Lastname	Name	Student code

Section 1. QUIZ

1. The **rotameter** is one of the Differential Pressure Flowmeters

   true ☐ false ☐

2. The **membrane valve** got this name just because has a **ceramic membrane** in contact with the flowing fluid

   true ☐ false ☐

3. The **Coriolis Flowmeter** is a transducer of volumetric flowrate

   true ☐ false ☐

4. The level can be measured also for **granular solids**

   true ☐ false ☐

Section 2. MULTIPLE CHOICE QUESTIONS

1. When the percentage of flow through a valve equals the percentage of plug movement, a valve has
   a. ☐ Linear flow characteristic
   b. ☐ Equal percentage flow characteristic
   c. ☐ Quick opening flow characteristic
   d. ☐ Curved flow characteristic

2. Which of the following parts of a globe valve serves the same purpose as the disk in a butterfly valve?
   a. ☐ Seat
   b. ☐ Plug
   c. ☐ Packing rings
   d. ☐ Packing flange

3. What is roughly a **gauge pressure** of 195 psi when converted in absolute psi ?
   a. ☐ 151
   b. ☐ 164
   c. ☐ 178
   d. ☐ 210

4. In the processing industry, the most common control valve body style is
   a. ☐ Saunders
   b. ☐ Three-Way
   c. ☐ Globe
   d. ☐ Bourdon

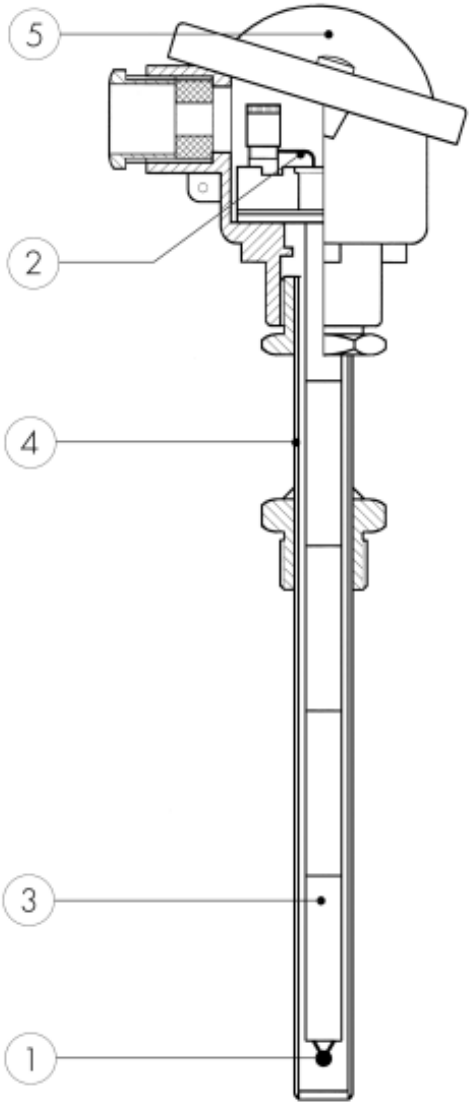
5. A magnetic flow meter determines the flow by measuring the following property of the fluid:
   a. ☐ velocity
   b. ☐ density
   c. ☐ temperature
   d. ☐ volume

Section 3: SENSORS AND INSTRUMENTATION EQUIPMENT FOR PROCESS MEASUREMENTS

3.1. Termocouple

With ref. to the figure,

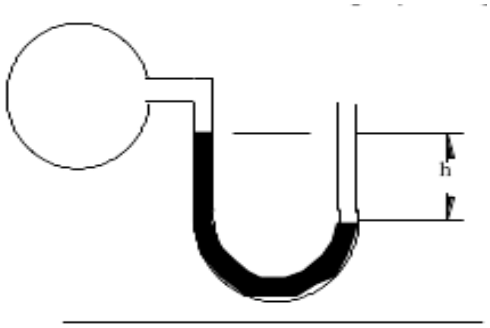
a. is this a thermocouple for **laboratory** or **industrial** use?
b. recognize and list the five numbered parts



3.2. Pressure measurement

With ref. to the figure,

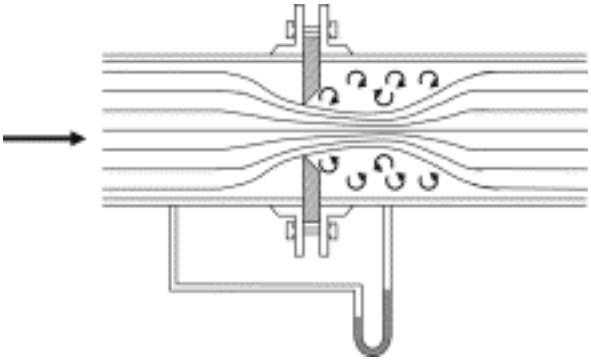
a) Recognize the type of pressure sensor in the image
b) Is it measuring the of a **gas or a liquid**?
c) Based on the image, is the absolute pressure larger at the right-side or the left-side port ?
d) Is this sensor a **transducer**?



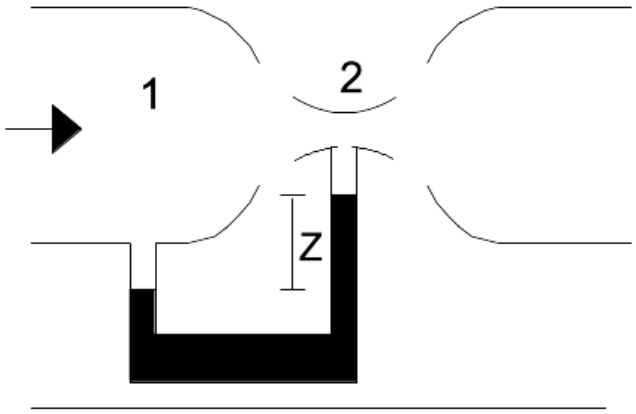
3.3. Other sensors

With ref. to the figures,

a. Recognize the type of sensor in the first image



b. Recognize the type of sensor in the second image



c. Which process variable do they measure?

d. Is the special tubing positioned at the bottom of the schemes the same device described in the previous section 3.2?

e. Obtain and provide here the working equation

3.4. The "sonar" level meter

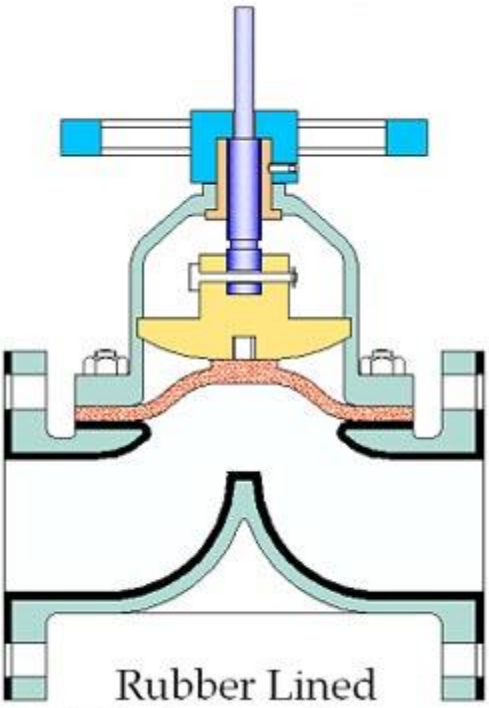
a. Provide a schematic drawing of how it works

Section 4: Valves

4.1 Valve technology

With ref. to the figure,

a. Recognize the **type of valve** in the figure

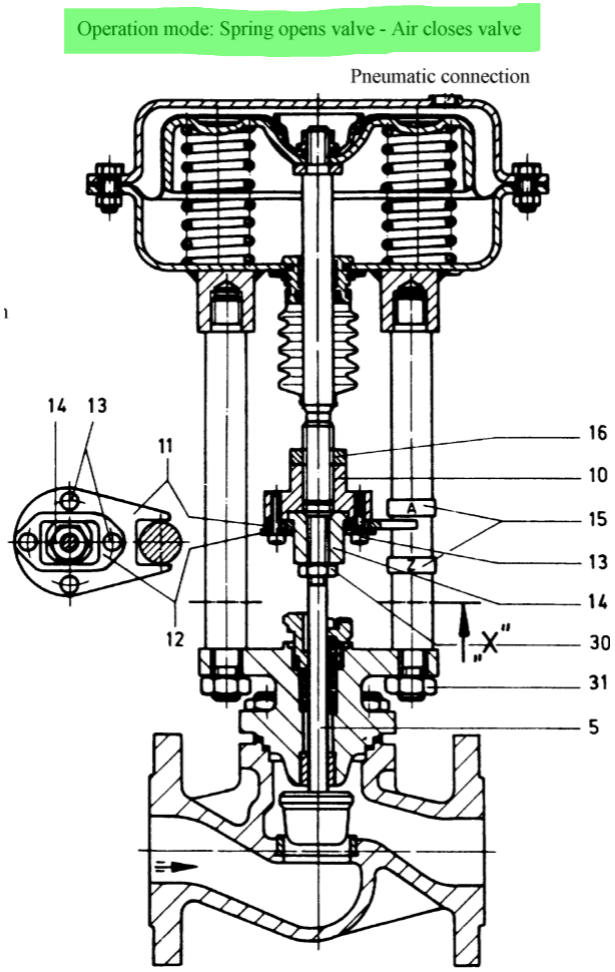


b. Is it a **linear** or **rotary** valve?
c. What is its **application purpose**?
d. Recognize the main **component parts** of valve in the figure and list them
e. Is this type of valve subject to possible **cavitation**?

4.2 Valve actuator

With ref. to the figure and its title on top,

a. briefly discuss its operation



4.3. Sizing problem

A Valve from the manufacturer Assured Automation is to be selected for flow control of the following fluid:

liquid: maple juice
density $\rho = 1370$ kg/m^3;

under the following additional conditions:

nominal diameter of the line:	DN = 4 in
pressure upstream of the valve:	P_1= 25 psi
pressure downstream of the valve:	P_2= 21 psi
nominal flow rate:	$\dot{m}$ = 11.6 kg/s
vapor pressure:	P_v = 1.2 psi

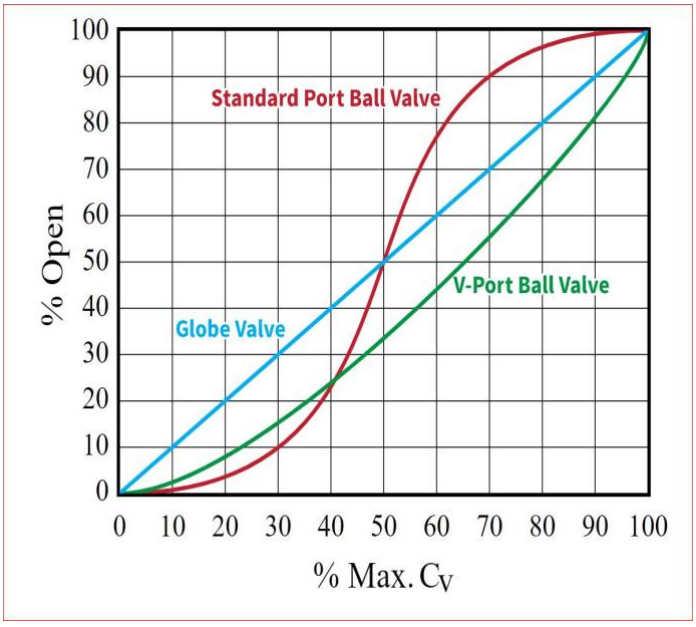
ratio coefficient of the critical pressure for liquids: $F_F = 0.956$

1. Calculate **the flow coefficient C_v**

The **ASSURED AUTOMATION** valve is available with the following manufacturer's table and 3 different intrinsic characteristics (see image):

I. **Modulating Ball valve with standard port**
II. **Modulating Ball valve with special V-port**
III. **GVI Globe valve**

Valve Size in	**C_{vn}** gpm psi$^{-1/2}$
1”	12
2”	43
3”	100
4”	170



2. Choose the valve with the most suitable DN and intrinsic characteristics
3. Calculate the relevant points characterizing the **flow characteristic**, put them in a graph and determine if the valve operates under **normal flow** conditions
4. Calculation of the “vapor pressure” which would determine cavitation in the chosen valve

Next, you are prompted to enter the sized valve in a circuit, taking ΔP_n equal to the original value ($P_1 - P_2$) and the **authority V=0.25.**

5. How much is the ΔP_u pressure drop across the user equipment?
6. How much is the ΔP_0 pressure drop across the entire circuit?

7. Calculate the value of the nominal flow $\dot{V}_n$ that passes through the valve in the circuit

8. How much is the flow rate $\dot{V}_1(h)$ which passes the valve for $h_1 = 0.15$?
9. How much is the actual pressure drop across the valve ΔP_{v1} for $h_1 = 0.15$?

10. How much will the relative stroke h_2 be for which a flow rate $\dot{V}_2(h) = 147.5$ gpm will transit into the valve inserted in the circuit?