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Aromatic hydrocarbons and electrophilic substitution

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Huckel rule	aromatic if planar, cyclic, conjugated and pi electrons = 4n + 2 (2, 6, 10, 14) Valid when: planar, cyclic, fully conjugated ring	count of electrons
Electrophile in nitration	HNO3 + 2 H2SO4 gives NO2+ + H3O+ + 2 HSO4- Valid when: nitration with concentrated HNO3 and H2SO4	n/a (equation)
Electrophile in halogenation	X2 + FeX3 gives X+ (polarised complex) for Cl and Br Valid when: Cl2 or Br2 with Lewis acid FeX3 or AlX3	n/a (equation)
Friedel-Crafts alkylation	ArH + RX (AlCl3) gives ArR + HX; R+ may rearrange Valid when: ring not strongly deactivated and no NH2; primary R may rearrange	n/a (equation)
Friedel-Crafts acylation	ArH + RCOCl (AlCl3) gives ArCOR + HCl; no rearrangement Valid when: ring not strongly deactivated; AlCl3; acylium ion does not rearrange	n/a (equation)
Ortho/para, activating	-OH, -OR, -NH2, -NHR, -NR2, -R Valid when: directing effect on electrophilic substitution of a monosubstituted benzene	n/a (list)
Ortho/para, deactivating	-F, -Cl, -Br, -I Valid when: directing effect on electrophilic substitution; halogens deactivate but direct o/p	n/a (list)
Meta, deactivating	-NO2, -CN, -CHO, -COR, -COOH, -COOR, -SO3H, -NR3+ Valid when: directing effect on electrophilic substitution; ring deactivated	n/a (list)
Degree of unsaturation	(2C + 2 - H) / 2; benzene 4, naphthalene 7 Valid when: Hydrocarbon or C,H-only formula; for C H X N use H+X-N in place of H; O and S ignored; neutral molecule	dimensionless
Sigma bonds in benzene	6 C-C + 6 C-H = 12 sigma, plus 3 pi (Kekule)	count

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/chemistry/hydrocarbons/aromatic-hydrocarbons-and-electrophilic-substitution

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