

Name:

1. Through a microscope, you can see a cell plate beginning to develop across the middle of a cell and nuclei re-forming on either side of the cell plate. This cell is most likely
 - a. An animal cell in the process of cytokinesis
 - b. A plant cell in the process of cytokinesis
 - c. An animal cell in the S phase of the cell cycle
 - d. A bacterial cell dividing
 - e. A plant cell in metaphase
2. An inhibitor of which of the following could be used to block the release of calcium from the endoplasmic reticulum?
 - a. Tyrosine kinases
 - b. Serine/threonine kinases
 - c. Phosphodiesterase
 - d. Phospholipase C
 - e. Adenylyl cyclase
3. Huntington's disease is a dominant disorder with late age of onset in humans. If one parent has the disease (Hh), what is the probability that his or her child will have the disease?
 - a. 1
 - b. $\frac{3}{4}$
 - c. $\frac{1}{2}$
 - d. $\frac{1}{4}$
 - e. 0
4. Which is incorrectly matched for mitosis?
 - a. Prometaphase – nuclear envelope fragments
 - b. Prophase – DNA is still chromatin form
 - c. Metaphase – longest phase of mitosis
 - d. Anaphase – Sister chromatids separate
 - e. Telophase – the daughter nuclei each have $\frac{1}{2}$ the number of chromosomes compared to the cell in metaphase
5. The activation of receptor tyrosine kinases is characterized by
 - a. Dimerization and phosphorylation
 - b. IP3 binding
 - c. A phosphorylation cascade
 - d. GTP hydrolysis
 - e. Channel protein shape change
6. Consider this pathway: epinephrine → G protein coupled receptor → G protein → adenylyl cyclase → cAMP. Identify the second messenger.
 - a. cAMP
 - b. G protein
 - c. GTP
 - d. Adenylyl cyclase
 - e. G protein coupled receptor

7. Which of the following does not occur during Mitosis?
 - a. Condensation of the chromosomes
 - b. Replication of the DNA
 - c. Separation of sister chromatids
 - d. Spindle formation
 - e. Separation of the spindles poles
8. In familial hypercholesteremia two wild type alleles produce a normal number of receptors to bind LDL cholesterol. One normal allele and one mutant allele produce half the number of receptors. This is an example of
 - a. incomplete dominance
 - b. complete dominance
 - c. codominance
 - d. epistasis
 - e. Apoptosis
9. When crossing an organism that is recessive for a single trait with a heterozygote, what is the chance of producing an offspring with the recessive phenotype?
 - a. 0%
 - b. 25%
 - c. 50%
 - d. 75%
 - e. 100%
10. Vinblastine is a standard chemotherapeutic drug used to treat cancer. Because it interferes with the assembly of microtubules, its effectiveness must be related to
 - a. Disruption of mitotic spindle formation
 - b. Inhibition of regulatory protein phosphorylation
 - c. Suppression of cyclin production
 - d. Myosin denaturation and inhibition of cleavage furrow formation
 - e. Inhibition of DNA synthesis
11. Lipid soluble signaling molecules, such as testosterone, cross the membranes of all cells but affect only target cells because
 - a. Only target cells retain the appropriate DNA segments
 - b. Intracellular receptors are present only in target cells
 - c. Most cells lack the Y chromosome required
 - d. Only target cells possess the cytosolic enzymes that transduce the testosterone
 - e. Only in target cells is testosterone able to initiate the phosphorylation cascade leading to activated transcription factor
12. At the neuromuscular junction, an action potential (electrical signal) is carried along a neuronal axon and this triggers the release of the neurotransmitter acetylcholine which diffuses across the axon terminals to reach its target cell. Such a stimulation is called
 - a. Paracrine signaling
 - b. Cell-Cell recognition
 - c. Synaptic signaling
 - d. Gap junctions signaling
 - e. Plasmodesmata signaling

13. Which of the following would cause genetic variation
 - a. Random fertilization
 - b. Mutation
 - c. Crossing over
 - d. Independent assortment
 - e. A & C only
 - f. All of the above
14. Mature human sperm and ova are similar in that
 - a. They both have the same number of chromosomes.
 - b. They are approximately the same size.
 - c. They each have a flagellum that provides motility.
 - d. They are produced from puberty until death.
 - e. They are formed before birth.
15. When steroid hormones bind to their receptors;
 - a. Adenylyl cyclase is activated
 - b. G proteins are inhibited
 - c. Cyclic nucleotides are formed
 - d. Gene transcription may start or stop
 - e. Tyrosine kinase is deactivated
16. When G protein hydrolyzes GTP back to GDP
 - a. Activated G-protein dissociates from receptor
 - b. G protein is then activated and deactivates GTPase
 - c. Receptor is activated, changes shape
 - d. G protein is the inactive and pathway shuts down
 - e. G protein binds to inactive membrane enzyme
17. One difference between cancer cells and normal cells is that cancer cells
 - a. Are unable to synthesize DNA
 - b. Are arrested at the S phase of the cell cycle
 - c. Continue to divide even when they are tightly packed together
 - d. Cannot function properly because they are affected by density-dependent inhibition
 - e. Are always in the M phase of the cell cycle
18. A particular cell has half as much DNA as some other cells in a mitotically active tissue. The cell in question is most likely in
 - a. G1
 - b. G2
 - c. Prophase
 - d. Metaphase
 - e. Anaphase
19. A tetrad includes which of the following sets of DNA strands?
 - a. Two single stranded chromosomes that have synapsed
 - b. Two sets of sister chromatids that have synapsed (4 total chromosomes)
 - c. Four sets of sister chromatids (8 total chromosomes)
 - d. Four sets of unique (different) chromosomes (8 total chromosomes)
 - e. Eight sets of sister chromatids (16 total chromosomes)

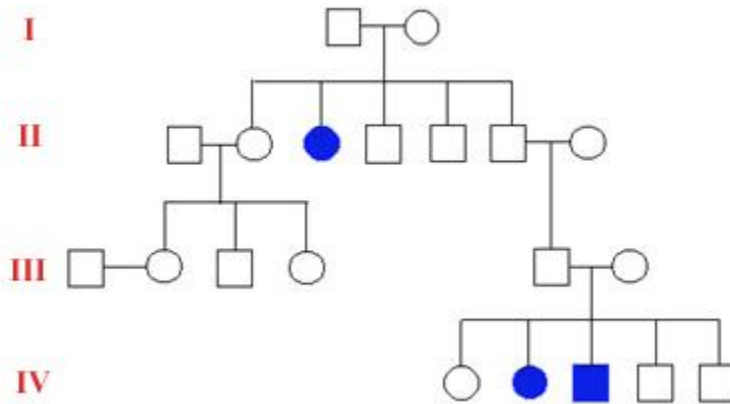
For Questions 20 – 21

20. Given the parents AaBBCcddEe x AabbCcDdee, assume complete dominance and independent assortment. What proportion of the progeny will be expected to phenotypically resemble the first parent?
- $\frac{3}{4}$
 - $\frac{1}{8}$
 - $\frac{1}{32}$
 - $\frac{3}{16}$
 - $\frac{9}{64}$
21. From question 20, what proportion of offspring from the same parental cross would be expected to be aaBbCcddEE?
- $\frac{3}{4}$
 - $\frac{12}{32}$
 - $\frac{1}{32}$
 - $\frac{3}{16}$
 - $\frac{9}{64}$
22. In the cells of some organisms, mitosis occurs without cytokinesis. This will result in
- Cells with more than one nucleus
 - Cells that are unusually small
 - Cells lacking nuclei
 - Destruction of chromosomes
 - Cell cycles lacking an S phase
23. John's brother has Gaucher disease (recessive). John marries an Ashkenazi Jewish woman. The carrier frequency in this population is 1 in 50. What is the risk of this couple having an affected child?
- $\frac{1}{150}$
 - $\frac{1}{300}$
 - $\frac{3}{400}$
 - $\frac{3}{800}$
 - $\frac{1}{600}$
24. Which of the following best illustrates the difference between dominant and recessive traits?
- Dominant traits unmask the recessive trait in an F₂ generation.
 - For a recessive trait to be expressed, two recessive genes are needed.
 - Dominant traits only affect the phenotype of an organism while recessive traits only affect the genetic makeup of the organism and are therefore not expressed.
 - For a dominant trait to be expressed, two dominant genes are needed.
 - More than one is correct.
25. What would one expect to find in a certain chemical, DZX4, whose function is to increase the productivity of Adenylyl cyclase but inhibits the phosphodiesterase function?
- Cellular signaling would last longer due to phosphodiesterase saturation in the cytoplasm.
 - There would be net influx in the amount of cellular AMP
 - The cAMP propagation would last longer than usual since none of the cAMP is being reconverted.
 - The cAMP propagation would last longer than usual since none of the cAMP is being converted to ATP by phosphodiesterase.
 - The membrane receptors will show a decrease affinity for Norepinephrine and hence a rise in cellular adenylyl cyclase.

26. Where do the microtubules of the spindle originate during mitosis in both plants and animal plants?
- Centromere
 - Centrosome
 - Asters
 - Chromatid
 - Kinetochores
27. If there are 40 chromatids in a cell, how many centromeres are there?
- 10
 - 20
 - 30
 - 40
 - 80

Questions 28 - 30

Consider the following Pedigree chart of a family showing four generations:



The above chart represents a rare disease called Osteomalacia in a family tracked over four generations. Shaded circles and squares represent infected individuals.

28. A baby born (second generation) to two healthy parents is diagnosed with a rare form of osteomalacia, softening of bones; mild form is known as rickets. Which of the following is true?
- Both mom and dad are homozygous to the disease
 - One of the parents must be heterozygous to the disease
 - There is 50% chance every child born to both parents will have osteomalacia
 - Both parents must be heterozygous to the disease
 - None of the above
29. From the chart above, which statement is true?
- Osteomalacia cannot be a genetic disorder
 - Osteomalacia is a disorder only found in women who pass it to their offspring through their X chromosome
 - Osteomalacia is a recessive disorder
 - Children who have osteomalacia must have two completely homozygous parents.
 - There is a 0.75 chance for offspring born with osteomalacia if both parents are not heterozygous

30. Assuming that the male offspring in generation 2 married someone who is NOT a carrier for the disease, what is the probability of any offspring to show symptoms of the disease by the fourth generation?
- 2/9
 - 4/9
 - 1/12
 - 1/18
 - 1/9
31. When a disease is said to have a multifactorial basis, it means that
- Both genetic and environmental factors contribute to the disease
 - It is caused by a gene with a large number of alleles
 - It affects a large number of people
 - It has many different symptoms
 - It tends to skip a generation
32. A human cell containing 22 autosomes and a Y chromosome is
- A sperm
 - An egg
 - A zygote
 - A somatic cell of a male
 - A somatic cell of a female
33. Homologous chromosomes move toward opposite poles of a dividing cell during
- Mitosis
 - Meiosis I
 - Meiosis II
 - Fertilization
 - Binary fission
34. A man with type O blood has a child with a woman who has type A blood. The woman's mother is type AB blood and her father is type O. What is the probability the child is of blood type B?
- 0
 - $\frac{1}{2}$
 - $\frac{1}{4}$
 - 1/8
 - 1/16
35. Phenylketonuria (PKU) is an inherited disease caused by a recessive allele. If a woman and her husband, who are both carriers, have three children, what is the probability that one or more of the three children have the disease?
- 1/64
 - 37/64
 - 27/64
 - 63/64
 - None of the above

36. A couple has four children whose blood types are A, B, and AB. Which of the following genotypes is capable of producing the blood types of this couple's children?
- $I^A i$ and $I^B i$
 - $I^A i$ and $I^B I^B$
 - $I^B i$ and ii
 - $I^A i$ and ii

Questions 37 – 38

Radish flowers may be red, pink, or white. A cross between a red flowered plant and a white flowered plant yields all pink offspring. The part of the radish we eat may be oval or long, with long being the dominant characteristic.

37. If true breeding red long radishes are crossed with true breeding white oval radishes, the F1 will be expected to be which of the following?
- Red and long
 - Red and oval
 - White and long
 - Pink and long
 - Pink and oval
38. The flower color trait in radishes is an example of which of the following?
- A multiple allelic system
 - Sex linkage
 - Codominance
 - Incomplete dominance
 - Epistasis
39. During which phases of the cell cycle are chromosomes composed of two chromatids?
- From interphase through the end of anaphase
 - From G1 of interphase through the end of metaphase
 - From metaphase through the end of telophase
 - From anaphase through the end of telophase
 - From G2 of interphase through the end of metaphase
40. Mackenzie underwent genetic testing and learned she has a 1 in 10 chance of developing lung cancer and a 2 in 1,000 chance of developing colon cancer. What is the probability she will develop both cancers?
- 2/1000
 - 1/500
 - 1/50000
 - 2/10000
 - 2/100
41. Which of the substances below is a protein that can hold several other relay proteins for efficient signaling?
- Transcription factor
 - Second messenger
 - Ligand
 - Scaffolding protein
 - Protein kinase

42. Blake's mother has Huntington's disease (autosomal dominant), but her father does not. Blake marries an African American man. The carrier frequency in this population is 1 in 10. What is the probability that Blake will have the disease?
- 1/40
 - 1/20
 - 1/15
 - $\frac{1}{2}$
 - 1/6
43. Which of the following is true about monozygotic siblings
- Have the same behavior
 - Are phenotypically different
 - Are genotypically equal
 - From two eggs release during the same cycle
 - Have different behaviors

Questions 44-45

Parthenogenesis is a form of asexual reproduction found in females, where growth and development of embryos occur without fertilization by a male. Occurs in both vertebrates and invertebrates.

44. The chromosome number of an offspring produced via parthenogenesis would be
- diploid
 - haploid
 - $2n$
 - A & C are correct
45. If humans reproduced by parthenogenesis,
- Males would need to produce more sperm.
 - The number of males in the population would most likely increase.
 - The number of females in the population would most likely increase.
 - The children would be identical to their parents.
 - There would be no need for mitosis.
46. Two parents are carriers of Disease E, a recessive disease. They have a healthy baby. What is the probability their baby is a carrier also?
- 0
 - $\frac{1}{2}$
 - $\frac{1}{4}$
 - $\frac{2}{3}$
 - 1
47. Which of the following takes place in both Mitosis and Meiosis?
- Formation of four new nuclei, each with half the chromosomes present in the parental nucleus
 - Alignment of tetrads at the metaphase plate
 - Separation of sister chromatids
 - Separation of the homologues; no uncoupling of the centromeres
 - Synapsis and crossing over

For Questions 48-50 Consider the following stages of Meiosis and match them correctly for questions 48 – 50.

- I. Prophase I
- II. Metaphase I
- III. Anaphase I
- IV. Telophase I
- V. Prophase II
- VI. Metaphase II
- VII. Anaphase II
- VIII. Telophase II

48. Independent assortment occurs in _____, while crossing over occurs in _____.

- a. II, VI
- b. I, III
- c. II, I
- d. I, II
- e. VI, V

49. Centromeres of sister chromatids disjoin and chromatids separate

- a. II
- b. III
- c. IV
- d. VIII
- e. VII

50. Independent assortment of chromosomes is a result of

- a. The random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I.
- b. The random nature of the fertilization of egg by sperm
- c. The random distribution of the sister chromatids to the two daughter cells during anaphase II
- d. The relatively small degree of homology shared by the X and Y chromosomes
- e. Only Two above are correct
- f. All of the above are correct

Good Luck!!

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