

**BIOLOGY**

1. Bt cotton variety that was developed by the introduction of toxin gene of *Bacillus thuringiensis* (Bt) is resistant to
  - a) insect pests
  - b) fungal diseases
  - c) plant nematodes
  - d) insect predators.
2. Which of the following statements is incorrect regarding RNA interference?
  - a) It is a method of cellular defense.
  - b) The introduction of DNA into the host cell produces both sense and anti-sense RNA.  $\frac{1000}{3} = \frac{1}{2}mv^2$
  - c) It involves silencing of a specific mRNA.
  - d) Dicer is a DNase enzyme that cuts the dsRNA molecules into siRNAs.
3. A permanent cure for ADA deficiency could be:
  - a. Enzyme replacement therapy
  - b. Bone marrow transplant  $\frac{1}{2} = \frac{1}{2} \times 1$
  - c. Introduction of a functional ADA cDNA into lymphocytes
  - d. Introduction of gene isolated from marrow cells producing ADA into early embryonic cells
4. RNAi is a mechanism to silence genes with the help of
  - a. ssRNA
  - b. dsRNA
  - c. ssDNA
  - d. dsDNA
5. The two polypeptides of human insulin are linked together by
  - a. phosphodiester bonds
  - b. covalent bonds
  - c. disulphide bridges
  - d. hydrogen bonds
6. Acrosome is a type of
  - a. lysosome
  - b. flagellum
  - c. ribosome
  - d. basal body.
7. Which of the following contains the actual genetic part of a sperm ?
  - a. Whole of it
  - b. Tail
  - c. Middle piece
  - d. Head
8. The sperms undergo physiological maturation, acquiring increased motility and fertilizing capacity in
  - a. seminiferous tubules
  - b. vasa efferentia
  - c. epididymis
  - d. vagina.
9. At what stage of life is oogenesis initiated in a human female ?
  - a. At puberty
  - b. During menarche
  - c. During menopause
  - d. During embryonic development
10. 1st polar body is formed at which stage of oogenesis ?
  - a. 1st meiosis
  - b. 2nd mitosis
  - c. 1st mitosis
  - d. Differentiation
11. A stamen is regarded as a
  - a. Microsporophyll
  - b. Megasporophyll
  - c. Microsporangium
  - d. Megasporangium
12. A typical anther is generally
  - a. Bisporangiate
  - b. Tetrasporangiate
  - c. Monosporangiate
  - d. Multisporangiate
13. The tapetal cells of anther shows
  - a. Haploidy
  - b. Diploidy
  - c. Triploidy
  - d. Polyploidy
14. During microsporosis, meiosis occurs in-
  - a. Endothecium
  - b. Microspore mother cell
  - c. microspore tetrads
  - d. Pollen grains
15. The outermost and the innermost wall layers of microsporangium in an anther are respectively -
  - a. Endothecium and tapetum
  - b. Epidermis and endodermis
  - c. Epidermis and middle layers
  - d. Epidermis and tapetum
16. What is the term for the spread of cancer cells from the primary site to other parts of the body?
  - a) Metastasis
  - b) Invasion
  - c) Angiogenesis
  - d) Carcinogenesis
17. Assertion: HIV attacks and destroys CD4 cells.  
Reason: CD4 cells are responsible for cell-mediated immunity.
  - a) Both assertion and reason are true
  - b) Assertion is true, reason is false
  - c) Assertion is false, reason is true
  - d) Both assertion and reason are false
18. Assertion: Antiretroviral therapy (ART) can cure HIV infection.  
Reason: ART suppresses viral replication and boosts the immune system.
  - a) Both assertion and reason are true
  - b) Assertion is true, reason is false
  - c) Assertion is false, reason is true
  - d) Both assertion and reason are false
19. Assertion: Carcinogens can cause genetic mutations leading to cancer.

Reason: Carcinogens are substances that can cause cancer.

- a) Both assertion and reason are true  
c) Assertion is false, reason is true

- b) Assertion is true, reason is false  
d) Both assertion and reason are false

20. Assertion: Cancer cells undergo apoptosis.

Reason: Apoptosis is programmed cell death.

- a) Both assertion and reason are true  
c) Assertion is false, reason is true

- b) Assertion is true, reason is false  
d) Both assertion and reason are false

21. In prokaryotes, gene regulation is primarily controlled at which level?

- a) Transcriptional level    b) Post-transcriptional level    c) Transfer of mRNA to cytoplasm    d) Post-translational level

22. The lac operon is considered an inducible operon because:

- a) It is always turned on.  
c) It is turned on when lactose is present.  
b) It is turned off when lactose is present.  
d) It is turned on when glucose is present.

23. What is the role of tRNA in translation?

- a) Carrying genetic information from DNA to ribosomes  
c) Delivering amino acids to the ribosome  
b) Catalyzing peptide bond formation  
d) Regulating the expression of genes

24. Which of the following is essential for the initiation of translation in eukaryotes?

- a) Ribosome only  
c) mRNA, tRNA, and ribosomes, amino acid  
b) Ribosomal subunit 30S, mRNA  
d) Amino acid only

25. Which molecule acts as an inducer in the lac operon system?

- a) Glucose    b) Lactose    c) cAMP    d) Galactose

26. Assertion: Migration leads to an increase in population size.

Reason: Individuals move from one population to another.

- a) Both assertion and reason are correct and related.  
c) Assertion is incorrect, reason is correct.  
b) Both assertion and reason are correct but unrelated.  
d) Both assertion and reason are incorrect.

27. Assertion: Birth rate is the primary factor influencing population growth.

Reason: Death rate has a lesser impact on population growth.

- a) Both assertion and reason are correct and related.  
c) Assertion is incorrect, reason is correct.  
b) Both assertion and reason are correct but unrelated.  
d) Both assertion and reason are incorrect.

28. Assertion: Population density affects the distribution of organisms.

Reason: Organisms compete for resources.

- a) Both assertion and reason are correct and related.  
c) Assertion is correct, reason is incorrect.  
b) Both assertion and reason are correct but unrelated.  
d) Assertion is incorrect, reason is correct.

29. Assertion: Carrying capacity is the maximum population size an environment can support.

Reason: Resources are limited.

- a) Both assertion and reason are correct and related.  
c) Assertion is correct, reason is incorrect.  
b) Both assertion and reason are correct but unrelated.  
d) Assertion is incorrect, reason is correct.

30. Assertion: Exponential growth occurs when resources are unlimited.

Reason: Population growth rate remains constant.

- a) Both assertion and reason are correct and related.  
c) Assertion is correct, reason is incorrect.  
b) Both assertion and reason are correct but unrelated.  
d) Assertion is incorrect, reason is correct.

### MATHEMATICS

1. The value of  $\sin\left(\sin^{-1}\frac{1}{3} + \sec^{-1}3\right) + \cos\left(\tan^{-1}\frac{1}{2} + \tan^{-1}2\right)$  is

- (a) 2    (b) 1    (c) 3    (d) 4

2) Two dice are thrown together. If the numbers appearing on the two dice are different, then what is the probability that the sum is 6

- (a)  $\frac{2}{15}$     (b)  $\frac{5}{36}$     (c)  $\frac{1}{6}$     (d) None of these

3)  $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\cot x}}{\sqrt{\cot x} + \sqrt{\tan x}} dx =$

- (a)  $\frac{\pi}{4}$     (b)  $\frac{\pi}{2}$     (c)  $\pi$     (d) 0

4.  $\lim_{x \rightarrow \infty} \frac{e^{x^2 - \cos x}}{x^2}$  is equal to

- (a)  $\frac{2}{3}$     (b)  $\frac{1}{2}$     (c)  $\frac{3}{2}$     (d) None of these



5. If  $y(t)$  is solution of  $(t+1)\frac{dy}{dx} - ty = 1, y(0) = -1$  at  $t = 1$ , the solution is

- (a)  $e + \frac{1}{2}$  (b)  $-\frac{1}{2}$  (c)  $\frac{1}{2}$  (d) None of these

6. Three fair coins are tossed. If both heads and tails appears, then the probability that exactly one head appears, is

- (a)  $\frac{3}{8}$  (b)  $\frac{1}{6}$  (c)  $\frac{1}{3}$  (d)  $\frac{1}{2}$

7. If  $A = \begin{bmatrix} \log x & -1 \\ -\log x & 2 \end{bmatrix}$  and if  $\det(A) = 2$ , then the value of  $x$  is equal to

- (a) 2 (b) -2 (c)  $e^2$  (d) None of these

8. The value of  $\frac{dy}{dx}$  at  $x = \frac{\pi}{2}$ , where  $y$  is given by  $y = x^{\sin x} + \sqrt{x}$  is

- (a)  $1 + \frac{1}{\sqrt{2\pi}}$  (b) 1 (c)  $\frac{1}{\sqrt{2\pi}}$  (d) none of these

9. The projection of vector  $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$  along  $\vec{b} = \hat{i} + 2\hat{j} + 2\hat{k}$  is

- (a)  $\frac{2}{3}$  (b)  $\frac{1}{3}$  (c) 2 (d) None of these

10. The integral  $\int \frac{3x^{13} + 2x^{11}}{(2x^4 + 3x^2 + 1)^4} dx$  is equal to

- (a)  $\frac{x^4}{6(2x^4 + 3x^2 + 1)^3} + c$  (b)  $\frac{x^4}{(2x^4 + 3x^2 + 1)^3} + c$  (c)  $\frac{x^{12}}{6(2x^4 + 3x^2 + 1)^3} + c$  (d) None of these

### CHEMISTRY

1. If 0.15 g of solute, dissolved in 15 g of solvent, is boiled at a temperature higher by  $0.216^\circ\text{C}$ , than that of the pure solvent, the molecular weight of the substance is (molal elevation constant for the solvent is  $2.16^\circ\text{C}$ )

- (a) 1.01 (b) 10 (c) 10.1 (d) 100

2. Vapour pressure of benzene at  $30^\circ\text{C}$  is 121.8 mm. When 15 g of a non-volatile solute is dissolved in 250 g of benzene its vapour pressure decreased to 120.2 mm. The molecular weight of the solute is (mol. weight of solvent = 78)

- (a) 356.2 (b) 456.8 (c) 530.1 (d) 656.7

3. Which of the following molecules acts as a Lewis acid?

- (a)  $(\text{CH}_3)_3\text{B}$  (b)  $(\text{CH}_3)_2\text{O}$  (c)  $(\text{CH}_3)_3\text{P}$  (d)  $(\text{CH}_3)_3\text{N}$

4. The molar conductivity of a  $0.5 \text{ mol/dm}^3$  solution of  $\text{AgNO}_3$  with electrolytic conductivity of  $5.76 \times 10^{-3} \text{ S cm}^{-1}$  at 298 K is

- (a)  $2.88 \text{ S cm}^2/\text{mol}$  (b)  $11.52 \text{ S cm}^2/\text{mol}$  (c)  $0.086 \text{ S cm}^2/\text{mol}$  (d)  $28.8 \text{ S cm}^2/\text{mol}$

5. The specific conductance of a  $0.1 \text{ N KCl}$  solution at  $23^\circ\text{C}$  is  $0.012 \Omega^{-1} \text{ cm}^{-1}$ . The resistance of cell containing the solution at the same temperature was found to be  $55 \Omega$ . The cell constant will be

- (a)  $0.142 \text{ cm}^{-1}$  (b)  $0.66 \text{ cm}^{-1}$  (c)  $0.918 \text{ cm}^{-1}$  (d)  $1.12 \text{ cm}^{-1}$

6. A substance A decomposes by a first order reaction starting initially with  $[A] = 2.00 \text{ m}$  and after 200 min,  $[A]$  becomes  $0.15 \text{ m}$ . For this reaction  $t_{1/2}$  is

- (a) 53.49 min (b) 50.49 min (c) 48.45 min (d) 46.45 min

7. In collision theory of chemical reaction,  $Z_{AB}$  represents

- (a) the fraction of molecules with energies greater than  $E_a$   
(b) the collision frequency of reactants, A and B  
(c) steric factor  
(d) the fraction of molecules with energies equal to  $E_a$

8. Urea reacts with water to form A which will decompose to form B. B when passed through  $\text{Cu}^{2+}(\text{aq})$ , deep blue colour solution C is formed. What is the formula of C from the following?

- (a)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  (b)  $\text{Cu}(\text{OH})_2$  (c)  $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$  (d)  $\text{CuSO}_4$

9. Elimination reaction of 2-bromo-pentane to form pent-2-ene is

1.  $\beta$ -elimination reaction. 2. Follows Zaitsev rule. 3. Dehydrohalogenation reaction.  
4. Dehydration reaction.

- (a) (1), (3), (4) (b) (2), (3), (4) (c) (1), (2), (4) (d) (1), (2), (3)

10. Which of the following can be used as the halide component for Friedel-Crafts reaction?

- (a) Chlorobenzene (b) Bromobenzene (c) Chloroethene (d) Isopropyl chloride

## PHYSICS

Q1. A solid conducting sphere having a charge  $Q$  is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be  $V$ . If the shell is now given a charge of  $-3Q$ , the new potential difference between the same two surfaces is

- (a)  $V$  (b)  $2V$  (c)  $4V$  (d)  $-2V$

Q2. An insulated ring of radius  $4m$  having a charge  $q_1 = 2 \times 10^{-5} C$  is uniformly distributed over it. Another particle having charge  $q_2 = 4 \times 10^{-4} C$  is released from rest along its axis at a distance  $x=3m$  from its centre. Mass of both ring and the particle is  $1 kg$  each. Neglect gravitational effects. Ring is free to move. Maximum speed of particle will be

- (a)  $4.4 m/s$  (b)  $3.1 m/s$  (c)  $5.2 m/s$  (d)  $6.1 m/s$

Q3. You are given an arrangement of three point charges  $q$ ,  $2q$  and  $xq$  separated by equal finite distances so that electric potential energy of the system is zero. Then the value of  $x$  is

- (a)  $-\frac{3}{2}$  (b)  $-\frac{1}{3}$  (c)  $\frac{3}{2}$  (d)  $\frac{3}{2}$

Q4. In a certain region of space, there exists a uniform and constant electric field of strength  $E$  along  $x$ -axis and uniform and constant magnetic field of induction  $B$  along  $z$ -axis. A charged particle having charge  $q$  and mass  $m$  is projected with speed  $v$  parallel to  $x$ -axis from a point  $(a, b, 0)$ . When the particle reaches a point  $(2a, b/2, 0)$  its speed becomes  $2v$ . Find the value of electric field strength in terms of,  $m$ ,  $v$  and co-ordinates.

- (a)  $3mv^2/2qa$  (b)  $mv^2/qb$  (c)  $2mv^2/qb$  (d)  $mv^2/2qa$

Q5. An electron is moving along positive  $x$ -axis. A uniform electric field exists towards negative  $y$ -axis. What should be the direction of magnetic field of suitable magnitude so that net force on electron is zero?

- (a) Positive  $z$ -axis (b) negative  $z$ -axis (c) positive  $y$ -axis (d) negative  $y$ -axis

Q6. The ratio between total acceleration of the electron in singly ionized helium atom and hydrogen atom (both in ground state) is

- (a) 1 (b) 8 (c) 4 (d) 16

Q7. The shortest wavelength of the Bracket series of a hydrogen like atom (atomic number =  $Z$ ) is the same as the shortest wavelength of the Balmer series of hydrogen atom. The value of  $Z$  is

- (a) 2 (b) 3 (c) 4 (d) 6

Q8. According to Bohr's theory of hydrogen atom, the product of the binding energy of the electron in the  $n$ th orbit and its radius in the  $n$ th orbit

- (a) is proportional to  $n^2$  (b) is inversely proportional to  $n^3$   
(c) has a constant value of  $10.2 eV-\text{\AA}$  (d) has a constant value of  $7.2 eV-\text{\AA}$

Q9. An electron and a photon have same wavelength. If  $p$  is the momentum of electron and  $E$  the energy of photon.

The magnitude of  $p/E$  in SI unit is

- (a)  $3.0 \times 10^8$  (b)  $3.33 \times 10^{-9}$  (c)  $9.1 \times 10^{-31}$  (d)  $6.64 \times 10^{-34}$

Q10. In X-ray tube when the accelerating voltage  $V$  is halved, the difference between the wavelengths of  $K\alpha$  line and minimum wavelength of continuous X-ray spectrum

- (a) remains constant (b) becomes more than two times (c) becomes half (d) becomes less than two times