Uva Wellassa University, Sri Lanka
Faculty of Science and Technology
Science and Technology Degree Programme
1st Semester Examination –March/April 2013

SCT 262-2 Engineering Physics

Instructions to candidate
Number of questions: Six (06)
Answer Three 03 questions only
Time allocation: Two (02) hours
Total marks allocated: 300

1.

a. A 4 kg platform is attached to the end B of a wooden beam AB of 20 x 50 mm cross sectional area, which is supported as shown by a pin at A and by slender steel rod BC.

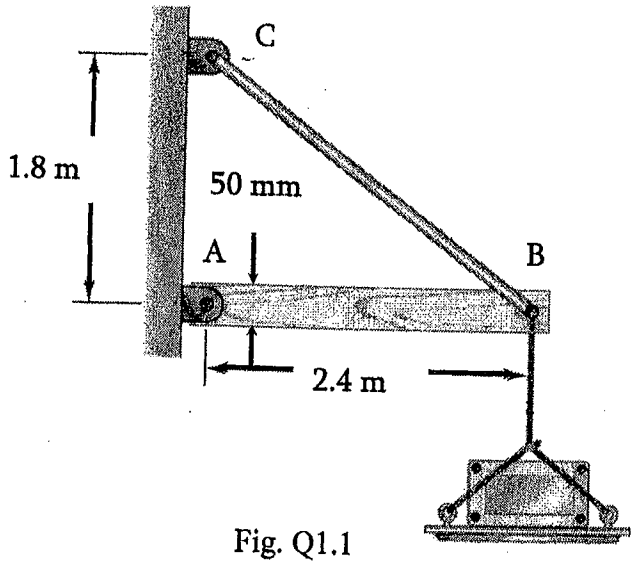

Fig. Q1.1

Determine the following,

i. Reactions at joints A and C (12 marks)

ii. Internal forces of rods AB and BC. (14 marks)

iii. According to your calculations which type of stresses would produce within rods? (04 marks)

iv. Assume the diameter of the rod BC is 25 mm. If the rod is made of a steel with a maximum allowable stress σ_{all} = 165 MPa. Can rod BC safely support the load to which it will be subjected? (20 marks)

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b. Draw the shear and bending-moment diagrams for the beam shown in Fig. Q1.2.

(50 marks)

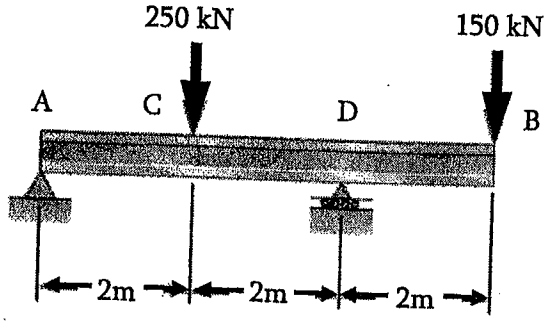

Fig. Q1.2

2.

a. Water flows from A towards D and E ends through the series pipeline shown in Fig. Q2.1 Given the pipe diameters, velocities and flow rates below, complete the tabular data for this system

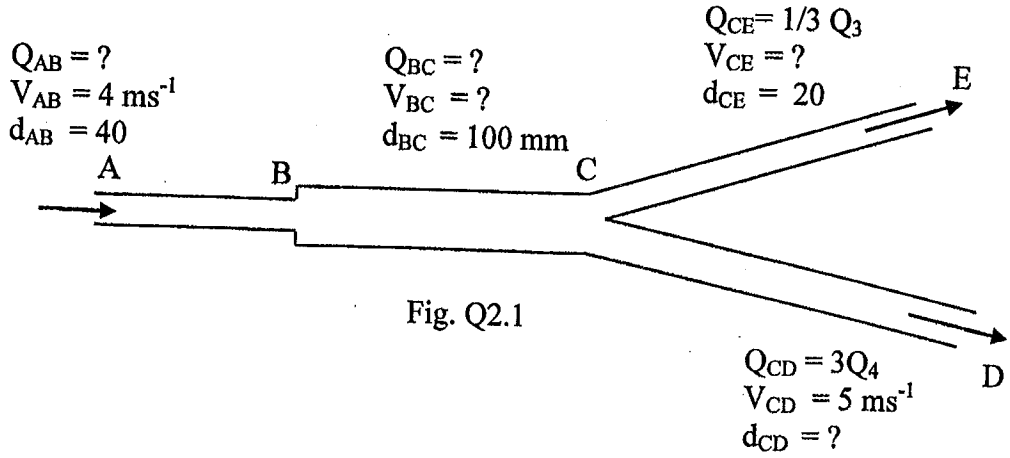

Fig. Q2.1

Pipe	Diameter (mm)	Flow Rate (m^3s^{-1})	Velocity (ms^{-1})
AB			
BC			
CD			
CE			

(60 marks)

b. A closed cylindrical tank filled with water has a hemispherical dome and is connected to an inverted piping system as shown in Fig.Q2.2. The liquid in the top part of the piping system has specific gravity of 0.8, and the remaining parts of the system are filled with water. The pressure guage reading at A is 60 kPa.

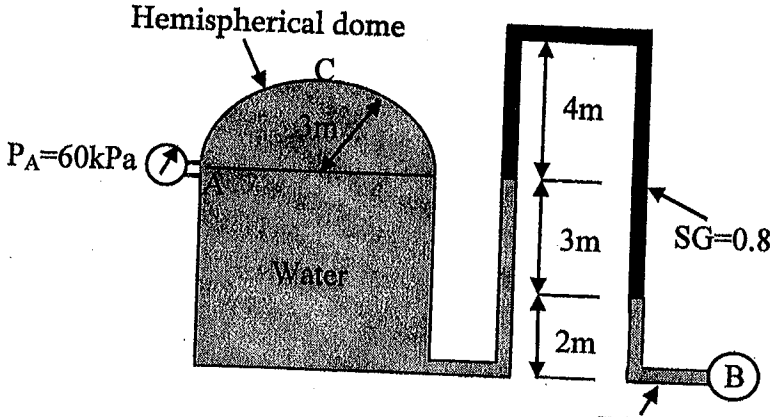

Fig.Q2.2

Density of water is 1000 kg m^{-3}. Determine the following.

i. The pressure in pipe B (30 marks)

ii. The pressure head in millimeters, at the top of the dome (point C) (10 marks)

3.

a. A homogenous, 4 m wide, 8 m long rectangular gate weighing 800 kg is held in place by a horizontal flexible cable as shown in Fig.Q3.1 Water acts against the gate which is hinged at point A. Friction at the hinge is negligible. Determine the tension in the cable. (50 marks)

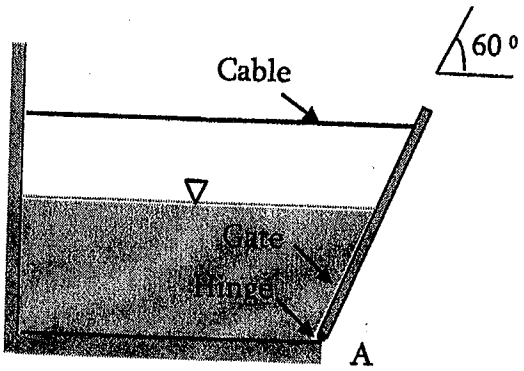

Fig.Q3.1

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b. A layer of fluid flows down fixed inclined surface with a velocity profile shown in Fig.Q3.2. Determine the magnitude and direction of the shearing stress that the fluid exerts on the fixed surface for $V = 2$ m/s and $h = 0.1$ m. $\mu = 0.4$ Ns/m^2

$$\frac{u}{V} = 2\frac{y}{h} - \frac{y^2}{h^2}$$

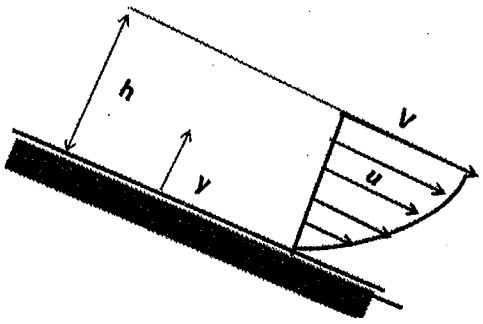

Fig.Q3.2

(50 marks)

4.

a. A housewife is cooking beef stew for her family in a pan that is (i) uncovered, (ii) covered with a light lid, and (iii) covered with a heavy lid. In which case will the cooking time be shortest? Explain the reason for your answer.

(10 marks)

b. A piston–cylinder device initially contains 50 l of liquid water at 40°C and 200 kPa. Heat is transferred to water at constant pressure until the entire liquid is vaporized.

i. What is the mass of water?

(10 marks)

ii. What is the final temperature?

(05 marks)

iii. Determine the total enthalpy change.

(10 marks)

iv. Show the process on a T-v diagram with respect to saturation lines.

(05 marks)

c. Determine the missing parameters and the phase descriptions in the following table for water and complete the following table.

T, °C	P, kPa	u, kJ/kg	Phase description
	400	1450	
220			Saturated vapor
190	2500		
	4000	3040	

(60 marks)

A piston–cylinder device initially contains 0.07 m^3 of nitrogen gas at 130 kPa and 120°C. The nitrogen is now expanded polytropically to a pressure of 100 kPa with a polytropic exponent whose value is equal to the specific heat ratio (called *isentropic expansion*). The properties of nitrogen are $R = 0.2968$ kJ/kg.K and $k = 1.4$

i. Determine the final temperature.

(15 marks)

ii. Define the polytropic process.

(10 marks)

iii. Calculate the boundary work done during this process.

(25 marks)

b. Argon gas enters an adiabatic turbine steadily at 900 kPa and 450°C with a velocity of 80 m/s and leaves at 150 kPa with a velocity of 150 m/s. The inlet area of the turbine is 60 cm^2. If the power output of the turbine is 250 kW, determine the exit temperature of argon.

The gas constant of Argon, $R = 0.2081$ kPa.m^3/kg.K and the specific heat of Argon, $Cp = 0.5203$ kJ/kg·°C

(50 marks)

a. A 80 m long wire of 5 mm diameter is made of a steel with E = 200 GPa and an ultimate tensile strength of 400 MPa. If a factor of safety is 3.2, determine

i. the largest allowable tension in the wire

(20 marks)

ii. the corresponding elongation of the wire

(20 marks)

b. Two solid cylindrical rods are joined at B and loaded as shown in Fig.Q6. Rod AB is made of steel (E = 200 GPa) and rod BC of brass (E = 105 GPa). Determine

i. the total deformation of the composite rod ABC (40 marks)

ii. the deflection of point B. (20 marks)

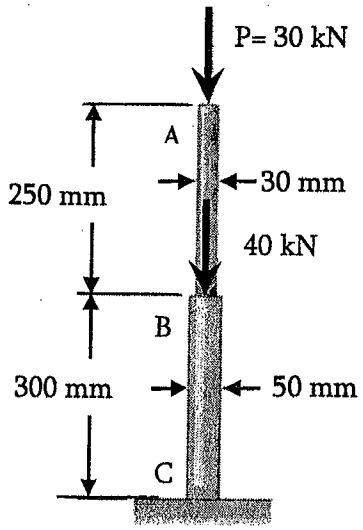

Fig.Q6