Alexandria University

Faculty of Engineering

Textile Engineering Department

2nd year

Exercise Sheet

Prof. Ayman Bakry

2011 - 2012

FLUID PROPERTIES

Dimensions and Units

1. Convert the following properties to appropriate SI units:
   a. Specific weight = 62.29 lb/ft^3
   b. Viscosity = 2.05×10-4 lb-s/ft2
   c. Bulk modulus = 320000 psi
   d. Power = 10 HP
2. Show that each of the following is non-dimensional using the basic dimensions (M, L, T):
   a. $\frac{\rho v d}{\mu}$ Reynolds number
   b. $\frac{v}{\sqrt{gl}}$ Froude number
   c. $\frac{v}{\sqrt{\frac{k}{\rho}}}$ Mach number

Where; ρ (density), v (velocity), d (diameter), μ (viscosity), l (length), g (gravitational acceleration) and k (bulk modulus of elasticity).

3. Find the dimensions of the following quantities and their SI units :
   a. Bulk modulus of elasticity.
   b. Dynamic viscosity.
   c. Surface tension.
   d. Pressure.

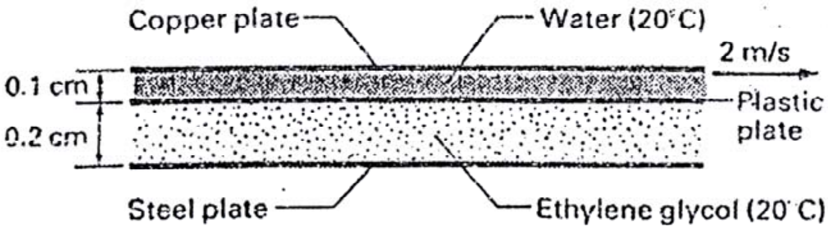
Fluid Density

4. The density of a substance is 800 kg/m^3. What are its *specific gravity*, *specific weight* and *specific volume*?

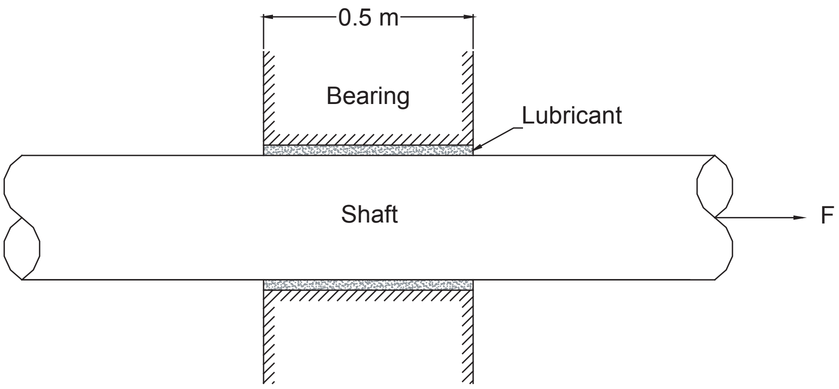
Fluid Viscosity

5. Show by sketch the difference between Newtonian and Non-Newtonian fluids.
6. A very large plate is placed equidistant between two vertical walls. The 10-mm spacing between the plate and each wall is filled with a liquid of absolute viscosity 1.92 x 10^{-3} Pa-s. Determine the force per unit plate area required to move the plate upward at a speed of 35 mm/s. Assume linear variation of velocity between the plate and the walls.
7. Three large plates are separated by thin layers of ethylene glycol (μ_{eg} = 0.0199 $N.s/m^2$) and water

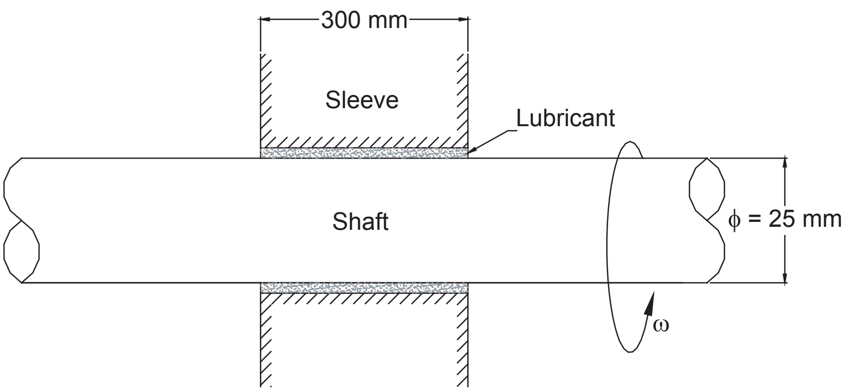
(μ_w = 0.001 N.s/m2), as shown in figure. The top plate moves to the right at 2 m/s. At what speed and in what direction must the bottom plate be moved to hold the centre plate stationary?



8. A 25-mm diameter shaft is pulled through a cylindrical bearing as shown in Figure. The lubricant that fills the 0.3-mm gap between the shaft and the bearing is oil having a kinematic viscosity of 8.0×10^{-4} m^2/s and a specific gravity of 0.91. Determine the force F required to pull the shaft at a velocity of 3 m/s. Assume the velocity distribution in the gap is linear.



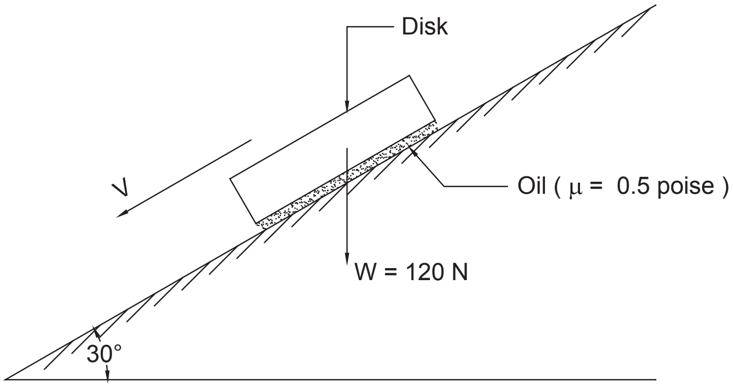
9. A 25-mm diameter shaft is rotated in a 26.2-mm diameter 300-mm-long sleeve containing SAE 50 oil (μ = 0.44 Pa-s) as shown in Figure. Estimate the torque required to rotate the shaft at a speed of 1800 rpm. Also determine the power lost in viscous friction.



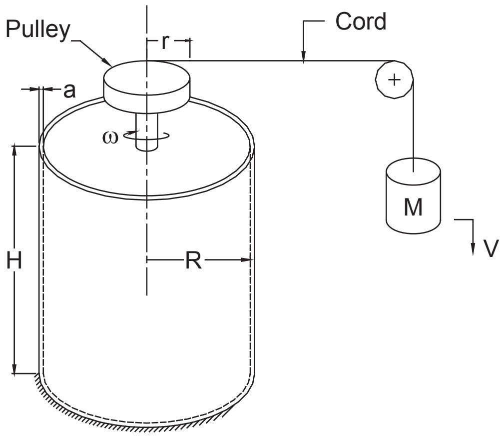
10. A cylinder of 0.12-m radius rotates concentrically inside of a fixed cylinder of 0.13-m radius. Both cylinders are 0.3-m long. Determine the viscosity of the liquid which fills the space between the cylinders if a torque of 0.88 N-m is required to maintain an angular velocity, ω, of 2π rad/s. For the

small space between cylinders, the velocity gradient may be assumed constant.

11. Determine the constant speed with which the disk shown in Figure will move down on the inclined surface if the 0.02-cm gap between the disk and the surface contains oil having viscosity of 0.5 poise. The disk is 50 cm diameter and weighs 120 N.



12. A concentric cylinder viscometer is driven by a falling mass (M) connected by a cord and pulley to the inner cylinder, as shown in Figure. The liquid to be tested fills the annular gap of width (a) and height (H). After a short starting transient, the mass falls at constant speed. Develop an expression for the liquid viscosity in the device in terms of M, g, V, r, R, a and H. Evaluate the viscosity of the liquid using:
M = 0.1 kg, r = 25 mm, R = 50 mm, a = 0.2 mm, H = 50 mm, V = 40 mm/s.

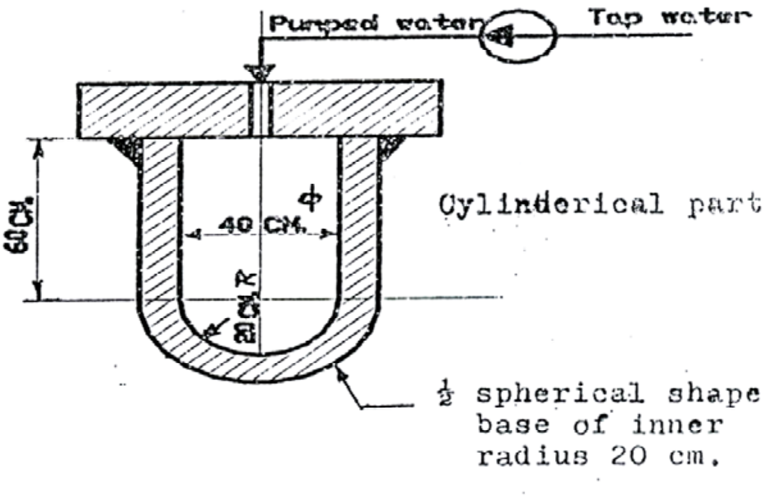


Fluid Compressibility

13. If the pressure of a fluid increases from 1 bar to 100 bar at constant temperature, find the corresponding change in fluid volume if:
    a. The fluid is gas.
    b. The fluid is liquid (K = 20000×105 N/m2).

14. It was wanted to test a pipe 1 km long and 20 cm diameter. Water ($K=2\times10^9$ Pa) is pumped to fill the pipe at 1 bar. Then an extra amount of water is added to reach a test pressure of 20 bar. Find the amount of the extra water.

15. How many litres of tap water needed to be pumped into the shown rigid vessel until the pressure reaches 400 bar? Neglect vessel expansion and consider bulk modulus $K=2\times10^9$ N/m^2 for water.



General Questions

16. Choose the correct answer(s) for the following, statements:

a. The bulk modulus of elasticity, K, for water at 20°C and at pressure 1 bar is 21000 bar. The corresponding value of K at a pressure 300 bar and the same temperature is:

i. 20000 bar ii. 21000 bar iii. 24000 bar.

b. The kinematic viscosity, ν, of air at atmospheric pressure and 20°C is 15×10^{-6} m^2/s. The corresponding value of ν at atmospheric pressure and 80°C is:

i. 14×10^{-6} m^2/s ii. 15×10^{-6} m^2/s iii. 21×10^{-6} m^2/s.

c. The dimensions for kinematic viscosity are:

i. $FL^{-2}T$
ii. ML-1T-1
iii. L2T2
iv. L2T-1
v. L2T

d. The bulk modulus of elasticity (K) for a gas at constant temperature (T_o) is given by:

i. $\frac{p}{\rho}$

ii. RT_0

iii. $p\rho$

iv. ρRT_0

17. Use neat drawing to show variation of power lost in viscous friction of a bearing with temperature of lubricating fluid in case of:

    a. Oil lubrication.

    b. Air lubrication.

18. A journal bearing has an oil film of 0.01 mm thickness and rotates at a speed of 1000 rpm. The power lost in viscous friction is 240 W.

a. If the oil film thickness becomes 0.012 mm due to wear of the sleeve and speed remains 1000 rpm, the power lost becomes:

i. the same 240 W   ii. 280 W   iii. 200 W

b. If the speed of rotation is increased to 2000 rpm and film thickness remains 0.01 mm , the power lost becomes :

i. 120 W   ii. 480 W   iii. 960 W

19. A gas is contained in a glass container whose thermal expansion is negligible. When the ambient temperature increases:

a. The viscosity of the gas will :

i. increase   ii. decrease   iii. remain constant

b. The mass of gas will:

i. increase   ii. decrease   iii. remain constant

c. The volume of gas will:

i. increase   ii. decrease   iii. remain constant

d. The pressure of the gas will:

i. increase   ii. decrease   iii. remain constant

e. The density of the gas will:

i. increase   ii. decrease   iii. remain constant

20. If the temperature of the oil used in the bearing is increased and the other parameters remained constant. The heat generated in the oil due to viscous friction per second will:

i. increase   ii. decrease   iii. remain constant

21. On increasing the pressure on a liquid excessively,

a. The volume of the liquid:

i. increases ii. decreases iii. remains constant

b. The bulk modulus of elasticity (k):

i. increases ii. decreases iii. remains constant

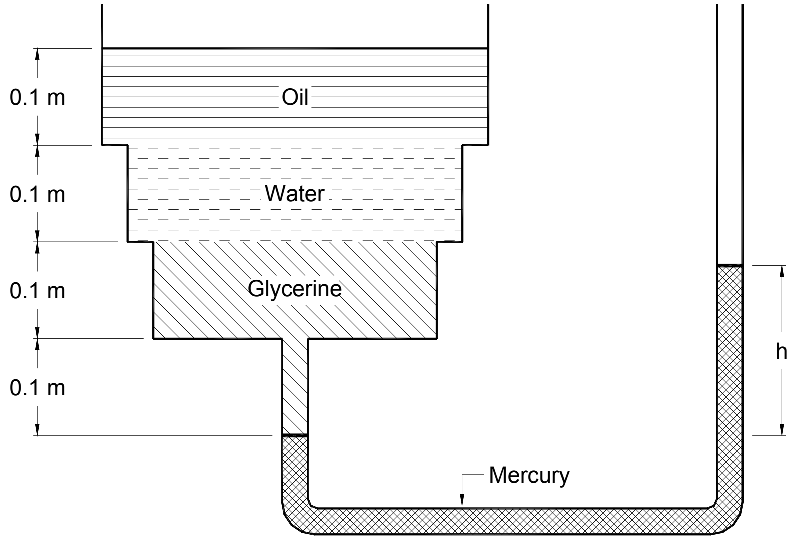
FLUID STATICS

Basics and Concepts

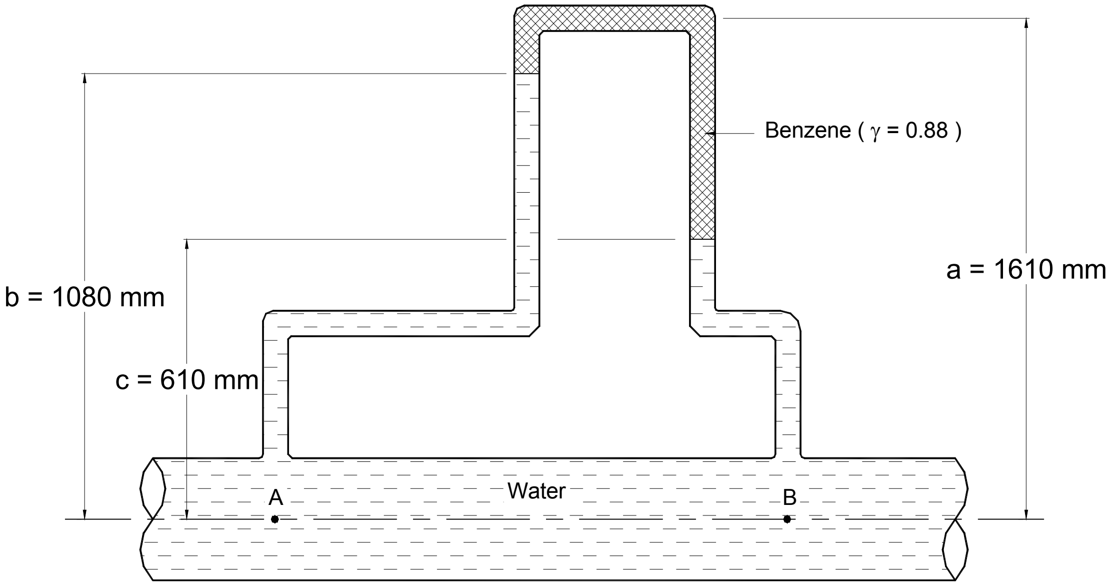
22. Sketch the relation between gauge, absolute and atmospheric pressures, show on the sketch what is meant by vacuum.
23. What is the minimum permissible head in a hydraulic circuit using a liquid of specific gravity 0.85 and vapour pressure 6.2 kPa at the working temperature?
24. A diver is working at a depth of 18 m below the sea surface. Determine the absolute pressure at this depth if the specific weight of the sea water is 10000 N/m3.
25. At what depth of oil (sp. gr. = 0.8), the pressure is 3 bar. What is the equivalent depth of water that would produce the same pressure?
26. Convert a pressure head of 15 m of water to meters of carbon tetra chloride (sp. gr. = 1.6).

Manometers

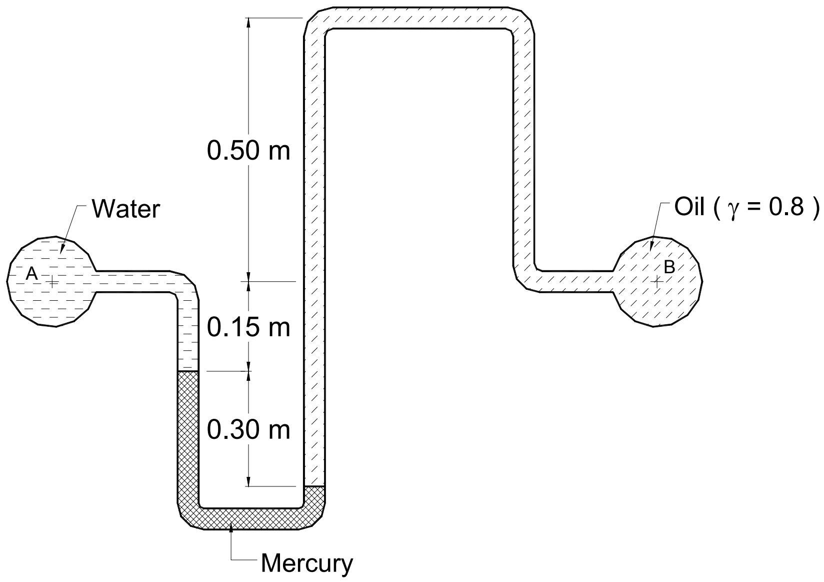
27. A mercury U-tube manometer is used to measure the pressure of water at a section (A) in a pipe, the water being in contact with mercury in the left hand limb. If the mercury is 30 cm below (A) in the left hand limb and 20 cm above (A) in the right hand limb which is open to the atmosphere. What is the gauge pressure at (A)?
28. A tank is constructed of a series of cylinders having diameters of 0.30, 0.25, and 0.15 m as shown in Figure. The tank contains oil (sp. gr. = 0.8), water, and glycerine (sp. gr. = 1.26). A mercury manometer is attached to the bottom as illustrated. Calculate the manometer reading, h.



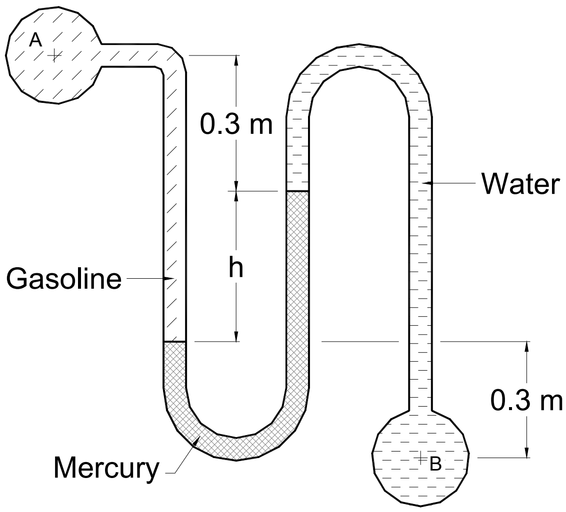
29. Consider a manometer connected as shown in Figure. Calculate the pressure difference between (A) and (B).



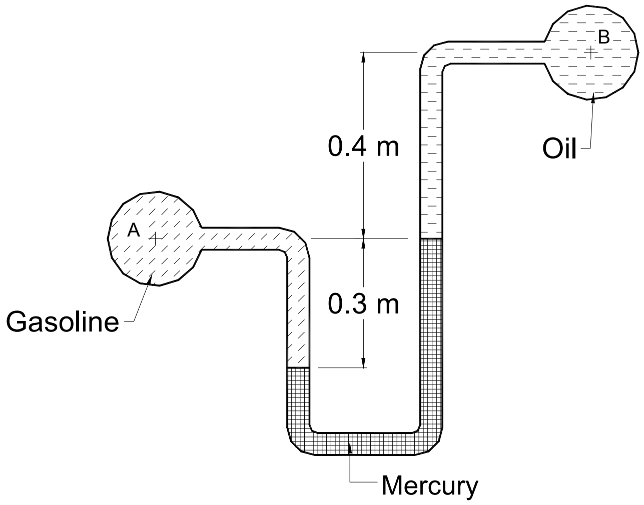
30. The mercury manometer shown in Figure indicates a differential reading of 0.3 m when the pressure in pipe (A) is 25 mm Hg vacuum. Determine the pressure in pipe (B).



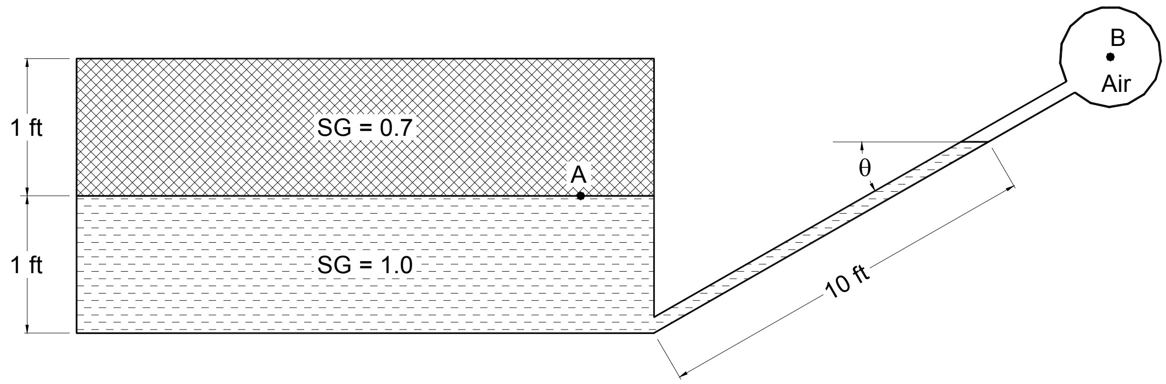
31. The differential mercury manometer shown in Figure is connected to pipe (A) containing gasoline (sp. gr. = 0.65), and to pipe (B) containing water. Determine the differential reading, h, corresponding to a pressure in (A) of 20 kPa and a vacuum of 150 mm Hg in (B).



32. In the following Figure, pipe (A) contains gasoline (sp. gr. = 0.7), pipe (B) contains oil (sp. gr. = 0.9), and the manometer fluid is mercury. Determine the new differential reading if the pressure in pipe (A) is decreased 25 kPa, and the pressure in pipe (B) remains constant. The initial differential reading is 0.30 m as shown.



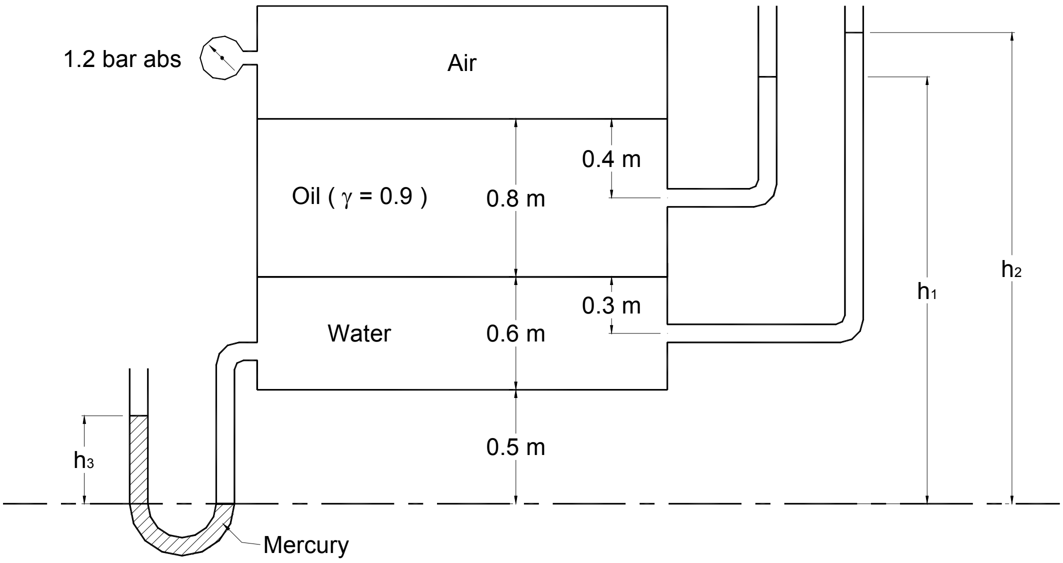
33. Determine the angle θ of the inclined tube shown in Figure if the pressure at (A) is 2 psi greater than that at (B).



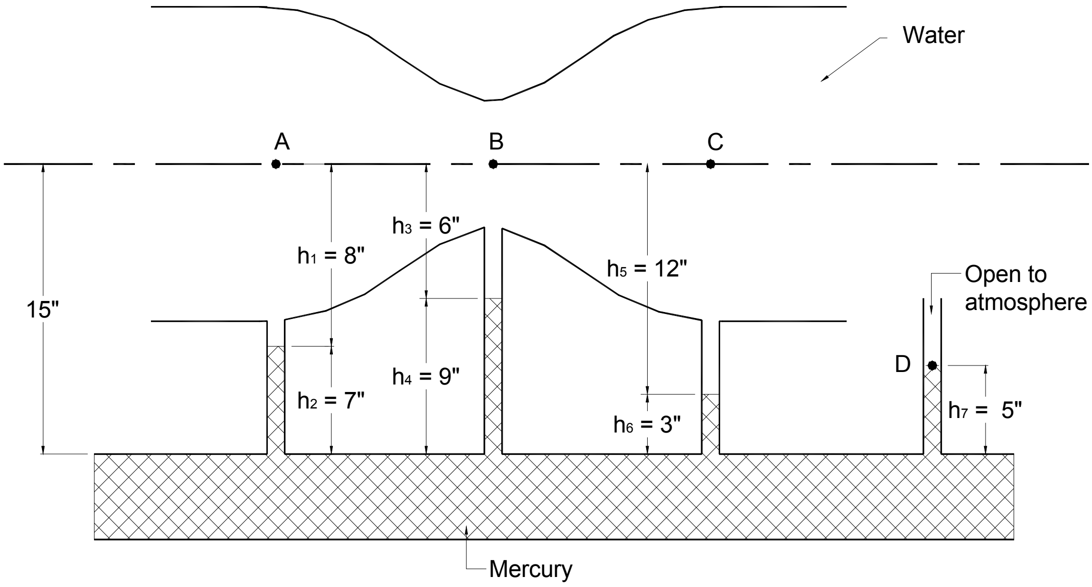
34. For the tank shown in Figure, it is required to calculate:

a. h_1, h_2 of the piezometer tubes.

b. The reading, h3, of the mercury U-tube manometer.



35. In the following Figure, find the gauge pressure at points (A), (B) and (C) in the pipe filled with flowing water.



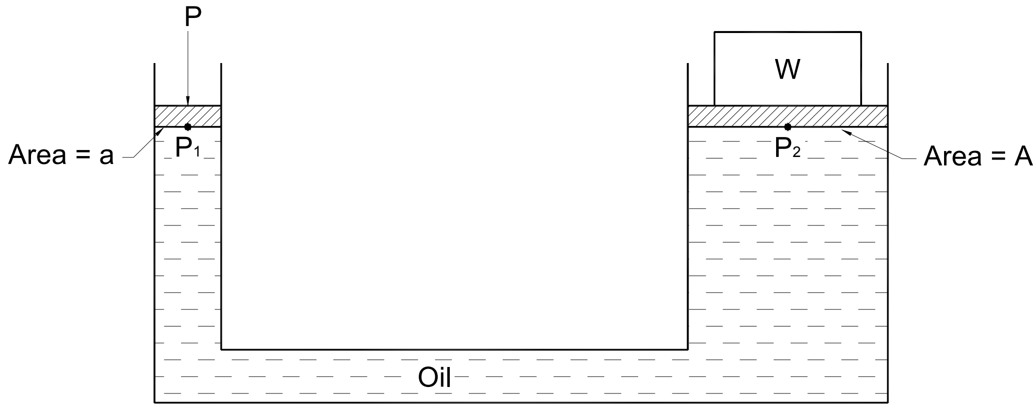
Hydraulic Jack

36. A force of 850 N is applied to the smaller cylinder of a hydraulic jack (shown in Figure). The area (a) of the small piston is 15 cm^2 and the area (A) of the larger piston is 150 cm^2. What load (W) can be lifted on the larger piston:

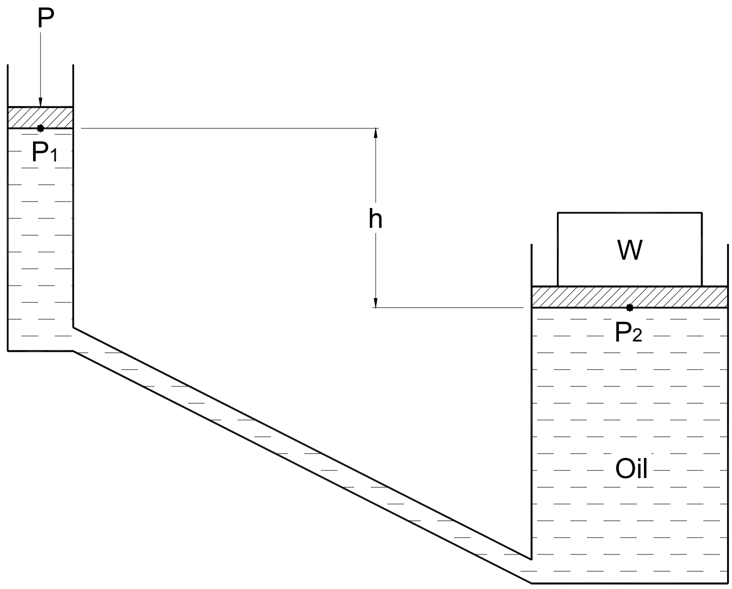
a. If the pistons are in the same level?

b. If the large piston is 0.75 m below the smaller one?

Where, μ_{Liquid} in the jack = 800 kg/m^3.



(a)



(b)

37. In a hydraulic jack, a force (F) is applied to the small piston to lift the load on the large piston. If the diameter of the small piston is 15 mm and that of the large piston is 180 mm, calculate the value of (F) required for lifting a mass of 1000 kg.

38. Sketch a hydraulic jack and deduce the relation between the force on the lever and the weight to be lifted.

39. A hydraulic press has a ram of 125 mm diameter and a plunger of 12.5 mm diameter. What force is required on the plunger to raise a mass of 1000 kg on the ram? If the plunger had a stroke of 250 mm, neglecting losses and assuming that the weight moves continuously, what power would be applied to the plunger if the weight is lifted 1 m in 12 minutes? Find also the number of strokes required.

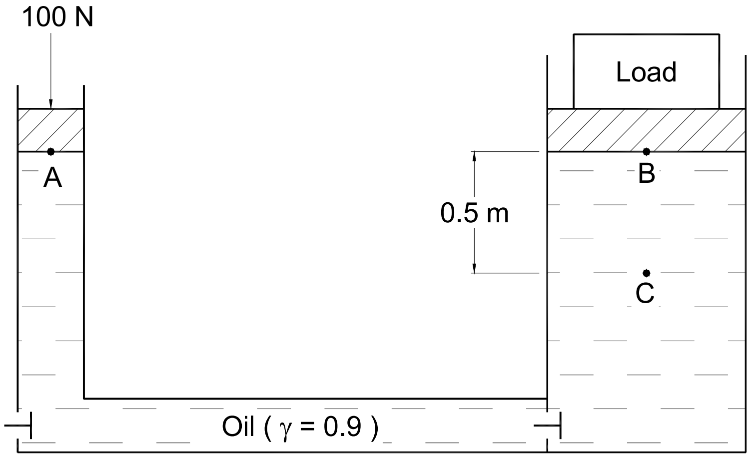
40. The motor operated hydraulic jack, shown in Figure, has a small piston area 10 cm^2, and large

piston (ram) area of 500 cm^2. If the force applied on the top of the small piston is 100 N , motor power equals 0.5 kW, and the efficiency of the jack is 0.8. Determine:

a. The pressure at points (A), (B), (C).

b. The maximum load that can be raised.

c. The time required to raise this load a distance of 2 m.



General Questions

41. Answer the following questions:

a. Choose the correct completion for the following statements:

i. In a hydraulic system the pressure is expected to fall very much below atmospheric pressure, three liquids are available for use in this system. The vapour pressures for the three liquids are, respectively: liquid (a): 0.3 bar, liquid (b): 0.03 bar and liquid (c): 0.003 bar. The most probable suitable liquid for this system is liquid:(a), (b) or (c)

ii. Strain gauge pressure transducers are used for measuring:

a) Static pressures only

b) Dynamic pressures only

c) Both static and dynamic pressures

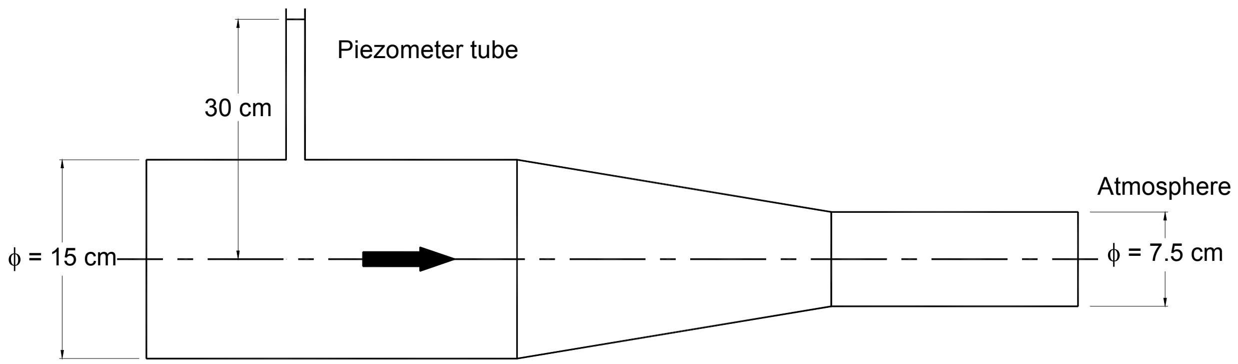
FLOW OF INCOMPRESSIBLE FLUIDS

Bernoulli Equation and TEL & HG

42. A piston 6-cm diameter moves with a velocity of 2 cm/min, into a closed cylinder 6.5-cm diameter full of oil. Calculate the velocity of oil through the annular space between the piston & the cylinder.

43. A pipe 4 cm diameter is connected in series to a pipe 8-cm diameter. For a discharge of 6 lit/s, of a liquid of sp. gr. 0.9, the pressure before & after the sudden enlargement was 2 bar & 2.04 bar. Calculate the head lost in the enlargement.

44. Calculate the discharge in lit/sec, through the pipeline shown below. Also draw the T.E.L & H.G., considering ideal flow.



45. The diameter of a pipe changes from 20 cm at a section 5 m above datum, to 5 cm at a section 3 m above datum. The pressure of water at the first section is 5 bar. If the velocity of flow at the first section is 1 m/s, determine the pressure at the second section.

Venturi

46. A venturi-meter is used to measure the discharge in 100-mm water pipe line. The venturi throat is 60-mm diameter and it's discharge coefficient C_d = 0.96. Calculate the water discharge and the energy loss in the convergent part when a U-tube manometer containing carbon-tetra-chloride (sp.gr = 1.64) is connected between the venturi inlet and throat sections reads 80 cm.

47. A venturi meter is to be fitted to a 25-cm diameter horizontal pipe, in which the maximum flow is 7200 lit/min. of water and the pressure head at the inlet to the venture is 6-m water. What is the minimum diameter of the throat so that there is no negative pressure in it? Assume ideal flow.

48. 4 lit/s of a liquid of sp. gr. 0.95 flows through a 6-cm pipe. A venturi meter with 3-cm throat diameter and C_d = 0.94 is used to measure the discharge through the pipe. What would be the reading of a mercury U-tube connected to the meter if the venturi is:

    a. Horizontal.

b. Inclined 45°.

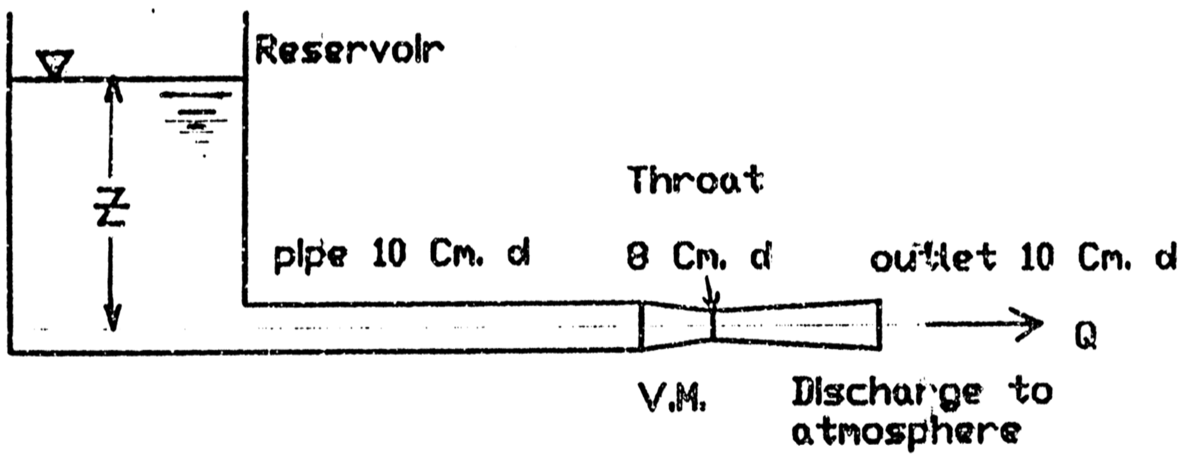
c. Vertical.

49. Considering ideal flow of water at 20°C through the shown pipe ending with a venturi-meter (V.M.)

a. Draw T.E.L. & H.G. throughout the flow.

b. Determine the maximum discharge (Q_{max}) and also the corresponding maximum level of water in the reservoir (Z_{max}) so that flow continues without vapour formation. Given: vapour pressure for water at 20°C is 2.45 KPa.

c. Connect a mercury U-tube manometer between inlet and throat of the (V.M.) and then determine its reading (Y) for the above condition of Q_{max}.



Orifice

50. A tank contains a liquid to a height of 1.5 m, & is opened to the atmosphere. Calculate the velocity of flow through the orifice at the bottom of the tank if the liquid is:

a. Water.

b. Oil of sp. gr. 0.9.

c. 0.5 m of water and 1m of oil.

Given that the coefficient of velocity of the orifice for water = 0.97 & for oil = 0.8.

51. Calculate the instantaneous velocity & discharge through an orifice meter in the bottom of a tank containing liquid of sp. gr. 0.95 to a height of 2 m, above which there is a gas pressure of 1.5 bar absolute. The coefficient of velocity of the orifice is 0.97 & its coefficient of contraction is 0.65. Calculate the energy loss in the orifice. In order to double this discharge, what should be the gas pressure? Given that the diameter of orifice = 10 cm.

Weir

52. A rectangular weir 60-cm long is constructed across a channel to measure the discharge of water pump. If the head over the weir is constant at 25 cm, what is the pump discharge? Coefficient of discharge of weir = 0.63.

53. Determine the head on a 60° V-notch, $C_d = 0.62$, for a discharge of 50 lit/s.

Pitot tube

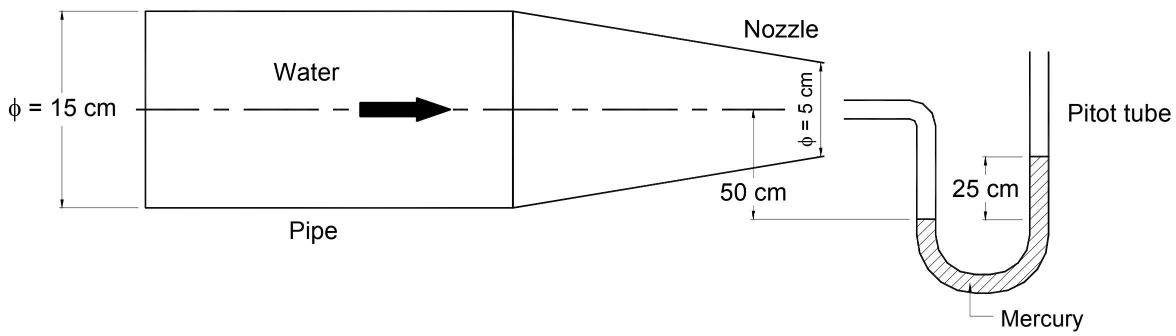
54. A Pitot-static tube connected to a mercury U-tube manometer was directed into a 4 m/s water stream. The U-tube reading was 5 cm. Determine the coefficient of the Pitot-static tube.

55. Water flows in a pipe 15 cm diameter ending with a nozzle 5 cm diameter & discharges into the atmosphere. A Pitot tube is used for measuring the velocity head at the exit section of the nozzle & is connected to one end of a U-tube manometer containing mercury, while the other end of the manometer is open to the atmosphere. If the tube reading is 25 cm & considering ideal flow, determine:

a. The discharge through the nozzle in m^3/s.

b. The pressure in the pipe in N/m^2.

c. Draw the TEL and the HG for the flow in the pipe and nozzle



General Questions

56. Draw the total energy line (T.E.L.) & hydraulic gradient (H.G) for real flow through a venturi meter having an inlet diameter twice the throat diameter and the pressure at the throat is negative.

57. Can the Pilot-static tube be used to measure the mean velocity in pipes? Explain.

58. Answer the following questions:

a. What are the differences between laminar and turbulent regimes?

b. Define the following, using sketches illustrating your answers:

i) Stream line and streak line ii) Rotational flow and irrotational flow.

59. State the name of each instrument required to measure each of the following:

a. Atmospheric pressure,

b. Liquid pressure,

c. Small liquid pressure,

d. Water pipe discharge,

e. Natural gas flow rate through pipe,

f. Local velocity in a water channel.

60. Is it possible for the energy loss between two points to be equal to the difference in pressure energy between the same two points? Explain your answer.

61. Draw with reasonable proportions the total energy line and the hydraulic gradient for a venturi-meter in which the inlet diameter = 2 × throat diameter, when the venturi discharges into the atmosphere.

FLOW IN PIPES

62. A 10 cm commercial steel pipe 100 m long carries oil of sp.gr. 0.9 and viscosity 2.5 poise from (A) to (B) which is 2 m lower than A. Calculate the required pressure at (A) to deliver 20 lit/sec, if the pressure at (B) = 4 kg/cm^2.

63. A pump delivers 1 lit/s of a liquid through a galvanized iron pipe "AB" 5 cm diameter and 1 km long discharging into the atmosphere at (B) which is 4 m higher than (A). What should be the pressure at (A) if the liquid is :
    a. Water.
    b. Liquid: S.G = 0.90, μ = 0.004 N.s/m^2 (0.04 poise).
    c. Liquid: S.G = 0.95, μ = 0.350 N.s/m^2 (3.50 poise).

64. A pump takes gasoline from a tank in which the level is 50 cm above pump level, through a 0.5 cm diameter smooth pipe 100 cm long. What is the pressure in kg/cm^2 just before the pump when 4.5 cm^3/sec of gasoline is flowing through the pipe? If the discharge is tripled, what would be this pressure?

    Given that, $S.G_{gasoline}$ = 0.57, $\mu_{gasoline}$ = 0.0055 poise and ' f ' for turbulent flow = 0.002.

65. A pipe 2 km long connects two water tanks where the free surface level difference = 10 m. The first km is 4 cm diameter and the second km is 6 cm diameter, and each has one bend (c = 0.8). Compute the discharge given that 'f' for the pipe = 0.02.

66. Two reservoirs are connected by a pipeline which is 150 mm diameter for the first 6 m and 225 mm diameter for the remaining 15 m. The entrance and exit are sharp and the change of section is sudden. The water surface in the upper reservoir is 6 m above that in the lower. Each pipe contains a bend (c = 0.8), take f = 0.03 for the 150 mm pipe and f = 0.02 for the 225 mm pipe. Calculate the discharge.

67. Two water reservoirs with a difference in level of 10 m are connected by a pipeline 100 m long and 0.5 m diameter. If the friction factor for the pipe is 0.001, calculate the flow rate. If at a later date the pipeline is replaced by two pipes in parallel each 0.4 m diameter with the same friction factor as the original pipe. Calculate the flow rate.

68. A long pipeline 25 cm diameter conveys water from (A) to (B). If the middle third is damaged and is replaced by two equal pipes in parallel having 12.5 cm diameter, calculate the percentage change in discharge. The pressure at (A) and (B) are kept constant in both cases and ' f ' is the same. Neglect secondary losses and kinetic energy.

69. Two reservoirs having a constant difference in water level of 66 m are connected by a 225 mm diameter pipe, 4 km long. The pipe is tapped at a point distant 1.6 km from the upper reservoir and water is drawn off at the rate of 42.5 lit/s. If the friction coefficient ' f ' = 0.036, determine the discharge reaching the lower reservoir. Neglect the secondary losses.

70. Two reservoirs have a difference of level of 6 m and are connected by a pipeline which consists of a single 600 mm diameter pipe 3000 m long feeding a junction from which two pipes, each of 300 mm diameter and 3000 m long, lead in parallel to the lower reservoir. If ' f ' = 0.04, what will be the total discharge?

General Questions

71. What is the effect of pipe roughness on the friction loss under laminar flow condition? Explain your answer.

72. The friction loss in pipe flow can be written in the form $h = \frac{fLv^2}{2gd}$. Is it possible for the factor 'f' to be greater than one? Explain your answer.

73. Why are eddies formed when there is a change in the velocity vector through a pipe?

74. In a pipe flow, under what condition can you measure the energy difference between two points using only two pressure gauges?

75. What are the measuring instruments required to determine the energy difference between two points along an inclined convergent pipe transmitting liquid?

76. What is the effect of temperature rise on the coefficient of friction of a rough pipe transmitting liquid at highly turbulent flow condition?

77. What are the factors affecting the friction loss in case of laminar and turbulent flow?

78. Friction loss in a pipe line transmitting fluid under turbulent flow condition is mainly due to friction between the fluid and pipe wall. Show how you can prove this statement experimentally.

PUMPS

Centrifugal Pumps

79. A water centrifugal pump has the following performance at design speed

Q (lit/s)	0	2	4	6	8	10	12
H (m)	22	24	23.5	21.5	18.5	14	9.5
η %	0	31	54	72	84	84	74

a. What is the normal discharge and normal shaft power?

b. Estimate the shaft power when the delivery valve is completely closed and the pump is rotating at design speed.

c. Determine the maximum discharge obtained when this pump is used in a 2 in. C.I. pipe 50 m long having 2 bends (k = 0.8), static head = 3 m and f = 0.01.

d. If the delivery valve is partially closed so that the discharge is 6 Lit/s, calculate the power lost in the valve.

80. The performance of a centrifugal pump at the working speed is given by:

Q (lit/s)	0	5	10	15	20
H (m)	24	24	22	18	12
η %	0	36	63	75	60

This pump gave a maximum discharge of 15 Lit/s in a pipeline where the static lift 10 m.

a. If the static lift became 6 m, what would be the maximum discharge? If the delivery valve was partially closed to keep the discharge 15 Lit/s. calculate the shaft power lost in the valve.

b. For the same valve opening in (a) what would be the maximum discharge if the static lift became 10 m again.

81. 40 Lit/s of water flows from tank A to tank B due to a difference of water level of 10 m. In order to increase this discharge, a booster dynamic pump is used in the line. Calculate the percentage of increase in the discharge and the input power. The performance of the pump is given by:

Q (lit/s)	0	20	40	60	80	100
H (m)	30	31	29	25	20	12.5

η %	0	40	60	70	75	70

82. The performance of a centrifugal pump is given by:

Q (lit/s)	50	100	150	200	250	300
H (m)	21	20	19	17.5	15	12.5

When this pump is used with a long pipeline of 450 mm diameter, it lifts a maximum discharge of 150 Lit/s with a static lift of 10 m. If it is required to lift 250 Lit/s by the same pump and using another pipeline of the same length as the first one and parallel to it, select the minimum size of the new line if the available pipes diameters are: 200, 250, 300, 350, 400, ...etc. (mm).

97. A centrifugal pump has the following performance:

Q (lit/s)	0	20	40	60	80
H (m)	26	26	24	20	14
η %	0	50	70	78	75

When this pump is used in 150 mm pipe of length L, it gave 60 Lit/s against a static lift of 16 m. If L/4 of this pipe is replaced by two 75 mm diameter pipes of L/4 length each and arranged in parallel. Calculate the new pump discharge and shaft power. You may neglect the secondary losses, the kinetic energy and assume ' f ' is constant.

98. The following figures related to a centrifugal pump running at speed of 1500 rpm:

Q (lit/s)	0	15	30	45	60
H (m)	40.5	40	36.5	30	20

Plot to scale H-Q curve for a speed of 1200 rpm and also estimate the speed at which the pump should run in order to deliver 40 Lit/s against head of 40 m

99. A pump has the following characteristic when running at 1450 rpm:

Q (m3 /s)	0	0.225	0.335	0.425	0.545	0.650	0.750	0.800
H (m)	20	17	15	13	10	7	3	0

A system is designed so that the static lift is 5 m and the operating point is at H = 11.1 m and Q = 0.5 m3/s using the pump as above. The system is redesigned, the static lift being 5 m as before but the frictional and other losses increase by 40 %. Find the new pump speed such that a flow rate of 0.5 m3/s can be maintained.

Positive Displacement Pumps

100. Calculate the volumetric and mechanical efficiencies of a gear pump rotating at 1200 rpm and discharging 1.27 lit /sec using 0.7 hp motor. The gear is 6 cm diameter and 4 cm thick and when

one gear was put in a vessel full of water, 80 cm^3 of the water was spilt. The pump is working at a suction pressure = 0.2 Kg/cm^2 and delivery pressure = 2.3 Kg/cm^2.

101. A constant speed gear pump lifts oil of sp. gr. 0.9 from low level tank to a higher tank. The pump level is 2 m above suction level and 5 m below delivery level. The manometers at suction and delivery read - 0.4 and 2 kg/cm^2 respectively. Calculate:

    a. The manometers readings when the suction level drops 3 m.
    b. The percentage change in S.P in this case.