



The Open University of Sri Lanka
Faculty of Engineering Technology
Final Examination 2006
AEX5230 Power and Machinery in Agriculture
AED2211 Power Utilization in Agriculture

Date : 10-03-2006

Time : 13.30 PM-16.30PM

SECTION 2

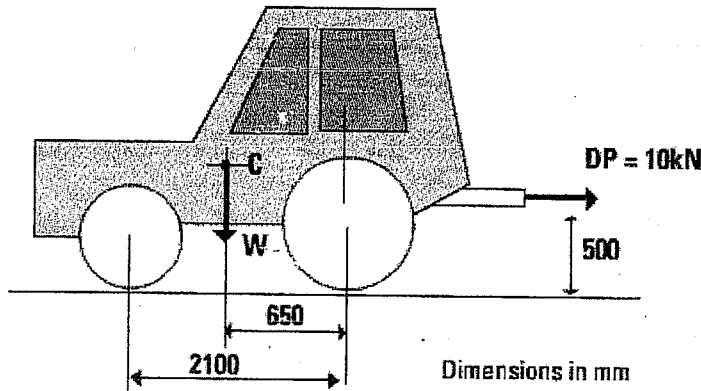
Section A

- Q1. Discuss two (02) possible applications of solar energy in agricultural work. Give examples.
- Q2. (a) Briefly discuss the advantages and disadvantages of farm mechanization.
(b) What process steps in paddy cultivation and processing that can be mechanized successfully in Sri Lanka? Give reasons.
- Q3. (a) Discuss the factors affecting the use of human power in agricultural work.
(b) How is machine work justified in certain agricultural crop production in Sri Lanka?
- Q4. Discuss the energy sources available for farm mechanization and crop processing of tea and coconut in Sri Lanka.
- Q5. Write short notes on following,
(a) Mould board plough
(b) Disc plough
(c) Rotary tiller
- Q6. A farmer plans to plant a row crop in 160 hectares using a planter having a cutter bar width of 4.5m. The row spacing and working speed are 0.75m and 6 km/h respectively. If it is possible to work 10 h/day, how many days are required to cover the total extent? Assume 70% field efficiency.

Section B

Q1. A rear wheel driven four-wheel tractor is used to plough a land with soil properties given below. The draw bar pull is 10kN. Determine the following.

- (a) Load on the rear axle when tractor travels at a uniform speed.
- (b) Maximum possible thrust per wheel.
- (c) Actual thrust when the tractor experiences 20% wheel slip.



Soil properties :

Cohesion = 12kN/m^2
 Angle of internal friction = 30°
 Soil deformation modulus = 40mm

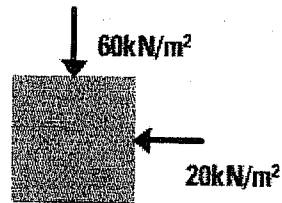
Tractor information:

Mass = 2500kg
 Contact patch area per wheel (at rear) = 0.12m^2
 Contact patch length per wheel (at rear) = 0.4m

Table of α values

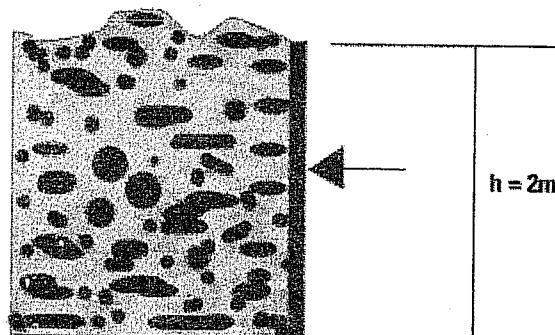
J_k	0	1	2	3	4	5	6	7	8	9
.00	0.000	0.368	0.568	0.683	0.755	0.801	0.834	0.857	0.875	0.889
.05	.025	.381								
.01	.048	.394	.582	.692						
.15	.071	.406								
.20	.094	.418	.596	.700	.765	.809	.839	.861	.878	.891
.25	.115	.429								
.30	.136	.440	.609	.708						
.35	.156	.451								
.40	.176	.462	.621	.716	0.776	.816	.844	.865	.881	.894
.45	.195	.472								
.50	.231	.482	.633	.723						
.55	.231	.492								
.60	.248	.501	.644	.730	.785	.822	.849	.868	.884	.896
.65	.265	.510								
.70	.281	.519	.655	.736						
.75	.296	.528								
.80	.312	.536	.665	.743	.793	.828	.853	.872	.886	.898
.85	.326	.544								
.90	.341	.552	.674	.749						
.95	.354	.560								

Q2 (a) Sample of soil is subjected to principal stresses as shown below.



- (i) Draw Mohr's stress circle for the stress element.
- (ii) Find out maximum shear stress and mark the plane on which this occurs.
- (iii) If the Coulomb line touches the above circle determine the cohesion and angle of internal friction of the soil.

(b) Determine the minimum horizontal force needed to prevent collapsing the soil mass shown in figure below. The soil is cohesionless and has an angle of internal friction of 30°



You may use the following relationships with usual notation.

$$\sigma_1 = 2c\sqrt{N_\phi} + \sigma_2 N_\phi \quad \text{and} \quad N_\phi = \tan^2 \left[45 + \frac{\phi}{2} \right]$$

Q3 Discuss the factors affecting use of human power and animal power in farm work indicating possible efficiency improvements, and barriers to effective use of these power sources in Sri Lanka.