

Instructions:

Answer 3/4 out of the 6/7 questions. No extra credit will be given for more than 3 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.

Note: All information is given in metric and English units. You may select the units of your choice for each of the questions. **However do NOT use different unit systems within a single question.**

Show all calculation steps to ensure that partial credit is earned, even if the final answer is incorrect. In cases where the answer is obviously wrong, some credit will be given if you identify this as an improbable answer.

Power Equations

$$P=2\pi TN/60,000 \quad \text{or} \quad P=2\pi TN/33,000$$

Traction Equations:

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

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

$$C_n = CI * bd/W$$

$$B_n = [CI * bd/W] * [(1+5*\delta/h)/(1+3*b/d)]$$

$$\mu_g = F/W = 0.88 * [1 - \exp(-0.1B_n)] * [1 - \exp(-7.5S)] + 0.04$$

$$\rho = TF/W = 1.0/B_n + 0.04 + 0.5s/(B_n)^{1/2}$$

$$\mu_g = F/W = 0.88 * [1 - \exp(-0.1B_n)] * [1 - \exp(-9.5S)] + 0.0325$$

$$\rho = TF/W = 0.9/B_n + 0.0325 + 0.5s/(B_n)^{1/2}$$

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

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

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

$$e_i = (TF_i / R_i) * \text{Rolling Radius}$$

(Bias Ply)

(Bias Ply)

(Radial Ply)

(Radial Ply)

Weight Transfer

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

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

Sideways Overturns

$$V_c = [(g * r * Y_{cg}) / Z_{cg}]^{1/2} \quad (\text{On flat surface only})$$

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

$T = p * D / 2\pi$

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

Power, $P = p * Q$

$P = p * Q / 60$

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

Note: F= force, P=Power, Q=Flowrate, p=pressure, T=Torque, N=rpm, V=velocity

Units Conversions

1 BTU = 778 ft.lb of work

1 kN.m = 1 kJ

1 Hp = 0.7457 kW

33000 ft.lb/min = 1 Hp

1 kJ/sec = 1 kW

1 ft.lb = 1.356 N.m

550 ft.lb/sec = 1 Hp

1000 liters = 1 m3

1 pound force = 4.45 Newton

1 gal = 231 cubic inches

1000 cm3 = 1 liter

1 gal = 3.785 liters

1 mile = 5280 ft

1 psi = 6.8948 kPa

1 inch = 0.0254 meters

1 ft = 0.3048 meters

1 BTU = 1.0551 kJ

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