Roll No. ....

O. M. R. Serial No.

M. Sc. (Industrial Chemistry) (Second Semester)

EXAMINATION, 2022-23

POLYMER CHEMISTRY

Paper Code

M	S	I	C	2	0	1

Time : 1:30 Hours]

[*Maximum 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.

(Remaining instructions on the 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, तो उसे तुरन्त बदल लें।

(शेष निर्देश अन्तिम पृष्ठ पर)

(Only for Rough Work)

1. Polymer degradation is :

    (A) thermal degradation

    (B) photo degradation

    (C) mechanical degradation

    (D) All of the above

2. The neighbouring polymeric chains in thermoplastics are held together by :

    (A) Donie bond

    (B) Covalent bond

    (C) Secondary forces

    (D) All of the above

3. The formula of number average molecular weight $(\overline{M}_n)$ is :

    (A) $\overline{M}_n = \Sigma n_i\, M_i / \Sigma n_i$

    (B) $\overline{M}_n = \Sigma n_i\, M_i$

    (C) $\overline{M}_n = \Sigma n_i / \Sigma M_i$

    (D) $\overline{M}_n = \Sigma n_i^2\, M_i$

4. The formula of weight average molecular weight $(\overline{M}_w)$ is :

    (A) $\overline{M}_w = \Sigma n_i\, M_i / \Sigma n_i$

    (B) $\overline{M}_w = \Sigma n_i\, M_i / \Sigma n_i\, Mi^2$

    (C) $\overline{M}_w = \Sigma n_i\, M_i^2 / \Sigma n_i\, Mi$

    (D) $\overline{M}_w = \Sigma n_i\, M_i$

5. Equal masses of polymer molecules with $M_1 = 10{,}000$ and $M_2 = 100{,}000$ are mixed. The value of $\overline{M}_w$ is :

    (A) 18,182

    (B) 50,000

    (C) 55,000

    (D) 70,500

6. In osmotic pressure method, the molecular mass of the polymer can be expressed as :

    (A) $\dfrac{\Pi}{e} = \dfrac{RT}{M_n}$

    (B) $\dfrac{\Pi}{e} = \dfrac{RT}{M_w}$

    (C) $\Pi e = RT\, M_n$

    (D) $\Pi e = RT\, M_w$

7. Which statement is true for osmotic pressure method ?

    (A) used to calculate weight average molecular weight

    (B) used to calculate number average molecular weight

    (C) Both (A) and (B)

    (D) None of the above

8. Which statement is not correct for light scattering method ?

    (A) Weight average molecular weight

    (B) Number average molecular weight

    (C) Measure polydispersity

    (D) Sample preparation is difficult

9. The relation between Molecular Weight (M) and Degree of Polymerization (DP) is :

[m = molecular weight of the moment]

(A) $M = D_P . m$

(B) $D_P = Mm$

(C) $M = \dfrac{D_P}{m}$

(D) None of the above

10. Equal number of molecules with $M_1 = 10,000$ and $M_2 = 100,000$ are mixed.

The value of $\overline{M}_n$ is :

(A) 50,000

(B) 55,000

(C) 70,500

(D) 91,818

11. The Mark-Houwink equation is :

(A) $[n] = KM^{\alpha}$

(B) $[n] = KM$

(C) $[n] = K/M$

(D) None of the above

12. The Mark-Houwink equation is used to :

(A) determine monomer units

(B) determine density

(C) determine chain length

(D) determine molecular weight

13. In a polymer of X monomer units, the root mean square separation between the two ends is proportional to :

(A) X^2

(B) X

(C) $X^{1/2}$

(D) $5X$

14. The degree of polymeriration $< N >$ is :

(A) $< N > = kt \ [M_0] + L$

(B) $< N > = kt \ [M_0]$

(C) $< N > = M_0$

(D) $< N > = \dfrac{kt \ [M_0]}{2}$

15. Mathematical expression of Polydispersity Index (PDI) is :

(A) $PDI = \overline{M}_w \ \overline{M}_n$

(B) $PDI = \overline{M}_w / \overline{M}_n$

(C) $PDI = \overline{M}_n / \overline{M}_w$

(D) $PDI = \overline{M}_n + \overline{M}_w$

16. The calculated $\overline{M}_n$ of the polymer is

[Given $n_1 = 50, M_1 = 5,000$, $n_2 = 75$ and $M_2 = 6,000$] :

(A) 5,500

(B) 5,600

(C) 5,700

(D) 11,000

17. Number of steps involved in free radical polymerization is :
    (A) One
    (B) Two
    (C) Three
    (D) Four

18. For a monodisperse polymer, the number average molar mass and $(\overline{M}_n)$ and weight average molar mass $(\overline{M}_w)$ are related as :
    (A) $\overline{M}_n > \overline{M}_w$
    (B) $\overline{M}_n < \overline{M}_w$
    (C) $\overline{M}_w = \overline{M}_n$
    (D) $\overline{M}_w = \dfrac{\overline{M}_n}{2}$

19. In case of polymer there are .... types of average molecular weight.
    (A) 2
    (B) 4
    (C) 6
    (D) 8

20. A sample of polystyrene is composed of three weight fractions : 0.20, 0.50 and 0.30. The molecular weight of these fractions are 10,000, 40,000 and 60,000 respectively. The weight average molecular weight $(\overline{M}_w)$ of this sample is :
    (A) 40,000
    (B) 50,000
    (C) 55,000
    (D) 60,000

21. Which statement is true for smart polymer ?
    (A) Stimuli-responsive polymers
    (B) Mimic biopolymers
    (C) Respond to a variety of signals
    (D) All of the above

22. What are the uses of smart polymers ?
    (A) Drug delivery system
    (B) Antifouling coating
    (C) Biosensors
    (D) All of the above

23. Caprolactum can be obtained from :
    (A) Benzaldehyde
    (B) Cyclohexanone
    (C) Benzophenone
    (D) Adipic acid

24. The monomer unit of silicones a water repellant, acid resistant and heat resistant polymer is :
    (A) $CaSiO_3$
    (B) SiO_2
    (C) R_2SiO
    (D) All of the above

25. In the Mark-Houwink equation the empirical constants K & *a* are dependent on :

(A) solvent only

(B) polymer only

(C) polymer-solvent pair

(D) polymer-polymer interaction

26. For a polydispersed macromolecular colloid, light scattering method gives :

(A) weight average molecular weight

(B) number average molecular weight

(C) viscosity average molecular weight

(D) All of the above

27. National Rubber has :

(A) all trans configuration

(B) all cis configuration

(C) alternate cis and trans configuration

(D) random cis and trans configuration

28. Which polymers are human made polymers ?

(A) Natural

(B) Synthetic

(C) Biodegradable

(D) Hydrogel

29. Which of the following statements is not true about low density polythene ?

(A) Tough

(B) Hard

(C) Poor conductor of electricity

(D) Highly branched star

30. Polymer that can be prepared by condensation polymerization is :

(A) Teflon

(B) Nylon-6, 6

(C) Rubber

(D) Polystyrene

31. The mass average molecular mass and number average molecular mass of a polymer are respectively 40,000 and 30,000. The polydispersity index of polymer will be :

(A) 0

(B) 1

(C) < 1

(D) > 1
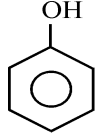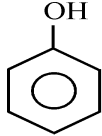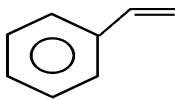
32. An example of synthetic polymer :

    (A) Nucleic acid

    (B) Starch

    (C) Protein

    (D) Bakelite

33. Which of the following polymers is bio-degradable ?

    (A) Cellulose

    (B) Polythene

    (C) PVC

    (D) Nylon-6

34. The commercial name of polyacrylonitrile is :

    (A) Bakelite

    (B) PVC

    (C) Orlon

    (D) Teflon

35. Which of the following polymers of glucose is stored by animals ?

    (A) Glycogen

    (B) Cellulose

    (C) Amylopectin

    (D) Amino acids

36. .... polymer is obtained by heating caprolactum.

    (A) Nylon-6

    (B) Nylon-6, 6

    (C) Nylon-2, 6

    (D) Nylon-2

37. Benefits of vulcanised rubber :

    (A) Excellent resilience

    (B) Low water absorption

    (C) Good electrical insulator

    (D) All of the above

38. Buna-N Rubber is a copolymer of :

    (A) Acrylonitrite and Butadiene

    (B) Phenol and Butadiene

    (C) Isoprene and Neoprene

    (D) Acrylonitrite and Phenol

39. Among PVC, cellulose, nylon and natural rubber the polymer in which the intermolecular force of attraction weakest is :

    (A) Natural Rubber

    (B) PVC

    (C) Cellulose

    (D) Nylon

40. One of the characteristics of polymer is :

(A) high temperature stability

(B) high elongation

(C) low hardness

(D) high mechanical strength

41. Which of the following polymers is used to make bulletproof glass ?

(A) Glyptal

(B) Teflon

(C) Ebonite

(D) PMMA

42. The non-metal used in the vulcanisation of rubber is :

(A) Black-P

(B) Black-C

(C) Sulphur

(D) Graphite

43. A polymer of methylene chloride and sodium polysulphide is :

(A) Glyptal

(B) Thiokol

(C) Metamine

(D) PVC

44. Ethylene and propylene rubber can be vulcanised by :

(A) sulphur

(B) peroxides

(C) Zno

(D) All of the above

45. One of the following Rubbers is used in making oil seals, tank lining :

(A) Neoprene

(B) Buna-S

(C) Buna-N

(D) None of the above

46. Painting material among the following is :

(A) Glyptal

(B) Polypropane

(C) Polyvinyl chloride

(D) Polystyrene

47. Rayon is used for :

(A) pipelines

(B) artificial fibre

(C) cloths

(D) coating of non-stick

48. Polymer that contains isoprene units is :

   (A) Nylon-6, 6

   (B) Natural Rubber

   (C) Polythene

   (D) Dacron

49. Which one of the following is a natural polymer ?

   (A) Silk

   (B) Bakelite

   (C) Buna-N

   (D) PVC

50. Which type of Rubber Ebonite is ?

   (A) Natural Rubber

   (B) Synthetic Rubber

   (C) Highly Vulcanised Rubber

   (D) Low Vulcanised Rubber

51. Flame proof fabrics contain :

   (A) Urea.Na_2SO_4

   (B) Urea.H_3PO_4

   (C) Thiourea.Na_2SO_4

   (D) Thiourea.H_3PO_4

52. Glyptal is formed by the reaction between :

   (A) Pthalimide and Glycerol

   (B) Pthalimide and Ethylene Glycol

   (C) Pthalic anhydride and Glycerol

   (D) Pthalic anhydride and Ethylene glycol

53. The non-stick layer of kitchenware contains :

   (A) Acrilan

   (B) Dacron

   (C) Teflon

   (D) Nylon

54. What is not true about polymers ?

   (A) Polymers do not carry any charge

   (B) Polymers have high viscosity

   (C) Polymers scatter light

   (D) Polymers have low molecular weight

55. Which of the following polymers has ester linkage ?

   (A) Nylon-6, 6

   (B) Terylene

   (C) Buna-S

   (D) PVC

56. Which of the following is not a copolymer ?

   (A) Cellulose

   (B) Buna-S

   (C) Protein

   (D) Nucleic Acid

57. Which is a naturally occurring polymer ?

   (A) Polythene

   (B) Protein

   (C) Polypropene

   (D) Polyvinyl Chloride

58. Polyethylene is :

   (A) Copolymer

   (B) Homopolymer

   (C) Crosslinked copolymer

   (D) Alternate copolymer

59. Why pure monomers are used in addition polymerisation ?

   (A) Due to carbocation formation

   (B) Due to free radical formation

   (C) Due to carbanion formation

   (D) None of the above

60. Cellulose is a polymer of :

   (A) Fructose

   (B) Ribose

   (C) Sucrose

   (D) Glucose

61. Which of the following polymers have vinylic monomer units ?

   (A) Teflon

   (B) Polyacrylonitrile

   (C) Polystyrene

   (D) All of the above

62. Which polymers are used in laminated sheets ?

   (A) Phenol-Formaldehyde resin

   (B) Urea-Formaldehyde resin

   (C) Polythene

   (D) Polypropene

63. Which of the following polymers are condensation polymers ?

   (A) Polyethylene

   (B) Teflon

   (C) Bakelite

   (D) Butyl Rubber

64. Which of the following are addition polymers ?

    (A) Nylon

    (B) Polystyrene

    (C) Polypropene

    (D) All of the above

65. Which one is protein fibre ?

    (A) Cotton

    (B) Silk

    (C) Rayon

    (D) Polyster

66. Nylon-6, 6 is a :

    (A) Polyester

    (B) Polycarbonate

    (C) Polyamide

    (D) Polypeptide

67. Terylene is a condensation polymer of ethylene glycol and :

    (A) Benzoic acid

    (B) Salicylic acid

    (C) Phthalic acid

    (D) Terephthalic acid

68. Bakelite is prepared by the reaction between :

    (A) $NH_2-\overset{\overset{O}{\|}}{C}-NH_2$ and HCHO

    (B) $NH_2-\overset{\overset{O}{\|}}{C}-NH_2$ and (phenol with OH)

    (C) HCHO & (phenol with OH)

    (D) (styrene) & HCHO

69. Thermoplastics are :

    (A) Linear polymers

    (B) Soften or melt on heating

    (C) Molten polymer can be moulded in desired shape

    (D) All of the above

70. Which of the following is a thermosetting polymer ?

    (A) Nylons

    (B) Polystyrene

    (C) Polyolefins

    (D) Phenolic resins

71. Which of the following is a fully fluorinated polymer ?

    (A) Neoprene

    (B) Teflon

    (C) Thiokol

    (D) PVC

72. The polymer containing strong inter-molecular forces e.g. hydrogen bonding is :

(A) Teflon

(B) Polystyrene

(C) Natural Rubber

(D) Nylon-6, 6

73. Monometer of Nylon-6, 6 is :

(A) Adipic acid and Hexamethylene diamine

(B) Adipic acid and Ethylene diamine

(C) Benzole acid and Ehylene diamine

(D) Terephthalic acid and Hexamethylene diamine

74. .... is called Gutta-Percha.

(A) cis-polyisoprene

(B) trans-polyisoprene

(C) cis-polystyrene

(D) trans-polystyrene

75. Accelerator in vulcanisation process is :

(A) Di-thiocarbamate

(B) Guanidine

(C) Xanthate

(D) All of the above

76. Ebonite Rubber contains .... % of sulfur.

(A) 1-5%

(B) 5-10%

(C) 10-20%

(D) 30-45%

77. Synthetic human hair wigs are made from a copolymer of........ and ....

(A) Vinyl chloride and acrylonitrile

(B) Benzoic acid and vinyl chloride

(C) Acrylonitrile and phthalic acid

(D) Styrene and butadiene

78. Which of the following natural products is not a polymer ?

(A) Cellulose

(B) ATP

(C) DNA

(D) Protein

79. Which among the following polymers have lowest solubility ?

(A) Polyethylene

(B) Polystyrene

(C) Nylon-6

(D) Epoxyresin

80. The tensile strength range of fibres is :

    (A) 5,000-10,000

    (B) 10,000-15,000

    (C) 15,000-20,000

    (D) 20,000-1,50,000

81. Which statement is not true for calendering process ?

    (A) A mechanical process

    (B) Forming composite sheets

    (C) Smooth and commingle the materials

    (D) Fabric, rubber and plastic materials is not used

82. In Radical chain polymerisation the quantity given by the rate of monomer depletion, divide by the rate of propagating radical formation is called :

    (A) Kinetic chain length

    (B) Propagation efficiency

    (C) Propagation rate constant

    (D) Polymerisation time

83. What are the names of smart polymers ?

    (A) Poly urethanes

    (B) Poly methyl methacrylates

    (C) Both (A) and (B)

    (D) None of the above

84. A sample experiment revealed that PVC formed in the medium has $< M_n > = 13$ and $< M_w > = 16$. The variance of M_n will be :

    (A) 39

    (B) 87

    (C) 29

    (D) 3

85. A plastic which can be softened on heating and hardened on cooling is called :

    (A) Thermomite

    (B) Thermosetting

    (C) Thermoplastic

    (D) Thermoelastic

86. The trade name of PMMA is :

    (A) Plexiglas

    (B) Polycarbonate

    (C) Fibers

    (D) None of the above

87. The degree of polymerisation at $t = 10h$ of a polymer formed by a stepwise process with polymerisation rate const. of 3×10^{-2} M S^{-1} and an Initial monomer concentration of 50 mm is :

    (A) 55

    (B) 65

    (C) 505

    (D) 550

88. The *y* intercept obtained from the plot of viscosity of a series of polymer solutions against the conc. is 0.05. The const. K and a value for this polymers are 5×10^{-5} and 0.5 respectively. The molecular mass of polymer in g mol^{-1} is :

(A) 10^5

(B) 10^6

(C) 10^7

(D) 10^9

89. The $< N >$ and fraction of monomer consumed $< P >$ for the polymesiration reaction are related as :

(A) $<N> = \dfrac{1}{1-P}$

(B) $<N> = \dfrac{1}{1+P}$

(C) $<N> = \dfrac{1}{P}$

(D) $<N> = \dfrac{1}{P^2}$

90. A 5g/L polymer solution is prepared with a polymer whose molar mass is 25 kg. The osmotic pressure of this solution at 25°C is $[RT = 2500 \text{ J mol}^{-1}]$.

(A) .005 atm

(B) .05 atm

(C) .5 atm

(D) 5 atm

91. Which of the following is present in silk fibre ?

(A) Lipids

(B) Fats

(C) Carbohydrate

(D) Protein

92. The intermolecular forces in polymers :

(A) van der Waals' forces

(B) Dipole-dipole attraction

(C) Hydrogen bonding

(D) All of the above

93. Polymers are :

   (A) semi-crystalline materials

   (B) thermal and electrical insulators

   (C) combustible materials

   (D) All of the above

94. The optimum degree of polymerisation (DP) values of vinyl polymers are :

   (A) 50

   (B) 100

   (C) 250

   (D) 400

95. Example of tri-functional monomers :

   (A) Melamine

   (B) Amino acid

   (C) Vinyl chloride

   (D) Ethylene glycol

96. If average degree of polymerisation of polystyrene is 10^5, tsssshe value of average molecular weight is :

   (A) 104

   (B) 10.4×10^6

   (C) 104×10^6

   (D) 105

97. The example of conducting polymers :

   (A) Polyaniline

   (B) Poly pyrrole

   (C) Both (A) and (B)

   (D) None of the above

98. Polythiophene is obtained by :

   (A) Anodic oxidation of thiophene

   (B) Anodic reduction of thiophene

   (C) Cathodic reduction of thiophene

   (D) Formaldehyde and thiophene

99. Amorphous polymers do not possess any clear :

   (A) T_g

   (B) T_m

   (C) Both (A) and (B)

   (D) None of the above

100. Functionality of phenol is :

   (A) 1

   (B) 2

   (C) 3

   (D) 4

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 :

Example :

Question :

Q. 1 Ⓐ ⬤ Ⓒ Ⓓ
Q. 2 Ⓐ Ⓑ ⬤ Ⓓ
Q. 3 Ⓐ ⬤ Ⓒ Ⓓ

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

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 and 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 ny discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

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 आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ⬤ Ⓒ Ⓓ
प्रश्न 2 Ⓐ Ⓑ ⬤ Ⓓ
प्रश्न 3 Ⓐ ⬤ Ⓒ Ⓓ

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

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

6. सभी उत्तर केवल ओ. एम. आर. 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. ओ. एम. आर. 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 के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, 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।

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