College of Engineering & Technology

Department : Mechanical Engineering
Lecturer : Prof. Dr. Kamal Abd-El Aziz and Dr. Rola Afify
Course : Hydraulics
Course code : ME 362   Marks : 40
Date : 25/5/2015   Time : 2 hrs

Answer All Questions:

1- A 10 kg block slides down a smooth inclined surface as shown in Fig. 1 with a velocity 0.22 m/s. The gap between the block and the surface is 0.1 mm. Assume the velocity distribution in the gap is linear and the area of the block in contact with oil is 0.2 m^2. The kinematic viscosity of oil is $4.2 \times 10^{-4} m^2/s$. Find for oil;

      a- The mass density
      b- The specific gravity
      c- The specific weight
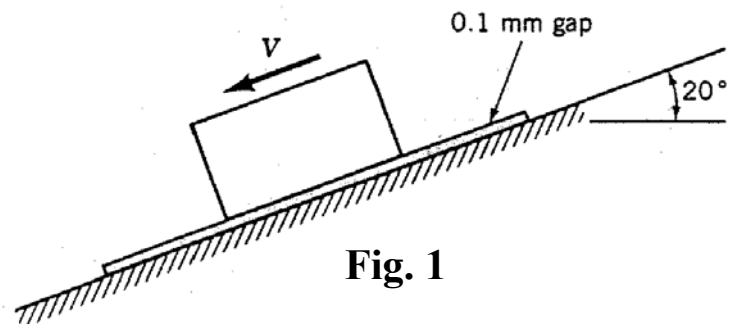   d- The shear stress
        [8 Marks]

Fig. 1

2-Water flows steadily from a large open tank and discharges into the atmosphere through a 7.62 cm-diameter pipe as shown in Fig 2. Determine the diameter, d, in the narrowed section of the pipe at A, if the pressure gauges at A and B indicate the same pressure. The flow discharged into atmosphere at point C. **[8 Marks]**
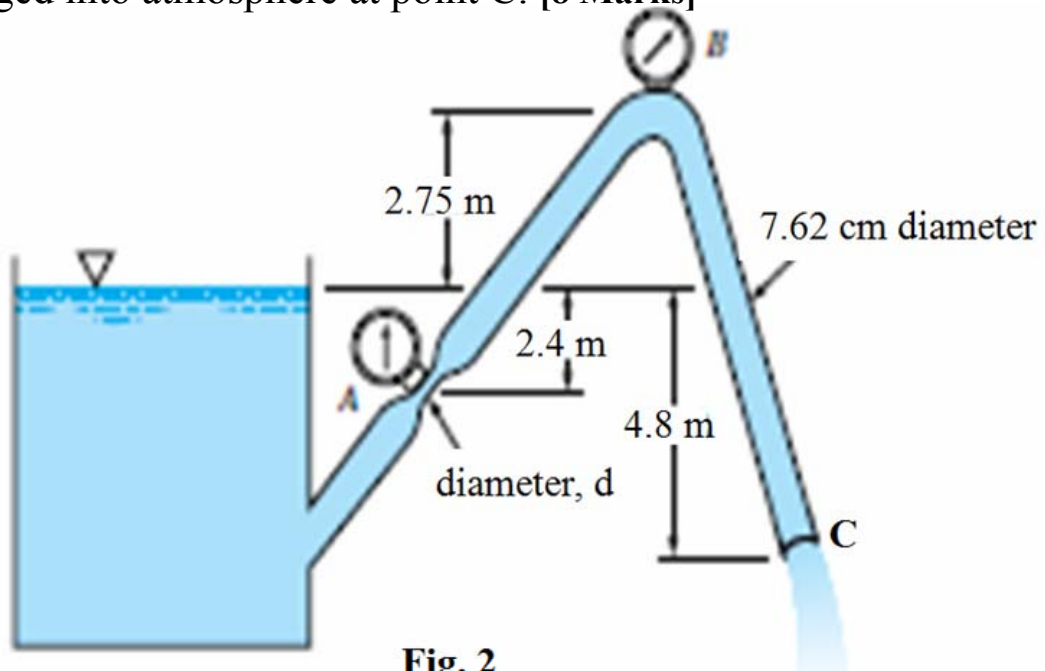

Fig. 2

3-A closed cylindrical tank filled with water has a hemispherical dome and is connected to an inverted piping system as shown in Fig. 3. 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. If the pressure gauge reading at A is 60 kPa, determine:

(a) the pressure in pipe B,

(b) the pressure head in millimeters mercury at the top of dome (point C).

[8 Marks]

Fig. 3
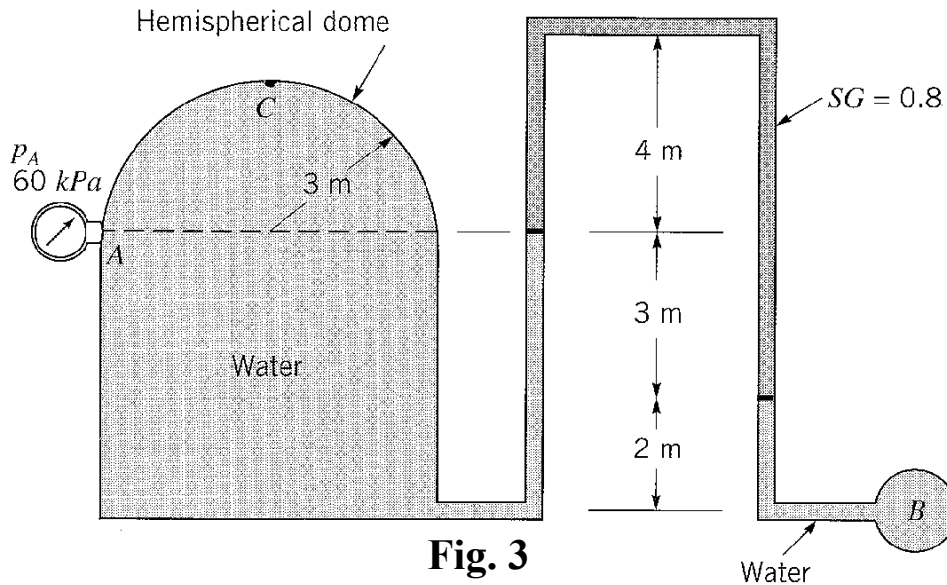
4- Long solid cylinder of radius 0.8 m hinged at point A is used as an automatic gate, as shown in Fig. 4. When the water level reaches 5 m, the gate opens by turning about the hinge at point A. Determine :

    a. The hydrostatic force acting on the cylinder and its line of action when the gate opens.

    b. The weight of the cylinder per m length of the cylinder. **[8 Marks]**

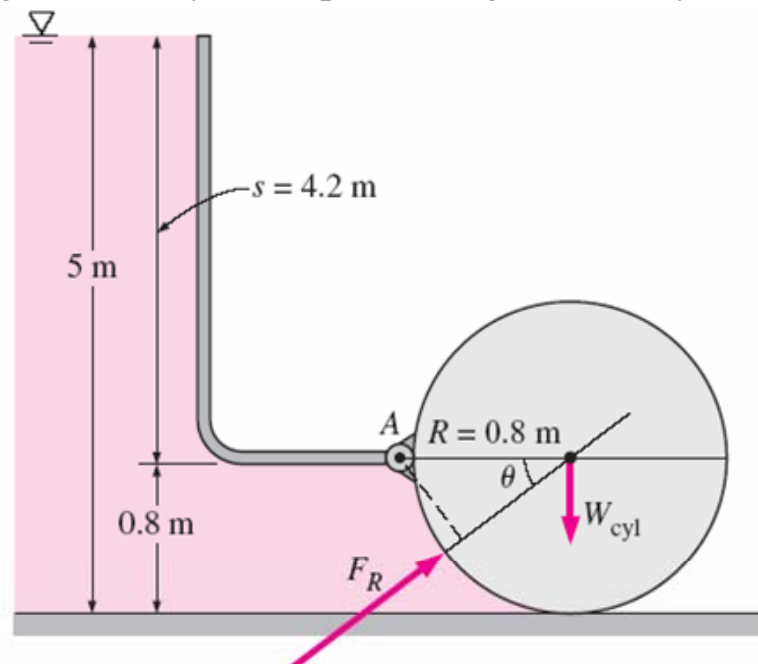**Fig. 4**

5-Water flows from the basement to the second floor through the 20 mm diameter copper pipe (ε = 0.0015 mm) at a rate of 0.75 L/s and exits through a faucet of diameter 13 mm, as shown in Fig. 5. Determine the pressure at point (1), if all losses are included.

(Use water density as 1000kg/m³ and water dynamic viscosity as 1.12x10⁻³ N.s/m²) **[8 Marks]**

Fig. 5

Relative roughness $\frac{\epsilon}{D}$

0.05
0.04
0.03
0.02
0.015
0.01
0.008
0.006
0.004
0.002
0.001
0.0008
0.0006
0.0004
0.0002
0.0001
0.000 05
0.000 01
0.000 005
0.000 001

Complete turbulence, rough pipes

Laminar flow $f = \dfrac{64}{R}$

Laminar | Critical | Transition
flow | zone | zone

R^{cr}

Smooth pipes

	ϵ ft	ϵ mm	
Riveted steel	0.003–0.03	0.9–9.	0.015
Concrete	0.001–0.01	0.3–3.	
Wood stave	0.0006–0.003	0.18–0.9	
Cast iron	0.00085	0.25	
Galvanized iron	0.0005	0.15	
Asphalted cast iron	0.0004	0.12	
Commercial steel or wrought iron	0.00015	0.046	0.01
Drawn tubing	0.000005	0.0015	0.009

Friction factor $f = \dfrac{h_f}{\dfrac{L}{D}\dfrac{V^2}{2g}}$

0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.025
0.02

10^3 $2(10^3)$ 10^4 $2(10^4)$ 10^5 $2(10^5)$ 10^6 $2(10^6)$ 10^7 $2(10^7)$ 10^8

Reynolds number $\mathbf{R} = \dfrac{VD}{\upsilon}$, consistent units

Good Luck   **4/4**
Prof. Kamal Abd-El Aziz
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