HGA

2019

1. If you want to compare the means of weights in two groups of sizes 7 and 8, respectively, then the degree of freedom of the t-test is
   a. 15
   b. 14
   c. 13
   d. None of the above

2. For any set of observations
   a. the mean is greater than the median.
   b. the mean is less than the median.
   c. the mean is equal to the median.
   d. none of the above statements is necessarily true.

3. Suppose data are available on BMI (Y) and fasting glucose levels (X). The regression line of Y on X is $Y = 0.25X - 0.1$. Then
   a. the regression line of X on Y cannot be determined from the above information.
   b. the regression line of X on Y is $X = 4Y + 0.4$.
   c. the correlation coefficient between X and Y is 0.25.
   d. the correlation coefficient between X and Y is 0.4.

4. The prevalence of a disease in a population is 10%. If 3 individuals are selected at random, what is the probability that one of them is affected?
   a. 0.1
   b. 0.3
   c. 0.81
   d. 0.243

5. It is suspected that a novel protein only interacts with the promoter region of a gene. Which of the following techniques are suitable to confirm this suspicion?
   a. EMSA and DNase footprinting but not ChIP.
   b. DNase footprinting and ChIP but not EMSA.
   c. EMSA and ChIP but not DNAse footprinitng.
   d. EMSA, ChIP and DNAse footprinting.

6. If a polymerase chain reaction (PCR) amplification was performed on human genomic DNA, multiple products of varying sizes were obtained, including one of the expected size. Which of the following modifications to the protocol is the most likely to eliminate the extra PCR productc?
   a. Raising the annealing temperature.
   b. Raising the denaturation temperature.
   c. Raising the elongation temperature.
   d. Increasing the elongation time.

7. Monoallelic expression of a gene
   a. occurs when the gene is imprinted.
   b. occurs when the gene has been duplicated.
   c. occurs when one copy of the gene carries a mutation.
   d. is not possible.

8. Which of the following actions best explains how a minor change in transcription factor levels could lead to a big change in transcriptional output of it's target gene?
   a. Chromatin modification.
   b. Cooeprative binding.
   c. Dimerization.
   d. Negative feedback.

9. Which of the following techniques serves well as the basis for a rapid and highly sensitive blood test to detect circulating cancer cells that carry the fusion *Bcr-Abl* gene?
   a. DNA sequencing.
   b. Flow cytometry.
   c. Western blotting.
   d. PCR analysis.

10. Which of the following provides key evidence that snRNPs are involved in the splicing of pre-mRNA?
    a. Association of snRNPs within ribosomes.
    b. Base-pairing between snRNAs and pre-mRNA splice sites.
    c. Introns within snRNAs.
    d. Lariat structure within snRNAs.

11. All dinucleotide frequencies in human and drosophila are similar, except the CpG dinucleotide. The most probable reason is
    a. CpG dinucleotides are methylated in human and methylated cytosines are prone to be deaminated.
    b. drosophila has a different GC composition than human.
    c. CpG dinucleotides not conserved across the mammals during evolution
    d. none of the above.

12. What is the main difference between the origins of siRNA and miRNA?
    a. siRNAs originate within the cell cytoplasm, while miRNAs originate from the cell genome.
    b. miRNAs are only expressed when siRNAs are unable to degrade mRNAs in the cell.
    c. miRNAs are processed from dsRNA viruses, while siRNAs are processed from ssRNA viruses.
    d. siRNAs originate predominantly from exogenous dsRNA, while miRNAs are endogenous product of the cell.

13. What do T-cells need to recognize so that they can respond to specific antigens?
   a. The antigenic epitope displayed by MHC molecules.
   b. B cells.
   c. Immunoglobulin.
   d. Cytokines.

14. Induced Treg cells maintain, in part tolerance to
   a. insulin.
   b. growth hormone
   c. peanuts
   d. none of the above.

15. If the DNA from a bacteriophage has base composition of 20% A, 30% T, 20% G and 30% C, then
   a. the DNA of the bacteriophage is linear and can tolerate base-pair mismatch.
   b. the genome of bacteriophage is single-stranded DNA.
   c. in viral genomes, the base pairing does not follow the standard Watson-Crick rules and allows G-T and C-A base pairings.
   d. the DNA of bacteriophage tightly binds with special proteins which inhibit standard Watson-Crick base-pairing.

16. The amino acid, proline, disrupts α-helical structure in proteins because it is
   a. an acidic amino acid
   b. a basic amino acid
   c. an aromatic amino acid
   d. an imino acid

17. Suppose, radioactive dCMP was added to an actively growing culture of *E. coli* bacteria. Which of the following would be the result if *E.coli* is allowed to replicate once in the presence of this radioactive base?
   a. Neither of the two daughter cells would have radioactive DNA
   b. One of the daughter cells, but not the other, would have radioactive DNA
   c. Both daughter cells would have radioactive DNA
   d. DNA replication would not occur

18. Which of the following hormones initiates biological actions by crossing the plasma membranes and then binding to a receptor?
   a. Glucagon
   b. Estradiol
   c. Insulin
   d. Norepinephrine

19. Which of the following amino acids is most compatible with a helical structure?
   a. Alanine
   b. Proline
   c. Tryptophan
   d. Cystine

20. The greatest buffering capacity at physiologic pH would be provided by a protein, rich in which of the following amino acids
   a. Lysine
   b. Aspartic acid
   c. Valine
   d. Histidine

21. If an affected male marries a normal female and produces affected daughters and sons in about the same numbers as unaffected daughters and sons, the traits are likely to be an
   a. X-linked dominant trait.
   b. autosomal recessive trait.
   c. autosomal dominant trait.
   d. X-linked recessive trait.

22. If ^{14}C-glycine is used for biosynthetic labelling, which one of the following molecules can be labelled in bacterial cells?
   a. Purines and pyrimidines
   b. Purines and proteins
   c. Proteins and lipids
   d. Proteins and pyrimidines

23. Which cellular processes produce the carbon dioxide that is exhaled?
   a. Glycolysis but not citric acid cycle.
   b. Citric acid cycle but not glycolysis.
   c. Both glycolysis and citric acid cycle.
   d. Neither Citric acid cycle nor glycolysis.

24. Absorbance of 0.02mM ATP solution at 260nm with a cuvette having a path length of 0.5cm is 0.154. The molar absorption coefficient [in L mol^{-1} cm^{-1}] of ATP is
   a. 7700
   b. 1540
   c. 770
   d. 15400

25. If a patient is deficient in pyruvate kinase, how many net moles of ATP would be generated upon conversion of 1 mole of glucose to pyruvate?
    a. 0
    b. 1
    c. 2
    d. 3

26. Which of the following enzymes is involved in nucleic acid synthesis without requiring any template DNA?
    a. DNA polymerase I
    b. DNA polymerase II
    c. Poly (A) polymerase
    d. RNA polymerase

27. Telomerase is composed of
    a. protein and RNA.
    b. only protein.
    c. only RNA.
    d. protein and DNA.

28. Point mutations in RAS proto-oncogene that are associated with some cancers lead to
    a. loss of function.
    b. gain of function.
    c. no change of function.
    d. premature terminations.

29. The proportion of G is same as that of C and the proportion of A is same as that of T in double stranded DNA. Which of the following double stranded DNA molecule will potentially have the maximum diversity (i.e. information content per base)?
    a. DNA with 10% G.
    b. DNA with 20% G.
    c. DNA with 25% G.
    d. DNA with 35% G.

30. A patient with breast cancer was given a dose of radiation along with chemotherapy and was apparently cured of the tumour. After 5 years, a tumour was noticed in the patient's lungs. Which of the following is best possible explanation-
    a. Migration of residual chemo-resistant cells from the mammary gland resulted in tumour in the lung.
    b. Bacterial infection led to development of the tumour in lungs.
    c. Epithelial to mesenchymal transition had occurred in lung.
        d. Cells in lung were induced to become a tumour after chemotherapy.