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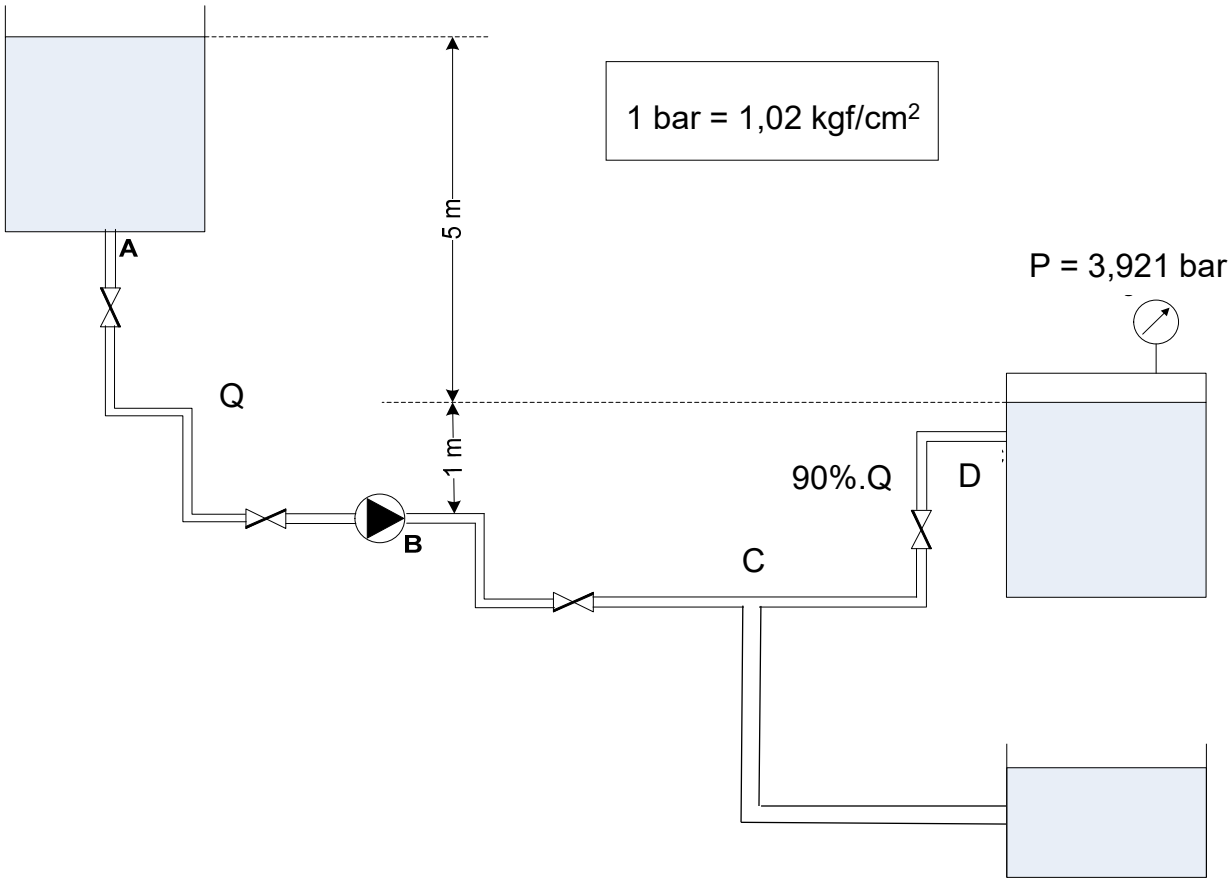
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LECTURES **HYDRAULIC MACHINES AND FLUID INSTALLATIONS** THEORETICAL-PRACTICAL

JULY 2025

Consider the installation shown in the figure used to pump water between two reservoirs.



Data:

Aspiration (inlet pipe):

Length of the pipe (AB)…….. 5 m

Diameter of the pipe (AB)…….…….. 60 mm

Material: Galvanized steel (ε = 0,15 mm)

Compression (outlet pipe):

Length of the pipe (BC)……..... 10 m

Length of the pipe (CD)…….. 5 m

Diameter of the pipe (BC e CD)…..……... 50 mm

Material: PVC (ε = 0,0015 mm)

- Characteristics of the fluid: Water

- Density (ρ) = 1000 kg/m^3

- Dynamic viscosity (μ) = 10^{-3} N.s/m^2

- Vapour pressure Pv = 2300 Pa

- **Local atmospheric pressure**: 750 mm.c.Hg

- Minor head losses coefficients, K:

Valve…….…….....	K = 2,0
Elbow, 90º……..……...……..	K = 0,9
Entrance of a reservoir ……...…….....	K = 1,0
Exit of a reservoir ……...……..……....	K = 0,5
"Tee" line flow ..……...……	K = 0,2
"Tee" branch flow……...……..	K = 1,8
Foot valve……..……...……	K = 2,0

- **Characteristics of the pump**

- Centrifugal pump - Rotation speed: 2900 r.p.m. - Diameter of the rotor: 75 mm

Consider also the selection diagram of the pumps shown in Figure S1 and the characteristics curves of the pump shown in Figure S2.

a) Determine the system characteristic equation, Hi, between point A and point D). Consider a reference flow of 25 m^3/h.

b) Based on the selection pump diagram (*vd.* Figure S1), which is the most appropriate pump for the present purpose?

c) Based on the characteristic curves of the selected pump (*vd.* Figure S2), determine the conditions of the operating point, namely the flow, the head, the rotation speed, the power, the efficiency and the net positive suction head (NPSH) values.

d) Calculate the rotation speed necessary to obtain a flow of 20 m^3/h in the system by using:

d1) The flowrate dimensionless coefficient

d2) The head rise dimensionless coefficient

d3) The power dimensionless coefficient

d4) Comment the results obtained in the preceding subheadings

In addition, calculate the power rating of the pump in this condition.

e) Taking into account the conditions defined in subheading d), verify if the pump is operating in cavitation conditions.

f) Fill in Table S1.

Table S1 Operating points.

	Point 1	**Point 2**	**Point 3**
Q [m^3/h]			
H [m]			
η, adm			
N [r.p.m.]			
P [kW]			
Hsi [m.c.H_2O]			

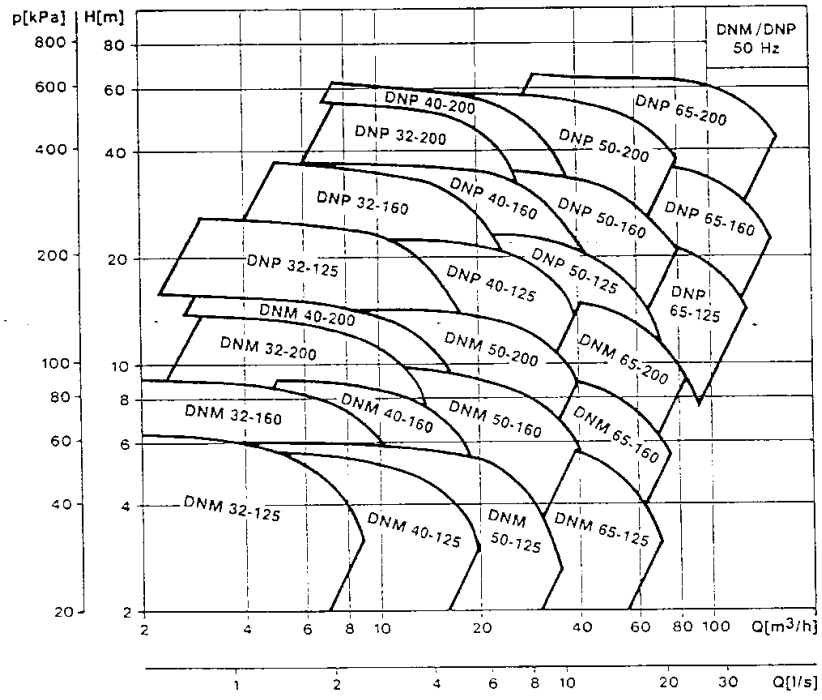


Figure S1 – Centrifugal pumps selection diagram (adapted from Grundfos).

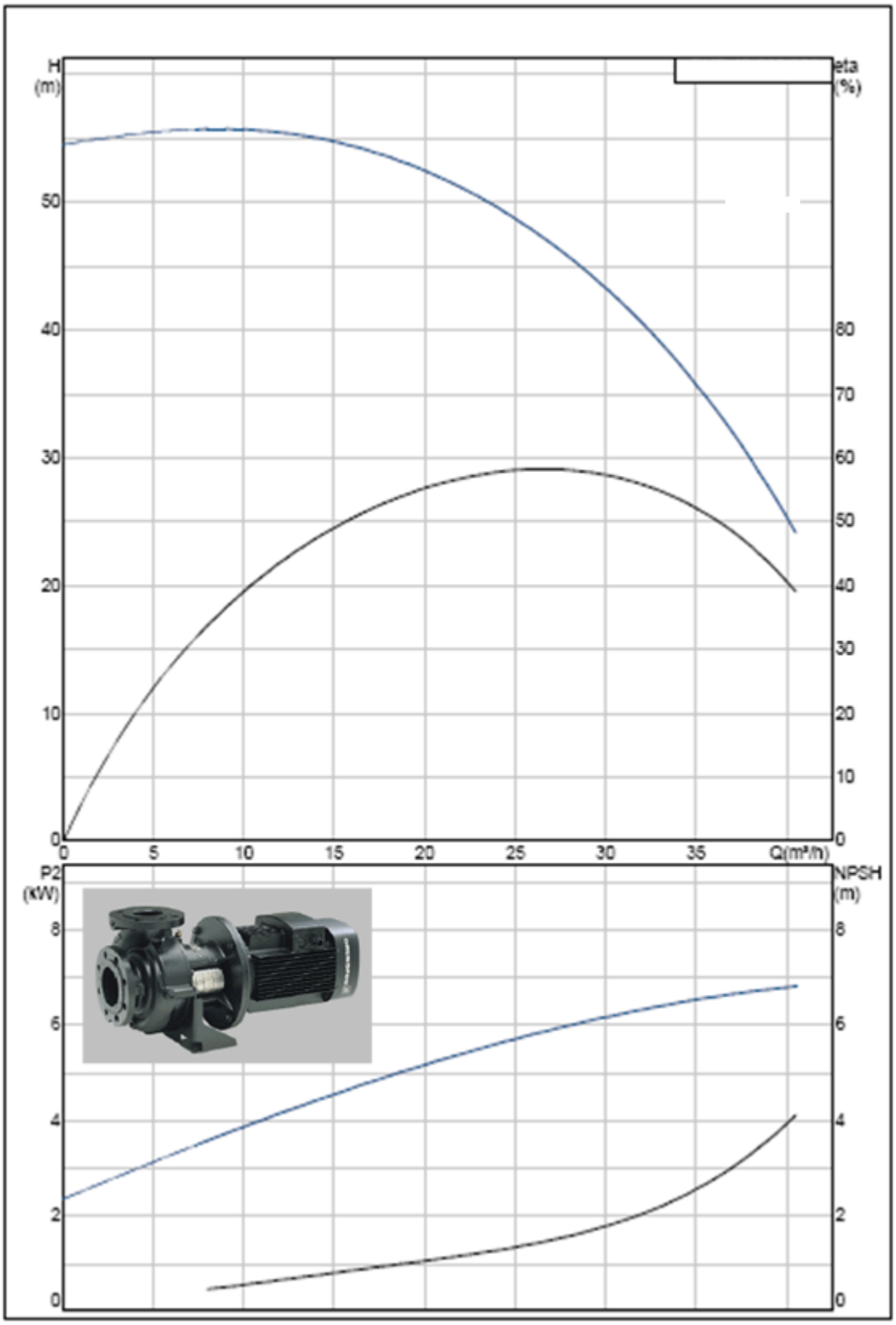


Figure S2 – Characteristics curves of the pump (adapted from Grundfos).