Analysis of Pupil Performance

ISC Year 2018 Examination

Sciences & Mathematics

PHYSICS

Research Development and Consultancy Division

Council for the Indian School Certificate Examinations

New Delhi

Year 2018

***Published by*:**

Research Development and Consultancy Division (RDCD)

Council for the Indian School Certificate Examinations

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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.

Gerry Arathoon
Chief Executive & Secretary

October 2018

PREFACE

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.

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.

Shilpi Gupta
Deputy Head - RDCD

October 2018

CONTENTS

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.

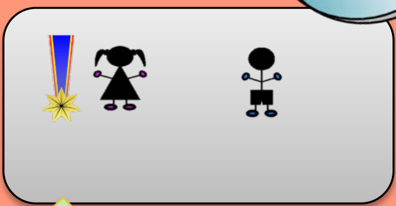
Given below is an example showing the comparison tables used in this section and the manner in which they should be interpreted.

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.



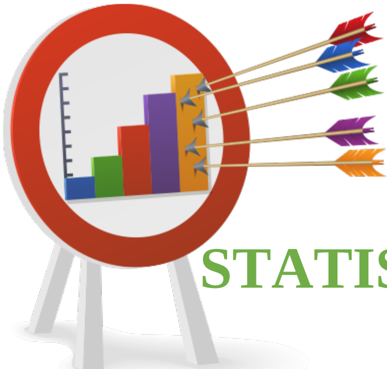
The results have also been depicted pictographically. In this case, the girls performed significantly better than the boys. This is depicted by the girl with a medal.

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

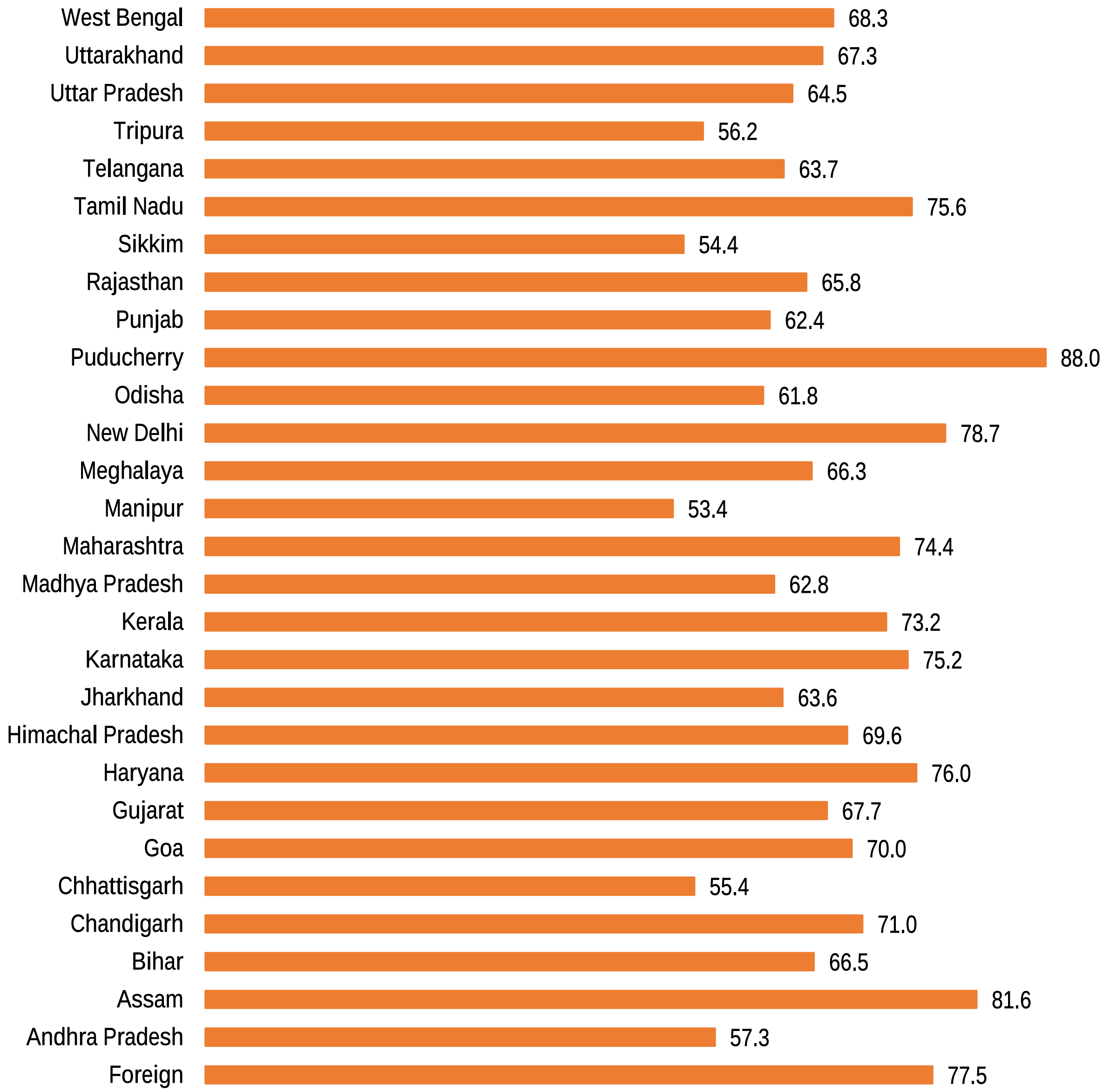
Total Number of Candidates: 42,069

Mean Marks: 66.5

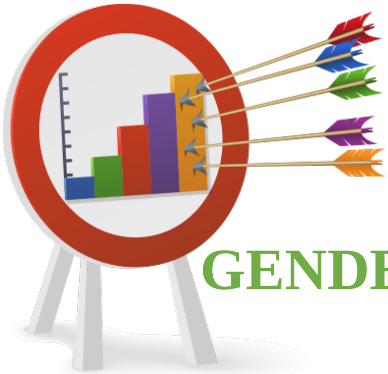
Highest Marks: 100

Lowest Marks: 03

PERFORMANCE (STATE-WISE & FOREIGN)



The States/ UTs of Puducherry, Assam and New Delhi secured highest mean marks. Mean marks secured by candidates studying in schools abroad were 77.5.



GENDER-WISE COMPARISON

GIRLS

Mean Marks: 67.0

Number of Candidates: 17,239

BOYS

Mean Marks: 66.2

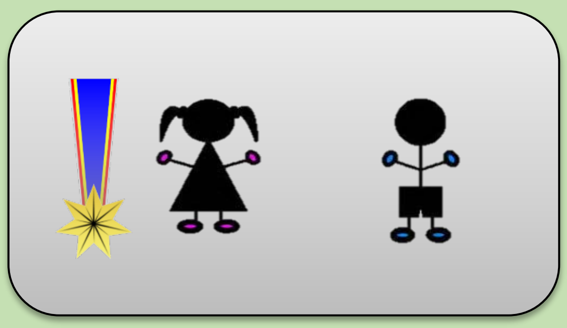
Number of Candidates: 24,830

Comparison on the basis of Gender

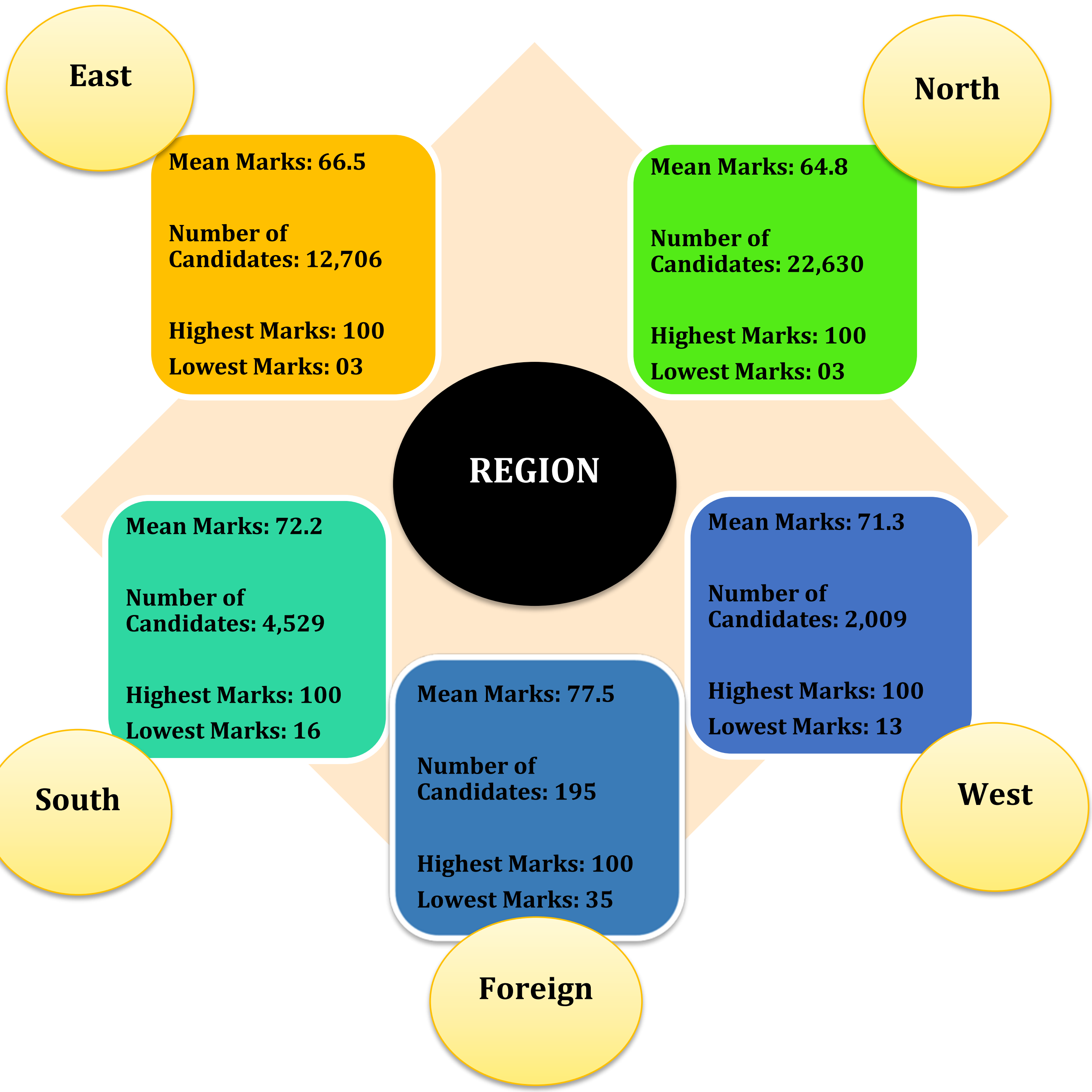
Gender	N	Mean	SE	t-value
Girls	17,239	67.0	0.14	4.54*
Boys	24,830	66.2	0.12	

*Significant at 0.05 level

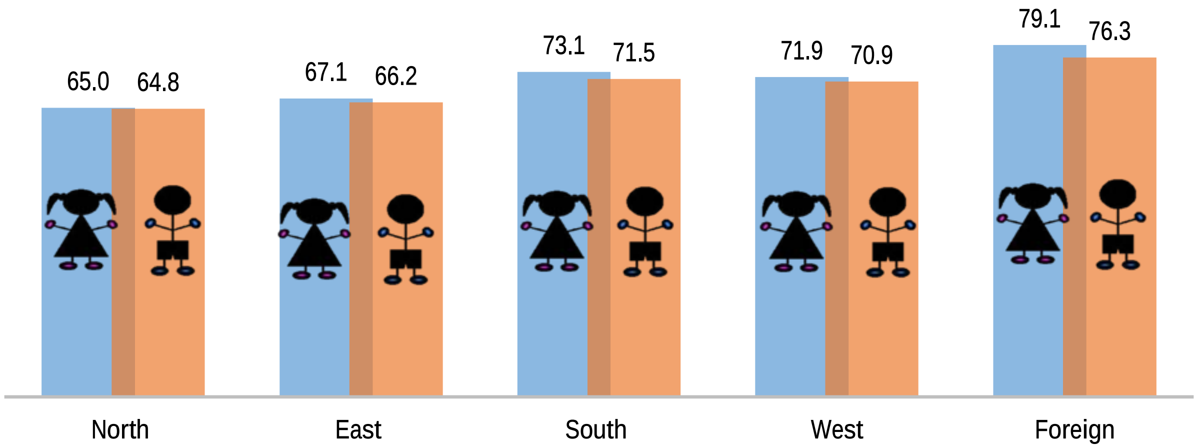
Girls performed significantly better than boys.



REGION-WISE COMPARISON



Mean Marks obtained by Boys and Girls-Region wise

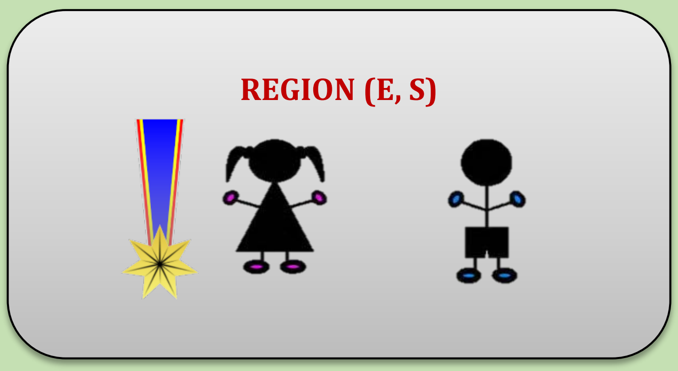


Comparison on the basis of Gender within Region

Region	Gender	N	Mean	SE	t-value
North (N)	Girls	9,039	65.0	0.19	0.92
	Boys	13,591	64.8	0.16	
East (E)	Girls	5,142	67.1	0.26	2.59*
	Boys	7,564	66.2	0.23	
South (S)	Girls	2,203	73.1	0.37	3.12*
	Boys	2,326	71.5	0.37	
West (W)	Girls	771	71.9	0.68	1.14
	Boys	1,238	70.9	0.56	
Foreign (F)	Girls	84	79.1	1.83	1.13
	Boys	111	76.3	1.73	

*Significant at 0.05 level

The performance of girls was significantly better than that of boys in the eastern and southern region. In other regions no significant difference was observed.



MARK RANGES : COMPARISON GENDER-WISE

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

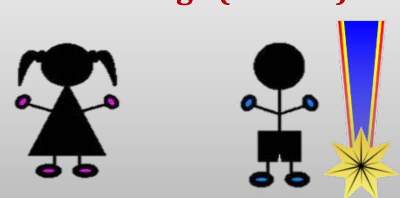
Marks Range	Gender	N	Mean	SE	t-value
Top Range (81-100)	Girls	4,919	89.2	0.08	-3.50*
	Boys	7,094	89.5	0.06	
Bottom Range (0-20)	Girls	8	16.6	1.86	0.53
	Boys	28	15.5	1.04	

*Significant at 0.05 level

Marks Range (81-100)

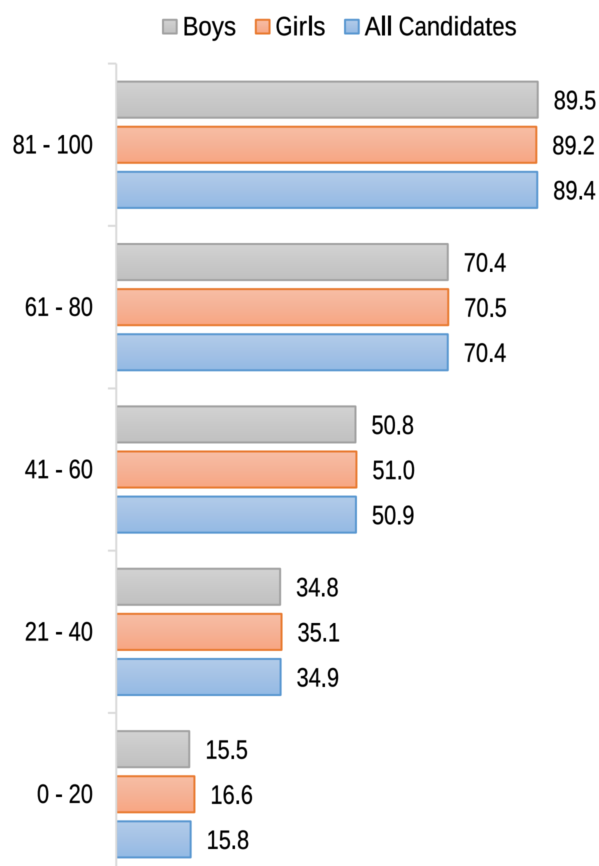
Performance of boys was significantly better than the performance of girls .

Marks Range (81-100)



Marks Range (0-20)

No significant difference was found in the performance of girls and boys in the bottom marks range.



GRADES AWARDED : COMPARISON GENDER-WISE

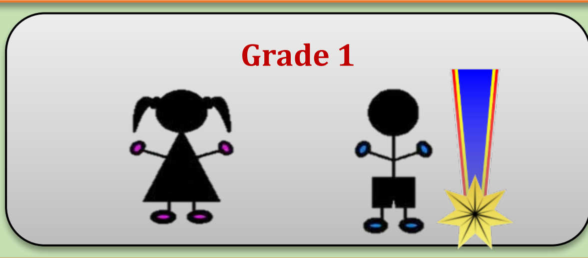
Comparison on the basis of gender in Grade 1 and Grade 9

Grades	Gender	N	Mean	SE	t-value
Grade 1	Girls	2,278	94.1	0.06	-2.75*
	Boys	3,470	94.3	0.05	
Grade 9	Girls	461	29.2	0.14	2.27*
	Boys	867	28.7	0.13	

*Significant at 0.05 level

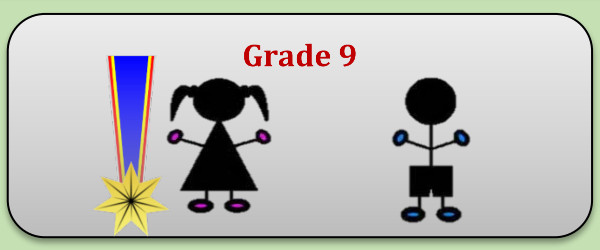
Grade 1

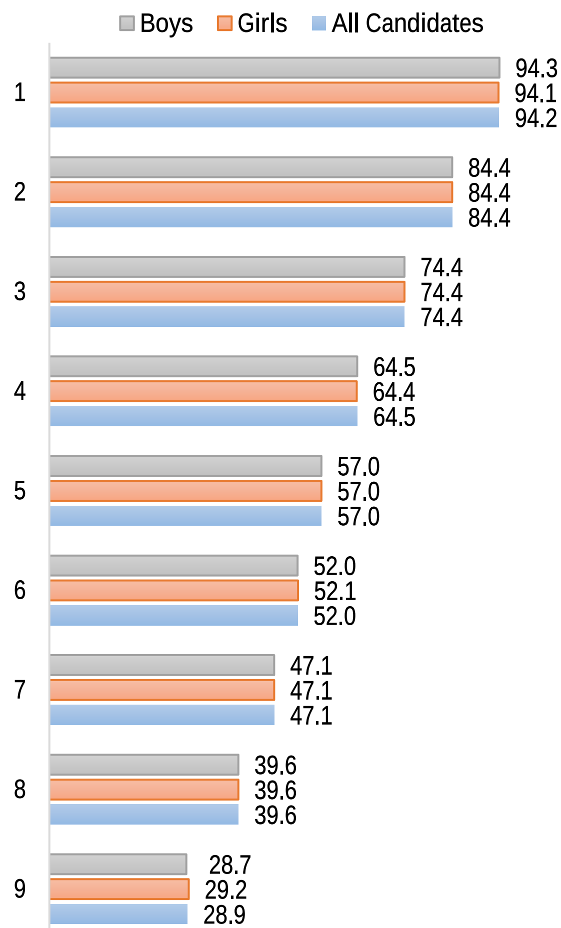
Performance of boys was significantly better than the performance of girls .



Grade 9

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





QUALITATIVE ANALYSIS

THEORY (PAPER 1)

Section A

*Answer **all** questions.*

Question 1

(A) Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: **[5×1]**

(i) The order of coloured rings in a carbon resistor is red, yellow, blue and silver. The resistance of the carbon resistor is:

(a) $24\times10^{6}\ \Omega \pm 5\%$

(b) $24\times10^{6}\ \Omega \pm 10\%$

(c) $34\times10^{4}\ \Omega \pm 10\%$

(d) $26\times10^{4}\ \Omega \pm 5\%$

(ii) A circular coil carrying a current I has radius R and number of turns N. If **all** the three, i.e. the current I, radius R and number of turns N are doubled, then, **magnetic field** at its centre becomes:

(a) Double

(b) Half

(c) Four times

(d) One fourth

(iii) An object is kept on the principal axis of a **concave mirror** of focal length 10 cm, at a distance of 15 cm from its pole. The image formed by the mirror is:

(a) Virtual and magnified

(b) Virtual and diminished

(c) Real and magnified

(d) Real and diminished

(iv) **Einstein's** photoelectric equation is:

(a) $E_{max} = h\lambda - \varphi_0$

(b) $E_{max} = \frac{hc}{\lambda} - \varphi_0$

(c) $E_{max} = h\nu + \varphi_0$

(d) $E_{max} = \frac{hc}{\lambda} + \varphi_0$

(v) In **Bohr's** model of hydrogen atom, radius of the first orbit of an electron is r_0. Then, radius of the **third** orbit is:

(a) $\frac{r_0}{9}$

(b) r_0

(c) $3r_0$

(d) $9r_0$

(B) Answer the following questions briefly and to the point. **[7×1]**

(i) In a **potentiometer** experiment, balancing length is found to be 120 cm for a cell E_1 of emf 2V. What will be the balancing length for another cell E_2 of emf 1·5V? (No other changes are made in the experiment.)

(ii) How will you convert a moving coil galvanometer into a **voltmeter**?

(iii) A moving charged particle **q** travelling along the positive x-axis enters a uniform magnetic field **B**. When will the **force** acting on **q** be **maximum**?

(iv) Why is the core of a transformer **laminated**?

(v) Ordinary (i.e. unpolarised) light is incident on the surface of a transparent material at the **polarising angle**. If it is partly reflected and partly refracted, what is the angle between the reflected and the refracted rays?

(vi) Define **coherent** sources of light.

(vii) Name a **material** which is used in making **control rods** in a nuclear reactor.

Comments of Examiners

A. (i) Many candidates made mistake in decoding tolerance percentage and selected option (a) in this part, in place of correct option (b).

(ii) Some candidates could not recall the correct formula while a few made errors in calculation.

(iii) Many candidates got confused between *real and magnified* and *virtual and diminished image* formed by the mirror.

(iv) This question was attempted correctly by most of the candidates. A few were not clear about the symbols.

(v) A few candidates either chose alternative (a) or (c) instead of (d).

B. (i) Some candidates made calculation errors, and a few did not express the answer with unit.

(ii) Most of the candidates attempted this part of the question correctly.

(iii) Most candidates answered this question correctly.

(iv) Most of the candidates could not write the correct reason for lamination of the core of a transformer.

(v) The angle between the reflected and the refracted rays was written correctly by most of the candidates.

(vi) Most candidates defined coherent sources of light correctly.

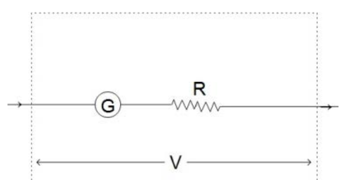
(vii) A few candidates wrote incorrect name of the material used for making control rods in a nuclear reactor**.**

Suggestions for teachers

- Develop the concept of *tolerance* by putting up more questions in the class.
- Give ample practice to students by discussing conceptual problems/ numerical problems in class to develop understanding of mathematical formulae, equations, laws and principles.
- Clarify the concept of magnification and sign-convention with the help of numerical and conceptual problems.
- Explain the relation between the radius and number of the orbit, the difference between the energy and the radius, quantization formula for H – atom clearly and give sufficient practice in class.
- Advise students to learn definitions, laws, principles in Physics, by heart and to practise by writing frequently.
- Clarify about shunt and its use in the electrical circuit.
- Teach students the vector equation like $\vec{F} = q(\vec{v} \times \vec{B})$ and the idea of maximum force along with direction and discuss it with appropriate examples.
- Give students enough practice of drawing labelled diagrams.
- Teach wave optics explaining the meaning and importance of terms such as, coherent sources of light with minute details.
- Revise the functions of each component in a nuclear reactor especially graphite/ D_2O for moderators and cadmium/boron for control rods from time to time.

MARKING SCHEME

Question 1

(A)		
	(i)	(b) or $24\times10^{6}\,\Omega \pm 10\%$
	(ii)	(a) or Double
	(iii)	(c) or Real and magnified
	(iv)	(b) or $\frac{hc}{\lambda} - \varphi_0$
	(v)	(d) or 9 r_0
(B)		
	(i)	$\frac{E_1}{E_2} = \frac{l_1}{L_2}$ or $\frac{2}{1{\cdot}5} = \frac{120}{L_2}$ $\therefore\ L_2 = 90\ cm$ **or** *answer expressed with any alternate correct unit.*
	(ii)	By connecting a high resistance in series with the galvanometer. **OR** A correct diagram. 
	(iii)	When it is moving perpendicular to the magnetic field. **OR** 90^{o} / $\pi/2$ / $\perp$ / correct diagram/ **OR** B is along Y axis **or** B is along Z axis.
	(iv)	To minimize the loss due to induced current or eddy current.
	(v)	90^{o} / $\pi/2$ / $\perp$ to each other/ shown in the diagram
	(vi)	Sources which emit light waves which are either in phase / which have a zero / a constant phase difference. (Same wavelength or frequency; same amplitude)
	(vii)	Cadmium, boron, silver and Indium *(Any one)*

Section B

*Answer **all** question.*

Question 2

[2]

Define **current density**. Write an expression which connects **current density** with **drift speed**.

Comments of Examiners

Most candidates defined current density correctly but could not write correct relation between current density and drift speed.

Suggestions for teachers

Teach students clearly about defining equations and their relationship with other parameters.

MARKING SCHEME

Question 2

Current density is defined as current per unit cross sectional area. **Or** I/A

Current density, J = n v_d e **or** n v e **or** $\frac{Nve}{V}$

Question 3

[2]

(a) A long horizontal wire P carries a current of 50A. It is rigidly fixed. Another wire Q is placed directly above and parallel to P, as shown in ***Figure 1*** below. The weight per unit length of the wire Q is 0·025 N m^{-1} and it carries a current of 25A. Find the distance '**r**' of the wire Q from the wire P so that the wire Q remains at rest**.**

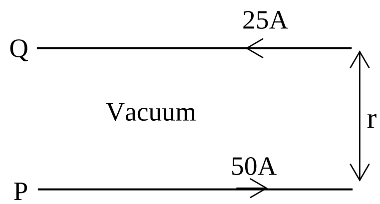


Figure 1

OR

(b) Calculate **force per unit length** acting on the wire B due to the current flowing in the wire A. (See ***Figure 2*** below)

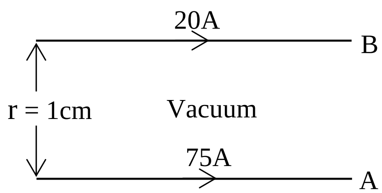


Figure 2

Comments of Examiners

(a) Some candidates used incorrect formula $\frac{F}{l} = \left(\frac{\mu_0}{4\pi}\right)\frac{II'}{r}$ or $\frac{F}{l} = \left(\frac{\mu_0}{4\pi}\right)\frac{II'}{r^2}$ to calculate the distance of the wire Q from the wire P. Several candidates could not interpret the relation between force and weight.

(b) Candidates who had attempted part (b) of this question, also made similar type/s of error/s as both parts (a) and (b) involved the same expression.

Suggestions for teachers

Give ample practice to students in correct usage of the formula, substitution and units.

MARKING SCHEME

Question 3

(a)	$\frac{F}{l} = \left(\frac{\mu_0}{4\pi}\right)\frac{2II'}{r}$ **or** $\frac{\mu_0 II'}{2\pi r}$ **or** $\frac{\mu_0 I_1 I_2}{2\pi r}$ **OR** $0.025 = \frac{10^{-7}\times 2\times 50\times 25}{r}$ $\therefore$ r = 0·01 m or 1cm	 Correct substitution with or without formula
(b)	$F' = \left(\frac{\mu_0}{4\pi}\right)\frac{2I\,I'}{L}$ **OR** $= 10^{-7}\times\frac{2\times 20\times 75}{0{\cdot}01}$ $=3\times 10^{-2}\quad Nm^{-1}$	 Correct substitution with or without formula Correct answer with correct unit

Question 4

[2]

(i) Explain **Curie's law** for a paramagnetic substance.

(ii) A rectangular coil having 60 turns and area of $0{\cdot}4 m^2$ is held at right angles to a uniform magnetic field of flux density 5×10^{-5}T. Calculate the magnetic **flux** passing through it.

Comments of Examiners

(i) Most candidates defined curie temperature instead of the relation of magnetic susceptibility and absolute temperature.

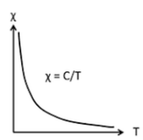
(ii) In calculation of magnetic flux, some candidates did not understand the concept of using angle i.e., the angle made by the coil with the magnetic field.

Suggestions for teachers

A clear understanding of the angle is called for from the students in the expression $\varphi = BA \cos \theta$, where θ is the angle between area vector, A and magnetic field B, not the angle between plane of the coil and magnetic field. Visual meaning of the same should be done in details.

MARKING SCHEME

Question 4

(i)	Magnetic susceptibility of a paramagnetic substance varies inversely with its absolute temperature. OR $\chi = \frac{C\,\mu_0}{T}$ **OR** $\boldsymbol{\chi\ \alpha\ \frac{1}{T}}$ **OR**  *(Alternate correct statements also acceptable.)*
(ii)	Φ = **BAN** $= 60\times5\times10^{-5}\times0{\cdot}4$ $= 1{\cdot}2\times10^{-3}$ Wb correct answer expressed with any alternate correct unit. OR If the angle between the magnetic field and area vector is taken to be 90^0. Then, $\Phi = BAN \cos 90^0 = 0$

Question 5

[2]

What is **motional emf?** State **any two** factors on which it depends.

Comments of Examiners

Most of the candidates did not know the correct meaning of motional *emf*. Some defined batteries *emf* while some mentioned changing flux causes *emf* etc.

Suggestions for teachers

Explain the phenomenon of electromagnetic induction to students comprehensively.

MARKING SCHEME		
Question 5		
	(i)	It is the emf induced in a conductor (rod / disc) due to its motion in a magnetic field.
	(ii)	(a) length of the rod (b) magnetic flux density (c) velocity (with which it is moved) (d) Sin **θ** (where θ is the angle between the rod and the field) *(Any two)*

[2]

Question 6

(i) What is the **ratio** of the speed of gamma rays to that of radio waves in vacuum?

(ii) Name an electromagnetic wave which is used in the **radar** system used in aircraft navigation.

Comments of Examiners

(i) A few candidates used the ratio of wave length to find the ratio of speed in vacuum.

(ii) Some candidates wrote IR rays or UV rays or X-rays as the answer.

Suggestions for teachers

A clear understanding of properties of electromagnetic waves is called for.

MARKING SCHEME	
Question 6	
(i)	1 **OR** 1:1 OR equivalent
(ii)	Short Radio waves or Microwaves

Question 7

[2]

A biconvex lens made of glass (refractive index 1·5) has two spherical surfaces having radii 20 cm and 30 cm. Calculate its **focal length**.

Comments of Examiners

Many candidates made errors in the formula – they used R= f and then $1/F = 1/f_1 + 1/f_2$ and most of the candidates also did not apply the correct sign in the formula $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} \mp \frac{1}{R_2}\right)$

Suggestions for teachers

- Stress upon drawing correct ray-diagrams with arrows marked on the straight lines indicating the path of light.
- Give adequate practice of the numerical with correct sign convention.

MARKING SCHEME

Question 7

$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} \mp \frac{1}{R_2}\right)$

OR

$= (1 \cdot 5 - 1)\ (\frac{1}{20} + \frac{1}{30})$

$\therefore \quad f = 24\ cm$

Question 8

[2]

State **any two** differences between **primary** rainbow and **secondary** rainbow.

Comments of Examiners

Most of the candidates were able to attempt this question correctly.

Suggestions for teachers

Give ample practice in drawing the correct diagram along with correct positions of red and violet colours with correct semi vertical angles .

MARKING SCHEME

Question 8

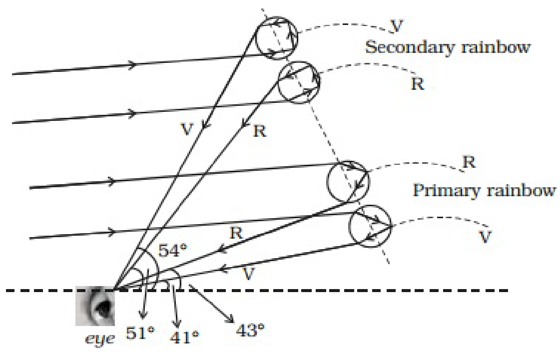
Any *two* of the following:

1. Total internal reflection takes place once in primary rainbow and twice in secondary rainbow.
2. Primary rainbow has violet colour on the inner edge whereas secondary rainbow has red colour on inner edge.

OR

Primary rainbow has red colour on the outer edge whereas secondary rainbow has violet colour on outer edge.

3. Primary rainbows are brighter than secondary rainbows.
4. Secondary rainbow is larger than primary rainbow.
5. Semi vertical angle for primary rainbow is 41^0 to 43^0 and that for a secondary rainbow is 51^0 to 54^0.



Question 9

[2]

(i) State **de Broglie** hypothesis.

(ii) With reference to **photoelectric** effect, define **threshold wavelength**.

Comments of Examiners

(i) Many candidates did not write the key word 'moving' in stating the **de Broglie** hypothesis.

(ii) A number of candidates did not understand that the wavelength corresponding to threshold frequency is not minimum but maximum wavelength beyond which no emission takes place.

Suggestions for teachers

- Stress upon the keyword *moving* while teaching the de Broglie hypothesis in class. All moving particles (not only charges like e^-) exhibit wave nature.
- Explain to students that for photons $c = \nu \times \lambda$, i.e., frequency and wave length have inverse relationship, for the smallest frequency, λ must be the largest.

MARKING SCHEME **Question 9**	
(b)	Moving particles can behave like waves. OR Moving particles can show wave nature OR Moving Particles show / exhibit dual nature OR $\lambda = \frac{h}{p}$ where p is momentum OR $\lambda = \frac{h}{mv}$
(b)	Maximum or the largest wavelength of incident radiation / light for which photoelectric effect takes place / observed / metal emits electrons.

[2]

Question 10

Calculate the **minimum** wavelength of the spectral line present in **Balmer** series of hydrogen.

Comments of Examiners

A few candidates made mistakes in calculation of the **minimum** wavelength of the spectral line present in **Balmer** series of hydrogen. They wrote $n_1 = 2$ and $n_2=3$ instead of $n_2 = \infty$, as a result giving longest wavelength. They did not understand the difference of energy levels correctly.

Suggestions for teachers

Give adequate practice in solving numerical for calculation of frequency/wavelength of different lines of emission spectra.

MARKING SCHEME **Question 10**	
	$\frac{1}{\lambda_{min}} = R\left[\frac{1}{2^2} - \left(\frac{1}{\infty}\right)\right]$ OR $\frac{1}{\lambda_{min}} = \frac{R}{4}$ OR $\frac{1}{\lambda_{min}} = \frac{1{\cdot}097\times10^7}{4}$ So, $\lambda_{min} = 3{\cdot}646\times10^{-7}$ m 364·6 nm or equivalent Alternate method: $\frac{hc}{\lambda} = E_\infty - E_2$

	= 0 – (- 3.4) OR $\frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{\lambda} = 3.4 \times 1.6 \times^{-19}$ (n_1 = 2 & n = ∞) λ_{min} = 3·646×10^{-7} m (Accept 'λ' in the range 3·63×10^{-7} m to 3·65×10^{-7} m)

Question 11

[2]

(a) What is meant by **pair annihilation**? Write a **balanced** equation for the same.

OR

(b) What is meant by the terms **half-life of a radioactive substance** and **binding energy of a nucleus**?

Comments of Examiners

(a) Many candidates were confused between *pair annihilation* and *pair production.*

(b) *Half-life* was correctly explained by most candidates but only a few candidates could write the correct meaning of *binding energy of a nucleus*.

Suggestions for teachers

– Teach students mass energy principle in depth to give them clear understanding of pair annihilation and pair production.

– Explain clearly the various terms discussed in Nuclear physics (e.g., half-life, mean life, disintegration constant, mass defect, binding energy etc.) and ensure by giving ample practice that they understand the terms and are able to apply them in different numerical problems.

MARKING SCHEME

Question 11

(a)	When a particle / electron meets an antiparticle / positron, they destroy / each other, creating energy. Annihilate. ${}_{-1}^{0}e + {}_{1}^{0}e \rightarrow \gamma + \gamma$ OR ${}_{-1}^{0}e + {}_{1}^{0}e \rightarrow h\nu + h\nu$ OR ${}_{-1}^{0}\beta + {}_{+1}^{0}\beta \rightarrow \gamma + \gamma$

(b)	Half-life: It is that time in which a given amount of radioactive substance becomes half. **OR** It is that time in which half the given number of nuclei disintegrate. Binding energy of a nucleus: It is the minimum amount of energy required to separate all the nucleons/protons and neutrons of a nucleus from each other.

Question 12

[2]

In a **communication** system, what is meant by **modulation**? State **any two** types of modulation.

Comments of Examiners

Many candidates did not define the modulation correctly.

Suggestions for teachers

Ensure that students understand the term *modulation* and its types.

MARKING SCHEME

Question 12

Modulation: Superposition or overlapping of a modulating wave /signal / low frequency wave on a carrier wave / high frequency wave is called modulation.

Any two of the following:

1. Amplitude modulation or AM
2. Frequency modulation or FM
3. Phase modulation or PM

Question 13

[3]

Obtain an expression for intensity of electric field at a point in **end on** position, i.e. **axial** position of an electric dipole.

Comments of Examiners

A few candidates derived an expression for intensity of electric field at a point in broad side **on** position, instead of **end on** position of an electric dipole.

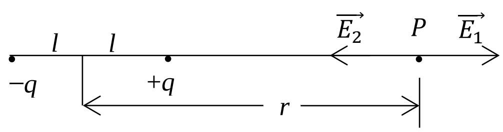
Some candidates used *1/r* in place of $1/r^2$ in electric field formula, for calculation of electric field intensity at a point due to a charge at a point. Several candidates made mathematical errors in calculation of the resultant electric field while some took dipole moment as *q.l* in place of *q.2l*.

Suggestions for teachers

- Explain the role of vectors in Physics, especially in Electric charges and Fields.
- Train students to read the question carefully. Advise them to pause and think over before writing the answer.
- Advise students to study and practice diagrams, along with learning of derivations.

MARKING SCHEME

Question 13



$$E_1 = \frac{1}{4\pi\epsilon_0} \quad \frac{q}{(r-l)^2}$$
$$E_2 = \frac{1}{4\pi\epsilon_0} \quad \frac{q}{(r+l)^2}$$

$$E = E_1 - E_2$$

$$E = \frac{1}{4\pi\epsilon_0} \quad \frac{2\,p\,r}{(r^2-l^2)^2}$$ / with some working

or $$E = \frac{1}{4\pi\epsilon_0} \quad \frac{4\,qlr}{(r^2-l^2)^2} \quad / \quad \frac{qlr}{\pi\epsilon_0(r^2-l^2)^2}$$

$$E = \frac{1}{4\pi\epsilon_0} \quad \frac{2\,pr}{(r^2-l^2)^2}$$

$$\mathbf{E = \frac{1}{4\pi\epsilon_0} \quad \frac{2\,p}{r3}}$$ **for r >> *l***

Question 14

[3]

Deduce an expression for **equivalent** capacitance C when three capacitors C_1, C_2 and C_3 are connected in **parallel**.

Comments of Examiners

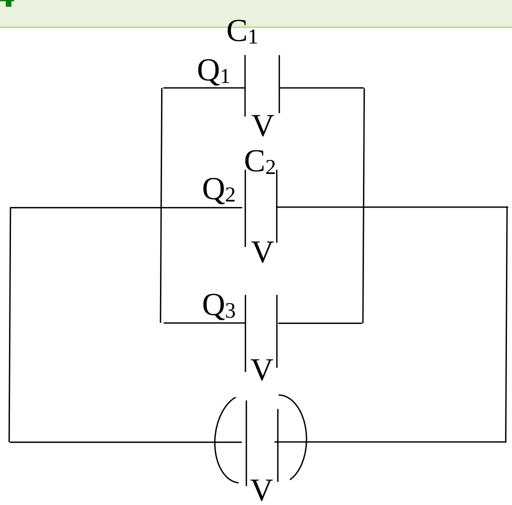
Some candidates could not draw the correct diagram required for deducing an expression for **equivalent** capacitance for three capacitors connected in parallel. For obtaining equivalent capacitance, a few candidates used Q to be constant and V different ($V = V_1 + V_2 + V_3$), as a result final expression obtained for equivalent capacitance was incorrect.

Suggestions for teachers

Give ample practice of connecting capacitors in a circuit in series and in parallel combinations, clearly explaining the status of charge on each capacitor and potential difference across each capacitor.

MARKING SCHEME

Question 14



$Q = Q_1 + Q_2 + Q_3$

$CV = C_1V + C_2V + C_3V$

$\mathbf{C = C_1 + C_2 + C_3}$

Question 15

[3]

(a) ε_1 and ε_2 are two batteries having emf of 34V and 10V respectively and internal resistance of 1Ω and 2Ω respectively. They are connected as shown in ***Figure 3*** below. Using **Kirchhoff's' Laws** of electrical networks, calculate the currents I_1 and I_2.

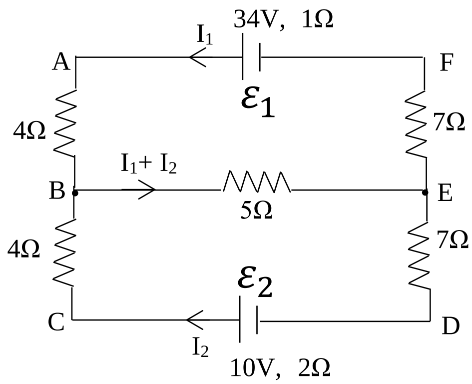


Figure 3

(b) An electric bulb is marked 200 V, 100 W. Calculate **electrical resistance** of its filament. If **five** such bulbs are connected in **series** to a 200 V supply, how much **current** will flow through them?

Comments of Examiners

(a) Many candidates could not solve this part of the question based on Kirchhoff's' Laws of electrical networks, correctly due to following reasons:
- did not consider the sign convention;
- ignored the polarity of the cells completely;
- ignored the role of internal resistance in the loops;
- could not solve the simultaneous equations formed.

(b) Some candidates could not use the formula $P = V^2/R$ correctly. Some candidates took the effective resistance R/5 instead of 5 × R while a few took the potential difference as 200 V in all of them separately.

Suggestions for teachers

- Explain Kirchhoff's laws of electrical networks comprehensively giving adequate practice in solving numerical problems based on these laws.
- Encourage students to draw a circuit diagram as per the data given in the question so as to understand by visual inspection about the magnitude of current and voltage between any two points in the circuit. Also train them to apply relevant law in different parts of the electrical circuit.

MARKING SCHEME

Question 15

(a)	In the loop ABEFA $4I_1 + 5 (I_1 + I_2) + 7I_1 + 1 I_1, = 34$ Or $17I_1 + 5I_2 = 34$ ……[1] In the loop CBEDC $4I_2 + 5 (I_1 + I_2) + 7I_2 + 2 I_2, = 10$ Or $5I_1 + 18I_2 = 10$ ……[2] Solving, equations [1] and [2], we get $I_1 = 2A$ and $I_2 = 0$ In the loop ABCDEFA. $4I_1 – 4I_2 – 2I_2 -7I_2 + 7I_1 + 1I_1 = 34 – 10$ Or $12I_1 + 13I_2 = 24$ ……..[3]
(b)	$R = \frac{V^2}{P} =/ \frac{200\times200}{100} = 400\ \Omega$ Total resistance = 5×400 = 2000 Ω Reading of ammeter = Current $= \frac{\varepsilon}{R} = \frac{200}{2000}$ = 0·1 A

Question 16

[3]

(a) For any prism, prove that:

$$\text{'n' or } \mu = \frac{Sin\left(\frac{A+\delta_m}{2}\right)}{Sin\left(\frac{A}{2}\right)}$$

where the terms have their usual meaning.

OR

(b) When two **thin** lenses are kept in contact, prove that their **combined** or **effective** focal length F is given by:

$$\frac{1}{\mathrm{F}} = \frac{1}{f_1} + \frac{1}{f_2}$$

where the terms have their usual meaning.

Comments of Examiners

(a) Some candidates could not draw the correct diagram. The arrows were also found to be missing in many cases. Some candidates could not apply the conditions for minimum deviation.

(b) Only some candidates attempted this part of the question. Common errors observed were:
  - ray diagram not drawn correctly;
  - arrows were not marked in the ray diagram;
  - sign convention was not followed.

Suggestions for teachers

- Train students to draw ray diagram of prism in minimum deviation condition.
- Give adequate practice in applying Snell's law in different situations.
- Teach students the concepts of equivalent lens and effect of combination of lenses on their focal lengths.
- In Geometrical optics (or Ray optics) emphasise on drawing correct ray diagrams with arrows marked to indicate the path of light.
- Stress upon proper sign convention.

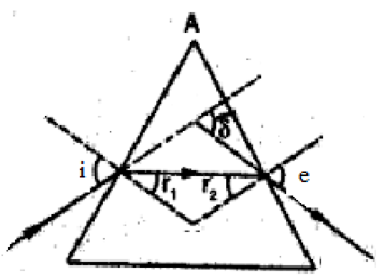
MARKING SCHOOL

Question 16

(a) For any prism:

$$A = r_1 + r_2$$

$$A + \delta = i + e$$



In minimum deviation,

$$i = e \text{ and } r_1 = r_2$$

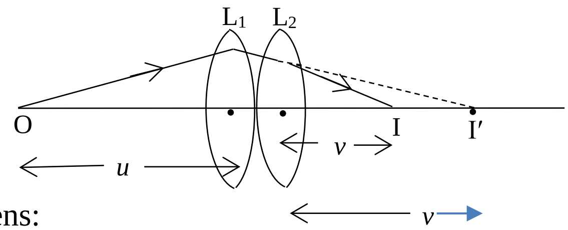
So, $i = \frac{A+\delta m}{2}$ and

$$r = \frac{A}{2}$$

By Snell's Law:

$$\mu = \frac{Sin\ i}{Sin\ r}$$

i.e. $\mu = \frac{Sin\left(\frac{A+\delta m}{2}\right)}{Sin\left(\frac{A}{2}\right)}$

	OR
(b)	 For 1st Lens: $\frac{1}{u} + \frac{1}{v'} = \frac{1}{f_1}$ OR $\frac{1}{v'} - \frac{1}{u} = \frac{1}{f_1}$ For 2nd Lens: $\frac{1}{-v'} - \frac{1}{v} = \frac{1}{f_2}$ OR $\frac{1}{v} - \frac{1}{-v'} = \frac{1}{f_2}$ On adding: $\frac{1}{u} + \frac{1}{v} = \frac{1}{f_1} + \frac{1}{f_2}$ OR $\frac{1}{v} - \frac{1}{u} = \frac{1}{f_1} + \frac{1}{f_2}$ i.e. $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$ Note: All sign conventions are acceptable.

Question 17

[3]

(i) In **Young's** double slit experiment, show graphically how intensity of light varies with distance.

(ii) In **Fraunhofer** diffraction, how is the angular width of the central bright fringe affected when slit separation is increased?

Comments of Examiners

(i) In graphical representation of variation of intensity of light with distance in **Young's** double slit experiment, many candidates got confused with diffraction pattern and made incorrect intensity diagram. A few marked the axis incorrectly.

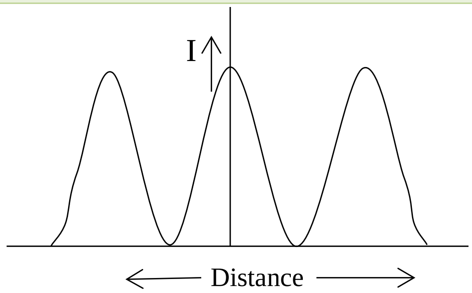
(ii) This part was generally answered correctly.

Suggestions for teachers

- Explain the difference between interference and diffraction clearly. Give practice in drawing the variation of intensity of light with distance in both the cases with reasoning and axis clearly marked.
- Discuss correct formula along with mathematical reasoning in detail along with graphical representations.

MARKING SCHEME

Question 17

(i)	
(ii)	Decreases

[3]

Question 18

Write one **balanced equation** each to show:

(i) Nuclear fission

(ii) Nuclear fusion

(iii) Emission of β^- (i.e. a negative beta particle)

Comments of Examiners

Most of the candidates could not write correct balanced equations for sub-parts (i), (ii) & (iii) of this question. Besides this, the following errors were observed:

- Some candidates did not write neutron/s for fission reaction.
- Some candidates did not change the element of the daughter nuclei and wrote the same as the parent nuclei.
- Antineutrino was not written by most of the candidates.

Suggestions for teachers

- Teach students that in a nuclear reaction, mass number (A) and atomic number (Z) should be balanced.
- Give practice to students in writing the basic equation of nuclear fission.

MARKING SCHEME

Question 18

(i)	$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{148}_{57}La + ^{85}_{35}Br + 3^{1}_{0}n$ OR $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3^{1}_{0}n$ OR any other correct balanced equation showing fission fragments.
(ii)	$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He + ^{1}_{0}n$ OR $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$ OR $4^{1}_{1}H \rightarrow ^{4}_{2}He + 2^{0}_{-1}e/\beta$ *OR any other correct balanced equation showing nuclear fusion*
(iii)	$^{1}_{0}n \rightarrow ^{1}_{1}H\ /\ p + ^{0}_{-1}e + \bar{v}$ OR $^{14}_{6}c \rightarrow ^{14}_{7}N + ^{0}_{-1}e + (\bar{v})$ *OR any other correct balanced equation showing emission of* β^{-}

Question 19

[3]

With reference to semiconductor devices, define a ***p***-type semiconductor and a **Zener** diode.
What is the use of a **Zener** diode?

Comments of Examiners

Some common errors observed in this question were:

– A few candidates could not define *p*-type semiconductor and wrote that pentavalent impurity must be added.

– Some candidates made the schematic of Zener Diode but could not define the construction. Several candidates wrote that Zener diode is used as a rectifier/ current stabilizer.

Suggestions for teachers

– Stress upon concept clarity and comprehension of terms pertaining to semiconductor devices and ensure that students understand the terms potential barrier, depletion region, drift current, diffusion current, forward bias, reverse bias, p-type semiconductor, n-type semiconductor, Zener diode, characteristics of a diode, etc.

– Tell students to practice drawing labelled diagrams/graphs.

MARKING SCHEME

Question 19

By adding/doping a trivalent group 3 element to a pure / intrinsic crystal of a semiconductor /(silicon / germanium)

It is that negative voltage

OR voltage during reverse bias, at which current becomes large, current shoots up

OR

A Zener diode is a particular type of diode that, unlike a normal one, allows current to flow not only from its anode to its cathode, but also in the reverse direction.

OR It is designed to operate under reverse bias in the breakdown region, its p and n regions are heavily doped.
Use of a Zener diode: Voltage regulator or voltage stabilization or to provide steady voltage **OR** to convert a fluctuating voltage to a steady voltage OR to prevent appliances from getting damaged due to voltage fluctuations.

Section D

*Answer **all** questions.*

Question 20

[5]

(a) An alternating emf of 220V is applied to a circuit containing a resistor R having resistance of 160 Ω and a capacitor 'C' in **series**. The current is found to lead the supply voltage by an angle $\theta = \tan^{-1}(3/4)$.

(i) Calculate: (1) The capacitive reactance (2) Impedance of the circuit (3) Current flowing in the circuit

(ii) If the frequency of the applied emf is 50 Hz, what is the value of the capacitance of the capacitor 'C'?

OR

(b) An A.C. generator generating an emf of $\varepsilon = 300 \sin(100\pi t)\ V$ is connected to a **series** combination of 16μF capacitor, 1H inductor and 100 Ω resistor. Calculate:

(i) Impedance of the circuit at the **given frequency**.

(ii) **Resonant** frequency f_o.

(iii) Power factor at **resonant** frequency f_o.

Comments of Examiners

Some common errors made by candidates in this question, in parts (a) and (b), were:

(a)
- Several candidates applied $\tan\theta = R/X_c$ instead of $\tan\theta = X_c/R$;
- Some candidates calculated X_c incorrectly;
- A few wrote X_c in farad and expressed various other terms in incorrect units;
- Most candidates did not make phasor diagram;
- A few candidates could not solve for impedance as they wrote incorrect formula;
- Many candidates could not differentiate between 'ω' and 'f'.
- $X_c = \frac{1}{2\pi f C}$ was not applied properly by a number of candidates.

Suggestions for teachers

- Train the students to read the question carefully, ascertain the requirement and answer it accordingly.
- Explain the topics reactance, impedance, LCR series circuit, resonance, power in ac circuit etc. thoroughly and give adequate practice in solving numerical problems based on these topics.
- Train students by giving regular practice in the class to solve the numerical problems based on variation of voltage and current in ac circuits consisting of only resistor, only inductor, only capacitor (phasor representation), series circuits-LC, RL, RC and LCR, phase lag and phase lead and other concepts of this unit as per the prescribed syllabus.

(b) - Most of the candidates used Z= $\sqrt{R^2 + X_L^2 - X_C^2}$ instead of using the formula Z= $\sqrt{R^2 + (X_L - X_C)^2}$

- Many candidates did not write the answer in correct significant figures and as a result the answer did not come within the range;
- The capacitance of a capacitor given in the unit μF was not converted into farad by many candidates;
- A few candidates used $\omega = \frac{1}{\sqrt{LC}}$ instead of $f = \frac{1}{2\pi\sqrt{LC}}$;
- Some candidates used $X_L = 1/\omega L$ and $X_C = \omega C$;
- Most candidates calculated the incorrect value of Power factor.

MARKING SCHEME

Question 20

(a)	(i)	(1)	$\tan\theta = \frac{X_c}{R}$ $or\ X_c = \frac{3}{4} \times 160 = 120\ \Omega$ Correct result with unit with correct formula.
		(2)	$Z = \sqrt{X_c^2 + R^2}$ $= \sqrt{120^2 + 160^2}$ $= 200\ \Omega$ Correct result with correct unit **with** correct formula or correct substitution
		(3)	$I = \frac{V}{z} / \frac{220}{200} = 1{\cdot}1$ A
	(ii)		$X_c = \frac{1}{2\pi f C}$ $120 = \frac{1}{2\times 3{\cdot}14\times 50\ C}$ $\therefore \left(C = \frac{1}{120 \times 314}\right)$ $\therefore C = 2\cdot 65 \times 10^{-5}$ F or equivalent **OR**
(b)	(i)		$Z = \sqrt{(X_L - X_C)^2 + R^2}$ or $= \sqrt{\left(100\pi \text{ x } 1 - \frac{1}{100\pi\times 16\times 10^{-6}}\right)^2 + 100^2}$ $= \sqrt{(314 - 199)^2 + 100^2}$ $= 152{\cdot}4\ \Omega$ RANGE ~ 152·4 to 152·6 Ω

	(ii)	$f_0 = \frac{1}{2\pi\sqrt{LC}}$ or $= \frac{1}{2\times3\cdot14\sqrt{1\times16\times10^{-6}}}$ $= 39\cdot8$ Hz (Range from 39.6 Hz – 40.0 Hz)
	(iii)	1 / cos 0

Question 21

[5]

(a) Draw a labelled ray diagram of an image formed by a **refracting telescope** with final image formed at **infinity.** Derive an expression for its magnifying power with the final image at infinity.

OR

(b) (i) Using **Huygen's** wave theory, derive **Snell's** law of refraction.

(ii) With the help of an **experiment**, state how will you identify whether a given beam of light is polarised or unpolarised.

Comments of Examiners

(a) A few candidates made the diagram of compound microscope instead of refracting telescope. Many candidates made the image at the least distance of distinct vision instead of at infinity. Most candidates did not write α, β and could not derive magnifying power correctly. Some candidates did not mark the arrows on the rays in the drawn ray diagram.

(b) In part (i), several candidates marked angle of incidence and angle of refraction incorrectly. Some candidates used i/r instead of $\frac{\sin i}{\sin r}$. Laws of reflection were written by many candidates.
In part (ii), many candidates did not write that during this experiment analyzer should be rotated and instead wrote that polarizer and analyzer both should be used which was incorrect.

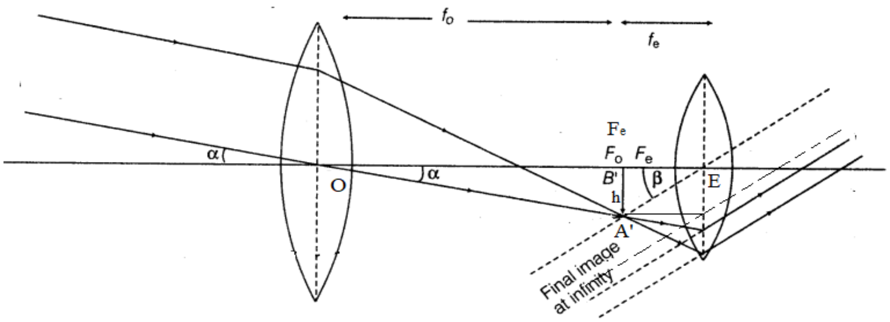
Suggestions for teachers

- Train students to draw ray diagrams on compound microscope/telescope (refracting/reflecting) which are based on lenses in combination.
- Give practice in deriving magnifying power of optical instruments.
- Guide students to mark all the relevant angles and distances in the ray diagrams.
- Advise students to learn the experiment to identify whether a given beam of light is polarised or unpolarised.

MARKING SCHEME

Question 21

(a)



Any two incident rays, parallel to each other, with an arrow on one of them, incident on objective, labelled as O or L_1

Two emergent rays, with an arrow, on at least one of them, emerging from the eye piece labelled as E or L_2.

Final image, at f_o and f_e coinciding and α and β marked.

$\tan\alpha \approx \alpha = \frac{h}{f_o}$ and

$\tan\beta \approx \beta = \frac{h}{v_e}$

$M = \frac{f_o}{h} \times \frac{h}{f_e} = \frac{f_o}{f_e}$

Alternate:

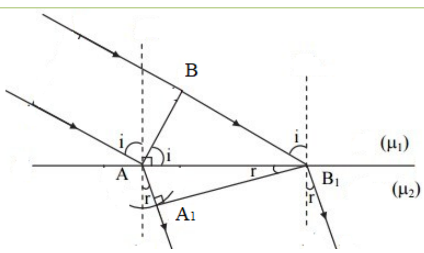
$M = m_o \times m_e$

$M = \frac{f_o}{f_e}$

OR

(b)

(i)



Sin i = BB_1/AB_1 and sin r = AA_1/AB_1

$\frac{\sin i}{\sin r} = \frac{ct}{Vt} = \frac{c}{V} = n/\mu\ /const$

(ii)	Pass the light through a polaroid or tourmaline crystal or Nicol prism. The polaroid is rotated about the incident light and the intensity of light emerging from the polaroid is noted. (i) If there is no change in intensity of the emergent light, the given beam of light is ***unpolarised.*** (ii) If the intensity of emergent light changes then the incident light is polarised. OR If the intensity of emergent light changes but never becomes zero, the given beam of light is ***partially polarised.*** *OR* If the intensity of emergent light changes and becomes zero twice in one complete revolution, the given beam of light is ***completely plane-polarised.***

Question 22

[5]

(a) (i) The forward characteristic curve of a junction diode is shown in ***Figure 4*** below:

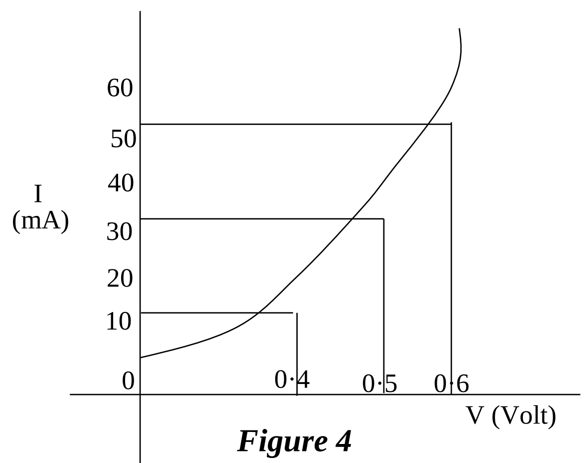


Figure 4

Calculate the resistance of the diode at:

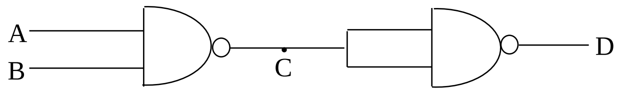
(1) V = 0·5 V

(2) I = 60 mA

(ii) Draw **separate** energy band diagrams for conductors, semi-conductors and insulators and label each of them.

OR

(b) (i) The arrangement given below represents a logic gate:



Copy the following truth table in your answer booklet and complete it showing outputs at C and D.

A	B	C	D
0	0		
1	0		
0	1		
1	1		

(ii) Draw a labelled diagram of a **common emitter** amplifier, showing waveforms of **signal** voltage and **output** voltage.

Comments of Examiners

(a) (i) Many candidates could not find resistance of the diode correctly from the graph. Some of them did not convert the current in SI units and got incorrect value of the resistance.

(ii)Several candidates did not show the proper spacing between the valance band, conduction band and forbidden gap. A few candidates mixed up the diagrams for insulators and semiconductors.

(b) (i)Correct output of C was not done by a few candidates. Hence, complement of C was also incorrect.

(ii)In this sub-part, common errors made by the candidates were:

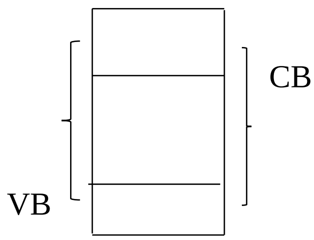
- Many candidates did not mark the input signal.
- In some answer scripts, biasing was either missing or proper biasing was not done.
- In transistor symbol, arrow to differentiate emitter from collector was not marked.
- Output wave form was not shown inverted and amplified, by many candidates.
- Some candidates drew common emitter characteristic circuit instead of common emitter amplifier.

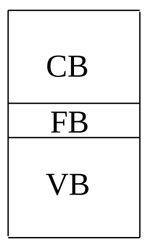
Suggestions for teachers

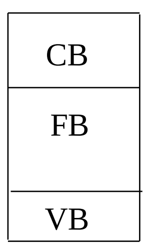
- Give ample practice on graph based numerical problems related to diodes and transistors. Familiarise students with the probable errors that may be committed while answering questions which are based on graphs.
- Teach students how to draw energy band diagrams for conductors, semi-conductors and insulators correctly.
- Encourage students to copy the given arrangement of the gates and solve for the output, with intermediate values clearly written.
- Instruct students to ensure that in drawing a labelled diagram of a common emitter amplifier they should complete the requirements at least as per the demand of the question.

MARKING SCHEME

Question 22

<table>
<tr><td>(a)</td><td>(i)</td><td>(1)</td><td>$R = \frac{V}{I} / \frac{0\cdot5}{40\times10^{-3}} \quad = 12\cdot5\ \Omega$</td></tr>
<tr><td></td><td></td><td>(2)</td><td>$R = \frac{V}{I} / \frac{0\cdot6}{60\times10^{-3}} \quad = 10\ \Omega$</td></tr>
<tr><td></td><td>(ii)</td><td colspan="2">Conductors,


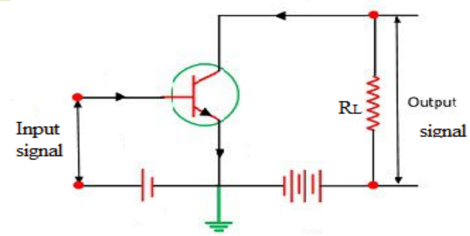
Semi-conductors and


Insulators

</td></tr>
<tr><td></td><td colspan="3">OR</td></tr>
</table>

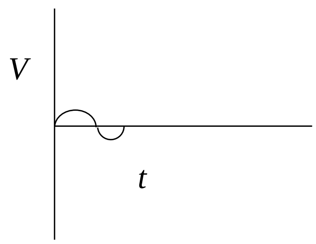
(b) (i)

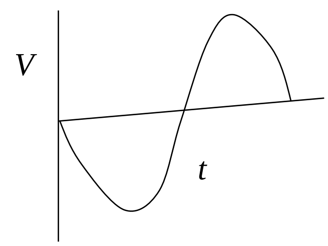
A	B	C	D
0	0	1	0
1	0	1	0
0	1	1	0
1	1	0	1

(ii)



Circuit requirements: Input circuit showing signal and battery biasing correctly
Output circuit load or R_L, and collector battery with correct biasing





Correct wave forms with phase reversal
V-t marked in at least one graph
Correct diagram with P-N-P/N-P-N transistor is acceptable with proper polarities.

Note: For questions having more than one correct answer/solution, alternate correct answers/solutions, apart from those given in the marking scheme, have also been accepted.

GENERAL COMMENTS

Topics found difficult by candidates

- Combination of capacitors
- Kirchhoff's Law
- Motional emf
- Power Factor
- Numerical problem based on alternating current
- Sign convention in telescopes or in lenses
- Huygen's wave theory
- Einstein's photoelectric equation
- Binding energy
- Nuclear fusion and β-emission
- Modulation
- Zener diode

Concepts in which candidates got confused

- Curie's Law
- Magnetic Flux (Either 0^0 or 90^0)
- Magnetic field in a coil
- A.C. circuits
- Polarizer and Analyzer
- Threshold Wavelength and threshold frequency
- Pair Production

Suggestions for candidates

- Organize your study space and study regularly.
- Practise conversion of one system of unit to other system of unit.
- Take notes and summarize lectures or articles in your own words for better comprehension of the key concepts.
- Prepare a list of formulae, definitions, laws, derivations, etc. from each chapter.
- Learn the laws, principles, definitions, etc. by heart.
- Focus on key words and terminology. Highlight key sentences, key words and a few important phrases here and there in the unit.
- Prepare a Mind Map for each unit as a ready reference to revise the topics quickly at the time of examination.
- Learn all the formulae with meaning of each term involved.
- Practise derivations and numerical problems regularly.
- Practise drawing diagrams, ray diagrams, circuit diagrams, etc. regularly.
- Solve past years' question papers and sample papers of ISC.
- During examination read every question carefully and answer to the point.
- Draw labelled diagrams. In Ray optics, don't forget to put arrows to the rays.
- While solving numerical, read the question carefully and write the given data. Before substituting in a relevant formula, ensure that all the given quantities are in the same system of units (preferably SI units). Make proper conversions (if required). Be careful with units like mm, cm, nm, μC and μF, mA, electron volt etc. These must be converted to SI units.
- Write complete answer with unit and direction (if it is a vector quantity).
- Do not spend too much time on any one question.
- Write only what is asked for. Write in brief and to the point.