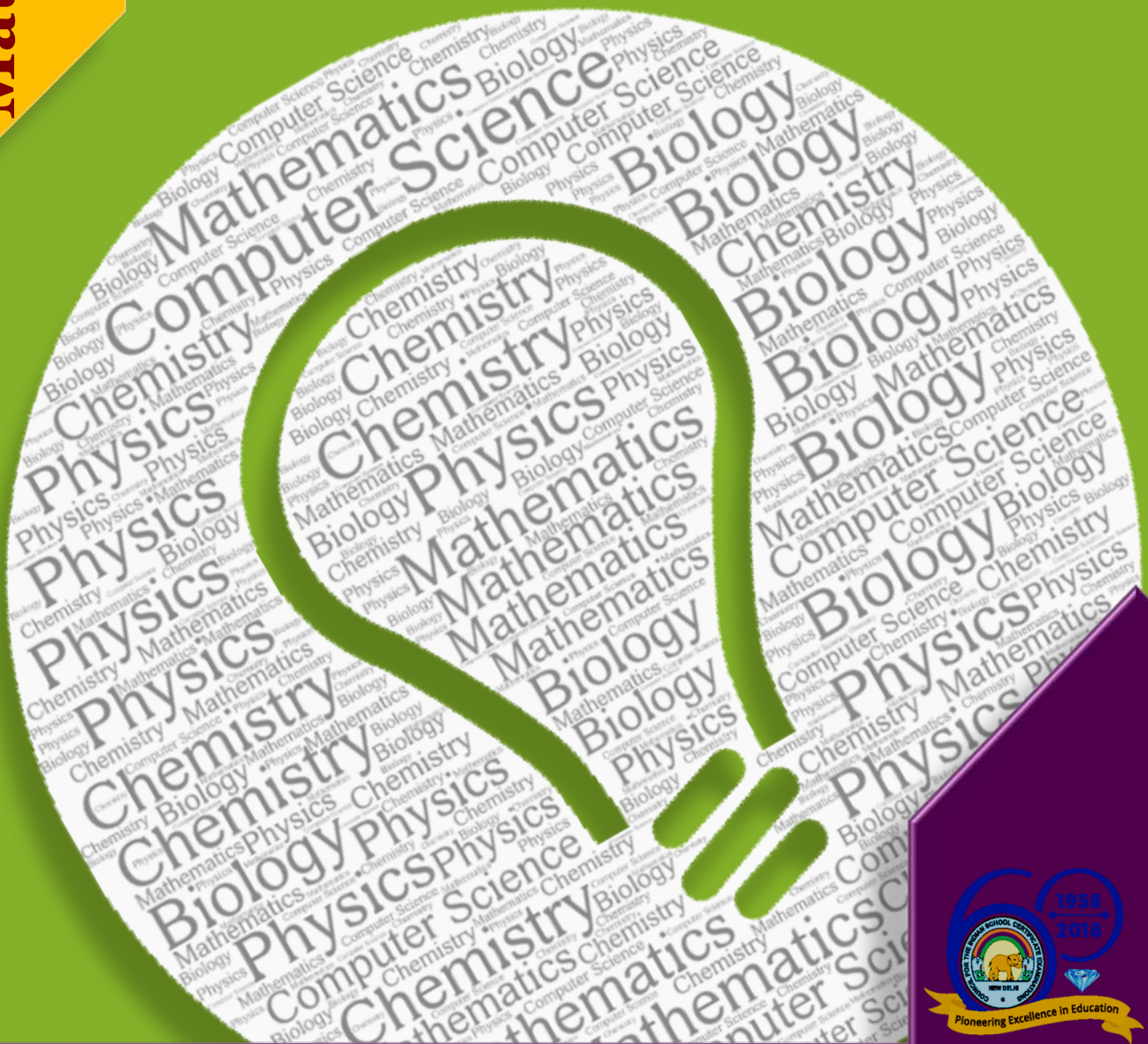


# Analysis of Pupil Performance

ISC Year 2018  
Examination

Sciences  
&  
Mathematics

# BIOLOGY



*Research Development and Consultancy Division*

**Council for the Indian School Certificate Examinations  
New Delhi**

**Year 2018**

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## FOREWORD

This document of the Analysis of Pupils' Performance at the ISC Year 12 and ICSE Year 10 Examination is one of its kind. It has grown and evolved over the years to provide feedback to schools in terms of the strengths and weaknesses of the candidates in handling the examinations.

We commend the work of Mrs. Shilpi Gupta (Deputy Head) of the Research Development and Consultancy Division (RDCD) of the Council and her team, who have painstakingly prepared this analysis. We are grateful to the examiners who have contributed through their comments on the performance of the candidates under examination as well as for their suggestions to teachers and students for the effective transaction of the syllabus.

We hope the schools will find this document useful. We invite comments from schools on its utility and quality.

**October 2018**

**Gerry Arathoon  
Chief Executive & Secretary**

The Council has been involved in the preparation of the ICSE and ISC Analysis of Pupil Performance documents since the year 1994. Over these years, these documents have facilitated the teaching-learning process by providing subject/ paper wise feedback to teachers regarding performance of students at the ICSE and ISC Examinations. With the aim of ensuring wider accessibility to all stakeholders, from the year 2014, the ICSE and the ISC documents have been made available on the Council's website [www.cisce.org](http://www.cisce.org).

The documents include a detailed qualitative analysis of the performance of students in different subjects which comprises of examiners' comments on common errors made by candidates, topics found difficult or confusing, marking scheme for each answer and suggestions for teachers/ candidates.

In addition to a detailed qualitative analysis, the Analysis of Pupil Performance documents for the Examination Year 2018 have a component of a detailed quantitative analysis. For each subject dealt with in the document, both at the ICSE and the ISC levels, a detailed statistical analysis has been done, which has been presented in a simple user-friendly manner.

It is hoped that this document will not only enable teachers to understand how their students have performed with respect to other students who appeared for the ICSE/ISC Year 2018 Examinations, but also provide information on how they have performed within the Region or State, their performance as compared to other Regions or States, etc. It will also help develop a better understanding of the assessment/ evaluation process. This will help teachers in guiding their students more effectively and comprehensively so that students prepare for the ICSE/ ISC Examinations, with a better understanding of what is required from them.

The Analysis of Pupil Performance document for ICSE for the Examination Year 2018 covers the following subjects: English (English Language, Literature in English), Hindi, History, Civics and Geography (History and Civics, Geography), Mathematics, Science (Physics, Chemistry, Biology), Commercial Studies, Economics, Computer Applications, Economic Applications, Commercial Applications.

Subjects covered in the ISC Analysis of Pupil Performance document for the Year 2018 include English (English Language and Literature in English), Hindi, Elective English, Physics (Theory), Chemistry (Theory), Biology (Theory), Mathematics, Computer Science, History, Political Science, Geography, Sociology, Psychology, Economics, Commerce, Accounts and Business Studies.

I would like to acknowledge the contribution of all the ICSE and the ISC examiners who have been an integral part of this exercise, whose valuable inputs have helped put this document together.

I would also like to thank the RDCD team of, Dr. M.K. Gandhi, Dr. Manika Sharma, Mrs. Roshni George and Mrs. Mansi Guleria who have done a commendable job in preparing this document.

*October 2018*

*Shilpi Gupta*  
*Deputy Head - RDCD*

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# INTRODUCTION

This document aims to provide a comprehensive picture of the performance of candidates in the subject. It comprises of two sections, which provide Quantitative and Qualitative analysis results in terms of performance of candidates in the subject for the ISC Year 2018 Examination. The details of the Quantitative and the Qualitative analysis are given below.

## Quantitative Analysis

This section provides a detailed statistical analysis of the following:

- Overall Performance of candidates in the subject (Statistics at a Glance)
- State wise Performance of Candidates
- Gender wise comparison of Overall Performance
- Region wise comparison of Performance
- Comparison of Region wise performance on the basis of Gender
- Comparison of performance in different Mark Ranges and comparison on the basis of Gender for the top and bottom ranges
- Comparison of performance in different Grade categories and comparison on the basis of Gender for the top and bottom grades

The data has been presented in the form of means, frequencies and bar graphs.

## Understanding the tables

Each of the comparison tables shows N (Number of candidates), Mean Marks obtained, Standard Errors and t-values with the level of significance. For t-test, mean values compared with their standard errors indicate whether an observed difference is likely to be a true difference or whether it has occurred by chance. The t-test has been applied using a confidence level of 95%, which means that if a difference is marked as 'statistically significant' (with \* mark, refer to t-value column of the table), the probability of the difference occurring by chance is less than 5%. In other words, we are 95% confident that the difference between the two values is true.

t-test has been used to observe significant differences in the performance of boys and girls, gender wise differences within regions (North, East, South and West), gender wise differences within marks ranges (Top and bottom ranges) and gender wise differences within grades awarded (Grade 1 and Grade 9) at the ISC Year 2018 Examination.

The analysed data has been depicted in a simple and user-friendly manner.

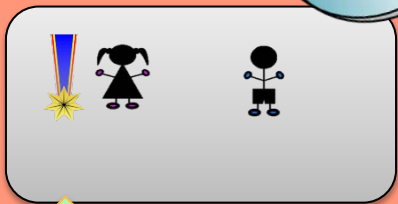
Given below is an example showing the comparison tables used in this section and the manner in which they should be interpreted.

**Comparison on the basis of Gender**

Gender	N	Mean	SE	t-value
Girls	2,538	66.1	0.29	11.91*
Boys	1,051	60.1	0.42	

\*Significant at 0.05 level

**Girls performed significantly better than boys.**



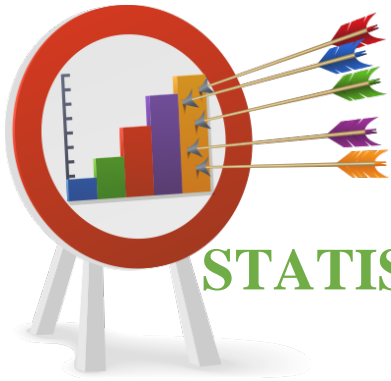
The results have also been depicted pictographically. In this case, the girls performed significantly better than the boys. This is depicted by the girl with a medal.

The table shows comparison between the performances of boys and girls in a particular subject. The t-value of 11.91 is significant at 0.05 level (mentioned below the table) with a mean of girls as 66.1 and that of boys as 60.1. It means that there is significant difference between the performance of boys and girls in the subject. The probability of this difference occurring by chance is less than 5%. The mean value of girls is higher than that of boys. It can be interpreted that girls are performing significantly better than boys.

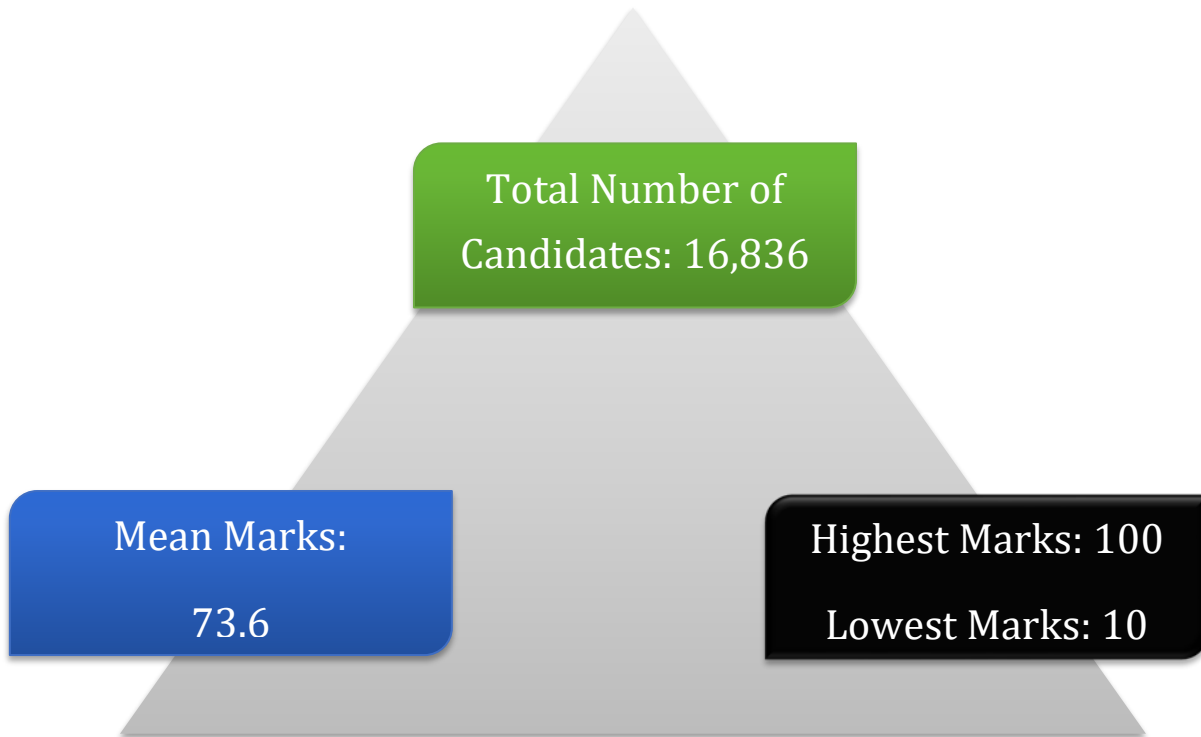
## Qualitative Analysis

The purpose of the qualitative analysis is to provide insights into how candidates have performed in individual questions set in the question paper. This section is based on inputs provided by examiners from examination centres across the country. It comprises of question wise feedback on the performance of candidates in the form of *Comments of Examiners* on the common errors made by candidates along with *Suggestions for Teachers* to rectify/ reduce these errors. The *Marking Scheme* for each question has also been provided to help teachers understand the criteria used for marking. Topics in the question paper that were generally found to be difficult or confusing by candidates, have also been listed down, along with general suggestions for candidates on how to prepare for the examination/ perform better in the examination.

# QUANTITATIVE ANALYSIS



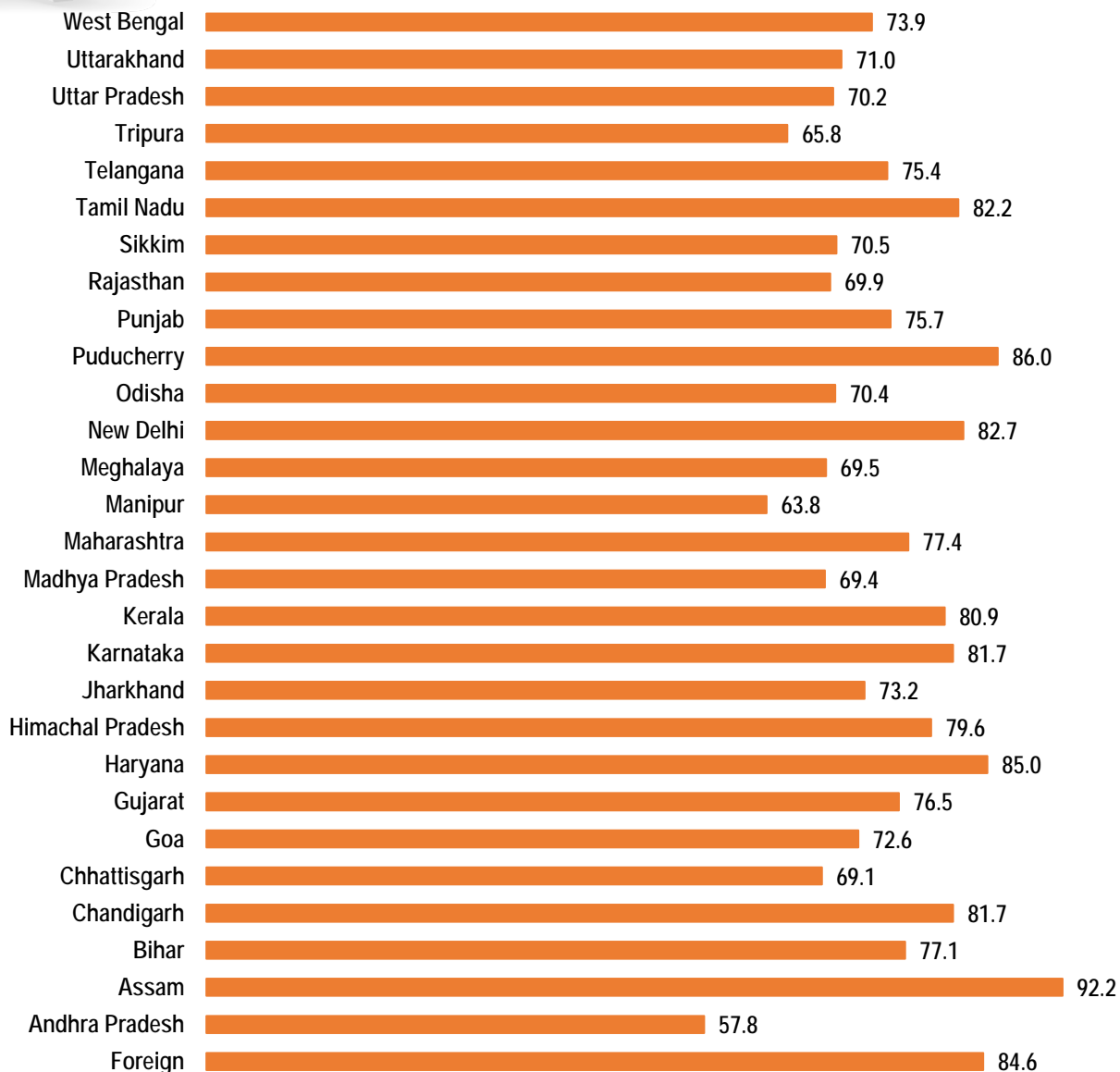
## STATISTICS AT A GLANCE







## PERFORMANCE (STATE-WISE & FOREIGN)



**The States/ UTs of Assam, Puducherry and Haryana secured highest mean marks. Mean marks secured by candidates studying in schools abroad were 84.6.**



## GENDER-WISE COMPARISON



### GIRLS

Mean Marks: 75.0

Number of  
Candidates: 10,055



### BOYS

Mean Marks: 71.5

Number of  
Candidates: 6,781

### Comparison on the basis of Gender

Gender	N	Mean	SE	t-value
Girls	10,055	75.0	0.16	13.07*
Boys	6,781	71.5	0.21	

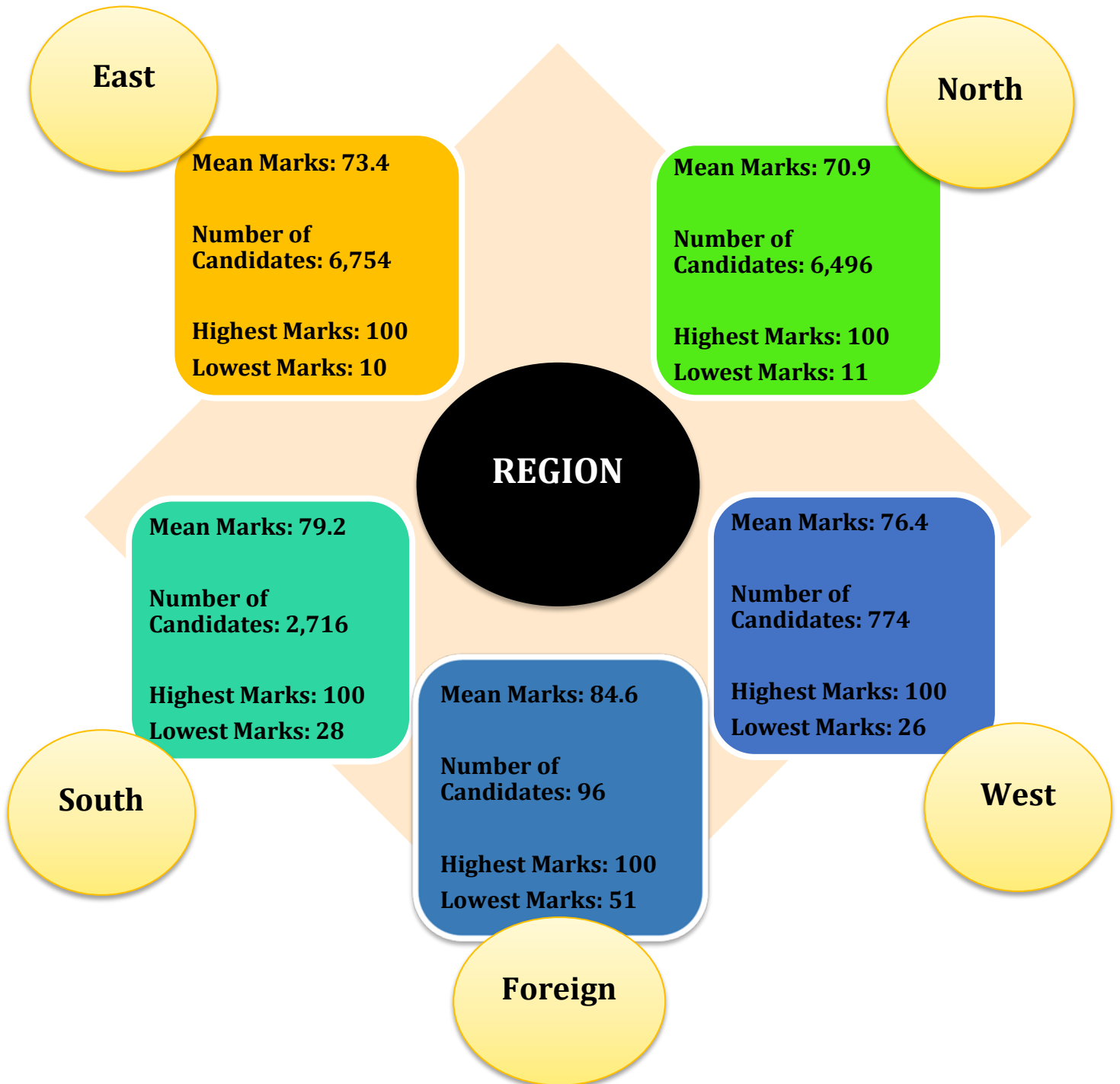
\*Significant at 0.05 level

**Girls performed  
significantly better than  
boys.**

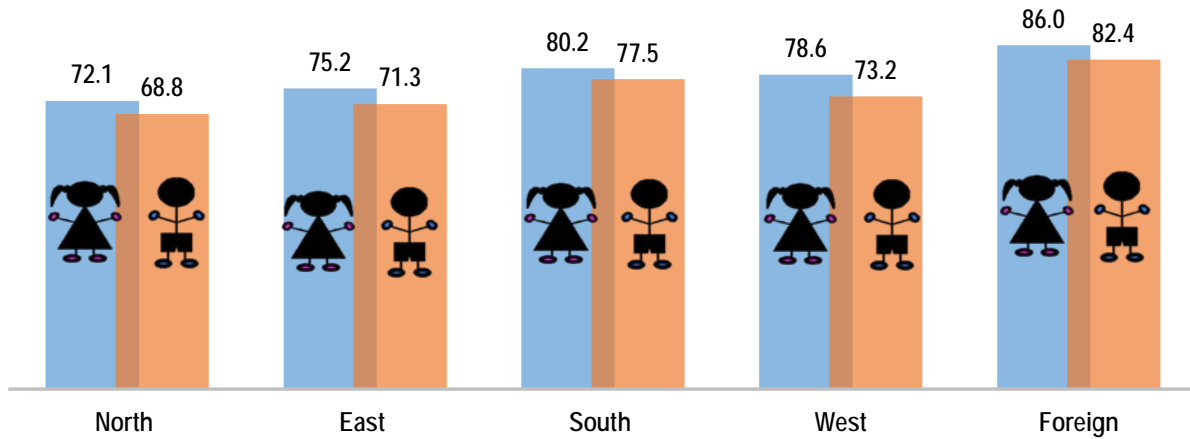




## REGION-WISE COMPARISON



## Mean Marks obtained by Boys and Girls-Region wise

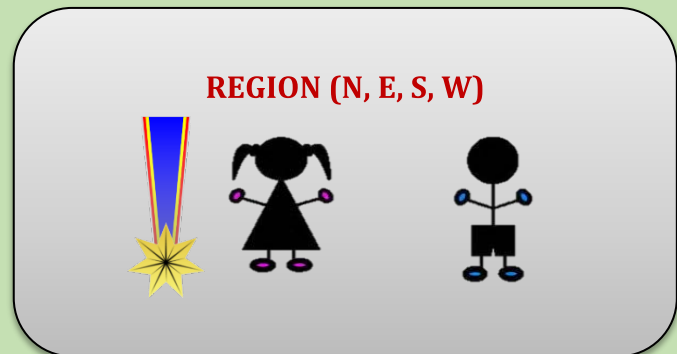


### Comparison on the basis of Gender within Region

Region	Gender	N	Mean	SE	t-value
North (N)	Girls	4,238	72.1	0.25	7.39*
	Boys	2,258	68.8	0.37	
East (E)	Girls	3,602	75.2	0.25	10.04*
	Boys	3,152	71.3	0.30	
South (S)	Girls	1,698	80.2	0.37	4.48*
	Boys	1,018	77.5	0.49	
West (W)	Girls	458	78.6	0.77	4.32*
	Boys	316	73.2	0.99	
Foreign (F)	Girls	59	86.0	1.52	1.36
	Boys	37	82.4	2.16	

\*Significant at 0.05 level

**The performance of girls was significantly better than that of boys in all the regions except foreign region.**



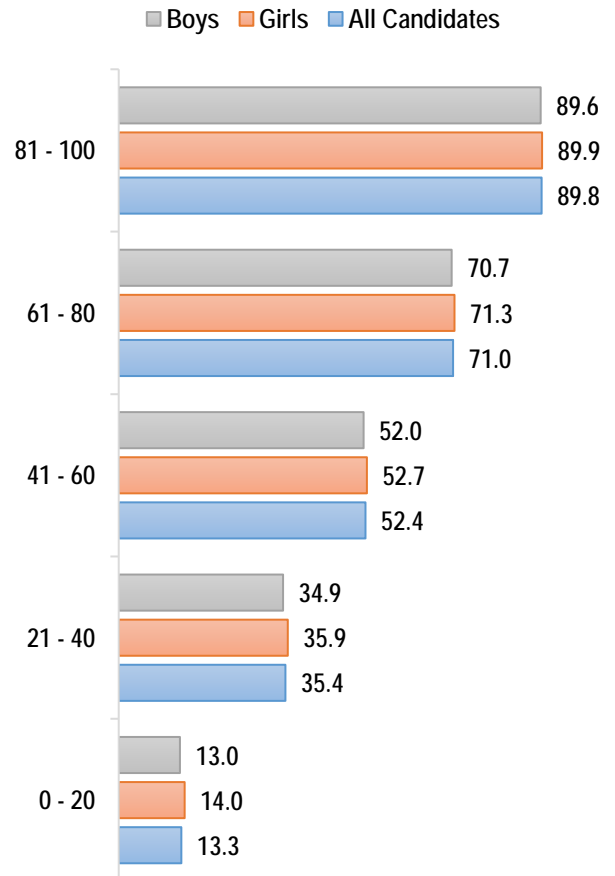


## MARK RANGES : COMPARISON GENDER-WISE

Comparison on the basis of gender in top and bottom mark ranges

Marks Range	Gender	N	Mean	SE	t-value
Top Range (81-100)	Girls	4,242	89.9	0.08	1.82
	Boys	2,421	89.6	0.11	
Bottom Range (0-20)	Girls	2	14.0	1.00	0.49
	Boys	4	13.0	1.78	

**No significant difference was found in the performance of girls and boys.**





# GRADES AWARDED : COMPARISON GENDER-WISE

## Comparison on the basis of gender in Grade 1 and Grade 9

Grades	Gender	N	Mean	SE	t-value
Grade 1	Girls	2,229	94.3	0.06	-1.19
	Boys	1,168	94.4	0.09	
Grade 9	Girls	75	31.0	0.42	2.37*
	Boys	121	29.6	0.41	

\*Significant at 0.05 level

### Grade 1

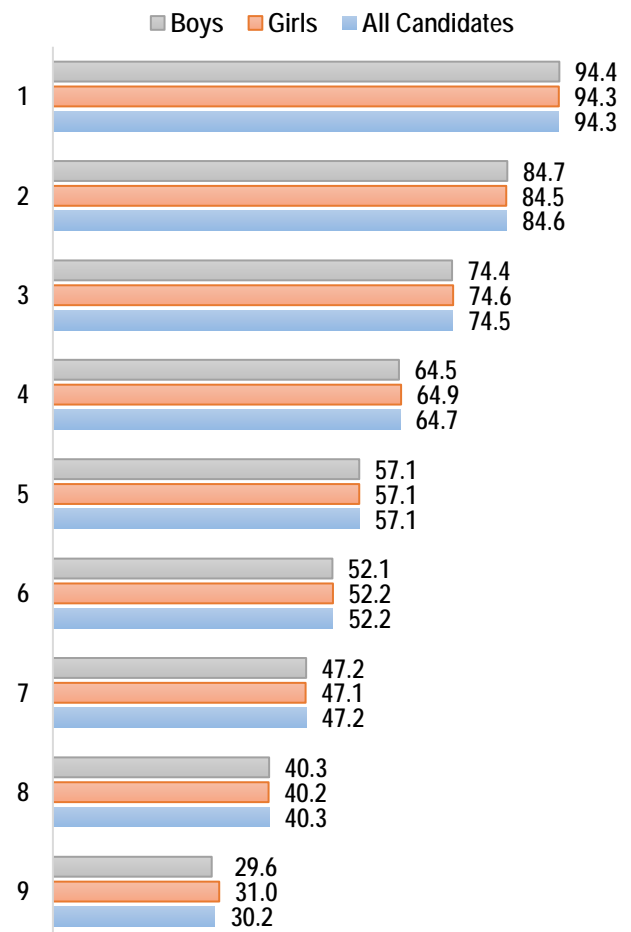
No significant difference was observed between the performance of girls and boys.

### Grade 9



### Grade 9

Performance of girls was significantly better than the performance of boys .



# QUALITATIVE ANALYSIS

## BIOLOGY THEORY (PAPER I)

### Part I (20 Marks)

*Answer all questions*

#### Question 1

- (a) Answer the following questions briefly and to the point: [8×1]
- (i) Give a significant point of difference between *Oestrous* and *Menstrual cycle*.
  - (ii) Give the biological name of the organism causing typhoid.
  - (iii) If the haploid number of chromosomes in a plant species is 20, how many chromosomes will be present in the cells of the shoot tip?
  - (iv) Name a plant which flowers every twelve years.
  - (v) Name the diagnostic test for AIDS.
  - (vi) Name the terminal stage of ageing in the life cycle of plants.
  - (vii) Which organisms constitute the last trophic level?
  - (viii) What is *emasculation*?
- (b) Each of the following questions has four choices. Choose the best option in each case: [4×1]
- (i) Length of the DNA with 23 base pairs is:
    - (1) 78.4 Å
    - (2) 78.2 Å
    - (3) 78 Å
    - (4) 74.8 Å
  - (ii) Opium is obtained from:
    - (1) *Papaver somniferum*
    - (2) *Cannabis sativa*

(3) *Erythroxylum coca*

(4) *Datura metel*

(iii) According to Abiogenesis, life originated from:

(1) Non-living matter

(2) Pre-existing life

(3) Oxygen

(4) Extra-terrestrial matter

(iv) The largest unit in which gene flow is possible is:

(1) Organism

(2) Population

(3) Species

(4) Genes

(c) Give *one* significant contribution of each of the following scientists: [4×1]

(i) P. Maheshwari

(ii) E. Wilson

(iii) M. S. Swaminathan

(iv) H. Boyer

(d) Define the following: [2×1]

(i) Bio patent

(ii) Parthenocarpy

(e) Give a reason for each of the following: [2×1]

(i) Pollen grains of wind pollinated flowers are produced in large quantities.

(ii) Equilibrium of a forest ecosystem can be disturbed by uncontrolled hunting of big predators.



## Comments of Examiners

- (a) (i) While some candidates were unable to write a compatible difference between *Oestrous* and *Menstrual cycle*, a few others wrote the opposite answer. Some candidates were able to explain the menstrual cycle but did not seem to be clear about oestrous cycle as they wrote that it operates in frog, reptiles, etc. The word *non-primates* was not mentioned in many cases and many of those who mentioned non-primates, did not write *mammals*. A few candidates wrote the duration of oestrous cycle as 10 days, 13 days, 23 days, etc. Some candidates, instead of writing the difference, wrote the names of the stages.
- (ii) Many candidates mis-spelt the biological name of Salmonella, e.g., Selmonala, Semlonala, etc. Some candidates wrote only the generic name. The scientific name, according to the rules of Binomial nomenclature, was not written by many candidates.
- (iii) Majority of the candidates were unclear of the concept of haploid and diploid. Some candidates wrote only the haploid number, i.e., 20. They were not clear that every somatic cell has diploid number of chromosomes. Very few candidates were able to write the correct number of chromosomes as answers like 10, 20, and 40 were written.
- (iv) Many candidates, instead of writing *Strobilanthus kunthiana*, wrote Bamboo.
- (v) Majority of the candidates were able to write the correct name for the diagnostic test for AIDS. Some candidates wrote Widal test, AIDS test, PAP smear test, LISA/ALIZA etc. A few candidates wrote the wrong order for ELISA.
- (vi) Several candidates mis-spelt *senescence*. Some candidates repeated the question itself, writing the terminal stage as *aging*. A few candidates wrote vague answers like death and dying. A few answer scripts had the word *terminal*, which was a part of the question.
- (vii) Many candidates, instead of writing the names of the organisms like *Decomposers*, *Top Carnivores*, wrote *producers*, *predators*, *carnivores*. The answers of majority of the

## Suggestions for teachers

- Lay stress on writing compatible differences.
- Tell students that menstrual cycle occurs only in monkeys, apes and human beings whereas oestrous occurs in non-primates, i.e., cats and dogs. Teach the differences between oestrous cycle and menstrual cycle in a tabular form, emphasizing key words like 'in primates and non-primate mammals', duration, names of the phases, shedding/reabsorption of uterine endometrium, etc.
- Teach students pathogens of diseases and to write biological names with correct spellings according to the rules of binomial nomenclature.
- Repeated tests will help the students to remember the scientific names.
- Clearly explain Haploid (n) and Diploid (2n) concept. While teaching plant reproduction, at every step, remind the students the basic concepts of alternation of generation, viz., megasporogenesis, microsporogenesis, fertilisation, embryonic development and endosperm formation. Teach location of haploid and diploid number of chromosomes also mentioning somatic/body cells and gametes.
- Teach special flowering phenomena with the name, its interesting features and where located.
- Give proper reference about symptoms of AIDS, its modes of transmission, diagnosis, etc.

candidates had no reference to actual trophic levels, i.e. *primary, secondary, tertiary, top apex*, etc.

- (viii) Most of the candidates were able to answer this question. Some candidates, however, vaguely wrote it as the process of removal of reproductive parts/ removal of stamen and/or pistil. Some candidates did not mention the words *from a bisexual flower*, which implies that emasculation applies even to animals. A few candidates, instead of writing *anthers/stamens/male part* wrote removal of reproductive parts. Some candidates confused emasculation with contraceptive and surgical methods.
- (b) (i) Majority of the candidates were unable to write the correct length of the DNA.
- (ii) Most of the candidates were able to write the correct option. However, some candidates wrote *Cannabis/ Erythroxyllum/ Datura* as the source of opium.
- (iii) Majority of the candidates were able to write the correct option. However, some candidates, instead of *non-living matter*, wrote *pre-existing life*.
- (iv) Most of the candidates wrote the correct option.
- (c)(i) Many candidates gave the contribution of the scientist as *embryogenesis* in general without any mention of plant or plant culture.
- (ii) Most of the candidates were able to answer this question. Some candidates, however, gave the answer as *Father of Ecology*. A few candidates did not attempt the question.
- (iii) Very few candidates wrote *Green revolution*.
- (iv) Most of the candidates were able to answer this question. Some candidates, however, wrote - *discovered the structure of DNA*.

- Explain the phases of life cycle in detail under the headings Juvenile/Vegetative, reproductive and Senescence. Teach the three phases by making comparisons and giving examples from day-to-day life.
- While teaching food chains, ecological pyramids and food webs, highlight the exact place occupied by a species and the specific role played by that species in that particular ecosystem as sometimes the same species may occupy a different trophic level in one ecosystem and the other in some other ecosystem. Explain trophic levels by means of diagrams and examples.
- Emphasise the importance of key words by analysing them. For example, split the word *emasculation* into 'e + masculine' to stress that it involves removal of male part. Since it is an important step in PLANT hybridization, therefore, discuss it in the proper context and not in isolation merely as a definition. Discuss emasculation, while teaching artificial hybridisation.
- While explaining DNA structure, mention that One Base Pair =  $3.4 \text{ \AA}$  of length.
- Give sufficient practice to the students on solving problems based on application-based questions. For example, make the students solve the problems based on dimensions of DNA, number of nucleotides, codons and corresponding amino acids, energy at different trophic levels, growth rate of population, etc.

- (d) (i) Majority of the candidates did not mention the key words *legal rights* in the definition of Biopatent. Most of the candidates wrote general answers without mentioning the biological discovery or product. Some candidates were confused between *bio patent* and *bio piracy*. A few candidates wrote the definition of patent, without relating it to biological inventions.
- (ii) A number of the candidates, instead of describing *parthenocarpy*, described *parthenogenesis*. Many candidates defined it as the formation of embryo without fertilisation or development of animals without fertilisation. Some candidates gave the example of the honey bee.
- (e) (i) Most candidates, instead of writing valid points like, wastage of pollen grains and to ensure pollination, wrote general answers. Some candidates wrote how the wind helps in the process of pollination. A few candidates wrote the features of anemophilous flowers, confusing them with entomophilous and mentioned the role of insects. In a few answer scripts, contrivances of cross pollination were written in detail.
- (ii) Majority of the candidates were not clear about the role of predators. Most candidates vaguely wrote that the predators disturb the ecosystem. Some candidates gave the reason as uncontrolled hunting *by* the predators, not *of* the predators. Some candidates copied the question. In some answer scripts there was no mention of increase of herbivores to exhaust vegetation leading to death of herbivores.

- Discuss Abiogenesis with reference to *originate from non-living*. Explain the different theories of origin of life. Clearly differentiate between abiogenesis and biogenesis.
- Teach Gene flow and genetic drift separately.
- Advise students to write the correct option and the correct number corresponding to the option to avoid errors.
- Encourage students to learn the precise contribution of each scientist from the list of scientists and their contributions given in the syllabus.
- Emphasize the importance of key words. Explain these ideas with appropriate examples from daily life. Illustrate the terms bio patent and bio piracy with examples.
- Explain Parthenocarpy and parthenogenesis. Break the word into fragments ‘partheno = virgin’ and ‘carpo = fruit’ for better understanding.
- Discuss, with examples, the characteristics of different types of pollination and reasons for their adaptation.
- While discussing food chain, explain to the students the specific role of a species in its eco-system. At this stage, interlink the concepts of keystone species, rivet popper species, co-extinction, etc. Discuss eco-systems with examples.

## MARKING SCHEME

### Question 1

(a)														
	(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Oestrous Cycle</th> <th style="text-align: center;">Menstrual Cycle</th> </tr> </thead> <tbody> <tr> <td>In non-primate mammals or example</td> <td>In primate mammals / humans/ apes/ monkeys</td> </tr> <tr> <td>Very few / no blood flow</td> <td>Proper menstruation / blood flow occurs</td> </tr> <tr> <td>Variable duration 7/14/21 days</td> <td>Fixed duration / 28 days</td> </tr> <tr> <td>Broken endometrium reabsorbed by uterus.</td> <td>Broken endometrium shed by uterus.</td> </tr> <tr> <td>Female receptive (allows mating) only during heat /oestrous phase</td> <td>Always receptive</td> </tr> </tbody> </table> <p style="text-align: right;">(Any one)</p>	Oestrous Cycle	Menstrual Cycle	In non-primate mammals or example	In primate mammals / humans/ apes/ monkeys	Very few / no blood flow	Proper menstruation / blood flow occurs	Variable duration 7/14/21 days	Fixed duration / 28 days	Broken endometrium reabsorbed by uterus.	Broken endometrium shed by uterus.	Female receptive (allows mating) only during heat /oestrous phase	Always receptive
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Variable duration 7/14/21 days	Fixed duration / 28 days													
Broken endometrium reabsorbed by uterus.	Broken endometrium shed by uterus.													
Female receptive (allows mating) only during heat /oestrous phase	Always receptive													
	(ii)	<i>Salmonella typhi</i>												
	(iii)	40 chromosomes/diploid/2n/double/20 pairs												
	(iv)	<i>Strobilanthes kunthiana/ S. kunthiana/ Neelakurunji/ Kurunji</i>												
	(v)	ELISA test/Western Blot/PCR												
	(vi)	Senescence												
	(vii)	Decomposers / Top carnivores/ apex predator												
	(viii)	Emasculation is the removal of anthers from bisexual flower before maturing for cross fertilisation.												
(b)														
	(i)	(4) or 74.8												
	(ii)	(1) or <i>Papaver somniferum</i>												
	(iii)	(1) or Non-living matter												

	(iv)	(3) or Species/ (2) or Population
(c)		
	(i)	P. Maheshwari: Plant tissue culture/Plant embryology/Production of haploid
	(ii)	E. Wilson: (Coined the term) Biodiversity
	(iii)	M. S. Swaminathan: Green Revolution in India
	(iv)	H. Boyer: Discovered Restriction Enzyme / Endonuclease
(d)		
	(i)	Biopatent: It is a legal right given to the owner for a biological discovery or biological product/ Intellectual Property Right.
	(ii)	Parthenocarpy: Production of seedless fruits / development of fruits without fertilisation.
(e)		
	(i)	Pollen grains of wind pollinated flowers are produced in large quantities because, large number of pollen grains may be wasted on the way / to ensure / to increase the chance of pollination.
	(ii)	Equilibrium of a forest ecosystem can be disturbed by uncontrolled hunting of big predators as population of herbivores will increase rapidly which will exhaust vegetation, causing herbivores to starve to death. /disturbs food chain/ intraspecific competition.

**Part II**  
**SECTION A (14 Marks)**  
*(Answer all questions)*

**Question 2**

[2]

- (a) A woman with blood group O married a man with blood group AB. Show the possible blood groups of the progeny. List the alleles involved in this inheritance.

**OR**

- (b) If the mother is a carrier of colour blindness and the father is normal, show the possible genotype and phenotype of the offspring of the next generation, with the help of a punnet square.

## Comments of Examiners

- (a) Majority of the candidates did not write the answer in two parts. They had to write the possible blood groups separately. In the latter part of the question they had to list the alleles involved. Most of the candidates just showed the cross between woman having blood group 'O' and man with blood group 'AB'. Correct alleles were not given. Many candidates mentioned the occurrence of all the four blood groups in the progeny. Very few candidates used the correct format to represent the type of alleles. Instead of writing as  $I^A$ ,  $I^B$  and  $i$ , they wrote 'alleles A, B and O'. Some candidates showed the possible combinations of alleles in the progeny but did not mention the corresponding blood groups.
- (b) Majority of the candidates did not show the phenotype and genotype by means of Punnett square. Very few candidates drew the Punnett square. Many candidates wrote the genotype and phenotype of the parents but not the progeny. Several candidates did not follow the correct format for writing the genotype but wrote formats like  $X^n$  for normal and  $X^{cb}$  for colour blind. Many candidates, instead of following the concept of writing proper genotype in the gamete, wrote gametes with XX and XY constitution.

## Suggestions for teachers

- Discuss simple problems along with the explanation of Punnett square. Teach the concept of multiple allele with examples of blood groups and with alleles involved. Solve the questions on inheritance of genetic traits (autosomal or sex-linked) with the help of Punnett square. Teach students to calculate the probabilities in terms of percentage and not as absolute figures, e.g., instead of answering *one colour-blind son* emphasise that the probability of a colour-blind son is  $\frac{1}{4}$  (25%).
- Advise students to read the questions carefully and answer the questions part-by-part.
- Illustrate to students, by showing different examples of crosses between colour-blind and normal. Cite some examples of sex-linked inheritance. Also explain why sex-linked characters are common in males. Ask students to carry out crosses with different combinations of sex linked diseases to write the genotype and phenotype correctly.

## MARKING SCHEME

### Question 2

(a)	Woman	Man	
	<b>O</b>	<b>X</b>	<b>AB</b>
Genotype	$I^o I^o$	$I^A I^B$	
	<b>GAMETES</b>	<b><math>I^A</math></b>	<b><math>I^B</math></b>
	<b><math>I^o</math></b>	$I^A I^o$ (A)	$I^B I^o$ (B)
	<b><math>I^o</math></b>	$I^A I^o$ (A)	$I^B I^o$ (B)
(i)	Possible blood groups of the progeny: <b>A &amp; B</b>		

(ii) Alleles involved –  $I^A, I^B, I^o$

(Any two alleles)

$I^o I^o \times I^A I^B / AB \quad I^o I^o \times I^A I^B$

	$I^o/i$	$I^o/i$			
$I^A$	$I^A I^o$	$I^A I^o$			
$I^B$	$I^B I^o$	$I^B I^o$			
Alleles involved are A and B or A, B and i					

(b)

Normal female but carrier  $\times$  Normal male

Normal female but carrier / Normal male	$X^C$	Y
$X^C$	$X^C X^C$ Normal female	$X^C Y$ Normal male
$X^c$	$X^C X^c$ Carrier female	$X^c Y$ Colour blind male

Normal female -1  
Normal male -1  
Carrier female -1  
Colour blind male -1  
1:1:1:1

(or)

Normal female but carrier / Normal male	X	Y
$X^o$	$X^o X$ Carrier female	$X^o Y$ Colour blind male
X	$X X$ Normal female	$X Y$ Normal male

## Question 3

[2]

Define *life span*. Give the life span of an elephant.

### Comments of Examiners

Majority of the candidates did not use the term *natural death* while defining life span but defined it as the period between birth and death. Some candidates defined it as an *average life of an individual*. Most of the candidates wrote the correct life span of an elephant. However, a few candidates wrote it as 150 years or 200 years or even 2,000 years.

### Suggestions for teachers

- Emphasise that it is imperative to write key words in the definitions which are also mentioned in the scope of the syllabus. Insist that the definition of life span includes *from birth to natural death*.
- Instruct students to learn the life spans of those organisms which are mentioned in the syllabus.
- Ask students the life spans of different animals frequently.

## MARKING SCHEME

### Question 3

*Life span* is the time period from birth to natural death.

Life span of an elephant: 20 - 90 years.

## Question 4

[2]

Give *two* characteristic features of each of the following:

- Ramapithecus*
- Cro-Magnon man



## Comments of Examiners

- (a) Most of the candidates wrote general characteristics leaving out the valid points. Several candidates, instead of writing the correct cranial capacity as *short, man-like features, lived in forests*, wrote the terms *less* and *more*. Some candidates wrote that these *ancestors existed during the times of God Ram*. A few candidates gave the characteristics of Dryopithecus.
- (b) Majority of the candidates could not write the valid points. Most candidates instead of mentioning the approximate height in feet, wrote just tall height. Several candidates wrote the incorrect cranial capacity.

### Suggestions for teachers

- Explain to the students the distinguishing characteristics of Ramapithecus like their feeding habits, teeth (small canines), knuckle walking, and exact cranial capacity.
- Discuss only the characteristic features of human ancestors. Do a comparative analysis of the fossils of human ancestors mentioning posture, height, cranial capacity, feeding habits etc.
- Elucidate the distinguishing characteristics typical of Cro-Magnon man.

## MARKING SCHEME

### Question 4

Characteristic features:

(a)	<p><i>Ramapithecus:</i></p> <ul style="list-style-type: none"> <li>• Approx 1.2 m</li> <li>• Man, like feeding habits/Omnivore</li> <li>• Bipedal/semi-erect/almost erect</li> <li>• Canines small</li> <li>• Short face</li> <li>• Small brain</li> <li>• Thickly enameled teeth</li> <li>• They could bend their knuckles/knuckle walking</li> <li>• Lived in late Miocene / early Pliocene</li> <li>• Fossil collected from India and Africa</li> <li>• 650 cranial capacity</li> </ul> <p style="text-align: right;"><i>(Any two)</i></p>
(b)	<p><i>Cro-Magnon man:</i></p> <ul style="list-style-type: none"> <li>• 1.8 m tall / 6 - 6.5 ft</li> <li>• Head large/ Broad flat forehead</li> <li>• Prominent supra – orbital ridges</li> <li>• Erect posture/Bipedal</li> <li>• Body less hairy/</li> <li>• Chin prominent</li> </ul>

- Nose narrow and elevated
- Face /orthognathus
- Cranial capacity 1650 – 1660 cc
- Cave dwellers and hunters
- Drawing and painting pictures
- Learnt to make tools
- Buried their dead
- Cooked food on fire/ Use of fire
- Domesticated animals
- Social life/lived in families
- Skill of talking/language/facial gesture/ Communication/expression
- Omnivorous

(Any two)

## Question 5

[2]

(a) List *any four* effects of global warming.

**OR**

(b) State *any four* measures to control noise pollution.

### Comments of Examiners

- (a) Majority of the candidates were mystified between global warming and ozone hole. Some candidates wrote about Ozone depletion and Acid rain. A few candidates, instead of writing the effects of global warming, wrote its causes.
- (b) Most candidates wrote about fire crackers and no horn zones. Several candidates wrote the same points in different words. For example, use of ear plugs, cotton and muffler to cover the ears were enumerated as three separate points. Similarly, many candidates, wrote the use of microphone, loudspeakers and public-address systems as three separate points. Some candidates wrote general points.

### Suggestions for teachers

- Explain the effects of global warming under the following heads:
  1. Weather and Climate
  2. Animals and plants
  3. Food production
- Clarify the causes and effects of pollution under separate heads to the students.
- Discuss all the important measures to control pollution.
- Instruct students to write the answer pointwise and each point must reflect a separate idea. Advise them not to repeat the same point in different words.

## MARKING SCHEME

### Question 5

(a) Effects of global warming:

1. Effects on weather and climate:

- (i) Mean temperature increases by approximately 0.6% in the 20<sup>th</sup> century.
- (ii) Frequency of extreme events like extreme cold/heat/drought and floods are expected to increase/coastal flood.
- (iii) Increased moisture carrying capacity of air/affects rains
- (iv) Rise in mean sea-level.
- (v) melting of ice caps, glaciers and Greenland ice sheets/polar caps/snow
- (vi) thermal expansion of ocean water
- (vii) Odd climatic conditions/El nino phenomenon.

2. Effects on animals and plants

- (i) Any temperature change affects the distribution pattern of plants.
- (ii) Extinction of a large number of plant and animal species.

3 Effects on food production

- (i) Explosive growth of weeds
- (ii) Eruption of a number of plant diseases and pests.
- (iii) Increased basal rate of respiration in plants.
- (iv) Decrease in food production.

*(Any four)*

**OR**

(b) Measures to control noise pollution:

- (i) Use of better designed, quieter machines industries.
- (ii) Use of proper lubrication and better maintenance.
- (iii) Sound proof jackets or filters can reduce noise from machines/use of acoustic material.
- (iv) Workers should wear protective devices like ear muffs or cotton plugs.
- (v) Noisy industries should be away from the residential areas.
- (vi) Enforce restriction on the use of loudspeakers and amplifiers.
- (vii) Plantation of coniferous trees on highways. /green mufflers
- (viii) Strict laws to use better designed engines for aeroplanes.
- (ix) No horn zones (schools/hospitals)
- (x) Strict norms for vehicular horns/silencers
- (xi) Use of sound absorbent materials/ mufflers/use of curtains
- (xii) Machines with low sound emissions to be used
- (xiii) Ban on use of fire crackers.

*(Any four)*

## Question 6

[2]

Define BOD. What is its significance in an aquatic ecosystem?

### Comments of Examiners

Majority of the candidates, instead of defining BOD, expanded the acronym. Most of the candidates could not write the significance of BOD in an aquatic ecosystem. Several candidates were not clear as to how BOD indicates the level of pollution in a water body.

### Suggestions for teachers

- Discuss thoroughly, the significance of BOD in an aquatic ecosystem. Also connect water pollution to algal bloom.
- Advise students to carefully read and understand the requirement of the question before answering it.

## MARKING SCHEME

### Question 6

BOD: (Biochemical/biological oxygen demand) It is the amount of dissolved oxygen needed by aerobic organisms to breakdown organic material present in a given water sample, (at a certain temperature, over a specific time period). /oxygen content of water/dissolved oxygen in H<sub>2</sub>O.

Its significance in an aquatic ecosystem: It indicates water pollution. Greater BOD more polluted/unfit for organisms to live/survive/measures organic matter in water/measures oxygen content/death of organisms/leads to Eutrophication /algal growth/microbial growth

## Question 7

[2]

Give *one* significant difference between each of the following pairs:

- Humoral immunity* and *cell mediated immunity*.
- Benign tumour* and *malignant tumour*

## Comments of Examiners

- (a) While some candidates were unable to write a compatible difference between *Humoral immunity* and *cell mediated immunity*, a few others misunderstood humoral and cell-mediated immunity for active and passive immunity and defined them accordingly. Some candidates simply wrote *produced antibodies* and *did not produce antibodies* without mentioning *T cells* and *B cells*.
- (b) Many candidates wrote *non-cancerous* for benign tumour and *cancerous* for malignant tumour. Some candidates wrote opposite statements.

### Suggestions for teachers

- Explain the differences with respect to B cells and T cells, virus and bacteria, activity against cancer cells.
- Give an outline classification of immunity on different bases, for example, (i) humoral and cell mediated (ii) active and passive and (iii) natural and acquired, etc.
- Teach students the differences point wise and in a tabular form along with examples for better understanding and retention.

## MARKING SCHEME

### Question 7

(a)

Humoral Immunity	Cell mediated Immunity
Consists of B-Lymphocytes/B cells	T-lymphocytes/ T cells/macrophages/ phagocytic cell
Produced antibodies circulate in body	Produce four types of T-cells accept names like HT-cells, KT-cells, ST-cells
Against viruses and bacteria	All pathogens including fungi & protozoa/bacteria/virus
Does not respond to transplants/Not active against cancer cells extra cellular microbes.	Reacts against transplants/cancer cells/auto immune disorders/Intracellular microbes

(Any one)

(b) *Benign tumour and malignant tumour:*

<b>Benign tumour</b>	<b>Malignant tumour</b>
Confined to affected organ	Spreads to other organs of body
Growth rate is slow	Rapid
No latent stage	Has latent stage
No metastasis	Shows metastasis
Non-cancerous/Non-neoplastic	Cancerous/Neoplastic
Cause little damage to the body	Extensive damage to the body
Encapsulated curable	No capsule Not curable

(Any one)

## Question 8

[2]

Give *four* causes of infertility in males.

### Comments of Examiners

Majority of the candidates did not know the meaning of *cryptorchidism*, *oligospermia*, etc. Some candidates wrote the causes of infertility in general without referring specifically to males. For example, some answer scripts had causes such as *blockage of tubes* (Fallopian tube or vas deferens?), *acidity in reproductive tract* (male or female?), *hormonal imbalance* (androgens or oestrogens?). A few candidates only wrote *less sperms* and *abnormal sperms*. Some candidates repeated the same point, namely oligospermia.

### Suggestions for teachers

Discuss all causes of infertility. While discussing reasons for infertility, list its causes separately with reference to male and female sterility.

## MARKING SCHEME

### Question 8

Causes of infertility in males:

- (i) Cryptorchidism / azoospermia / oligospermia/low sperm count
- (ii) Alcoholism/ Smoking
- (iii) Thyroid dysfunction/ Hormonal imbalance/ Gonadotropin deficiency
- (iv) Impotency/Incapacitation
- (v) Under secretion of accessory glands
- (vi) Y chromosome deletions /Genetic problem
- (vii) Use of antihypertensive/ antipsychotic drugs/radiotherapy/surgery
- (viii) Erectile dysfunction
- (ix) Vas deferens blockage
- (x) Acidity in urethra
- (xi) Low sperm motility
- (xii) Hyperthermia/high temp/tight undergarment
- (xiii) Genetic problem
- (xiv) Infection/Any STD
- (xv) Deformities in sperm/abnormal shape, size
- (xvi) Nutritional deficiency
- (xvii) Age/Senility
- (xviii) Mechanical damage/injury to reproductive part

*(Any four*

## SECTION B (21 Marks)

(Answer *all* questions)

### Question 9

[3]

(a) Draw a labelled diagram of L.S. of human testis.

OR

(b) Draw a labelled diagram of the mature embryo sac of angiosperms.

### Comments of Examiners

- (a) Some candidates, instead of drawing the L.S. of human testis, drew the T.S. Those candidates who drew the L.S, either labelled only a few parts or were unable to label the parts correctly, e.g., candidates labelled locules in place of lobules, epididymis as vas deferens. A few candidates drew the T.S. of stamen.
- (b) Many candidates, instead of drawing the Embryo sac, drew the entire anatropous ovule. Some candidates labelled the diagram incorrectly, e.g., *filiform apparatus* was labelled as *fulliform apparatus*. Some candidates drew Micropylar and chalazal ends in opposite directions. A few candidates were confused between *polar nuclei* and *secondary nucleus*.

### Suggestions for teachers

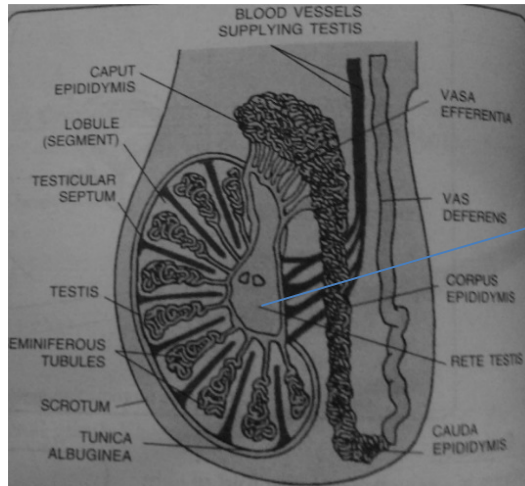
- Explain the concept of L.S. and T.S. of human testis with diagrams.
- Give sufficient practice to the students to draw diagrams.
- Train students to draw a neat labelled diagram of the mature embryo sac of angiosperms.
- Lay stress on drawing correct diagrams. Also explain thoroughly the position of antipodal cells and egg apparatus with reference to micropyle.



## MARKING SCHEME

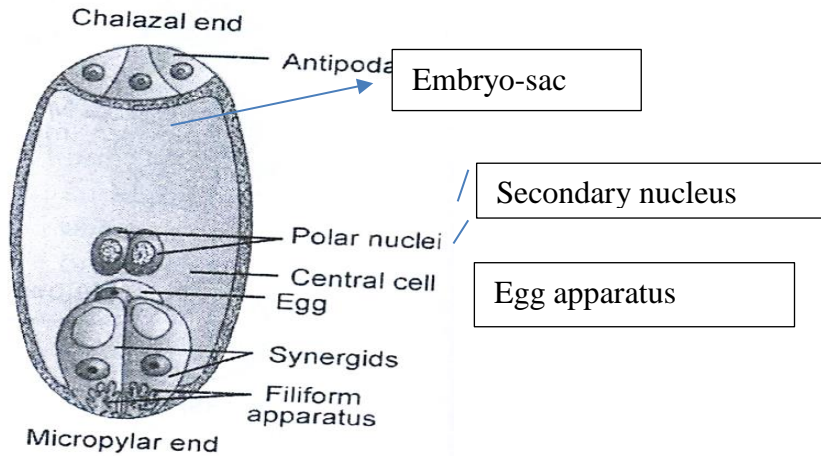
### Question 9

(a) Draw a labelled diagram of L.S. of human testis:



mediastenum

(b) Diagram of the mature embryo sac of angiosperms:



Embryo-sac

Secondary nucleus

Egg apparatus

## Question 10

Explain *gene therapy*, with reference to treatment of SCID.

### Comments of Examiners

Many candidates answered this question correctly. Some common errors observed were:

- could not correlate SCID with ADA deficiency.
- simply expanded SCID.
- mis-spelt adenosine deaminase as adenosine diaminase.
- just wrote that genetically altered cells were re-introduced in patient's body without mentioning the use of proper vector (i.e., disarmed retro-virus).
- Instead of writing the deficiency of T-cell and B-cells 'both', vaguely wrote that *immune system does not work properly*, or *deficiency of lymphocytes*.
- wrote about genetic counselling.

### Suggestions for teachers

- Discuss gene therapy and treatment of SCID.
- Teach the students the relevance of each step-in gene therapy. For example, explain in detail, topics like why only stem cells are used, what is the source of the functional gene, that SCID stands for severe combined immune deficiency, why the word 'combined', SCID is caused by the deficiency of which gene, which vector is used to transfer the transformed cells back into the patient's body, etc.

## MARKING SCHEME

### Question 10

*Gene therapy*: Correction of genetic defect through genetic engineering /rDT.

- (i) Deficiency of Adenosine Deaminase causes SCID (Severe combined immune deficiency)
- (ii) Patient lacks T-cells and B-cells.
- (iii) Cells from bone marrow of the patient are cultured outside the body.
- (iv) The functional ADA gene is transferred into these cells through/ retrovirus vector/use of restrictions enzyme, ligase
- (v) Transformed cells are transferred to the patient.
- (vi) T cells and B cells appear in the blood.
- (vii) After birth has to be done repeatedly
- (viii) Effective in embryonic condition/before birth

## Question 11

[3]

Study the table given below. Do not copy the table, but write the answers in the correct order.

Scientific Name	Commercial Product	Use
(a)_____	Streptokinase	(b) _____
<i>Monascus purpureus</i>	(c)_____	(d)_____
(e)_____	Lactic acid	(f)_____

### Comments of Examiners

Majority of the candidates showed following lapses:

- mis-spelt Streptococcus.
- Either unable to write the use of Streptokinase or mentioned that it is used in dairy products instead of in curd, in bakeries, in production of antibiotics, for clotting instead of clot dissolving.
- mis-spelt Statins.
- Either did not write the commercial product of *Monascus purpureus* or wrote cyclosporine-A as the product of *Monascus purpureus*.
- did not write the use of *Monascus purpureus*. Or wrote its use as immunosuppressant (which is actually the role of cyclosporine-A).

### Suggestions for teachers

Discuss the scientific name, commercial product and its use.

Sub-parts (e) and (f) were answered correctly by most of the candidates. However, some candidates were unable to write the scientific name of Lactic acid.

## MARKING SCHEME

### Question 11

- (a) *Streptococcus*
- (b) Clot dissolving/clot buster/treatment of myocardial infarction/Heart attack/Thrombolytic agent
- (c) Statins
- (d) Blood cholesterol lowering agent/acts as competitive inhibitor of enzyme involved in cholesterol
- (e) *Lactobacillus*/Lactic Acid Bacteria
- (f) Curd production

## Question 12

[3]

Explain *industrial melanism*.

### Comments of Examiners

Majority of the candidates were unable to explain *industrial melanism*. The common anomalies found in the answer scripts were:

- There was no mention of different varieties of peppered moths.
- There was no mention of Natural Selection.
- General effect of industrialisation was mentioned.
- Industrial pollution and its effects on plants and animals was mentioned.
- Wrote about only industrialization, but nothing was mentioned related to biology.
- Colour of the skin of individuals was mentioned black due to deposition of melanin in their skin.

### Suggestions for teachers

- Discuss Industrial Melanism while teaching Natural Selection. Teach this topic with respect to different coloured moths, effect of industrialisation and natural selection of black moths.
- Ensure that the scope of the syllabus is referred to for all the topics mentioned therein and are explained to the students.

## MARKING SCHEME

### Question 12

*Industrial melanism:*

- (i) Two varieties of peppered moth.
- (ii) *Biston betularia* – white / dull gray
- (iii) *Biston carbonaria* – black
- (iv) Before industrialization – number of white variety was more
- (v) After industrialization – number of black variety increased.
- (vi) Due to pollution lichens disappeared
- (vii) Trees became dark
- (viii) Added advantage to black variety through camouflage
- (ix) Selective feeding by the predator birds
- (x) Directional selection/Natural selection

variety

Any effect

## Question 13

[3]

Describe the tissue culture technique in plants.

### Comments of Examiners

Most of the candidates described the tissue culture technique in plants correctly. However, a few could not attempt it correctly due to deviation from the requirement of the question. The anomalies noticed were as follows:

- wrote the advantages and uses of tissue culture.
- described the technique of hybridization in plants.
- did not use the term sterilization or mentioned the use of autoclaving technique for sterilizing plant tissue (explants)
- wrote the applications of plant tissue culture e.g. micro propagation and protoplast fusion.
- discussed the use of auxins and cytokinins for differentiation.

### Suggestions for teachers

- Advise the students to read the question attentively.
- Explain the techniques of tissue culture and hybridization separately so that students understand the difference between both.
- Discuss the technique of tissue culture with relevance of each step, e.g., why to sterilize the plant tissue and different techniques of sterilization for different components (glassware, forceps, scalpel and live tissues etc.).
- Clarify the processes involved in tissue culture in proper sequence like de-differentiation, differentiation and re-differentiation.

## MARKING SCHEME

### Question 13

The tissue culture technique in plants:

1. Selection of explants/plant tissue
2. Sterilization of explant / culture medium / instruments
3. Inoculation in the culture medium
4. Incubation under ideal / sterile / aseptic conditions
5. Callus formation
6. Differentiation (by auxins / cytokinins)
7. Generation of plantlets
8. Hardening
9. Transferred to fields
10. Organogenesis

(Any six points)

## Question 14

[3]

Define the following:

- (a) Spermiogenesis
- (b) Reproductive health
- (c) Amenorrhea

### Comments of Examiners

- (a) Some candidates defined *spermatogenesis* instead of *spermiogenesis*. A few candidates used the term *division* in place of *transformation* of spermatids to form spermatozoa.
- (b) While defining reproductive health, many candidates did not mention the word *reproduction*, thereby defining *general health*.
- (c) While defining *amenorrhea*, some candidates used the term *permanent* stoppage of menstruation, which implies menopause. Some candidates defined *lactation* and did not use the words *stoppage of menstruation* anywhere in the definition.

### Suggestions for teachers

- Stress upon the importance of key words.
- Explain the proper sequence of events in spermatogenesis.
- Clearly explain the difference between spermatogenesis and spermiogenesis.

## MARKING SCHEME

### Question 14

(a)	Spermiogenesis: Transformation of spermatid into sperm.
(b)	Reproductive health: Ability of a person to produce healthy offspring / total well-being in all aspects of reproduction (physical, physiological, psychological and social)
(c)	Amenorrhea: Stoppage of menstruation. /absence of menstrual cycle/absence of menstruation during lactation after birth of child.

## Question 15

[3]

- (a) Define the following:
  - (i) Hotspots
  - (ii) Ramsar Sites
  - (iii) Red data book

OR

- (b) Define the following:
- (i) Biodiversity
  - (ii) Eutrophication
  - (iii) PAR

## Comments of Examiners

- (a)(i) Some candidates, instead of defining *hotspots* defined *biosphere reserves*. Some candidates did not write the keyword *endemic species*.
- (ii) Very few candidates, while defining Ramsar sites, wrote the key term *wetlands*.
- (iii) Some candidates did not write the catchword *endangered* while defining Red Data Book. A few defined it as a sacred site *related to God Ram*.
- (b) Most candidates wrote the correct definitions of biodiversity and eutrophication asked in sub-parts (i) and (ii). Very few candidates defined PAR asked in sub-part (iii).

### Suggestions for teachers

- Instruct students to write key words like *high level of endemic species* or *rich in biodiversity* in defining the terms.
- Give regular practice in learning the acronyms with understanding.

## MARKING SCHEME

### Question 15

(a)	
(i)	Hotspots: a region with high level of endemic species / an area rich in biodiversity/area of high level of species richness/underthreat
(ii)	Ramsar Sites: wet land areas of biodiversity/conservation of wetlands.
(iii)	Red data book: book containing list of endangered species/rare flora and fauna.
<b>OR</b>	
(b)	
(i)	Biodiversity: Degree of variation of life forms/variety of organisms in an area/richness of organisms in an area/totality of genes, species and ecosystems of a given region.
(ii)	Eutrophication: process of accumulation of inorganic nutrients in an aquatic ecosystem/nutrient enrichment/dumping of domestic and industrial wastes in water leading to depletion of oxygen/Deadening of water bodies/algal bloom.
(iii)	PAR: it is the amount / wavelength of light available for photosynthesis.

## SECTION C (15 Marks)

(Answer all questions)

### Question 16

[5]

(a) Describe post transcriptional processing of RNA in eukaryotes.

OR

(b) Describe Avery, McLeod and McCarty's experiment. State its significance.

### Comments of Examiners

- (a) Some candidates, instead of describing the process of post-transcriptional processing, described transcription. While explaining *capping* and *tailing*, many candidates did not mention *5-end* or *3-end*. Some candidates, when writing on *splicing*, mentioned only *removal of intron* without mentioning *followed by joining of exons*.
- (b) Many candidates, instead of describing Avery, McLeod and McCarty's experiment, described Griffith's experiment or Meselson and Stahl's experiment. Some candidates mentioned the use of DNAase, RNAase and protease but did not correlate it with the corresponding observations.

### Suggestions for teachers

- Lay stress on the importance of directionality.
- Discuss specific steps in detail and correlate each step with the previous step and the next step.
- Ensure that the requirement for splicing is understood by the students by explaining that the eukaryotic gene is interrupted and hence exons have to be excised for it to be functional.
- Explain the three experiments, Griffith's, Avery et al's, and Hershey and Chase's experiments together and compare them to prove that DNA is the genetic material
- Correlate the principles involved in these experiments with the procedures followed in each experiment.

## MARKING SCHEME

### Question 16

(a) Post transcriptional processing of RNA in eukaryotes:

Definition: Changes in primary transcript (hnRNA) to mature / functional mRNA.

- 5' capping – with methylguanosine
- Poly –A tail – addition of adenylate residues at 3' end
- Splicing of introns/removing introns
- Joining of Exons



	Capping and tailing prevents degradation of mRNA	(Any five)
<b>OR</b>		
(b)	<p>Avery, McLeod and McCarty's experiment:</p> <ul style="list-style-type: none"> <li>• Extracted and purified proteins, DNA, RNA, etc. from heat killed S-strain bacteria. <i>/Pneumococci</i></li> <li>• Treated the extract with <u>protease</u>, <u>RNase</u> and <u>DNase</u></li> <li>• DNase treated extract did not kill the mice</li> </ul> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">           Protease RNase         </div> <div style="border-left: 1px solid black; border-right: 1px solid black; border-bottom: 1px solid black; padding: 5px; margin-left: 10px;">           Mice killed         </div> </div> <ul style="list-style-type: none"> <li>• Proved DNA is the genetic material</li> </ul> <p>Significance - Hereditary material can be extracted from one organism and introduced into another (transformation)/DNA is a transforming principle</p>	

## Question 17

[5]

(a) Write a short note on Chipko Movement.

**OR**

(b) Write a short note on Joint forest management.

### Comments of Examiners

- (a) Majority of the candidates wrote on Chipko Movement correctly. Some candidates, however, mentioned incorrect names of the famous personalities associated with this Movement.
- (b) Most of the candidates considered the word *joint forest management* in literal terms and wrote that all the forests of the country should be *joined* together. Many candidates could not explain the collaborative efforts between the Forest Department (Government) and Local Tribes/villagers for sustainable development of forest without damaging the ecosystem.

### Suggestions for teachers

- Discuss the relevant points related to the Chipko movement along with the specific names of the village, place and leaders associated with this movement.
- Explain to the students, the meaning of the word *joint* in *joint forest management*. Clarify the reason for its implementation and the strategy to implement it.

## MARKING SCHEME

### Question 17

(a)	<p>Chipko movement:</p> <ul style="list-style-type: none"> <li>• People lost their lives</li> <li>• Related to forest conservation</li> </ul>
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	<ul style="list-style-type: none"> <li>• Villages in Garhwal started this movement</li> <li>• To protect the trees from cutting /felling</li> <li>• Gained momentum under the leadership of Sunderlal Bahuguna/Amrita Devi</li> <li>• Trees were hugged by rural people/embraced the trees</li> <li>• Chipko name given means embrace</li> <li>• Prevented contractors from cutting the trees.</li> <li>• This became a turning point in the history of eco-development.</li> <li>• Movement encourages planting of trees for timber/food/shelter/making villages self-sufficient.</li> <li>• Amrita Devi Award instituted <span style="float: right;"><i>(Any five)</i></span></li> </ul>
<b>OR</b>	
(b)	<p>Joint forest management:</p> <ul style="list-style-type: none"> <li>• Established by the Government of India.</li> <li>• Involves both, state forest department and local rural communities</li> <li>• Currently 17.30 hectares forest area under them</li> <li>• Rural communities protect the forest from fire/ grazing/ illegal harvesting/Poaching</li> <li>• In return forest department provides non-timber forest products and share of revenue from the sale. / provides employment</li> <li>• Products offered are gums, resins and medicines.</li> <li>• Avoid urban tribal conflict. <span style="float: right;"><i>(Any five)</i></span></li> </ul>

## Question 18

[5]

(a) What does PCR stand for? Describe the different steps of PCR.

**OR**

(b) Give an account of the Blue-White Method of selection of recombinants.

## Comments of Examiners

- (a) Majority of the candidates could not answer this question correctly. Many candidates described the process of DNA replication and DNA fingerprinting. Some candidates wrote the full form of PCR as *Police Control Room / Private Community Rational / Pulmonary Cardio Resuscitation*. While describing PCR, very few candidates mentioned the exact temperatures which cause Denaturation, Annealing and Extension. Only a few candidates mentioned the role of Taq polymerase in this technique.
- (b) Majority of the candidates described the occurrence of blue and white moths and the role of natural selection. Candidates were confused between recombinants and non-recombinants. Several candidates wrote that the *recombinant colonies turn blue* and *non-recombinant colonies remain white*, which was just the *opposite* of the correct answer. Many candidates did not mention the role of the gene *lacZ* and the enzyme beta-galactosidase in this process.

### Suggestions for teachers

- Explain the significance of temperature at each step of PCR technique and the specific reason for using Taq polymerase (temperature resistant).
- Clarify to the students that the gene *LacZ* is inactivated due to insertion of the foreign DNA, hence recombinant colonies do not express beta-galactosidase, thus, X-Gal (chromogenic substance) cannot be converted into blue-coloured metabolite.

## MARKING SCHEME

### Question 18

- (a) **Polymerase Chain Reaction:** It is a method of making multiple copies of the gene of interest (gene amplification) *in vitro* using oligonucleotides and DNA polymerase.

Or

PCR technique is used for gene amplification.

Steps:

(i) **Denaturation:**

- Target DNA heated to a high temperature (94-96 °C)
- results in the separation of two strands
- Each strand serves as a template for DNA synthesis.

(ii) **Annealing:**

The two oligonucleotide primers are annealed (hybridized) to each single stranded DNA following rule of complementarity. (60 °C)

It is caused at low temperature (40<sup>0</sup> - 60<sup>0</sup>)

(iii) **Extension (Polymerisation):**

With the help of Taq DNA Polymerase

DNA is synthesized between the primers using dNTPs and Magnesium ions (72 °C).

- (iv) The newly synthesized DNA is subjected to same procedure to double the DNA content from the previous cycle.

Accept properly labelled diagram or flow chart

**OR**

(b) Blue-White Method of selection of recombinants:

1. Based on insertional inactivation
2. Foreign gene inserted or using restriction endonuclear/Ligase
3. Lac Z gene (coding for Beta – galactosidase enzyme)
4. Beta – galactosidase converts colourless substrate (chromogenic substrate) (X-gal) into blue coloured product.
5. In transformed hosts Lac Z inactivated due to insertion of foreign DNA.
6. Non-transformed colonies convert colourless X-gal into blue coloured product.
7. Transformed colonies remain white.
8. It helps to differentiate between transformant/recombinant and non-transformant/ non-recombinant.

*(Any five)*

## GENERAL COMMENTS

### Topics found difficult by candidates

- Bio patent
- Ecosystem (Food chain)
- Acronyms BOD, PAR, PCR, SCID
- Human evolution
- Gene therapy / SCID
- Role of microbes in human welfare
- Industrial melanism
- Ramsar sites
- Blue-white method of selection of recombinants
- Oestrous cycle
- Structure of DNA
- Punnett square

### Concepts in which candidates got confused

- Source of opium (*Papaver* / *Cannabis*)
- Avery, McCleod, McCarty's experiment / Griffith's experiment
- Abiogenesis / Biogenesis
- Bio patent / Bio piracy
- Parthenocarpy / Parthenogenesis / Apomixis
- Global warming / Ozone hole
- Types of immunity
- Tissue culture technique / Plant hybridization
- Spermiogenesis / Spermatogenesis
- Hotspots / Biosphere reserves
- Amenorrhoea / Lactation

### Suggestions for candidates

- Avoid selective study and rote learning.
- Study all topics thoroughly.
- Lay stress on understanding the terms/concepts instead of rote learning.
- Learn main laws, principles and key-words/acronyms with proper understanding.
- Learn the biological names and scientific terms with correct spellings.
- Follow binomial nomenclature.
- Prepare short notes of the concepts using reference books, magazines, journals, projects etc. as it is easier to study.
- Use actual specimen for the diagram and not the book.
- Read the question carefully, understand it and then proceed.
- Write answers point-wise rather than in the form of an essay.
- Answers should be written in the correct sequence.
- Differences must be written in tabular form and should be compatible.
- Draw neat labelled diagrams.