Marking Scheme

Strictly Confidential

(For Internal and Restricted use only)

Senior Secondary School Examination, 2026 (XIIth)

SUBJECT NAME: - …bio-technology……. (Q.P. CODE…045……

General Instructions: -

1	The CBSE has decided to introduce On Screen Marking (OSM) for the evaluation of Class XII answer Book with the 2026 Examination.
2	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.
3	**"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."**
4	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.**
5	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.

6	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 deliberation 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.
7	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.**
8	If a question has parts, please award marks on the right-hand side for each part in the OSM Portal. Marks awarded for different parts of the question will be totaled up by the OSM System.
9	If a question does not have any parts, marks must be awarded in the left-hand margin in the OSM Portal. This may also be followed strictly.

10	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"**.
11	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
12	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.
13	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.
14	Ensure that you do not make the following common types of errors committed by the Examiner in the past :- ● 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.
15	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.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for Spot Evaluation**" before starting the actual evaluation.
17	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.

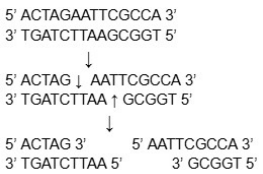
MARKING SCHEME
BIOTECHNOLOGY (Subject Code – 045)
(PAPER CODE: 99) (26-04-45N)

SECTION A

Q.No	Expected Outcomes	Book Reference	Marks
1	(A) Incorrect folding and intracellular accumulation of recombinant proteins	Unit VI, Ch 1, p.102-103	1
2	(C) 5-10% CO_2	Unit VI, Ch 3, p.143	1
3	(A) cDNA	Unit V, Ch 3, p.67	1
4	(C) Anther	Unit VI, Ch 2, P.112	1
5	(B) 150 mg	Unit VI, Ch 1, p.93	1
6	(C) Destruction of invading viral DNA	Unit V, Ch1, p.04	1
7	(B) Rigby and Paul Berg in 1977	Unit V, Ch 3, p.65	1
8	(C) Provide information on official gene name	Unit V, Ch 3, p.79	1
9	(A) Providing strength to our bones	Unit V, Ch 2, p.29	1
10	(A) Monoclonal antibodies are preferred over polyclonal antibodies	Unit VI, Ch 3, p.149	1
11	(C) In both coding and non-coding regions of a genome	Unit V, Ch 3, p.63	1
12	(A) Adenosine deaminase	Unit V, Ch 2, p.30	1
13	(B) Both Assertion (A) and Reason (R) are true, but the Reason (R) is not the correct explanation of the Assertion (A)	Unit VI, Ch 3, p.153	1
14	(C) Assertion (A) is true, but Reason (R) is false	Unit VI, Ch 1, p.102	1
15	(A) Both Assertion (A) and Reason (R) are true, and the Reason (R) is the correct explanation of the Assertion (A)	Unit V, Ch 1, p.10-11	1

16	(A) Both Assertion (A) and Reason (R) are true, and the Reason (R) is the correct explanation of the Assertion (A)	Unit VI, Ch 2, p.128	1

SECTION B

Q.No	Expected Outcomes	Book Reference	Marks
17 (a)	Fertility (F) plasmid/ plasmid from *E.coli* /bacterial plasmid (1) Replication and maintenance genes/selectable markers/cloning sites. (any TWO) (0.5+0.5) **OR**	Unit V, Ch 1, p.12	1 (0.5+0.5)=2
17 (b)	EcoRI *(1)* The two generated fragments in double stranded forms  (0.5+0.5) For making two fragments	Unit V, Ch 1, p.5-6	1 (0.5+0.5)=2
18	Antibiotics control the growth of bacteria/ fungi in culture medium (1) Penicillin and Streptomycin (any 2 antibiotics) (0.5+0.5)	Unit VI, Ch 3, p.142	2 (1+0.5+0.5)
19	Selectively removing a gene from mouse ES cells. (1) Usefulness: (any one) (1) 1) To understand the genetic basis of a disease 2) To search new diagnostic techniques 3) To search for therapeutic modalities **Alternative Question for Visually impaired** Animal cells at the bottom can be visualized, (1) because optical system is at the bottom with light source on the top (1)	Unit VI, Ch 3, p.153-154 Unit VI, Ch 3, p.144	2 (1+1) 2 (1+1)
20	A proteolytic cut / cut by Trypsin in chymotrypsinogen results in conformational change exposing the active site (1) *In-situ* activation (1)	Unit V, Ch 2, p.34-35	2 (1+1)
21	Due to existence of overlapping genes and splice variants (1+1)	Unit V, Ch 3, p.61	2 (1+1)

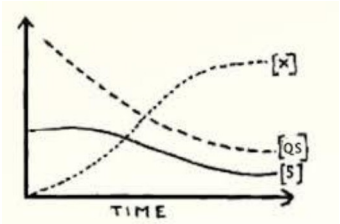
SECTION C

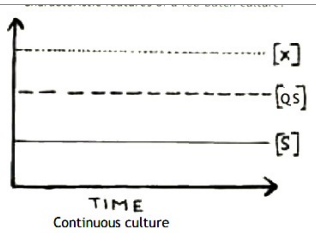
Q.No	Expected Outcomes	Book Reference	Marks
22	Substitution of Valine for Glutamic acid at 6^{th} position of Beta chain of haemoglobin (1) It results in the formation of fibres within RBCs causing sickling (1) Sickle RBCs get stuck in the capillaries/ ScHb has impaired oxygen carrying capacity. (1)	Unit V, Ch 2, p.36-37	3 (1+1+1)
23	Culturable and non culturable bacteria/ utilises large number of genome (0.5) Isolation of DNA from environmental sample collection→ DNA manipulation → Ligation → Cloning / Library construction → Protein expression (0.5x5=2.5)	Unit VI, Ch 1, p.103	3 (0.5+0.5+ 0.5+0.5+0 .5+0.5)
24	For longer shelf life/ transport to longer distances without spoilage (1) Ripening is slowed down by blocking/reducing ethylene production/by introducing ethylene producing genes in a way that suppresses its own production in the crop plant. (any two) (1+1)	Unit VI, Ch 2, p.128	3 (1+1+1)
25	Ser 221, His 64, and Asp 32 (1) Subtilisin native enzyme is inactivated by bleach (oxidation of Met222) (1) Met 222 was substituted by various amino acids/ alanine to retain enzyme activity and stability in the presence of bleach./ SDM Site Directed Mutagenesis/protein engineering (1) **Alternative Question for Visually impaired** Whey proteins elevate glutathione (1) which detoxifies xenobiotics (1) and protects cellular components from oxygen intermediates and free radicals.(1)	Unit V, Ch 2, p.51-52 Unit V, Ch 2, p.50	3 (1+1+1) 3 (1+1+1)

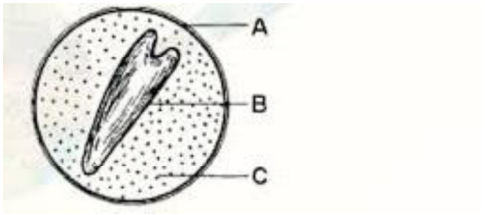
26	Antibiotic resistance/ expression of an enzyme such as β-galactosidase / protein such as GFP / dependence or independence of a nutritional requirement such as amino acid leucine.(any 3) (1mk each)	Unit V, Ch 1, p.15	3 (1+1+1)
27 (a) 27 (b)	**Transfection**: Mixing of foreign DNA with charged substance calcium phosphate / cationic liposomes/DEAE dextran / overlaying on recipient/ host cells (1) **Electroporation**: An electric current is used to create transient microscopic pores in the recipient host cell to allow rDNA(1) **Biolistics**: A gene / particle gun is used to bombard microscopic gold/ tungsten particles coated with DNA into the host cells (1) **OR** Insertional inactivation of lac Z gene coding for B galactosidase enzyme in pUC 19 plasmid; (1) plating of E.coli host cells after transformation on solid media containing X-gal; (1) white colonies à with rDNA; Blue colonies à without rDNA.(1)	Unit V, Ch 1, p.15 Unit V, Ch 1, p.17	3 (1+1+1) 3 (1+1+1)
28	Differentiate on the basis of any 2 properties of the cells from the following: (2mk) (i) Limited life span (ii) Contact inhibition (iii) Density limitations (iv) Anchorage dependence (v) Growth rate (vi) Growth form (vii) Doubling time (viii) Change in ploidy (ix) Change in shape of cell Examples: CHO cell line and HeLa cell line, cos-1 cell lines (any other suitable example) (1mk)	Unit VI, Ch 3, p.138-140	3 (2+1)

SECTION D

Q.No	Expected Outcomes	Book Reference	Marks
29 (i)	abl and bcr genes (0.5+0.5)	Unit V, Ch 3, p.65-67	(0.5+0.5)=1
29 (ii)	No; a part of chr 9 along with abl gene is translocated to chr 22/ absence of fluorescent gene (0.5+0.5)		1 (0.5+0.5)
29 (iii) a			2

29 (iii) b	Nicks created by DNase I, (0.5) DNA polymerase I (0.5) synthesizes new DNA ,incorporation of labelled nucleotides (1) **OR** CML lymphocytes smear cells hybridized with two probes In-situ,(0.5) yellow fluorescence under fluorescent microscope.(0.5) Fluorescent DNA probes for abl and bcr genes (0.5) bind to exhibit merged fluorescence colour under fluorescent microscope (0.5)		(0.5+0.5+1) 2 (0.5+0.5+0.5+0.5)
30 (i) 30 (ii) 30 (iii) a 30 (iii) b	Nutrient depletion/ done in small scale/havesting and addition of medium cannot be done at the same time/ waste accumulation/ limited growth/ cells exposed to continually changing environment (any two) (0.5+0.5) "Addition of nutrients" during cultivation of microbes/ continuously and sequentially fed with fresh medium (1) Chemostat maintains constant chemical environment (1) Turbidostat maintains turbidity of culture medium/constant cell concentration (1) **OR** Labelled graphs (I mk each) of batch and continuous cultures as on Fig. 5 and Fig. 7 (p.91-92)  Fig. 5. Characteristic features of a batch culture.	Unit VI, Ch 1, p.91-92	1 (0.5+0.5) 1 2 (1+1) 2 (1+1)

	 Where [X]à cell density [S] à Concentration of substrate [QS] à Cell specific substrate turnover rate		
	SECTION E		
31 (a) 31 (b)	Separation of molecular ions according to mass to charge/ m/z ratio. (1) Procedure of MALDI (all steps) Ionisation,(1) Ion separation,(1) Detection/Analysis in a mass spectrum. (1) Matrix absorbs laser light energy and vaporises/ Sample is transferred from condensed phase to gas phase/ used to volatilise & protonate peptide and proteins ,(1) **OR** Due to deficiencies of certain essential amino acids in cereals and legumes. ,(1) Two genetic engineering approaches used to improve protein quality in seeds, are: (I) To engineer genes that encode seed storage proteins with more nutritionally desirable amino acids by inserting genes of additional amino acids and by substituting existing amino acids with new ones. ,(2) (II) By introducing genes of entirely novel proteins that are highly enriched in specific amino acids/ modification of endogenous genes / any other genetic approach,(2)	Unit V, Ch 2, p.45-46 Unit VI, Ch 2, p.129 Unit V.Ch 2.p.53-54	5 (1+1+1+1+1) 5 (1+2+2)
32 (a)	(i) By meristem culture from virus infected plants/ Apical / Axillary meristem (any one) ,(1) Increased yield / quality / to obtain virus free plants from infected crop plant (any two) (0.5+0.5) (ii) Artificial seeds are produced either by encapsulating somatic embryos in a protective coating i.e Calcium alginate beads or by desiccating the somatic embryos with or without coating,(1)	Unit VI, Ch 2, p.117	5 (1+0.5+0.5+1+2)

32 (b)	(iii) Diagram drawing (0.5)  labelling (0.5x3) The artificial seed coat [A] Somatic embryo at Torpedo stage [B] Artificial endosperm [C] **OR** Three genes involved in the biosynthetic pathway (1) for β-carotenoid production (1) were introduced under the control of endosperm specific promoter, so that gene products (enzymes) are synthesized in the rice endosperm. (1) Advantages: Provitamin A is produced in the entire grain/ prevents night blindness (any one) (1) Further engineered golden rice by introducing three more genes from different organisms for iron source and its absorption. (1)	Unit VI, Ch 2, p.129	5 (1+1+1+1+ 1)
33 (a) 33 (b)	(i) Brief description of "Denaturation, Annealing, Extension" with temperature (1x3) (ii) Formula, 2^n (where n = no of cycles) (1mk) Total no of double stranded DNA molecules = 3 X 2^{10}= 3072 (1mk) **OR** Restriction Fragment Length Polymorphism (1) **Principle**: Variation in size (length) of the restriction enzyme generated fragments between individuals within a given species. (1) Difference in movement of DNA fragments on electrophoresis after digestion with restriction enzymes. (1) **Applications** (Any Two (1mk each)): Forensic sciences/Identify individuals/ criminals Relate individuals Paternity/ parentage testing DNA fingerprinting	Unit V, Ch 1, p.17-18 Unit V, Ch 1, p.6-7	5 (1+1+1+1+ 1) 5 (1+1+1+2)