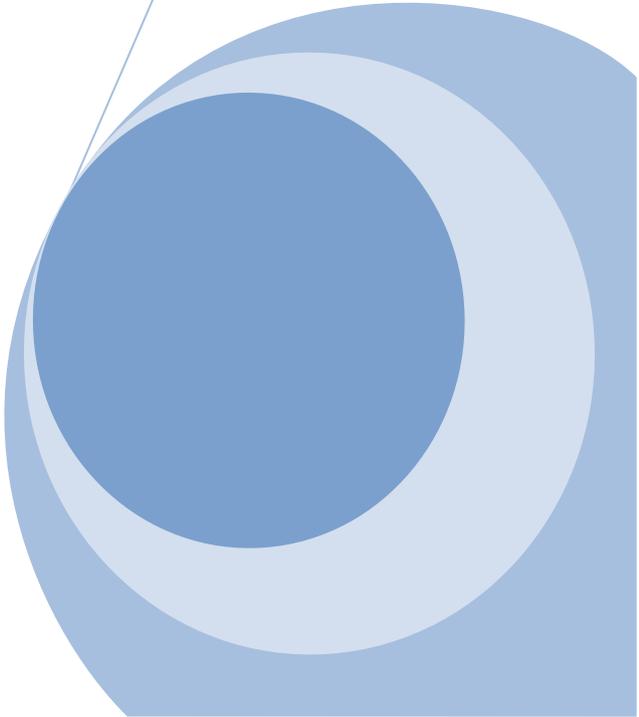# GRASSROOTS ACADEMY
GATE-BIOTECH 2008
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GATE BIOTECHNOLOGY – 2008

1 – 6 carry one mark each.

1. Diauxic pattern of biomass growth is associated with
   (P) Multiple lag phases
   (Q) Sequential utilization of multiple substrates
   (R) Simultaneous utilization of multiple substrates
   (S) Absence of lag phase

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

2. Zinc fingers are characteristics of
   (A) Blood clotting proteins
   (B) RNA chaperones
   (C) DNA binding proteins
   (D) Lysosomal hydrolases

3. Parthenogenetic embryos in plants are those which are formed by
   (A) Unfertilized eggs
   (B) Fertilized eggs
   (C) Sporophytic cells
   (D) Male gametophyte

4. Which one of the following is the growth factor used for growth of tissues and organs in plant tissue culture?
   (A) Cysteine   (B) Cytokinin
   (C) Cytidylate   (D) Cyclic AMP

5. Which of the following techniques is best for immobilizing an affinity ligand?
   (A) Physical adsorption   (B) Gel entrapment
   (C) Cross-linking with a polymer   (D) Covalent linkage to a spacer arm

6. Multiplication of genetically identical copies of a cultivar by asexual reproduction is known as

   (A) Aclonal propagation   (B) Vegetative propagation
   (C) Polyclonal propagation   (D) Clonal propagation

   7 – 24 carry two marks each

7. Identify the correct statements for the 'HAT Medium'
   (P) Includes drug aminopterin to block major pathway for synthesis of deoxyribonucleotides
   (Q) Hypoxanthine is precursor for thymidine
   (R) Includes drug aminopterin to block major pathway for synthesis of polypeptides
   (S) Cells can grow in presence of aminopterin only if they have enzymes thymidine kinase and hypospboribosyl transferase
   (A) P, Q   (B) P,S
   (C) R, S   (D) Q, S

8. A DNA fragment of 4500 bp has to be tailed with dT residues by using dTTP and the enzyme 'terminal transferase'. The stock solution of dTTP that is used as a substrate has a concentration of 150 μM. Ten μl of this stock solution is added to a total volume of 200 μl reaction. What will be the concentration of dTTP in the reaction?
   (A) 7.5 μM (B) 75 μM
   (C) 0.75 μM (D) 0.075 μM

9. Determine the correctness or otherwise of following **Assertion [a]** and **Reason [r].**

Assertion: The enzymatic degradation of cell wall to obtain single cell called protoplast has helped immensely in developing somatic cell genetics in plants
Reason: In plants or animals, fusion of two cells must occur through the plasma membrane
(A) Both [a] and [r] are true and [r] is the correct reason for [a]
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) [a] is true but [r] is false
(D) [a] is false but [r] is true

10. In bioinformatics, the term 'BLAST' refers to
   (A) Database retrieval tool
   (B) Computational tool for sequence homology searching and alignment
   (C) Computational tool to view genomic sequences
   (D) Computational tool to view protein structures

11. Match the terms in group I with their possible explanations in group 2

Group 1	**Group 2**
p. Orthologs	1. A cell or an organism having foreign Gene
Q. Paralogs	2. The complement of a protein Expressed by a genome
R. Proteome	3. Genes from different species related To each other
S. Transgenic	4. Genes from same species related to Each other

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

12. Which of the following statements are true with respect to a special complex called 'dicer'?
   (P) It consists of deoxyribonuclease and DNA fragments
   (Q) It consists of ribonuclease and RNA fragments
   (R) It is involved in gene silencing
   (S) It triggers apoptosis

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

13. Some living cells (e.g. plant cell) have the capacity to give rise to whole organism. The term used to describe this property is
   (A) Morphogenesis   (B) Androgenesis
   (C) Totipotency   (D) Organogenesis

14. Match the items in group 1 with the terms given in group 2

Group 1	**Group 2**
(P) *Lactobacillus and Bifidobacteria*	1. Prebiotics
(Q) Polychlorobenzenes	2. Probiotics
(R) Fructo-oligosaccharides	3. Antibiotics
(S) β-Lactams	4. Xenobiotics

   (A) P-2, Q-4, R-1, S-3   (B) P-3, Q-4, R-1, S-2
   (C) P-4, Q-1, R-2, S-3   (D) P-1, Q-3, R-4, S-2
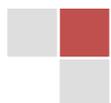
15. Match the coefficients in group 1 with their corresponding downstream processing steps given in group2

Group 1	**Group 2**
(P) Sedimentation coefficient	1. Aqueous two phase extraction
(Q) Partition coefficient	2. Ultrafiltration
(R) Rejection coefficient	3. Dialysis
(S) Activity coefficient	4. Centrifugation

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

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

16. Match the bioreactor components in group 1 with the most appropriate function given in group2

Group 1	**Group 2**
(P) Marine type impeller	1. Recirculation of medium
(Q) Draft tube	2. Aeration of medium
(R) Diaphragm valve	3. Animal cell cultivation
(S) Sparger	4. Sterile operation

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

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

17. Evaluate the Michaelis constant for the following lipase catalyzed trans-esterification reaction for the production of biodiesel

Vegetable oil +Lipase $\overset{k_1}{\rightleftharpoons}$ Oil – lipase comples $\overset{k_2}{\rightarrow}$ Biodiesel + Glycerol

Where, $k_1 = 3 \times 10^8$ M^{1} s^{1} ; $k_{1} = 4 \times 10^4$ s^{1} and $k_2 = 2 \times 10^3$ s^{1}

(A) 4.2×10^{-3} M   (B) 14.0×10^{-4} M

(C) 6.4×10^{-6} M   (D) 1.4×10^{-4} M

18. In a chemostat, evaluate the dilution rate at the cell wash – out condition by applying Monod's model with the given set of data: $\mu_{max} - 1$ h^{-1}; $y_{X/S} - 0.5$ g g^{-1}; $K_s - 0.2$ g L^{-1}; $S_0 - 10$ g L^{-1}

(A) 1.00 h^{-1} (B) 0.49 h^{-1}

(C) 0.98 h^{-1} (D) 1.02 h^{-1}

19. Match the products in group1 with their producer organisms given in group 2

Group 1	**Group 2**
(P) Ethanol	1. *Streptomyces orientalis*
(Q) L-Lysine	2. *Saccharomyces cerevisiae*
(R) Biopesticide	3. *Corynebacterium glutamicum*
(S) Vancomycin	4. *Bacillus thuringiensis*

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

20. A polymerase chain reaction was performed beginning with 400 template DNA molecules in a 100 μl reaction. After 20 cycles of polymerase chain reaction, how many molecules of the amplified product will be present in 0.1 μ l of reaction?
(A) 2.19×10^4 (B) 4.19×10^4
(C) 2.19×10^5 (D) 4.19×10^5

21. A bacterial culture with an approximate biomass composition of $CH_{1.8}O_{0.5}N_{0.2}$ grown aerobically on a defined medium containing glucose as the sole carbon source and ammonia being the nitrogen source. In this fermentation, biomass is formed with a yield coefficient of 0.35 gram dry cell weight per gram of glucose and acetate is produced with a yield coefficient of 0.1 gram acetate per gram of glucose. The respiratory coefficient for the above culture will be
(A) 0.90   (B) 0.95
(C) 1.00   (D) 1.05

22. A bacterial culture having a specific oxygen uptake rate of 5 mmol O_2 $(g–DCW)^1 hr^{-1}$ is being grown aerobically in a fed– batch bioreactor. The maximum value of the volumetric oxygen transfer coefficient is $0.18\ s^{-1}$ for the stirred tank bioreactor and the critical dissolved oxygen concentration is 20% of the saturation concentration (8 mg/ml). The maximum density, to which the cells can be grown in the fed–batch process without the growth limited by oxygen transfer, is approximately.
(A) 14 g/l   (B) 26 g/l
(C) 32 g/l   (D) 65 g/l

Common Data Questions
Common Data for Questions 23 and 24:

An enzyme (24000 Da) undergoes first – order deactivation kinetics while catalyzing a reaction according to Michaelis–Menten kinetics ($k_m = 10^{-4}$ M). The enzyme has a turnover number of 10^4 molecules substrate / min – (molecule enzyme) and a deactivation constant (k_4) of 0.1 min^1 at the reactions. The reaction mixture initially contains 0.6 mg/ l of active enzyme and 0.02 M of the substrate.

23. The time required to convert 10% of the substrate will be approximately
(A) 16 min   (B) 24 min
(C) 32 min   (D) 8 min

24. The maximum possible conversion for the enzymatic reaction will be
(A) 100%   (B) 50%
(C) 25%   (D) 12.5%

Statement for Linked Answer Questions 25 and 26:

A Nick Translation reaction in a final volume of 100 μ l was carried out by using 25 μCi of labeled [α- ^{32} P] – dCTP for labeling a 1.2 kb γ – interferon DNA fragment.

25. After completion of Nick translation reaction, 10 μ l of reaction was spotted on a glass–fiber filter that upon counting resulted into 4.2×10^4 cpm in reaction. Another 10 μl was processed for TCA precipitation to determine radioisotope incorporation. The TCA precipitated sample gave 2.94×10^4 cpm. What is the percent of [α -^{32} p]-dCTP incorporation into the DNA sample?
(A) 40%   (B) 50%
(C) 60%   (D) 70%

26. If 2.94×10^4 cpm of TCA precipitable counts of the 10 μl sample were taken from 1/10 dilution of the 100 μl Nick Translation reaction containing 1 μg of γ- interferon DNA, what is the specific activity of the labeled product?

(A) 1.47×10^6 cpm / μg   (B) 1.47×10^7 cpm / μg

(C) 2.94×10^6 cpm / μg   (D) $2.94 \times 10_7$ cpm / μg

Statement for Linked Answer Questions 27 and 28:

A double reciprocal plot was created from the specific growth rate and limiting–substrate concentration data obtained from a chemostat experiment. A linear regression gave values of 1.25 hr and 100 mg–hr–l^{-1} for the intercept and slope, respectively.

27. The respective values of the Monod kinetic constant μ_a [hr^{-1}] and k_s (mg/l) are as follows:

(A) 0.08,8   (B) 0.8, 0.8

(C) 0.8, 80   (D) 8, 8

28. The same culture (with the μ_m and K_s values as computed above) is cultivated in a 10–litre chemostat being operated with a 50 ml/min sterile feed containing 50 g/l of substrate. Assuming an overall yield coefficient of 0.3 g – DCW /g-substrate, the respective values of the outlet biomass and substrate concentrations are

(A) 15 g/l, 48 mg / l   (B) 15 g/l, 0.48 g/l

(C) 48 g/l, 15 g/l   (D) 4.8 g/l, 4.8 g/l