EngineeringRise

Dynamics of circular motion and banking

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

Result	Formula	Units or note
Centripetal acceleration and force	a = v^2/r = w^2 r; F = m v^2/r Valid when: circular path of radius r; radial component of acceleration	m/s^2 (N)
Angular speed	w = 2 pi n = 2 pi N/60 (N in rpm) Valid when: uniform rotation; w in rad/s, n in rev/s, N in rpm	rad/s
Level road, maximum speed	v_max = sqrt(mu r g) Valid when: level road, friction alone gives centripetal force, car not skidding	m/s
Level road, smallest radius at speed v	r_min = v^2/(mu g) Valid when: level road, friction alone gives centripetal force	m
Banked road, no friction	tan(theta) = v^2/(r g); N = m g/cos(theta) Valid when: banked road with no friction, ideal speed	dimensionless, N
Banked road, maximum speed with friction	v_max = sqrt(r g (tan(theta) + mu)/(1 - mu tan(theta))) Valid when: banked road, friction at its limit acting down the slope, mu tan(theta) < 1	m/s
Banked road, minimum speed with friction	v_min = sqrt(r g (tan(theta) - mu)/(1 + mu tan(theta))), if mu < tan(theta); else 0 Valid when: banked road, friction at its limit acting up the slope; zero speed if mu >= tan(theta)	m/s
Scaling rule	level: v is proportional to sqrt(mu r); bank: v_0 is proportional to sqrt(r tan(theta)) Valid when: banked road or level road, same turn; only for scaling comparisons	ratio

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/physics/laws-of-motion/dynamics-of-circular-motion-and-banking

EngineeringRise is an unofficial study site. It is not affiliated with NTA, the IITs, BITS, VIT, SRM or any exam body.