

UNIVERSITY OF BOLTON

**SCHOOL OF BUILT ENVIRONMENT &
ENGINEERING**

**BENG (HONS) MECHANICAL ENGINEERING/
BENG (HONS) AUTOMOBILE ENGINEERING/**

SEMESTER 2 EXAMINATIONS 2008/2009

THERMOFLUIDS

MODULE NO: AME1014

Date: Wednesday, 27 May 2009

Time: 2.00 – 4.00 p.m.

INSTRUCTIONS TO CANDIDATES:

There are **SIX** questions on this paper

Answer **ANY FOUR** questions.

All questions carry equal marks.

CANDIDATES REQUIRE:

Formula Sheet

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- Q1 a) State the difference between Fluids and Solids. (10 marks)
- b) Describe, with sketches, a method of measuring atmospheric pressure. (8 marks)
- c) A manometer connected to a pipe indicates a negative pressure of 50mm of mercury. What is the absolute pressure in the pipe if the atmospheric pressure is 1 bar? (7 marks)

Total 25 marks

- Q2 a) Explain the meaning of deformation in fluid. (5 marks)
- b) Describe, in detail, Newton's experiment on viscosity. (13 marks)
- c) At what depth below the surface of oil, relative density 0.8, will produce a pressure of 120 kPa. (7 marks)

Total 25 marks

- Q3 a) Explain the term surface tension and state the effect of temperature on its value. (8 marks)
- b) A venturi meter with an entrance of 0.3m and a throat diameter of 0.2m is used to measure the volume of gas flowing through a pipe. The discharge coefficient of the meter is 0.96. Assuming the specific weight of the gas to be constant at 19.62 N/m^3 , calculate the volume flowing when the pressure difference between the entrance and the throat is measured as 0.6m on a water U-tube manometer. (17 marks)

Total 25 marks

- Q4 a) Water has a surface tension of 0.4 N/m , in a 3mm diameter vertical tube, if liquid rises 6mm above the liquid outside the tube, calculate the contact angle. (8 marks)
- b) Water is being fired at 20 m/s from a hose of 80mm diameter into the atmosphere. The water leaves the hose through a nozzle with a diameter of 25mm at its exit. Find the pressure just upstream of the nozzle and the force on the nozzle. (17 marks)

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- Q5 a) Explain, in detail, the first law of thermodynamics. (10 marks)
- b) A closed system of mass 5kg undergoes a process in which there is a heat transfer of 150 kJ from the system to the surroundings. The work done by the system is 75 kJ. If the initial specific internal energy is 450 kJ/Kg, what is the final specific internal energy. Neglect changes in kinetic and potential energy. (15 marks)

Total 25 marks

- Q6 a) Define :
- (i) Temperature (2 marks)
 - (ii) Heat transfer (2 marks)
 - (iii) Work transfer (2 marks)
 - (iv) Internal energy (2 marks)
 - (v) Thermodynamic system (2 marks)
- b) A closed system initially at rest on the surface of the earth undergoes a process for which there is a net energy transfer to the system by work of magnitude 200 kJ. During the process there is a net heat transfer of energy from the system to its surroundings of 30 kJ. At the end of the process, the system has a velocity of 60 m/s at an elevation of 60 m. The mass of the system is 25 Kg, and the local acceleration of gravity $g = 9.8 \text{ m/s}^2$. Determine the change of internal energy of the system for the process. (15 marks)

Total 25 marks

END OF QUESTIONS

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Formulae Sheet

$$P = F/A$$

$$\rho = m/v$$

$$\dot{m} = \rho AV$$

$$P = P_g + P_{\text{atm}}$$

$$P = \rho gh$$

$$\text{Bulk Modulus } \beta = - \frac{dP}{dv/v}$$

$$\tau = \mu du/dy$$

$$h = \frac{4\sigma}{\rho g s d}$$

$$Z_1 + \frac{P_1}{\rho g} + \frac{V_1^2}{2g} = Z_2 + \frac{P_2}{\rho g} + \frac{V_2^2}{2g}$$

$$V_1 = \sqrt{\frac{2g h \left(\frac{\rho_L}{\rho} - 1 \right)}{\left(\frac{a_1}{a_2} \right)^2 - 1}}$$

$$Q - W = \Delta U + \Delta PE + \Delta KE$$

$$W = \int P dV$$

$$P V^n = C$$

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$$W = \frac{P_1 V_1 - P_2 V_2}{n - 1}$$

$$W = P (v_2 - v_1)$$

$$W = P V \ln \left(\frac{V_2}{V_1} \right)$$

$$Q = C_d A \sqrt{2gh}$$

$$V_1 = C \sqrt{2g h_2 \left(\frac{\rho g_m}{\rho g} - 1 \right)}$$

$$\sum F = \frac{\Delta M}{\Delta t} = \Delta M \dot{t}$$

$$F = \rho QV$$

$$Re = V L \rho / \mu$$