sheet #5 : Pumps

1. A three cylinders piston pump having ram. 30 cm diameter by 60 cm stroke,is required to lift 80 liter of water per second against a static head of 85 mt. The friction loss in the suction pipe is estimated at. 1.2 mt and in the delivery pipe at 12 mt. The pipe velocity is 1 mt./ sec. The mechanical eff, of the pump is. 90% and the η_{vol}=98% Calculate the speed at which the pump should run and the power required to drive it

2. Calculate the weight of oil which leaks from a 3 cylinders piston pump rotating at 120 rpm.The piston has diameter of 4 cm and stroke 6 cm The slip = ~~4~~ hp. and mechanical efficiency 89% specific gravity of oil 0.81. Delivery pressure 49.6 bar and Suction pressure 0.4 bar.
2.75

3. Calculate the volumetric and mechanical efficiencies of gear pump rotating at 1200 rpm . And discharging 1.27lit /sec. using o.7 hp . The gear is 6 cm. diameter and 4 cm thick. Suction pressure o.2 bar , delivery pressure 2.3 bar when one gear was put in a vessel full of water 80 $cm^3$of the water was split ,

4. A parallel cylinder rotary pump is driven by a 40 hp motor calculate the maximum possible inclination of the fixed housing to the vertical, when the pump works against a pressure of 5 bar. Number of cylinders is 11, diam , of cylinders is 6 cm ., pitch circle diam, is 30 cm slip is 3 % efficiency is 7o % speed of pump is 300 rpm and sp,gr. of oil used is 0.95.

5. A pump lifts water from a sump where the free surface level is 2 m below the pump. The free surface level in the delivery tank is 5 m above pump level. The suction pipe is 10 m long and the delivery pipe is 100 m long, both pipes are C.I. 4 inch diameter; the velocity of flow through the pipes is 2 m/s. There is a strainer at the inlet to the suction pipe so that the entrance head loss coeff. = 2.5. A bend in the suction pipe has a head loss coeff. = 0.75. Compute the manometric suction head, the manometric delivery head and the power required to drive the pump assuming its efficiency 80%

6. 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 pump 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, 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.

7) 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 lit became 10 m again.

8) 40 Lit/s of water flows from tank A to tank B due to difference of water level 10 m. In order to increase this discharge, a booster dynamic pump is used in the line. Calculate the % 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

9) A dynamic pressure pump has the following performance:

Q (lit/s)	0	10	20	30	40
H (m)	20	19	17.5	15	10
η %	0	55	75	78	70

a. If one pump give 40 lit/s in a pipeline where the static lift is 5 m, Calculate the discharge and slip when two units are used in parallel.

b. If one pump gives 10 lit/s is another pipe line where the static lift is 15 m. Calculate the discharge and slip when two units are used in series.

10) The characteristics of a centrifugal pump at constant speed are as follows:

$Q\ (m^3/s)$	0	0.012	0.018	0.024	0.030	0.036	0.042
H (m)	22.6	21.3	19.4	16.2	11.6	6.5	0.6
η %	0	74	86	85	70	46	8

The pump is used to lift water over a vertical distance of 6.5 m by means of a 10 cm diameter, 65 m long pipe line with f = 0.02.

a. Determine the rate of flow and power supplied to the pump.

b. If it is required to increase the rate of flow and this may be achieved only by an addition of a second identical pump (running at the same speed), investigate whether it should be connected in series or in parallel with the original pump. Justify your answer by determining the increased rate of flow and the power consumed by both pumps.

11) The centrifugal pump shown in following figure has the following performance at working speed:

Q (lit/s)	0	20	40	60	80
H (m)	40	38	35	30	20
η %	0	50	70	78	75

When this pump was operated at its normal speed it gave 40 lit/s with the delivery valve fully opened and at this time signs of cavitation were observed. In order to prevent cavitation suction level is to be changed, what will be the minimum allowable level of the suction tank? Estimate the pump shaft power in this case

$h_{atm} - h_{vap}$ = 10 m water)

NPSH = 4 m