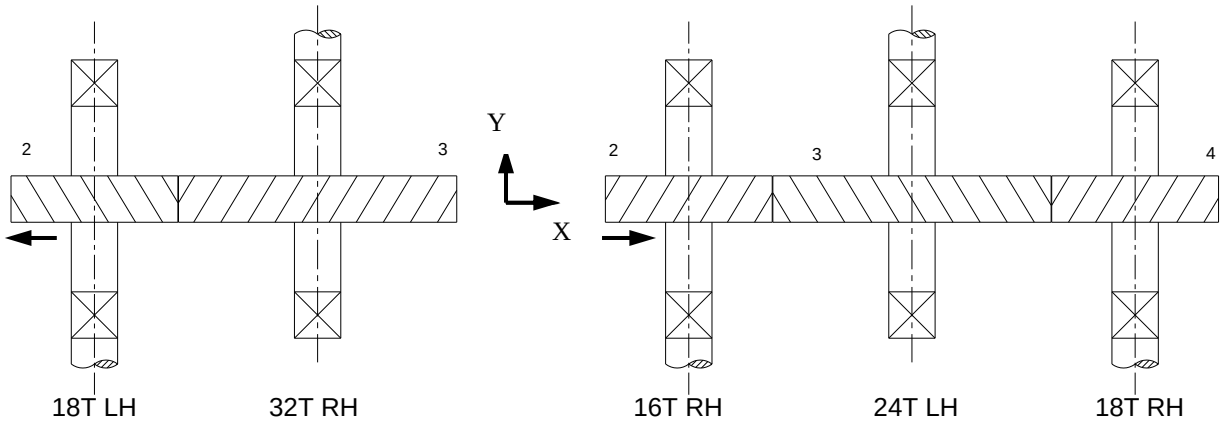
1- The gears in the two trains shown below have a normal module of 6 mm, a normal pressure angle of 20° and a 30° helix angle. For both gear trains the transmitted load is 3500 N.
a) Find the forces acting on each gear in part a if the pinion is rotating in the clockwise direction about the y-axis.
b) For part b find the forces acting on gear 3. The pinion rotates ccw and gear 3 is an idler gear.



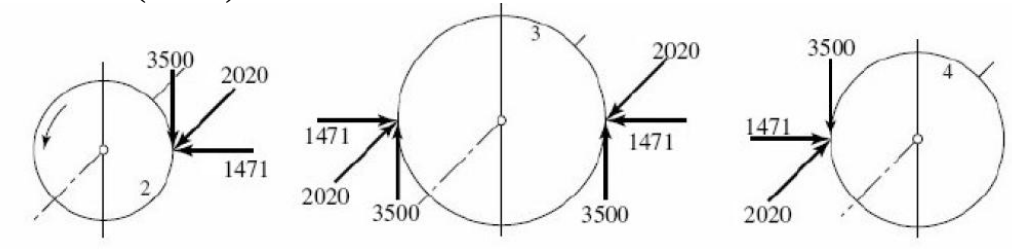
(a) (b)

a) Forces acting on the pinion:
W^t_{32} = 3500 N (-ve Z)
tan Φ_t = tan Φ_n / cos ψ = 0.42
$W^r_{32} = W^t_{32}$ tan Φ_t = 3500 * 0.42 = 1470.9 N (-ve X)
$W^a_{32} = W^t_{32}$ tan ψ = 3500 * tan 30 = 2020.7 N (+ve Y)

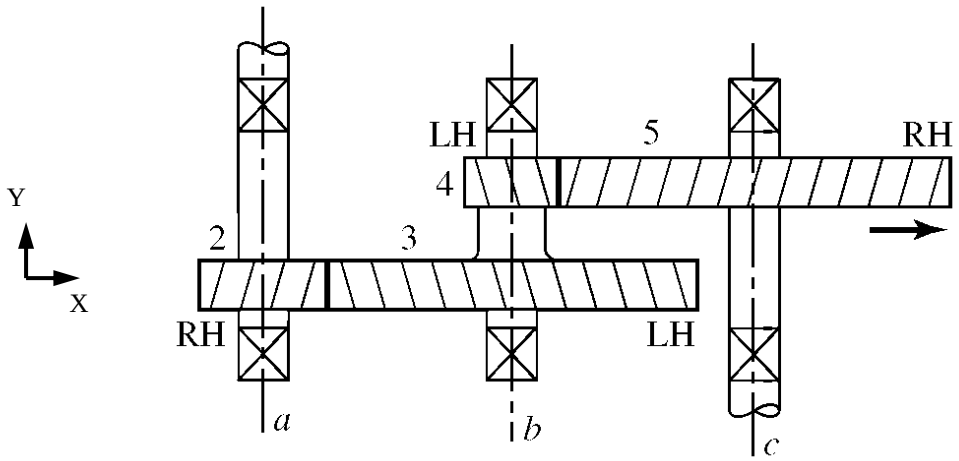
Forces acting on the gear:
$W^t_{23} = W^t_{32}$ = 3500 N (+ve Z) → (same magnitude, opposite direction)
W^r_{23} = 1470.9 N (+ve X)
W^a_{23} = 2020.7 N (-ve Y)

b) Forces acting on (3) from (2):
$W^t_{23} = W^t_{32}$ = 3500 N (-ve Z)
W^r_{23} = 1470.9 N (+ve X)
W^a_{23} = 2020.7 N (-ve Y)

Forces acting on (3) from (4):
$W^t_{43} r_3 = W^t_{23} r_3$ (equilibrium of torques about Y axis)
W^t_{43} = 3500 N (-ve Z)
W^r_{43} = 1470.9 N (-ve X)
W^a_{43} = 2020.7 N (+ve Y)

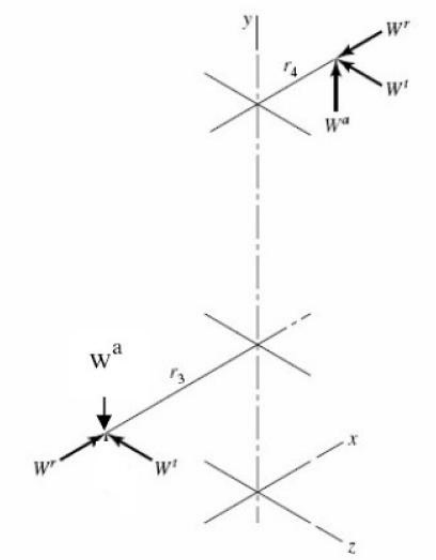


2- A gear train is composed of four helical gears with the three axes in a single plane, as shown in the figure. The gears have a normal pressure angle of 20° and 30° helix angle. Shaft b is an idler and the transmitted load acting on gear 3 is 2250 N. The gears on shaft b have 14 and 54 teeth with a normal module of 3 mm. Find the forces and moments exerted by gears 3 and 4 on shaft b.



Gear 3

$m = m_t = m_n/\cos\psi = 3.46$ mm
$d_3 = m_t N_3 = 3.46 \times 54 = 187$ mm
$W^t_{23} = 2250$ N (-ve Z)
$W^a_{23} = 2250 \tan 30° = 1299$ N (-ve Y)
$W^r_{23} = 2250 \tan 22.8° = 945.8$ N (+ve X)
All forces are translated to the shaft with same magnitudes to the center of the gear accompanied with torque T_3 and bending moment M_{z3}
$T_3 = 2250 \times 0.187/2 = 210.4$ N.m (cw about +Y)
$M_{z3} = 1299 \times 0.187/2 = 121.46$ N.m (ccw about +Z)



Gear 4

$d_4 = m_t N_4 = 3.46 \times 14 = 48.44$ mm
$T_4 = T_3$
$W^t_{43} = 8.7$ kN (-ve Z)
$W^a_{43} = 8.7 \tan 30° = 5$ kN (+ve Y)
$W^r_{43} = 8.7 \tan 22.8° = 3.66$ kN (-ve X)
All forces are translated to the shaft with same magnitudes to the center of the gear accompanied with torque T_4 and bending moment M_{z4}
$T_4 = 210.4$ N.m (ccw about +Y)
$M_{z4} = 5000 \times 0.04844/2 = 121$ N.m (ccw about +Z)