XL (S): Q. 1 – Q. 10 carry one mark each & Q. 11 – Q. 20 carry two marks each.

Q.1 David Baltimore's classification of viruses is based on differences in

(A) host cell receptors used by viruses
(B) the pathways required to synthesize virus mRNA
(C) the modes of transmission of viruses
(D) the envelope proteins on the surface of viruses

Q.2 Which of the following immune system components can function as an opsonin?

(A) Antibodies (B) T-cell receptors
(C) Histamines (D) Interferons

Q.3 The oral polio vaccine (OPV) consists of

(A) live attenuated virus (B) killed virus
(C) viral toxin (D) viral capsid subunit

Q.4 Which of the following eukaryotic cellular components carries out intracellular degradation during autophagy?

(A) Nucleus (B) Golgi bodies (C) Ribosomes (D) Lysosomes

Q.5 Analysis of DNA sequences suggest that eukaryotic mitochondrial genomes primarily originated from

(A) fungi (B) protozoa (C) algae (D) bacteria

Q.6 Binomial nomenclature has NOT yet been adopted for

(A) bacteria (B) fungi (C) viruses (D) protozoa

Q.7 Which of the following is NOT an accepted method for sterilization?

(A) Autoclaving (B) X-rays
(C) Gamma rays (D) UV rays

Q.8 The primary product of nitrogen fixation is

(A) N_2 (B) NH_4^+ (C) NO_2^- (D) NO_3

Q.9 In humans, the key stages in the life cycle of malarial parasites occur in

(A) red blood cells and the liver
(B) red blood cells and platelets
(C) red blood cells and the pancreas
(D) red blood cells and the gut

Q.10 You have a 50 mg/mL stock solution of arginine. To prepare 1 liter of growth medium for an arginine auxotroph that requires 70 µg/mL of arginine, the volume of this stock solution that should be added is _____ mL (up to 1 decimal point) .

Q.11 Accumulating evidence suggest that Domain Archaea is more closely related to Domain Eukarya than to Domain Bacteria. Which of the following properties are shared between eukaryotes and archaea ?

(i) Protein biogenesis
(ii) Presence of sterol containing membranes
(iii) Ribosomal subunit structures
(iv) Adaptation to extreme environmental conditions
(v) Fatty acids with ester linkages in the cell membrane

(A) (ii), (iii) and (v)
(B) (i), (ii), (iv), and (v)
(C) (i) and (iii)
(D) (iii) and (iv)

Q.12 Match the antimicrobial agents in group I with their category/mode of action in group II.

Group I	Group II
(i) Fluoroquinolones	(p) beta lactam antimicrobial
(ii) Amphotericin B	(q) inhibition of protein synthesis
(iii) Tetracycline	(r) inhibition of nucleic acid synthesis
(iv) Amoxicillin	(s) antifungal agent

(A) (i)-(q), (ii)-(s), (iii)-(r), (iv)-(p)
(B) (i)-(s), (ii)-(r), (iii)-(p), (iv)-(q)
(C) (i)-(r), (ii)-(s), (iii)-(q), (iv)-(p)
(D) (i)-(s), (ii)-(r), (iii)-(q), (iv)-(p)

Q.13 Match the microorganisms to their predominant modes of transmission.

Microorganism	Mode of Transmission
(i) *Bordetella pertussis*	(p) Vector-borne
(ii) Dengue virus	(q) Blood-borne
(iii) *Entamoeba histolytica*	(r) Droplet infection
(iv) Hepatitis B virus	(s) Contaminated food

(A) (i)-(r), (ii)-(p), (iii)-(s), (iv)-(q)
(B) (i)-(s), (ii)-(q), (iii)-(p), (iv)-(r)
(C) (i)-(q), (ii)-(p), (iii)-(s), (iv)-(r)
(D) (i)-(s), (ii)-(r), (iii)-(p), (iv)-(q)

Q.14 Match the precursors/intermediates with the corresponding metabolic pathways.

Precursor/Intermediates	Metabolic pathway
(i) Inosine monophosphate	(p) L-methionine biosynthesis
(ii) Ornithine	(q) L-tryptophan biosynthesis
(iii) Chorismate	(r) Purine biosynthesis
(iv) Homocysteine	(s) L-arginine biosynthesis

(A) (i)-(q), (ii)-(r), (iii)-(s), (iv)-(p)
(B) (i)-(p), (ii)-(r), (iii)-(s), (iv)-(q)
(C) (i)-(r), (ii)-(p), (iii)-(s), (iv)-(q)
(D) (i)-(r), (ii)-(s), (iii)-(q), (iv)-(p)

Q.15 Match the scientists to their area of major contribution

Scientists	Area of major contribution
(i) Antonie van Leeuwenhoek	(p) Taxonomy
(ii) Carl Linnaeus	(q) Antimicrobial agents
(iii) Sir Alexander Fleming	(r) Vaccination
(iv) Louis Pasteur	(s) Microscopy

(A) (i)-(s), (ii)-(q), (iii)-(p), (iv)-(r) (B) (i)-(s), (ii)-(p), (iii)-(q), (iv)-(r)
(C) (i)-(p), (ii)-(s), (iii)-(r), (iv)-(q) (D) (i)-(q), (ii)-(p), (iii)-(r), (iv)-(s)

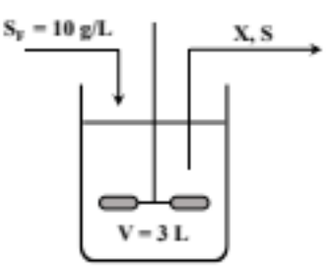
Q.16 Which of the following combinations would improve the resolution of a microscope?

(i) Increasing the half aperture angle of the objective lens
(ii) Decreasing the wavelength of the illumination source
(iii) Decreasing the numerical aperture of the objective lens
(iv) Decreasing the refractive index of immersion medium

(A) (i) and (ii) (B) (ii) and (iii) (C) (ii) and (iv) (D) (i) and (iii)

Q.17 Active transport involves the movement of a biomolecule against a concentration gradient across the cell membrane using metabolic energy. If the extracellular concentration of a biomolecule is 0.005M and its intracellular concentration is 0.5M, the least amount of energy that the cell would need to spend to transport this biomolecule from the outside to the inside of the cell is _____ kcal/mol (up to 2 decimal points).
(Temperature T = 298K and universal gas constant R= 1.98 cal/mol·K)

Q.18 A continuous cell culture being carried out in a stirred tank reactor is described in terms of its cell mass concentration X and substrate concentration S. The concentration of the substrate in the sterile feed stream is S_F = 10 g/L and yield coefficient $Y_{x/s}$ = 0.5. The flow rates of the feed stream and the exit stream are equal (F=5 mL/min) and constant. If the specific growth rate (h^{-1}) $\mu = \frac{0.3\,S}{(1+S)}$, the steady state concentration of S is _____ g/L (up to 1 decimal point).



Q.19 The initial concentration of cells (N_0) growing unrestricted in a culture is 1.0×10^6 cells/mL. If the specific growth rate (μ) of the cells is 0.1 h^{-1}, the time required for the cell concentration to become 1.0×10^8 cells/mL is _____ hours (up to 2 decimal points).

Q.20 The following stoichiometric equation represents the conversion of glucose to lactic acid in a cell:

$$\text{Glucose} + 2\text{Pi} + 2\text{ADP} \rightarrow 2\text{Lactate} + 2\text{ATP} + 2\text{H}_2\text{O}$$

If the free energy of conversion of glucose to lactic acid only is $\Delta G^0 = -47000$ cal/mol, the efficiency of energy transfer is _____ % (up to 1 decimal point).
(ΔG^0 for ATP hydrolysis is −7.3 kcal/mol)

END OF THE QUESTION PAPER