Q1) Match the media component (Column I) with its role (Column II)

Column I	Column II
P. Sucrose	1. Anti-foam agent
Q. Zinc Chloride	2. Nitrogen source
R. Ammonium Sulphate	3. Carbon source
S. Silicone Oil	4. Trace element

(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-1, R-3, S-4
(C) P-3, Q-2, R-4, S-1
(D) P-3, Q-4, R-2, S-1

Q2) The overall stoichiometry for an aerobic cell growth is

$$3C_6H_{12}O_6 + 2.5NH_3 + O_2 \longrightarrow 1.5C_aH_bO_cN_d + 3CO_2 + 5H_2O$$

What is the elemental composition formula of the biomass?

(A) $C_9H_{18.2}O_5N_{1.667}$
(B) $C_9H_{22.33}O_6N_{1.667}$
(C) $C_{10}H_{18.2}O_5N_{1.667}$
(D) $C_{10}H_{22.33}O_6N_{1.667}$

Q3) In binomial nomenclature, the name of a bacterial strain is written with the first letter of _____ word(s) being capitalised.
(A) first
(B) second
(C) neither
(D) first and second

Q4) Which of the following statements about reversible enzyme inhibitors are CORRECT?

P. Uncompetitive inhibitors bind only to the enzyme-substrate complex
Q. Non-competitive inhibitors bind only at a different site from the substrate
R. Competitive inhibitors bind to the same site as the substrate

(A) P and Q only

(B) P and R only
(C) Q and R only
(D) P, Q and R

Q5) Match the component of eukaryotic cells (Column I) with its respective function (Column II).

Column I	Column II
P. Lysosome	1. Digestion of macromolecules
Q. Peroxisome	2. Detoxification of harmful compounds
R. Glyoxysome	3. Conversion of fatty acids to sugar
S. Cytoskeleton	4. Involvement in cell motility

(A) P-1, Q-2, R-3, S-4
(B) P-2, Q-1, R-3, S-4
(C) P-3, Q-1, R-2, S-4
(D) P-4, Q-3, R-1, S-2

Q6) In animal cells, the endogenously produced miRNAs silence gene expression by
(A) base pairing with the 3'-untranslated region of specific mRNAs
(B) blocking mRNA synthesis
(C) binding to the operator site
(D) base pairing with the 3' region of specific rRNAs

Q7) Terpenoids are made of _____ units
(A) amino acid
(B) carbohydrate
(C) isoprene
(D) triacylglycerol

Q8) Match the microbial product (Column I) with its respective application (Column II).

Column I	Column II
P. Methane	1. Biosurfactant
Q. Glycolipids	2. Bioplastic
R. Polyhydroxy alkanoate	3. Biofuel

(A) P-1, Q-2, R-3
(B) P-2, Q-1, R-3
(C) P-3, Q-2, R-1
(D) P-3, Q-1, R-2

Q9) Which of the following is NOT used for generating an optimal alignment of two nucleotide sequences?
(A) Gap penalties
(B) Match scores
(C) Mismatch scores
(D) Nucleotide composition

Q10) Among individuals in a human population, minor variations exist in nucleotide sequences of chromosomes. These variations can lead to gain or loss of sites for specific restriction enzymes. Which of the following techniques is used to identify such variations?
(A) Polymerase dependent fragment insertion
(B) Real-time polymerase chain reaction
(C) Restriction fragment length polymorphism
(D) Reverse transcriptase polymerase chain reaction

Q11) Assuming independent assortment and no recombination, the number of different combinations of maternal and paternal chromosomes in gametes of an organism with a diploid number of 12 is _____.

Q12) The degree of reduction of lactic acid ($C_3H_6O_3$) is _____.

Q13) The specific growth rate of a yeast having a doubling time of 0.693 h (rounded off to the nearest integer) is_____h^{-1}.

Q14) Which of the following conditions will contribute to the stability of a gene pool in a natural population?
P. Large population
Q. No net mutation
R. Non-random mating
S. No selection

(A) P only
(B) P and Q only
(C) P and R only
(D) P, Q and S only

Q15) Match the media component used in mammalian cell culture (Column I) with its respective role (Column II).

Column I	Column II
P. Hydrocortisone	1. Mitogen
Q. Fibronectin	2. Vitamin
R. Epidermal growth factor	3. Hormone
S. Riboflavin	4. Cell attachment

(A) P-3, Q-4, R-1, S-2
(B) P-3, Q-4, R-2, S-1
(C) P-4, Q-3, R-1, S-2
(D) P-4, Q-3, R-2, S-1

Q16) Match the cell type (Column I) with its function (Column II).

Column I	Column II
P. B cells	1. Humoral immunity
Q. Neutrophils	2. Cytotoxicity
R. T cells	3. Histamine-associated allergy
S. Mast cells	4. Phagocytosis

(A) P-1, Q-2, R-3, S-4
(B) P-1, Q-4, R-2, S-3
(C) P-4, Q-3, R-1, S-2
(D) P-4, Q-3, R-2, S-1

Q17) Match the stationary phase (Column I) with its corresponding chromatography technique (Column II).

Column I	Column II
P. Protein A	1. Size exclusion chromatography
Q. Sephadex	2. Ion-exchange chromatography
R. Phenylsepharose	3. Affinity chromatography
S. Diethylaminoethyl cellulose	4. Hydrophobic interaction chromatography

(A) P-1, Q-4, R-2, S-3
(B) P-3, Q-1, R-4, S-2
(C) P-3, Q-4, R-2, S-1
(D) P-4, Q-1, R-3, S-2

Q18) Which of the following statements are CORRECT for a controller?
P. In a proportional controller, a control action is proportional to the error
Q. In an integral controller, a control action is proportional to the derivative of the error
R. There is no “offset” in the response of the closed-loop first-order process with a proportional controller
S. There is no “offset” in the response of the closed-loop first-order process with a proportional-integral controller

(A) P and Q only
(B) P and R only
(C) P and S only
(D) Q and S only

Q19) Which of the following are CORRECT about protein structure?
P. Secondary structure is formed by a repeating pattern of interactions among the polypeptide backbone atoms
Q. Tertiary structure is the three-dimensional arrangement of the polypeptide backbone atoms only
R. Quaternary structure refers to an assembly of multiple polypeptide subunits

(A) P and Q only
(B) P and R only
(C) Q and R only
(D) P, Q and R

Q20) The enzymes involved in ubiquitinylation of cell-cycle proteins are
(A) E_1 and E_2 only
(B) E_1 and E_3 only
(C) E_1 and E_4 only
(D) E_1, E_2 and E_3

Q21) The maximum parsimony method is used to construct a phylogenetic tree for a set of sequences. Which one of the following statements about the method is CORRECT?
(A) It predicts the tree that minimises the steps required to generate the observed variations
(B) It predicts the tree that maximises the steps required to generate the observed variations
(C) It predicts the tree with the least number of branch points
(D) It employs probability calculations to identify the tree

Q22) Which of the following spectroscopic technique(s) can be used to identify all the functional groups of an antibiotic contaminant in food?
P. Infrared
Q. Circular dichroism
R. Nuclear magnetic resonance
S. UV-Visible

(A) P only
(B) P and R only
(C) P, Q and R only
(D) P, Q, R and S

Q23) Adenine can undergo a spontaneous change to hypoxanthine in a cell, leading to a DNA base pair mismatch. The CORRECT combination of enzymes that are involved in repairing this damage is
(A) Nuclease, DNA polymerase, DNA ligase
(B) Nuclease, DNA ligase, helicase
(C) Primase, DNA polymerase, DNA ligase
(D) Primase, helicase, DNA polymerase

Q24) Which of the following statements are CORRECT for an enzyme entrapped in a spherical particle?
(A) Effectiveness factor is ratio of the reaction rate with diffusion-limitation to the reaction rate without diffusion-limitation
(B) Internal diffusion is rate-limiting at low values of Thiele modulus
(C) Effectiveness factor increases with decrease in Thiele modulus
(D) Internal diffusion-limitation can be reduced by decreasing the size of the particle

Q25) Which of the following is(are) COMMON feature(s) for both aerobic and anaerobic bacterial cultures?
(A) Glycolysis
(B) NAD^+ is the oxidising agent
(C) Oxidative phosphorylation
(D) Two net ATP molecules formed per glucose molecule

Q26) Which of the following statement(s) is(are) CORRECT regarding the lac operon in *E.coli* when grown in the presence of glucose and lactose?
(A) At low glucose level, the operon is activated
(B) At high glucose level, the operon is activated to enable the utilisation of lactose
(C) The *lac* repressor binds to operator region inactivating the operon
(D) Binding of lactose to the lac repressor induces the operon

Q27) Emerging viruses such as SARS-CoV2 cause epidemics. Which of the following process(es) contribute to the rise of such viruses?
(A) Mutation of existing virus
(B) Jumping of existing virus from current to new hosts
(C) Spread of virus in the new host population
(D) Replication of virus outside a host

Q28) Introduction of foreign genes into plant cells can be carried out using
(A) Agrobacterium
(B) $CaCl_2$ mediated plasmid uptake
(C) Electroporation
(D) Gene gun

Q29) Which of the following statement(s) regarding trafficking in eukaryotic cells is(are) CORRECT?
(A) Dynamin binds GTP and is involved in vesicle budding
(B) Dynamin is involved in cytoskeletal remodelling
(C) Dynein binds ATP and is involved in movement of organelles along microtubules

(D) Dynein binds GTP and is involved in movement of organelles along microtubules

Q30) A circular plasmid has three different but unique restriction sites for enzymes ‘a’, ‘b’ and ‘c.’ When enzymes ‘a’ and ‘b’ are used together, two fragments of equal size are generated. Enzyme ‘c’ creates fragments of equal size only from one of the fragments generated by those cleaved by ‘a’ and ‘b’. The plasmid is treated with a mixture of ‘a’, ‘b’ and ‘c’ and analysed by agarose gel electrophoresis. The number of bands observed in the gel is _____.

Q31) In mismatch correction repair, the parental DNA strand is distinguished from the daughter strand by
(A) acetylation
(B) phosphorylation
(C) methylation
(D) glycosylation

Q32) Idiotypic determinants of an antibody are associated with the
(A) constant region of the heavy chains
(B) constant region of the light chains
(C) variable region
(D) constant regions of light and heavy chains

Q33) Identification of blood groups involves
(A) precipitation
(B) neutralisation
(C) opsonization
(D) agglutination

Q34) A humanised antibody is one in which the
(A) heavy and light chains are from human
(B) heavy chain is from human and light chain is from mouse
(C) light chain is from human and heavy chain is from mouse
(D) CDRs are from mouse, and the rest is from human

Q35) Nude mice refers to
(A) mice without skin
(B) mice without thymus
(C) knockout mice
(D) transgenic mice

Q36) A protein is phosphorylated at a serine residue. A phosphomimic mutant of the protein can be generated by substituting that serine with
(A) glycine
(B) alanine
(C) aspartate
(D) threonine

Q37) Protein-DNA interactions *in vivo* can be studied by
(A) gel shift assay
(B) Southern hybridisation
(C) chromatin immunoprecipitation assay
(D) fluorescence *in situ* hybridisation assay

Q38) The direction of shell coiling in the snail *Limnaea peregra* is a classic example of
(A) chromosomal inheritance
(B) extra-chromosomal inheritance
(C) chromosomal translocation
(D) homologous recombination

Q39) Identify the statement that is NOT applicable to an enzyme catalysed reaction.
(A) Enzyme catalysis involves propinquity effects
(B) The binding of substrate to the active site causes a strain in the substrate
(C) Enzymes do not accelerate the rate of reverse reaction
(D) Enzyme catalysis involves acid-base chemistry

Q40) Synteny refers to
(A) gene duplication from a common ancestor
(B) a tree representation of related sequences
(C) the extent of similarity between two sequences
(D) local conservation of gene order