J : Biotechnology

Q.1-10 carry one mark each

Q.1 Expression of hundreds of different genes in DNA microarray technology is monitored by using
(A) Radioactive probe
(B) Visible chromogenic probe
(C) UV absorbing probe
(D) Fluorescent probe

Q.2 Transfer of T-DNA from Ti plasmid into plant cell is mediated by
(A) *mob* gene
(B) *vir* gene
(C) *nif* gene
(D) *octopine* gene

Q.3 For the growth of T-cell, the growth factor needed would be
(A) Epidermal growth factor
(B) Interleukin-2
(C) Fibroblast growth factor
(D) TNF-α

Q.4 Nick translation of DNA is a method for making DNA probes. Identify from below what is **NOT** required for nick translation method
(A) DNA polymerase
(B) DNAase
(C) Primers
(D) Deoxyribonucleotides

Q.5 During the functioning of biosensor which of the following sequences of events occurs
(A) Enzymatic/cellular reaction → detector → transducer
(B) Enzymatic/cellular reaction → transducer → detector
(C) Enzymatic/cellular reaction → pressure gauge → time
(D) Enzymatic/cellular reaction → vibrator → mechanical signal

Q.6 During the media preparation for cultivation of cells, insoluble precipitates of calcium phosphates are often formed. Identify which method can be adopted to avoid this problem
(A) Hold the pH at 5.6
(B) Hold the pH at 7.5
(C) Add calcium salt first and then phosphate source
(D) None of the above

Q.7 Somatic embryogenesis is a procedure in plant tissue culture methodology described best as

(A) Formation of both shoot and root meristem
(B) Formation of stable embryos
(C) Formation of axillary buds
(D) None of the above

Q.8 An immobilized enzyme being used in a continuous plug flow reactor exhibits an effectiveness factor (η) of 1.2. The value of η being greater than one could be apparently due to one of the following reasons. Identify the correct reason.

(A) The enzyme follows substrate inhibited kinetics with internal pore diffusion limitation
(B) The enzyme experiences external film diffusion limitation
(C) The enzyme follows sigmoidal kinetics
(D) The immobilized enzyme is operationally unstable

Q.9 The degree of inhibition for non-competitive inhibition of an enzyme catalyzed reaction

(A) Increases with increase in substrate concentration
(B) Reaches a maxima with increase in substrate concentration and then decreases
(C) Is independent of substrate concentration
(D) Decreases with increase in substrate concentration

Q.10 The two columns given below indicate some of the fermentation products and the microbial cultures used for their production. Identify the correct set of groups from the four options.

Fermentation products	Microbial cultures
(a) Ethanol	(p) *Aspergillus niger*
(b) Streptomycin	(q) *Zymomonas mobilis*
(c) Citric acid	(r) *Streptomyces griseus*
(d) Cellulase	(s) *Trichoderma reesei*

(A) a-p; b-q; c-r; d-s
(B) a-q; b-r; c-p; d-s
(C) a-q, b-r; c-s; d-p
(D) a-s; b-r; c-q; d-p

Q. 11 – 30 carry two marks each.

Q.11 The culture fluids of 1000 to 5000 colonies of hybridoma are screened for monoclonal antibody by

P western blot analysis
Q antigen capture analysis
R northern blot analysis
S antibody capture analysis

Choose the correct pair from the following

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

Q.12 Tobacco leaf discs are transfected with *Agrobacterium tumefaciens* strain containing binary vector (GUS as reporter gene) with selectable marker *neo* (kanamycin resistant gene) and then regenerated to plants. The plants are kanamycin resistant but leaf tissues are negative to GUS assay. The explanations are

(A) The plants are transformed for both genes but GUS gene is turned off
(B) The plants are transformed for only *neo* gene not the GUS gene
(C) The plants are not transformed at all, but the development of kanamycin resistance is due to somaclonal variation
(D) All the above

Q.13 The restriction endonuclease *Hae*III recognizes the sequence GG↓CC and the point of cleavage is given by the arrow. If you want to clone a piece of DNA in a plasmid digested by *Hae*III, what will be restriction enzyme of choice

(A) *Sma*I (CC↓GGG)
(B) *Not*I (GC↓GGCCGC)
(C) *Salm*III (GG↓CC)
(D) *Pst*I (CTGCA↓G)

Q.14 For the sequence of ds DNA given below, identify the set of primers required to amplify this DNA by PCR

3' GACTCCA .....TACAACC 5'
5' CTGAGGT.....ATGTTGG 3'

(A) 5' GGTTGTA and 5' GACTCCA
(B) 5' CTGAGGT and 5' CCAACAT
(C) 5' ACTCAGT and 5' ATGTTGG
(D) None of the above

Q.15 Expression of antisense RNA of ACC synthase in transgenic tomato plants inhibited the synthesis of ethylene resulting in

(A) Change in color from green to red.
(B) Change in aroma
(C) Change in color from red to green
(D) None of the above

Q.16 Some of the genes from viruses introduced into plants in fully functional form often exhibit Mendelian inheritance because

(A) the genes are stably integrated in chromosomes
(B) the genes are stably maintained in vectors
(C) the genes are co-expressed with chromosomal genes
(D) the genes are not interrupted by introns

Q.17 Agrobacterium based transformation of protoplasts obtained from dicots is based on the fact that

(A) These exhibit strong chromosomal structures
(B) These have two cotyledons
(C) These exhibit strong wound response
(D) These have long tap root system

Q.18 What would be the effect of addition of 2,4-D on the production of berberine by cell culture of *Thalictrum minus*

(A) To stimulate growth and thereby urease secondary metabolite production
(B) Stimulate dedifferentiation and thereby decrease secondary metabolite production
(C) Stimulate proliferation and reduce secondary metabolite production
(D) None of the above

Q.19 Reverse vaccinology indicates

(A) From antigenic protein to vaccine development
(B) From antigenic polysaccharide to vaccine development
(C) From antibody to vaccine development
(D) From genome sequence to vaccine development

Q.20 An enzyme following Michaelis – Menten kinetics with $V_m = 2.5$ mmol m^{-3} s^{-1} and $K_m = 5.0$ mM was used to carry out the reaction in a batch stirred reactor. Starting with an initial substrate concentration of 0.1 M, the time required for 50% conversion of the substrate will be about: (ln 2 = 0.69)

(A) 01 hr
(B) 06 hr
(C) 02 hr
(D) 12 hr

The maximum reaction velocity (V_m) for an enzyme catalyzed reaction was experimentally measured at two different temperatures and following results were obtained:

Temperature, °C	27	37
V_m, mmol m^{-3} s^{-1}	2.25	4.50

The energy of activation for the reaction is:

(A) 12834 cal mol^{-1}
(B) 25668 cal mol^{-1}
(C) 6417 cal mol^{-1}
(D) 19251 cal mol^{-1}

Q.22 In a heterogeneous population of cells containing T-cells, B-cells and macrophages, the cells are separated in the following scheme

Heterogeneous cell suspension → Cell suspension left in a petri-plate for 3 hrs → Supernatant cells passed through nylon wool column → nylon wool adhered cell

↓

Flow through cell

Identify the major population of cells present in petri-plate, nylon wool adhered and nylon wool column flow through respectively

(A) Macrophage, B-cell, T-cell
(B) T-cell, B-cell, macrophage
(C) Macrophage, T-cell, B-cell
(D) B-cell, T-cell, macrophage

Q.23 Match the following genetic elements with their functions.

Genetic elements	Functions
a. *neo*^{R}	1.Facilitates inducible expression of genes in eukaryotes
b. SV40	2.Facilitates constitutive expression of genes in eukaryotes
c. LTR	3.Allows amplification of gene
d. *dhfr*	4. Provides way of selecting eukaryotic cells, which have received foreign DNA

(A) a → 4, b → 2, c → 1, d → 3
(B) a → 2, b → 4, c → 1, d → 3
(C) a → 1, b → 4, c → 2, d → 3
(D) a → 4, b → 2, c → 3, d → 1

Q.24 In the cell cycle of a typical eukaryote, the sequence of events operating at the time of cell division is

(A) S phase → G2 phase → G1 phase → M phase
(B) S phase → M phase → G1 phase → G2 phase
(C) S phase → G2 phase → M phase → G1 phase
(D) S phase → G1 phase → M phase → G2 phase

Q.25 Batch fermentation of glucose to ethanol yields a productivity of 4.5 g l^{-1} hr^{-1}. If the yeast cell concentration in the fermentation broth is 5% (v/v) and the intracellular NAD^+:NADH concentration in the yeast cells is 10 µM, the cycling rate of $NAD^+ \Leftrightarrow$ NADH will be:

(A) 50,000 cycles hr^{-1}
(B) 20,000 cycles hr^{-1}
(C) 160 cycles hr^{-1}
(D) None of the above

Q.26 The kinetics of the disintegration of baker's yeast cells in a bead mill is described as $dP/dt = K(P_m - P)$, where P is the concentration of protein released and P_m is the maximum protein concentration achievable. K is the first order rate constant and is 0.5 hr^{-1} for the system studied. The time required for the release of 90% of the intracellular proteins will be:

(A) 10 hr
(B) 02 hr
(C) 4.6 hr
(D) None of the above

Q.27 Inversion of sucrose by immobilized invertase follows a substrate inhibited kinetics. The reaction rate (v) in mol m^{-3} hr^{-1} can be expressed as:
$v = 800 [S] / \{400 + 50 [S] + [S]^2\}$, where [S] is the sucrose concentration.
The immobilized invertase preparation is used in a CSTR with 100 mol m^{-3} sucrose concentration in the feed stream. If the reaction velocity passes through a maxima at [S] = 20 mol m^{-3}, the feed flow rate for a reactor volume of $1m^3$ to get the maximum productivity from the reactor should be:

(A) 0.11 m^3 hr^{-1}
(B) 1.10 m^3 hr^{-1}
(C) 5.05 m^3 hr^{-1}
(D) None of the above

Q.28 Phytase, an enzyme produced by *Aspergillus niger* can be adsorbed on microcrystalline cellulose powder (MCCP). The adsorption follows a Langmuir isotherm and the maximum concentration of the protein that can be obtained on the adsorbent is 70 mg cm^{-3}. At a concentration of 50 mg l^{-1} of protein in the solution, the concentration of protein on the adsorbent reaches 35 mg cm^{-3}. It is desired to recover 90% of the protein from 1.5 litre of the cell free culture filtrate containing 220 mg l^{-1} protein by addition of MCCP to the solution. The concentration of the protein adsorbed on the solid at equilibrium will be:

(A) 21.4 mg cm^{-3}
(B) 214 mg cm^{-3}
(C) 2.14 mg cm^{-3}
(D) None of the above

Q.29 Measurement of k_La in a bioreactor can be carried out by sodium sulfite oxidation method, that is based on the oxidation of sodium sulfite to sodium sulfate in the presence of a catalyst (Cu^{++} or Co^{++}). In a typical experiment, a laboratory fermenter was filled with 5 litre of 0.5 M sodium sulfite solution containing 0.003 M Cu^{++} ions and the air was sparged in. After 10 minutes, the air flow was stopped and a 10 ml sample was taken and titrated. The concentration of sodium sulfite in the sample was found to be 0.20 M. The oxygen uptake rate for this aerated system will work out to be:

(A) $0.08\ g\ l^{-1}\ s^{-1}$
(B) $0.008\ g\ l^{-1}\ s^{-1}$
(C) $0.8\ g\ l^{-1}\ s^{-1}$
(D) None of the above

Q.30 Examine the data given below in the table on purification of a protein X

Step	volume (ml)	protein concentration (mg/ml)	Enzyme activity (units/ml)
Crude cell-free extract	500	12.0	5.0
Ammonium sulfate precipitation	125	3.0	11.0
Ion-exchange chromatography	10	9.0	75.0

The yield percent and purification factor respectively at the end of the experiment will be approximately

(A) 25 and 3
(B) 30 and 20
(C) 20 and 30
(D) 75 and 30