Faculty of Engineering

End-Semester 2 Examination in Engineering: March 2014

Module Number: CE2201 **Module Name: Fundamentals of Fluid Mechanics**

[Three Hours]

[Answer **all** questions]

Q1. a. What do you understand by i. Coefficient of velocity C_v ii. Coefficient of contraction C_c, and iii. Coefficient of discharge C_d ?

[3 Marks]

b. A large open tank contains a liquid of density 820 kg/m^3 to a depth z. A small orifice of diameter 30 mm on the vertical side of the tank discharges a horizontal jet to atmosphere. The jet strikes the base level of the tank at a horizontal distance x as shown in Figure Q1. The orifice has coefficients C_v=1.0 and C_c = 0.66.

Show that $x^2 + 4y^2 = 4yz$ and that the maximum horizontal distance $x_{max} = z$.

[6 Marks]

c. When $x = 2y = 1.2\ m$ find the discharge through the orifice and the force on the tank due to discharging jet. [6 Marks]

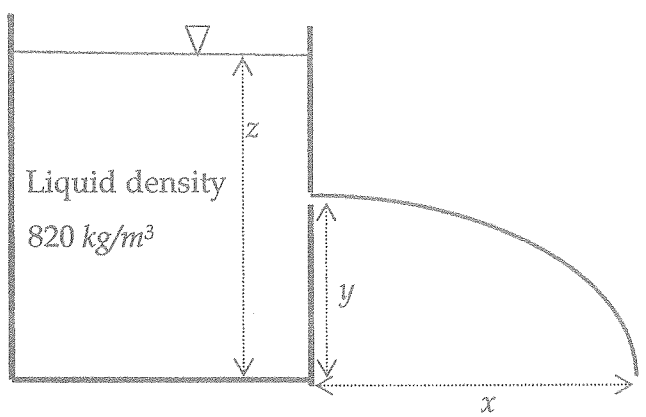

Figure Q1

Q2. a. What do you understand by steady one dimensional frictionless flow? [3 Marks]

b Figure Q2 shows a short pipe JKM of uniform diameter 150 *mm* connected to a closed tank containing water and air under pressure p_0. The pipe ends with a horizontal nozzle MN of exit diameter 100 *mm* discharging to atmosphere at N.

If the pressure at K is equal to p_0 find i.) The discharge at N , ii.) The pressure p_0 and iii.) the force on MN.

Assume steady one dimensional frictionless flow. [12 Marks]

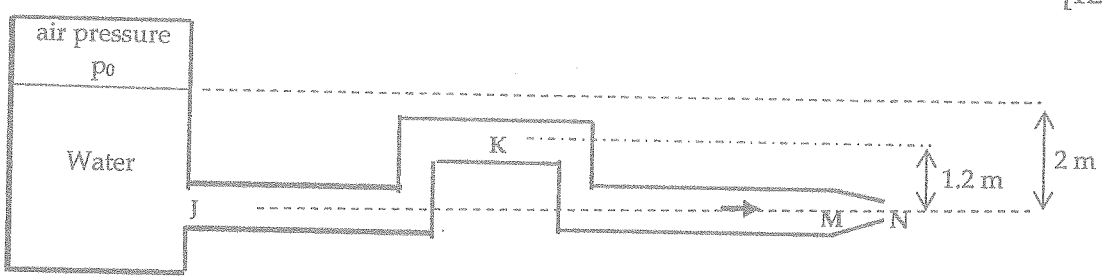

Figure Q2

Q3 a. With the aid of a neat sketch explain the principle of the stagnation tube. [3 Marks]

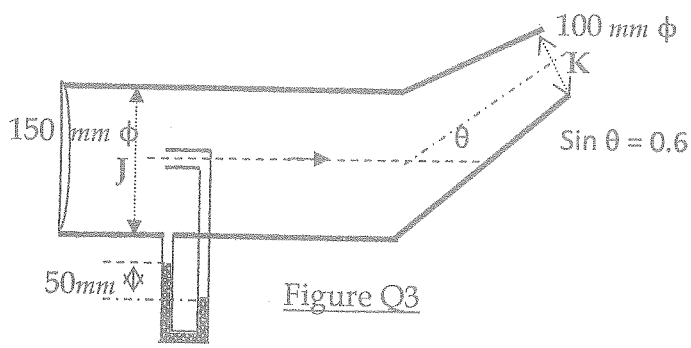

Figure Q3

b. The horizontal reducing bend JK in figure Q3 issues a free jet of liquid of density 800 kg/m^3 to atmosphere at K. The head loss between J and K is $\frac{2.5\ V_j^2}{2g}$ where V_j is the velocity at section J. When the manometer containing mercury of density 13600 kg/m^3 connected across a stagnation tube and a static tube at J records a deflection of 50 *mm*, find the volume flow rate and the force on the bend in magnitude and direction.

Assume steady one dimensional flow. [12 Marks]

Q4.

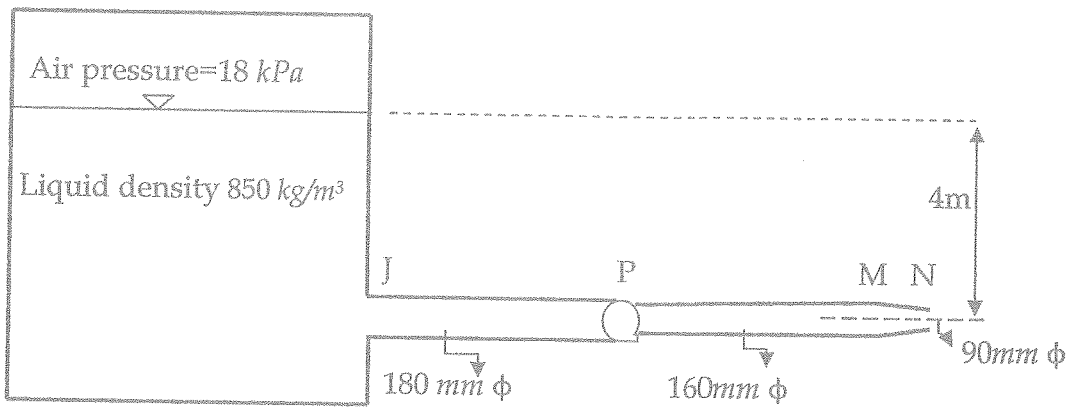

Figure Q4

A large closed tank contains a liquid of density 850 kg/m^3 and air under a pressure of 18 kPa. The tank is discharged to atmosphere through the horizontal pipeline JPM fitted with a nozzle MN of exit diameter 90 mm and a pump P of efficiency 80%. The head loss in the suction pipe JP of diameter 180 mm is $\frac{8V_1^2}{2g}$ and the head loss in the delivery pipe PM of diameter 160 mm is $\frac{7.5V_2^2}{2g}$ where V_1 is the velocity in JP and V_2 the velocity in PM. The head loss in MN is negligible.

Find the power required by the pump to deliver 80 l/s. [10 Marks]

Draw the total head line clearly indicating magnitudes of changes in head. [5 Marks]