1. The presence of circular chromosomes in the mitochondria and chloroplasts of eukaryotic cells suggests:

a) that chromosomes are only stable in a circular configuration
b) that these organelles evolved from prokaryotic cells
c) that mitochondria are maternally inherited
d) that the genetic code is different in mitochondria

2. A sample of DNA is found to contain 27% cytosine. This sample contains:

a) 23% adenine
b) 27% adenine
c) 23% guanine
d) 27% thymine

3. Which of the following proteins is a non-chromatin nuclear component?

a) cytochrome c
b) histone 2A
c) lamin
d) cohesin

4. A DNA strand has the sequence 5'-GTACGGTATCATAG -3'. The complementary strand will be:

a) 5' - CTATGATGTCGTAC - 3'
b) 5' - CTATGATACCGTAC - 3'
c) 5' - GTACGGTATCATAG - 3'
d) 5' - CATGCCATAGTATC - 3'

5. Centromeres

a) prevent fusion of chromosomes
b) help DNA polymerase replicate the whole chromosome
c) provide the site of chromosomal attachment to the mitotic spindle
d) protect chromosome from attack by deoxyribonucleases.

6. Identify the correct statement

a) During mitotic cell division, nuclear chromosomes are duplicated exactly and distributed more or less equally between daughter cells
b) Mitochondria are fragmented at the time of mitosis and reformed in daughter cells
c) It does not matter if daughter cells receive unequal numbers of chloroplasts as a result of mitosis
d) Daughter cells are always genetically identical to their mother cell

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7. A single base pair mutations that results in premature termination of translation of the corresponding mRNA is called a _____ mutation.

a) nonsense
b) missense
c) non-conserved
d) silent

8. Which statement is true regarding the nuclear envelope?

a) it is structurally supported by a “meshwork” of lamina proteins
b) It is supported from inside by a network of microtubules
c) it contains microfilaments
d) the inter-membrane space is continuous with the nucleoplasm

9. During meiosis, homologous chromosomes move towards opposite poles of the spindle during:

a) anaphase I
b) metaphase I
c) anaphase II
d) metaphase II

10. How many of the following statements are true?

I. Meiosis can be interrupted for a period of many years before completion
II. Meiosis II is known as a reduction division
III. Oogenesis produces one mature gamete for every meiosis, whereas spermatogenesis produces four mature gametes for every meiosis
IV. Primary spermatocytes are diploid

a) 1
b) 2
c) 3
d) 4

11. Consider a short mature mRNA molecule with the sequence:
“GUAGACUAGAGCCAUGAUCAAGUUUACGAUUCAGUCAUAGAGAUACAGAA”

Where “G indicates the 5’ cap and A” indicates the 3’ poly A tail). How many amino acids would be in the encoded polypeptide?

a) 2
b) 4
c) 8
d) 16

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12. Identify the incorrect statement about gene expression in eukaryotic cells.

a) Transcription occurs in the nucleus, translation occurs in the cytoplasm
b) Primary mRNA transcripts are usually spliced before they are exported from the nucleus
c) Processed mRNA molecules leave the nucleus through the nuclear pore complex
d) Ribosomes are positioned on mRNAs by interacting with the Shine-Dalgarno sequence

13. Identify the best order for the following mutations with respect to the likelihood that they will represent a null allele in a protein-coding gene, least likely first.

a) missense, frameshift, silent
b) frameshift, silent, missense
c) silent, frameshift, missense
d) silent, missense, frameshift

14. Mutations in DNA

a) are silent
b) are random
c) reduce genetic diversity
d) don't occur in somatic cells

15. In a monohybrid cross, if the P generation consists of plants that are true breeding then the F2 generation will consist of organisms that exhibit what ratio of dominant phenotypes to recessive phenotypes?

a) 3:2
b) 1:2
c) 1:3
d) 3:1

16. In a monohybrid cross, if the P generation consists of plants that are true breeding then the F2 generation will consist of organisms that exhibit what ratio of homozygous dominant individuals to heterozygous individuals to homozygous recessive individuals?

a) 3:2:1
b) 1:3:1
c) 1:2:1
d) 3:1

17. In a mitotically dividing cell, will an allele on one sister chromatic match the allele on the other sister chromatid?

a) Yes, if no errors have been made during DNA synthesis
b) Yes, but only if both sister chromatids are inherited from the same parent
c) Yes, or the chromatids won't disjoin during anaphase
d) Yes, but only when an individual is homozygous for that allele

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18. Using the pedigree below, and bearing in mind that this is a rare condition, what is the chance that the couple III-3 and III-4 will have an affected child?

a) 0
b) 1/4
c) 1/3
d) 1/2

19. Referring to the pedigree in question 17, what is the chance that a child of couple III-1 and III-2 will have an affected child?

a) 0
b) 1/4
c) 1/3
d) 1/2

The next three questions refer to the following pedigree:

20. What is the most probably mode of inheritance for the rare trait indicated in this pedigree?

a) sex-linked
b) recessive
c) rapidly mutating
d) dominant

21. Which of the following best explains why no one is affected in the first generation?

a) The couple in the first generation were related
b) The allele must have switched from a recessive to a dominant mode of inheritance at generation II
c) The mutant allele must have arisen in a gamete in someone from the first generation
d) The couple in the first generation died before they could display the trait

22. What is the probability that the next child born to individuals III-6 and III-7 is affected?

a) 0
b) 0.25
c) 0.5
d) 0.75

23. Which of the following cellular processes would be disrupted by a drug that interferes with the polymerization of tubulin?

1. chromosome disjunction 2. translation 3. transcription 4. dynein-mediated intracellular transport 5. ribosome assembly

a) 1 and 4
b) 1, 2, and 5
c) 1, 4, and 5

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d) 2 and 4

24. Epistasis influences

a) genotypic ratios
b) segregation of alleles
c) the phenotypic ratio
d) the kinds of gametes formed

25. A medical technician is analyzing a blood sample in a clinical lab. In determining the blood type the technician determines that the red blood cells have A antigens present on their surface but not B antigens. In this case, is it possible for the technician to unambiguously assign a genotype to the patient?

a) No, because fA is dominant over Fb
b) No, because there are three genotypes that specify this phenotype
c) No, because there are two genotypes that specify this phenotype
d) No, because human blood type alleles show co-dominance

26. A woman who is blood type A has a child who is blood type O. Which of the following individuals could not be the father of this child?

a) type A
b) type AB
c) type B
d) type O

27. During a typical cell cycle, S phase is followed by

a) G1
b) mitosis
c) G2
d) interphase

28. In the following pedigree for a recessive trait, what is the likelihood that individual II-4 is heterozygous?

1) 1/3
2) 1/2
3) 1/4
4) 0

29. b denotes blue eyes in humans and B for brown eyes is completely dominant over b. b is partially dominant over bg (green eyes) and bh (hazel eyes) and bh is completely dominant over bg (green eyes). What is the best representation of the dominance hierarchy for this trait?

a) B > b > bg > bh
b) B > b > bh > bg
c) b > B > bg > bh

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d) B > bg > bh > b

30. A monohybrid cross between heterozygous rabbits produces progeny in two phenotypic classes, in a ratio of 2:1 instead of the normal 3:1. What is a likely explanation for this altered ratio?

a) Homozygous recessive individuals die during embryonic development due to the presence of a lethal mutation
b) Homozygous individuals are physiologically more able to adapt to the birth process
c) Homozygous individuals occur more frequently in nature
d) Heterozygous individuals have increased fitness

31. Which of the following statements regarding the components of the cytoskeleton is false?

a) All three cytoskeleton components are polymers
b) Microfilaments are polar
c) Microtubules are polar
d) Intermediate filaments are polar

32. Which of the following statements regarding gene activity is true?

a) One gene can influence multiple traits
b) Gene activity can be modified by environmental conditions
c) Genes act in networks with other genes
d) All of these statements are true

33. When two or more genes influences a trait, an allele of one of them may have an overriding effect on the phenotype. When an allele has such an overriding effect, it is said to be:

a) Dominant
b) Recessive
c) Persistant
d) Epistatic

34. In a mating between individuals with the genotypes Ibi and ii, what percentage of the offspring are expected to have the O blood type?

a) 10%
b) 25%
c) 50%
d) 100%

35. A daughter of the mating in question 34 has a child with a man with type O blood. What is the probability that they will have two children with type B blood?

a) 1/2
b) 1/4
c) 1/8
d) 1/16

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36. In which of the following locations would you expect to find ribosomal subunits of various stages of assembly?

a) nuclear matrix
b) nucleolus
c) nuclear pore complex
d) cytoplasm

37. Which of the following accurately describes intermediate filaments?

a) they are found only in epithelial cells and neurons
b) they are larger than microtubules but smaller than F-actin filaments
c) The monomers of which they are made contain a central a-helical domain
d) they form highly unstable polymers

38. A tall pea plant has green, wrinkled peas. If the dominant alleles for these three traits are D, Y, and W respectively, what is the genotype of the plant that would be used in a test cross?

a) dd yy ww
b) Dd Yy Ww
c) DD YY WW
d) unable to determine based on the information given

39. Tissue specific enhancers are found in

a) genes that encode metabolic enzymes essential for core cellular functions
b) all genes
c) genes that encode regulatory transcription factors
d) ribosomal RNA genes

40. What process must always happen in order for a gene to be expressed?

a) transcription
b) translation
c) nuclear export of RNA
d) correct protein folding

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