MCQ 50 marks

1. **B. 4**
Explanation: Chiral carbons are C2 and C3, i.e. n = 2
The two ends of the molecule differ (CH_3 and C_2H_5), so it is unsymmetrical and no meso form is possible
Optical isomers = $2^n = 2^2 = 4$

2. **B. 2,4-Dimethylhexane**
Explanation: Including the ethyl group in the main chain gives the longest chain of 6 carbons
$CH_3 - CH(CH_3) - CH_2 - CH(CH_3) - CH_2 - CH_3$
Numbering starts from the end that gives the two methyl groups the lowest locants (2, 4)
Therefore, the name is 2,4-dimethylhexane

3. **B. n-Pentane and neopentane**
Explanation: Chain isomers differ in the carbon skeleton (straight vs branched) while the functional group stays the same
n-Pentane is straight-chain, whereas neopentane (2,2-dimethylpropane) is branched
Therefore, they are chain isomers

4. **D. 2-Bromo-2-methylbutane**
Explanation: Addition of H^+ first gives a 2° carbocation: $CH_3 - C^+H - CH(CH_3)_2$
A hydride (H^-) shift from the adjacent carbon gives the more stable 3° carbocation
Br^- adds to that 3° carbon to give $(CH_3)_2CBr - CH_2CH_3$
Therefore, the product is 2-bromo-2-methylbutane

5. **D. Xylene**
Explanation: Reforming involves cyclization and dehydrogenation, but the number of carbons is unchanged
n-Octane has 8 carbons, so the product is a C_8H_{10} aromatic compound
Therefore, xylene is mainly obtained

6. **C. 6**
Explanation: The two ring C = C bonds contribute 4 π electrons
The lone pair on N contributes 2
Total = 4 + 2 = 6, which satisfies 4n + 2 (n = 1)

7. **D. Heating excess ethanol with concentrated H_2SO_4 at 140°C**
Explanation: At 140°C with excess ethanol, intermolecular dehydration takes place
$2C_2H_5OH \xrightarrow{H_2SO_4,\ 140°C} C_2H_5 - O - C_2H_5 + H_2O$
The product is diethyl ether, not an alkene

8. **D. $-NH_2$**
Explanation: The lone pair on the N of $-NH_2$ donates electrons strongly into the ring by the +M effect
This greatly increases the electron density of the ring
Therefore, $-NH_2$ is the strongest activating group

9. **B. Coke, at about 2000°C**
Explanation: Calcium carbide is made by heating lime (CaO) with coke at about 2000°C in an electric furnace
$CaO + 3C \xrightarrow{2000°C} CaC_2 + CO$

10. **A. 2-Methyl-1,3,5-trinitrobenzene**
Explanation: TNT is 2,4,6-trinitrotoluene
Taking benzene as the parent, the $-NO_2$ groups are at positions 1, 3, 5 and the $-CH_3$ group is at position 2
Therefore, the IUPAC name is 2-methyl-1,3,5-trinitrobenzene

11. **C. Formation of the more stable carbocation**
Explanation: In the first step, H^+ adds to form a carbocation; stability: 3° > 2° > 1°
H^+ adds to the carbon that gives the more stable carbocation
X^- then adds to that positive carbon

12. **D. Propanone and ethanoic acid**

Explanation: A strong oxidant cleaves the double bond
The $(CH_3)_2C =$ part has no H, so it gives the ketone $(CH_3)_2C = O$ (propanone)
The $= CH - CH_3$ part has one H, so it is oxidized up to the acid, giving CH_3COOH

13. **D. It is a reversible reaction**
Explanation: $C_6H_6 + H_2SO_4 \rightleftharpoons C_6H_5SO_3H + H_2O$
Passing superheated steam through the dilute acid reverses it (desulfonation)
Therefore, sulfonation is a reversible reaction

14. **A. Methane**
Explanation: In the Wurtz reaction, two alkyl groups join: $2R - X + 2Na \rightarrow R - R + 2NaX$
So the product contains at least 2 carbons
Therefore, methane, with only 1 carbon, cannot be made this way

15. **A. 2**
Explanation: To get propane (C_3H_8), the salt of a 4-carbon acid is needed, which leaves propane after losing $-COONa$
$CH_3CH_2CH_2COONa \rightarrow CH_3CH_2CH_3$
$(CH_3)_2CHCOONa \rightarrow CH_3CH_2CH_3$
Therefore, 2 acids in total

16. **B. 62.5%**
Explanation: Let the fraction of the (+) enantiomer in the mixture be x
Given, $36x - 36(1 - x) = -9$
or, $72x = 27$
or, $x = 0.375$
Therefore, (−) enantiomer $= 1 - 0.375 = 0.625$, i.e. 62.5%

17. **D.** $C_6H_5CH = CH_2$
Explanation: The monomer of polystyrene is styrene, or vinylbenzene ($C_6H_5CH = CH_2$)
Its double bond opens up in addition polymerization
$n\, C_6H_5CH = CH_2 \rightarrow -[CH(C_6H_5) - CH_2]_n-$

18. **C. Cyclobutadiene**
Explanation: Cyclobutadiene is planar, cyclic and fully conjugated
It has 4 π electrons, which fits $4n$ ($n = 1$)
Therefore, it is anti-aromatic

19. **C. Propane**
Explanation: HI with red P is a strong reducing agent; it converts $-COOH$ into $-CH_3$ without changing the number of carbons
$CH_3CH_2COOH + 6HI \xrightarrow{P,\ 150°C}$
$CH_3CH_2CH_3 + 2H_2O + 3I_2$
Product: propane

20. **A. Benzene and methane**
Explanation: In hydrodealkylation, the carbon–carbon bond of the side chain is broken
$C_6H_5CH_3 + H_2 \rightarrow C_6H_6 + CH_4$
Products: benzene and methane

21. **A. Arenium ion**
Explanation: In the slow step, E^+ bonds to a ring carbon to form a resonance-stabilized carbocation
This is the arenium ion, or σ-complex
In the following fast step, loss of H^+ restores aromaticity

22. **A. Vinyl chloride**
Explanation: $HC \equiv CH + HCl \xrightarrow{HgCl_2}$
$CH_2 = CHCl$
The product is vinyl chloride, the monomer of PVC

23. **D. Nylon-6,6**
Explanation: The repeating unit of nylon-6,6 contains $-CO - NH-$ (amide) linkages
Therefore, nylon-6,6 is a polyamide

24. **C.** 1.39 Å
Explanation: Because of resonance, all carbon–carbon bonds in benzene are equal in length
The value lies between a single and a double bond: 1.39 Å

25. **B. meso-Tartaric acid**
Explanation: Although meso-tartaric acid has two chiral carbons, a plane of symmetry passes through the middle of the molecule
So it is optically inactive due to internal compensation

26. **C. Ethene**
Explanation: In Kolbe electrolysis:
$^-OOC - CH_2 - CH_2 - COO^- \rightarrow CH_2 = CH_2 + 2CO_2 + 2e^-$
Both $-COO^-$ groups leave as CO_2 and a

double bond forms between the two adjacent carbons
Product: ethene

27. **B.** $H_2O > HC \equiv CH > NH_3 > CH_2 = CH_2$
Explanation: pK_a: $H_2O \approx 15.7$, $HC \equiv CH \approx 25$, $NH_3 \approx 38$, $CH_2 = CH_2 \approx 44$
The lower the pK_a, the stronger the acid
Therefore, the order is
$H_2O > HC \equiv CH > NH_3 > CH_2 = CH_2$

28. **A. 11**
Explanation: $C_xH_y + \left(x + \frac{y}{4}\right) O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$
Here, $x = 7$, $y = 16$
$O_2 = 7 + \frac{16}{4}$
$= 11$ mol

29. **A.** C_5H_{10}
Explanation: $C_nH_{2n} + \frac{3n}{2}O_2 \rightarrow nCO_2 + nH_2O$
Given, $\frac{3n}{2} = 7.5$
or, $n = 5$
Therefore, the alkene is C_5H_{10}

30. **C. 3-Phenylpropanal**
Explanation: The principal group is $-CHO$, whose carbon is C1
C1 (CHO), C2, C3 (bearing C_6H_5)
The benzene ring is named as the substituent 'phenyl'
Therefore, the name is 3-phenylpropanal

31. **D. Thermosetting condensation polymer**
Explanation: Bakelite forms from phenol and formaldehyde with loss of H_2O, so it is a condensation polymer
Its three-dimensional network does not soften on heating, so it is thermosetting

32. **A. 2-Methylbutan-2-ol**
Explanation: The longest chain containing the carbon bearing $-OH$ has 4 carbons, so the parent is butanol
Giving $-OH$ the lowest number places both $-OH$ and CH_3 on C2
Therefore, the name is 2-methylbutan-2-ol

33. **C. 3-Methylhex-4-en-1-yne**
Explanation: The main chain has 6 carbons
Numbering from the $\equiv CH$ end gives yne = 1, ene = 4, i.e. the lowest locant set {1,4}
The methyl group is on C3
'ene' is written before 'yne' in the name
Therefore, the name is 3-methylhex-4-en-1-yne

34. **C. 1-Chloropropan-2-ol**
Explanation: In HOCl, Cl is partially positive ($HO^{\delta-} - Cl^{\delta+}$)
Cl^+ adds to the terminal CH_2 to form a 2° carbocation
OH^- adds to that 2° carbon
Therefore, the product is
$ClCH_2 - CH(OH) - CH_3$, i.e. 1-chloropropan-2-ol

35. **C. 4**
Explanation: Each of the two double bonds can show geometrical isomerism
The two ends of the molecule differ (CH_3 and C_2H_5), so no form is repeated
Isomers = $2^2 = 4$: (2E,4E), (2E,4Z), (2Z,4E), (2Z,4Z)

36. **B. 5**
Explanation: Structural isomers: 1-chlorobutane, 2-chlorobutane, 1-chloro-2-methylpropane and 2-chloro-2-methylpropane, i.e. 4
Of these, 2-chlorobutane is chiral, so it exists as d and l forms
Therefore, total = 4 + 1 = 5

37. **B. Benzaldehyde**
Explanation: This is the Étard reaction; CrO_2Cl_2 is a mild oxidant
So the $-CH_3$ group is oxidized only as far as $-CHO$
$C_6H_5CH_3 \rightarrow C_6H_5CHO$ (benzaldehyde)

38. **D. Butane**
Explanation: In Clemmensen reduction, the $-CHO$ group is converted into $-CH_3$
$CH_3CH_2CH_2CHO + 4[H] \xrightarrow{Zn(Hg),\ HCl} CH_3CH_2CH_2CH_3 + H_2O$
Product: butane

39. **B.** 4.48 L
Explanation: $C_4H_6 + 2H_2 \rightarrow C_4H_{10}$
Molar mass of $C_4H_6 = 54$
Moles = $\frac{5.4}{54} = 0.1$ mol
H_2 required = $2 \times 0.1 = 0.2$ mol
Therefore, volume = $0.2 \times 22.4 = 4.48$ L

40. **C. Cyclohexane**
Explanation: With excess H_2, the benzene ring is fully saturated
$C_6H_6 + 3H_2 \xrightarrow{\text{Ni, 180–200°C}} C_6H_{12}$
Product: cyclohexane

41. **B. Cold, dilute alkaline $KMnO_4$ solution**
Explanation: Cold, dilute (1%) alkaline $KMnO_4$ solution is called Baeyer's reagent
It detects double or triple bonds (unsaturation); its pink colour disappears and a brown precipitate of MnO_2 forms

42. **C.** $CH_3CH = NOH$
Explanation: In $CH_3CH = NOH$ (acetaldoxime), the carbon of the C = N bond carries two different groups (CH_3 and H)
So the −OH group can point towards either of them
This gives two geometrical isomers, syn and anti

43. **A. 800**
Explanation: Molecular mass of the monomer $CH_2 = CH_2 = 28$
Number of monomer units, $n = \frac{22400}{28} = 800$

44. **A. 6**
Explanation: $DU = C + 1 + \frac{N}{2} - \frac{H}{2}$
Here, C = 8, H = 7, N = 1
Therefore, $DU = 8 + 1 + \frac{1}{2} - \frac{7}{2} = 6$

45. **D. Cracking**
Explanation: In cracking (thermal decomposition), carbon–carbon bonds of large alkanes break to form smaller alkanes and alkenes
Example: $C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$

46. **A. But-1-ene**
Explanation: Dehydration on the Al_2O_3 surface does not form a free carbocation, so no rearrangement occurs
$CH_3CH_2CH_2CH_2OH \xrightarrow{Al_2O_3,\ 350°C} CH_3CH_2CH = CH_2 + H_2O$
Product: but-1-ene

47. **C. 2-Bromo-2-methylpropane**
Explanation: Bromination is highly selective ($1° : 2° : 3° \approx 1 : 82 : 1600$)
The 3° free radical is the most stable, so the 3° H is substituted
$(CH_3)_3CH + Br_2 \xrightarrow{h\nu} (CH_3)_3CBr + HBr$

48. **D. 1 : 3**
Explanation: $CO + 3H_2 \xrightarrow{\text{Ni, 250–300°C}} CH_4 + H_2O$
Therefore, $CO : H_2 = 1 : 3$

49. **B. Toluene > benzene > chlorobenzene > nitrobenzene**
Explanation: $-CH_3$ is activating, so toluene is nitrated fastest
−Cl is weakly deactivating (−I > +M), so chlorobenzene is slower than benzene
$-NO_2$ is strongly deactivating, so nitrobenzene is the slowest
Therefore, the order is toluene > benzene > chlorobenzene > nitrobenzene

50. **A. Propene and H_2**
Explanation: In dehydrogenation, two H atoms are removed from adjacent carbons to form a double bond
$CH_3CH_2CH_3 \xrightarrow{\text{Cu, 300°C}} CH_3CH = CH_2 + H_2$