

Automotive Transmission Cheat Sheet

Gear ratios, road speed, manual vs. automatic vs. CVT

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Gear ratio	$GR = \text{teeth}_{\text{driven}} / \text{teeth}_{\text{driving}}$	GR > 1 multiplies torque and cuts speed. GR < 1 (overdrive) does the reverse
Overall ratio	$G = GR \times FD$	FD = final drive (differential) ratio
Wheel torque	$T_{\text{wheel}} = T_{\text{engine}} \cdot G \cdot \eta$	η = driveline efficiency
Road speed (mph)	$v = \text{RPM} \times C_{\text{in}} \times 60 / (G \times 63,360)$	C_{in} = tire circumference in inches (63,360 in per mile)
Worked example	1.5×3.7 , 78.5 in tire, 3,000 RPM → ≈ 40 mph	Matches the guide's setup; low gears for launch and towing, high gears for cruising
Yaw inertia	$I = \sum m r^2$	Mass far from the center (behind the rear axle) makes the car harder to rotate and recover

Key takeaways

- An IC engine cannot make torque from zero speed and makes peak power only in a narrow RPM band. The transmission matches engine speed and torque to the road.
- **Manual:** driver-operated clutch and shift forks. **Automatic:** torque converter plus planetary gear sets, shifted by an electro-hydraulic control system.
- **AMT** automates a manual gearbox with actuators. **CVT** uses a belt for infinite ratios so the engine can sit in its efficient sweet spot.
- A **transaxle** combines transmission and final drive in one unit, common in front-wheel drive, saving space and weight.
- FWD: lighter, more cabin room, better fuel economy. RWD: more balanced handling and torque capacity.
- A ten-speed automatic uses four planetary gear sets and six shift elements (two brakes, four clutches).
- Gearbox mass placed ahead of the rear axle (between the axles) keeps yaw inertia low.

Typical efficiency (from the guide)

Type	Manual	Automatic	CVT
Efficiency	96.2%	~86%	~84%