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Assignment-1 Questions-(2 of 2)

Sl.no.	ROLL NO	THEORY QUESTIONS IN ANNEXURE-I					PROBLEMS IN ANNEXURE-II				
1.	114122001	24	47	58	95	133	8	49	56	79	102
2.	114122002	3	46	66	80	124	24	45	67	78	101
3.	114122003	14	33	74	99	142	1	30	71	82	104
4.	114122004	24	32	69	78	124	11	45	54	93	97
5.	114122005	11	45	61	77	136	2	45	74	85	99
6.	114122006	21	30	74	93	114	3	33	75	92	108
7.	114122007	13	48	73	88	132	8	41	65	89	104
8.	114122008	1	39	59	96	114	6	26	58	82	100
9.	114122009	18	32	75	99	133	2	45	62	85	107
10.	114122011	19	29	53	85	113	8	35	74	84	98
11.	114122012	4	39	64	88	134	19	47	74	87	99
12.	114122014	16	37	67	76	127	2	38	55	84	100
13.	114122015	3	26	55	79	144	23	38	54	94	109
14.	114122016	11	28	70	89	120	3	32	52	88	97
15.	114122017	3	42	66	96	123	8	49	61	92	109
16.	114122019	4	37	74	76	121	4	36	65	86	108
17.	114122020	20	42	65	82	114	17	28	69	83	108
18.	114122021	3	35	64	100	113	3	41	64	83	98
19.	114122022	4	36		90	111	20	32	74	81	100
20.	114122023	18	30	58	90	115	22	38	71	77	101
21.	114122025	14	46	74	78	141	17	50	72	85	98
22.	114122026	18	44	59	78	134	24	31	54	79	102
23.	114122027	21	44	74	92	112	2	38	67	77	107
24.	114122028	4	50	62	82	102	3	49	60	92	107
25.	114122029	6	41	67	94	139	16	29	67	89	104
26.	114122030	5	45	64	90	132	4	33	64	92	105
27.	114122031	13	35	61	94	111	19	37	72	79	108
28.	114122032	21	36	59	88	110	6	42	75	82	98

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Sl.no.	ROLL NO	THEORY QUESTIONS IN ANNEXURE-I					PROBLEMS IN ANNEXURE-II				
29.	114122033	13	29	69	100	118	5	35	58	84	107
30.	114122034	22	46	57	79	130	11	36	66	93	106
31.	114122035	4	35	65	82	128	11	33	65	82	108
32.	114122036	10	36	63	98	122	19	36	52	84	107
33.	114122037	24	32	59	89	139	23	35	74	80	102
34.	114122038	1	42	73	89	143	15	36	51	90	107
35.	114122039	10	39	75	96	121	16	26	75	84	103
36.	114122040	15	37	52	96	130	16	26	52	79	107
37.	114122041	5	32	67	98	134	8	46	61	76	110
38.	114122042	6	27	75	76	128	23	30	59	80	102
39.	114122043	14	28	59	97	112	21	27	69	92	110
40.	114122044	11	28	66	78	144	2	43	60	96	99
41.	114122045	17	50	55	89	125	19	28	51	82	109
42.	114122045	16	36	56	86	120	15	25	55	85	105
43.	114122047	20	28	60	84	107	4	40	73	85	104
44.	114122048	24	30	75	77	106	20	45	70	90	107
45.	114122049	6	45	66	90	122	13	41	70	90	104
46.	114122050	10	32	59	83	132	11	49	60	87	102
47.	114122051	13	43	53	93	120	25	47	58	93	98
48.	114122052	14	28	69	83	134	15	32	69	80	110
49.	114122053	17	48	61	92	139	8	48	66	81	109
50.	114122055	5	35	72	91	127	2	30	58	83	101
51.	114122057	22	36	65	87	131	22	45	72	86	100
52.	114122056	1	34	64	84	130	21	31	71	81	101
53.	114122058	17	50	58	92	107	5	40	73	85	98
54.	114122059	12	32	66	97	140	15	29	55	94	100
55.	114122060	5	36	51	98	136	2	47	65	82	106
56.	114122061	15	42	71	85	115	22	37	71	76	97

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Sl.no.	ROLL NO	THEORY QUESTIONS IN ANNEXURE-I					PROBLEMS IN ANNEXURE-II				
57.	114122062	14	49	53	94	103	19	35	57	78	99
58.	114122063	21	30	75	100	108	1	31	70	80	102
59.	114122064	2	41	73	77	115	21	36	62	80	106
60.	114122065	21	49	52	79	118	7	33	69	91	101
61.	114122066	23	31	54	86	115	11	42	71	86	97
62.	114122067	12	34	64	90	107	10	40	65	80	107
63.	114122068	12	26	52	92	111	14	47	67	88	101
64.	114122069	13	39	54	97	138	11	35	62	95	109
65.	114122070	4	44	75	95	107	2	36	65	96	104
66.	114122072	22	37	51	76	111	23	48	53	96	98
67.	114122073	12	27	61	98	118	10	34	60	79	97
68.	114122074	18	27	66	85	122	6	45	55	85	99
69.	114122075	6	35	63	92	101	2	28	56	93	98
70.	114122076	24	39	72	91	132	4	44	55	96	104
71.	114122077	24	31	64	83	112	7	34	53	95	107
72.	114122078	6	28	69	87	138	25	30	65	81	110
73.	114122079	24	50	55	84	125	4	27	72	95	106
74.	114122080	18	27	59	85	125	8	39	58	92	106
75.	114122081	7	46	75	94	122	8	37	66	84	103
76.	114122082	18	29	74	85	102	4	31	56	95	101
77.	114122083	22	42	54	84	133	16	49	75	80	106
78.	114122084	21	36	51	100	107	15	49	55	85	104
79.	114122085	15	40	67	82	145	23	29	66	91	98
80.	114122086	16	45	61	82	126	25	26	63	96	100
81.	114122087	1	44	70	96	105	10	29	62	78	108
82.	114122088	22	36	56	96	137	14	36	58	84	106
83.	114122089	2	33	53	90	113	6	34	70	95	109
84.	114122091	15	27	64	85	143	25	31	60	78	100

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Sl.no.	ROLL NO	THEORY QUESTIONS IN ANNEXURE-I					PROBLEMS IN ANNEXURE-II				
85.	114122092	23	30	63	92	133	4	30	74	77	102
86.	114122093	15	48	62	94	102	15	46	59	90	100
87.	114122094	14	36	56	76	116	4	38	54	80	100
88.	114122095	16	40	59	86	121	22	37	70	89	110
89.	114122096	18	42	57	80	104	1	44	51	90	107
90.	114122097	24	44	75	78	111	6	50	52	94	102
91.	114122098	12	47	71	83	126	6	39	73	96	107
92.	114122099	10	30	65	79	134	2	47	54	91	105
93.	114122100	1	29	59	87	114	22	40	72	94	104
94.	114122101	25	45	57	90	110	23	28	58	78	106
95.	114122102	17	30	53	94	111	2	40	72	82	110
96.	114122103	12	34	65	77	144	5	28	66	85	106
97.	114122104	1	39	64	92	139	4	32	73	78	104
98.	114122106	6	42	60	76	141	3	45	73	93	99
99.	114122107	13	35	71	86	117	10	48	66	77	101
100.	114122108	21	27	52	77	101	6	32	65	85	107
101.	114122109	8	41	55	79	138	3	49	67	92	100
102.	114122110	6	46	70	92	136	21	50	52	89	107
103.	114122111	18	28	64	100	134	10	32	57	79	98
104.	114122112	11	27	64	83	104	4	47	69	78	107
105.	114122113	9	33	60	93	105	6	49	75	79	102
106.	114122114	12	40	59	96	118	8	35	63	91	102
107.	114122115	7	37	73	90	130	5	28	74	94	98

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THEORY QUESTIONS IN ANNEXURE-I

1. Define fluid power.
2. Differentiate between oil hydraulics and pneumatics.
3. What is the basic law that is important in applying fluid power and what is its significance?
4. List five fields of application of fluid power.
5. Why is hydraulic power especially useful with heavy work?
6. Where are pneumatic systems preferred?
7. Compare the use of fluid power to a mechanical system listing the advantages and disadvantages of each.
8. What is the main difference between an open-loop and closed-loop fluid power system?
9. List the three basic types of fluid power control systems.
10. What are the four primary functions of hydraulic fluid?
11. Name few properties which a hydraulic fluid should posses?
12. What are the differences between liquid and gas?
13. What is meant by the term bulk modulus?
14. Differentiate between the terms viscosity and viscosity index.
15. Name two undesirable results when an oil with a viscosity that is too high.
16. Name two undesirable results when an oil with a viscosity that is too low.
17. Relative to viscosity measurement, what is Saybolt Universal Second (SSU)?
18. Define the term pour point.
19. Name three different types of fire resistant fluids.
20. Why must a hydraulic fluid have good lubricating ability?
21. What is the significance of the neutralisation number?
22. What type of fluid is more generally used to transmit power in a hydraulic system?
23. Explain what is meant by Reynolds number.
24. What is the purpose of Darcy-Weisbach equation?
25. State the use of Moody diagram.
26. What is equivalent length?
27. Differentiate Laminar and turbulent flow.
28. Name the basic components required in hydraulic system.
29. What is a positive displacement pump, and in what ways does it differ from a centrifugal pump?
30. How is pumping action in the positive pumps accomplished.
31. Name the three popular construction types of positive displacement pumps.
32. Name different designs of gear pump.
33. Why is the operation of a screw pump quiet?
34. Name different designs of vane pump.
35. What is the difference between fixed displacement and variable displacement pumps?
36. Why gear pump cannot be used as variable displacement pump?
37. How the unbalanced pump can be used as a variable displacement pump?
38. What is the pressure compensated vane pump and how does it work?
39. What is meant by a balanced design vane pump?
40. Name the two basic types of piston pumps.
41. How the displacement of an axial piston pump can be varied?
42. Why positive displacement pumps must be protected by relief valves?

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43. How is volumetric efficiency, mechanical efficiency and overall efficiency of a positive displacement determined.
44. Draw the graphical symbols for the following pump types
    a. Fixed displacement
    b. Variable displacement
    c. Bidirectional
    d. Pressure compensated
45. What is a hydraulic actuator?
46. What are the types of hydraulic actuator?
47. What is the purpose of hydraulic motor and how does it differ from the hydraulic pump?
48. Name the construction types of hydraulic motor available.
49. Where are external gear motors used?
50. Can a vane motor be used as a variable displacement motor?
51. For a hydraulic motor, define volumetric efficiency, mechanical efficiency and overall efficiency?
52. Why is the actual flow rate required for a hydraulic motor is higher than the theoretical flow rate?
53. Why is the actual torque output given by a hydraulic motor is less than the theoretical flow rate?
54. What is a semi-rotary actuator?
55. Name common types of semi-rotary actuators.
56. List few applications of semi-rotary actuator.
57. What is the difference between semi-rotary actuator and a fluid motor?
58. What is a semi-rotary actuator?
59. Name common types of semi-rotary actuators.
60. List few applications of semi-rotary actuator.
61. What is the difference between semi-rotary actuator and a fluid motor?
62. What is the difference between the single acting cylinder and double acting cylinder?
63. How is single acting cylinder retracted?
64. What is cylinder cushion? What is its purpose?
65. What is the advantage and disadvantage of tandem cylinder?
66. For what application, double rod cylinder is best suited?
67. What is a telescoping cylinder? When is it normally used?
68. Name four types of cylinder mountings.
69. What are the three important things that are controlled in a hydraulic system?
70. What is the function of relief valve in a hydraulic system?
71. How do a simple pressure relief valve and compound relief valve differ in operation?
72. What is the function of an unloading valve?
73. How is an unloading valve different from a pressure relief valve?
74. What is the advantage of using an unloading circuit, when feed and speed of a machine need to be varied?
75. What is the function of a sequence valve?
76. What is the purpose of the check valve in sequence circuit?
77. Name one application of counterbalance valve?
78. When is a pressure reducing valve used in a hydraulic system?
79. What is the purpose of a direction control valve?
80. What is a check valve?
81. How does a pilot operated check valve differ from a simple check valve?

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82. When are three-way valves used in a hydraulic system?
83. What is a four-way direction control valve?
84. How are direction control valve actuated?
85. What is a solenoid and how does it work?
86. Explain the difference between open center system and closed center system?
87. Give the hydraulic symbol for 3 position-4-way closed center solenoid operated direction control valve?
88. What is the purpose of a flow control valve?
89. What is meant when a flow control valve is said to be pressure compensated?
90. What is the need for temperature compensation in flow control valves?
91. Name the three ways of applying flow control valves?
92. What is meter-in circuit and where is it used?
93. What is meter-out circuit and where is it used?
94. Differentiate meter-in and meter-out controls?
95. What is a flow divider and name the different types?
96. What is the purpose of deceleration valve?
97. What is a modular valve and what is its benefit?
98. What is a catridge valve?
99. What results when a hydraulic system has internal leaks?
100. Explain the difference between internal and external leaks?
101. What is the difference between
    a. Positive and non-positive seal
    b. Static and dynamic seal.
102. Why are backup rings sometimes used with O-rings?
103. What effect does the speed of an actuating cylinder or hydraulic motor have on the selection of sealing devices?
104. Name four types of materials used for seals.
105. What is the purpose of wiper seal?
106. Which type of sealing materials used for high temperature operations?
107. Name various shapes of sealing devices which are normally used with hydraulic systems.
108. What are the ways in which the hydraulic fluid becomes contaminated?
109. What is the difference between a strainer and filter?
110. How are the filters rated?
111. Name some of the basic types of filter media.
112. Name the three basic types of filtering methods.
113. What is Beta ratio of a filter?
114. What is meant by Beta ratio $\beta_{20} = 80$?
115. How is Beta ratio related to removal efficiency?
116. List the various locations where filters are installed in hydraulic systems?
117. What is a hydraulic accumulator?
118. Name the basic types of accumulator.
119. Why weight loaded type accumulator is undesirable for mobile equipment?
120. Name the major classifications of separator accumulator.
121. What are the advantages and disadvantages of piston type accumulator?
122. What is the advantage of diaphragm type accumulator?
123. Bladder type accumulators provide quick pressure response than piston type accumulators. Reason out.

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124. What is the main advantage of bellows type accumulator over piston and diaphragm type accumulators?
125. List the applications of accumulator.
126. What is servo valve, and what is its function in a hydraulic system?
127. What is the purpose of feedback in a servo system?
128. Name one application of mechanical-hydraulic servo system.
129. What is the difference between single stage and a two-stage servo valve?
130. What are some common applications of servo valves?
131. Compare electro-hydraulic servo valve and proportional hydraulic valves.
132. What is the function of intensifier in hydraulic circuits?
133. What is meant by synchronisation of cylinder motion? Name the various methods to obtain it.
134. What is the purpose of a regenerative circuit?
135. Why is the load carrying capacity of a regenerative cylinder small if its piston rod area is small?
136. What is banked unit? Mention one of its application.
137. What is a fail-safe circuit?
138. What is hydrostatic transmission?
139. Differentiate open circuit and closed-circuit hydrostatic transmission.
140. List the applications of hydrostatic transmission.
141. What do you understand by the term power pack?
142. Draw a hydraulic circuit for a drilling machine incorporating the following features.
    a. Slow drill feed
    b. Rapid drill release
143. With a circuit, explain how an intensifier is used in a press.
144. Design a hydraulic sequence circuit for a drilling machine consisting of two cylinders one for operating the power vice jaw and the other for controlling the drill spindle travel.
145. Draw a hydraulic circuit for a hydraulic planner.

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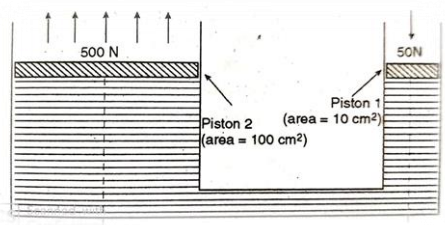
PROBLEMS IN ANNEXURE-II

Problems

1. Consider the arrangement similar to that shown in figure below. The piston diameter of the small cylinder is 25mm and the large cylinder is 100mm. The force needed at the large cylinder piston is 2000N.
    a. Calculate the amount of force applied at the small cylinder piston.
    b. How far the large piston will move if the small piston moves 100mm.



2. A hand operated hydraulic jack as shown in figure below has a piston pump with a cylinder diameter of 30mm and a stroke of 50mm. The operator makes one cycle (one suction stroke and one delivery stroke) per second in the pump. The ram cylinder of 60mm diameter raises a load of 8000N. Calculate the following
    a. Pressure in the system
    b. Force exerted on the rod of pump
    c. Force on the handle given by the operator
    d. The number of cycles of hand pump to lift the load by 500mm.
    e. What is the output power assuming 90% efficiency.

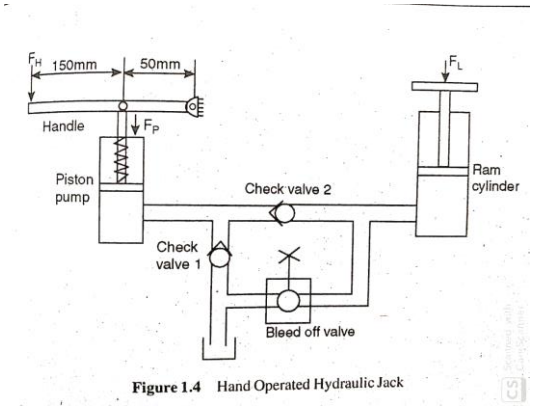


Figure 1.4 Hand Operated Hydraulic Jack

3. A 8 liter sample of oil is compressed in a cylinder until its pressure increases from 0.7MPa to 2.7 MPa. If the bulk modulus equals 80MPa, find the change in the volume of oil.
4. An oil has a viscosity of 80 SSU at 38°C. Find the corresponding viscosity in Ns/m^2 units. The specific gravity of oil is 0.9.

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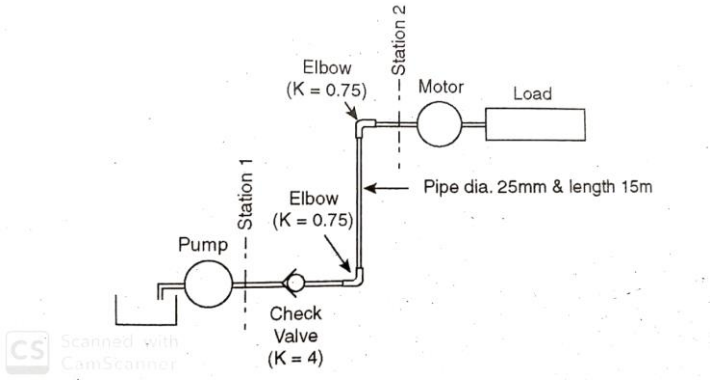
5. A Sample oil is tested with a 0 VI oil and a 100VI oil whose viscosity values at 38°C are 400 and 150 SSU, respectively. If the viscosity of the sample oil at 38°C is 200 SSU, what is the VI of sample oil.
6. Oil with a kinematic viscosity of 0.32×10^{-4} m^2/s is flowing through a 25 mm pipe at the rate of 375 ltr/min. Is the flow laminar or turbulent?
7. Oil with a specific gravity of 0.85 and an absolute viscosity of $0.044 Ns/m^2$ is flowing in a 25 mm diameter pipe 120m long at the rate of 55 ltr/min. Determine the type of flow and calculate the pressure drop.
8. Oil with a specific gravity of 0.85 and a kinematic viscosity of $1.932 \times 10^{-4} m^2/s$ is flowing through a 50 mm diameter commercial steel pipe at the rate of 3500 ltr/min. What is the pressure drop in 150m.
9. A hydraulic pump delivers oil at 60 bar, 120 ltr/min into a circuit laid on a horizontal plane. There are four elbows (K=0.75), one globe valve fully open (K=10) and a direction control valve (pressure drop = 3 bar) with the inside diameter of the pipe as 30 mm. The total length of the straight run pipe is 20m and the specific gravity of the oil is 0.9. The kinematic viscosity of the oil is $0.0001 m^2/s$. Determine the pressure at the exit point of the pipe.
10. The system as shown in figure below contains a pump delivering high pressure oil of specific gravity 0.9 and kinematic viscosity $1.25 \times 10^{-4} m^2/s$, to a hydraulic motor. A pipe connects the pump and motor has an inner diameter of 25mm and length 15m. The pipe has two elbow fittings (K=0.75) and one check valve (K= 4.0). The motor is placed 6 m above the pump. The inlet pressure to the motor is 34 bar. Determine the pump discharge pressure, if the discharge from the pump is 150 ltr/min.



11. A gear pump with the following specification runs at 1400 rpm.

    Module = 3mm/tooth

    Gear width= 15mm

Number of teeth= 12

Pressure angle= 20°

a. Calculate the theoretical discharge
b. Calculate the hydraulic power produced by the pump when working against a pressure of 100 bar

12. Find the actual delivery of the gear pump with following specification

    Outside diameter of the gear = 80mm

    Inside diameter of the gear= 60mm

    Gear width = 20mm

    Speed of the pump = 1600 rpm

    Volumetric efficiency 88%

13. A vane pump is to have a volumetric displacement of 121.8cm^3. It has a rotor diameter of 65mm, a camring diameter of 90mm and a vane width of 50mm. What must be the eccentricity?
14. What is the theoretical flow rate for a fixed displacement axial piston pump with a nine bore cylinder having 12mm bore and 20mm stroke operating at 3000 rpm.
15. The swash plate type axial piston pump delivers 2 ltr/s at 3000rpm. The pump has nine 16mm diameter pistons arranged on a 130 mm piston circle diameter. Find the offset angle. Assume the volumetric efficiency as 95%.
16. A pump has a displacement of 81.9cm^3. It delivers 75.8x 10^{-3} m^3/min at 1000 rpm at 67 bar. If the prime mover input torque is 100 Nm
    a. What is its overall efficiency and volumetric efficiency?
    b. What is the theoretical torque required to operate the pump?
17. A radial piston pump has the following specifications

    Maximum pressure = 30 bar

    Diameter of plunger = 50mm

    Number of plungers = 7

    Maximum eccentricity = 10mm

    Speed of rotation of shaft = 1500 rpm, Calculate,

    a. the theoretical and actual discharge
    b. the theoretical and actual power required to drive the pump, given that Mechanical efficiency is 80% and volumetric efficiency is 90%

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18. A hydraulic system requires 32 /min of fluid at a pressure of 260 bar. The pump to be used is a manually variable axial piston pump having a maximum displacement per revolution of 28 cm. The pump is driven at 1430 rpm and has an overall efficiency of 0.85 and a volumetric efficiency of 0.9. Calculate
    a. at what percentage of maximum displacement, the pump has to be set
    b. what power is needed to drive the pump.
19. A hydraulic motor has a volumetric displacement of 125cm^3 and a pressure rating of 150 bar. It receives a theoretical flow rate of oil 0.0015m^3/s from a pump. Find the motor
    a. speed
    b. theoretical torque
    c. theoretical power.
20. A hydraulic motor has a displacement of 150cm^3 and operates with a pressure of 120 bar and a speed of 2500rpm. The actual flow rate consumed by the motor is 0.00781 m^3/s and the actual torque delivered by the motor is 250Nm. Find
    a. Volumetric efficiency
    b. Mechanical efficiency
    c. Overall efficiency
    d. Power delivered by the motor
21. A motor has a displacement of 300cm^3 and a speed of 200 rpm with a pressure drop of 200 bar. The volumetric efficiency is 90% and the mechanical efficiency is 95%. Determine theoretical and actual
    a. Discharge
    b. Torque
    c. Power
22. A hydraulic motor with a displacement of 475cm^3/rev is used to directly drive a conveyor drum having a diameter of 0.7m. The pressure drop over the motor is 140 bar and the actual flow into the motor is 48 ltr/min. The overall and mechanical efficiency of the motor are 0.90 and 0.94 respectively. Determine
    a. the torque at the conveyor drum
    b. the power in kW supplied to the conveyor drum
    c. the linear speed of the conveyor belt

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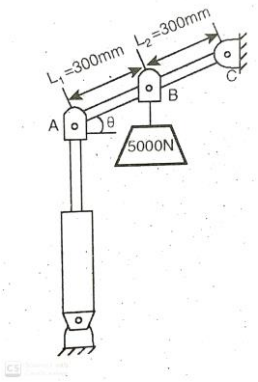
23. A pump supplies oil at 0.002 m^3/s to a 50mm diameter double acting cylinder and a rod diameter is 20 mm. If the load is 6000N both in extending and retracting, find
    a. Piston velocity during the extension stroke and retraction stroke
    b. Pressure during the extension stroke and retraction stroke
    c. Power during the extension stroke and retraction stroke
24. A hydraulic cylinder has to move a table of weight 13KN. Speed of the cylinder is to be accelerated upto a velocity of 0.13m/s in 0.5 seconds and brought to a stop within a distance of 0.02m. Assume coefficient of sliding friction as 0.15 and cylinder bore diameter as 50mm. Calculate the surge pressure.
25. A cylinder has a bore of 80mm diameter and a rod of 45mm diameter. It drives a load of 6700N, travelling at a velocity of 15m/min. The load slides on a flat horizontal surface having a coefficient of friction of 0.12. The load is to be decelerated to rest within a cushion length of 20mm. If the relief valve is set at 50 bar, compute the fluid pressure developed in the cushion.
26. A cylinder has a bore of 125mm diameter and a rod of 70mm diameter. It drives a load of 2000 kg vertically up and down at a maximum velocity of 3m/s. The load is slowed down to rest in the cushion length of 50mm. If the relief valve is set at 140 bar. Determine the average pressure in the cushions while extending and retracting.
27. For a second class lever system given in figure below determine the hydraulic cylinder force required to overcome the load.



28. For the crane system given in figure below, find the cylinder force required to lift a load of 9000 N.

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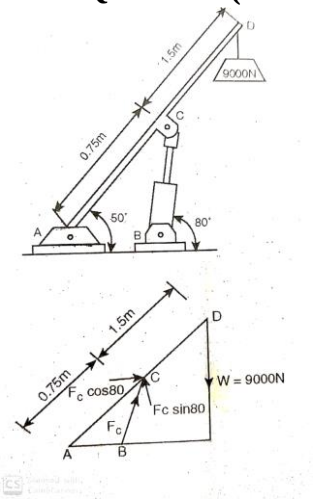
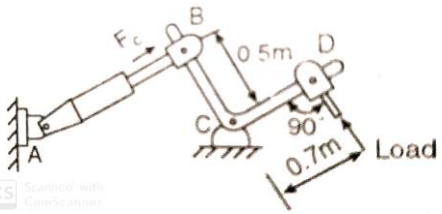


29. For a bent lever system shown in figure below, the cylinder force is 1400N. How much load the system can drive.



30. A two-stage telescopic cylinder is used to tilt the body of a lorry, When the lory is fully laden, the cylinder has to exert a force equivalent to 40KN at all points in its stroke. The outside diameter of the tubes forming two stages are 75mm and 100mm. If the pump powering the cylinder delivers 12 ltr/min, calculate the extend speed and pressure required for each stage of the cylinder when tilting fully laden lorry.

31. A pressure relief valve has a pressure setting of 200 bar. Determine the loss across the valve if all the pump flow of 120 ltr/min flows back to the reservoir through this valve.
32. A high-low circuit with an unloading valve is employed for press application. The press requires a flow rate of 200 ltr/min for high-speed opening and closing of the dies at maximum pressure of 30 bar. The work stroke needs a maximum pressure of 400 bar, but a flow rate between 12 and 20 ltr/min will be acceptable. Determine the suitable delivery for each pump.
33. A press with the tool weighing 5 kN is used for forming. The force required for pressing is 100 KN and a counterbalance valve is used to counteract the weight of the tools. The cylinder with piston diameter 80mm and rod diameter 60mm is used. Calculate the pressure to achieve 100kN pressing force.
34. A flow control valve with a flow coefficient of 2.5 lpm/ $(kPa)^{1/2}$ has a pressure drop of 690 kPa. The specific gravity of the hydraulic oil used is 0.9. Determine the flow rate

through the valve.

35. In a meter-in circuit, a cylinder with 100mm bore diameter and 70mm diameter is used to exert a forward thrust of 100N, with a velocity of 0.5m/min. Neglect the pressure drop through the piping and valves. If the pump flow is 20 lit/min, find
    a. Pressure required at pump on extend
    b. Flow through the flow control valve
    c. Relief valve setting
    d. Flow out of pressure relief valve
    e. System efficiency during extend
36. A fluid having 20000 particles of size 5µm or greater passing through a filter. In the downstream side, the fluid is found to have 1000 particles of 5µm or greater. Determine the Beta ratio and removal efficiency of the filter.
37. A weight loaded accumulator has a ram of 300mm diameter and stroke of 6m. It is loaded with 500KN weight. The packing friction accounts for 3% of the total force. If the ram falls steadily through its full range in 120 seconds and pump delivers 7.5 ltr/min at the same time. Determine the total discharge and power supplied at the mains.
38. What is the size of accumulator necessary to supply 4920 cm^3 of oil with an allowable pressure from 210 bar absolute to 105 bar absolute? The pre-charge pressure is 70 bar absolute. The charging and discharging processes are isothermal.
39. Determine the size of accumulator to reduce hydraulic line shock in a system handling gasoline with a specific gravity of 0.88 with a normal rate of flow 12.65 ltr/s. The inner diameter of the pipe is 150mm and the length is 1924m. The system pressure at normal rate of flow is 10 bar absolute. Maximum allowed shock pressure when shut-off valve is closed is 17 bar absolute. The accumulator is pre-charged with nitrogen.
40. Determine the size of accumulator required to limit the pressure increase from 1.7 bars absolute at 24°C to 5.3 bar absolute at 60°C in a closed system. The coefficient of linear expansion of pipe material is 8.7×10^{-6} per °C and coefficient of cubical expansion of fluid is 9.3×10^{-4} per °C. The pipe is of 130mm diameter and 12m long. A nitrogen gas pre-charge of 1.5 bar absolute is assumed for the accumulator.
41. A hydraulic intensifier is meant to enhance the fluid pressure from 50 bar to 20 bar. Its small cylinder capacity is 23 litres and has a stroke of 1.5m. Find diameter of the larger cylinder to be used for this intensifier.

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42. A punch press circuit with five stations operated by five parallel cylinders connected to an intensifier. The cylinders are single acting cylinders with spring return and piston diameter of the cylinder is 140mm. The cylinders are used for punching 10mm diameter holes on sheet metal 1.5mm thickness. The ultimate shear stress of sheet material is 300MN/m^2. The punching stroke requires 10mm travel. In the intensification ratio is 20 and the stroke of the intensifier is 1.3m. Determine the
    a. pressure of oil from the pump
    b. the diameter of small and large cylinder of intensifier
43. A double acting cylinder is hooked up in a regenerative circuit for drilling application. The relief valve is set at 75 bar. The piston diameter is 140mm and rod diameter is 100mm. If the pump flow is 80 ltr/min. Find the cylinder speed and load carrying capacity for various positions of direction control valve.
44. Two double acting cylinders are to be synchronized by connecting them in series. The load acting in each cylinder is 4000N, if one of the cylinders having the piston diameter 50mm and rod diameter 28mm, find
    a. the diameter of the second cylinder
    b. pressure requirement of pump
    c. Power of the pump in kW if cylinder velocity is 4m/s.
45. A pressure relief valve has a pressure setting of 69 bars. a) Compute the hydraulic power loss across this valve if it returns all the flow back to the tank from a 0.0013m^3/s discharge pump. b) If unloading valve is used to unload the pump and if the pump discharge pressure during unloading equals 1.72 bars, how much power is being wasted?
46. A double acting cylinder is hooked up to reciprocate. The relief valve setting is 70 bars. The piston area is 0.016 m^2 and the rod area is 0.0045 m^2. If the pump flow is 0.0013m^3 / s, find the cylinder speed and load- carrying capacity for the a. Extending stroke b. Retracting stroke.
47. A double acting cylinder is hooked up in the regenerative circuit. The relief valve setting is 100 bars and the pump flow is 0.0016m^3 / s. If the regenerative and retracting speed are equal to 0.25m/ s, find the piston and rod area and also load- carrying capacity for the a. Extending stroke, b. Retracting stroke.
48. An actuator forward speed is controlled by a meter-in circuit. The pressure setting of relief valve is 50 bar and the pump discharge = 30 litres /min. The cylinder has to carry

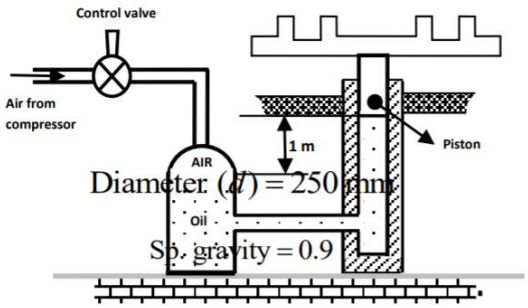
a load of 3600 N during the forward motion. The area of piston is 15 cm^2 and rod area = 8cm^2. The flow control valve is set to allow only 10 litres/ min. Calculate the power input to motor, forward speed and return speed and efficiency of the circuit.

49. A Hydrostatic transmission operating at 70 bar pressure has the following characteristic for the pump and the motor:

    Pump: Capacity of pump, CP = 82 cm^3/ rev (pump displacement), Volumetric efficiency of pump, η_{VP} = 82 %, Mechanical efficiency of pump, η_{MP} = 88 %, Speed of pump , N = 500 rev / min

    Motor: Capacity of motor, CM =? Volumetric efficiency of motor, η_{VM} = 92 % Mechanical efficiency of motor, η_{MM} = 90 % Desired speed of motor, N = 400 rev / min, Actual Torque, Ta = ?

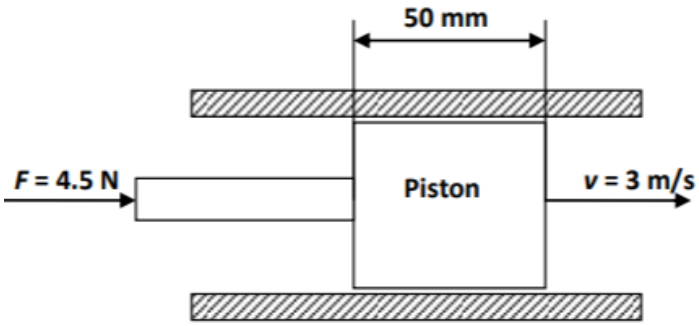
50. Air at 20°C and atmospheric pressure has a density of 1.23 kg/m3 . Find its specific gravity. What is the ratio of the specific gravity of water to the specific gravity of air at 20°C and atmospheric pressure? What is the significance of the ratio?
51. A cylinder container has a diameter of 0.5 m and a height of 1 m. If it is to be filled with a liquid having a specific weight of 2000 N/m3 , how many kg of this liquid must be added?
52. One liter of SAE30 oil weighs 8.70 N. Calculate its specific weight, density and specific gravity.
53. For the fluid power automobile lift system of Fig. 1.5, the air pressure equals 550 kPagauge. If the hydraulic piston has a diameter of 250 mm, what is the maximum weight of an automobile that can be lifted? The specific gravity of oil is 0.9. What percentage error in the answer to this problem occurs by ignoring the 1-m head of oil to between the air and interface surface and bottom surface of the piston? 3 Density (ρ) =900 kg / m^3.



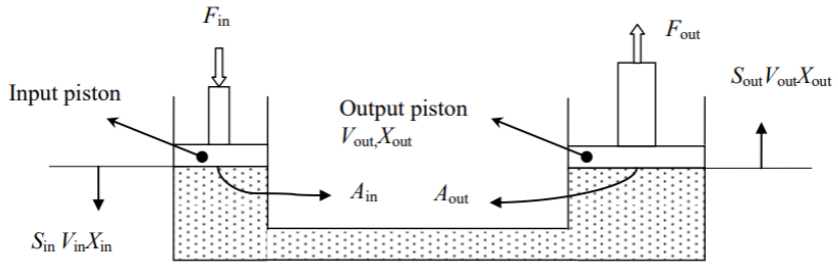
54. A 500 cm^3 sample of oil is to be compressed in a cylinder until its pressure is increased

from 1 to 50 atm. If the bulk modulus of oil equals 1750 MPa, find the percentage change in its volume.

55. An 8 L sample of oil is compressed in a cylinder until pressure increases from 0.7 to 2.7 MPa. If the bulk modulus equals 80 MPa, find the change in the volume of oil.
56. A 4.5 N force moves a piston inside a cylinder at a velocity of 3 m/s as shown in Fig. 1.11. The piston of 10.16 cm diameter is centrally located in the cylinder having an internal diameter of 10.17 cm. An oil film separates the piston from the cylinder. Find the absolute viscosity of the oil.

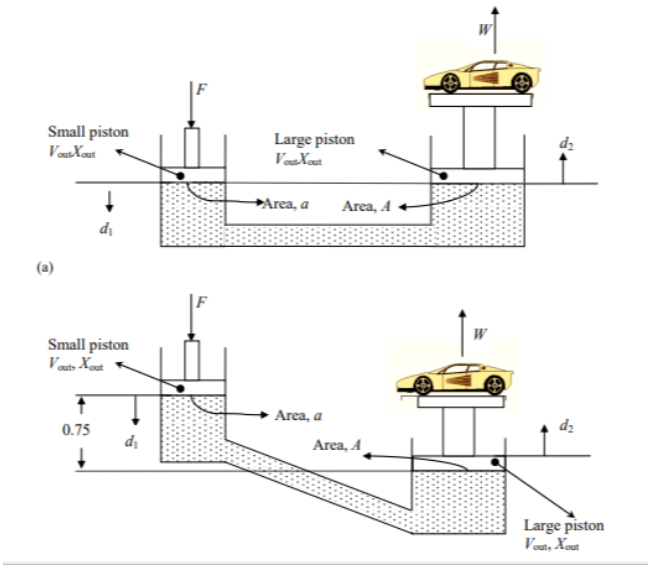


57. A sample of oil with viscosity index of 70 is tested with a 0 VI oil and a 100 VI oil whose viscosity values at 100°F are 375 and 125 SUS, respectively. What is the viscosity of the sample oil at 100°F in units of SUS?
58. A sample oil is tested with a 0 VI oil and a 100 VI oil whose viscosity values at 38°C are 400 and 150 SUS, respectively. If the viscosity of the sample oil at 38°C is 200 SSU, what is the viscosity index of the sample oil?
59. An input cylinder with a diameter of 30 mm is connected to an output cylinder with a diameter of 80 mm (Figure). A force of 1000 N is applied to the input cylinder. (a) What is the output force? (b) How far do we need to move the input cylinder to move the output cylinder 100 mm?

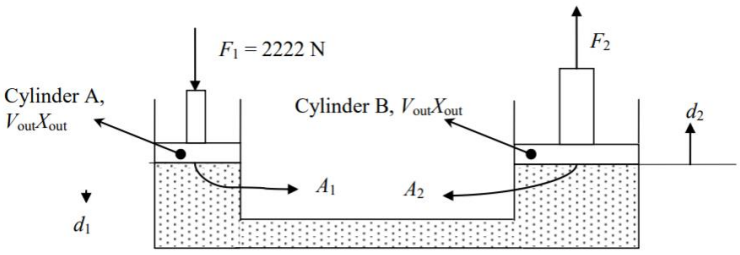


60. A force of P = 850 N is applied to the smaller cylinder of a hydraulic jack (Figure below). The area a of the small piston is 15 cm^2 and the area A of the larger piston is 150 cm^2 . What load W can be lifted on the larger piston (a) if the pistons are at the same level,

(b) if the large piston is 0.75 m below the smaller one? The mass density ρ of the liquid in the jack is 103 kg /m^3 .



61. Two hydraulic cylinders are connected at their piston ends (cap ends rather than rod ends) by a single pipe (Fig below). Cylinder A has a diameter of 50 mm and cylinder B has a diameter of 100 mm. A retraction force of 2222 N is applied to the piston rod of cylinder A. Determine the following: (a) Pressure at cylinder A. (b) Pressure at cylinder B. (c) Pressure in the connection pipe. (d) Output force of cylinder B.



62. A pump delivers oil to a cylindrical storage tank, as shown in Fig below. A faulty pressure switch, which controls the electric motor driving the pump, allows the pump to fill the tank completely. This causes the pressure p1 near the base of the tank to build to 103.4 kPa. (a) What force is exerted on the top of the tank? (b) What does the pressure difference between the tank top and point 1 say about Pascal's law? (c) What must be true about the magnitude of system pressure if the changes in pressure due to elevation changes can be ignored in a fluid power system (assume the specific gravity of oil to be 0.9).

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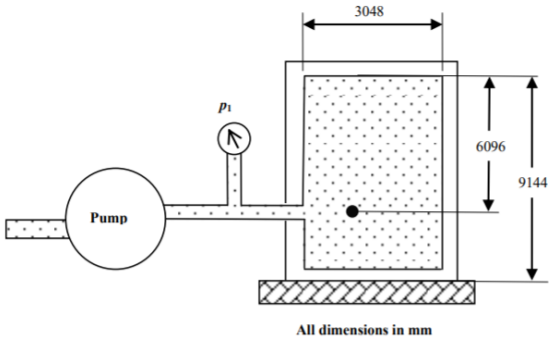
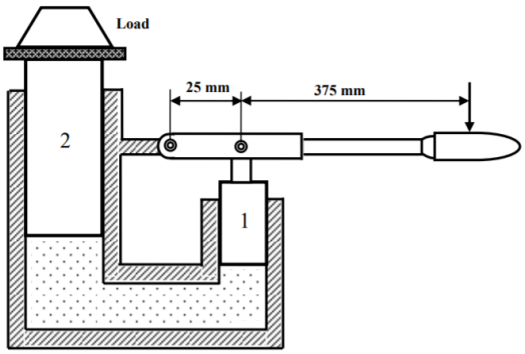
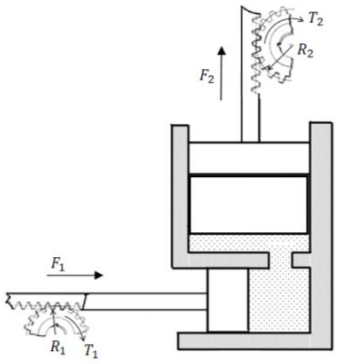


63. The hydraulic jack, shown in Fig below, is filled with oil. The large and small pistons have diameters of 75 and 25 mm, respectively. What force on the handle is required to support a load of 8896 N? If the force moves down by 125 mm, how far is the weight lifted?



64. In the hydraulic device shown in Fig below, calculate the output torque T2, if the input torque T1 =10 Ncm. Use the following data: radius R1 = 2 cm, diameter d1 = 8 cm, radius R2 = 4 cm, diameter d2 = 24 cm.



65. A hydraulic system has 380 L reservoir mounted above the pump to produce a positive pressure (above atmospheric) at the pump inlet, as shown in Fig below. The purpose of the positive pressure is to prevent the pump from cavitating, when operating, especially at start up. If the pressure at the pump inlet is to be 0.35 bar prior to turning the pump ON and the oil has a specific gravity of 0.9, what should the oil level be above the pump inlet?

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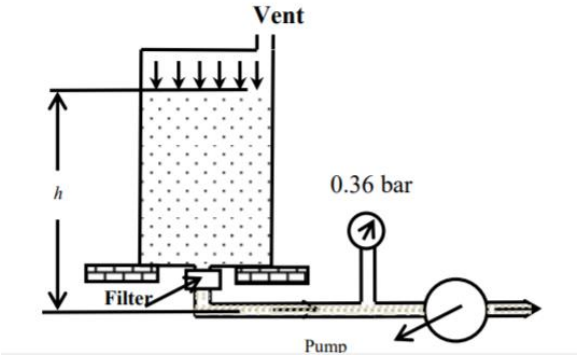
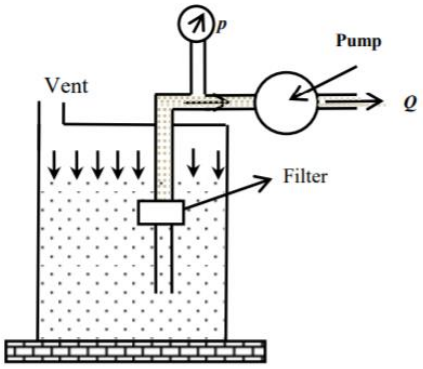
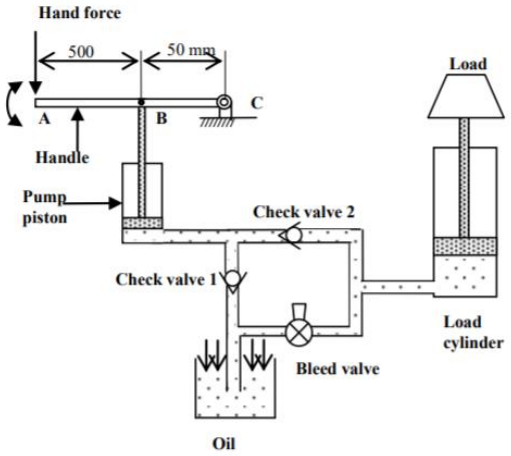


66. For the hydraulic pressure shown in Fig. below, what would be the pressure at the pump inlet if the reservoir were located below the pump so that the oil level would be 1.22 m below the pump inlet? The specific gravity of oil is 0.90. Ignore frictional losses and changes in kinetic energy on the pressure at the pump inlet. Would this increase or decrease the chances for having pump cavitation? If yes, why?

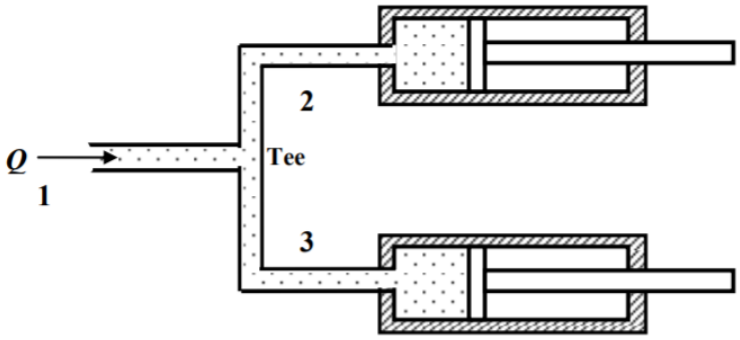


67. A hydraulic cylinder is to compress a body down to bale size in 10 s. The operation requires a 3 m stroke and a 40000 N force. If a 10 MPa pump has been selected, assuming the cylinder to be 100% efficient, find (a) The required piston area. (b) The necessary pump flow rate. (c) The hydraulic power delivered to the cylinder. (d) The output power delivered to the load. (e) Also solve parts (a)–(d) assuming a 400 N friction force and a leakage of 1 LPM. What is the efficiency of the cylinder with the given friction force and leakage?
68. An automobile lift raises a 15600 N car 2.13 m above the ground floor level. If the hydraulic cylinder contains a piston of diameter 20.32 cm and a rod of diameter 10.16 cm, determine the (a) Work necessary to lift the car. (b) Required pressure. (c) Power if the lift raises the car in 10 s. (d) Descending speed of the lift for 0.000629 m^3 /s flow rate. (f) Flow rate for the auto to descend in 10 s.
69. An operator makes 15 complete cycles in 15 s interval using the hand pump shown in Fig. below. Each complete cycle consists of two pump strokes (intake and power). The pump has a piston of diameter 30 mm and the load cylinder has a piston of diameter

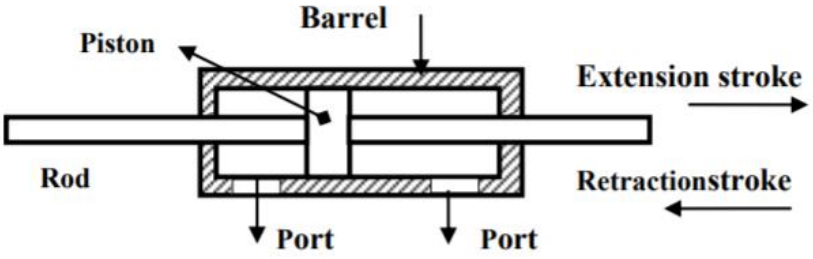
150 mm. The average hand force is 100 N during each power stroke. (a) How much load can be lifted? (b) How many cycles are required to lift the load by 500 mm, assuming no oil leakage? The pump piston has 20 mm stroke. (c) What is the output power assuming 80% efficiency?



70. Oil with specific gravity 0.9 enters a tee, as shown in Fig. below, with velocity v1 =5 m/s. The diameter at section 1 is 10 cm, the diameter at section 2 is 7 cm and the diameter at section 3 is 6 cm. If equal flow rates are to occur at sections 2 and 3, find the velocities v2 and v3.



71. A double-rod cylinder is one in which a rod extends out of the cylinder at both ends (Fig. below). Such a cylinder with a piston of diameter 75 mm and a rod of diameter 50 mm cycles through 254 mm stroke at 60 cycles/min. What LPM size pump is required?



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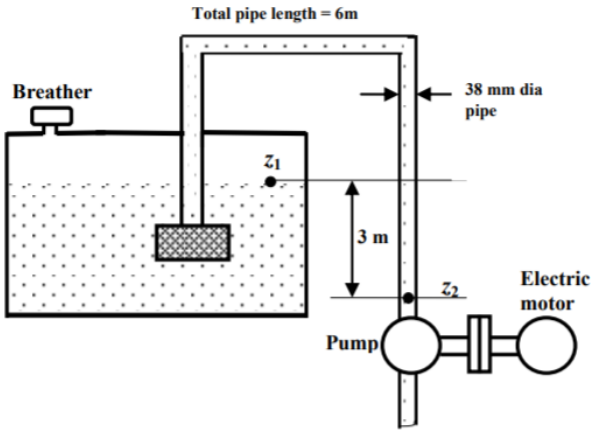
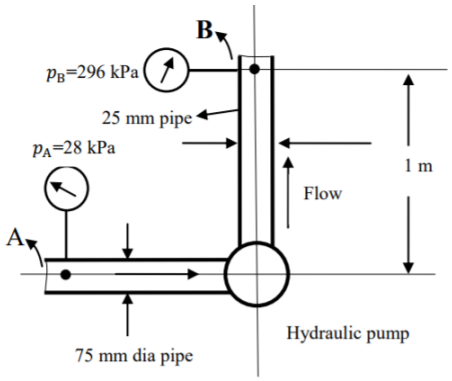
72. A cylinder with a piston of diameter 8 cm and a rod of diameter 3 cm receives fluid at 30 LPM. If the cylinder has a stroke of 35 cm, what is the maximum cycle rate that can be accomplished?
73. A hydraulic pump delivers a fluid at 50 LPM and 10000 kPa. How much hydraulic power does the pump produce?
74. The oil tank for the hydraulic system shown in Fig.1.26is pressurized at 68 kPa gauge pressure. The inlet to the pump is 3 m below the oil level. The pump flow rate is 0.001896 m^3 /s. Find the pressure at station 2. The specific gravity of oil is 0.9 and kinematic viscosity of oil is 100 cS. Assume the pressure drop across the strainer to be 6.9 kPa. Also given the pipe diameter is 38 mm and the total length of the pipe is 6 m.



75. The volume flow rate through the pump shown in Fig.1.27is 7.8 m^3 /s. The fluid being pumped is oil with specific gravity 0.86. Calculate the energy delivered by the pump to the oil per unit weight of oil flowing in the system. Energy losses in the system are caused by the check valve and friction losses as the fluid flows through the piping. The magnitude of such losses has been determined to be 1.86 N m/N.



76. A pump produces a flow rate of 75 LPM. It has been established that the fluid velocity in a discharge line should be between 6 and 7.5 m/s. Determine the minimum and maximum pipe inside diameter that should be used.

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77. A steel tubing has an outside diameter of 30 mm and an inside diameter of 24 mm. It is made up of commercial steel of the tensile strength of 520 MPa. What is the safe working pressure? Assuming that tubing is subjected to a high-pressure shock, determine the tensile stress for an operating pressure of 10 MPa
78. What is the minimum size of commercial pipe tubing with a wall thickness of 2 mm required at the inlet and outlet of a 75 LPM pump? The inlet and outlet velocities are limited to 1.2 and 6.1 m/s, respectively.
79. A steel tube of inner diameter 25 mm has a burst pressure of 50 MPa. If the tensile strength is 380 MPa, find the minimum acceptable OD.
80. What is the minimum size of commercial pipe tubing with a wall thickness of 2.4 mm required at the inlet and outlet of a 0.00189 m^3/s pump? The inlet and outlet velocities are limited to 1.92 m/s and 6.08 m/s, respectively.
81. The flow rate of certain fluid in a pipe is 0.001 m3 /s and an operating pressure is 70 bar. The maximum recommended velocity is 6.1 m/s and the factor of safety of 8 is allowed. Select a metric steel tube when (a) Material is SAE 1010 with a tensile strength of 380 MPa. (b)Material is AISI 4130 with a tensile strength of 570 MPa.
82. The inlet to a hydraulic pump is 0.6 m below the top surface of an oil reservoir. If the specific gravity of the oil used is 0.86, determine the static pressure at the pump inlet.
83. A hydraulic pump delivers 12 L of fluid per minute against a pressure of 200 bar. (a) Calculate the hydraulic power. (b) If the overall pump efficiency is 60%, what size of electric motor would be needed to drive the pump?
84. A gear pump has an outside diameter of 80mm, inside diameter of 55mm and a width of 25mm. If the actual pump flow is 1600 RPM and the rated pressure is 95 LPM what is the volumetric displacement and theoretical discharge.
85. Calculate the theoretical delivery of a gear pump. Module of the gear teeth is 6mm and width of gear teeth is 25mm. Number of teeth on driver gear is 18 and pressure angle of the gear is 20 . Pump speed is 1000 RPM. Volumetric efficiency is 90%.
86. Calculate the theoretical delivery of a gear pump. Module of the gear teeth is 6mm and width of gear teeth is 65mm. Number of teeth on driver gear is 16 and pressure angle of the gear is 20 . Pump speed is 1600 RPM. Outer diameter of gear is 108 mm and Dedendum circle diameter is 81 mm. Volumetric efficiency is 88%at 7 MPa.

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87. What is the theoretical flow rate from a fixed-displacement axial piston pump with a ninebore cylinder operating at 2000 RPM? Each bore has a diameter of 15 mm and stroke is 20 mm.
88. A gear pump has an outside diameter of 82.6 mm, inside diameter of 57.2 mm and a width of 25.4 mm. If the actual pump flow is 1800 RPM and the rated pressure is 0.00183m^3 /s, what is the volumetric efficiency?
89. A pump having a volumetric efficiency of 96% delivers 29 LPM of oil at 1000 RPM. What is the volumetric displacement of the pump?
90. A pump has a displacement volume of 98.4 cm^3 . It delivers 0.0152 m^3 /s of oil at 1000 RPM and 70 bar. If the prime mover input torque is 124.3 Nm. What is the overall efficiency of pump? What is the theoretical torque required to operate the pump?
91. How much hydraulic power would a pump produce when operating at 140 bar and delivering 0.001 m^3 /s of oil? What power rated electric motor would be selected to drive this pump if its overall efficiency is 85%?
92. Calculate the pipe bores required for the suction and pressure lines of a pump delivering 40 L/min using a maximum flow velocity in the suction line of 1.2 m/s and a maximum flow velocity in the pressure line of 3.5 m/s.
93. A pump has a displacement volume of 120 cm^3 . It delivers 0.0015 m^3 /s at 1440 RPM and 60 bar. If the prime mover input torque is 130 Nm. What is the overall efficiency of the pump? What is the theoretical torque required to operate the pump. The pump is driven by an electric motor having an overall efficiency of 88%. The hydraulic system operates 12 h/d for 250 days per year. The cost of electricity is Rs 8 per kWh. Determine the yearly cost of electricity to operate the hydraulic system. The amount of the yearly cost of electricity that is due to the inefficiencies of the electric motor and pump.
94. A hydraulic motor has a 100 cm^3 volumetric displacement. If it has a pressure rating of 140 bar and receives oil from a 0.001 m^3/s theoretical flow rate pump, find the motor (a) speed, (b) theoretical torque, (c) theoretical kW power.
95. The pressure rating of the components in a hydraulic system is 10^5 kPa. The system contains a hydraulic motor to turn a 0.3 m radius drum at 30 RPM to lift a weight of load 4000 N as shown in Fig below. Determine the flow rate and brake power if the motor efficiency is 90%.

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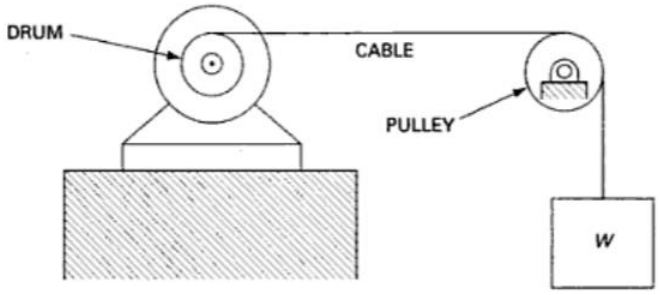
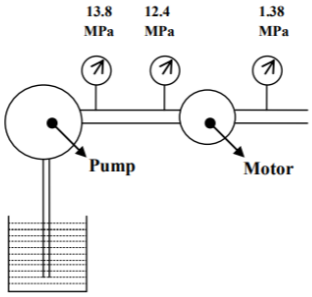


96. A hydraulic system contains a pump that discharges oil at 13.8 MPa and 0.00632 m^3 / s to a hydraulic motor shown in Fig. below. The pressure at the motor inlet is 12.40 MPa due to pressure drop in the line. If oil leaves the motor at 1.38 MPa, determine the power delivery by the 100% efficient motor. (a) What torque would a hydraulic motor deliver at a speed of 1750 RPM if it produces 3 kW? (b) If the pressure remains constant at 13.8 MPa, (i) what would be the effect of doubling the speed on the torque and (ii) what would be the effect of halving the speed on the torque?



97. A hydraulic motor has a displacement of 164 cm^3 and operates with a pressure of 70 bar and a speed of 2000 rpm. If the actual flow rate consumed by the motor is 0.006 m^3 /s and the actual torque delivered by the motor is 170 Nm, find (a) η_v (b) η_m , (c) η_o and (d) actual power delivered by the motor?
98. A hydraulic motor receives a flow rate of 72 LPM at a pressure of 12000 kPa. If the motor speed is 800 RPM and if the motor has a power loss of 3 kW, find the motor actual output torque and overall efficiency.
99. A hydraulic motor has a volumetric efficiency of 90% and operates at a speed of 1750 RPM and a pressure of 69 bar. If the actual flow rate consumed by the motor is 0.0047 m3 /s and the actual torque delivered by the motor is 147 Nm, find the overall efficiency of the motor.

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100. A displacement-type cylinder has a rod of 65 mm diameter and is powered by a hand pump with a displacement of 5 mL per double stroke. The maximum operating pressure of the system is to be limited to 350 bar. (a) Draw a suitable circuit diagram showing the cylinder, pump and any additional valving required. (b) Calculate the number of double pumping strokes needed to extend the cylinder rod by 50 mm. (c) Calculate the maximum load that could be raised using this system.

101. An 8 cm diameter hydraulic cylinder has a 4 cm diameter rod. If the cylinder receives flow at 100 LPM and 12 MPa, find the (a) extension and retraction speeds and (b) extension and retraction load carrying capacities.

102. A pump supplies oil at 0.0016 m^3 /s to a 40 mm diameter double-acting hydraulic cylinder. If the load is 5000 N (extending and retracting) and the rod diameter is 20 mm, find the (a) Hydraulic pressure during the extending stroke. (b) Piston velocity during the extending stroke. (c) Cylinder kW power during the extending stroke. (d) Hydraulic pressure during the retracting stroke, (e) Piston velocity during the retracting stroke. (f) Cylinder kW power during the retracting stroke.

103. A hydraulic cylinder has a rod diameter equal to one half the piston diameter. Determine the difference in load-carrying capacity between extension and retraction stroke if pressure is constant. What would happen if the pressure were applied to both sides of the cylinder at the same time?

104. A cylinder with a bore of 150 mm and a piston rod diameter of 105 mm, has to extend with a speed of 7 m/s, pressure applied is 150 bar. Calculate (a) The flow rate in LPM of oil to extend the cylinder (b) The flow rate in LPM from annulus side to extend the cylinder. (c) The retract speed in m/min using (a). (d) The flow rate from full bore end on retract.

105. A 6000 N weight is to be lifted upward in a vertical direction for the system shown in Fig. below. Find the cylinder force required to (a) Move the weight at a constant velocity of 1.75 m/s. (b) Accelerate the weight from zero velocity to 1.75 m/s in 0.5 s.

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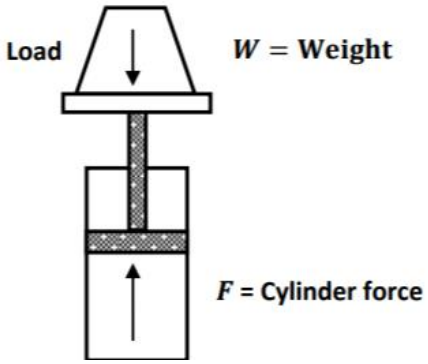
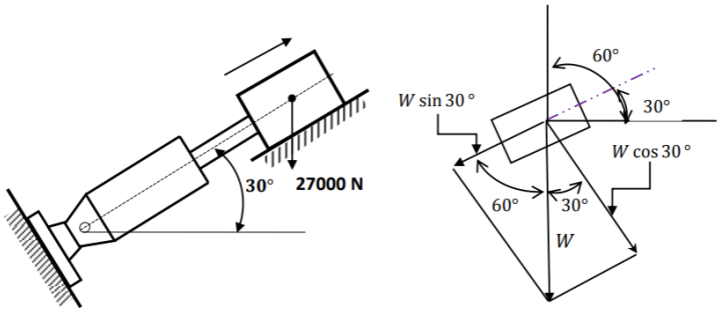


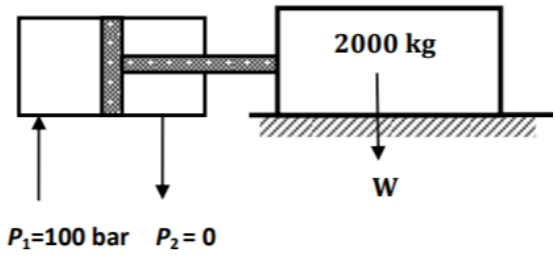
106. A 27000 N weight is being pushed up on an inclined surface at a constant speed by a cylinder, as shown in Fig below. The coefficient of friction between the weight and the inclined surface equals 0.15. (a) Determine the required cylinder piston diameter for the pressure of 6894 kPa, (b) Determine the required cylinder piston diameter, if the weight is to accelerate from a 0 mm/s to a 1524 mm/s in 0.5 s.



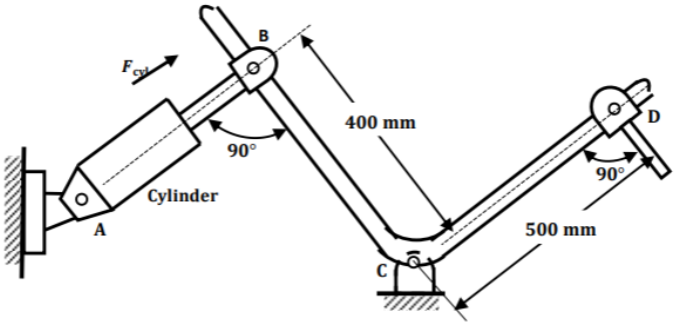
107. A hydraulic cylinder has a bore of 200 mm and a piston rod diameter of 140 mm. For an extend speed of 5 m/min, calculate (a) The supply flow rate. (b) The flow rate from the annulus side on extend. (c) The retract speed using QE. (d) The flow rate from the full-bore end on retract. Also, if the maximum pressure applied to the cylinder is 100 bar, calculate the (e) dynamic extend thrust and the (f) dynamic retract thrust assuming that dynamic thrust = 0.9 × static thrust. Moreover, the hydraulic cylinder having a bore of 200 mm diameter and a rod of 140 mm diameter are connected regeneratively. (g) If the same flow rate of 157 L/min is used, calculate the extend speed. (h) If the maximum system pressure is 100 bar, calculate the dynamic extend thrust.

108. A mass of 2000 kg is to be accelerated horizontally up to a velocity of 1 m/s from the rest over a distance of 50 mm (Fig. below). The coefficient of friction between the load and guide is 0.15. Calculate the bore of the cylinder required to accelerate this

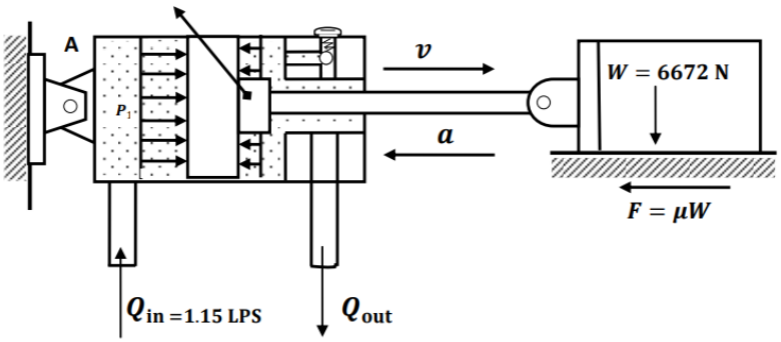
load if the maximum allowable pressure at the full bore end is 100 bar (take seal friction to be equivalent to a pressure drop of 5 bar). Assume that the back pressure at the annulus end of the cylinder is zero.



109. For the system given in Fig. below determine the force required to drive a 1000 N load.



110. A pump delivers oil at a rate of 1.15 LPS into the blank end of the 76.2 mm diameter hydraulic cylinder shown in Fig. 1. 30. The pistons decelerate over a distance of 19.05 mm at the end of its extension stroke. The cylinder drives a 6672 N weight which slides on a flat horizontal surface having a coefficient of friction (CF) equal to 0.12. The pressure relief valve setting equals 51.7125 bar. Therefore, the maximum 11 pressure (p1) at the blank end of the cylinder equals 51.7125 bar while the cushion decelerates the piston. Find the maximum pressure (p2) developed by the cushion.



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Theory Questions ANNEXURE-III

1.	What is Automations?
2.	What are the different types of Automations? Explain.
3.	What are advantages and disadvantages of Automations?
4.	What are the applications of automations?
5.	What are the different system configurations used in Automated assembly process? Explain.
6.	With neat sketch explain the part delivery systems at workstation in Automated assembly process.
7.	With neat sketch explain the operation of vibratory bowl feeder used in Automated assembly process?
8.	Write short note on i. Part selection and orientation ii. Escapement devices iii. Placement Devices iv. Escapement and Placement devices v. Feeders track
9.	Explain BLADED WHEEL HOPPER FEEDER and REVOLVING HOOK HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
10.	Explain CENTERBOARD HOPPER FEEDER and RECIPROCATING TUBE HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
11.	Explain CENTRIFUGAL HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
12.	Explain ELEVATOR HOPPER FEEDER and MAGNETIC DISC HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
13.	Explain RECIPROCATING TUBE HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process
14.	Explain ROCKING TROUGH HOPPER FEEDER and ROTARY CENTERBOARD HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
15.	Explain ROTARY CENTERBOARD HOPPER FEEDER and ROTARY DISC HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
16.	Explain SLOTTED WHEEL HOPPER FEEDER and ROTARY HOOK HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.
17.	Explain TUMBLING BARREL HOPPER FEEDER and STATIONARY HOOK HOPPER FEEDER non-vibratory feeder systems with neat sketch used in Automated assembly process.