

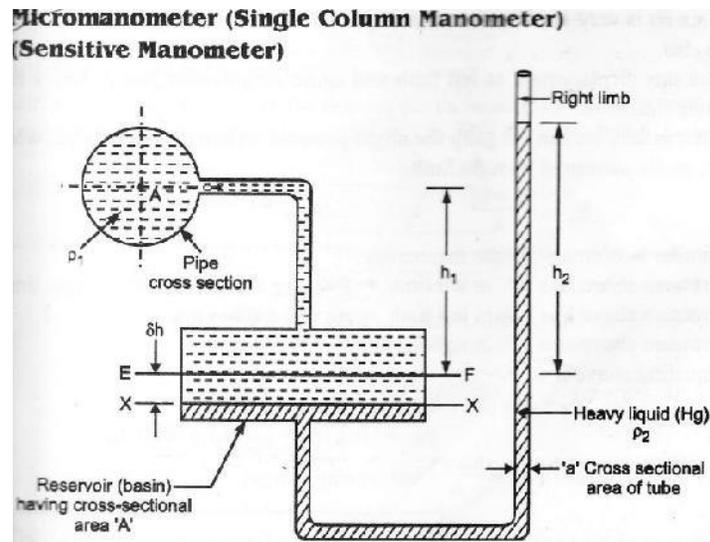


Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate’s answers and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate’s understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Marks

1. a) Attempt any <u>THREE</u> of the following.	<b>12</b>
i) Define specific weight ,specific gravity, surface tension and capillarity	<b>04</b>
<b>Answer :</b> <b>Specific Weight:</b> Specific Weight of a fluid is the ratio between the weight of a fluid to its volume. Or weight per unit volume of a fluid is called specific weight. It is denoted by w.	<b>01</b>
<b>Specific gravity:</b> It is defined as the ratio of the weight density (density) of a fluid to the weight density (density) of a standard fluid. It is denoted by S.	<b>01</b>
<b>Surface Tension:</b> - It is the force required to maintain unit called length of the film in equilibrium condition. Or It is defined as the tensile force acting on the surface of a liquid in contact with a gas or on the surface between two immiscible liquids such that the contact surface behaves like a membrane under tension. Unit:-N/m	<b>01</b>
<b>Capillarity:</b> :- It is defined as a phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid. The rise of liquid surface is known as capillary rise while the fall of the liquid is known as capillary fall or depression.	<b>01</b>
ii) Draw and explain working of micro manometer	<b>04</b>
<b>Answer: Micromanometer:</b> <ul style="list-style-type: none"> <li>• It is sensitive manometer of a modified version of U tube manometer &amp; used for precise measurement of pressure. With micromanometer we can measure the slight changes of pressure in pipe. These slight changes are difficult to measure with the help of ordinary U-tube manometer.</li> <li>• The left limb is connected to the pipe and right limb is open to atmosphere. Right limb is either vertical or inclined. The high pressure liquid in pipe will push the heavy liquid in basin downward this causes liquid in right limb to rise considerably. That means we can magnify the slight pressure difference at point ‘A’, which can be easily measured by right limb.</li> </ul>	<b>02</b>



02

iii) Define laminar and turbulent flow. Give its example

04

**Answer:**

**Laminar flow:** The flow in which each liquid particle has definite path and the path of individual particles do not cross each other is called as stream line flow.

01

**Example:** flow of river having large banks, flow of tap water, flow of water through channel, flow of thick oil through tube

01

**Turbulent flow:** Flow in which each liquid particle does not have a definite path, and the paths of individual particles also cross each other is called turbulent flow.

01

**Example:** flow of river during flood, flow of water after opening valve.

01

Any suitable examples may be considered.

iv) Explain the orifice meter with neat sketch.

04

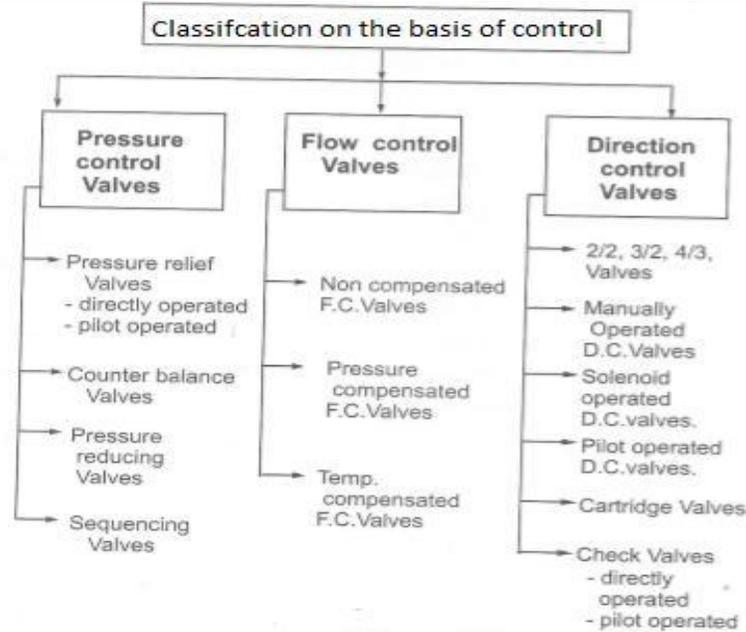
**Answer:**

Orifice meter:- it is used to measure the discharge in pipe. It consists of a plate having a sharp edge circular hole known as an orifice. The plate is fixed inside a pipe as shown in figure. As the fluid flows through the orifice meter it accelerates thereby increasing velocity and decreasing pressure since orifice diameter is less than the pipe diameter. This pressure difference is measured by the manometer. Orifice meter is cheaper for discharge measurement and requires smaller space as compared with venturimeter.

02

02





**Function of valve:** (any four)

1. Blocking or stopping of flow
2. To release the flow of working medium
3. To give the Direction of flow
4. To maintain the Pressure of working medium for safety purpose.
5. To maintain Flow quantity as per requirement

2. Attempt any FOUR of the following

16

a) Name the different hydraulic coefficient and define them.

04

**Answer :**

There are four hydraulic coefficients-

**1. Coefficient of contraction (Cc):** It is the ratio of area of jet at vena contracta to the area of Orifice is known as Coefficient of contraction.

01

**2. Coefficient of velocity(Cv):** It is the ratio of actual velocity of jet at vena contracta to the theoretical velocity of jet is known as Coefficient of velocity

01

**3. Coefficient of discharge (Cd):** It is the ratio of actual discharge through an orifice to the theoretical discharge is known as Coefficient of discharge.

01

**4. Coefficient of Resistance (Cr):** It is the ratio of loss of head in the orifice to the head of water available at the exit of orifice is known as Coefficient of resistance.

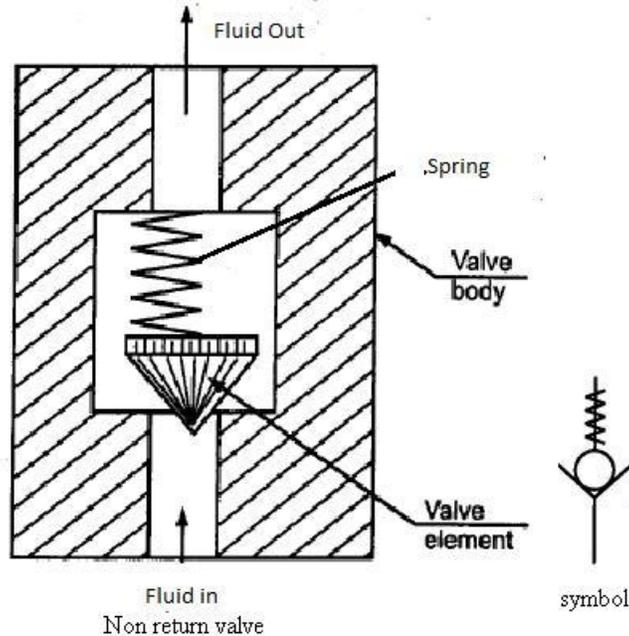
01



b) Draw a labeled sketch of non return valve and explain it.

04

**Answer-** Non return valve is also called as Check valve or one way valve.



02

This valve consists of valve body with inlet and outlet ports having valve element like cone, ball or spherical poppet. The valve element is incorporated with specially designed spring.

When pressurized oil comes in through port A it will lift up the cone by overcoming spring force and flow will start from port A to port B. When flow from A stops spring will expand and cone will block the flow hence only one direction of flow is possible.

02

c) Compare reciprocating compressor and rotary compressor ( any four points)

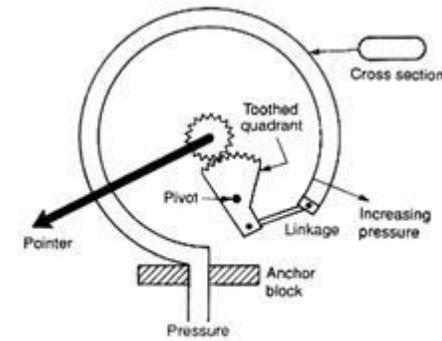
04

**Answer: (Any four points carrying one mark each)**

Compression between Reciprocating and rotary compressor:

Parameters	Reciprocating	Rotary
1. Air discharge	Low at very high pressure 300 m <sup>3</sup> /min up to 1k bar	Large at low pressure 3000 m <sup>3</sup> /min up to 10k bar
2. Speed	Low	High
3. Receiver required	Yes, as supply is intermittent	No as supply is continuous
4. Size	Large for the same discharge	Small
5. Balancing problem	Yes, due to more no of parts.	No, due to less no of parts
6. Quality of air supplied	Less cleaner	More cleaner.
7. Lubrication system	More complicated	Simple
8. Compression process	Isothermal	Isentropic





Bourdan Tube Gauge

02

3. Attempt any FOUR of the following:

16

a) Explain meter in type hydraulic circuit.

04

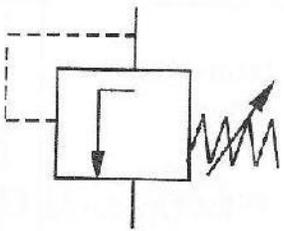
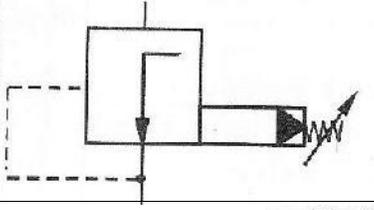
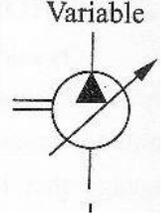
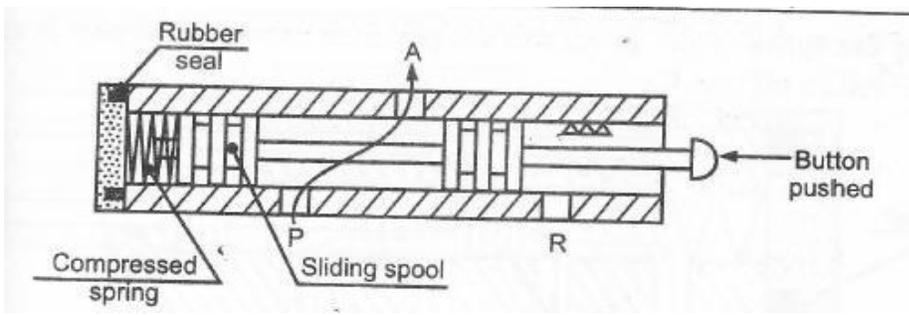
**Answer:**

Figure shows circuit connections of a meter in circuit in which the flow control valve is placed in the primary line, directly after load. In meter in circuit speed control is achieved by changing the flow adjustment of flow control valve which controls the oil going to the blind end of the cylinder. When spool valve is operated pump is connected to blind end of cylinder thus piston moves forward causing work done. During return stroke the fluid returns back through non return valve. Meter in circuit are generally used when load characteristics are constant and positive, in grinding and milling machine.

02

02



b) Draw a symbol for pressure relief valve and variable speed unidirectional pump.			04
<b>Answer: ( Any one symbol of pressure relief valve 02 marks, 02 marks for variable speed unidirectional pump)</b>			
a) Directly operated pressure relief valve.	Normally closed (Open on actuation)		02
b) Pilot operated pressure relief valve.			
<b>Variable speed Unidirectional pump</b>			02
c) What are the direction control valves? Explain construction of 3/2 direction control valve.			04
<b>Answer:</b> Direction control valves are used for direction the pressurized fluid to obtain different positions.			01
<b>Construction 3 X 2 DC valve</b>			
			01
<p>3 X 2 means 3 ports &amp; 2 positions. In 3x2 DC spool type valve, spool reciprocates in a finely finished bore. The spring is attached to front spool.</p> <p><b>Position 1:(Actuated position)</b> Figure shown is actuated position. Push button is pressed in the port P is connected to port A and no flow through R. When spool is pressed in spring is compressed.</p>			02

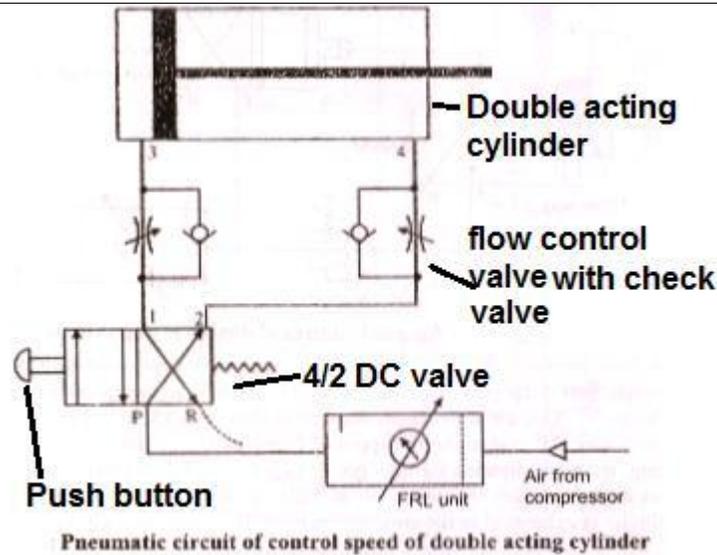


**Position 2 (Normal Position)**

Now push button is released, spring will expand and spool will move towards right. Now port A will be connected to port R and Port P will be disconnected so that flow of used oil will start from port A to R and then to oil reservoir.

d) Explain with neat sketch pneumatic speed control circuits.

04



02

Speed control circuit is used to control the speed of pneumatic actuator; this is achieved by controlling air supplied to the actuators. The air flow to actuator is controlled either the supply line or drain line.

In speed control of a cylinder, a flow control valve along with a check valve is normally used, but this combination provides speed control in one direction. In case of speed control in both direction of double acting cylinder, two sets of combination flow control and check valve are used. Speed in a extension and retraction can be changed independently. It should be noted that position of check valves permits free flow of air to the cylinder chambers and throttled flow of air from the chamber.

02

**(Note: speed control circuit of single acting circuit may be considered )**

e) What is the function of seals and gaskets? State their application

04

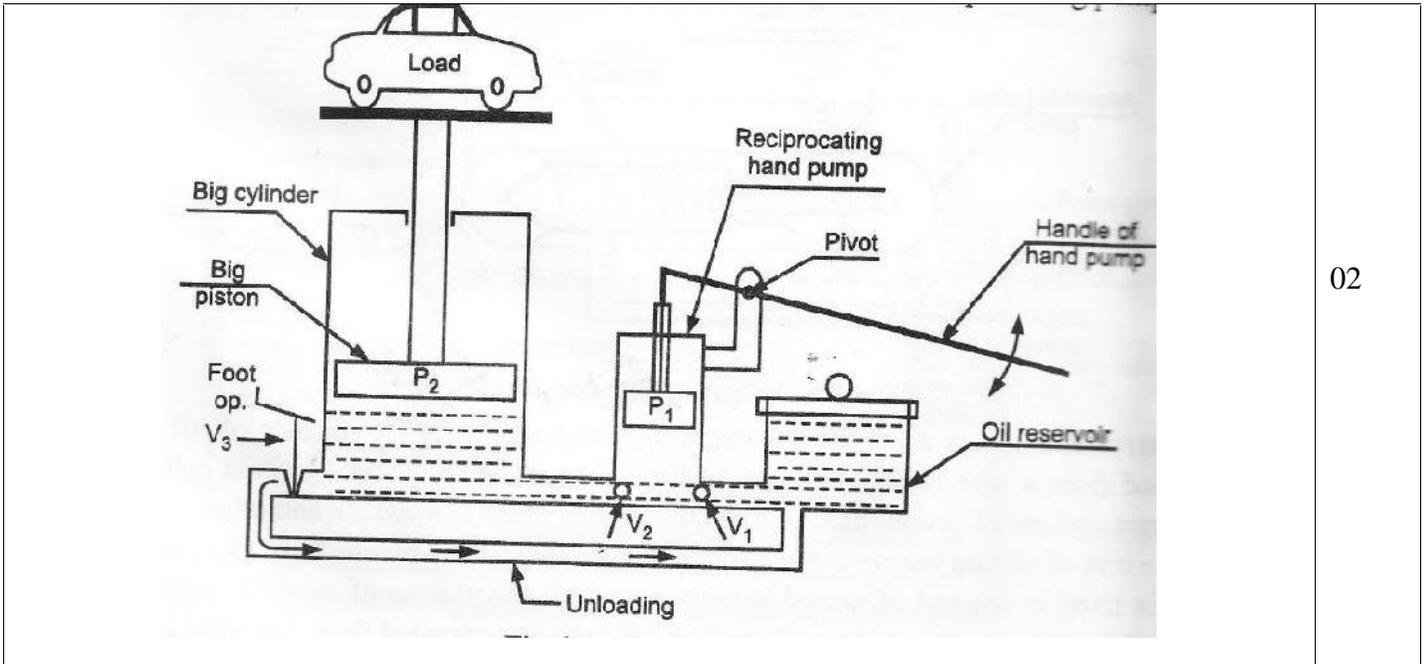
**Answer:**

**Function of seals:** (Any two)

1. Prevent escape of fluid.
2. It Prevents contamination.
3. To enhance working life of system.
4. Prevent environmental damage.
5. To stop the leakage of oil
6. To maintain the pressure

01





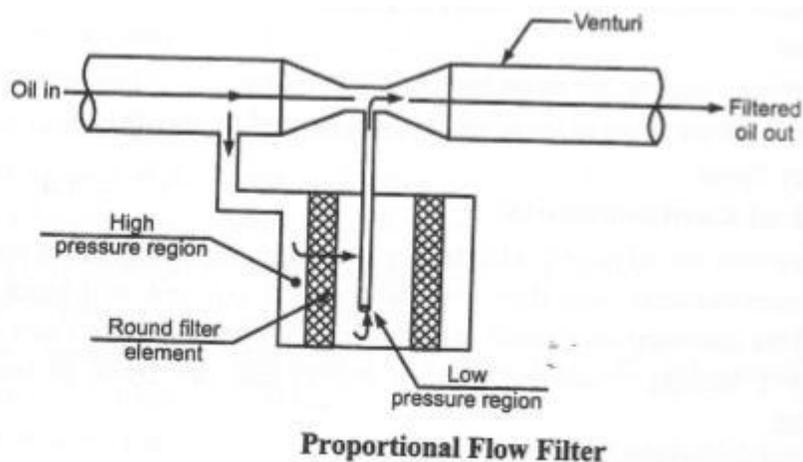
02

iii) Draw a labeled sketch of any one type of filter and describe its working.

04

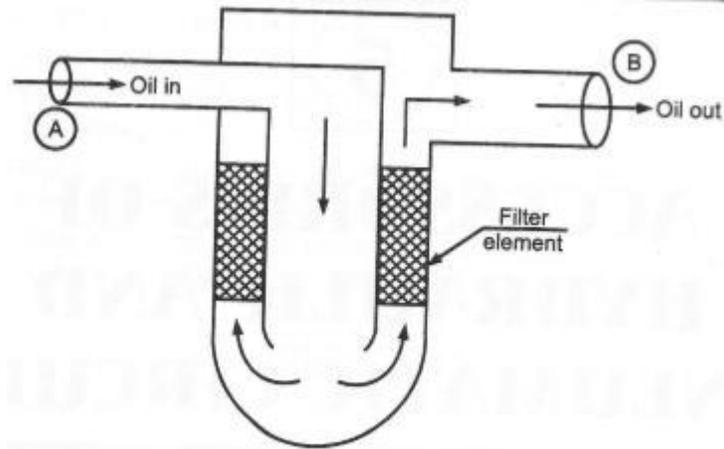
**Answer:** (Any one type- 02 marks for sketch & 02 marks for description)

**Proportional flow filter:** In this filter main oil flow passes through venturi, which create localize low pressure area inside the filter element. Outside of the filter element there is high pressure oil, due to the pressure difference crated across filter element. The propionate quantity passes through filter element. In this filter the pressure drop is very low hence is having wide application.



OR

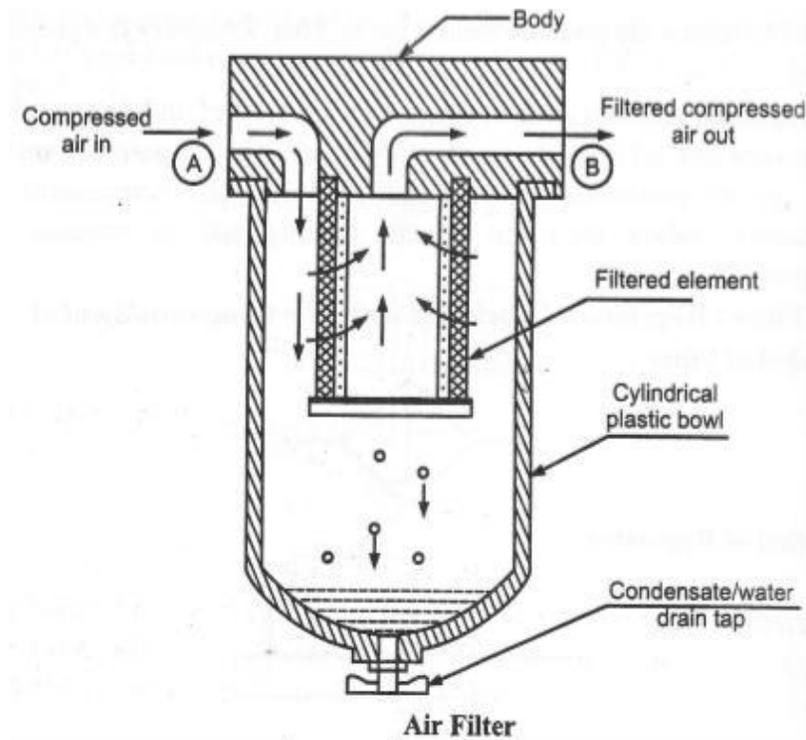
**Full flow filter:** In this filter oil comes in through port A, passes through filter element and goes out through port B. in this filter all flow passes through filter. Hence it is called as a full flow filter. This is very efficient filter but only drawback of this filter there is large pressure drop. It increases due to clogging of filtering element.



**Full Flow Filter**

OR

**Air filter:** The compressed air which is unfiltered enters through the port A and comes into bowl. It has no alternative than to enter into the filtering element. The special zigzag passages created in filtering element, arrest the micron and sub micron particles and clean air go out through port B.





iv) State Bernoulli's theorem. Also state its assumption.

04

**Answer:** This theorem states that 'whenever there is a continuous flow of liquid, the total energy at every section remains the same provided that there is no loss of addition of the energy.

Mathematically,

$$Z + v^2 / 2g + P/w = \text{constant}$$

02

Where,

Z= potential energy

$v^2 / 2g$ = kinetic energy

P/w= pressure energy

The following are the assumptions:

1. The fluid is ideal i.e. viscosity is zero
2. The flow is steady
3. The flow is incompressible
4. The flow is irrotational

02

b) Attempt any ONE of the following:

06

i) Compare hydraulic and pneumatic circuit( any six points)

06

**Answer:**

SR. NO.	Hydraulic circuit	pneumatic circuit
01	Used for circuits up to 700 bar pressure	Operative below 10 bar pressure.
02	Uses hydraulic oil as a medium	Uses air as a medium
03	Pump is used to pressure the oil	Compressor is used to pressurize the air.
04	Since hydraulic oil is reused in the circuit hydraulic oil tank is a must and there are return lines	Air is taken from atmosphere and is vented to atmosphere after use. Hence no return lines. Air reservoir is used to store pressurized air.
05	The rigidity of the system using hydraulic circuit is good.	The rigidity of the system using hydraulic circuit is poor.
06	Moderate operating cost.	Operating cost is low.
07	Maintenance is critical.	Maintenance is simple.
08	Very suitable for accurate speed/feed movement of cutting tool mechanism.	No accuracy in movement.
09	The system using hydraulic circuit is not clean due to oil leakages.	Pneumatic circuits are very clean.
10	Weight to pressure ratio is small.	Weight to pressure ratio is high.
11	Problem of cavitations is serious in hydraulic circuit.	No problem of cavitations.
12	Hydraulic circuits are used in tackling heavy loads, hence used in earthmoving equipments, CNC-VMC machines.	Pneumatic circuits are used when loads are much lighter. Hence used in transferring the light weight components, vacuum handling in printing press, food industry.

06



ii) What are applications of pneumatic circuit? Draw a circuit of any one

06

**Answer: (02 marks for application, 03 for figure, 01 for label)**

applications of pneumatic circuit:

1. Air suspension system.
2. Air braking system
3. Boring machine
4. Pneumatic drill
5. Pneumatic gun
6. Pneumatic wood cutter
7. Pneumatic hammer
8. Pneumatic chain saw

**Note: credit to suitable diagram of any one appropriate application of pneumatics circuit.**

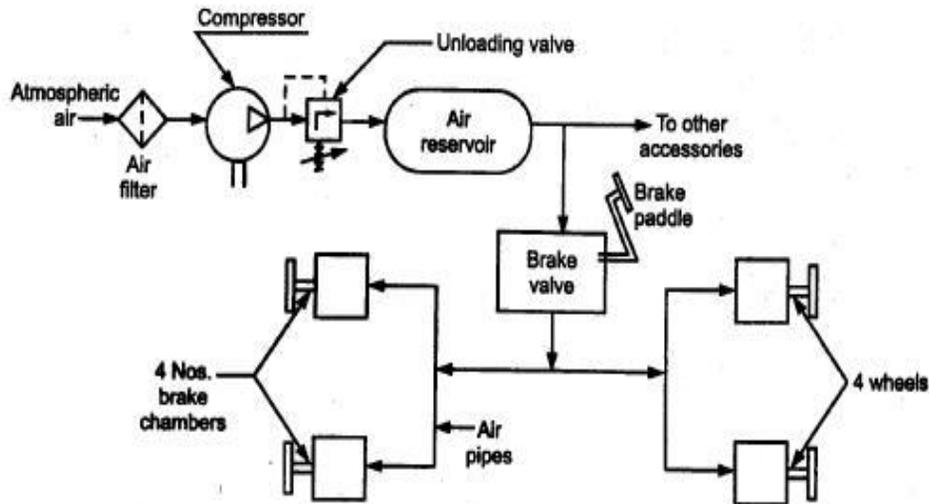
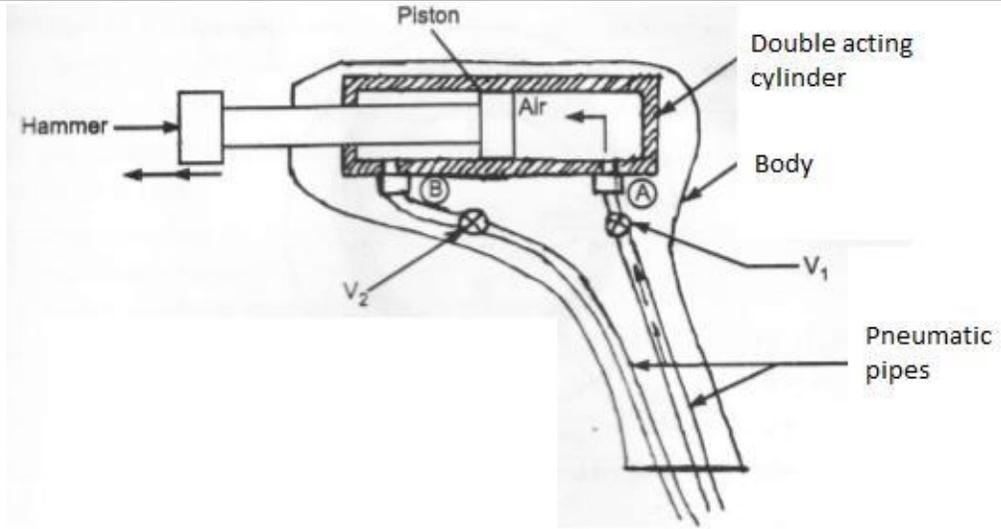


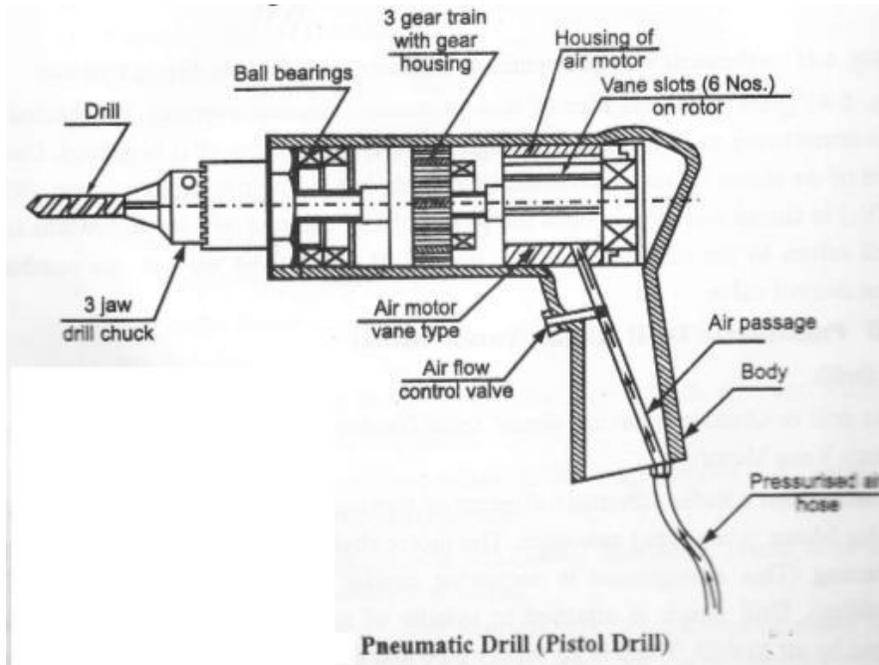
Figure: Air Braking System

OR



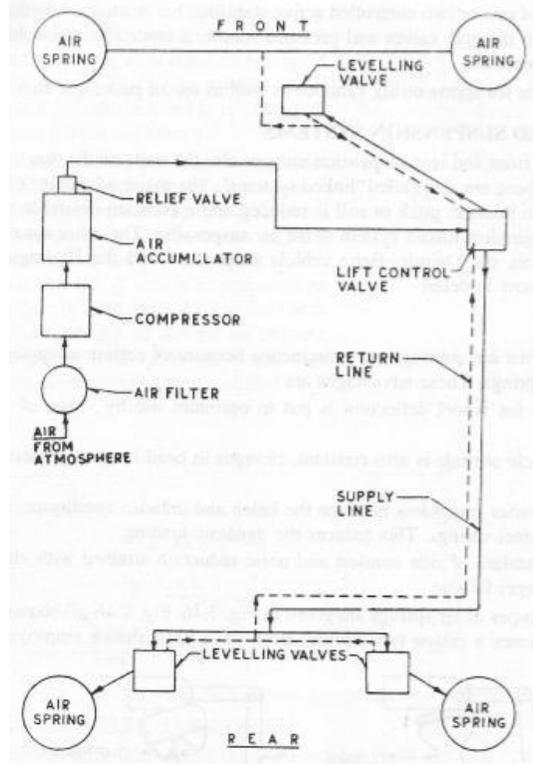
Pneumatic Hammer

OR



Pneumatic Drill (Pistol Drill)

OR



Air Suspension System

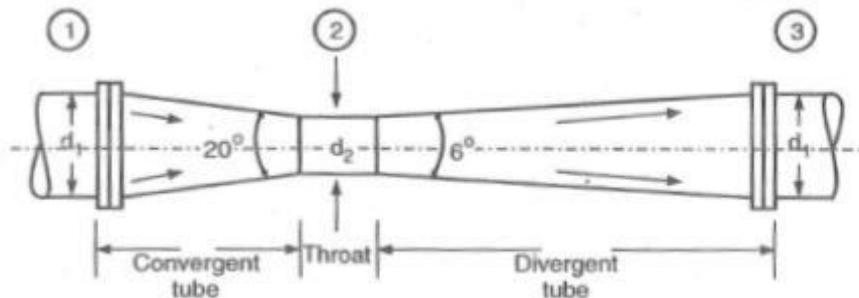
5 Attempt any TWO of the following

16

a) i) With a neat sketch explain the construction and application of Venturimeter

04

**Answer:**



01

Construction: it is device used for measuring the rate of flow or a discharge of a fluid flowing through a close pipe or channel.

It consist of three parts:

1. Short convergent cone
2. Throat
3. Long divergent cone

**1. Short convergent cone:** The inlet section of Venturimeter is called as a convergent cone. The



<p>diameter of convergent cone is equivalent of diameter of pipe.(d1). In convergent section the diameter decreases to diameter to (d2). Here velocity increases and pressure decreases. The other end of convergent section is attached to throat. In convergent section the pressure measuring device i. e. pizometer is connected which gives a pressure head in cm or m. the angle suspended by a convergent section with throat is 20°</p> <p>2. <b>Throat:</b> It is small constant diameter pipe. In which there is no fall or increase in pressure and velocity. At the upper end of throat, pressure measuring device is connected to measure the pressure head in terms of cm or m of liquid. The pressure difference between two pizometer is measured and rate of discharge is calculated.</p> <p>3. <b>Long divergent cone:</b> It is used to regain original pressure which is smaller in convergent section. In divergent cone due to increase in diameter there is increase in pressure. However if decrease in velocity of flow in divergent section is allowed to take place rapidly in small length, then the flowing fluid will not remain in contact with the boundary of diverging flow passage, flow will separate from walls and eddies are formed. Therefore length of divergent section has more than convergent section and it is kept 2 to 3 times that of convergent section.</p> <p><b>Application:</b> 1. Lubricator 2. Carburetor 3. To measure discharge through pipe (Any other suitable applications may be consider)</p>	<p>02</p> <p>01</p>
<p>ii) A Venturimeter is used to measure that rate of flow of a liquid whose specific gravity is 0.8. Inlet diameter of Venturimeter is 80mm and throat diameter is 50mm. The differential manometer reads 20 cm of mercury. Calculate the rate of flow if the coefficient of discharge is 0.98.</p>	<p>04</p>
<p><b>Answer:</b> Given Data Sp. Gravity = g= 0.8 (inlet) =d<sub>1</sub> = 80 mm = 0.08m (Throat) = d<sub>2</sub> = 50 mm= 0.05m x = 20cm=0.2m Cd = 0.98 Q = ?</p> <p>1) Area at inlet = d<sub>1</sub> = <math>\frac{\pi}{4} \times d_1^2</math></p> $= \frac{\pi}{4} \times (0.08)^2$ $= 5.0265 \times 10^{-3} m^2$ <p>2) Area at throat = d<sub>2</sub> = <math>\frac{\pi}{4} \times d_2^2</math></p> $= \frac{\pi}{4} \times (0.05)^2$ $= 1.9634 \times 10^{-3} m^2$ <p>Calculation of manometric head in terms of oil column</p>	<p>01</p>



$h = x \left( \frac{s_m}{s_o} - 1 \right)$ $h = 0.2 \left( \frac{13.6}{0.8} - 1 \right)$ $h = 0.2(16)$ $h = 3.2m \text{ of oil}$ <p>Rate of flow Q</p> $Q = C_d \times \frac{a_1 \times a_2 \times \sqrt{2gh}}{\sqrt{a_1^2 - a_2^2}}$ $= 0.98 \times \frac{5.0265 \times 10^{-3} \times 1.9634 \times 10^{-3} \sqrt{2 \times 9.81 \times 3.2}}{\sqrt{(5.0265 \times 10^{-3})^2 - (1.9634 \times 10^{-3})^2}}$ $Q = 0.0165m^3 / \text{sec}$	01
<p>b) Explain the working of centrifugal pump with neat sketch. What is meant by priming? Why it is necessary for centrifugal pump.</p>	08

<p><b>Answer:</b></p> <div data-bbox="548 1060 1117 1449" data-label="Diagram"> </div> <p>It consists of casing, impeller, suction pipe, delivery pipe, delivery valve and electric motor.</p>	02
<p>The first step in the operation of a centrifugal pump is priming so that no air pocket is left. After pump is primed, the electric motor is started to rotate the impeller. The rotation of impeller forces the water in radially outward direction in delivery pipe with high velocity. This high velocity water gets converted into high pressure when it passes through spiral casing.</p> <p>At the eye of the impeller due to centrifugal action partial vacuum is created. This causes liquid from the sump to rush through suction pipe to the eye as sump is at atmospheric pressure.</p> <p>This high pressure of liquid leaving the impeller is utilized in lifting the liquid to the required height through the delivery pipe.</p>	03



**Priming of Centrifugal pump:**

It is the operation in which the suction pipe, casing of the pump and the portion of delivery pipe up to delivery valve is completely filled with the liquid which is to be raised by pump. This operation is carried out only once before starting the pump thus air within these parts is removed.

02

**Necessity:**

The pressure developed by the impeller of the centrifugal pump is proportional to the density of fluid in the impeller. It is thus obvious that if the impeller is running in a air, it will produce only negligible pressure which may not suck liquid from its source through the suction pipe. To avoid this, the pump is first primed.

01

c) Explain with neat sketch swash plate type of pump.

08

**Answer:**

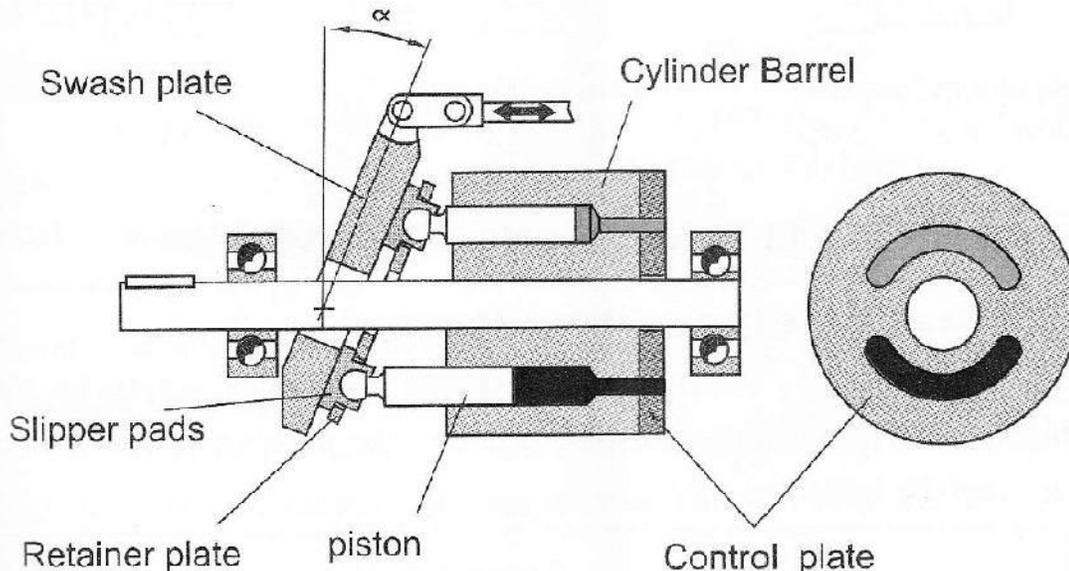
Swash plate type axial pumps as shown in diagram consists of rotating cylinder barrel having piston arranged on it axially. The piston ends are connected to an inclined swash plate

The direction of piston movement (forward or backward i.e. suction or delivery) is decided by its peripheral position on swash plate. The friction between piston ends and stationary swash plate is kept intact with swash plate by retaining ring. The suction and delivery chambers are shown in cross section

04

As the shaft rotates it imparts motion to piston but since piston ends are connected to an inclined swash plate the piston start reciprocating (with a stroke length as determined by inclination of swash plate  $\alpha$  ) The reciprocating motion of piston causes suction and delivery of fluid as the respective piston uncover the suction and delivery ports. The delivery (discharge) of this type of pump can be varies or even reversed by changing the swash plate angle.

Following are the various position indicating maximum forward flow neutral position (no flow) and maximum reverse flow (suction and delivery ports get interchanged).



04



6 Attempt any TWO of the following

16

a) Explain with neat sketch construction and working of single acting reciprocation pump.

08

**Answer:**

**Construction:**

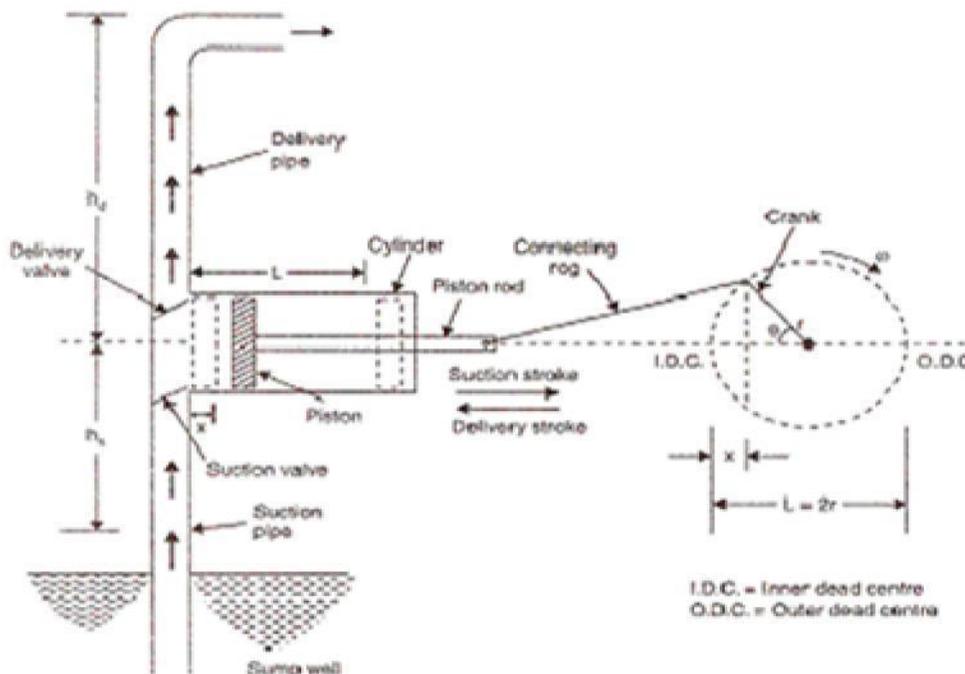
Figure shows a single acting reciprocating pump, which consist of a piston which moves forwards and backwards in a close fitting cylinder. The movement of the piston is obtained by connecting the piston rod to crank by means of connecting rod. The crank is rotated by means of an electric motor. Suction and delivery pipe with suction valve and delivery valve are connected to the cylinder. The suction and delivery valves are one way valves or non return valves, which allow the water flow in one direction only. Suction valve allows water from suction pipe to the cylinder which delivery valve allows water from cylinder to delivery pipe only.

02

**Working:**

When crank starts rotating, the piston moves to and fro in the cylinder. When crank is at A, the piston is at the extreme left position in the cylinder. As the crank is rotating from A to C, the piston is moving towards right in the cylinder. The movement of the piston towards right creates a partial vacuum in the cylinder. But on the surface of the liquid in the sump atmosphere pressure is acting, which is more than the pressure inside the cylinder. Thus the liquid is forced in the suction pipe from the sump. This liquid opens the suction valve and enters the cylinder. When crank is rotating from C to A, the piston from its extreme right position starts moving towards left in the cylinder. The movement of piston towards left increases the pressure of the liquid inside the cylinder more than atmosphere pressure. Hence suction valve closes and delivery valve opens. The liquid is forced into the delivery pipe and is raised to required height.

02

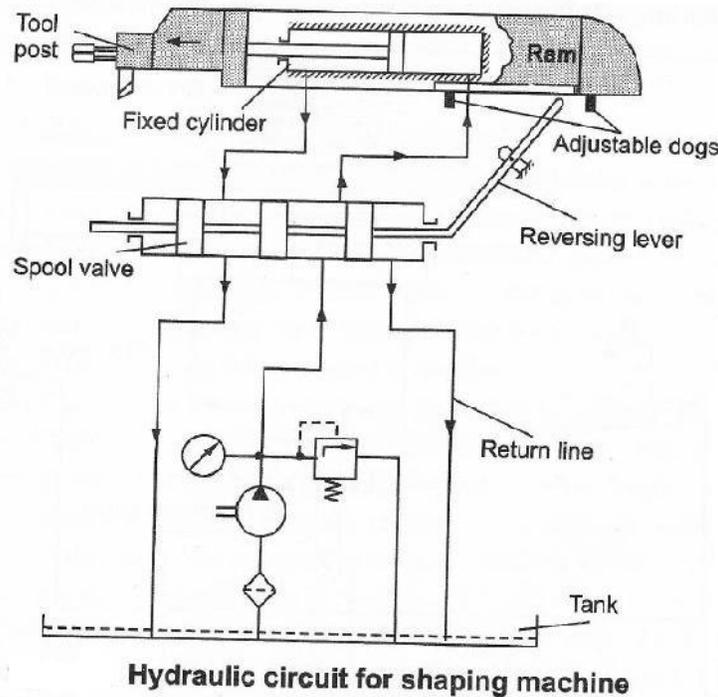


04

b) Draw the hydraulic circuit used for shaping machine, explain the operation in brief.

08

**Answer:**



04

**Operation:** Figure shows the hydraulic circuit for shaping machine. The circuit utilizes the double acting cylinder with a single piston rod and spool type direction control which is shifted by reversing lever. Hydraulic power-pack supplies the pressurized oil to spool valve. The position of spool valve decides whether the pressurized oil should go the head end or piston rod end of the cylinder. The cylinder is mounted in a manner that the forward stroke occurs when the oil is supplied to head end of the cylinder and reverse stroke occurs when oil is supplied to piston rod end of the cylinder. Due to the difference in annular areas of head end and piston rod end, the return stroke is faster than the forward stroke. The stroke length of the ram can be adjusted by changing the positions of the adjustable dogs, i.e. closer the adjustable dogs shorter the stroke length and vice versa.

04

c) State and explain possible causes if centrifugal pump fail to start pumping.

08

**Answer: (Any four 02 marks each)**

Possible causes if centrifugal Pump fails to start pumping:

1. Pump may not be properly primed: - due to improper priming delivery of liquid is not obtained as air takes the place of liquid. This causes difference in density of liquid to be pumped and density of air. The remedy is to fill the suction valve, suction pipe, impeller and delivery pipe up to delivery valve with liquid to be pumped.
2. Total head against which the pump is working may be more than the designed head:- if working head is more than designed head pump fails to deliver the fluid. In this case either



reduces the head or change pump with pump having higher total head.

3. Impeller, strainer or suction line may be clogged:- it may be due to debris or leaves in tank from where liquid is pumped. Because of this liquid is unable to suck and hence delivery is not possible. Remedy is to clean the pump parts.
4. Suction lift may be excessive. Check the vacuum gauge fitted on the suction side. If suction height is more than it is not possible to lift the liquid from the underground tank this causes fluid may not be pumped. Remedy is to Reduce the suction lift
5. Speed may be low. Check the speed with a tachometer and compare it with the design speed. If the speed of pump is low impeller will rotate with low speed this causes lower centrifugal force to be developed and hence pump is unable to delivery to fluid. Remedy is Increase the speed.
6. The impeller might be rotating in the wrong direction. Check the direction of the impeller with that marked on the casing. Change the direction of rotation by changing electric connections.