

請選擇一個答案(單選),將代表字母(a 或 b 或 c...)填寫於答案卷內,每題2分,共100分

1). Which of the following is the most important difference between eukaryotes and prokaryotes?

- a. Eukaryotes have a cell wall, prokaryotes do not.
- b. Prokaryotes divide by binary fission, eukaryotes do not.
- c. Eukaryotes have a true nucleus, prokaryotes do not.
- d. Eukaryotes are multicellular, prokaryotes are unicellular.
- e. Eukaryotes have a cell membrane, prokaryotes do not.

2). All of the following statements about sub-cellular organelles are true, except:

- a. Rough ER is associated with protein synthesis.
- b. Protein modifications occur in the mitochondria.
- c. Lysosomes contain powerful digestive enzymes.
- d. Enzymes contained in the peroxisomes use molecular oxygen for their action.
- e. Chloroplasts are sites of photosynthesis.

3). Which of the following is the correct sequence of events in mitosis?

- a. prophase, interphase, metaphase, telophase, and anaphase
- b. interphase, cytokinesis, telophase, metaphase, and prophase
- c. cytokinesis, telophase, interphase, metaphase, and prophase
- d. prophase, anaphase, metaphase, telophase, and cytokinesis
- e. interphase, prophase, metaphase, anaphase, and telophase

4). All of the following statements regarding meiosis are true, except:

- a. The end result of meiosis is four haploid cells.
- b. The most important consequence of meiosis is the production of genetic variation.
- c. Meiosis only occurs in eukaryotes that reproduce sexually.
- d. Behavior of chromosomes during meiosis is contradictory to Mendel's laws of independent assortment.
- e. Exchange of genetic material takes place during the process of crossing over of chromosomes.

5). The definition of Mendel's principle of segregation is:

- a. the alleles in a heterozygote separate from each other in gamete formation.
- b. in a heterozygote one allele may conceal the presence of another.
- c. the alleles of different genes segregate independently of each other.
- d. the diploid gene number will be restored when sperm and egg unite to form a zygote.
- e. the alleles will segregate from each other when a diploid organism is formed.

6). Siblings share what percentage of their alleles?

- a. 1/2
- b. 1/4
- c. 1/8
- d. 1/10
- e. 1/16

7). Suppose you roll a six-sided die two times. Which of the following statements are true?

- a. The probability of two 6's is 1/64.
- b. The probability of a 4 and a 3 is 1/36.
- c. The probability of no 1's is 25/36.
- d. The probability of two 3's or two 5's is 1/32.
- e. The probability of the same number on both rolls is 1/6.

- 8). In a heterozygote, one allele conceals the presence of another. This is Mendel's:
- principle of segregation.
  - principle of independent assortment.
  - principle of dominance.
  - principle of dihybrid crosses.
  - principle of monohybrid crosses.
- 9). When we cross two strains of a popular garden plant (one with white flowers and one with red). The F<sub>1</sub> hybrids are all pink. The resulting F<sub>2</sub> from self-fertilization of the F<sub>1</sub> is a 1:2:1 ratio (white, pink, and red). What is the best hypothesis for explaining this data?
- Flower color is controlled by a single gene with 2 alleles.
  - Flower color is controlled by 2 different genes.
  - Red is only partially dominant over white.
  - a and c.
  - b and c.
- 10). What is/are the necessary assumptions in a dihybrid cross to predict the phenotypic ratio 9:3:3:1?
- Each gene segregates its alleles.
  - There is no linkage between the 2 genes.
  - Haploid gametes will contain one copy of a gene.
  - Cross fertilization of the P<sub>1</sub> will produce an F<sub>1</sub> that is doubly heterozygous.
  - a and d.
  - a and b.
- 11). A woman with type A blood would like to know what the possible blood types of her children would be if she mated with a type AB male. What are they?
- A
  - A, AB, or B
  - A or AB
  - O
  - B or AB
- 12). There are three phenotypes for fur color in monsters: wild-type fur is brown, one mutant color is purple, another is lavender. When we cross the two mutant monsters, we find that the F<sub>1</sub> has only brown fur. What is the best explanation?
- The combination of lavender and purple equals brown.
  - There was a back mutation to brown in one of the genes.
  - The mutations are in two different genes affecting color.
  - The lavender and purple gene are codominant.
  - The purple gene is completely dominant over the lavender gene.
- 13). A cross between two heterozygotes for one trait yields a phenotypic ratio of 2:1. What is the best explanation?
- The dominant trait is lethal in its homozygous form.
  - The trait forms sterile progeny.
  - Either the dominant or the recessive allele in its homozygous form is lethal.
  - The trait causes semisterility in one of the parents.
  - The recessive allele for the trait is lethal in its homozygous form.
  - a and d.

14). What is the chromosomal basis for Mendel's principles of segregation and individual assortment?

- a. independent behavior of pairs of chromosomes during the first meiotic division
- b. disjunction of chromosomes during meiosis
- c. during anaphase of the first meiotic division chromosomes join
- d. all of the above
- e. a and b

15). Dosage compensation of *X*-linked genes in mammals is achieved by

- a. forming genetic mosaics in females with cells with one functional *X*-chromosome.
- b. a gene that is turned off in males that allows expression of the *X*-chromosome.
- c. the addition of methyl groups to the *Y*-chromosome.
- d. a site on a chromosome which controls *X*-expression called the *X*-hyperactivation center.
- e. both *X*-chromosomes in the female being inactivated.

16). Down Syndrome is an example of:

- a. hypoploidy.
- b. hyperploidy.
- c. trisomy.
- d. aneuploidy.
- e. monosomy.
- f. a, c, and d.
- g. b, c, and d.

17). F1 plants that were heterozygous for two traits are crossed. The resulting phenotypic ratio is 23.3:1:1:6.8. What is the best explanation for this result?

- a. The result is expected.
- b. A crossover event has occurred.
- c. The two genes are on the same chromosome.
- d. Recombination has occurred forming new gene combinations.
- e. The genes are on different chromosomes.
- f. c and d.

18). A P1 with blue-flowered, short-stalked plants and white-flowered, long-stalked plants is crossed as is the resulting F1. You find:

- 400 blue, short.
- 400 white, long.
- 100 blue, long.
- 100 white, short.

What is the recombination frequency?

- a. 0.25
- b. 0.2
- c. 0.08
- d. 0.1
- e. 0.05

19). In a data set to determine crossover frequency between the *sc*, *ec*, and *cv* genes in *Drosophila*, the crossover frequency between *ec* and *sc* = 0.15, and *ec* and *cv* = 0.25. The number of double crossover flies was 15 out of 500 flies. Assuming *sc*, *ec*, *cv* is the respective order of the genes, what can we conclude from this result?

- a. The coefficient of coincidence is near zero.
- b. The expected number of crossovers and the observed numbers are not different.
- c. The genes are tightly linked.
- d. The coefficient of coincidence is near one.
- e. There is a large amount of interference between these genes.
- f. b and d.
- g. a, c, and e.

20). *Saccharomyces cerevisiae* is a good experimental organism for the study of meiosis because:

- a. it is haploid with a sexual cycle.
- b. it produces 4 ascospores.
- c. you can analyze all 4 products of a single meiosis.
- d. there are many mutations that have been identified.
- e. all of the above.
- f. b and c.

21). Crossing yeast with two different mutations yields almost all asci with a parental ditype pattern. We can conclude that:

- a. the genes are loosely linked.
- b. the genes are on two different chromosomes.
- c. the genes are closely linked.
- d. neither of the two genotypes like the parental genotype
- e. we need more data to determine the linkage.

22). In *Neurospora*, there are different patterns of segregation for genes during meiosis. A first division segregation pattern indicates that :

- a. there has been crossing over.
- b. the two alleles are in each of the daughter nuclei of ascospore division.
- c. no crossing over has taken place.
- d. there is linkage between the genes.

23). Equation A: recombination frequency =  $[(1/2)T + \text{NPD}]/\text{Total}$ ; Equation B: recombination frequency =  $[(1/2)T + 3\text{NPD}]/\text{Total}$ . What is the difference between these two equations?

- a. Equation A only calculates recombination frequency and not map distance.
- b. Equation B is used for calculating the recombination frequency between three mutant genes.
- c. Equation A produces an overestimate for map distance between 2 genes.
- d. Equation B corrects for the inability to count two-strand and three-strand double crossovers.
- e. Equation A is used for ordered tetrad analysis while Equation B is not.

24). A Lod score of 3 is found for two loci. What does this tell you?

- a. the data are 1000 times more likely under a model of independent assortment than a model of linkage.
- b. There is no evidence for linkage.
- c. The data are 1000 times more likely under a model of linkage than of independent assortment.
- d. There is strong evidence for linkage.
- e. a and b.
- f. c and d.

25). Satellite DNA is:

- a. repetitive
- b. prokaryotic.
- c. randomly distributed throughout the genome.
- d. expressed.
- e. identified on the bases of density-gradient centrifugation.

26). Complementary strands of a DNA double helix have opposite chemical polarity but are synthesized in the same direction (replication fork movement). This is accounted for by:

- a. Using a 3'→5' polymerase to synthesize the lagging strand.
- b. Using discontinuous synthesis on the leading strand.
- c. Using the polymerase activity of DNA ligase.
- d. Using the 5' → 3' polymerase activity of Pol III to synthesize multiple short segments which are later covalently joined.
- e. none of the above.

27). The following statements about telomerase are true:

- a. It extends the 3' end of a linear chromosome one repeat at a time.
- b. It uses a built-in DNA to act as a template for synthesis of the telomeric repeat.
- c. Without telomerase, linear chromosomes would become progressively shorter.
- d. a and b
- e. a and c.

28). The majority of eukaryotic pre-mRNA's, which encode peptides, undergo which of the following modifications?

- a. Addition of a 7-Methyl guanosine cap to the 5'-end of the transcript.
- b. Poly (U) tails are added to the 3' ends of the transcripts.
- c. Exons are spliced out of the primary transcripts and degraded in the nucleus.
- d. Editing of U residues.
- e. none of the above

29). Introns:

- a. begin with the sequence GU(5') and end with the sequence AG(3').
- b. were first identified with mRNA-DNA hybrids forming R-loops.
- c. are present in all eukaryotic genes.
- d. encode for peptide sequence.
- e. have no biological significance.

30). Which of the following codons are involved with initiation of peptide synthesis?

- a. AUG, UAG
- b. UGA, UAA
- c. UAA, AUG
- d. GUG, AUG
- e. UAG, AUG

31). Replacement of adenine with thymine by mutation is referred to as what?

- a. frameshift
- b. transition
- c. transversion
- d. deletion
- e. insertion

32). Which of the following is an operational definition of the gene?

- a. the basic unit of genetic information
- b. the unit that controls a specific aspect of phenotype
- c. the unit that specifies the synthesis of one polypeptide
- d. the unit of function defined by the complementation test
- e. all of the above

33). The genetic material of HIV consists of:

- a. one strand RNA.
- b. two strands of RNA.
- c. one strand DNA.
- d. two strands of DNA.
- e. a DNA-RNA duplex.

34). Reverse Transcriptase:

- a. is found in the HIV protein core.
- b. is a hallmark of retroviruses.
- c. activity is present in telomerase.
- d. transcribes DNA from a RNA template.
- e. all of the above.

35). A mutant of *E. coli* is designated  $\text{Str}^r$  and  $\text{arg}^-$ . Which of the following best describes this genotype?

- a. antibiotic resistant, prototrophic
- b. antibiotic resistant, auxotrophic
- c. antibiotic sensitive, prototrophic
- d. antibiotic sensitive, auxotrophic
- e. antibiotic resistant, carbon-source mutant

36). Non-Mendelian inheritance of organelles may be characterized by:

- a. preferential transmission of organelles through gametes of one sex.
- b. maternal inheritance.
- c. irregular segregation of phenotypes.
- d. paternal inheritance.
- e. all of the above.

37). Which of the following is NOT a cloning vector?

- a. cosmid
- b. plasmid
- c. autonomously replicating sequence (ARS)
- d. yeast Artificial Chromosome (YAC)
- e. bacterial Artificial Chromosome (BAC)

38). If you wanted to identify and characterize a protein in a cellular extract, which of the following techniques would you use?

- a. Southern blotting.
- b. western blotting.
- c. northern blotting.
- d. polymerase chain reaction.
- e. a complementation.

39). If you were constructing a cDNA library, you would need all of the following except:

- a. DNA ligase.
- b. DNA template.
- c. RNA template.
- d. poly-T oligomers.
- e. reverse transcriptase.

40). *Taq* polymerase has made PCR very easy and convenient because:

- a. it is required in smaller amounts than DNA polymerase I.
- b. it acts more rapidly than DNA polymerase I.
- c. it is inactivated easily by heat.
- d. it has a half life several times longer than other enzymes.
- e. it does not have to be added after each cycle of heat-denaturation.

41). Restriction fragment length polymorphisms arise by:

- a. large scale chromosomal rearrangements.
- b. mutations that change sequences in restriction cleavage sites.
- c. insertion of retroviruses in genomic sequences.
- d. differences in the number of copies of tandem repeats.
- e. all of the above.

42). Imagine you are an MD and are consulted by a patient who has a family history of Huntington's disease. Which of the following molecular diagnostic tests would you recommend to find out if the patient has an expanded trinucleotide repeat?

- a. DNA sequencing
- b. positional cloning
- c. PCR
- d. RFLP analysis
- e. chromosome walking

43). Which of the following motifs is NOT characteristic of a eukaryotic transcription factor?

- a. transmembrane domain
- b. helix-turn-helix
- c. leucine zippers
- d. helix-loop-helix
- e. all of the above

44). Which of the following is the best example of a tumor-suppressor gene?

- a. the *RB* gene involved in retinoblastoma.
- b. Philadelphia chromosome in chronic myelogenous leukemia.
- c. *c-ras* involved in human bladder cancer.
- d. *c-myc* involved in Burkitt's lymphoma.
- e. platelet-derived growth factor (PDGF).

45). The term pseudogene refers to:

- a. a cloned gene carried on plasmid vectors.
- b. cloned genes introduced into the chromosome of an organism.
- c. introns of eukaryotic genes.
- d. a non-coding duplicate of a normal gene.
- e. any non-coding region of the chromosome.

46). The following are true about oogenesis and fertilization, except:

- a. two meiotic divisions take place in the egg which reduce the chromosome number to half.
- b. in some organisms, the second meiotic division is not completed until after the egg has been fertilized.
- c. development is profoundly affected by cytoplasmic materials present in the egg.
- d. the main function of the egg yolk is to provide nourishment for the developing animal.
- e. the determinative components of the egg cytoplasm are manufactured after fertilization.

47). Which of the following statements best characterizes a homeotic gene?

- a. They define segmental regions in the embryo.
- b. They define the anterior and posterior compartments of individual segments.
- c. Mutations in these genes cause one body part to look like another.
- d. They are responsible for sex determination.
- e. They are involved in gene dosage compensation.

48). Which of the following statements is true about IgE antibodies?

- a. They are involved in allergies like asthma and hay fever.
- b. They are found in large quantities in human blood.
- c. *They are most commonly found in body secretions like saliva and tears.*
- d. They are pentameric molecules with ten antigen-binding sites.
- e. They are involved in the secondary immune response.

49). Which of the following is not an example of a multifactorial disorder?

- a. cystic fibrosis
- b. diabetes
- c. hypertension
- d. obesity
- e. partial epilepsy

50). Which of the following is not a feature of an ideal population under the Hardy-Weinberg Theorem?

- a. few individuals
- b. isolated from migration
- c. no mutation
- d. no selection
- e. random mating