Mansoura University
Faculty of Engineering
Dept. of Power Mech. Eng.
Course Title: Fluid Mechanics 1
Course Code: MPE4123

1st year Mech.
May 2012
Exam Type: Final
Time: 3 Hours
Full Mark: 100

Answer all the following questions.

Question (1)

a- If water occupies 1 m^3 at 1 atm. pressure, estimate the pressure required to reduce its volume by 5 percent. ($K = 2.06 \times 10^9$ Pa) [4 Marks]

b- A disk of radius R rotates at an angular velocity inside a disk-shaped container filled with oil of viscosity μ as shown in Fig.1. Assuming a linear velocity profile and neglecting shear stress on the outer disk edges, derive a formula for the viscous torque on the disk. [8Marks]

c- In the the closed tank in Fig. 2 the pressure at point A is 95 kPa absolute, what is the absolute pressure at point B in kPa? [8 Marks]

Question (2)

a- The dam in Fig. 3 is a quarter circle 50 m wide into the paper. Determine the horizontal and vertical components of the hydrostatic force against the dam and the point CP where the resultant strikes the dam. [10 Marks]

b- Consider a wooden cylinder (SG = 0.6) 1 m in diameter and 0.8 m long. Would this cylinder be stable if placed to float with its axis vertical in oil (SG = 0.8)? [10 Marks]

Question (3)

a- The tank of liquid in Fig. 4 accelerates to the right with the fluid in rigid-body motion. (i) Compute a_x in m/s^2(ii) Determine the gage pressure at point A if the fluid is water. [10 Marks]

b- An idealized velocity field is given by the formula $\mathbf{V} = 4tx\mathbf{i} - 2t^2y\mathbf{j} - 4xz\mathbf{k}$
Is this flow field steady or unsteady? Is it two- or three-dimensional? At the point $(x, y, z) = (-1, 1, 0)$, compute the acceleration vector. Is it satisfies the continuity . [10 Marks]

Question (4)

a- Air flows through a smooth contraction in a pipe (Fig. 5) with negligible friction losses (the pipe diameters are $D_1 = 0.3$ m and $D_2 = 0.15$ m). The pressure difference between the two sections is measured by a water manometer. If the height difference Δh measured between the two vertical tubes is 0.2 m, calculate the mass flow rate (assume the air density is 1.22 kg/m^3). [12 Marks]

P.T.O.

b- Water flows through the circular nozzle shown in the Fig. 6 at a rate of 0.3 m^3/s). The diameter at section 1 is 0.3 m and at section 2 is 0.1 m. Calculate the velocities at stations 1 and 2 and the force acting on the flange. Assume that the pressure at station 1 inside the nozzle is 700,000 N/m^2 and is zero at station 2. [12 Marks]

Question (5)

Water is flowing from the taller container through a long pipe that has two segments, as shown in the Fig.7. The inner diameter of the thicker pipe is 6 cm and its length is 30 m, whereas the length of the thinner pipe is 20 m and its inner diameter is 4 cm. The loss that is due to the transition between the two pipe diameters is $K = 0.2$ and the friction factor for both pipes is $f = 0.03$. Calculate the flow rate between the two containers when $z_1 = 3$ m and $z_2 = 5$ m. [16 Marks]

مع أطيب التمنيات *Prof.Dr. Hassan Mansour*

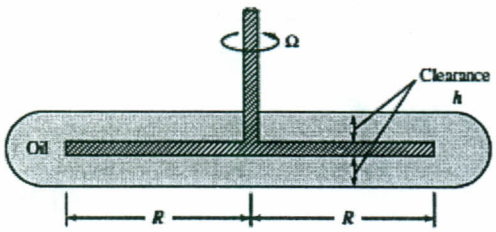

Fig. 1

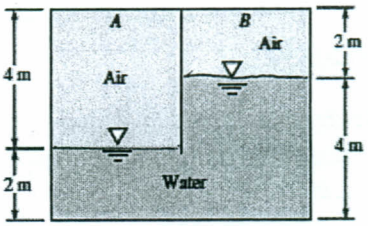

Fig. 2

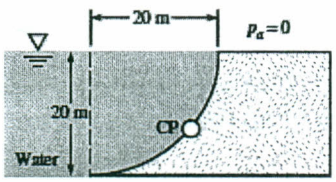

Fig. 3

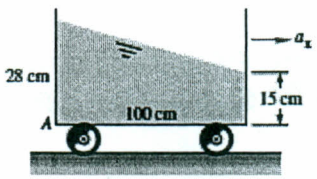

Fig. 4

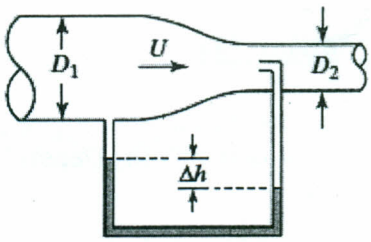

Fig. 5

Fig. 6

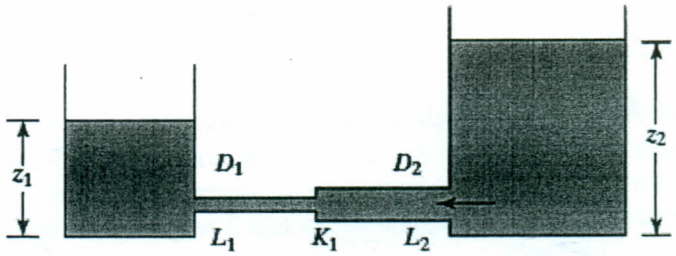

Fig. 7