Equations for Robot Winch Power Assignment

Gear Ratio

$GR = \tau_{out} / \tau_{in} = N_{out} / N_{in} = \omega_{in} / \omega_{out}$ where: τ = torque, N = # of teeth, ω = angular velocity ("speed")
Note: Motor is input and gearbox is output

Force / Work / Energy / Power

$\tau = F \cdot r$ where: F = force, r = radius

$W = Fd$ where: W = work, F = force, d = distance

$P = W/t$ (mech. power) where: W = work, t = time
Note: you don't have d or t in this project, so use the next equation instead.
It is a completely equivalent equation – for a free thrill, see if you can prove it.

$P = \tau \cdot \omega$ (mech. power) where: P = power, τ = torque, ω = angular velocity ("speed")
Note: to get P in Watts, put ω in radians/sec,and put τ in Nm
Note: 1 revolution = 2π radians

Motor Equations: requires motor specification data

$\%\text{ Torque} = \%\tau = \tau / \tau_s$ where: % Torque = percent of max torque being used,
T = actual torque, T_s = stall torque of the motor

$\omega = (1 - \%\tau)\ \omega_f$ where: $\%\tau$ = %max Torque, ω = speed, ω_f = free speed of motor

$I = I_f + (I_s - I_f)\ \%\tau$ where: I = actual current, I_s = stall current of motor,
I_f = free current of motor, $\%\tau$ = % of max torque

Electrical Power / Efficiency

$V = IR$ where: V = voltage, I = current, R = resistance

$P = IV$ (elec. power) where: P = elec. power, I = current, V = voltage

$Eff = P_{out} / P_{in}$ where: Eff = power efficiency of system, P_{out} = output power,
P_{in} = input power
Note: figure out which is input power and which is output power: mech vs elec