

Instructions: Answer 3/4 out of the 7/8 questions. No extra credit will be given for more than three/? answers. If more than three/? questions are attempted, CLEARLY indicate which questions are to be graded, otherwise only the first three/? answers will be graded, and the rest ignored. Show all calculation steps to ensure that partial credit is earned, even if the final answer is incorrect. Do not spend all your time on one question, come back to it at the end.

The following Equations are given:

$$\text{Power} = 2\pi * T * N / 60,000 \text{ (kW)}$$

$$\text{Power} = 2\pi * T * N / 33,000 \text{ (Hp)}$$

Planetary Gears

$$(N_s - N_c)/(N_r - N_c) = -(n_r/n_s)$$

Traction Equations: (You will have a choice of either using a ZOZ chart question or using the Wismer-Luth Equations shown below for a different question. A ZOZ chart will be provided)

$$\mu_g = F/W = 0.75(1 - \exp[-0.3C_nS])$$

$$\rho = TF/W = 1.2/C_n + 0.04$$

$$C_n = CI * bd/W$$

$$\text{Slip or TR} = 100 * (1 - V_a / V_o)$$

$$TE = P_{db} / P_a$$

$$TE = (F_{db} * V_a) / P_a$$

Traction/Weight Transfer

$$W * X_{cg} = R_r * WB + F_{db} * Z_r$$

$$R_r * WB = W * (WB - X_{cg}) + F_{db} * Z_f$$

Sideways Overturns

$$V_c = [(g * r * Y_{cg}) / Z_{cg}]^{1/2} \text{ (Note: This equation is only valid on a flat surface)}$$

Hydraulics. The equations below are given without units, and may require unit conversions

Force $F = p * A$

Flowrate $Q = V * A$

Flowrate, $Q_{\text{Theoretical}} = D * N$

Torque, $T_{\text{Theoretical}} = \Delta p * D / 2\pi$

Power, $P = \Delta p * Q$

$$T = \Delta p * D / 2\pi$$

$$P = \Delta p * Q / 60$$

$$T = \Delta p * D / 2\pi * 1/12$$

$$P = \Delta p * Q * 231 * 1/12 * 1/33000$$

Note: F= force, P=Power, Q=Flowrate, p=pressure, T=Torque, N=rpm, V=velocity, S = Speed
SRAF is defined as the Static Rear Axle Force

Units Conversions

1 inch = 0.0254 meters

1 ft = 0.3048 meters

1 pound force = 4.45 Newton

1 psi = 6.8948 kPa

1 Hp = 0.7457 kW

1 ft.lb = 1.356 N.m

1 gal = 3.785 liters

1 gal = 231 cubic inches

33000 ft.lb/min = 1 Hp

1 mile = 5280 ft

1000 liters = 1 m³

1000 cm³ = 1 liter

Force (N)=mass(kg)*gravity(m/s²) 1 (N)= 1 (kg) * 9.8 (m/s²)