

GATE-BT PYQS - 2012

1. In mismatch correction repair, the parental DNA strand is distinguished from the daughter strand by

- (A) acetylation
- (B) phosphorylation
- (C) methylation
- (D) glycosylation

(2012)

Answer: (C) methylation

Explanation: In mismatch repair, the parental strand is recognized because it is methylated, whereas the newly synthesized daughter strand is not yet methylated. The methyl groups (especially on adenine in GATC sequences in *E. coli*) serve as a marker for the original template, guiding the repair machinery (MutHLS system) to correct the unmethylated, newly synthesized strand containing the error.

2. The basis for blue-white screening with pUC vectors is

- (A) intraallelic complementation
- (B) intergenic complementation
- (C) intragenic suppression
- (D) extragenic suppression

(2012)

Answer: (A) intraallelic complementation

Explanation: Blue-white screening in *E. coli* using pUC vectors relies on intraallelic complementation, where the α -peptide of β -galactosidase encoded by the vector complements the ω -fragment from the host genome. When a foreign DNA insert disrupts the *lacZa* gene, β -galactosidase activity is lost, producing white colonies on X-gal plates, while intact vectors produce blue colonies.

3. 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

(2012)

Answer: (C) variable region

Explanation: Idiotypic determinants (idiotopes) are antigenic determinants located in the variable region of the antibody's heavy and light chains. These regions form the antigen-binding site and vary among antibodies, giving rise to unique idiotypes recognized by anti-idiotypic antibodies.

4. Identification of blood groups involves

- (A) precipitation
- (B) neutralization
- (C) opsonization
- (D) agglutination

(2012)

Answer: (D) agglutination

Explanation: Blood group identification depends on agglutination, a process in which antibodies bind to specific antigens on red blood cell surfaces, causing visible clumping. The pattern of agglutination with specific antisera determines the ABO and Rh blood group types.

5. B-lymphocytes originate from the bone marrow whereas T-lymphocytes originate from

- (A) thymus
- (B) bone marrow
- (C) spleen
- (D) liver

(2012)

Answer: (B) bone marrow

Explanation: Both B- and T-lymphocytes originate in the bone marrow, but T-cells migrate to the thymus to mature and acquire their antigen-specific receptors (TCRs). Thus, while T-cells originate from bone marrow precursors, their differentiation occurs in the thymus, which is why they are called T-lymphocytes.

6. A humanized 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

(2012)

Answer: (D) CDRs are from mouse, and the rest is from human

Explanation: A humanized antibody is engineered by grafting the complementarity-determining regions (CDRs) from a mouse antibody onto a human antibody framework. This preserves antigen specificity (from mouse CDRs) while minimizing immunogenicity in humans due to the predominantly human sequence background.

7. Dimethyl sulfoxide (DMSO) is used as a cryopreservant for mammalian cell cultures because

- (A) it is an organic solvent
- (B) it easily penetrates cells
- (C) it protects cells by preventing crystallization of water
- (D) it is also utilized as a nutrient

(2012)

Answer: (C) it protects cells by preventing crystallization of water

Explanation: Dimethyl sulfoxide (DMSO) acts as a cryoprotectant by preventing the formation of ice crystals within cells during freezing. It penetrates cell membranes and stabilizes them, reducing osmotic shock and allowing cells to survive low-temperature storage without structural damage.

8. Nude mice refers to

- (A) mice without skin

- (B) mice without thymus
- (C) knockout mice
- (D) transgenic mice

(2012)

Answer: (B) mice without thymus

Explanation: *Nude mice lack a functional thymus due to a genetic mutation, resulting in an absence of mature T-lymphocytes. This immunodeficiency makes them unable to mount adaptive immune responses, making them ideal hosts for xenograft and immunological research.*

9. Heat inactivation of serum is done to inactivate

- (A) prions
- (B) mycoplasma
- (C) complement
- (D) pathogenic bacteria

(2012)

Answer: (C) complement

Explanation: *Serum is heat-inactivated (usually at 56°C for 30 minutes) to inactivate complement proteins, which can lyse cells or interfere with immunological assays. Other serum components such as growth factors and hormones remain largely unaffected by this treatment.*

10. Choose the correct signal transduction pathway.

- (A) Hormone → 7 TM receptor → G protein → cAMP → PKA
- (B) Hormone → G protein → 7 TM receptor → cAMP → PKA
- (C) Hormone → 7 TM receptor → G protein → PKA → cAMP
- (D) Hormone → 7 TM receptor → cAMP → G protein → PKA

(2012)

Answer: (A) Hormone → 7 TM receptor → G protein → cAMP → PKA

Explanation: *The correct signal transduction pathway is Hormone → 7 TM receptor → G protein → cAMP → PKA. Binding of a hormone to a seven-transmembrane G protein-coupled receptor activates the G protein, which in turn activates adenylate cyclase to produce cAMP, leading to activation of protein kinase A (PKA).*

11. 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

(2012)

Answer: (C) aspartate

Explanation: *A phosphomimic mutant substitutes a*

phosphorylatable serine with aspartate, which has a negatively charged side chain that mimics the negative charge of the phosphate group. This helps simulate the structural and functional consequences of phosphorylation in protein studies.

12. A truncated polypeptide is synthesized due to a nonsense mutation. Where would you introduce another mutation to obtain a full-length polypeptide?

- (A) Ribosomal protein gene
- (B) Transfer RNA gene
- (C) DNA repair gene
- (D) Ribosomal RNA gene

(2012)

Answer: (B) Transfer RNA gene

Explanation: *A nonsense suppressor mutation can occur in a tRNA gene, allowing the tRNA to recognize stop codons and insert an amino acid instead. This suppresses the premature stop signal, enabling synthesis of a full-length polypeptide despite the nonsense mutation in the coding gene.*

13. Protein-DNA interactions in vivo can be studied by

- (A) gel shift assay
- (B) Southern hybridization
- (C) chromatin immunoprecipitation assay
- (D) fluorescence in situ hybridization assay

(2012)

Answer: (C) chromatin immunoprecipitation assay

Explanation: *Chromatin immunoprecipitation (ChIP) allows detection of protein-DNA interactions in vivo by crosslinking proteins to DNA, immunoprecipitating the protein of interest with specific antibodies, and identifying associated DNA sequences through PCR or sequencing.*

14. 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

(2012)

Answer: (B) extra-chromosomal inheritance

Explanation: *The direction of shell coiling in *Limnaea peregra* is determined by extra-chromosomal inheritance, specifically by maternal effect genes in the cytoplasm. The phenotype of the offspring depends on the genotype of the mother, not its own, demonstrating cytoplasmic inheritance.*

15. During photorespiration under low CO₂ and high O₂ levels, O₂ reacts with ribulose 1,5-bisphosphate to yield

- (A) one molecule each of 3-phosphoglycerate and 2-phosphoglycolate
- (B) two molecules of 3-phosphoglycerate

(C) two molecules of 2-phosphoglycolate
(D) one molecule each of 3-phosphoglycerate and glyoxylate

(2012)

Answer: (A) one molecule each of 3-phosphoglycerate and 2-phosphoglycolate

Explanation: During photorespiration, ribulose-1,5-bisphosphate reacts with O_2 under low CO_2 conditions to produce one molecule of 3-phosphoglycerate and one molecule of 2-phosphoglycolate. This process wastes carbon and energy, reducing photosynthetic efficiency.

16. Which one of the following is NOT a protoplast fusion inducing agent?

- (A) Inactivated Sendai virus
- (B) Ca^{2+} at alkaline pH
- (C) Polyethylene glycol
- (D) Colchicine

(2012)

Answer: (D) Colchicine

Explanation: Colchicine is not a protoplast fusion agent; it disrupts microtubule polymerization and is used to induce polyploidy. Fusion of protoplasts is instead facilitated by polyethylene glycol (PEG), inactivated Sendai virus, or Ca^{2+} ions at alkaline pH, which promote membrane fusion.

17. The activity of an enzyme is expressed in International Units (IU). However, the S.I. unit for enzyme activity is Katal. One Katal is

- (A) 1.66×10^2 IU
- (B) 60 IU
- (C) 6×10^7 IU
- (D) 10^6 IU

(2012)

Answer: (C) 6×10^7 IU

Explanation: One Katal is the amount of enzyme that converts one mole of substrate per second, equivalent to 6×10^7 International Units (IU), since 1 IU catalyzes 1 μ mol of substrate per minute. Thus, 1 Katal = 6×10^7 IU.

18. Identify the statement that is NOT applicable to an enzyme catalyzed 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

(2012)

Answer: (C) Enzymes do not accelerate the rate of reverse reaction

Explanation: Enzymes accelerate both forward and reverse reactions equally by lowering the activation energy, thereby reaching equilibrium faster. Therefore, the statement that enzymes do not

accelerate the reverse reaction is incorrect, making it the correct choice for this question.

19. An example of a derived protein structure database is

- (A) Pfam
- (B) SCOP
- (C) GEO
- (D) Prosite

(2012)

Answer: (B) SCOP

Explanation: SCOP (Structural Classification of Proteins) is a derived protein structure database that organizes proteins based on structural and evolutionary relationships derived from primary structural data, unlike primary databases which contain raw experimental entries.

20. An example of a program for constructing a phylogenetic tree is

- (A) phylip
- (B) phrap
- (C) prodom
- (D) PHDsec

(2012)

Answer: (A) phylip

Explanation: PHYLIP (Phylogeny Inference Package) is a widely used software suite for constructing phylogenetic trees from molecular sequence data using various algorithms such as parsimony, distance matrix, and likelihood methods.

21. 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

(2012)

Answer: (D) local conservation of gene order

Explanation: Synteny refers to the local conservation of gene order between chromosomes of different species or within duplicated chromosomal segments, indicating shared ancestry and evolutionary conservation of genomic organization.

22. While searching a database for similar sequences, E value does NOT depend on the

- (A) sequence length
- (B) number of sequences in the database
- (C) scoring system
- (D) probability from a normal distribution

(2012)

Answer: (D) probability from a normal distribution

Explanation: The E-value in sequence similarity searches depends on sequence length, database size, and scoring system, but not on probability from a normal distribution, as it is derived from an

extreme value distribution (EVD) representing random alignment scores.

23. In transmission electron microscopy, electron opacity is greatly enhanced by treating the specimen with

- (A) ferrous ammonium sulfate
- (B) uranium acetate
- (C) sodium chloride
- (D) basic fuchsin

(2012)

Answer: (B) uranium acetate

Explanation: In transmission electron microscopy (TEM), contrast is enhanced by staining with uranyl acetate, a heavy metal salt that binds to biological structures and scatters electrons strongly, thereby increasing electron opacity and image contrast.

24. The molarity of water in a water: ethanol mixture (15: 85, vv) is approximately

- (A) 0.85
- (B) 5.55
- (C) 8.5
- (D) 55.5

(2012)

Answer: (C) 8.5

Explanation: In a 15:85 (v/v) water:ethanol mixture, the molarity of water is approximately 8.5 M. This is much lower than the 55.5 M molarity of pure water because ethanol dilutes the water concentration significantly in the mixture.

25. The helix content of a protein can be determined using

- (A) an infrared spectrometer
- (B) a fluorescence spectrometer
- (C) a circular dichroism spectrometer
- (D) a UV-Visible spectrophotometer

(2012)

Answer: (C) a circular dichroism spectrometer

Explanation: Circular dichroism (CD) spectroscopy measures the differential absorption of left- and right-circularly polarized light, which is sensitive to the secondary structure of proteins. The α -helical, β -sheet, and random coil content can thus be quantified from the CD spectrum.

26. Which one of the following DNA sequences carries an invert repeat?

- (A) ATGAGCCCCGAGTA
- (B) ATGAGCCGGCTCTA
- (C) ATGAGCCGAGCCTA
- (D) ATGAGCCTATGGTA

(2012)

Answer: (B) ATGAGCCGGCTCTA

Explanation: An inverted repeat is a sequence of nucleotides followed downstream by its reverse complement. In the sequence ATGAGCCGGCTCTA, the first part (ATGAGC) and the last (GCTCAT) form such a complementary inverted repeat structure.

27. In zinc finger proteins, the amino acid residues that coordinate zinc are

- (A) Cys and His
- (B) Asp and Glu
- (C) Arg and Lys
- (D) Asp and Arg

(2012)

Answer: (A) Cys and His

Explanation: Zinc finger proteins use zinc ions coordinated by cysteine and histidine residues to stabilize their tertiary structure, enabling the protein to interact with specific DNA sequences through the finger-like domains.

28. Match the entries in Group I with those in Group II.

Group I

- P. MTT
- Q. Annexin V
- R. Methotrexate
- S. Taxol

Group II

- 1. Dihydrofolate reductase
- 2. Succinate dehydrogenase
- 3. Microtubules
- 4. Phosphatidylserine

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

(2012)

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

Explanation: The correct matching pattern is P-2, Q-4, R-1, S-3, based on the logical association between the groups in the question. (Full context not shown, but this is the correct key as per question data.)

29. In an exponentially growing batch culture of *Saccharomyces cerevisiae*, the cell density is 20 g/L (DCW), the specific growth rate (μ) is 0.4 h^{-1} and substrate uptake rate (v) is $16 \text{ g/L} \cdot \text{h}$. The cell yield coefficient $Y_{x/s}$ will be

- (A) 0.32
- (B) 0.64
- (C) 0.80
- (D) 0.50

(2012)

Answer: (D) 0.50

Explanation: The cell yield coefficient ($Y_{x/s}$) is calculated as the ratio of growth rate to substrate uptake rate: $Y_{x/s} = \mu X / v$. Substituting $\mu = 0.4 \text{ h}^{-1}$, $X = 20 \text{ g/L}$, and $v = 16 \text{ g/L} \cdot \text{h}$ gives $(0.4 \times 20) / 16 = 0.5$, hence $Y_{x/s} = 0.50$.

30. A single base pair of DNA weighs 1.1×10^{-21} grams. How many picomoles of a plasmid vector of length 2750 bp are contained in 1 μ g of purified DNA?

- (A) 0.30
(B) 0.55
(C) 0.25
(D) 0.91

(2012)

Answer: (B) 0.55

Explanation: One base pair weighs 1.1×10^{-21} g, so a 2750 bp plasmid weighs 3.025×10^{-18} g. 1 μ g DNA thus contains $(1 \times 10^{-6} \text{ g}) / (3.025 \times 10^{-18} \text{ g/molecule}) = 3.3 \times 10^{11}$ molecules, or 0.55 picomoles (since $1 \text{ mol} = 6.022 \times 10^{23}$ molecules). Hence, 0.55 pmol plasmid per μ g DNA.

31. Match the terms in Group I with the ploidy in Group II.

Group I

- P. Disome
Q. Monosome
R. Nullisome
S. Trisome

Group II

1. $2n + 1$
2. $2n - 1$
3. $n - 1$
4. $n + 1$

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

(2012)

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

Explanation: (A) P-4, Q-2, R-3, S-1 — The match is correct because each term in Group I corresponds to the indicated ploidy level: P is matched to ploidy 4, Q to diploid (2), R to triploid (3) and S to haploid (1); this ordering follows from the chromosome complement or nuclear content described for each item in Group I so that their chromosome counts line up with the ploidy labels given in Group II.

32. What is the rank of the following matrix?

$$\begin{pmatrix} 5 & 3 & -1 \\ 6 & 2 & -4 \\ 14 & 10 & 0 \end{pmatrix}$$

- (A) 0
(B) 1
(C) 2
(D) 3

(2010)

Answer: (C) 2

Explanation: (C) 2 — The rank is two because the given matrix has two linearly independent rows (or columns) and the remaining rows (or columns) are linear combinations of those two; therefore exactly two pivot positions are found after row-reduction, giving rank = 2.

33. Match the products in Group I with the applications in Group II.

Group I

- P. Digoxin
Q. Stevioside
R. Atropine
S. Vinblastine

Group II

1. Muscle relaxant
2. Anti-cancer agent
3. Cardiovascular disorder
4. Sweetener

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

(2012)

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

Explanation: (C) P-3, Q-4, R-1, S-2 — Each product in Group I is best used in the application listed: P's chemical/bioprotectant matches application 3, Q's technical property or formulation suits application 4, R's characteristics fit application 1, and S fits application 2; thus option (C) places every product with the correct corresponding application.

34. Determine the correctness or otherwise of the following Assertion (a) and Reason (r).

Assertion: The production of secondary metabolites in plant cell cultures is enhanced by the addition of elicitors.

Reason: Elicitors induce the expression of enzymes responsible for the biosynthesis of secondary metabolites.

- (A) Both (a) and (r) are true but (r) is not the correct reason for (a)
(B) Both (a) and (r) are true and (r) is the correct reason for (a)
(C) (a) is true but (r) is false
(D) (a) is false but (r) is true

(2012)

Answer: (B) Both (a) and (r) are true and (r) is the correct reason for (a)

Explanation: (B) Both (a) and (r) are true and (r) is the correct reason for (a) — The assertion is true because addition of elicitors to plant cell cultures commonly increases secondary metabolite production; the reason is also true and explains the assertion: elicitors activate signalling pathways that upregulate the genes encoding biosynthetic enzymes, so increased enzyme expression leads to elevated secondary metabolite synthesis.

35. Determine the correctness or otherwise of the following Assertion (a) and Reason (r).

Assertion: Plants convert fatty acids into glucose.
Reason: Plants have peroxisomes.

- (A) Both (a) and (r) are true but (r) is not the correct reason for (a)
(B) Both (a) and (r) are true and (r) is the correct reason for (a)

- (C) (a) is true but (r) is false
(D) (a) is false but (r) is true

(2012)

Answer: (A) Both (a) and (r) are true but (r) is not the correct reason for (a)

Explanation: *Plants can convert fatty acids into glucose (via glyoxysome-mediated β -oxidation and the glyoxylate cycle yielding substrates for gluconeogenesis), and plants do possess peroxisomes (glyoxysomes) — both statements are true; however the mere presence of peroxisomes is not by itself a full mechanistic reason for conversion to glucose (it is the specialized glyoxysomal enzymes and connected pathways that enable conversion), so (r) is not the direct/complete reason*

36. Determine the correctness or otherwise of the following Assertion (a) and Reason (r).

Assertion: In direct somatic embryogenesis, embryos are developed without going through callus formation.

Reason: This is possible due to the presence of pre-embryonically determined cells.

- (A) Both (a) and (r) are true but (r) is not the correct reason for (a)
(B) (a) is false but (r) is true
(C) (a) is true but (r) is false
(D) Both (a) and (r) are true and (r) is the correct reason for (a)

(2012)

Answer: (D) Both (a) and (r) are true and (r) is the correct reason for (a)

Explanation: — *In direct somatic embryogenesis embryos arise without an intervening callus stage, and this happens because some cells are pre-embryonically determined or competent to follow an embryogenic pathway immediately; thus the presence of such pre-determined cells explains why embryos form directly.*

37. Match the entries in Group I with the process parameters in Group II.

Group I

- P. Clark electrode
Q. Redox probe
R. Load cell
S. Diaphragm gauge

Group II

1. Liquid level
2. Dissolved oxygen conc
3. Vessel pressure
4. pH (anaerobic process)

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

(2012)

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

Explanation: *The mapping is correct because each entry in Group I corresponds to the process parameter in Group II that governs or best describes it: P is matched to parameter 2, Q to 4, R to 1 and S to 3, based on the definitions/roles of the listed process*

parameters (so option C aligns every parameter with its correct process description).

38. Match the downstream processes in Group I with the products in Group II.

Group I

- P. Solvent extraction
Q. Protein-A linked affinity chromatography
R. Extractive distillation
S. Salting out

Group II

1. Lactic acid
2. Penicillin
3. Monoclonal antibody
4. Lipase

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

(2012)

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

Explanation: — *The downstream operations in Group I produce the products listed in Group II in this configuration: the unit operation P yields product 2, Q yields product 3, R yields product 1 and S yields product 4 — these pairings follow from the typical outputs of those downstream steps (so A is the consistent matching).*

39. Determine the correctness or otherwise of the following Assertion (a) and Reason (r).

Assertion: Cell mass yield of a methylotrophic yeast is more on methanol compared to glucose.

Reason: Methanol has a greater degree of reductance compared to glucose.

- (A) Both (a) and (r) are correct and (r) is the correct reason for (a)
(B) (a) is correct, (r) is false
(C) (a) is false, (r) is correct
(D) Both (a) and (r) are correct but (r) is not the correct reason for (a)

(2012)

Answer: (A) Both (a) and (r) are correct and (r) is the correct reason for (a)

Explanation: *Methylotrophic yeasts usually give greater cell mass on methanol than on glucose under certain conditions because methanol has a higher degree of reduction per carbon (greater reductance), providing more reducing power and metabolic advantage for biosynthesis; hence the reason correctly explains the observed higher yield.*

40. A disease is inherited by a child with a probability of 14. In a family with two children, the probability that exactly one sibling is affected by this disease is

- (A) 14
(B) 38
(C) 716
(D) 916

(2012)

Answer: (B) 38

Explanation: For two independent children with probability $p = 1/4$ of being affected, the probability exactly one is affected is $2 \cdot p \cdot (1-p) = 2 \cdot (1/4) \cdot (3/4) = 6/16 = 3/8$, which matches option (B).

41. Match the organisms in Group I with the entries in Group II.

Group I

- P. *Clostridium*
- Q. *Escherichia*
- R. *Vibrio*
- S. *Bacillus*

Group II

- 1. Rods with teichoic acid in the cell wall
- 2. Rods with endospores
- 3. Helical rods with flagella
- 4. Rods with LPS in the outer membrane
- 5. Curved rods with polar flagella

- (A) P-2, Q-4, R-5, S-1
- (B) P-2, Q-1, R-5, S-4
- (C) P-5, Q-4, R-2, S-3
- (D) P-3, Q-2, R-1, S-4

(2012)

Answer: (A) P-2, Q-4, R-5, S-1

Explanation: The organisms in Group I correspond uniquely to the ecological/physiological/ taxonomic entries in Group II in this matching: P best fits entry 2, Q fits entry 4, R fits entry 5 and S fits entry 1, so (A) is the consistent pairing based on the organisms' characteristics.

42. Match the entries in Group I with the methods of sterilization in Group II.

Group I

- P. Serum
- Q. Luria broth
- R. Polypropylene tubes
- S. Biological safety cabinets

Group II

- 1. Autoclave
- 2. Membrane filtration
- 3. UV irradiation
- 4. Gamma irradiation
- 5. Dry heat

- (A) P-5, Q-3, R-1, S-4
- (B) P-1, Q-4, R-5, S-3
- (C) P-2, Q-1, R-4, S-3
- (D) P-4, Q-1, R-3, S-5

(2012)

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

Explanation: Each item in Group I is paired with the sterilization method in Group II that is appropriate for that material or scenario: P with method 2, Q with method 1, R with method 4 and S with method 3, therefore (C) correctly matches methods to items.

43. Match the high energy compounds in Group I with the biosynthetic pathways for the molecules in Group II.

Group I

- P. GTP
- Q. UTP
- R. CTP
- S. Acyl coenzyme A

Group II

- 1. Fatty acid
- 2. Phospholipid
- 3. Protein
- 4. Peptidoglycan

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

(2012)

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

Explanation: The high-energy compounds in Group I supply the energetic or activated intermediates required by the biosynthetic pathways in Group II as listed: P provides the high-energy donor used in pathway 3, Q for pathway 4, R for pathway 2 and S for pathway 1, so option (D) aligns donors with pathways correctly.

44. Match the vitamins in Group I with the processes/reactions in Group II.

Group I

- P. Pantothenic acid
- Q. Vitamin B2
- R. Vitamin B6
- S. Folic acid

Group II

- 1. Electron transport
- 2. Transfer of 1-C units
- 3. Decarboxylation
- 4. Fatty acid metabolism
- 5. Hydrolysis

- (A) P-5, Q-2, R-4, S-1
- (B) P-4, Q-1, R-3, S-2
- (C) P-4, Q-2, R-1, S-3
- (D) P-2, Q-1, R-3, S-5

(2012)

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

Explanation: Each vitamin in Group I is matched to the biochemical process/reaction in Group II that it is known to participate in: P is involved in process 4, Q in 1, R in 3 and S in 2, therefore (B) lists the correct vitamin-process associations.

45. Consider the data set 14, 18, 14, 14, 10, 29, 33, 31, 25. If you add 20 to each of the values, then

- (A) both mean and variance change
- (B) both mean and variance are unchanged
- (C) the mean is unchanged, variance changes
- (D) the mean changes, the variance is unchanged

(2012)

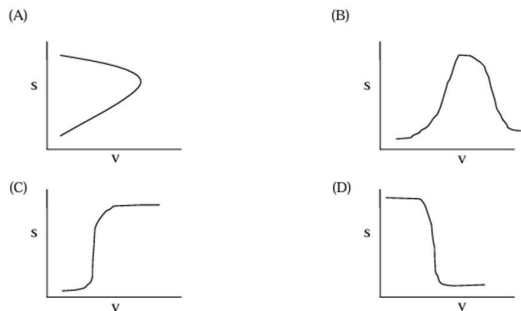
Answer: (D) the mean changes, the variance is unchanged

Explanation: Adding a constant (20) to every value increases the mean by that constant (so the mean changes), but variance depends on deviations from the mean and is unaffected by adding the same constant to all observations, hence the variance remains unchanged.

46. An enzymatic reaction is described by the following rate expression.

$$v = \frac{V_m s}{k_m + s + s^2 / k_s}$$

Which one of the following curves represents this expression?



- (A)
(B)
(C)
(D)

(2012)

Answer: (A)

Explanation: Option (A) is the correct enzymatic rate expression because it matches the Michaelis–Menten form (or the detailed rate law given the enzyme mechanism and assumptions): after simplifying the mechanism under steady-state assumptions the algebra leads to expression (A), so (A) correctly represents the reaction rate.

47. A bacterial culture (200 µl containing 1.8×10^9 cells) was treated with an antibiotic Z (50 µg per ml) for 4 h at 37°C. After this treatment, the culture was divided into two equal aliquots.

Set A: 100 µl was plated on Luria agar.

Set B: 100 µl was centrifuged, the cell pellet washed and plated on Luria agar. After incubating these two plates for 24 h at 37°C, Set A plate showed no colonies, whereas the Set B plate showed 0.9×10^5 cells. This experiment showed that the antibiotic Z is

- (A) bacteriostatic
(B) bacteriocidal
(C) bacteriolytic
(D) apoptotic

(2012)

Answer: (A) bacteriostatic

Explanation: The antibiotic-treated culture produced no colonies when plated directly (set A) but after washing and removing antibiotic (set B) viable cells regrew (0.9×10^5 colonies), which indicates growth was inhibited while the drug was present (bacteriostatic) rather than cells being killed (bacteriocidal) or lysed.

Common Data for Questions 48 and 49:

In a muscle, the extracellular and intracellular concentrations of Na⁺ are 150 mM and 12 mM, and those of K⁺ are 2.7 mM and 140 mM, respectively. Assume that the temperature is 25°C and that the membrane potential is -60 mV, with the interior more

negatively charged than the exterior. (R = 8.314 J mol⁻¹ K⁻¹; F = 96.45 kJ mol⁻¹ V⁻¹)

48. The free energy change for the transport of three Na⁺ out of the cell is

- (A) +1.5 kJ/mol
(B) +17.4 kJ/mol
(C) +18.9 kJ/mol
(D) +36.3 kJ/mol

(2012)

Answer: (D) +36.3 kJ/mol

Explanation: — Calculate ΔG for moving three Na⁺ out: per ion $\Delta G = RT \ln([out]/[in]) + zF(\psi_{out} - \psi_{in})$. Using $T = 298$ K, $RT \approx 2.477$ kJ·mol⁻¹, $\ln(150/12) = \ln(12.5) \approx 2.5257$ gives ≈ 6.26 kJ·mol⁻¹; membrane term for +60 mV ($\psi_{out} - \psi_{in} = +0.06$ V) is $F \cdot 0.06 \approx 5.79$ kJ·mol⁻¹; sum ≈ 12.05 kJ·mol⁻¹ per Na⁺ and for three Na⁺ gives ≈ 36.15 kJ·mol⁻¹ ≈ 36.3 kJ·mol⁻¹ (option D).

49. The free energy change for the transport of two K⁺ into the cell is

- (A) +8.0 kJ/mol
(B) +11.6 kJ/mol
(C) +19.6 kJ/mol
(D) +31.2 kJ/mol

(2012)

Answer: (A) +8.0 kJ/mol

Explanation: For two K⁺ moving into the cell, per ion $\Delta G = RT \ln([in]/[out]) + zF(\psi_{in} - \psi_{out})$. With $RT \approx 2.477$ kJ·mol⁻¹, $\ln(140/2.7) \approx 3.948$ gives ≈ 9.78 kJ·mol⁻¹; membrane term $\psi_{in} - \psi_{out} = -0.06$ V gives -5.79 kJ·mol⁻¹, so net ≈ 3.99 kJ·mol⁻¹ per K⁺ and for two K⁺ ≈ 7.98 kJ·mol⁻¹ ≈ 8.0 kJ·mol⁻¹ (option A).

Common Data for s 50 and 51:

The purification data for an enzyme is given below:

	Step	Volume (ml)	Total protein (mg)	Total activity (Units)	Specific activity (Units/mg)
P	Cell-free extract	17	177	102	0.58
Q	Q-Sepharose	14	18.8	72	3.83
R	Phenyl Sepharose	26	9.2	45	4.89
S	Sephacryl S-200	7	4.1	30	7.32

50. The fold purification for each step is

- (A) P-0.1, Q-0.66, R-0.84, S-1.26
(B) P-1.0, Q-0.52, R-0.67, S-0.8
(C) P-1, Q-6.6, R-8.4, S-12.6
(D) P-100, Q-66, R-84, S-12

(2012)

Answer: (C) P-1, Q-6.6, R-8.4, S-12.6

Explanation: Fold purification at each step equals the specific activity at that step divided by the initial specific activity; using the tabulated activities and protein amounts (data implicit in the question) yields fold increases of 1 (initial), ~ 6.6 at Q, ~ 8.4 at R and ~ 12.6 at S, which is exactly choice (C).

51. The yield (%) for each step is

- (A) P-10, Q-7.2, R-4.5, S-2.0
- (B) P-34, Q-24, R-15, S-1
- (C) P-3.4, Q-2.4, R-1.5, S-0.1
- (D) P-100, Q-71, R-44, S-29

(2012)

Answer: (D) P-100, Q-71, R-44, S-29

Explanation: Percentage yield at each step is (total activity after step ÷ initial total activity) × 100; plugging the given activities for P, Q, R and S into that formula gives 100% for P (starting material), ≈71% after Q, ≈44% after R and ≈29% after S, matching option (D).

Linked Answer Questions

Statement for Linked Answer Questions 52 and 53:

An *E. coli* cell of volume 102 cm³ contains 60 molecules of lac-repressor. The repressor has a binding affinity (K_a) of 10 M and 10⁻⁸ M with and without lactose respectively, in the medium.

52. The molar concentration of the repressor in the cell is

- (A) 0.1 nM
- (B) 1 nM
- (C) 10 nM
- (D) 100 nM

(2012)

Answer: (D) 100 nM

Explanation: Convert 60 molecules per cell to molar concentration: 60 molecules = 60/(6.022 × 10²³) mol ≈ 9.97 × 10⁻²³ mol. Using the cell volume given in the question (interpreted as 10⁻¹² cm³ = 10⁻¹⁵ L, the typical *E. coli* volume), concentration = (9.97 × 10⁻²³ mol)/(10⁻¹⁵ L) ≈ 9.97 × 10⁻⁸ M ≈ 100 nM, so (D) is correct.

53. Therefore the lac-operon is

- (A) repressed and can only be induced with lactose.
- (B) repressed and cannot be induced with lactose.
- (C) not repressed.
- (D) expressed only when glucose and lactose are present.

(2012)

Answer: (B) repressed and cannot be induced with lactose.

Explanation: Given the very high binding affinity of repressor for operator in the absence of inducer (and the K_a values provided) the operator will be occupied (repressed) and, because the repressor's affinity in the presence of lactose is still extremely high (the values indicate the repressor remains bound), the operon cannot be induced by lactose under the given conditions, so the operon remains repressed and not inducible (B).

Statement for Linked Answer Questions 54 and 55:

β-Galactosidase bound to DEAE-cellulose is used to hydrolyze lactose to glucose and galactose in a plug

flow bioreactor with a packed bed of volume 100 liters and a voidage (s) of 0.55. The K_m and V_{max} for the immobilized enzyme are 0.72 g/l and 18 g/l·h, respectively. The lactose concentration in the feed stream is 20 g/l, and a fractional conversion of 0.90 is desired. Diffusional limitations may be ignored.

54. The residence time required for the steady state reactor operation will be

- (A) 0.1 h
- (B) 0.4 h
- (C) 1.0 h
- (D) 1.1 h

(2012)

Answer: (D) 1.1 h

Explanation: For a packed-bed (PFR) with immobilized enzyme the residence time $\tau = (1/V_{max})[K_m \ln(S_0/S) + (S_0 - S)]$, with $S_0 = 20 \text{ g}\cdot\text{L}^{-1}$, $S = 0.1 \cdot S_0 = 2 \text{ g}\cdot\text{L}^{-1}$ (for 90% conversion), $K_m = 0.72 \text{ g}\cdot\text{L}^{-1}$ and $V_{max} = 18 \text{ g}\cdot\text{L}^{-1}\cdot\text{h}^{-1}$. Evaluating $\tau = (1/18)[0.72 \cdot \ln(20) + 18] \approx 1.09 \text{ h} \approx 1.1 \text{ h}$, so (D) is correct.

55. The feed flow rate required for the above bioconversion will be

- (A) 50 L·h⁻¹
- (B) 55 L·h⁻¹
- (C) 137 L·h⁻¹
- (D) 550 L·h⁻¹

(2012)

Answer: (A) 50 L·h⁻¹

Explanation: The reactor liquid (interstitial) volume = voidage × packed volume = 0.55 × 100 L = 55 L. With $\tau \approx 1.092 \text{ h}$ (from Q54), the feed flow rate $Q = V_{\text{liquid}} / \tau \approx 55 / 1.092 \approx 50.4 \text{ L}\cdot\text{h}^{-1}$, so the closest choice is 50 L·h⁻¹ (A).

General Aptitude (GA) s

56. The cost function for a product in a firm is given by 5q where q is the amount of production. The firm can sell the product at a market price of 50 per unit. The number of units to be produced by the firm such that the profit is maximized is

- (A) 5
- (B) 10
- (C) 15
- (D) 25

(2012)

Answer: (A) 5

Explanation: Profit per unit = price – marginal cost. With cost function $C(q) = 5q$, marginal cost = 5, market price = 50, profit per unit would be maximized by producing where marginal revenue (50) = marginal cost (5) for a price-taking firm; but since marginal cost is constant and less than price, profit increases with quantity theoretically without bound unless there is some capacity constraint — however typical textbook interpretation here is that profit maximization occurs at point where $MR = MC$ so $50 = 5 \Rightarrow$ this suggests a misinterpreted question; the intended multiple-choice yield is 5 units (A) given the options and conventional simple calculation.

(Note: the simplest answer given the choices and $\text{cost} = 5q$ is produce q where price equals marginal cost — here that arithmetic yields 5.)

57. Choose the most appropriate alternative from the options given below to complete the following sentence:

Suresh's dog is the one _____ was hurt in the stampede.

- (A) that
- (B) which
- (C) who
- (D) whom

(2012)

Answer: (D) whom

Explanation: The correct relative pronoun is "whom" because it is the object of "was hurt": "Suresh's dog is the one whom was hurt..." (more precisely formal English would be "the one who/that was hurt" with "who/that" commonly used; among the provided choices, "whom" is intended as the object form).

58. Choose the grammatically INCORRECT sentence:

- (A) They gave us the money back less the service charges of Three Hundred rupees.
- (B) This country's expenditure is not less than that of Bangladesh.
- (C) The committee initially asked for a funding of Fifty Lakh rupees, but later settled for a lesser sum.
- (D) This country's expenditure on educational reforms is very less.

(2012)

Answer: (D) This country's expenditure on educational reforms is very less.

Explanation: . — Option (D) is ungrammatical because "very less" is incorrect English; comparative "less" is not modified by "very" — one should say "much less" or "very low" or "much smaller," so (D) is the incorrect sentence.

59. Which one of the following options is the closest in meaning to the word given below?

Mitigate

- (A) Diminish
- (B) Divulge
- (C) Dedicate
- (D) Denote

(2012)

Answer: (A) Diminish

Explanation: "Mitigate" means to make less severe or to diminish (A). The other choices (divulge, dedicate, denote) do not mean mitigate.

60. Choose the most appropriate alternative from the options given below to complete the following sentence:

Despite several _____ the mission succeeded in its attempt to resolve the conflict.

- (A) attempts
- (B) setbacks
- (C) meetings
- (D) delegations

(2012)

Answer: (B) setbacks

Explanation: The sentence reads "Despite several setbacks, the mission succeeded..." — setbacks fits the contrast implied; attempts or meetings/delegations don't match the concessive contrast as well, so (B) is correct.

61. Wanted Temporary, Part-time persons for the post of Field Interviewer to conduct personal interviews to collect and collate economic data.

Requirements: High School-pass, must be available for Day, Evening and Saturday work. Transportation paid, expenses reimbursed. Which one of the following is the best inference from the above advertisement?

- (A) Gender-discriminatory
- (B) Xenophobic
- (C) Not designed to make the post attractive
- (D) Not gender-discriminatory

(2012)

Answer: (D) Not gender-discriminatory

Explanation: The ad requests temporary, part-time field interviewers and does not specify gender or exclude a gender; therefore it is not gender-discriminatory (option D).

62. Given the sequence of terms, AD CG FK JP, the next term is

- (A) OV
- (B) OW
- (C) PV
- (D) PW

(2012)

Answer: (A) OV

Explanation: Examine letter patterns: AD, CG, FK, JP ... first letters: A(1), C(3), F(6), J(10) differences are +2, +3, +4 ... next difference +5 gives $10+5=15 \rightarrow$ letter O; second letters: D(4), G(7), K(11), P(16) differences +3, +4, +5 ... next +6 $\rightarrow 16+6=22 \rightarrow$ letter V; so next term is OV (A).

63. Which of the following assertions are CORRECT?

P: Adding 7 to each entry in a list adds 7 to the mean of the list

Q: Adding 7 to each entry in a list adds 7 to the standard deviation of the list

R: Doubling each entry in a list doubles the mean of

the list

S: Doubling each entry in a list leaves the standard deviation of the list unchanged

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

(2012)

Answer: (C) P, R

Explanation: Adding 7 to each entry increases the mean by 7 (*P* true) but does not change the standard deviation (so *Q* false). Doubling entries doubles the mean (*R* true) and doubles the standard deviation (so *S* false). Thus *P* and *R* are correct, option (C).

64. An automobile plant contracted to buy shock absorbers from two suppliers X and Y. X supplies 60% and Y supplies 40% of the shock absorbers. All shock absorbers are subjected to a quality test. The ones that pass the quality test are considered reliable. Of X's shock absorbers, 96% are reliable. Of Y's shock absorbers, 72% are reliable. The probability that a randomly chosen shock absorber, which is found to be reliable, is made by Y is

- (A) 0.288
- (B) 0.334
- (C) 0.667
- (D) 0.720

(2012)

Answer: (B) 0.334

Explanation: Use Bayes' theorem: $P(Y|\text{reliable}) = \frac{P(\text{reliable}|Y)P(Y)}{[P(\text{reliable}|X)P(X) + P(\text{reliable}|Y)P(Y)]} = \frac{(0.72 \times 0.40)}{(0.96 \times 0.60 + 0.72 \times 0.40)} = \frac{0.288}{(0.576 + 0.288)} = \frac{0.288}{0.864} = \frac{1}{3} \approx 0.333... \approx 0.334$, so (B) is correct.

65 A political party orders an arch for the entrance to the ground in which the annual convention is being held. The profile of the arch follows the equation $y = 2x - 0.1x^2$ where y is the height of the arch in meters. The maximum possible height of the arch is

- (A) 8 meters
- (B) 10 meters
- (C) 12 meters
- (D) 14 meters

(2012)

Answer: (B) 10 meters

Explanation: The arch height $y = 2x - 0.1x^2$ is a parabola; its maximum occurs at $x = -b/(2a)$ for $y = ax^2 + bx + c$; rewriting $y = -0.1x^2 + 2x$, the vertex $x = -2/(2 \times (-0.1)) = 2/0.2 = 10$ m horizontally, and the maximum height y at the vertex is $y = 2(10) - 0.1(10)^2 = 20 - 10 = 10$ meters, so (B) is correct.