# Uva Wellassa University, Sri Lanka

## 2006/07 BSc in Export Agriculture Degree Programme

## 2006/07 BASc Degree Programme

**End Semester Examination - Semester 1**

**January 2008**

**EAG 213-2 Principles of Agricultural Engineering**

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**Instructions**
Answer for **Four (04)** questions **only**
No. of questions: Five (05)
No. of pages: Four (04)
Time: Two hours
Clearly state any assumptions made.
You can assume any missing data.

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**Question 01**

**(a)** What is an open system and close system?

(20%)

**(b)** A gas undergoes a thermodynamic cycle consisting of three processes

Process 1-2 compression with $pV = const$, from $p_1 = 1$ bar, $V_1 = 1.6\ m^3$ to $V_2 = 0.2\ m^3$, $U_2 - U_1 = 0$

Process 2-3 constant pressure to $V_3 = V_1$

Process 3-1 constant volume, $U_1 - U_3 = -3549$ kJ

There are no significant changes in kinetic energy and potential energy. Determine the heat transfer and work for process 2-3, in kJ.

U – Internal energy in kJ

p – Pressure in bar

V – Volume in $m^3$

(40%)

**(c)** The 100 $m^3$ air in a room has a pressure of 1 atm, a dry-bulb temperature of $24^0$C, and a wet-bulb temperature of $17^0$C. Using the Psychrometric chart, determine

I. Specific humidity
II. Enthalpy
III. Relative humidity
IV. Dew-point temperature
V. Mass of dry air
VI. Mass of vapour
VII. Specific volume



(40%)

## Question 02

**(a)** Define the following heat transfer situations as either conduction, convection, radiation, or a combination of the three. Clearly state between which two objects the heat transfer occurs and the direction of heat transfer.

*For example*: A person with a headache holds a cold ice pack to his/her forehead. *Answer*: Conduction occurs from the person's forehead to the ice pack.

a) The sun shines brightly on a car, making the black upholstery very hot.
b) A small 4" fan is installed in the back of a computer to help cool the electronics.
c) Potatoes are boiled in water.
d) A turkey is being roasted in the oven.
e) An ice cube placed on a metal tray is left out of the freezer

(20%)

**(b)** For heat transfer purposes, a standing man can be modelled as a 30cm diameter, 170cm long vertical cylinder with both top and bottom surfaces insulated and with the side surface at an average temperature of $34^0$C. For a convection heat transfer coefficient of 15 W/m$^2$ $^0$C determine the rate of heat loss from this man by convection in an environment at $20^0$C.

(40%)

**(c)** 2 kg of water, initially a saturated liquid at $150^0$C, is heated in a closed, rigid tank to a final state where the pressure is 2.5 MPa. Determine the final temperature in $^0$C, the volume of the tank in m$^3$, and sketch the process on T-v and p-v diagrams.

(40%)

## Question 03

**(a)** The velocity distribution for the flow of a Newtonian fluid between two wide, parallel plates (Fig Q3(a)) is given by the equation,

$$u = \frac{3V}{2}\left[1-\left(\frac{y}{h}\right)^2\right]$$

where V is the mean velocity. The fluid has a viscosity of 0.38 N.s/m$^2$. When V = 0.5 m/s and h = 0.1 m.

Determine

a. the shearing stress acting on the bottom wall
b. the shearing stress acting on a plane parallel to the walls and passing through the centerline (midplane)

(40%)

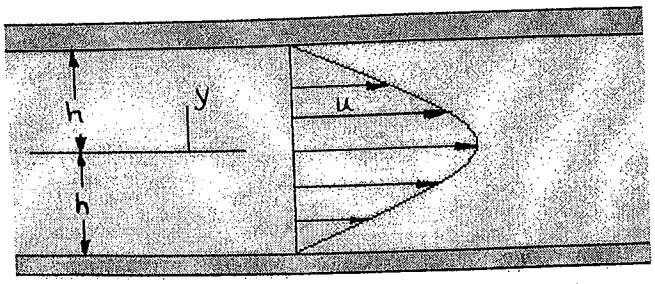



Fig Q3 (a)

**(b)** A U-tube manometer similar to that shown in Fig Q3 (a) is used to measure the gauge pressure of a fluid P of density $\rho = 800\ kgm^{-3}$. If the density of the liquid Q is 13.6 x $10^3$ $kgm^{-3}$ , what will be the gauge pressure at A if (a) $h_1 = 0.5$ m and D is 0.9 m above BC (b) $h_1 = 0.1$ m and D is 0.2 m below BC?

(60%)

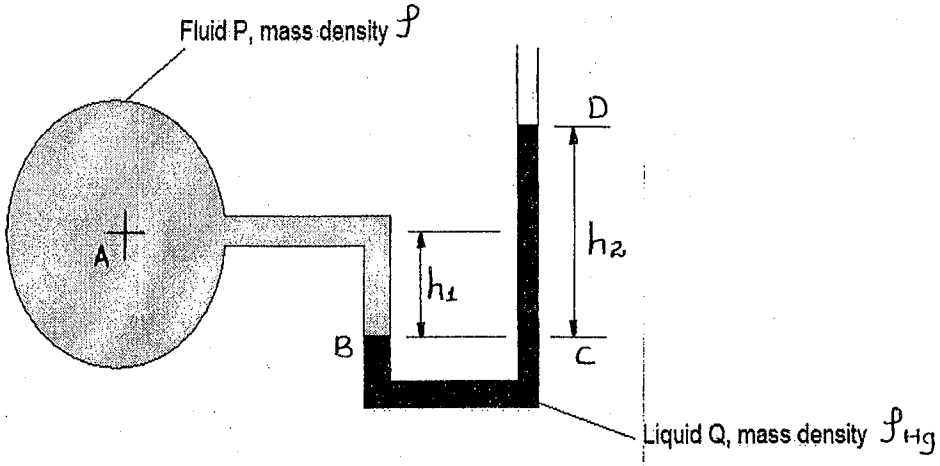



Fig Q3 (a)

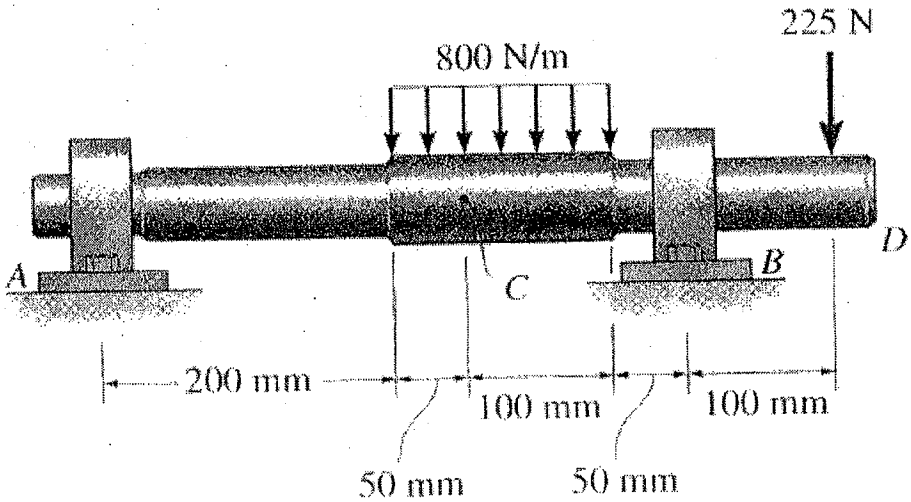
**Question 04**

**(a)** Briefly discuss about the characteristics of the conventional stress – strain curve of commonly used engineering materials.

(40%)

**(b)** Determine the resultant internal loadings acting on the cross section at C of the machine shaft shown in Fig Q4 (b). The shaft is supported by bearings at A and B, which exert only vertical forces on the shaft.

(60%)




(a)

Fig Q4 (b)





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**Question 05**

**(a)** Write short notes on the following topics.

I. Laminar flow
II. Turbulent flow
III. Reynold's number
IV. Factor of Safety
V. Bernoulli equation

(50%)

**(b)** The bar shown in Fig Q5 (b) has a square cross section for which the depth and thickness are 40 mm. If an axial force of 800 N is applied along the centroidal axis of the bar's cross-sectional area, determine the average normal stress and average shear stress acting on the material along (a) section plane a-a and (b) section plane b-b.

(50%)

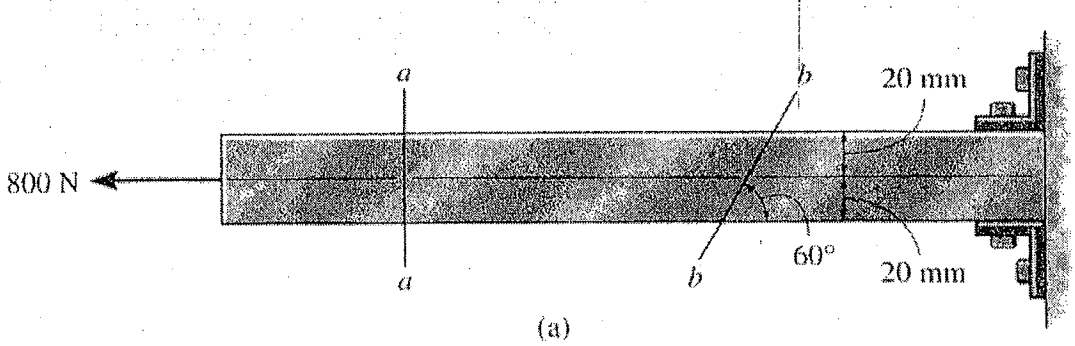


Fig Q5 (b)

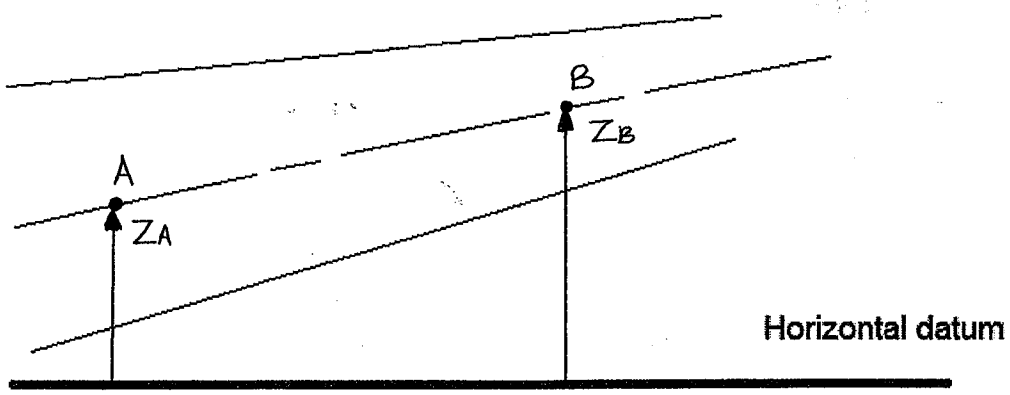


Fig Q3 (b)

(50%)

**Question 04**

**(a)** Briefly discuss about the characteristics of the conventional stress – strain curve of commonly used engineering materials.

(40%)

**(b)** The solid cylindrical rods AB and BC are welded together at B and loaded as shown in Fig Q4 (b). Knowing that $d_1$ = 30 mm and $d_2$ = 50 mm, find the average normal stress in the midsection of (a) rod AB, (b) rod BC

(60%)

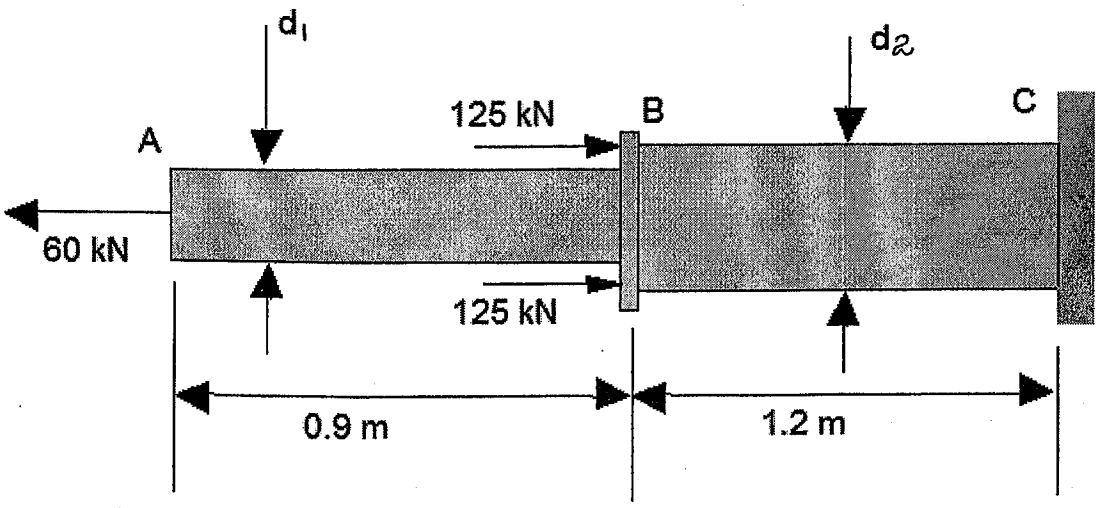


Fig Q4 (b)