



**Mechatronics Engineering Program / Mechanical  
Power Engineering Department**



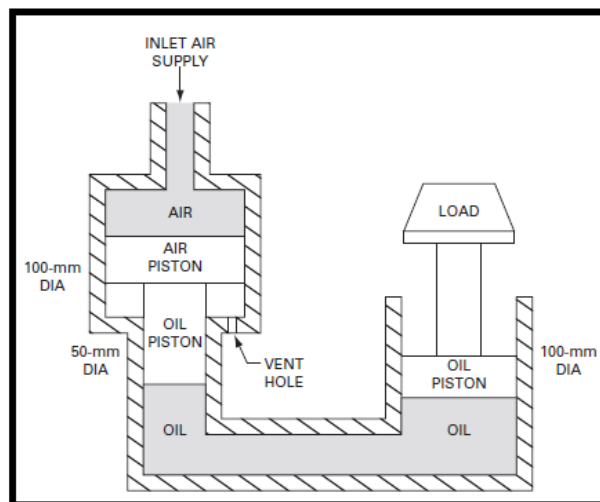
Tanta University

Faculty of Engineering

Course Title	Hydraulic/Pneumatic Systems Design	Academic Year 2022/2023 <u>Second</u> Semester Exam	Course Code	MEP331
Year/ Level	4 <sup>th</sup> Level		Allowed time	3 hrs
Date	<u>17-June- 2023</u>	No. of Pages (3)	Total Assessment Marks: 40	
Remarks: NO REMARKS				

**Question One, (12 Marks):**

- a) Sketch the engineering symbol for each of the following hydraulic circuits components and mention one function of its use in practical circuits: i- (pilot-operated check valve) ii- (bidirectional hydraulic rotary motor) iii- (pressure reducing valve) iv- (floating centre, manually-actuated by hand, spring-centered, 3-position, 4-way valve) v- (non-pressure compensated flow valve), vi- (sequence valve), vii- (counterbalance valve).
- b) Classify the types of hydraulic actuators. Mention examples of the types that cause limited-rotation or continuous rotary motion.
- c) Determine the maximum load that can be lifted in the following pneumatic/hydraulic system used to lift a load. If the inlet air pressure is 500 kPa.



**Question Two, (8 Marks):**

- a) Sketch a complete hydraulic circuit shows the function of the meter-in speed control of a hydraulic cylinder. Please, write the names of each component in the sketch.
- b) For the hydraulic system in the Figure (a), the following data are given:
1. The pump is adding 3.73 kW to the fluid.
  2. Pump flow is 0.0019 m<sup>3</sup>/s.
  3. All pipes has 1 inch (0.0254 m) inside diameter.
  4. The specific gravity of the oil is 0.9.
  5. The oil tank is vented to the atmosphere.
  6. The elevation difference between stations 1 and 2 is 6.1 m.
  7. The pressure at station 1 in the hydraulic tank is atmospheric
  8. The head loss  $H_L$  between stations 1 and 2 is 9.144 m of oil.



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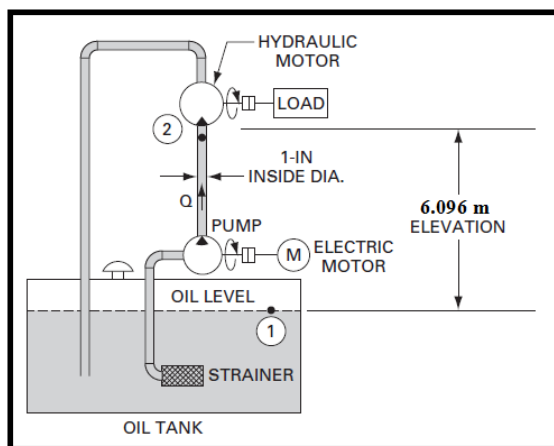
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Find the pressure available at the inlet to the hydraulic motor (station 2).

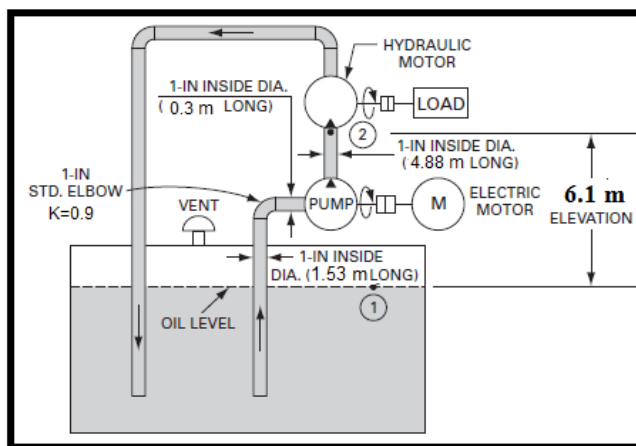
c) For the given hydraulic system in (a) with the same given data from point 1-7, the following data are also provided as shown in Figure (b):

1. The kinematic viscosity of oil is 100 cS. ( $\text{cS} = 10^{-6} \text{ m}^2/\text{s}$ ).
2. Pipe lengths are as follows: pump inlet pipe length = 1.53 m and pump outlet pipe length up to hydraulic motor = 4.88 m.

Find the pressure available at the inlet to the hydraulic motor (station 2).



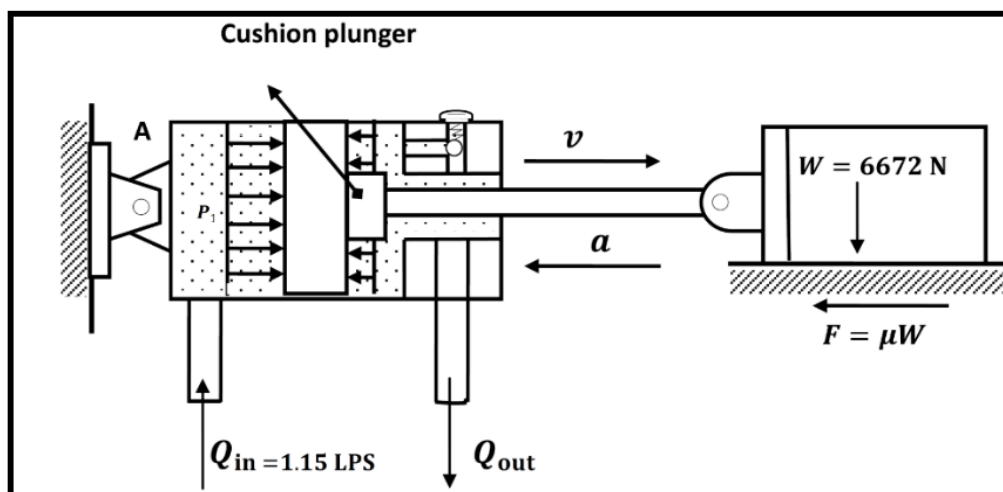
Problem 2 (a)



Problem 2 (b)

**Question Three, (8 Marks):**

- a) What is the purpose of cushion devices in hydraulic cylinders? Discuss using a neat sketch of the operation principle.
- b) A pump delivers oil at a rate of 1.15 L/s into the blank end of the 76.2 mm diameter hydraulic cylinder. The piston contains a 25.4 mm diameter cushion plunger that is 19.05 mm long. The cylinder drives a 6672 N weight which slides on a flat horizontal surface having a coefficient of friction ( $\mu$ ) equal to 0.12, see the Figure. The pressure relief valve setting equals 51.7 bar. Find the maximum pressure developed by the cushion.



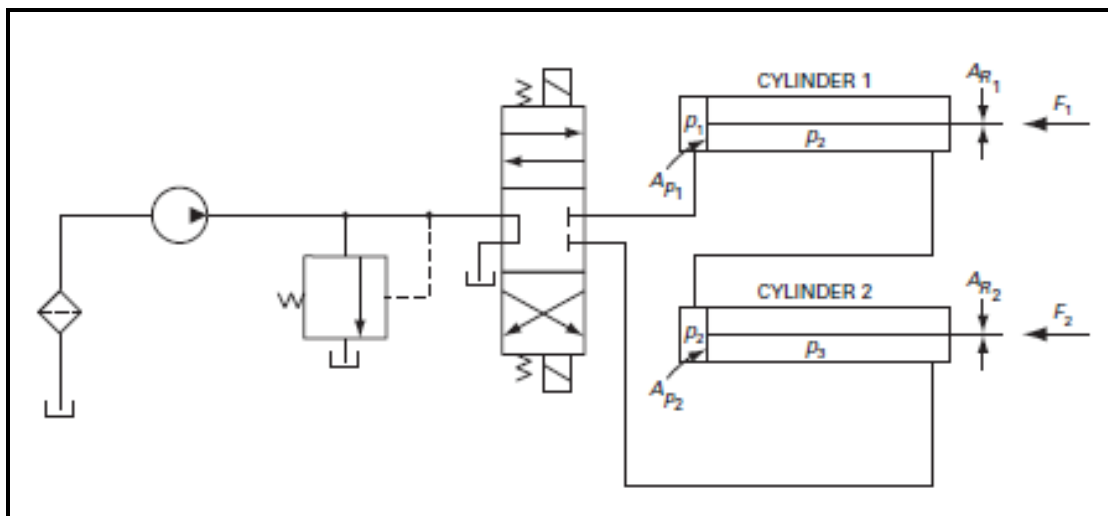


**Question Four, (12 Marks):**

- Sketch a complete hydraulic circuit used for the automatic continuous reciprocation of a hydraulic cylinder. Please, write the names of each component in the sketch.
- Discuss using neat sketch the operation principle of compound pressure relief valves.
- Sketch a complete hydraulic circuit used for locking a hydraulic cylinder using pilot check valves. Please, write the names of each component in the sketch.
- For the system in the Figure (for the extension strokes of the cylinders), what pump pressure is required if the cylinder loads are 22,000 N each and cylinder 1 has a piston area of 65 cm<sup>2</sup>?

Repeat the above system for the retraction strokes of the cylinders (loads pull to right). The piston and rod areas of cylinder 2 equal 50 cm<sup>2</sup> and 15 cm<sup>2</sup>, respectively.

Solve the above system using a back pressure  $p_3$  of 300 kPa instead of zero. The piston area and rod area of cylinder 2 equal 50 cm<sup>2</sup> and 15 cm<sup>2</sup>, respectively.



*End of questions*

*Good Luck*

EXAMINERS	Prof. Dr. Ayman Bakry	