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BIO · BIOLOGY

17. Biotechnology

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

30 Solved Questions

2005 to 2025 Archive

Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, SZABMU

Weightage: 34% of MDCAT (68 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

BUMHS 2025

In disease diagnosis, the main function of monoclonal antibodies is?

[Balochistan MDCAT 2025]

- (A) To stimulate white blood cell production
- (B) To bind to toxins produced by pathogens
- (C) To detect specific antigens in clinical samples
- (D) To label abnormal cells for immune destruction

Q2.

BUMHS 2025

Key benefit of using biotechnology in development of vaccine for malaria is?

[Balochistan MDCAT 2025]

- (A) To create a targeted immune response against the parasite
- (B) Its ability to work as antimalarial drugs
- (C) Its ability to directly kills the malaria parasite in mosquitoes
- (D) Its ability to develop endosymbiotic relationship with host

Q3.

SZABMU 2025

DNA/RNA probes are most commonly used as?

[Federal MDCAT 2025]

- (A) carrier in gene cloning experiments
- (B) diagnostic tools of infectious diseases
- (C) cementing material in somatic cell hybridization
- (D) carrier or vector in gene therapy

Q4.

SZABMU 2025

A biological laboratory is developing gene therapy with a modified virus that infects the blood only. Which of the following category does this virus belong to?

[Federal MDCAT 2025]

- (A) Algal virus
- (B) Fungal virus
- (C) Bacterial virus
- (D) Animal virus

Q5.

SZABMU 2025

A patient with a genetic disorder undergoes treatment where a normal gene is inserted into their cells. This is called?

[Federal MDCAT 2025]

- (A) Gene therapy
- (B) Genetic testing
- (C) Protein engineering
- (D) DNA fingerprinting

Q6.

KMU 2025

In somatic cell hybridization, which two cells are fused to produce monoclonal antibodies?

[KPK MDCAT 2025]

- (A) T-cells and nerve cells
- (B) B-lymphocytes and spleen cells
- (C) T-cells and liver cells
- (D) B-lymphocytes and macrophages

Q7.

KMU 2025

In molecular diagnostics, the primary function of DNA/RNA probes is to?

[KPK MDCAT 2025]

- (A) Replace mutated genes in affected cells
- (B) Cut genetic material at precise locations
- (C) Bind to specific DNA or RNA sequences for identification
- (D) Stimulate immune responses against disease-causing organisms

Q8.

KMU 2025

A set of uniform proteins generated by genetically identical immune cells (clonal sister) a descendent cell, are?

[KPK MDCAT 2025]

- (A) Therapeutic proteins
- (B) Monoclonal antibodies
- (C) Immunoglobulins
- (D) Recombinant proteins

Q9.

KMU 2025

Which biotechnological product is used to replace an abnormal gene in a patient's cells?

[KPK MDCAT 2025]

- (A) Antibiotic
- (B) Vaccine
- (C) Interferon
- (D) Vector

Q10.

DUHS 2025

Monoclonal antibodies are useful in cancer diagnosis by?

[Sindh MDCAT 2025]

- (A) Replacing damaged tissue
- (B) Detecting specific tumor markers in samples
- (C) Changing the genetic code of cancer cells
- (D) Killing healthy cells to reduce tumor spread

Q11.

DUHS 2025

In biotechnology, vaccines can be developed by cloning of?

[Sindh MDCAT 2025]

- (A) Gene for antigen of pathogen
- (B) Gene for receptor of the patient
- (C) Gene for antigen of patient
- (D) Gene for antibody of patient

Q12.

DUHS 2025

Which product is produced by genetically modified bacteria for patients with Diabetes mellitus?

[Sindh MDCAT 2025]

- (A) Erythropoietin
- (B) Insulin
- (C) Growth hormone
- (D) Vaccine

Q13.

DUHS 2025

Role of mRNA in COVID-19 vaccines like Pfizer and Moderna is to?

[Sindh MDCAT 2025]

- (A) Helps the immune system recognize the virus
- (B) Triggers immediate antibody release from memory cells
- (C) Instructs cells to produce the viral spike protein
- (D) Delivers enzymes that destroy the virus

Q14.

BUMHS 2025

Key benefit of using biotechnology in development of vaccine for malaria is?

[BUMHS 2025]

- (A) its ability to work as antimalarial drugs
- (B) its ability to directly kills the malaria parasite in mosquitoes
- (C) to create a targeted immune response against the parasite
- (D) its ability to develop endosymbiotic relationship with host

Q15.

BUMHS 2025

In disease diagnosis, the main function of monoclonal antibodies is?

[BUMHS 2025]

- (A) To detect specific antigens in clinical samples
- (B) To stimulate white blood cell production
- (C) To bind to toxins produced by pathogens
- (D) To label abnormal cells for immune destruction

Q16.

DUHS 2025

Monoclonal antibodies are useful in cancer diagnosis by?

[DUHS 2025]

- (A) Replacing damaged tissue
- (B) Changing the genetic code of cancer cells
- (C) Killing healthy cells to reduce tumor spread
- (D) Detecting specific tumor markers in samples

Q17.

DUHS 2025

In biotechnology, vaccines can be developed by cloning of?

[DUHS 2025]

- (A) Gene for receptor of the patient
- (B) Gene for antigen of pathogen
- (C) Gene for antigen of patient
- (D) Gene for antibody of patient

Q18.

DUHS 2025

Which product is produced by genetically modified bacteria for patients with Diabetes mellitus?

[DUHS 2025]

- (A) Erythropoietin
- (B) Growth hormone
- (C) Insulin
- (D) Vaccine

Q19.

DUHS 2025

Role of mRNA in COVID-19 vaccines like Pfizer and Moderna is to?

[DUHS 2025]

- (A) Instructs cells to produce the viral spike protein
- (B) Helps the immune system recognize the virus
- (C) Triggers immediate antibody release from memory cells
- (D) Delivers enzymes that destroy the virus

Q20.

KMU 2025

In somatic cell hybridization, which two cells are fused to produce monoclonal antibodies?

[KMU 2025]

- (A) T-cells and nerve cells
- (B) T-cells and liver cells
- (C) B-lymphocytes and spleen cells
- (D) B-lymphocytes and macrophages

Q21.

KMU 2025

In molecular diagnostics, the primary function of DNA/RNA probes is to?

[KMU 2025]

- (A) Bind to specific DNA or RNA sequences for identification
- (B) Replace malfunctioning genes in affected cells
- (C) Cut genetic material at precise locations
- (D) Stimulate immune responses against disease-causing organisms

Q22.

KMU 2025

A set of uniform proteins generated by genetically identical immune cells, which are?

[KMU 2025]

- (A) Therapeutic proteins
- (B) Immunoglobulins
- (C) Recombinant proteins
- (D) Monoclonal antibodies

Q23.

KMU 2025

Which biotechnological product is used to replace an abnormal gene in a patient's cells?

[KMU 2025]

- (A) Antibiotic
- (B) Vector
- (C) Vaccine
- (D) Interferon

Q24.

NUMS 2025

DNA/RNA probes are most commonly used as?

[NUMS 2025]

- (A) carrier in gene cloning experiments
- (B) cementing material in somatic cell hybridization
- (C) diagnostic tools of infectious diseases
- (D) carrier or vector in gene therapy

Q25.

SZABMU 2025

DNA/RNA probes are most commonly used as?

[SZABMU 2025]

- (A) diagnostic tools of infectious diseases
- (B) carrier in gene cloning experiments
- (C) cementing material in somatic cell hybridization
- (D) carrier or vector in gene therapy

Q26.

SZABMU 2025

A patient with a genetic disorder undergoes treatment where a normal gene is inserted into their cells. This is called?

[SZABMU 2025]

- (A) Genetic testing
- (B) Gene therapy
- (C) Protein engineering
- (D) DNA fingerprinting

Q27.

SZABMU 2025

F.C Steward used this plant for his experiment i.e (tissue culture)?

[SZABMU 2025]

- (A) Carrot
- (B) Radish
- (C) Corn
- (D) Maize

Q28.

SZABMU 2025

In gel electrophoresis, how do molecules migrate through the gel?

[SZABMU 2025]

- (A) By diffusion
- (B) Under the influence of an electric field
- (C) Active transport
- (D) Under the influence of agar

Q29.

SZABMU 2025

_____ is used in the production of Humulin.

[SZABMU 2025]

- (A) Fungi
- (B) Protozoa
- (C) Bacteria
- (D) Virus

Q30.

MDCAT 2005

The sequencing of human chromosome number 22 was completed in:

- (A) 1990
- (B) 1999
- (C) 2003
- (D) 2005

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 17. Biotechnology.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	BUMHS 2025	7	C	KMU 2025	13	C	DUHS 2025	19	A	DUHS 2025	25	A	SZABMU 2025
2	A	BUMHS 2025	8	B	KMU 2025	14	C	BUMHS 2025	20	C	KMU 2025	26	B	SZABMU 2025
3	B	SZABMU 2025	9	D	KMU 2025	15	A	BUMHS 2025	21	A	KMU 2025	27	A	SZABMU 2025
4	D	SZABMU 2025	10	B	DUHS 2025	16	D	DUHS 2025	22	D	KMU 2025	28	B	SZABMU 2025
5	A	SZABMU 2025	11	A	DUHS 2025	17	B	DUHS 2025	23	B	KMU 2025	29	C	SZABMU 2025
6	B	KMU 2025	12	B	DUHS 2025	18	C	DUHS 2025	24	C	NUMS 2025	30	B	MDCAT 2005

TOTAL MCQS
30

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in **BeambePrep Grind Mode** for automated error autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (C)

BUMHS 2025

In disease diagnosis, the main function of monoclonal antibodies is? [Balochistan MDCAT 2025]

CORE CONCEPT AND DERIVATION

Monoclonal antibodies (mAbs) are monospecific antibodies produced by identical immune cells (hybridomas) that bind specifically to one targeted epitope.

Solution:

In diagnostic biotechnology, monoclonal antibodies are primary biological tools utilized to detect minute quantities of specific antigens or pathogens in patient clinical samples (such as blood, urine, or tissue samples) using assays like ELISA and rapid immunochromatographic tests.

Why other options are incorrect:

- **To stimulate white blood cell production:** Colony-stimulating factors (CSFs) and specific cytokines carry out this physiological function, not monoclonal antibodies.
- **To bind to toxins produced by pathogens:** While neutralizing antitoxins can bind toxins therapeutically, this is not their primary diagnostic function.
- **To label abnormal cells for immune destruction:** This describes therapeutic monoclonal antibody mechanisms (like Antibody-Dependent Cellular Cytotoxicity) rather than diagnostic applications.

Question #2 Key: (A)

BUMHS 2025

Key benefit of using biotechnology in development of vaccine for malaria is? [Balochistan MDCAT 2025]

CORE CONCEPT AND DERIVATION

Recombinant DNA technology in vaccine development allows isolation and recombinant synthesis of specific antigenic surface proteins of complex pathogens.

Solution:

Biotechnology allows scientists to produce recombinant subunit vaccines containing isolated surface antigens of the *Plasmodium* parasite. This enables the human immune system to produce a highly targeted, protective humoral and cellular immune response without exposure to live or whole virulent pathogens.

Why other options are incorrect:

- **Its ability to work as antimalarial drugs:** Vaccines confer prophylactic immunity; they do not act directly as chemical antimalarial therapeutic drugs (such as artemisinin or chloroquine).
- **Its ability to directly kills the malaria parasite in mosquitoes:** Vaccines function within the human host immune system, not as direct insecticides or antiparasitic agents inside vector mosquitoes.
- **Its ability to develop endosymbiotic relationship with host:** Vaccines do not establish symbiotic relationships; they train the adaptive immune system to destroy pathogens.

Question #3 Key: (B)

SZABMU 2025

DNA/RNA probes are most commonly used as? [Federal MDCAT 2025]

CORE CONCEPT AND DERIVATION

Nucleic acid hybridization probes are single-stranded DNA or RNA molecules labeled with radioisotopes or fluorescent dyes.

Solution:

Probes possess sequence complementarity to specific pathogen genes or mutated human alleles. Because they bind exclusively to complementary target sequences, they serve as highly accurate diagnostic tools for detecting hereditary disorders and infectious diseases in techniques like Southern blotting and FISH.

Why other options are incorrect:

- **carrier in gene cloning experiments:** Plasmids, bacteriophages, and cosmids function as cloning vectors/carriers, not probes.
- **cementing material in somatic cell hybridization:** Polyethylene glycol (PEG) or inactivated Sendai virus acts as the fusogen, not nucleic acid probes.
- **carrier or vector in gene therapy:** Viral vectors (retroviruses, adenoviruses) or liposomes act as carriers in gene therapy.

Question #4 Key: (D)

SZABMU 2025

A biological laboratory is developing gene therapy with a modified virus that infects the blood only. Which of...

CORE CONCEPT AND DERIVATION

Viral tissue tropism determines host cell specificity based on surface receptor interactions.

Solution:

Viruses engineered for human gene therapy targeting human blood cells (such as hematopoietic stem cells or lymphocytes) belong to the category of modified mammalian/animal viruses (e.g., retroviruses, lentiviruses, adenoviruses).

Why other options are incorrect:

- **Algal virus:** Algal viruses specifically infect photosynthetic eukaryotic algae and cannot infect human target tissues.
- **Fungal virus:** Mycoviruses infect fungal organisms exclusively and do not possess tropism for human blood cells.
- **Bacterial virus:** Bacteriophages specifically infect bacterial cells and cannot naturally infect human somatic cells.

Question #5 Key: (A)

SZABMU 2025

A patient with a genetic disorder undergoes treatment where a normal gene is inserted into their cells. This i...

CORE CONCEPT AND DERIVATION

Therapeutic correction of genetic defects via genetic material introduction.

Solution:

Gene therapy is a medical technique that treats or prevents disease by inserting a normal, functional copy of a gene directly into a patient's cells to replace or compensate for a mutated, non-functional gene.

Why other options are incorrect:

- **Genetic testing:** The analysis of DNA to identify genetic variations or disease-causing mutations without delivering therapeutic genes.
- **Protein engineering:** Design and synthesis of novel or modified proteins with specific molecular functions.
- **DNA fingerprinting:** Identification technique that analyzes variable short tandem repeats (STRs) in human DNA.

Question #6 **Key: (B)**

KMU 2025

In somatic cell hybridization, which two cells are fused to produce monoclonal antibodies? [KPK MDCAT 2025]

CORE CONCEPT AND DERIVATION

Hybridoma technology for monoclonal antibody manufacturing.

Solution:

Monoclonal antibodies are produced by somatic cell fusion between antibody-secreting B-lymphocytes (harvested from the spleen of an immunized host) and cancerous myeloma cells to grant immortality to the resulting hybridoma cell line.

Why other options are incorrect:

- **T-cells and nerve cells:** T-cells perform cell-mediated immunity and do not secrete soluble antibodies; nerve cells do not divide or produce antibodies.
- **T-cells and liver cells:** Neither T-lymphocytes nor hepatocytes synthesize immunoglobulin antibody molecules.
- **B-lymphocytes and macrophages:** Macrophages are antigen-presenting phagocytic cells and do not form antibody-secreting hybrid lines.

Question #8 **Key: (B)**

KMU 2025

A set of uniform proteins generated by genetically identical immune cells (clonal sister) a descendent cell, a...

CORE CONCEPT AND DERIVATION

Clonal expansion and specificity of monoclonal antibody synthesis.

Solution:

Monoclonal antibodies are identical immunoglobulins produced by a single clone of B-lymphocytes or hybridoma cells. Because they originate from genetically identical parent cells, they possess identical antigen-binding specificity and structure.

Why other options are incorrect:

- **Therapeutic proteins:** Broad medical classification including recombinant hormones, clotting factors, and enzymes, not limited to single immune cell clones.
- **Immunoglobulins:** Broad umbrella term for all antibody molecules, including polyclonal mixtures secreted by diverse plasma cell lineages.
- **Recombinant proteins:** Any protein expressed from recombinant DNA technology in host expression systems.

Question #7 **Key: (C)**

KMU 2025

In molecular diagnostics, the primary function of DNA/RNA probes is to? [KPK MDCAT 2025]

CORE CONCEPT AND DERIVATION

Target recognition via complementary base pairing.

Solution:

The fundamental function of nucleic acid probes in molecular diagnostics is to hybridize selectively (bind via hydrogen bonding) to target complementary nucleic acid sequences, allowing precise identification of pathogen genomes or mutant genes.

Why other options are incorrect:

- **Replace mutated genes in affected cells:** This is the objective of gene therapy recombinant vectors, not nucleic acid probes.
- **Cut genetic material at precise locations:** Cleaving double-stranded DNA at specific recognition sites is performed by restriction endonucleases.
- **Stimulate immune responses against disease-causing organisms:** Vaccines and immunogens stimulate adaptive immune responses, not diagnostic probes.

Question #9 **Key: (D)**

KMU 2025

Which biotechnological product is used to replace an abnormal gene in a patient's cells? [KPK MDCAT 2025]

CORE CONCEPT AND DERIVATION

Delivery vehicles in human recombinant gene therapy.

Solution:

A molecular vector (such as a engineered retroviral genome, adenovirus, or recombinant plasmid) is the required transport vehicle engineered to carry and insert therapeutic genes into host target cells.

Why other options are incorrect:

- **Antibiotic:** Antimicrobial chemical compounds that inhibit or kill bacterial cells; they cannot insert therapeutic eukaryotic genes.
- **Vaccine:** Biological preparations that stimulate active acquired immunity against pathogens.
- **Interferon:** Signaling proteins (cytokines) produced by host cells in response to viral infections.

Question #10 **Key: (B)**

DUHS 2025

Monoclonal antibodies are useful in cancer diagnosis by? [Sindh MDCAT 2025]

CORE CONCEPT AND DERIVATION

Tumor marker binding specificity of targeted monoclonal antibodies.

Solution:

Malignant cells frequently overexpress unique surface antigens known as tumor markers (e.g., PSA, CEA, HER2). Monoclonal antibodies specifically target and bind to these antigens in biopsy tissue or serum samples, facilitating accurate early detection.

Why other options are incorrect:

- **Replacing damaged tissue:** Tissue regeneration is mediated by stem cell therapy and tissue engineering scaffold matrices, not antibodies.
- **Changing the genetic code of cancer cells:** Gene editing technologies (such as CRISPR-Cas9) alter genetic sequences, not monoclonal antibodies.
- **Killing healthy cells to reduce tumor spread:** Diagnostic procedures aim to preserve healthy host tissues without unnecessary cytotoxicity.

Question #11 **Key: (A)**

DUHS 2025

In biotechnology, vaccines can be developed by cloning of? [Sindh MDCAT 2025]

CORE CONCEPT AND DERIVATION

Subunit recombinant vaccine construction strategy.

Solution:

Recombinant vaccines are manufactured by isolating the gene encoding a potent immunogenic protein (antigen) of a target pathogen, cloning it into a vector, and expressing it in host bioreactors to mass-produce pure antigens.

Why other options are incorrect:

- **Gene for receptor of the patient:** Cloning human host receptors does not elicit protective immune responses against foreign infectious microbes.
- **Gene for antigen of patient:** Patient self-antigens induce immune self-tolerance or harmful autoimmune reactions rather than pathogen immunity.
- **Gene for antibody of patient:** Cloning antibody genes produces passive antibody therapies, not active immunization vaccines.

Question #12 **Key: (B)**

DUHS 2025

Which product is produced by genetically modified bacteria for patients with Diabetes mellitus? [Sindh MDCAT 2...]

CORE CONCEPT AND DERIVATION

Recombinant protein production in bacterial hosts.

Solution:

Recombinant human insulin (Humulin) was the first commercially approved therapeutic product of genetic engineering, synthesized by inserting human proinsulin gene cDNA into genetically engineered *Escherichia coli* cells.

Why other options are incorrect:

- **Erythropoietin:** A recombinant glycoprotein produced to treat anemia, not diabetes mellitus.
- **Growth hormone:** Recombinant somatotropin is used to treat pituitary dwarfism and growth disorders.
- **Vaccine:** Immunological preparations used to prevent infectious diseases rather than regulate blood glucose levels.

Question #13 **Key: (C)**

DUHS 2025

Role of mRNA in COVID-19 vaccines like Pfizer and Moderna is to? [Sindh MDCAT 2025]

CORE CONCEPT AND DERIVATION

Mechanism of action of mRNA-based immunizations.

Solution:

mRNA vaccines contain synthetic mRNA encoding the SARS-CoV-2 surface spike protein encapsulated in lipid nanoparticles. Upon entering host cells, the mRNA utilizes cellular ribosomes to translate and synthesize the harmless viral spike antigen, provoking a robust protective immune response.

Why other options are incorrect:

- **Helps the immune system recognize the virus:** While this describes the general outcome of vaccination, it does not state the specific intracellular role of the mRNA molecule itself.
- **Triggers immediate antibody release from memory cells:** Memory B-cells react upon secondary antigen re-exposure, whereas mRNA vaccines initiate primary protective antigen expression.
- **Delivers enzymes that destroy the virus:** mRNA vaccines do not encode or deliver viral-lytic enzymes; they encode immunogenic antigens.

Question #14 Key: (C)

BUMHS 2025

Key benefit of using biotechnology in development of vaccine for malaria is? [BUMHS 2025]

CORE CONCEPT AND DERIVATION

Recombinant antigen development for parasitic diseases.

Solution:

Biotechnological techniques allow cloning of specific sporozoite or merozoite surface antigens, enabling the production of vaccines (such as RTS,S) that induce protective, targeted antibody titers against the malaria parasite.

Why other options are incorrect:

- **its ability to work as antimalarial drugs:** Vaccines generate preventive adaptive immunity; they are not therapeutic antiparasitic drugs.
- **its ability to directly kills the malaria parasite in mosquitoes:** Human vaccines function inside the mammalian host, not inside the mosquito gut vector.
- **its ability to develop endosymbiotic relationship with host:** Vaccines eliminate or prevent pathogens rather than establishing symbiotic relationships.

Question #15 Key: (A)

BUMHS 2025

In disease diagnosis, the main function of monoclonal antibodies is? [BUMHS 2025]

CORE CONCEPT AND DERIVATION

Specific immunoreactions in molecular diagnostic assays.

Solution:

Monoclonal antibodies recognize and bind exclusively to single target epitopes, rendering them essential diagnostic tools to detect specific disease antigens in clinical samples.

Why other options are incorrect:

- **To stimulate white blood cell production:** Cytokines like colony-stimulating factors control white blood cell proliferation, not diagnostic antibodies.
- **To bind to toxins produced by pathogens:** Toxin neutralization is a therapeutic antitoxin mechanism rather than a primary diagnostic detection assay.
- **To label abnormal cells for immune destruction:** Cytotoxic cell labeling is an immunotherapeutic mechanism of monoclonal antibodies.

Question #16 Key: (D)

DUHS 2025

Monoclonal antibodies are useful in cancer diagnosis by? [DUHS 2025]

CORE CONCEPT AND DERIVATION

Diagnostic application of monoclonal antibodies in oncology.

Solution:

Monoclonal antibodies are engineered to bind specifically to tumor-associated antigens (tumor markers) present on cancerous cells or shed into body fluids, facilitating early cancer detection and staging.

Why other options are incorrect:

- **Replacing damaged tissue:** Tissue replacement requires stem cell therapies or bioengineered tissue constructs.
- **Changing the genetic code of cancer cells:** Altering genetic sequences requires genomic modification systems like CRISPR, not antibodies.
- **Killing healthy cells to reduce tumor spread:** Diagnostic methods target tumor markers non-destructively and do not aim to kill healthy host cells.

Question #17 Key: (B)

DUHS 2025

In biotechnology, vaccines can be developed by cloning of? [DUHS 2025]

CORE CONCEPT AND DERIVATION

Recombinant gene expression of protective antigens.

Solution:

Recombinant DNA technology isolates and clones the specific gene encoding a surface antigen of a pathogen, allowing host cells to express pure antigens for safe vaccine formulation.

Why other options are incorrect:

- **Gene for receptor of the patient:** Cloning human receptors does not stimulate active host immunity against foreign micro-organisms.
- **Gene for antigen of patient:** Patient self-antigens are tolerated by the immune system and do not confer protection against pathogens.
- **Gene for antibody of patient:** Cloning antibody genes produces passive immunoglobulins rather than active subunit vaccines.

Question #18 Key: (C)

DUHS 2025

Which product is produced by genetically modified bacteria for patients with Diabetes mellitus? [DUHS 2025]

CORE CONCEPT AND DERIVATION

Recombinant bacterial synthesis of pancreatic hormones.

Solution:

Genetically engineered *Escherichia coli* host cells carrying human cDNA sequences synthesize functional recombinant human insulin (Humulin) to regulate blood glucose levels in diabetic patients.

Why other options are incorrect:

- **Erythropoietin:** Hormone that stimulates erythrocyte maturation, utilized to manage chronic anemia.
- **Growth hormone:** Somatotropin is synthesized to manage pituitary dwarfism and growth deficiency syndromes.
- **Vaccine:** Biological formulations engineered to elicit adaptive immunity against infectious microbes.

Question #19 Key: (A)

DUHS 2025

Role of mRNA in COVID-19 vaccines like Pfizer and Moderna is to? [DUHS 2025]

CORE CONCEPT AND DERIVATION

Translational mechanism of nucleic acid-based vaccines.

Solution:

The synthetic messenger RNA (mRNA) acts as a transient genetic template instructing host ribosomal machinery to translate and express the viral spike glycoprotein, which then elicits an immune response.

Why other options are incorrect:

- **Helps the immune system recognize the virus:** This is the ultimate immunological goal, but not the direct molecular function of the mRNA strand inside the cell.
- **Triggers immediate antibody release from memory cells:** Memory B-cell activation occurs during secondary pathogen re-exposure, not during primary vaccination.
- **Delivers enzymes that destroy the virus:** mRNA vaccines carry translational genetic codes for antigens, not catalytic viral-lytic enzymes.

Question #20 Key: (C)

KMU 2025

In somatic cell hybridization, which two cells are fused to produce monoclonal antibodies? [KMU 2025]

CORE CONCEPT AND DERIVATION

Hybridoma technology cell fusion partners.

Solution:

Somatic cell hybridization merges antibody-secreting B-lymphocytes (isolated from immunized animal spleen tissue) with immortal myeloma cells to generate hybridomas capable of continuous monoclonal antibody production.

Why other options are incorrect:

- **T-cells and nerve cells:** T-cells function in cell-mediated immunity without producing soluble antibodies; nerve cells lack antibody production capacity.
- **T-cells and liver cells:** Hepatocytes and T-cells do not express immunoglobulin antibody molecules.
- **B-lymphocytes and macrophages:** Macrophages perform antigen phagocytosis and processing; they do not secrete monoclonal antibodies.

Question #21 Key: (A)

KMU 2025

In molecular diagnostics, the primary function of DNA/RNA probes is to? [KMU 2025]

CORE CONCEPT AND DERIVATION

High-affinity complementary nucleic acid hybridization.

Solution:

Probes are engineered single-stranded nucleic acids labeled with a reporter tag that bind specifically to target complementary DNA or RNA sequences, facilitating sequence identification in clinical diagnostic assays.

Why other options are incorrect:

- **Replace malfunctioning genes in affected cells:** Functional gene replacement is performed by gene therapy vectors, not diagnostic probes.
- **Cut genetic material at precise locations:** Cleaving double-stranded phosphodiester backbones is executed by restriction enzymes.
- **Stimulate immune responses against disease-causing organisms:** Antigens in vaccines stimulate immune responses, not labeled diagnostic probes.

Question #22 **Key: (D)**

KMU 2025

A set of uniform proteins generated by genetically identical immune cells, which are? [KMU 2025]

CORE CONCEPT AND DERIVATION

Monospecific homogeneous antibody generation.

Solution:

Monoclonal antibodies are homogeneous, identical antibody molecules synthesized by a single clone of hybridoma cells, targeted against one single antigenic epitope.

Why other options are incorrect:

- **Therapeutic proteins:** Broad functional category encompassing hormones, cytokines, and enzymes.
- **Immunoglobulins:** Heterogeneous antibody pool secreted by diverse physiological B-cell populations.
- **Recombinant proteins:** Proteins produced via heterologous gene expression in laboratory host systems.

Question #23 **Key: (B)**

KMU 2025

Which biotechnological product is used to replace an abnormal gene in a patient's cells? [KMU 2025]

CORE CONCEPT AND DERIVATION

Gene delivery vehicles in human therapeutics.

Solution:

Recombinant gene therapy vectors (such as adenoviruses, lentiviruses, or plasmids) are engineered vehicles used to deliver intact, functional therapeutic genes into target host human cells.

Why other options are incorrect:

- **Antibiotic:** Chemical compounds used to treat bacterial infections.
- **Vaccine:** Biological agents used to elicit protective immune responses against infectious diseases.
- **Interferon:** Antiviral cytokines that modulate host innate immune defenses.

Question #24 **Key: (C)**

NUMS 2025

DNA/RNA probes are most commonly used as? [NUMS 2025]

CORE CONCEPT AND DERIVATION

Diagnostic molecular probes in pathogen detection.

Solution:

DNA/RNA probes hybridize specifically to target genomic sequences of viruses, bacteria, or genetic mutations, functioning as crucial molecular diagnostic tools for infectious and genetic diseases.

Why other options are incorrect:

- **carrier in gene cloning experiments:** Cloning vectors (e.g., plasmids, bacteriophages) transfer recombinant DNA, not diagnostic probes.
- **cementing material in somatic cell hybridization:** Polyethylene glycol (PEG) acts as the chemical fusogen in cell fusion.
- **carrier or vector in gene therapy:** Modified viral delivery vectors transport therapeutic genes into host target cells.

Question #25 **Key: (A)**

SZABMU 2025

DNA/RNA probes are most commonly used as? [SZABMU 2025]

CORE CONCEPT AND DERIVATION

Diagnostic identification via nucleic acid hybridization.

Solution:

Probes utilize complementary base pairing to detect signature viral or bacterial sequences in clinical samples, establishing their role as diagnostic tools for infectious diseases.

Why other options are incorrect:

- **carrier in gene cloning experiments:** DNA vectors like plasmids carry recombinant genes, not diagnostic probes.
- **cementing material in somatic cell hybridization:** Chemical fusogens like PEG facilitate membrane fusion between cells.
- **carrier or vector in gene therapy:** Engineered viruses act as delivery vehicles for gene replacement therapy.

Question #26 Key: (B)

SZABMU 2025

A patient with a genetic disorder undergoes treatment where a normal gene is inserted into their cells. This i...

CORE CONCEPT AND DERIVATION

Therapeutic introduction of functional genetic sequences.

Solution:

Gene therapy is the direct therapeutic delivery of nucleic acid polymers into a patient's cells to correct functional deficits caused by genetic mutations.

Why other options are incorrect:

- **Genetic testing:** Molecular diagnosis aimed at detecting disease-causing mutations without genetic intervention.
- **Protein engineering:** Chemical or biological synthesis of tailored proteins with specific structural functions.
- **DNA fingerprinting:** Forensic analysis used to identify individuals based on unique restriction fragment patterns.

Question #27 Key: (A)

SZABMU 2025

F.C Steward used this plant for his experiment i.e (tissue culture)? [SZABMU 2025]

CORE CONCEPT AND DERIVATION

Cellular totipotency in plant tissue culture experiments.

Solution:

In 1958, F.C. Steward demonstrated cellular totipotency by culturing isolated phloem explants from wild carrot roots (*Daucus carota*) in coconut milk medium, successfully regenerating fully functional mature carrot plants.

Why other options are incorrect:

- **Radish:** Not used in Steward's landmark 1958 plant cellular totipotency tissue culture studies.
- **Corn:** Monocotyledonous plant model not utilized in Steward's original phloem explant experiments.
- **Maize:** Maize was not the experimental plant model used to demonstrate complete cell totipotency in 1958.

Question #28 Key: (B)

SZABMU 2025

In gel electrophoresis, how do molecules migrate through the gel? [SZABMU 2025]

CORE CONCEPT AND DERIVATION

Electrophoretic mobility of charged biological macromolecules.

Solution:

Gel electrophoresis separates biomolecules (DNA, RNA, proteins) based on size and charge as an applied external electric field forces negatively charged molecules (such as polyanionic DNA) to migrate toward the positive anode.

Why other options are incorrect:

- **By diffusion:** Passive random molecular movement down concentration gradients does not achieve directional separation.
- **Active transport:** ATP-dependent cellular transport mechanisms are absent in inanimate agarose/polyacrylamide gel matrices.
- **Under the influence of agar:** The porous gel matrix acts as a molecular sieve; it does not supply the driving force for migration.

Question #29 Key: (C)

SZABMU 2025

_____ is used in the production of Humulin. [SZABMU 2025]

CORE CONCEPT AND DERIVATION

Bacterial expression systems for human recombinant hormone synthesis.

Solution:

Transgenic **bacteria**, specifically modified strains of *Escherichia coli*, are cultured in large-scale bioreactors to manufacture commercial recombinant human insulin (Humulin).

Why other options are incorrect:

- **Fungi:** Yeast like *Saccharomyces cerevisiae* can express proteins, but *E. coli* bacteria were the primary organism used for classical Humulin synthesis.
- **Protozoa:** Single-celled eukaryotic protozoans are not utilized as industrial host expression systems for Humulin mass production.
- **Virus:** Viruses act as acellular gene delivery vectors; they cannot metabolize or express extracellular recombinant proteins independently.

Question #30 **Key: (B)**

MDCAT 2005

The sequencing of human chromosome number 22 was completed in:

CORE CONCEPT AND DERIVATION

Milestones of the Human Genome Project (HGP).

Solution:

Human **chromosome 22** was the first human chromosome to be fully sequenced, with its final sequence published in December **1999**.

Why other options are incorrect:

- **1990:** The year the Human Genome Project was officially launched internationally.
- **2003:** The year the complete draft of the entire human genome was officially announced.
- **2005:** Subsequent milestone year for other individual chromosome completions (e.g., Chromosome X).