Roll. No. .....

O.M.R. Serial No. | | | | | | | | |

Question Booklet Number

M.Sc. (SEM.-III) (NEP) (SUPPLE.)EXAMINATION, 2024-25

CHEMISTRY

(Application of Spectroscopy)

Paper Code							
B	0	2	0	9	0	2	T

Question Booklet Series

A

Time : 1 : 30 Hours **Max. Marks : 75**

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.
4. Four alternative answers are mentioned for each question as - A, B, C & D in the booklet. The candidate has to choose the correct / answer and mark the same in the OMR Answer-Sheet as per the direction :

(Remaining instructions on last page)

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, उसे तुरन्त बदल लें।
4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर- A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR उत्तर-पत्रक में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

(शेष निर्देश अन्तिम पृष्ठ पर)

1. Commonly used solvent in ESR spectroscopy is :
   (A) DPPH
   (B) TMS
   (C) Both (A) and (B)
   (D) None of these

2. The mathematical representation of Beer-Lambert law is :
   (A) $A = \varepsilon C \ell$
   (B) $A = \varepsilon C / \ell$
   (C) $A = \varepsilon / C \ell$
   (D) $A = \varepsilon \ell / C$

3. If a molecule contains n atoms the number of stretching vibrations are :
   (A) n–1
   (B) n–2
   (C) n
   (D) n–3

4. For a particular vibration node appears in the Raman spectrum, must change :
   (A) Frequency of radiation
   (B) Intensity of the radiation
   (C) Molecule shape
   (D) Molecule polarisibility

5. The structural group which is responsible for importing colour to compound called :
   (A) Auxochrome
   (B) Chromophore
   (C) Hydroxyl group
   (D) None of these

6. Vibrational frequency of stretching vibration of the diatomic molecule is:
   (A) $\nu / 2\pi = \sqrt{\frac{\mu}{K}}$
   (B) $\frac{\nu}{2\pi} = \sqrt{\frac{K}{\mu}}$
   (C) $\nu = \frac{1}{2\pi}\sqrt{\frac{K}{\mu}}$
   (D) $\nu = \frac{1}{2\pi}\sqrt{\frac{\mu}{K}}$

7. The most common solvent used in IR spectroscopy is :
   (A) Water
   (B) Acetone
   (C) Alcohol
   (D) Pair of CCl_4 and CS_2

8. Which of the following Nuclei will give NMR spectra?
   (A) ${}_2He^4$
   (B) ${}_6C^{13}$
   (C) ${}_6C^{12}$
   (D) ${}_8O^{16}$

9. Which transition requires least energy?
   (A) $n - \pi^*$
   (B) $\sigma - \sigma^*$
   (C) $\pi - \pi^*$
   (D) $n \rightarrow \sigma^*$

10. The frequency of UV radiation is greater than :
(A) Microwaves
(B) IR radiation
(C) Both (A) and (B)
(D) None of these

11. The number of peaks in the ESR spectrum of CH_3 redical is :
(A) 1
(B) 2
(C) 3
(D) 4

12. Which of the following is/are considered as an ambidentate ligand?
(A) NO_2
(B) SCN
(C) Both (A) and (B)
(D) None of these

13. UV-Visible spectroscopy is mainly related with :
(A) Rotational transition
(B) Vibrational transition
(C) Electronic transition
(D) All of these

14. How many vibrational modes are possible for HCl is :
(A) 0
(B) 1
(C) 2
(D) 3

15. TMS in NMR is used as an :
(A) External standard
(B) Internal standard
(C) Both (A) and (B)
(D) None of these

16. Which of the following will not show electron spin resonance?
(A) Free radicals
(B) Paramagnetic materials
(C) Transition metals
(D) Diamagnetic materials

17. The absorbance (A) is :
(A) $\log_{10}\left(\frac{I}{I_0}\right)$
(B) $\log_{10}\left(\frac{I_0}{I}\right)$
(C) $\frac{I}{I_0}$
(D) None of these

18. MRI (Magnetic Resonance Imaging) related to which of the following :
(A) NMR
(B) UV-visible
(C) IR
(D) X-ray

19. Which of the following shifts leads to the decreased wavelength of Absorption :
(A) Hypochromic effect
(B) Hyperchromic effect
(C) Hypsochromic shift
(D) Bathochromic shift

20. Which among the following transition is allowed?
(A) $g \rightarrow g$
(B) $u \rightarrow u$
(C) $g \rightarrow u$
(D) None of these

21. Which of the following wave have minimum energy?
(A) Microwave
(B) IR
(C) Radiowave
(D) X-ray

22. In Raman spectroscopy the radiation lies in the region :
(A) UV region
(B) Visible region
(C) Microwave region
(D) Radiowaves

23. An Auxochrome is/are :
(A) $-SO_3H$
(B) –OH
(C) $-NH_2$
(D) All of these

24. ^{13}C NMR spectra of $CDCl_3$ shows :
(A) Singlet
(B) Triplet
(C) Quintet
(D) Septet

25. The molecule has highly shielded proton is :
(A) CH_3Br
(B) CH_3Cl
(C) CH_3I
(D) CH_3F

26. During Hyperchromic effect :
(A) λ_{max} will increase
(B) ε_{max} will increase
(C) λ_{max} will decrease
(D) ε_{max} will decrease

27. Choose correct option in terms of wavelength for the different type of IR spectrometer :
(A) Near IR : 0.8–2.5 μ
(B) Mid IR : 0.8–2.5 mm
(C) Far IR : 2.5–50 mm
(D) Mid IR : 50–100 mm

28. The region of electromagnetic spectrum employed in the Electron Spin Resonance (ESR) spectroscopy is :
(A) Radiowave
(B) Microwave
(C) Infrared
(D) Visible

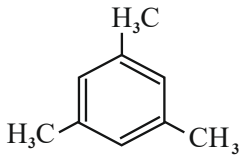
29. The total number of fundamental vibrational modes observed in the IR absorption spectrum of water is :
(A) 4
(B) 3
(C) 2
(D) Zero

30. The Base Value for the following compound

$CH_2 = CH - CH = CH - CH_3$ is :
(A) 246 nm
(B) 250 nm
(C) 230 nm
(D) 217 nm

31. Who discovered the mass spectrometer?
(A) Francis Aston
(B) J.J. Thomson
(C) Ernest O. Lawrance
(D) None of these

32. Raman active mode for CO_2 molecule is :
(A) Symmetric stretching mode
(B) Antisymmetric stretching mode
(C) Bending
(D) Both (A) and (C)

33. The number of NMR signal in the compound  (Mesitylene) is :
(A) 1
(B) 2
(C) 3
(D) 4

34. Chemical shift has the unit of :
(A) Parts per million
(B) Parts per billion
(C) Tesla
(D) No unit

35. Which of the following wave have minimum wavelength?
(A) Microwave
(B) IR
(C) Radiowave
(D) X-ray

36. How many vibrational modes are possible for acetylene?
(A) 2
(B) 6
(C) 7
(D) 8

37. In which state of matter mass spectroscopy is better performed?
(A) Solid
(B) Liquid
(C) Gaseous
(D) Plasma

38. Vibrational degrees of freedom for a non-linear molecule of n atoms is :
(A) 3n–5
(B) 3n–6
(C) 2n+5
(D) 2n–4

39. In CO_2 molecule certain bands may be :
(A) Raman active
(B) Infrared active
(C) Infrared and Raman active
(D) None of these

40. Which of the following molecule will have highest zero, point vibrational energy?
(A) CF_4
(B) CH_4
(C) CCl_4
(D) CBr_4

41. Signal splitting in NMR arises from :
(A) Shielding effect
(B) Spin-Spin decoupling
(C) Spin-Spin coupling
(D) Deshielding effect

42. The (m/e) value of Base peak in 2 methyl-2 propanol (tertiary butyl alcohol) in mass spectroscopy is :

(A) 57

(B) 59

(C) 51

(D) 53

43. The electron contribute to isomer shift in Mossbauer spectroscopy is :

(A) S-electron

(B) d-electron

(C) P-electron

(D) f-electron

44. Hyperfine splitting that can be observed with two equivalent proton will be :

(A) 2

(B) 3

(C) 5

(D) 6

45. Overtones are mainly observed in :

(A) Near IR

(B) Mid IR

(C) Far IR

(D) Not in IR region

46. The number of lines that appear in the ESR spectra of $[C_6H_6]$ is :

(A) 5

(B) 7

(C) 11

(D) 13

47. Wavelength range of UV spectrum of light is :

(A) 400 nm to 700 nm

(B) 700 nm to 1 mm

(C) 185 nm to 400 nm

(D) 0.1 nm to 10 nm

48. The possible number of fundamental vibrational modes for CO_2 is :

(A) 2

(B) 3

(C) 4

(D) 5

49. Which of the following electronic transition is not allowed?

(A) $\pi - \pi^*$

(B) $\sigma - \sigma^*$

(C) $\sigma - \pi^*$

(D) $n - \sigma^*$

50. In Raman spectroscopy study of a compound takes place due to :

(A) Absorption of light

(B) Scattering of light

(C) Both (A) and (B)

(D) None of these

51. The signal of proton is interfered by adjacent ^{13}C nucleus is known as :

(A) Homonuclear spin coupling

(B) Heteronuclear spin coupling

(C) Homonuclear shielding

(D) Heteronuclear shielding

52. Which of the following statement is correct?

(A) More the electronegativity lesser the chemical shift

(B) More the electron egativity more the chemical shift

(C) More the size of the atom lesser the chemical shift

(D) More the size of the atom more the chemical shift

53. The selection rule for the allowed rotation Raman lines is :

(A) $\Delta J = 0, \pm 2$

(B) $\Delta J = \pm 1$

(C) $\Delta J = 0$

(D) $\Delta J = 0, \pm 1$ and ± 2

54. The ratio of peak splitting that can be observed with three equivalent protons will be :

(A) 1 : 1

(B) 1 : 2 : 1

(C) 1 : 3 : 1

(D) 1 : 3 : 3 : 1

55. Among the following those can act as Mossbauer nuclei are :

(a) ^{129}I

(b) ^{57}Co

(c) ^{57}Fe

(d) ^{121}Sb

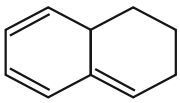
Choose the correct answer :

(A) (b), (c) and (d) only

(B) (a), (b) and (d) only

(C) (a), (c) and (d) only

(D) (a), (b), (c) and (d) only

56. λ_{max} for the compound  is :

(A) 303 nm

(B) 309 nm

(C) 267 nm

(D) 314 nm

57. Which of the following are correclly matched?

(1) UV–Bathochromic shift

(2) IR–Finger print region

(3) UV–chromophore

(4) IR–λ_{max}

Choose the correct answer :

(A) (1) and (2)

(B) (1) and (3)

(C) (1), (2), (3) and (4)

(D) (1), (2) and (3)

58. The solvent normally used for recording ^{13}C NMR spectra is :

(A) Water

(B) n-Hexane

(C) Deutrated Organic Solvent

(D) TMS

59. Absorption Bands Originate due to $n - \pi^*$ transition in UV spectrum is :

(A) K-Bands

(B) R-Bands

(C) B-Bands

(D) E-Bands

60. In FTIR initially spectra is recorded as:

(A) Volts Vs Time

(B) % Transmittance Vs Concentration

(C) Absorbance Vs Concentration

(D) Absorbance Vs Time

61. The number of lines in ESR spectrum of CO_3 ($I_D = 1$) is :

(A) 3 (B) 5

(C) 7 (D) 9

62. Separation of ions in mass spectrometer takes place on the basis of :

(A) Mass

(B) Charge

(C) Molecular weight

(D) Mass to Charge ratio

63. In vibrational spectrum of CO_2 the number of fundamental vibrational modes common in both IR and Raman are :

(A) Three

(B) Two

(C) One

(D) Zero

64. The absorption at $\lambda_{max}\,279\,nm\,(\varepsilon = 15)$ in the UV spectrum of acetone is due to :

(A) $\pi - \pi^*$ transition

(B) $n - \pi^*$ transition

(C) $\sigma - \sigma^*$ transition

(D) $\pi - \sigma^*$ transition

65. Fieser Woodward's rule is applicable for which of the following :

(A) Conjugated dienes

(B) Carbonyl compounds

(C) Polyenes

(D) All of these

66. Coupling constant of two nuclei is defined as :

(A) Ratio of chemical shifts

(B) Distance between splitted peaks in Hz

(C) Difference of shifts

(D) Ration of absorption frequencies

67. Nuclei having either the number of protons or neutrons odd have :

(A) Integral spin

(B) Half integral spin

(C) Zero spin

(D) Positive spin

68. The absorption bands of the carbonyl group in the IR spectra of CH_3COCH_3 is :

(A) $\sim 1900\ cm^{-1}$

(B) $\sim 1700\ cm^{-1}$

(C) $\sim 1770\ cm^{-1}$

(D) None of these

69. In the ^{1}H NMR spectrum of CH_3CH_2Cl the quartet of the CH_2 group has a coupling constant of 7Hz, what is the coupling constant for the CH_3 triplet?
(A) 0 Hz
(B) 3.5 Hz
(C) 7 Hz
(D) 10.5 Hz

70. What is the chemical shift of TMS relative to itself?
(A) 0 PPm
(B) 1 PPm
(C) 10 PPm
(D) 100 PPm

71. The nucleus that is most sensitive to the COSY experiment is :
(A) ^{1}H
(B) ^{13}C
(C) ^{15}N
(D) ^{31}P

72. Factor affecting the chemical shift of a nucleus is correct :
(A) Electronegativity of neighbouring atom
(B) Hybridisation of the carbon atom
(C) Dipole-Dipole interaction
(D) All of these

73. Mossbauer spectroscopy uses which radiation?
(A) γ - radiation
(B) β - radiation
(C) α -radiation
(D) δ -radiation

74. Techniques used to enhance the resolution of NMR (Nuclear Magnetic Resonance) spectra is :
(A) Fourier transform
(B) Spin-Spin coupling
(C) Relaxation time
(D) Chemical shift

75. Correct relationship between absorbance and % transmittance is/are:
(A) $A = \log_{10}\left(\frac{100}{\%T}\right)$
(B) $A = 2 - \log_{10}(\%T)$
(C) $A = \log_{10}\left(\frac{1}{T}\right)$
(D) All of the above

76. The difference in two rotational Raman spectrum lines is :
(A) B
(B) 2B
(C) 3B
(D) 4B

77. The correct order of increasing wave number of the stretching vibrations of
(1) C–H (alkane)
(2) O–H (alcohol)
(3) C=O (ketone)
(4) $C \equiv C$ (alkyne)
options are :
(A) (4) < (3) < (2) < (1)
(B) (3) < (4) < (2) < (1)
(C) (3) < (4) < (1) < (2)
(D) (4) < (3) < (1) < (2)

78. The technique can be used to enhance the resolution of NMR spectra is :

(A) DEPT

(B) COSY

(C) NOESY

(D) HETCOR

79. The characteristic of a molecular vibrational modes in Infrared (IR) spectroscopy is :

(A) They involve change in molecular rotation

(B) They involve change in melecular electronic states

(C) They involve change in bond lengths and angles

(D) They involve change in nuclear spin orientation

80. Mossbauer effect based on :

(A) Doppler effect

(B) Beer-Lambert's law

(C) Spin effect

(D) None of these

81. The wave number corresponds to the wavelength 2.5 μm is :

(A) 14000 cm^{-1}

(B) 4000 cm^{-1}

(C) 3600 cm^{-1}

(D) 400 cm^{-1}

82. Force constant is expressed in the SI unit as :

(A) Dynes cm^{-1}

(B) m dynes A^{-1}

(C) Nm^{-1}

(D) All of the above

83. TMS is used as reference compound in ^{1}H NMR because :

(A) It has sharp resonance line

(B) It does not interfere with other resonance

(C) It is highly volatile can easily be removed

(D) All of these

84. The ESR frequency of an unpaired electron in a magnetic field of 3000 gauss (0.3 Tesla) is :

(A) 9300 MHz

(B) 8397 MHz

(C) 7000 MHz

(D) 9230 MHz

85. In Mossbauer spectroscopy of a sample containing Iron recorded in the presence of a static magnetic field the number of possible allowed transitions are :

(A) Two

(B) Four

(C) Six

(D) Eight

86. Match the observed Principal observations in the visible spectrum show in List-I with bond shows this absorption in List-II :

	List – I		List – II
(1)	$\sigma - \sigma^*$	(i)	C – C
(2)	$n - \sigma^*$	(ii)	C – O
(3)	$n - \pi^*$	(iii)	C = O
(4)	$\pi - \pi^*$	(iv)	C = O

(A) (1)-(i) 2-(ii) 3-(iii) 4-(iv)

(B) (1)-(i) 2-(iii) 3-(iv) 4-(ii)

(C) (1)-(ii) 2-(i) 3-(iv) 4-(iii)

(D) (1)-(iv) 2-(ii) 3-(iii) 4-(i)

87. An organic compound C_4H_8O gave the following spectral data

UV-Weak absorption at λ_{max} 295

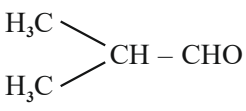
IR-ν_{max} 1715 cm^{-1}(strong)

^{1}H NMR-δ2.4(quartet 2H),

δ2.09(singlet 3H), δ1.4(triplet 3H)

The compound C_4H_8O is :

(A) $CH_3CH_2CH_2CHO$

(B) 

(C) 

(D) $CH_2 - CH = CH - CH_2OH$

88. Which of the following have maximum absorption frequency (ν_{max})?

(A) C – C

(B) C = C

(C) C ≡ C

(D) None of these

89. The number of ^{1}H NMR signals found in compound  are :

(A) 3 signals

(B) 2 signals

(C) 1 signal

(D) 4 signals

90. β-Cleavahe of a bond with $\gamma - H$ rearrangement to form a cation and neutral molecule is called :

(A) Retro-Diels-Alder reaction

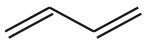
(B) Mc-Lafferty rearrangement

(C) H-transfer rearrangement

(D) None of these

91. Which of the following molecule has maximum value of λ_{max} ?

(A) 

(B) 

(C) 

(D) 

92. Most suitable techniques for determining the molecular structure of an organic compound is :

(A) UV-visible spectroscopy

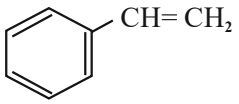
(B) NMR spectroscopy

(C) IR spectroscopy

(D) Mass spectroscopy

93. Which among the following will show pure rotational spectra?
(A) CO
(B) NO
(C) N_2O
(D) All of these

94. How many different types of proton (given unique chemical shifts in ^1H NMR) are present in (styrene)



is :
(A) Three (B) Four
(C) Five (D) Six

95. The reduced mass (μ) of the two atoms involved in stretching vibrations of diatomic molecule will be :

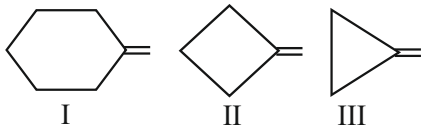
(A) $\mu = \frac{(m_1 + m_2)}{m_1 m_2}$

(B) $\mu = \frac{m_1 m_2}{(m_1 + m_2)}$

(C) $\mu = \frac{(m_1 + m_2)}{2}$

(D) $\mu = \frac{(m_1 + m_2)}{2m_1 m_2}$

96. Correct order of IR stretching frequency of the C=C in the following Olefin is :



(A) I > II > III
(B) II > III > I
(C) III > II > I
(D) III > I > II

97. Which of the region of IR spectra appears between (1400-600)cm^{-1}?
(A) Functional group region
(B) Fingerprint region
(C) Frequency region
(D) None of these

98. Limitation of the Lamberts-Beer's law is :
(A) Scattering of light due to particles
(B) Fluoirescence of sample
(C) Non monochromatic radiation
(D) All of these

99. Which component of the mass spectrometer seperates the ion beams into its components?
(A) Sample handling system
(B) Ion source
(C) Detector
(D) Analyser

100. Which of the following statement about 2D NMR spectroscopy is true?
(A) It provides information only about the chemical shifts of nuclei.
(B) It can reveal through bond and through space interactions between nuclei.
(C) It is used excclsively for analysis of crystalline solids.
(D) It cannot be applied to large molecules.

Rough Work

Rough Work

Example :

Question :

Q.1 Ⓐ ● Ⓒ Ⓓ

Q.2 Ⓐ Ⓑ ● Ⓓ

Q.3 Ⓐ ● Ⓒ Ⓓ

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.

6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.

7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.

8. After the completion of the examination, candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.

9. There will be no negative marking.

10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.

11. To bring and use of log-book, calculator, pager & cellular phone in examination hall is prohibited.

12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ● Ⓒ Ⓓ

प्रश्न 2 Ⓐ Ⓑ ● Ⓓ

प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ०एम०आर० उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।

7. ओ०एम०आर० उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।

8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।

9. निगेटिव मार्किंग नहीं है।

10. कोई भी रफ कार्य, प्रश्न-पुस्तिका में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैल्कुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।

12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्णः प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्नपुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्नपुस्तिका प्राप्त कर लें।