Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior Secondary School Certificate Examination, 2025
SUBJECT NAME BIOTECHNOLOGY (Q.P. CODE 99)

General Instructions: -

1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in Newspaper/Website, etc. may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them. In class-XII, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
4	The Marking scheme carries only suggested value points for the answers These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after delibration and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X' be marked. Evaluators will not put right (✓)while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**

7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks _____(example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totaling on the title page. ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for Spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

MARKING SCHEME

SUBJECT : BIOTECHNOLOGY THEORY (045)

AISSCE 2025

SET 4 QP. CODE 99

Series ZXW4Y

SESSION: 2024-25

GENERAL INSTRUCTIONS :

a. The Marking Scheme carries suggested value points for the answers.
b. These are guidelines which constitute the complete answer.
c. The students can have their own expression and if the expression is correct the marks can be awarded accordingly.

MARKING SCHEME
BIOTECHNOLOGY (045)
SET-4 (Series ZXW4Y)
Q.P. CODE 99
(2024-25)

SECTION – A

1	(B) T4 Bacteriophage	1
2	(A) Weight gain of an adult by consuming 1 g of food protein	1
3	(C) Four	1
4	(D) Alzheimer's disease	1
5	(B) Cereal grains	1
6	(A) M13 based vector	1
7	(C) SCID	1
8	(B) James Thomson	1
9	(A) GeneMark	1
10	(D) Whey protein concentrates	1
11	(C) Expression proteomics	1
12	(A) Therapy of early stage breast cancer	1
13	(A) Both Assertion (A) and Reason (R) are true and the Reason (R) is the correct explanation of the Assertion (A)	1
14	(B) Both Assertion(A) and Reason(R) are true but the Reason(R) is not the correct explanation of the Assertion(A).	1
15	(C) Assertion (A) is true, but Reason (R) is false.	1
16	(C) Assertion (A) is true, but Reason (R) is false.	1

SECTION – B

17

(a) Principle: Mass spectrometery determines the molecular weight of chemical compounds by separating molecular ions according to their mass / charge (m/ z) ratio.

Application: To obtain protein structural information such as peptide mass / amino acid sequence/ to identify type and location of amino acid modification within proteins/ to provide molecular weight of proteins. (any one) — 1+1=2

OR

(b) The enzyme chymotrypsin is made up of a linear chain of 245 amino acids interrupted into three peptides. The protein folds into a globular structure and the three important amino acid residues His(57), Asp(102) and Ser(195) come close together in space which allows a 'charge relay system' to operate. The negatively charged aspartate (102) is able to form hydrogen bond with the adjacent histidine (57) partially borrowing a hydrogen ion from the latter. The His (57) makes good its partial hydrogen ion loss to Asp(102) by attracting a hydrogen ion from the adjacent Ser(195) through the His(57) residue making Ser(195) acidic in nature. — 2

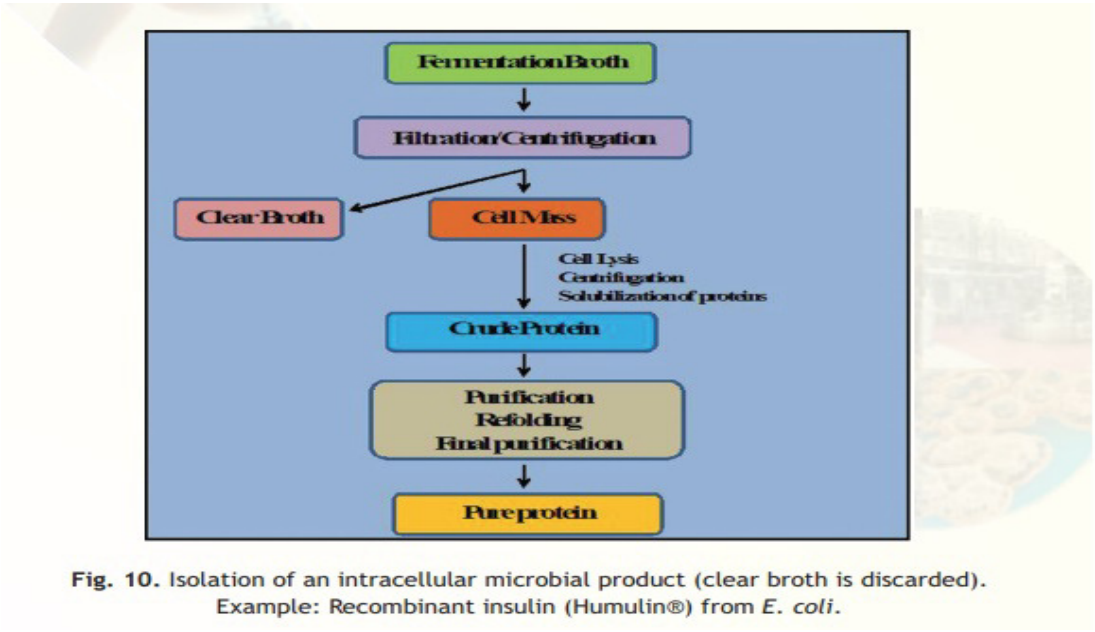
18

- **Any suitable example from Table 1, Pg 62** — 1

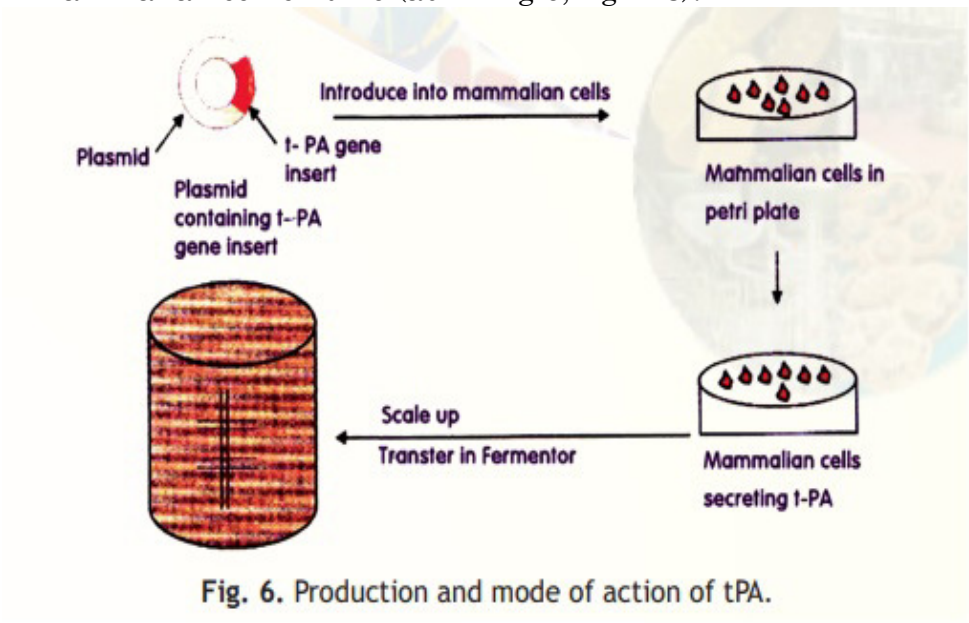
Table 1. Genome size and gene predictions between several organisms.

Organism	No. of chromo somes	Genome size in base pairs	The Number of Predicted genes	Part of the genome that encodes for protein
Bacteria *Escherichia coli*	1	500,000	5000	90%
Yeast *Saccharomyces cerevisiae*	16	12,068,000	6340	70%
Worm *Caenorhabditis elegans*	6	100,000,000	19,000	27%
Fly *Drosophila melanogaster*	4	175,000,000 - 196,000,000	13,600	20%
Weed *Arabidopsis thaliana*	5	157,000,000	25,498	20%
Human *Homo sapiens*	23	3,000,000,000	20,000 - 25, 000	< 5%

-No correlation exists between the number of predicted genes, with the genome size and the number of chromosomes in an organism due to **overlapping genes**, **splice variants.** — ½ + ½ = 1

19	- Chronic mylogenous leukemia is caused due to 9 - 22 translocation in the chromosome resulting into shorter chromosome 22 (philadelphia chromosome) - Fluorescence In situ Hybridisation Technique/ Karyotype analysis (any one) **Alternative question for visually impaired in lieu of Q. 19**. The uses of the data provided in RefSeq database are: 1. Designing gene chips. 2. Describing the sequence features of the human genome.	1 1 1+1=2
20	-Steps for isolation of recombinant Insulin (Humulin) from *Escherichia coli* as depicted in Fig 10 Pg-100  **Fig. 10.** Isolation of an intracellular microbial product (clear broth is discarded). Example: Recombinant insulin (Humulin®) from *E. coli*.	2

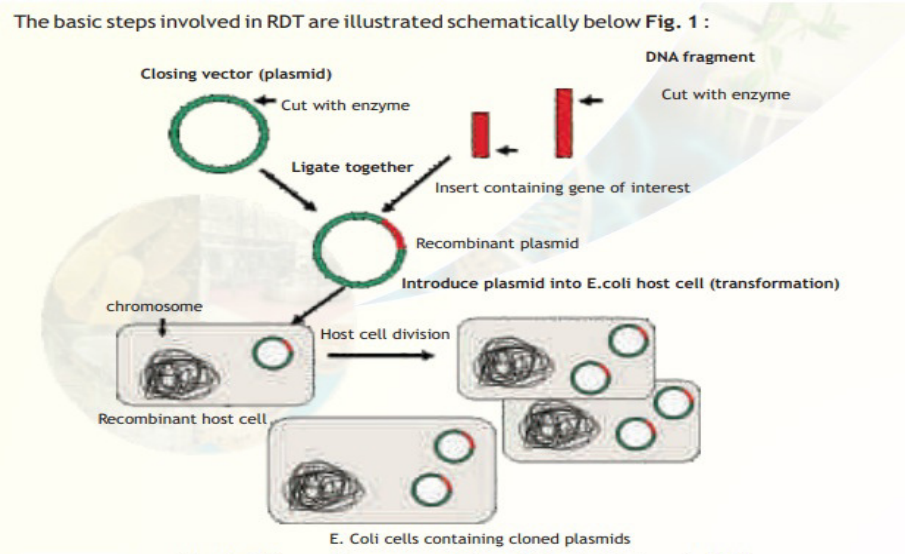
21	- Common cause of foaming in microbial culture medium is the presence of proteins in the culture medium. - Foaming denatures proteins and provides hindrance to free diffusion of oxygen in the medium.	1 ½ + ½ =1
	SECTION – C	
22	- Whey proteins result in the elevation of tripeptide glutathione (gamma-glutamyl cysteinyl glycine) in cells .Glutathione is a reducing compound which detoxifies xenobiotics and protects cellular components from the effect of oxygen intermediates and free radicals - Examples: Whey is used to treat various illnesses like jaundice, infected skin lesions, genito-urinary tract infections. (Any two examples.)	2 ½ + ½ =1
23	(a) Important features that were incorporated in each of the following vectors are : (i) COSMIDS : COS-sites of phage lambda, and features of plasmid (origin of replication, selectable marker, suitable restriction enzyme sites). (ii) Shuttle Vectors : Two types of origin of replication and selectable marker genes, one set which functions in the eukaryotic cells and another which functions in Escherichia coli. (iii) Expression Vectors : Signals necessary for transcription and translation of insert for expressing foreign protein. OR (b) - Blue –White selection method is based on the insertional inactivation of lac Z gene present on the vector pUC 19 . - The lac Z gene expresses the enzyme beta galactosidase which can cleave a colourless substrate called X-Gal into a blue coloured product - If Lac Z gene is inactivated due to the presence of the insert, then the enzyme is not expressed. - After a transformation experiment the E.coli host cells are plated on an ampicillin and X-Gal containing solid media plate - Colonies which appear blue are ampicillin resistant which have transformed cells but do not have insert. - Colonies which appear white are both ampicillin resistant and have the insert recombinant DNA.	1+1+1=3 ½ x 6 =3

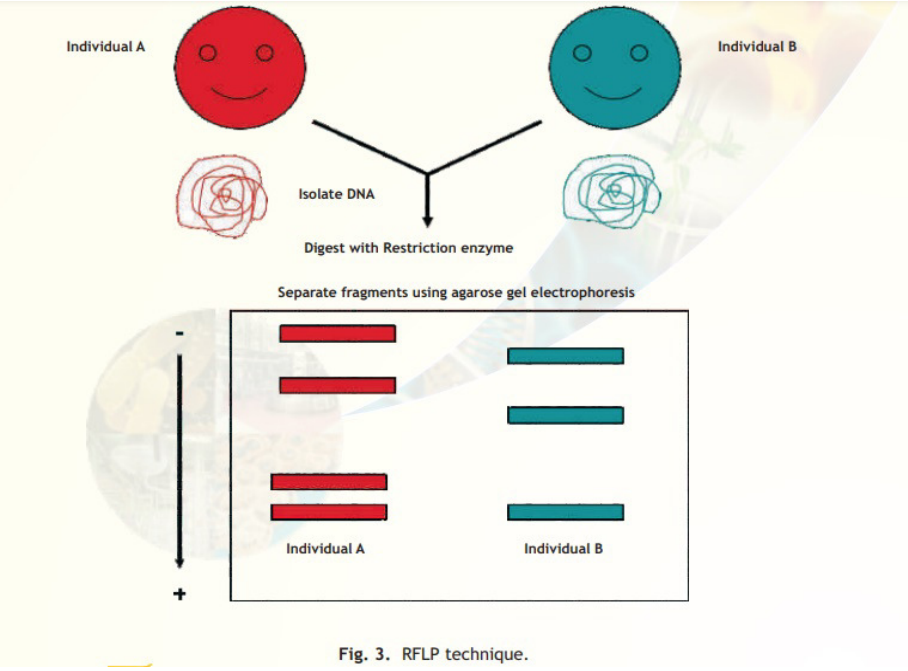
24	- Mode of action of tissue Plasminogen Activator (tPA): tPA converts plasminogen to plasmin, which dissolves blood clots. / tPA degrade - Plasminogen ------→ Plasmin--------→ Fibrin ----------→ Dissolution of blood clot (Inactive precursor enzyme)	1
	Schematic representation to show the method of production of tPA through mammalian cell culture (as in Fig 6, Pg-148).  Fig. 6. Production and mode of action of tPA.	2
	Alternative question for Visually Impaired in lieu of Q. 24. - Stem cells are cells that have the property of self-renewal through mitotic cell division and differentiation into a diverse range of specialized cell types.	1.
	-Two broad types of mammalian stem cells are –Adult stem cells and Embryonic stem cells. - Application of Adult stem cells- - Act as repair system for the body by (/) maintaining the normal turnover of regenerative organs (such as blood, skin or intestinal tissues). - Can be grown and transformed into specialized cells (such as muscles or nerves) through cell culture and (/) used in medical	½ + ½ =1

	therapies . - Can be used in medical conditions / where cells are either dead or injured or abnormal such as leukemia (cancerous blood cells), heart disease, heart attack (cardiac tissue damage), paralysis (spinal cord injury) , Alzheimer's , Parkinson's, Huntington's (dead brain cells), burns (damaged skin cells). **(Any one point)** (Any other relevant point can be considered) Application of Embryonic stem cells – -Can differentiate into cells of all types of specialized tissues. - Can be maintained in cell culture in the presence of irradiated fibroblast cells which can be reintegrated fully into embryogenesis if transferred. - Can be used to create Chimeric mice. - Can be used to create mouse models of human diseases. - Can be used to create mouse models with gene knock outs. **(Any one point)** (Any other relevant point can be considered)	½ ½
25	- Antibiotics are added in animal cell culture medium to control the growth of bacterial and fungal contaminants. - Two such antibiotics are Penicillin and Streptomycin	1 1+1=2
26	- It is very difficult to produce hybrids in case of interspecific and intergeneric crosses because of abnormal development of endosperm which causes premature death of hybrid embryo and leads to formation of sterile seeds. - Explanation of any one technique to obtain such novel hybrids: - Embryo rescue / Protoplast fusion to produce somatic hybrids and cybrids/ organelle transfer/organelle uptake .	1 2
27	- Engineering of Arabidopisis plant:- Three genes involved in PHB synthesis from *Alcaligenes eutrophus* were expressed exclusively in chloroplasts of Arabidopisis plant (to produce PHB globules), without affecting plant growth and development. - The drawback of producing PHB by fermentation using bacterium *Alcaligenes eutrophus* is high production cost.	2 1

28	- Red spots show genes expressed in high amounts in normal cells. - Green spots show genes expressed in high amounts in cancerous cells - Yellow spots show genes expressed approximately equally in both normal and cancerous cells .	1x3=3
	SECTION D	
29	(i) Only primers can be extended using single strand DNA template as a guide. (ii) The 3′OH group is present in dNTPs whereas 3′OH group is absent in ddNTPs (structures indicating correct labeling at 3' positions of dNTP and dd NTP can be considered). Function:- ddNTPs terminate the growing DNA chain where they are incorporated. (iii) Advantage:- Gels can be scanned by Laser / Danger of using radioisotopes is avoided / Single lane gel electrophoresis can be conducted instead of four lane gel. (Any one). **OR** (iii) DNA Polymerase	1 1 + 1 =2 1 1
30	(i) The culture of any piece of a part of a plant (explant) is known as explant culture. (ii) Auxin / Cytokinin / [Gibberellin] (any two) (iii) Plant cells without cell wall are known as " Protoplast" OR (iii) Micropropagation / Plant Regeneration / Preparation of single cell suspensions/ Preparation of protoplasts / Genetic transformation studies. (Any one)	1 1+1 =2 1 1

	SECTION E	
31	(a) The technique of peptide mapping used to compare normal haemoglobin with sickle cell haemoglobin:- 1, Pure Hb and scHb are taken separately into test tubes and are digested with the proteolytic enzyme trypsin. 2. Two separate strips of Whatman filter paper are spotted with Hb and scHb tryptic peptides and the peptides allowed to separate using the technique of paper electrophoresis at pH 2.0. 3. The paper strips are dried and chromatographed at right angles to the electrophoretic direction using a solvent system Butanol: Water:Acetic acid. 4, The chromatograms are dried and stained with a suitable visualisation reagent like Ninhydrin wherein peptide containing regions appear as orange yellow spots. 5. The peptide map for Hb and scHb are compared and the amino acid sequence of peptide differently placed in the scHb map is determined. OR (b) Any five protein based products as given below with one example of each:- 1. Blood products and vaccines. 2. Therapeutic antibodies and enzymes. 3. Therapeutic hormones and growth factors. 4. Regulatory factors. 5. Analytical application. 6. Industrial enzymes. 7. Functional non-catalytic proteins. 8. Nutraceutical proteins.	1x5 =5 (½+ ½) x5 =5

32	(a) The Basic steps of Recombinant DNA Technology are :- 1. Isolation of a DNA fragment containing a gene of interest that needs to be cloned (called as insert). 2. Generation of a recombinant DNA (rDNA) molecule by insertion of the DNA fragment into a carrier DNA molecule called vector (e.g. plasmid) that can self replicate within a host cell. 3. Transfer of the rDNA into an E. coli host cell (process called transformation). 4. Selection of only those host cells carrying the rDNA 5. Allowing recombinant cells to multiply thereby multiplying the rDNA Molecules / Flowchart with explanation of basic steps of Recombinant DNA Technology as given in fig.1 on page no.3 can be considered.  Fig. 1. Schematic representation of the basic steps in RDT.	1x5 =5

	OR (b) Procedure involved in Restriction Fragment Length Polymorphism (RFLP) Technique:- 1. Isolate test DNA samples 2. Digest test DNA samples with the same restriction enzyme 3. Separate the DNA fragments by agarose gel electrophoresis 4. Analysis of gel pattern. / Flowchart with explanation of steps as given in fig. 03 on page no.7 can be considered.  Fig. 3. RFLP technique. Application : To identify and relate individuals.	1x4 =4 1
33	(a) -The genomes contributed by both the culturable and the non-culturable variety of microbes together are termed as 'metagenome'. -Metagenomics approach:- The collective DNA is extracted from a sample of soil, water or any other environmental niche. The collective DNA is subjected to restriction digestion using restriction endonucleases. The DNA fragments obtained are cloned in suitable vectors. The clones are then screened for presence of a variety of molecules with improved characteristics.	1 3

	- Importance of metagenomics approach to study microorganisms is:- To cast a wider net on microbial resource present in the environment / to fish out genes of interest / to analyze the genomes of the microbes without culturing these in the laboratory / to study those microbes which are difficult to culture in the laboratory or have never been cultured in the laboratory as yet / analyze these microbes to see if they carry any genes which may be exploited for human use. OR	1
	(b) - In Continuous culture the growth medium is designed in such a way that one of the nutrients is in limited quantity. Thus, during the exponential growth just before the nutrient is fully exhausted, fresh medium containing the limited nutrient is added and this is repeated every time the limited nutrient is about to exhaust. -This system is also fitted with an overflow device so that the added volume displaces out an equal volume of culture from culture vessel. -In a chemostat, constant chemical environment is maintained whereas in a turbidostat constant cell concentration is maintained. Advantages of Continuous culture over Fed-batch culture :- - A steady state is achieved for an extended period of time. - Higher productivity. - Getting a continuous supply of microbial growth. - Easier control of constant growth conditions. - Continuous culture system can be maintained for a long period of time, (Any two advantages)	1x3=3 1+1=2