Answer the following questions:
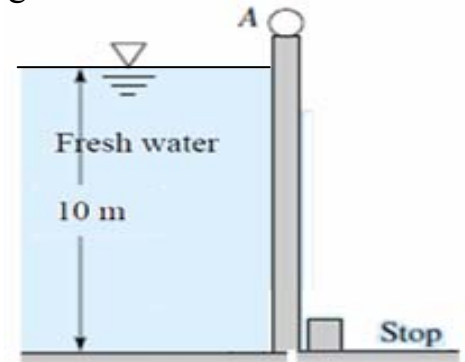## Question one (12 marks)

a) The pressure of a liquid ($k = 2 \times 10^9$ N/m^2) increases from 1 bar to 100 bars at constant temperature. Find the corresponding change in fluid volume to its initial volume.
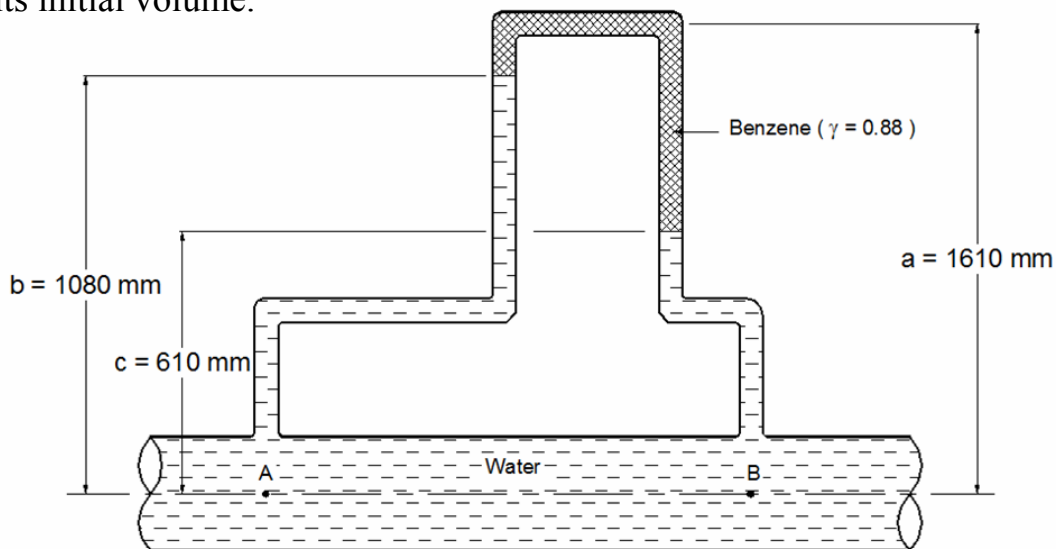
b) Consider a manometer connected as shown in Figure. Calculate the pressure difference between A and B.

c) Gate AB is 5 m wide perpendicular to the paper. Determine the hydrostatic force acting on the gate and its line of action, using neat sketches.

Question two (12 marks)

a) Compare between:
   - Barometric pressure and Bourdon tube guage.
   - Hydraulic jack and Hydraulic press.
   - Venturi and Orifice meters.

b) Water discharged from a large tank into atmosphere through a pipe of 50 mm diameter and 45 m long which is sharp at entry, after which there is a sudden enlargement to a pipe of 75 mm diameter, 30 m long. The point of delivery is 6 m below the surface water in the tank. Determine the discharge in m^3/sec. Assume that coefficient of friction (f) is equal to 0.02 for both pipes.

Question Three (12 marks)

a) Compare between Diaphram and Gear pumps.

b) A gear pump of volumetric and mechanical efficiencies are 95% and 80%, respectively, rotates at 1200 rpm. The gear is 6 cm diameter and 4 cm thick. The pump is working against head 22 m of water, area between teeth equals 1.655 cm^2 and each gear has five teeth. Calculate the power of the electric motor.

Question Four (12 marks)

a) Explain how to discover cavitation in the installed pumps.

b) A centrifugal pump, running at 2140 rpm with water at 20°C, produces the following performance data:

Q, m3/s	0.00	0.05	0.10	0.15	0.20	0.25	0.30
H, m	105	104	102	100	95	85	67
Power, kW		115	135	171	202	228	249

i. Determine the best efficiency point.
ii. Determine the mechanical losses.
iii. Determine the maximum discharge obtained when this pump is used in a 2in. pipe 100 m long having 2 bends (k = 0.8), static head = 20 m and f = 0.01.

Question Five (12 marks)

a) Write the functions of:-
   i. Oil.
   ii. Valves.
   iii. Actuators.

b) Draw a complete hydraulic circuit used to rotate a hydraulic motor with a controllable velocity. This circuit contains:-
   i. Vented reservoir.   ii. Variable speed Hydraulic pump.
   iii. Electric motor.   iv. Filter.   v. Check valve
   vi. Relief valve.   vii. Flow control valve.   viii. Hydraulic motor.
   ix. Directional control valve two chambers four ports using solenoid control.

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