Homework 4

Question 1 Given the following information for a tractor: (Note: Metric values are approximate conversions of the equivalent English values, therefore answers may be slightly different)

Rear Axle Weight	15500 lb	(7000 kg)
Front Axle Weight	4500 lb	(2000 kg)
Total Weight	20000 lb	(9000 kg)
Wheel Base	110"	(2800mm)
Center of Gravity	24.75"	(680mm)(Distance from rear axle)
Drawbar Height	24"	(600mm)

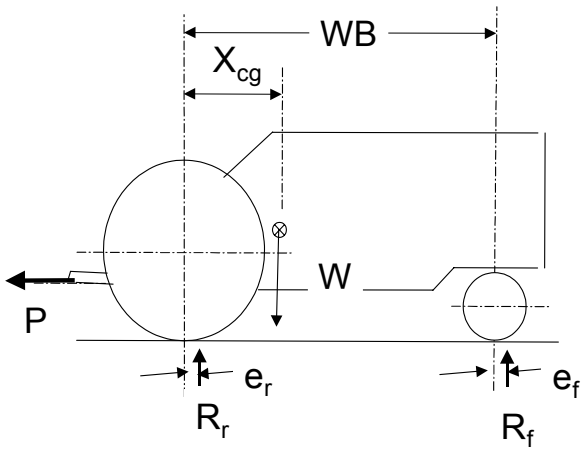
a) Determine the weight transfer to the rear wheels if a horizontal pull of 3000 lb (13.2 kN) is attached to the drawbar.
b) Under these conditions, is the weight transfer from the front wheels equal to the weight transfer to the back wheels.
c) Determine the horizontal pull required for the front wheels to begin lifting of the ground.

Question 2

Given the following information for the tractor shown:
Static Weight on Tires (zero drawbar pull)

	Ballasted Weight	
Rear Axle Weight	18000 lb	(8000 kg)
Front Axle Weight	5000 lb	(2200 kg)
Wheelbase	112"	(2845 mm)
Drawbar Height	20"	(500mm)

Rear Tire Dimensions	Front Tire
b = 19.2" (488mm)	b = 14" (355mm)
d = 64.8" (1645 mm)	d = 30" (785 mm)
h = 12" (300mm)	h = 8" (200mm)
= 2.4" (60mm)	= 1.2" (30mm)



You may use either the Wismer-Luth, Radial or Bias tire traction equations for this question. However only use one set of equations.

a) Given the horizontal pull P, on the drawbar is 10,000 lb. (45000N) for an ballasted tractor, 2 wheel drive tractor.
   i). Determine Dynamic Weight on each of the front and rear tires. You may assume that reaction forces are directly below the axle of the respective wheels.

b) If the tractor is operating in soil with a cone index of 300 psi (200 N/cm2)
   (i) Determine the towed force (TF) for required to move the front tire through the soil. (If you decide to use the radial or bias tire traction equations, assume that slip is 15% to save time, since you do not know actual slip)
   (ii) Determine the towed force (TF) for required to move the rear tire through the soil.(For radial or bias traction equations, assume that slip is 15% to save time)
   (iii) The Gross Tractive Force (F) required per driving tire.
   (iv) Calculate the Actual Travel Reduction (or wheel slip) required to generate the Gross Tractive force required to develop the drawbar pull.

Question 3 A double acting hydraulic cylinder has a bore diameter of 4", a rod diameter of 2". The maximum pump pressure is 2200 psi. One cylinder port is connected to the pump, and the return line feeds directly into the reservoir. Assume a pressure drop of 100 psi in both the pressure and return line to the cylinder. Pump delivery rate is 20 gal/min
a). What is the maximum load that can be moved when the cylinder is extending.
b). What is the maximum load that can be moved when the cylinder is retracting.
c). How fast will the cylinder extend.
d). How fast will the cylinder retract.
e). What is the flowrate of oil from the cylinder when it is retracting.

Question 4 Given the following specifications for a gear pump listed in a catalog.
Displacement = 1.8 in3/rev (29.5 cm3/rev)
Rate Speed = 2500 rpm
Rated Pressure = 3000 psi (20.7 MPA)
Rated Delivery = 18 gal/min (68.13 l/min)
Power Input = 38 Hp (28.35 kW)

a). Calculate theoretical delivery.

b). What is the volumetric efficiency?
c). What is the actual input Torque?
d). What is the theoretical input Torque?
e). Calculate the overall efficiency of the pump.
f). What is the mechanical efficiency.

Question 5 Given the following specifications for a motor listed in a catalog.

Displacement = 4 in3/rev (65.5 cm3/rev)
Rate Speed = 1800 rpm
Rated Pressure = 3000 psi (20.7 MPA)
Required Delivery = 35 gal/min (130 l/min)
Power Output = 48 Hp (35.8 kW)

a). Calculate theoretical flowrate for the motor at rated speed.
b). What is the volumetric efficiency?
c). What is the actual output Torque?
d). What is the theoretical output Torque .
e). Calculate the overall efficiency of the motor.
f). Determine the mechanical efficiency of the motor.

Note: $Hp = T N / 5252$ $kW = 2 p T N / 60000$
$Hp = Q P / 1714$ $kW = Q P / 60$