ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

Polymer Chemistry

Premium CSIR-NET PYQ Book

18 Previous-Year Questions · 18 with verified answers · Distractor Analysis

3-Slide Solutions | Distractor Analysis | Exam Tricks | Revision Sheets

CSIR-NET · GATE · IIT-JAM — 3 Topics · 18 Real PYQs

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Course Contents

3 Topics · 18 PYQs

1	**Molecular Weight Averages** 5 Qs E 1 · M 3 · H 1	28%
2	**Polymerisation Kinetics** 3 Qs E 1 · M 2 · H 0	17%
3	**Polymer Chemistry – General** 10 Qs E 2 · M 8 · H 0	56%

Legend: **E** Easy **M** Medium **H** Hard · **%** = exam weightage (share of the chapter)

TOPIC 1

Molecular Weight Averages

5 questions · Easy 1 | Medium 3 | Hard 1 · PYQ frequency: Occasional

Molecular Weight Averages

Q1 The osmotic pressure (π) of a polymer sample at different concentrations (c) was measured at T(K). A plot of (π/c) versus c gave a straight line with slope (m) and intercept (c'). The number average molecular weight of the polymer is (R = gas constant).

A. (Rt)/(c')

B. (c')/(RT)

C. RT

D. mRT

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Molecular Weight Averages

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'N for Number (harmonic), W for Weight (arithmetic)'.

Molecular Weight Averages

Correct Answer B (c')/(RT)

CONCEPT

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

↓

LOGIC / WORKING

- Apply the key idea: Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.
- Check each option against it — only (B) is consistent: (c')/(RT)

FINAL: (B) (c')/(RT)

SHORTCUT / EXAM TRICK

Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.

COMMON MISTAKE

Using mole fractions in the Mw formula or weight fractions in the Mn formula.

EXAM TIP

Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MEMORY TRICK

'N for Number (harmonic), W for Weight (arithmetic)'.

Why the Other Options Are Wrong

Correct answer: B

A **(Rt)/(c')**

Why (B) is the key — Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

C **RT**

Ruled out: Using mole fractions in the Mw formula or weight fractions in the Mn formula.

D **mRT**

Ruled out: Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

Q2

For a polydispersed macromolecular colloid, osmometry gives

A. weight-average molecular weight

B. number-average molecular weight

C. both weight-average and number average molecular weight

D. viscosity-average molecular weight

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Molecular Weight Averages

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'N for Number (harmonic), W for Weight (arithmetic)'.

Molecular Weight Averages

Correct Answer B number-average molecular weight

CONCEPT

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

↓

LOGIC / WORKING

- Number average molecular weight is determined by osmometry. Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (B).

FINAL: (B) number-average molecular weight

SHORTCUT / EXAM TRICK

Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.

COMMON MISTAKE

Using mole fractions in the Mw formula or weight fractions in the Mn formula.

EXAM TIP

Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MEMORY TRICK

'N for Number (harmonic), W for Weight (arithmetic)'.

Why the Other Options Are Wrong

Correct answer: B

A — **weight-average molecular weight**

Why (B) is the key — Number average molecular weight is determined by osmometry. Explanation as extracted from the printed page; notation may be imperfect.

C — **both weight-average and number average molecular weight**

Ruled out: Using mole fractions in the Mw formula or weight fractions in the Mn formula.

D — **viscosity-average molecular weight**

Ruled out: Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

Q3 A sample experiment revealed that PVC formed in the medium has $(M_n) = 13$, and $(M_w) = 16$, where (M_n) stands for the number average molar mass and (M_w) for the weight average molar mass. The variance of M_n will then be

A. 39

B. 3

C. 1

D. 87

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Molecular Weight Averages

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'N for Number (harmonic), W for Weight (arithmetic)'.

Molecular Weight Averages

Correct Answer A 39

CONCEPT

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

↓

LOGIC / WORKING

- Variance = (Difference between molar mass and weight molar mass) ×molar mass = (16-3)× 13 = 3×13=39 Here molar mass represented xi and weighted molar mass fi . In this question data set and there frequency is not given. All the final values are given. So, variance = $E\ x\ Z - E(x)$ Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (A).

FINAL: (A) 39

SHORTCUT / EXAM TRICK

Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.

COMMON MISTAKE

Using mole fractions in the Mw formula or weight fractions in the Mn formula.

EXAM TIP

Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MEMORY TRICK

'N for Number (harmonic), W for Weight (arithmetic)'.

Why the Other Options Are Wrong

Correct answer: A

B

3

Why (A) is the key — Variance = (Difference between molar mass and weight molar mass) ×molar mass = (16-3)× 13 = 3×13=39 Here molar mass represented xi and weighted molar mass fi . In this question data set and there frequency is not given. All the final values are given. So, variance = $E\ x\ Z - E(x)$ Explanation as extracted from the printed page; notation may be imperfect.

C

1

Ruled out: Using mole fractions in the Mw formula or weight fractions in the Mn formula.

D

87

Ruled out: Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

Q4

A polymer has the following molar mass distribution Number of molecules Molar mass (g.mol-1) 50 5000 75 6000 The calculated number average molar mass (M_n) of the polymer is

A. 5200

B. 5600

C. 5800

D. 6000

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Molecular Weight Averages

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'N for Number (harmonic), W for Weight (arithmetic)'.

Molecular Weight Averages

Correct Answer B 5600

CONCEPT

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

↓

LOGIC / WORKING

- Apply the key idea: Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.
- Check each option against it — only (B) is consistent: 5600

FINAL: (B) 5600

SHORTCUT / EXAM TRICK

Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.

COMMON MISTAKE

Using mole fractions in the Mw formula or weight fractions in the Mn formula.

EXAM TIP

Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MEMORY TRICK

'N for Number (harmonic), W for Weight (arithmetic)'.

Why the Other Options Are Wrong

Correct answer: B

A **5200**

Why (B) is the key — Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

C **5800**

Ruled out: Using mole fractions in the Mw formula or weight fractions in the Mn formula.

D **6000**

Ruled out: Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

Q5 **The correct expression for the product ($M_n \cdot M_w$) [M_n and M_w are the number average and weight average molar masses, respectively, of a polymer] is**

A $N^{-1}\Sigma_i N_i M_i$

B $N^{-1}\Sigma_i N_i M_i^2$

C $N/\Sigma_i N_i M_i$

D $N/\Sigma_i N_i M_i^2$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Molecular Weight Averages

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'N for Number (harmonic), W for Weight (arithmetic)'.

Molecular Weight Averages

Correct Answer B $N^{-1}\Sigma_i N_i M_i^2$

CONCEPT

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

↓

LOGIC / WORKING

- Apply the key idea: Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.
- Check each option against it — only (B) is consistent: $N^{-1}\Sigma_i N_i M_i^2$

FINAL: (B) $N^{-1}\Sigma_i N_i M_i^2$

SHORTCUT / EXAM TRICK

Equal masses of two polymers: Mn is the harmonic mean, Mw the arithmetic mean of the two molar masses.

COMMON MISTAKE

Using mole fractions in the Mw formula or weight fractions in the Mn formula.

EXAM TIP

Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MEMORY TRICK

'N for Number (harmonic), W for Weight (arithmetic)'.

Why the Other Options Are Wrong

Correct answer: B

A $N^{-1}\Sigma_i N_i M_i$

Why (B) is the key — Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

C $N/\Sigma_i N_i M_i$

Ruled out: Using mole fractions in the Mw formula or weight fractions in the Mn formula.

D $N/\Sigma_i N_i M_i^2$

Ruled out: Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

TOPIC REVISION

Molecular Weight Averages

5 PYQs · Last-minute revision

TOPIC SUMMARY

Mn weights each chain by number, Mw by mass; Đ = Mw/Mn measures the spread. For a mixture with weight fractions w_i: $1/Mn = \Sigma(w_i/M_i)$, $Mw = \Sigma w_i M_i$.

IMPORTANT FORMULA SHEET

- $Mn = \Sigma N_i M_i / \Sigma N_i$
- $Mw = \Sigma N_i M_i^2 / \Sigma N_i M_i$
- $1/Mn = \Sigma\, w_i/M_i$; $Mw = \Sigma\, w_i M_i$
- $Đ = Mw/Mn$

FREQUENTLY ASKED CONCEPTS

- Mn and Mw from a two-component mixture
- Which method measures which average
- Dispersity of step-growth polymers (Đ → 2)

COMMON MISTAKES & QUICK NOTES

Watch out:
Using mole fractions in the Mw formula or weight fractions in the Mn formula.
Mw/Mn for ideal step-growth at high conversion = 1 + p ≈ 2; for ideal living polymerisation ≈ 1.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q4 Q5

Expect 1 question(s) next session on Molecular Weight Averages.

TOPIC 2

Polymerisation Kinetics

3 questions · Easy 1 | Medium 2 | Hard 0 · PYQ frequency: Occasional

Q6

The degree of polymerization at t = 10 h of a polymer formed by a stepwise process with polymerization rate constant of 3×10^{-2} M^{-1} s^{-1} and an initial monomer concentration of 50 mM is

A. 55

B. 65

C. 550

D. 505

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymerisation Kinetics

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Initiator up → Rate √up, Length ↓'.

Correct Answer A 55

CONCEPT

Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

↓

LOGIC / WORKING

- Apply the key idea: Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.
- Check each option against it — only (A) is consistent: 55

FINAL: (A) 55

SHORTCUT / EXAM TRICK

Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.

COMMON MISTAKE

Forgetting that termination is second order in radicals (hence the square root).

EXAM TIP

High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

MEMORY TRICK

'Initiator up → Rate √up, Length ↓'.

Why the Other Options Are Wrong

Correct answer: A

B — **65**

Why (A) is the key — Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

C — **550**

Ruled out: Forgetting that termination is second order in radicals (hence the square root).

D — **505**

Ruled out: High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

Q7

During the addition polymerization, the reaction proceeds via

A. Step-growth process

B. Free-radical chain reaction

C. Cascade process

D. Addition reaction

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Polymerisation Kinetics

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Initiator up → Rate √up, Length ↓'.

Correct Answer B Free-radical chain reaction

CONCEPT

Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

↓

LOGIC / WORKING

- Apply the key idea: Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.
- Check each option against it — only (B) is consistent: Free-radical chain reaction

FINAL: (B) Free-radical chain reaction

SHORTCUT / EXAM TRICK

Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.

COMMON MISTAKE

Forgetting that termination is second order in radicals (hence the square root).

EXAM TIP

High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

MEMORY TRICK

'Initiator up → Rate √up, Length ↓'.

Why the Other Options Are Wrong

Correct answer: B

A — **Step-growth process**

Why (B) is the key — Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

C — **Cascade process**

Ruled out: Forgetting that termination is second order in radicals (hence the square root).

D — **Addition reaction**

Ruled out: High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

Q8 **In radical chain polymerization the quantity given by the 'rate of monomer depletion, divided by the rate of propagating radical formation' is called**

A. kinetic chain length

B. propagation efficiency

C. propagation rate constant

D. polymerization time

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymerisation Kinetics

PYQ FREQUENCY
Occasional · 3 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Initiator up → Rate √up, Length ↓'.

Correct Answer A kinetic chain length

CONCEPT

Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

↓

LOGIC / WORKING

- Apply the key idea: Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.
- Check each option against it — only (A) is consistent: kinetic chain length

FINAL: (A) kinetic chain length

SHORTCUT / EXAM TRICK

Rate ∝ [M][I]^½: doubling initiator raises rate by √2 but halves chain length.

COMMON MISTAKE

Forgetting that termination is second order in radicals (hence the square root).

EXAM TIP

High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

MEMORY TRICK

'Initiator up → Rate √up, Length ↓'.

Why the Other Options Are Wrong

Correct answer: A

B **propagation efficiency**

Why (A) is the key — Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

C **propagation rate constant**

Ruled out: Forgetting that termination is second order in radicals (hence the square root).

D **polymerization time**

Ruled out: High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

TOPIC REVISION

Polymerisation Kinetics

3 PYQs · Last-minute revision

TOPIC SUMMARY

Free-radical chain polymerisation: initiation, propagation, termination. Rate Rp = kp[M](f kd[I]/kt)^½; kinetic chain length ν = Rp/Ri ∝ [M]/[I]^½. Step-growth: Carothers Xn = 1/(1−p).

IMPORTANT FORMULA SHEET

- Rp = kp (f kd/kt)^½ [I]^½ [M]
- ν = kp[M]/(2(f kd kt)^½[I]^½)
- Xn = 1/(1−p) (Carothers)
- Đ = 1 + p

FREQUENTLY ASKED CONCEPTS

- Order in monomer and initiator
- Kinetic chain length
- Carothers equation
- Chain transfer

COMMON MISTAKES & QUICK NOTES

Watch out:
Forgetting that termination is second order in radicals (hence the square root).
High DP in step growth needs p > 0.99 — exact stoichiometry and removal of by-product.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q6 Q7 Q8

Expect 1 question(s) next session on Polymerisation Kinetics.

TOPIC 3

Polymer Chemistry – General

10 questions · Easy 2 | Medium 8 | Hard 0 · PYQ frequency: High

Q9

In a polymer of N monomer units, the root mean square separation between the two ends is proportional to

A. $N^{1}/2$

B. N

C. $N^{3}/2$

D. N^{2}

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer A $N^{1}/2$

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (A) is consistent: $N^{1}/2$

FINAL: (A) $N^{1}/2$

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: A

B **N**

Why (A) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

C **$N^{3}/2$**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D **N^{2}**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q10 **There are several types of mean molar masses for polymer and they are dependent on experimental methods like: (1) Osmometry (2) Light scattering (3) Sedimentation. Correct relation between mean molar masses and experimental method is:**

A M_n Rightarrow (3), M_w Rightarrow (2), M_z Rightarrow (1)

B M_n Rightarrow (2), M_w Rightarrow (3), M_z Rightarrow (1)

C M_n Rightarrow (1), M_w Rightarrow (2), M_z Rightarrow (3)

D M_n Rightarrow (1), M_w Rightarrow (3), M_z Rightarrow (2)

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer C M_n Rightarrow (1), M_w Rightarrow (2), M_z Rightarrow (3)

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (C) is consistent: M_n Rightarrow (1), M_w Rightarrow (2), M_z Rightarrow (3)

FINAL: (C) M_n Rightarrow (1), M_w Rightarrow (2), M_z Rightarrow (3)

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: C

A

M_n Rightarrow (3), M_w Rightarrow (2), M_z Rightarrow (1)

Why (C) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B

M_n Rightarrow (2), M_w Rightarrow (3), M_z Rightarrow (1)

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D

M_n Rightarrow (1), M_w Rightarrow (3), M_z Rightarrow (2)

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q11

The number-average molar mass (M_N) and weight-average molar mass (M_w) of a polymer are obtained respectively by

A. Osmometry and light scattering measurements

B. Osmometry and viscosity measurements

C. Light scattering and sedimentation measurements

D. Viscosity and light scattering measurements

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer B Osmometry and viscosity measurements

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (B) is consistent: Osmometry and viscosity measurements

FINAL: (B) Osmometry and viscosity measurements

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: B

A — **Osmometry and light scattering measurements**

Why (B) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

C — **Light scattering and sedimentation measurements**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D — **Viscosity and light scattering measurements**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q12

The intrinsic viscosity depends on the molar mass as $[\eta] = KM_a$. The empirical constants K and a are dependent on

A. solvent only

B. polymer only

C. polymer-solvent pair

D. polymer-polymer interaction

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer C polymer-solvent pair

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (C) is consistent: polymer-solvent pair

FINAL: (C) polymer-solvent pair

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: C

A **solvent only**

Why (C) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B **polymer only**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D **polymer-polymer interaction**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q13

The stability of a lyophobic colloid is the consequence of

A. van der Waals attraction among the solute-solvent adducts

B. Brownian motion of the colloidal particles

C. insolubility of colloidal particles in solvent

D. electrostatic repulsion among double layered colloidal particles

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer D electrostatic repulsion among double layered colloidal particles

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (D) is consistent: electrostatic repulsion among double layered colloidal particles

FINAL: (D) electrostatic repulsion among double layered colloidal particles

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: D

A **van der Waals attraction among the solute-solvent adducts**

Why (D) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B **Brownian motion of the colloidal particles**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

C **insolubility of colloidal particles in solvent**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q14

The correct form for a simple Langmuir isotherm is

A. $\theta = K_p$

B. $\theta = (K_p)^{1}/2$

C. $\theta = K_p/(1 + K_p)$

D. $\theta = (1 + K_p)/K_p$

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer C $\theta = K_p/(1 + K_p)$

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (C) is consistent: $\theta = K_p/(1 + K_p)$

FINAL: (C) $\theta = K_p/(1 + K_p)$

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: C

A $\theta = K_p$

Why (C) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B $\theta = (K_p)^1/2$

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D $\theta = (1 + K_p)/K_p$

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q15

The average end-to-end distance of a random coil polymer of 10^6 monomers (in units of segment length) is

A. 10^6

B. 10^5

C. 10^4

D. 10^3

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer D 10^3

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (D) is consistent: 10^3

FINAL: (D) 10^3

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: D

A 10^6

Why (D) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B 10^5

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

C 10^4

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q16

The condensation of hydroxy acid produces a polyster with the probability of linkage at both ends being p. The mole fraction of k-mer chain formation is

A. p^k

B. p(1-p)^k-1

C. p^k-1(1-p)

D. p_{k-1}

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
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EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer D p_{k-1}

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (D) is consistent: p_{k-1}

FINAL: (D) p_{k-1}

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: D

A **p^k**

Why (D) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

B **p(1-p)^k-1**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

C **p^k-1(1-p)**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q17

For a monodisperse polymer, the number-average molar mass (M_N) and weight-average molar mass (M_w) are related according to

A. $M_w < M_N$

B. $M_w = M_N$

C. $M_w > M_N$

D. $M_w < \log M_N$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer B M_w = M_N

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (B) is consistent: M_w = M_N

FINAL: (B) M_w = M_N

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: B

A **M_w < M_N**

Why (B) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

C **M_w > M_N**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D **M_w < log M_N**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

Q18

A polydisperse polymer sample has ten molecules of molar mass 20,000 g mol⁻¹ and fifteen molecules of molar mass 10,000 g mol⁻¹. The number-average molar mass (g mol⁻¹) (M_n) of the sample is

A. 13,000

B. 14,000

C. 15,000

D. 16,000

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Polymer Chemistry – General

PYQ FREQUENCY
High · 6 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Osmotic counts Numbers; Light weighs Weight'.

Correct Answer B 14,000

CONCEPT

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

↓

LOGIC / WORKING

- Apply the key idea: Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).
- Check each option against it — only (B) is consistent: 14,000

FINAL: (B) 14,000

SHORTCUT / EXAM TRICK

Mw ≥ Mn always; Đ = 1 only for a perfectly monodisperse sample (e.g. proteins, living polymers).

COMMON MISTAKE

Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

EXAM TIP

Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MEMORY TRICK

'Osmotic counts Numbers; Light weighs Weight'.

Why the Other Options Are Wrong

Correct answer: B

A **13,000**

Why (B) is the key — Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

C **15,000**

Ruled out: Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.

D **16,000**

Ruled out: Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

TOPIC REVISION

Polymer Chemistry – General

10 PYQs · Last-minute revision

TOPIC SUMMARY

Polymers are characterised by average molar masses (Mn, Mw, Mz, Mv), dispersity Đ = Mw/Mn, degree of polymerisation, tacticity and glass-transition temperature Tg.

IMPORTANT FORMULA SHEET

- $Mn = \Sigma N_i M_i / \Sigma N_i$
- $Mw = \Sigma N_i M_i^2 / \Sigma N_i M_i$
- $Đ = Mw/Mn \geq 1$
- $DP = M/M_0$

FREQUENTLY ASKED CONCEPTS

- Number vs weight average
- Dispersity index
- Chain vs step growth
- Tg and crystallinity

COMMON MISTAKES & QUICK NOTES

Watch out:
Averaging molar masses arithmetically when weight fractions, not mole fractions, are given.
Osmometry gives Mn, light scattering gives Mw, viscometry gives Mv (Mn ≤ Mv ≤ Mw).

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18

Expect 2 question(s) next session on Polymer Chemistry – General.

FOR STUDENTS AND EDUCATORS

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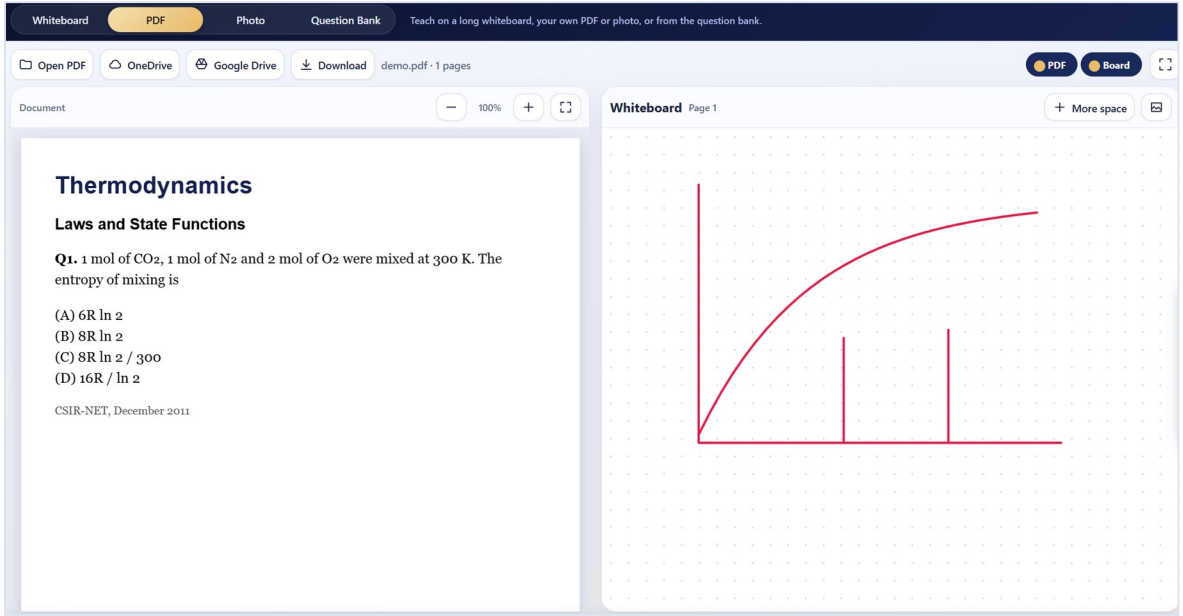
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