1. Suppose a man walks along the four sides of a square ground with speeds v_1, v_2, v_3, and v_4 km/hr, respectively. Then his average speed can be measured

   (A) either by arithmetic mean or harmonic mean.
   (B) either by arithmetic mean or geometric mean.
   (C) only by harmonic mean.
   (D) only by geometric mean.

2. Let the regression equation of y on x is $y+x=3$. The regression equation of x on y is either $2y + x = 0$ or $y + x = 0$. Then consider the following statements

   (i) x and y have a perfectly linear relationship for the pair of regression equations $y + x = 3$ and $2y + x = 0$.
   (ii) The regression equations $y + x = 3$ and $y + x = 0$ are parallel.
   (iii) The correlation coefficient between x and y is -1, if we consider the two regression equations $y + x = 3$ and $y + x = 0$.

   (A) Only (i) is correct.
   (B) Both (ii) and (iii) are correct.
   (C) Only (ii) is correct.
   (D) None of the statements (i), (ii) and (iii) is correct.

3. In a $k \times k$ Latin square design, the error degrees of freedom in ANOVA is

   (A) $k^2 - 2$.
   (B) $k^2 - k - 2$.
   (C) $k(k - 1)(k - 2)$.
   (D) $(k - 1)(k - 2)$.

4. Which of the following assumptions is used in constructing ANOVA?

   (A) The only requirement is samples must be independent.
   (B) Sample are not necessarily independent, but the population variations must be unequal.
   (C) Sample are not necessarily independent, but the population variations must be equal.
   (D) Sample must be independent, population variations must be equal, and the population must be normally distributed.

5. Selecting the appropriate media for an experiment is crucial for obtaining reliable results. The following plausible prerequisites may be considered when choosing a media:

   (a) Compatibility with organisms or cells.
   (b) Sterility.
   (c) PH and buffering capacity.
   (d) Osmolarity.

   Choose the correct alternative.

   (A) Only (a) is correct.
   (B) Both (a) and (b) are correct.
   (C) Both (a) and (c) are correct.
   (D) All are correct.

6. Two alleles, A and a, in a population are in Hardy-Weinberg equilibrium with allele frequencies 0.6 and 0.4, respectively. How many individuals in a sample of 200 from this population can be expected to be homozygous of a minor allele?

(A) 48

(B) 96

(C) 32

(D) 72

7. Activated memory T-cells can be distinguished from naive T-cells on the basis of expression of

   (A) T-cell receptor.
   (B) MHC class II molecules.
   (C) CD45RO.
   (D) Immunoglobulin.

8. Which of the following is not a characteristic feature of apoptosis?

   (A) Cell death.
   (B) Ruptured plasma membrane.
   (C) Cytoplasmic blebbing.
   (D) Chromatin condensation.

9. What are cryptic splice sites?

   (A) These splice sites are used in some cells but not others.
   (B) These are splice sites that are always used.
   (C) These are splice sites involved in alternative splicing, which removes exons from some mRNA molecules.
   (D) These splice sites have the potential to be selected by the spliceosome but are generally not used by the spliceosome.

10. Taq polymerase is capable of synthesizing relatively small pieces of DNA (usually up to 4000bp). Which of the following is a likely explanation for the inability of Taq polymerase to

synthesize long pieces of DNA?

(A) Taq polymerase can make only short Okazaki fragments.

(B) Taq polymerase lacks the helicase required for strand separation.

(C) Taq polymerase cannot remove mismatched bases from the $3'$ end.

(D) Taq polymerase synthesizes DNA in the $3'$-$5'$ direction.

11. Which of the following enzymes is involved in the DNA demethylation process?

(A) DNA methyltransferases 3A (DNMT3A).
(B) DNA methyltransferases 3L (DNMT3L).
(C) Ten-eleven translocation family proteins (TETs).
(D) Histone deacetylases (HDACs).

12. Amino acids at pH above its pI will be

(A) anionic.
(B) cationic.
(C) zitterionic.
(D) None of the above.

13. Which of the following is an example of physiological apoptosis?

(A) Cell death due to radiation.
(B) Cell death due to infection.
(C) Reduced cell proliferation by apoptosis of receptors to maintain homeostasis.
(D) Cell death due to accumulation of misfolded protein.

14. What is the role of locus control regions (LCRs) in the regulation of gene expression?

    (A) DNA binding proteins bind to the LCRs and stimulate DNA methylation.
    (B) DNA binding proteins bind to the LCRs and stimulate chromatin condensation.
    (C) Transcription factors bind to the LCRs and promote gene expression.
    (D) LCRs make attachments with the nuclear matrix.

15. Which of the following is a region of eukaryotic DNA containing one or more active genes that can be delineated by the treatment with DNase-I?

    (A) Euchromatin.
    (B) Heterochromatin.
    (C) Functional domain.
    (D) Facultative heterochromatin.

16. The high concordance rate for monozygotic vs dizygotic twins in type 1 diabetes indicates

    (A) a strong environmental element.
    (B) a strong genetic element.
    (C) the influence of HLA.
    (D) mitochondrial inheritance.

17. During the process of RNA-interference, endonuclease DICER cleaves

    (A) double-stranded DNA.
    (B) double-stranded RNA.
    (C) single-stranded RNA.
    (D) single-stranded DNA.

18. mRNA degradation takes place in

    (A) proteasome.
    (B) spliceosome.
    (C) P bodies.
    (D) R bodies.

19. Which of the following is correct about telomerase?

    (A) It is an RNA-dependent DNA polymerase.
    (B) It is a DNA-dependent DNA polymerase.
    (C) It is a DNA-dependent RNA polymerase.
    (D) It is an RNA-dependent RNA polymerase.

20. In a family with three children, what is the probability that two are boys and one is a girl?

    (A) $\frac{2}{3}$
    (B) $\frac{1}{2}$
    (C) $\frac{3}{8}$
    (D) $\frac{1}{8}$

21. Which of the following is most likely a cause for spontaneous mutation?

(A) Heat.
(B) Radiation.
(C) Deamination.
(D) Chemical mutagen.

22. The snRNPs (small nuclear ribonucleoprotein complexes) are the key functional components of the spliceosome. Which one of the following proteins might be expected to be found in a snRNP?

(A) A DNA helicase.
(B) An ATPase.
(C) An enhancer protein.
(D) A site-specific ribonuclease.

23. Which of the following factors has not been associated with the development of autoimmune disease?

(A) HLA.
(B) Genetic factors other than HLA.
(C) Severe combined immunodeficiency.
(D) Infection.

24. In a large population that reproduces by random mating, the frequencies of the genotypes GG, Gg, and gg are 0.04, 0.32, and 0.64, respectively. Assume that a change in the climate induces the population to reproduce exclusively by self-fertilization. What will the frequencies of the genotypes in this population be after many generations of self-fertilization?

(A) Ultimate frequency of GG and gg will be 0.2 and 0.8, respectively.

(B) Ultimate frequency of GG and gg will be 0.04 and 0.96, respectively.

(C) Ultimate frequency of GG and gg will be 0.36 and 0.64, respectively.

(D) Ultimate frequency of GG and gg will be 0.04 and 0.64, respectively.

25. What is the probability that a male will inherit an X-linked recessive allele from his father?

(A) 0
(B) 0.25
(C) 0.50
(D) 0.75

26. The most common amino acid observed in beta turn is

(A) cysteine.
(B) glycine.
(C) serine.
(D) methionine.

27. Which region of the mRNA is bound by the microRNAs to control gene expression?

(A) 5′-UTR.
(B) 3′-UTR.
(C) Poly A tail.
(D) Coding exon.

28. The total number of ATP synthesized in the EMP pathway by substrate-level phosphorylation is

    (A) 6
    (B) 4
    (C) 8
    (D) 30

29. Which of the following can be done using RNA-sequencing but not using cDNA microarray experiments in a transcriptomics study?

    (A) Differentially expressed genes can be identified.
    (B) Novel transcripts can be identified.
    (C) Differentially expressed non-coding RNAs can be identified.
    (D) None of the above.

30. All elements in the human genome are classified as

    (A) Long Interspersed Elements (LINEs).
    (B) Short Interspersed Elements (SINEs).
    (C) Retro-transposons.
    (D) Long Terminal repeats (LTRs).