J: Biotechnology

Q. 1 – Q. 6 carry one mark each.

Q.1 A thermostable DNA polymerase that can carry out both reverse transcription reaction and polymerization has been isolated from

(A) *Thermococcus litoralis*
(B) *Thermus aquaticus*
(C) *Thermotoga maritima*
(D) *Thermus thermophilus*

Q.2 When present in tissue culture medium, gibberellin

(A) helps to break dormancy of buds and bulbs
(B) promotes dormancy development in buds and bulbs
(C) is regarded as plant growth inhibitor
(D) prevents normal recognition of auxin molecule

Q.3 To promote attachment and spreading of anchorage-dependent animal cells, the surface of the culture vessel needs to be coated with

(A) trypsin   (B) collagen   (C) pronase   (D) polyglycol

Q.4 For amplification of GC rich sequences by polymerase chain reaction, identify the reagent that binds and stabilizes AT sequences and destabilizes GC regions.

(A) Tetramethyl ammonium chloride
(B) Betaine
(C) 7-deaza-2'-deoxyguanosine triphosphate
(D) Sodium dodecyl sulphate

Q.5 Which of the following statements is INCORRECT about immobilized plant cell cultures?

(A) It is possible to use high cell densities
(B) Cells remain active for long periods
(C) Cell products or inhibitors can be removed easily
(D) It provides low shear resistance to cells

Q.6 All the cells that participate in immune responses originate from a population of

(A) neutrophils   (B) stem cells   (C) macrophages   (D) lymphocytes

Q.7 Identify the natural plant growth regulators from the following list.
(P) Zeatin
(Q) Benzylaminopurine (BAP)
(R) Indole-3-acetic acid (IAA)
(S) 2,4-Dichlorophenoxyacetic acid

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

Q.8 A hybrid derived from the fusion of a myeloma cell (HPRT⁻) with an antibody secreting B-lymphocyte (HPRT⁺) can be selected to produce monoclonal antibody by growing in a medium containing

(A) thiamine, hypoxanthine, aminopterin
(B) thymidine, histidine, aminopterin
(C) uridine, hypoxanthine, aminopterin
(D) thymidine, hypoxanthine, aminopterin

Q.9 Match items in group 1 with correct options from those given in group 2.

Group 1	Group 2
P. VNTR sequence	1. Gene regulation on the same chromosome
Q. Leader sequence	2. Ribosome binding site
R. SD sequence	3. DNA finger printing
S. *cis*-acting sequence	4. Functions in attenuation

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

Q.10 During cultivation of microorganisms in a fermenter, various parameters are controlled by appropriate sensor (probe). Match each probe in group 1 with the appropriate response mechanism in group 2.

Group 1 (Probe)	Group 2 (Response)
P. Thermistor	1. Activation of acid / alkali pump
Q. Oxygen electrode	2. Activation of vegetable oil pump
R. Metal rod	3. Activation of hot / cold water pump
S. pH electrode	4. Increase / decrease in stirrer motor speed

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

Q.11 Which of these mice fail to develop a thymus?
(A) Mountain mice   (B) Beige mice
(C) Knock out mice   (D) Nude mice

Q.12 What are the experimental steps needed for screening an expression library for a clone encoding a protein X that has been isolated and purified?

(P) m-RNA isolation
(Q) Antibody preparation
(R) Cloning into an appropriate vector
(S) Western blotting on transferred plaques

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

Q.13 When electroporation is used for introducing DNA into mammalian cells
(P) a carrier for DNA is not required
(Q) the lipid bilayer (membrane) interacts with an electric pulse to generate permeation sites
(R) the viability of the cells becomes approximately zero percent
(S) the first step involves absorption of DNA on the cell membrane

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

Q.14 Immobilization of enzymes using entrapment method requires
(P) photosensitive polyethylene glycol dimethacrylate
(Q) CNBr activation of sepharose
(R) polyfunctional reagent like hexamethylene diisocyanate
(S) radiation of polyvinyl alcohol

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

Q.15 Which one of the following monolayer culture systems have the highest surface area : medium ratio?

(A) Roux bottle   (B) Spiracell roller bottle
(C) Hollow fibres   (D) Plastic bag/film

Q.16 Majority of the cereals are highly recalcitrant to *Agrobacterium*-mediated transformation, and so direct transformation methods have been developed to transform such plants. Which of the following direct transformation methods is applicable to intact plant tissues?

(A) Calcium chloride and PEG-mediated transformation
(B) Liposome-mediated transformation
(C) Electroporation
(D) Transformation using microprojectiles

Q.17 Match items in group 1 with correct options from those given in group 2

Group 1	Group 2
P. Tissue plasminogen activator	1. Immunomodulator
Q. Gamma interferon	2. Biodegradable plastic
R. Podophyllotoxin	3. Clot dissolution
S. Polyhydroxyalkanoate	4. Anti-tumor agent

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

Q.18 Match items in group 1 with correct options from those given in group 2

Group 1
P. Amperometric biosensor
Q. Evanescent wave biosensor
R. Calorimetric biosensor
S. Potentiometric biosensor

Group 2
1. Light beam
2. Flux of redox electrons
3. Field effect transistors
4. Exothermic reaction

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

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

Q.19 For prediction of three dimensional structure of protein
(P) homology modeling tries many possible alignments
(Q) threading first identifies homologues
(R) threading evaluates many rough models
(S) homology modeling optimizes one model

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

Q.20 Immobilization of enzymes
(P) increases the specificity of the enzyme for its reactants
(Q) facilitates reuse of the enzyme in batch reactions
(R) makes it unsuitable for its use in a continuous reactor system
(S) decreases the operational cost of the industrial process

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

Q.21 Which of the following would result in somaclonal variation in micropropagated plants?
(P) Propagation by axillary branching in the absence of plant growth regulators
(Q) Cell suspension maintained for five years before induction of somatic embryogenesis
(R) Callus induction using 20μM 2,4-Dichlorophenoxyacetic acid followed by shoot organogenesis
(S) Shoot organogenesis from an explant in the absence of an intermediate callus phase

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

Q.22 The enzymes that can be used in 5'end labeling of DNA are
(P) alkaline phosphatase
(Q) DNA ligase
(R) terminal transferase
(S) polynucleotide kinase

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

Common Data Questions

Common Data for Questions 23, 24:

Lignocellulosic biomass was subjected to microbial composting. The microbial consortium produced an extracellular enzyme xylanase, which was a glycoprotein having a molecular weight of 68 kDa and a positive charge. An aqueous extract of the enzyme could be easily prepared from the compost.

Q.23   What techniques would you recommend for confirming the molecular weight of the purified enzyme?
(P) Isoelectric focusing
(Q) SDS-PAGE
(R) Native PAGE
(S) Gel filtration

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

Q.24   If Con A sepharose column was used for the purification of enzyme, the separation would be based on

(A) molecular exclusion   (B) affinity binding
(C) ion exchange   (D) hydrophobic interaction

Linked Answer Question: Q. 25 to Q. 26 carry two marks each.

Statement for Linked Answer Question 25 & 26:

DNA content of *Caenorhabditis elegans* was analysed and found to contain 1.0×10^8 bp.

Q.25   How many standard λ- phage vector carrying 20kb DNA fragments or YACs carrying 250kb DNA fragments are theoretically required to constitute a complete *C. elegan* genomic library?

(A) 500 λ- phage vectors or 40 yeast clones
(B) 400 λ- phage vectors or 5000 yeast clones
(C) 5000 λ- phage vectors or 400 yeast clones
(D) 5×10^4 λ- phage vectors or 4000 yeast clones

Q. 26   How many λ- phage vectors / yeast clones should be prepared in order to ensure that every sequence is included in the library?

(A) 25×10^3 λ- phage vectors / 2000 yeast clones
(B) 20×10^3 λ- phage vectors / 1600 yeast clones
(C) 5×10^4 λ- phage vectors / 4000 yeast clones
(D) 10×10^4 λ- phage vectors / 10000 yeast clones

Statement for Linked Answer Questions 27 & 28:

A bioreactor of working volume 50 m^3 produces a metabolite (X) in batch culture under given operating conditions from a substrate (S). The final concentration of metabolite (X) at the end of each run was 1.1 kg m^{-1}. The bioreactor was operated to complete 70 runs in each year.

Q.27   What will be the annual output of the system (production of metabolite (X)) in kg per year?

(A) 55   (B) 3850   (C) 45.5   (D) 77

Q.28   What will be the overall productivity of the system in kg year^{-1} m^{-3}?

(A) 19250   (B) 38.50   (C) 3850   (D) 77

END OF THE SECTION