D
18.	E
19.	E
20.	A
21.	B
22.	D
23.	A
24.	C
25.	D
26.	B
27.	B
28.	A
29.	C
30.	E
31.	E
32.	D
33.	B
34.	B
35.	E

36.	A
37.	A
38.	D
39.	C
40.	A
41.	C
42.	B
43.	E
44.	D
45.	C
46.	C
47.	D
48.	A
49.	D
50.	D