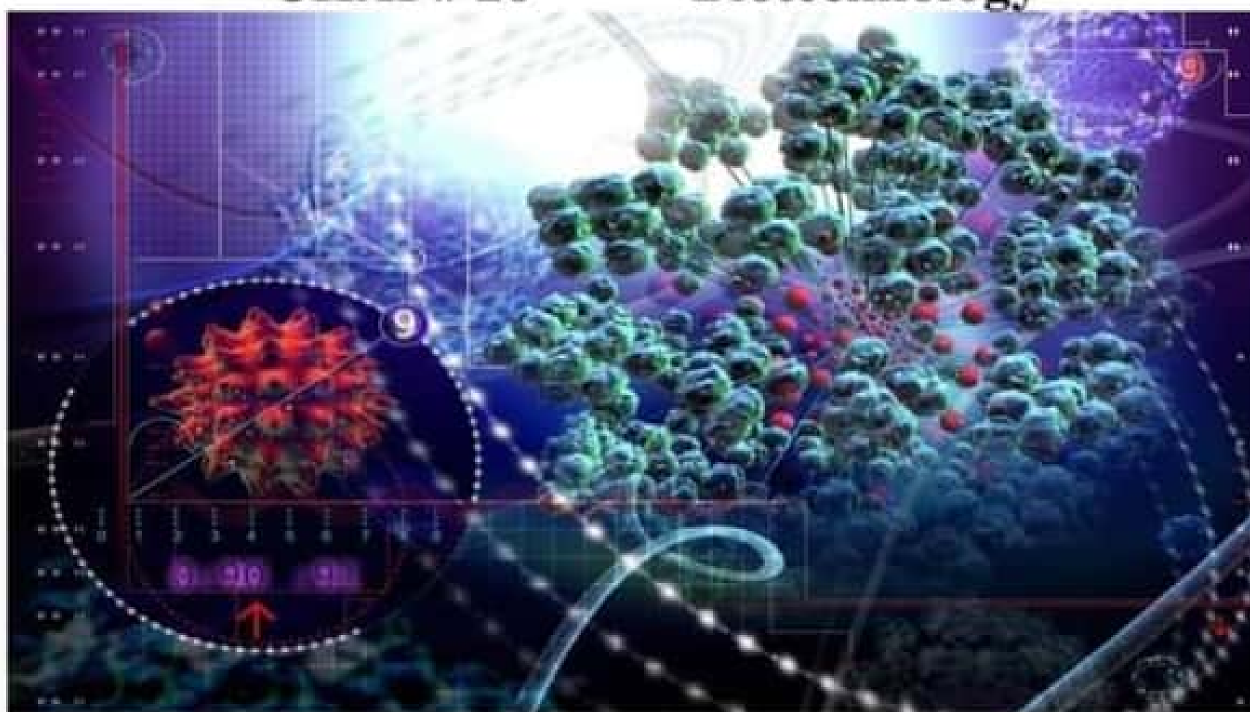
CHAP# 26 Biotechnology



S.No	Questions	Answers
3924.	**CLONING GENES**	
3925.	The history of biology is as old as history of	Man
3926.	The use of living organism or their processes and products for the welfare of mankind is called	Biotechnology
3927.	The act of making copies, or clones, of a single gene is called	Gene cloning
3928.	**The two possible ways of cloning of genes are** • Recombinant DNA technology • Polymerase chain reaction (PCR)	
3929.	**Components or tools required for Recombinant DNA technology are:** • Gene of interest • Molecular scissors • Molecular carrier or vectors • Molecular glue • Expression system	
3930.	**The desired gene or gene of interest can be obtained by following three possible ways:** 1. Artificial gene synthesis 2. Synthesis from mRNA 3. Cleavage from chromosomal DNA	
3931.	Complementary DNA is formed from	mRNA **ETEA-2012**
3932.	Gene of interest is cleaved from chromosomal DNA by	Restriction endonuclease **ETEA-2008**

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<table>
<tr><td>3933.</td><td colspan="2">Some restriction enzymes are:
EcoRI isolated from Escherichia coli
Hind II and Hind III from Haemophilus influenza
XhoI from Xanthomonas holcicola</td></tr>
<tr><td>3934.</td><td>The substrates for restriction enzyme are specific sequences of double stranded DNA called</td><td>Recognition sites or restriction sites</td></tr>
<tr><td>3935.</td><td colspan="2">Restriction enzyme produces one of the three different types of ends:
5' overhangs → Bam H1 cuts in this manner
3' overhangs → Kpn 1 cuts in this method
Blunts → Sma1 cuts in this way</td></tr>
<tr><td>3936.</td><td colspan="2">A DNA molecule should possess the following essential characteristics to act as cloning vector:
Origin of replication
Selectable markers
Multiple cloning sites (MCS) or polylinker
Small size</td></tr>
<tr><td>3937.</td><td>The most common markers used for the selection are the</td><td>Antibiotic resistant genes</td></tr>
<tr><td>3938.</td><td>If gene is present in bacteria it will show</td><td>Resistant to antibiotic</td></tr>
<tr><td>3939.</td><td>Ampicilline resistant gene is resistant to</td><td>Ampicilline antibiotic</td></tr>
<tr><td>3940.</td><td>All the unique restriction sites are grouped together in small region of a vector known as the</td><td>Multiple cloning sites (MCS) or polylinker</td></tr>
<tr><td>3941.</td><td>Relatively small vectors are more desirable because they increase the</td><td>Transformation efficiency and easy to manipulate
ETEA-2017</td></tr>
<tr><td>3942.</td><td colspan="2">Types of cloning vectors are six:
<table>
<tr><th>Types of vector</th><th>Insert DNA size in kb</th></tr>
<tr><td>Plasmid cloning vectors</td><td>0.5 – 8</td></tr>
<tr><td>Bacteriophage cloning vectors</td><td>2.5 – 9</td></tr>
<tr><td>Cosmid-cloning vectors(combination of plasmid and phage DNA)</td><td>30 – 45</td></tr>
<tr><td>Yeast artificial chromosomes</td><td>250 – 1000</td></tr>
<tr><td>Bacterial artificial chromosomes</td><td>50 – 300</td></tr>
<tr><td>Animal and plant vector (shuttle vector)</td><td>>1000</td></tr>
</table></td></tr>
<tr><td>3943.</td><td>The natural bacterial plasmid could be modified to produce new plasmid like</td><td>pBR322
ETEA-2016</td></tr>
<tr><td>3944.</td><td>The first widely used purpose built plasmid vector is</td><td>pBR322</td></tr>
<tr><td>3945.</td><td colspan="2">Useful features of pBR322:
Origin of replication → pMBI fragment which is origin of replication
Size → 4,363bp
Copy number → 15 copies per cell
Selectable marker → two antibiotic resistant genes(ampicillin and tetracyline)
Cloning sites</td></tr>
<tr><td>3946.</td><td>There is room in pBR322 for an insert of at least</td><td>6 kbp</td></tr>
</table>

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3947.	On pBR322, sites for Pse I, Pvu I and Sac I are found on	Ampicillin **ETEA-2010**
3948.	On pBR322, sites for Bam HI and Bam HIII are found on	tetracyaline
3949.	Cloning in one of the cloning sites inactivate the gene allowing recombinants to be differentiated from non-recombinants know as	Insertional inactivation
3950.	DNA ligase is responsible for the phosphodiester linkage between two adjacent nucleotides and thus join two double stranded DNA fragment, therefore it is also called	Molecular glue
3951.	A suitable organism that can act as host for the recombinant vector to express is called	Expression system
3952.	The ideal expression system is	Bacteria
3953.	**PROCEDURE OF RECOMBINANT DNA TECHNOLOGY**	
3954.	**Procedure of recombinant DNA technology:** • Formation of Recombinant DNA ➢ Digest vector to make it linear by endonuclease enzyme ➢ Isolate the DNA fragment by endonuclease enzyme ➢ Both DNA are bonded by DNA ligase. This results recombinant DNA molecule of vector and gene of interest. • Transformation of expression system ➢ Put bacterial cells and recombinant plasmids into the same medium • Identification of transformed clone ➢ If resistant is shown to antibiotic it means that gene is inserted and live.	
3955.	Bacterial cells take up the recombinant plasmid, if they are treated with the	Calcium chloride
3956.	If resistant is not shown to antibiotic by recombinant DNA, then it means that	Gene is not cloned
3957.	**POLYMERASE CHAIN REACTION (PCR)**	
3958.	A technique by which we can generate thousand to millions of copies from single or few copies of piece of DNA is called	Polymerase chain reaction (PCR)
3959.	Polymerase chain reaction was invented by Kary Mullis in 1983 and he was awarded by noble prize in	1993
3960.	Polymerase chain reaction (PCR) is based upon *in vitro* replication process by which it is carried out by	DNA polymerase enzyme
3961.	**Components of Polymerase chain reaction (PCR):** • Template DNA • Deoxyribo-nucleoside tri-phosphates (dNTPs) • Primers • *Taq* polymerase	
3962.	The piece of DNA to be amplified or to be cloned is called	Template DNA
3963.	Deoxyribo-nucleoside tri-phosphates (dNTPs): these are free nucleosides that act as raw material for synthesis of new DNA fragments. **There are four different type of DNTPs:** • dATP • dGTP • dCTP • dTTP	
3964.	Temperature-tolerant enzyme isolated from *thermos aquaticus* is called	*Taq* polymerase

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No.	Statement	Answer
3965.	The PCR mixture is placed in an instrument called	Thermal cycler/ reaction mixture
3966.	**Mechanism of PCR reaction: ETEA-2017-18** • Denaturation (94^{0}C for 1-5 min) • Primer annealing (54^{0}C for 2 min) • Extension or polymerization (72^{0}C for 1 min)	
3967.	Technique used for detection of specific infectious agents e.g. HBC, HIV,HCV is	Polymerize chain reaction
3968.	There is PCR-based cDNA synthesis know as	RT-PCR (reverse transcriptase PCR)
3969.	PCR has also shown its impact in	Criminology
3970.	**GENOMIC LIBRARY**	
3971.	A collection of bacterial or bacteriophages clones, each contains at least one copy of every DNA sequence in a genome of an organism is called	Genomic library
3972.	**To construct a genomic library, the genomic DNA of the organism is extracted and is cut into fragments of suitable sizes by any of the following three methods:** • Restriction enzymes. • Un-enzymatically by means of mechanical shearing such as sonication **ETEA-2012** • Partial enzymatic digestion with a restriction enzyme.	
3973.	A small, fluorescently or radioactively labeled DNA molecule that is used to locate similar or complementary sequences among a long stretch of DNA molecule or bacterial colonies such as genomic or cDNA or in a genome is called	A DNA probe **ETEA-2010-2017**
3974.	**DNA SEQUENCE**	
3975.	**The main principle of any DNA sequencing method is:** • To generate piece of DNA of different sizes all starting from the same point and ending at different points. • Separation of these different sizes pieces of DNA by gel electrophoresis • Reading of the sequences from the gel	
3976.	For generation of different size DNA fragments, the two different sequencing methods are: 1. Sanger method 2. Maxam-Gilbert method	
3977.	The widely used method and similar to the natural process of DNA replication is	Sanger method
3978.	Fredrich Sanger along with Andrew Coulson was awarded in 1977 by	Noble Prize
3979.	Sanger method is now become standard method because of its	Practicality
3980.	The key of sanger method is that all the reactions start from same nucleotide and end with	Specific base
3981.	In sanger method, bands of all different lengths are	Produced
3982.	The contents of each of the four tubes are run in separate plates on a polyacrylamide in order to separate	Different size bands from one another

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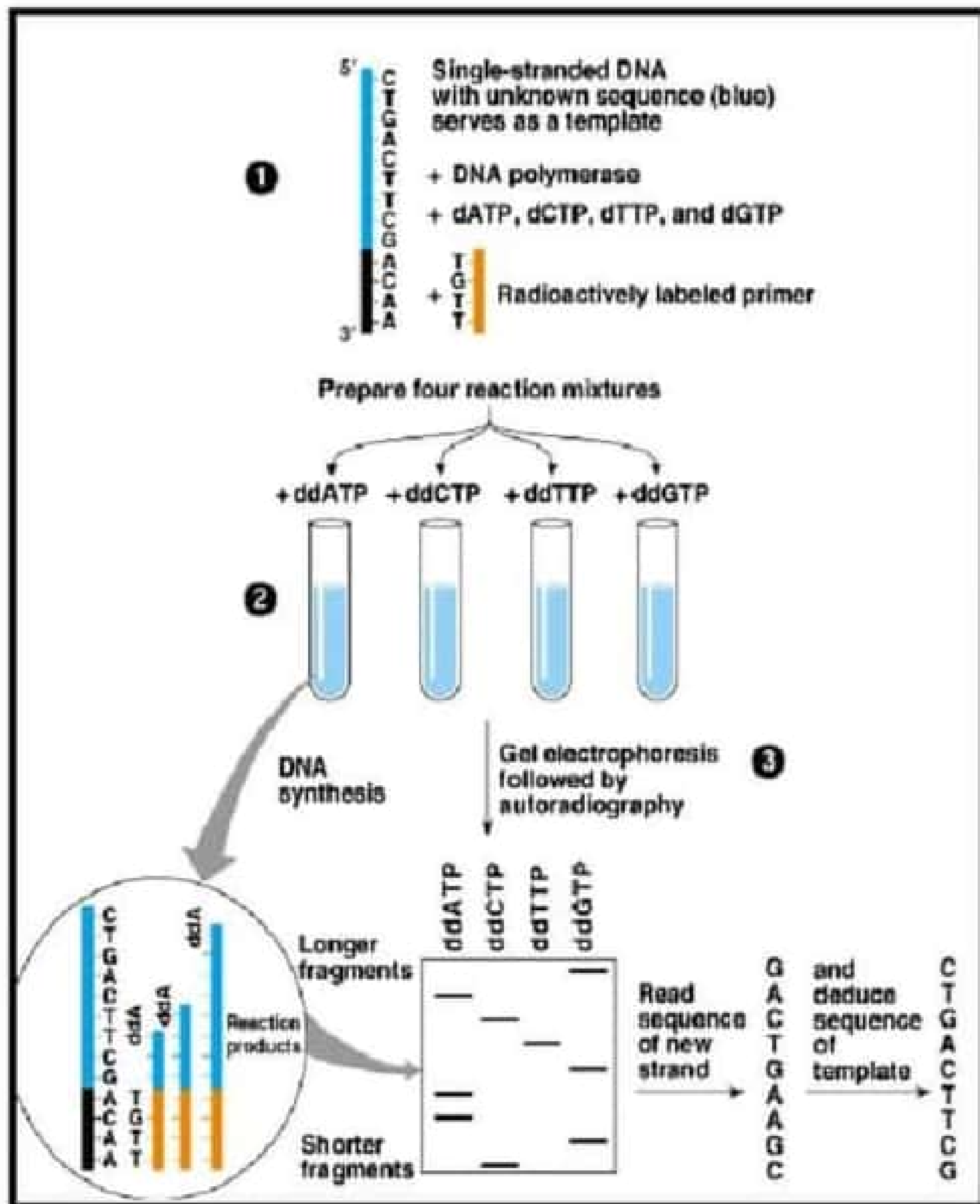
3983.	

3984.	A technique used in molecular biology to separate charge bearing polymers under influence of magnetic field is called	Gel electrophoresis
3985.	DNA electrophoresis is used to separate DNA fragments primarily by	Size
3986.	The types of gel most commonly used to separate electrophoresis are; **ETEA-2014** • Agarose → for relatively large DNA molecules • Polyacrylamide → for high resolution of short DNA fragments	
3987.	At one end of the gel some partial holes are made which are called	Wells
3988.	In Gel electrophoresis, the DNA fragments migrate relative to its	Size
3989.	Distance a DNA travelled is inversely proportional to its	Length

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3990.	Smaller fragments move faster through the gel matrix than	Larger matrix
3991.	**Although the movement of fragments also depends upon:** • Charges • Number of strands (single or double) • Shape of molecules (linear or circular) • Concentration of the gel (pore size)	
3992.	Bands cannot be viewed until they are labeled with	Florescent dyes or radioactive probes
3993.	There is no need for radiolabeling and auto radiography in	Automated DNA sequencing
3994.	In 1975-1977, Allan Maxam and Walter Gilbert developed a DNA sequencing method which is also called as	Chemical cleavage method
3995.	The DNA to be sequenced is end labeled by kinase treatment with	32P ATP
3996.	Dimethylsulphoxide (DMSO) is then added and the labeled DNA samples are heated with	90^0C
3997.	The two strand of DNA are separated from one another by	Gel electrophoresis
3998.	One strand is purified and divided into four samples which are treated with Cleavage reagent and	Modifying chemical reagent
3999.	**The four samples taken from one strand are:** • G • A+G • T+C • C	
4000.	**DNA ANALYSIS**	
4001.	DNA analysis and DNA fingerprinting is an examination method that emerged in the 1980s and is credited to	Alec Jeffrey
4002.	Each species has a unique	Genetic sequences
4003.	A process by which we can identify any type of organism by analyzing its genetic sequences is	DNA analysis
4004.	**The first method used in DNA analysis is Restriction fragment length polymorphism (RELP). Key steps to make DNA by this process are:** • Collection of DNA samples • Placement of RELP • Separation of RELPs • Southern blotting • Autoradiography	
4005.	RELP refers to the different size fragments of DNA produced by a	Restriction enzymes
4006.	Every person has a unique set of	RELPs
4007.	Restriction site of particular enzyme is always different in Numbers and distribution in all humans except the	Monozygotic (identical) twins
4008.	In nucleotide sequences of genome, entire human have	99% similarity
4009.	1% difference in genome sequences that establishes the individuality	Of every person **ETEA-2017**
4010.	A method which routinely used in molecular biology for the detection of a specific DNA sequences in DNA samples is called	Southern Blot
4011.	Subsequent fragment detection is done by	Probe hybridization

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4012.	The banding pattern, which was originally obtained in the gel due to the separation of the RELPs, is now developed on the	X-ray film
Application of DNA analysis to:		
4013.	Identify crime	
4014.	Identify relations	
4015.	Identify bacteria	
4016.	Match organ donor	
4017.	Identify potential suspects	
4018.	Determine pedigree for seed or livestock breeds	
4019.	Identify endangered and protected species	
4020.	**GENOME MAPS**	
4021.	The collection of all genes present in one complete set of chromosomes is called	Genome
4022.	**In his marvelous book, Genome, Matt Ridley wrote that (→ means "is like a"): ETEA-2012** • Human → Book • Chromosomes → Chapters(23) • Genes → Several thousand stories • Exons → Paragraphs • Introns → Advertisement • Codons → Words • Bases → Letters (A.G.C.T)	
4023.	**Commonly used DNA markers:** • RELPs → Restriction fragment length polymorphisms • VNTRS → variable number of tandem repeat polymorphism • SNPs → single nucleotide polymorphism • Microsatellite polymorphism	
4024.	The branch which deals with the exploration and analysis of complete DNA sequence of an organism's genome is called	Genomic
4025.	The first director of Human Genome Project(HGP) was	James D. Watson
4026.	The time of completion of project, the director of HGP was	Dr. Francis Collin
4027.	**Major goals of Human Genome Project(HGP) was:** • To identify 20,00 to 25000 genes of humans • To identify 3 billion chemical bases pairs of human DNA • Improve tools of data analysis • Address the Ethical, legal, and social issues (ELSI) that may arise from the project.	
4028.	**Benefits of Human Genome Project (HGP):** 1. **In molecular medicine** • Improve diagnosis of disease • Earlier detection of genetic predisposition to disease • Rational drug design • Gene therapy • Control system for drugs • Custom drugs 2. **In Bioarchaeology, Anthropology, Evolution and human migration** • Study evolution through germ line mutations in lineages • Study migration of different population groups based on female genetic inheritance	

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	• Study mutations on the y chromosomes to trace lineage and migration of males • Compare breakpoints in the evolution of mutations with ages of populations and historical events.	
4029.	**TISSUE CULTURE**	
4030.	The propagation of plant part or single cell or group of cells in a test tube under very controlled and hygienic conditions is called	Tissue culture
4031.	The generic term used for both organ culture and cell culture is	Tissue culture
4032.	The initial plant part which is used to develop tissue culture is called	Explant
4033.	**On the basis of explant tissue culture is variously called as** • Cell culture • Organ culture	
4034.	**Procedure of tissue culture:** **ETEA-2016** • Sterilization • Media preparation • Inoculation • Development of callus • Development of plantlets	
4035.	Tissue culture is performed under	Aseptic conditions
4036.	The placement of explant onto the surface of solid culture medium	Inoculation
4037.	Explant is allowed to grow into and unorganized mass of cells called	Callus
4038.	A callus if formed when auxin and cytokinin are in	Balance **ETEA-2017**
4039.	**Types of tissue culture:** 1. Callus culture 2. Cell suspension culture 3. Protoplast culture 4. Meristem culture 5. Anther culture	
4040.	Any plant tissue can be used as an explant in	Callus culture
4041.	The cell suspension culture produce the same chemicals as the	Entire plant
4042.	**Cell suspension culture of:** **ETEA-2014** • Cinchona ledgiriana produce Quinone • Digitalis lanata produce digitoxin	
4043.	Protoplast are plant cells with the	Cell wall removed
4044.	Protoplast are most commonly isolated from either leaf mesophyll or	Cell suspensions
4045.	The synthesis of embryo that are developed from somatic cells	Somatic embryogenesis
4046.	Protoplast culture can be used to develop whole plants by organogenesis or	Somatic embryogenesis
4047.	The variation which are induced in somatic embryos by exposing it to chemical or physical mutagens	Somaclonal variations
4048.	The rapid dividing and growing tissues, especially found at the apices of roots and shoots in other part of some plants is called	Meristems tissues
4049.	A tissue culture in which meristems are used as explants is called	Meristem culture
4050.	For micropropagation and to obtains viruses or bacteria free plant we use	Meristem culture
4051.	If plant is infected, the meristem are not affected because it	Lake vascular tissues **ETEA-2012**
4052.	Anther culture is also called as microspore culture or	Pollen culture

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	• Clotting factors to produce haemophilia • Growth hormone to treat dwarfism • Tissue plasminogen activator (tPA) to treat thrombotic disorders • Interferon for treating viral infections	
4076.	Modifying *P. syringae* may have unexpected consequences for	Climate
4077.	Ice nucleating proteins may play an important part in causing	Ice crystal to form in cloud
4078.	The main issue regarding genetically engineered bacteria is that	New pathogen may created
4079.	The first field trials of genetically engineered plants occurred in	France and USA in 1986 **ETEA-2016**
4080.	→ as per estimates recorded in 2002, transgenic crop was cultivated world-wide on about 148 million acres 587 million hecters land by about 5.5 million farmers.	
4081.	→ the first gene available for genetic engineering of crop plants for pest resistance were Cry genes (popularly known as Bt genes) from a bacterium Bacillus Thuringiensis.	
4082.	**Some of the commercially transgenic plants in developed countries are:** • Roundup ready → soyabean • Freedon II squash • High-lauric → represeed (canola) • Flavr Savr • Endless summer → tomatoes	
4083.	The Dolly sheep was produced in	July 2002 **ETEA-2011**
4084.	Animal which carries a foreign gene that has been deliberately inserted into its gene is called	Transgenic animals
4085.	**Transgenic animals have the potential to improve human welfare in:** • Agricultural • Medicine • Industry	
4086.	The model animal used in the field of transgenic is	Mice **ETEA-2006**
4087.	**The three principal methods used for the creation of transgenic animals are:** • DNA microinjection • Embryonic stem cell-mediated gene transfer • Retrovirus mediated gene transfer	
4088.	**BIOTECHNOLOGY AND HUMAN WELFARE**	
4089.	**Biotechnology is used in three different ways in the development of vaccine:** • Separation of a pure antigen using a specific monoclonal antibody • Synthesis of an antigen with the help of a cloned gene • Synthesis of peptides to be used as vaccines.	
4090.	The response of immune system to any antigen, even the simplest is	Polyclonal
4091.	Monoclonal antibodies (mAB) are a group of identical antibodies because they are made by	Identical immune cells
4092.	Monoclonal antibodies are typically made by fusing myeloma cells (cancerous B-lymphocytes) with the spleen cells from a mouse that has	Called somatic cell hybridization

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	been immunized with the desired antigen. This technique is	
4093.	The disease caused by protozoa and helminthes are diagnosed by	Monoclonal antibodies and DNA probes
4094.	A technique for correcting defective genes responsible for disease development is called	Gene therapy

Researches may use one of several approaches for correcting faulty genes:

4095. Normal gene insertion for replacement of abnormal gene
4096. Abnormal gene can be swapped by homologous recombination.
4097. Repair the abnormal gene by selective reverse mutation
4098. Regulation of particular gene could be altered

4099.	The most common vector for gene therapy is	Virus
4100.	The generation of a functional protein product from the therapeutic gene restores the target cell to	Normal state
4101.	An inherited disease that affect mucus and sweat glands is	Cystic fibrosis (CF)
4102.	The cause of Cystic fibrosis (CF) is Cystic fibrosis transmembrane conductance regulator (CFTR) gene that encodes a protein which	Controlled water and salt movement of cells
4103.	The sure of Cystic fibrosis (CF) is Gene therapy of	Cystic fibrosis
4104.	The science of applied biological processes is	Biotechnology
4105.	The result of marriage of biological science with technology is	Biotechnology
4106.	**SCOPE AND IMPORTANCE OF BIOTECHNOLOGY**	
4107.	The result of marriage of microchips business technology is	Biochip
4108.	The size of microchip is about size of uncooked grain of	Rice
4109.	The symbiotic association between fungi and roots of higher plants is	Mycorrhiza
4110.	Biologically fixed nitrogen consumes about25-30% less energy than normally by chemical process, and this is called	Biofertilizers
4111.	The study and manipulation of material between 1-100 nanometers is called	Nanotechnology

Students of biotechnology after completing their studies can have scope in following fields:

4112. Communication/media
4113. Computer science
4114. Pharmaceutical companies
4115. Engineering
4116. Research
4117. Diagnostic laboratories
4118. Waste management
4119. Medicine
4120. Bio power plants
4121. Bio-processing industry
4122. Agricultural and animal husbandry
4123. Legal field
4124. Millitary
4125. Crime and law

4126.	Never to produce microbial or other biological agents or toxins, whatever may be their method of production, for use in wars	Biological weapon conventions of 1972
4127.	**Intellectual property includes:** • Patents • Trade secrets • Copyrights	

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	• Trademarks	
4128.	The collective term applied to a number of different types of legal rights granted by each country	Intellectual property rights (IPR)

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