
Subject Code

- Any - ▼

Chapter Name

- Any - ▼

Apply

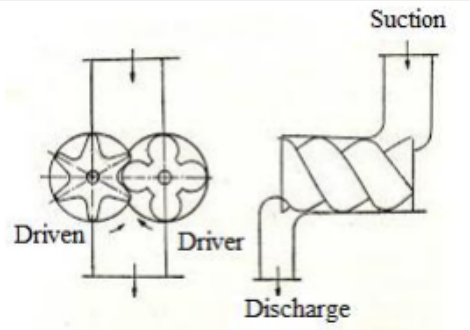
Examination:

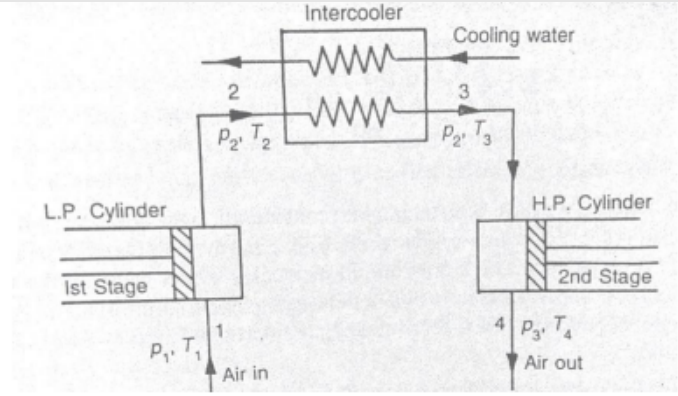
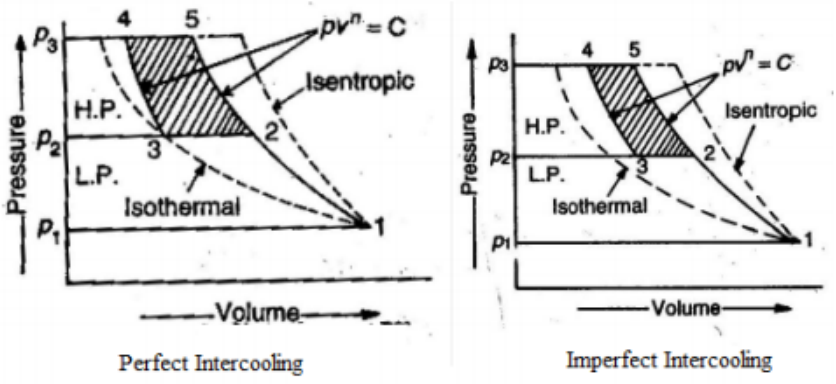
Que.No	Marks	
Q 6 b)	4	Question: **Define : i) Free air delivered ii) Compressor capacity iii) Swept volume iv) Pressure ratio, w.r.to compressor.** Answer: Define i) Free air delivered (FAD) – It is volume of air delivered under the condition of temperature and pressure existing at compressor intake, i.e. volume of air delivered at surrounding air temperature & pressure. In absence of any given free air conditions these are generally taken as 1.101325 bar and 150 c. ii) Compressor capacity – It is quantity of free air actually delivered by compressor in m3 /min. iii) Swept volume – It is the volume of air taken during sanction stroke. It is expressed in m3 . iv) Pressure ratio – It is defined as delivery pressure to suction pressure. ----------

Examination: 2017 SUMMER

Que.No	Marks	
Q 1a)(a)	4	Question: **Enlist uses of compressed air (any four).** Answer: Following are the applications of compressed air 1) To drive air motors in coal mines. 2) To inject fuel in air injection diesel engines. 3) To operate pneumatic drills, hammers, hoists, sand blasters. 4) For cleaning purposes. 5) To cool large buildings. 6) In the processing of food and farm maintenance. 7) In vehicle to operate air brake. 8) For spray painting in paint industry. ----------

Que.No	Marks	
Q 1a)(b)	4	Question: **What are the advantages of multistaging ?** Answer: 1. The air can be cooled in between two cylinders 2. The power required is less 3. Mechanical balance is good 4. Reduced leakage losses 5. More volumetric efficiency 6. High pressure range 7. Comparatively lighter in construction ----------
Q 2 c)	8	Question: **Differentiate between reciprocating air compressor and rotary air compressor.....** Answer: . Comparison of Reciprocating & Rotary compressor **Reciprocating Compressor** / **Rotary Compressor** 1. Compression of air takes place with the help of piston and cylinder arrangement with reciprocating motion of piston. / 1. Compression of air takes place due to rotary motion of blades. 2. Delivery of air is intermittent. / 2. Delivery of air is continuous. 3. Delivery pressure is high, i.e. Pressure ratio is high. / 3. Delivery pressure is low, i.e. Pressure ratio is low. 4. Flow rate of air is low. / 4. Flow rate of air is high. 5. Speed of compressor is low because of unbalanced forces. / 5. Speed of compressor is high because of perfect balancing. 6. Reciprocating air compressor has more number of moving parts. It needs proper lubrication and more maintenance. / 6. Rotary air compressor has less number of moving parts, therefore less maintenance is required. 7. Due to low speed of rotation it cannot be directly coupled to prime mover but it requires reduction of speed. / 7. Rotary air compressor can be directly coupled to prime mover. 8. Are used when small quantity of air at high pressure is required. / 8. Are used where large quantity of air at lower pressure is required. ----------

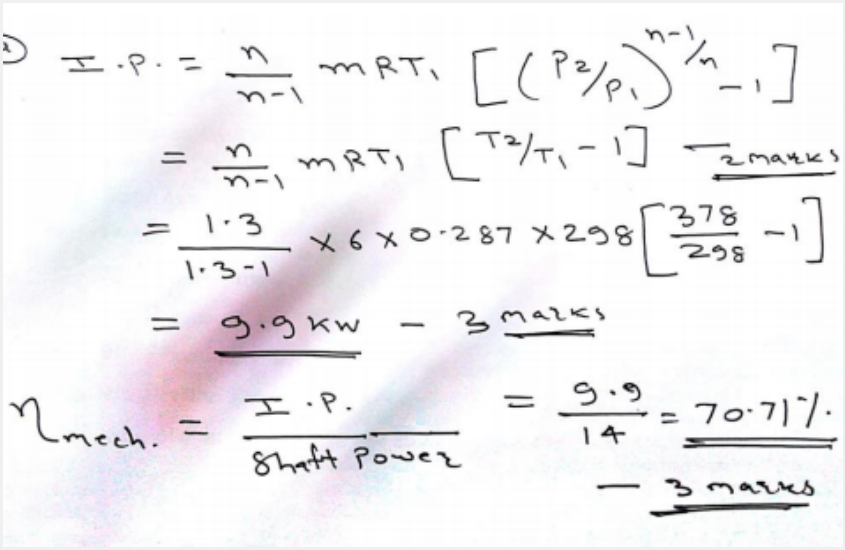
Que.No	Marks	
Q 4a)(b)	4	Question: **Explain with sketch working of screw compressor.** Answer: A rotary-screw compressor is a type of gas compressor that uses a rotary-type positivedisplacement mechanism. They are commonly used to replace piston compressors where large volumes of high-pressure air are needed, either for large industrial applications or to operate highpower air tools. Rotary-screw compressors use two meshing helical screws, known as rotors, to compress the gas. In a dry-running rotary-screw compressor, timing gears ensure that the male and female rotors maintain precise alignment. In an oil-flooded rotary-screw compressor, lubricating oil bridges the space between the rotors, both providing a hydraulic seal and transferring mechanical energy between the driving and driven rotor. Gas enters at the suction side and moves through the threadsas the screws rotate. The meshing rotors force the gas through the compressor, and the gas exits at the end of the screws.  ----------

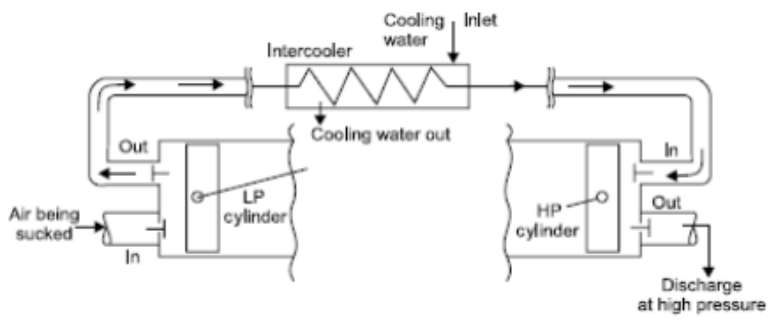
Que.No	Marks	
Q 4b)(ii)	6	Question: **Explain the working of two stage reciprocating compressor. Show work saved on PV diagram.** Answer:  Fig.Two stage reciprocating air compressor……..2M Working:- Let P1, V1 be the pressure and volume of air entering the low pressure cylinder P2, V2 be the pressure and volume of air leaving the low pressure cylinder or pressure and volume of air entering the intercooler P3, V3 be the pressure and volume of air entering the high pressure cylinder P4, V4 be the pressure and volume of air leaving the stage and 'n' be the index of compression(As suitable). ……..2M Work saved=Area(2-3-4-5)  ……2M ----------

Que.No	Marks	
Q 6 b)	4	Question: **What is the necessity of purification of air ? How to remove oil, moisture and dust from air?** Answer: The air sucked by the compressor is not clean. It contains various types of solid, liquid and gaseous contaminants such as dust, dirt, moisture etc. The presence of contaminants may have high damaging effects such as corrosion, wear and tear on the finely finished mating surfaces of pneumatic components. Air lines may get chocked or damaged. Therefore, purification of air by removing oil, moisture and dust is done to protect the pneumatic system from failure, so that the system should work efficiently. 1) Particulate Filters (Dry Air Filters) Particulate filters are used to remove dust and particles out of the air. This will allow air to travel faster in the piping system and prevent clogs. The main element in this filtration is the membrane. The membrane acts like a gate which only lets air pass through while anything bigger gets blocked by the membrane material. 2) Coalescing Filters Coalescing filters are used to capture oil and tiny moisture droplets and prevent condensate from developing in the system. This will prolong the life of the piping system and other components by avoiding rust. The main component used is the flow of the air. The filter may contain a membrane element in it as well but altering the flow of the air in a tight space causes condensate or oil to gather at the bottom of the filter. ----------

Examination: 2017 WINTER

Que.No	Marks	
Q 1a)(c)	4	Question: **Classify air compressors** Answer: Classification of Air compressors: 1. According to principle: a) Reciprocating air compressors b) Rotary air compressors 2. According to the capacity a. Low capacity air compressors b. Medium capacity air compressors c. High capacity air compressors 3. According to pressure limits a. Low pressure air compressors b. Medium pressure air compressors c. High pressure air compressors 4. According to method of connection a. Direct drive air compressors b. Belt drive air compressors c. Chain drive air compressors ----------

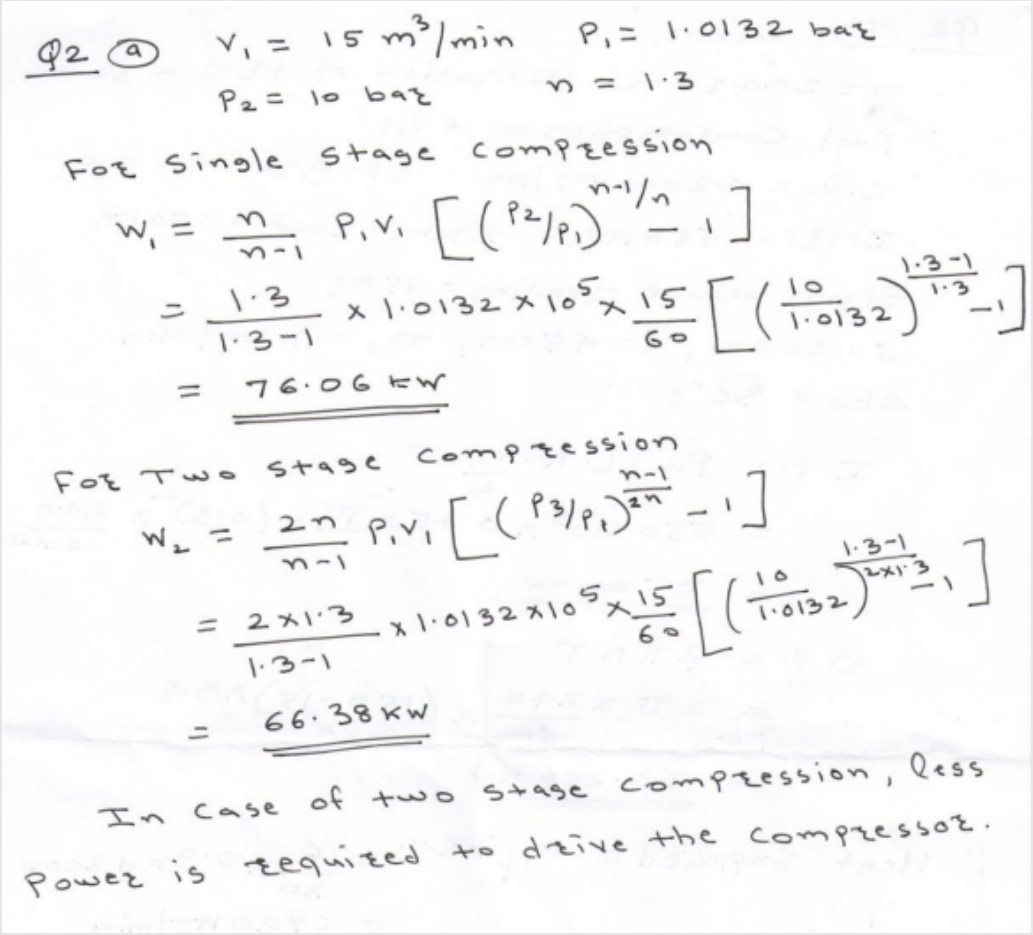
Que.No	Marks	
Q 2 a)	8	Question: **Reciprocating air compressor draws 6 kg of air per minute at 25°C. It compresses the air polytropically and delivers it at 105°C. Find the work done by the compressor and air power. Also find mechanical efficiency if shaft power is 14 kW. Assume R = 0.287 kJ/kg°K and n = 1.3.** Answer:  $\text{I.P.} = \frac{n}{n-1} m R T_1 \left[\left(P_2/P_1 \right)^{\frac{n-1}{n}} - 1 \right]$ $= \frac{n}{n-1} m R T_1 \left[T_2/T_1 - 1 \right]$ — 2 marks $= \frac{1.3}{1.3-1} \times 6 \times 0.287 \times 298 \left[\frac{378}{298} - 1 \right]$ $= 9.9 \text{ kW}$ — 3 marks $\eta_{mech.} = \frac{\text{I.P.}}{\text{Shaft Power}} = \frac{9.9}{14} = 70.71\%$ — 3 marks ----------

Que.No	Marks	
Q 5 a)	8	Question: **State the methods to improve efficiency of air compressor. Explain two stage air compressor with perfect intercooling with neat sketch.** Answer: **Following are the methods to improve efficiency of air compressor** 1. Cooling cylinder by spraying water during compression stroke. 2. Circulation of water surrounding to cylinder by providing jackets 3. Installing inter cooler between two cylinders 4. Providing greater fins on cylinder 5. By selecting suitable material for cylinder 6. By providing suitable choice of cylinder proportions i.e. short stroke and large bore in construction with sleeve valve Two stage reciprocating air compressor :  **Two stage reciprocating compressor** Multistage compression refers to the compression process completed in more than one stage i.e. a part of compression occurs in one cylinder (L.P. cylinder) and subsequently compressed air is sent to subsequent cylinders (H.P. cylinder) for further compression. Figure shows the schematic of two stage compressor with intercooler between stages. The total work requirement for running this shall be algebraic summation of work required for low pressure (LP) and high pressure (HP) stages. The size of HP cylinder is smaller than LP cylinder as HP cylinder handles high pressure air having smaller specific volume. Intake temp of air at LP =intake temp of air at HP for perfect intercooling. ----------

Que.No	Marks	
Q 5 b)	8	Question: **State the applications of reciprocating compressor and rotary compressor (4 each).** Answer: **Applications of Reciprocating Compressor** 1. In spray painting shop. 2. In workshop for cleaning machines. 3. For operation of pneumatic tool like rock drill, vibrator etc. 4. In automobile service station to clean vehicle. 5. To drive air motors in coal mines. 6. Food and beverage industry **Applications of Centrifugal Compressor** 1. In gas turbines and auxiliary power units. 2. In automotive engine and diesel engine turbochargers and superchargers. 3. In pipeline compressors of natural gas to move the gas from the production site to the consumer. 4. In oil refineries, natural gas processing, petrochemical and chemical plants. 5. Air-conditioning and refrigeration and HVAC: Centrifugal compressors quite often supply the compression in water chillers cycles. 6. In air separation plants to manufacture purified end product gases. 7. In oil field re-injection of high pressure natural gas to improve oil recovery. ----------
Q 6 d)	4	Question: **Enlist different uses of compressed air.** Answer: **Following are the applications of compressed air** 1) To drive air motors in coal mines. 2) To inject fuel in air injection diesel engines. 3) To operate pneumatic drills, hammers, hoists, sand blasters. 4) For cleaning purposes. 5) To cool large buildings. 6) In the processing of food and farm maintenance. 7) For spray painting in paint industry. 8) In automobile & railway braking systems. 9) To operate air tools like air guns. 10) To hold & index cutting tools on machines like milling ----------

Examination: 2016 SUMMER

Que.No	Marks	
Q 1a)(b)	4	Question: **Define following terms w.r.t. air compressor. i) FAD ii) Compression ratio.** Answer: i) FAD – It is the volume of air delivered under the intake conditions of temperature and pressure. ii) Compression ratio – It is defined as the ratio of absolute discharge pressure to the absolute inlet pressure. ----------
Q 1a)(c)	4	Question: **Enlist different uses of compressed air.** Answer: 1) To drive air motors in coal mines. 2) To inject fuel in air injection diesel engines. 3) To operate pneumatic drills, hammers, hoists, sand blasters. 4) For cleaning purposes. 5) To cool large buildings. 6) In the processing of food and farm maintenance. 7) For spray painting in paint industry. 8) In automobile & railway braking systems. 9) To operate air tools like air guns. 10) To hold & index cutting tools on machines like milling. ----------

Que.No	Marks	
Q 2 a)	8	Question: **It is desired to compress 15 m3 of air per minute from 1.0132 bar to 10 bar. Calculate minimum power required to drive the compressor having two stages and compared it the power required for single stage compression. Assume value of index for compression process to be 1.3 for both cases also assume the condition for maximum efficiency** Answer:  ----------

Q2 (a) $V_1 = 15\ m^3/min$ $P_1 = 1.0132$ bar

$P_2 = 10$ bar $n = 1.3$

For Single stage compression

$$W_1 = \frac{n}{n-1} P_1 V_1 \left[\left(P_2/P_1 \right)^{n-1/n} - 1 \right]$$

$$= \frac{1.3}{1.3-1} \times 1.0132 \times 10^5 \times \frac{15}{60} \left[\left(\frac{10}{1.0132} \right)^{\frac{1.3-1}{1.3}} - 1 \right]$$

$$= 76.06\ kW$$

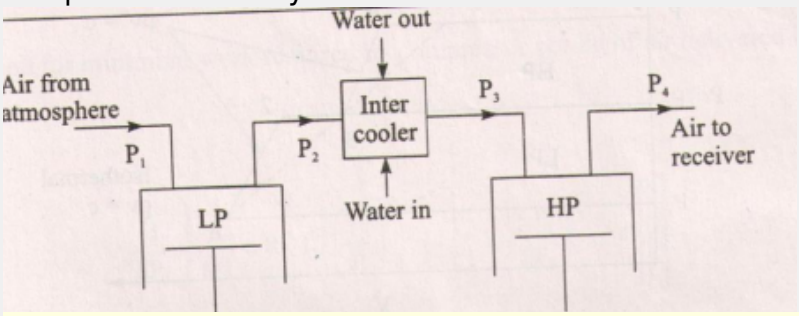
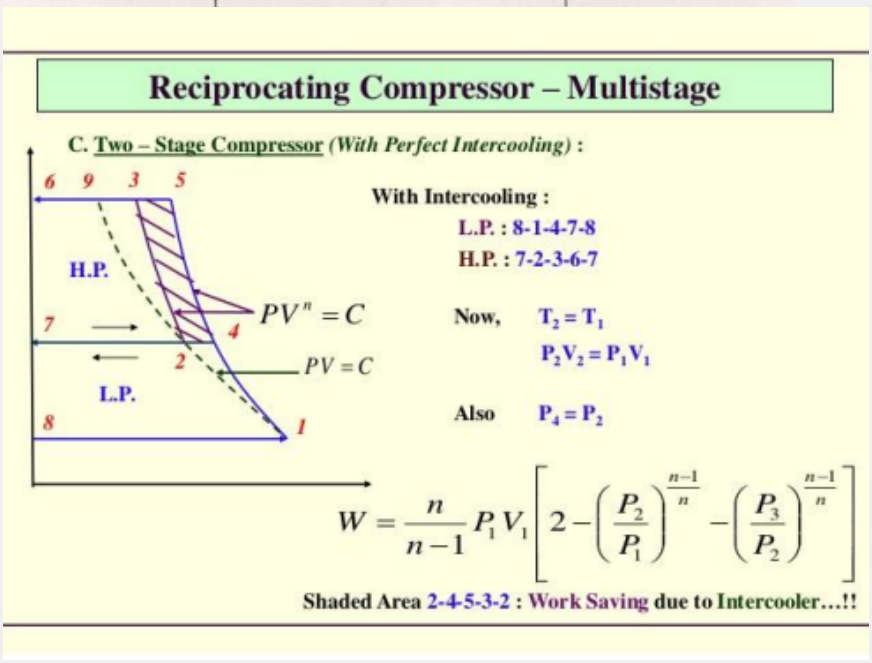
For Two stage compression

$$W_2 = \frac{2n}{n-1} P_1 V_1 \left[\left(P_3/P_1 \right)^{\frac{n-1}{2n}} - 1 \right]$$

$$= \frac{2 \times 1.3}{1.3-1} \times 1.0132 \times 10^5 \times \frac{15}{60} \left[\left(\frac{10}{1.0132} \right)^{\frac{1.3-1}{2 \times 1.3}} - 1 \right]$$

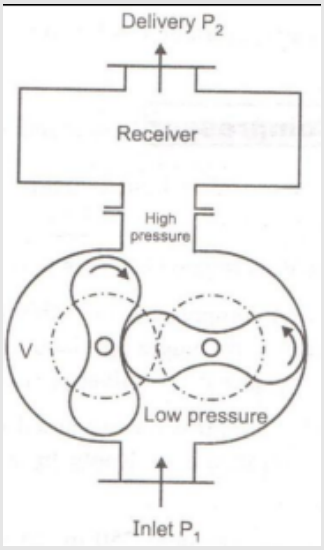
$$= 66.38\ kW$$

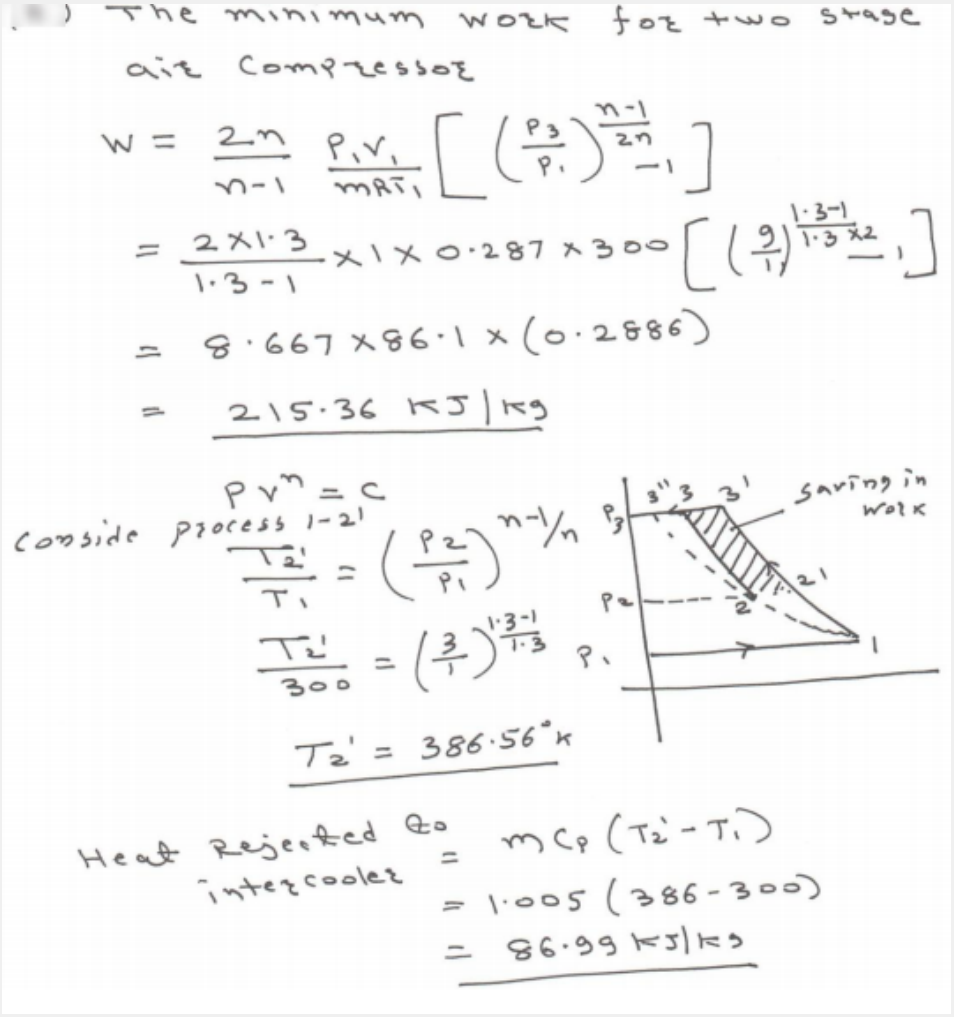
In case of two stage compression, less power is required to drive the compressor.

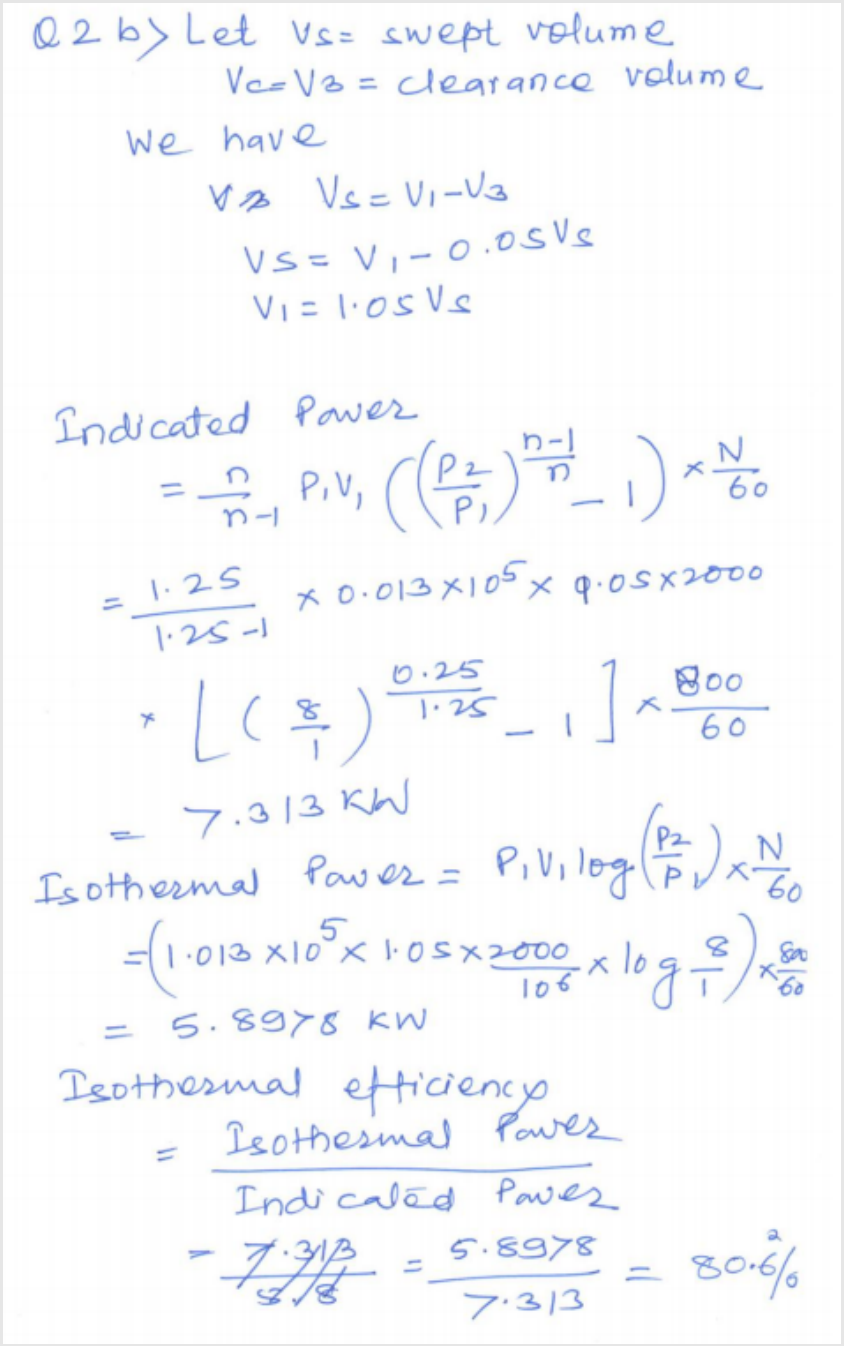
Que.No	Marks	
Q 5 b)	8	Question: **What do you mean by 'Perfect Intercolling' ? Explain with the help of P.V. diagram.** Answer: Intercooling : In perfect intercooling the temperature of air after passing out of intercooler is same as that of the temperature of air before compression of LP cylinder.   ----------

Que.No	Marks	
Q 6 b)	4	Question: **Why majority of air compressors available in the market are multi staged ? Explain** Answer: Multi-stage air compressors feature many benefits and so, they are mostly used in the market. Some of those features are given below 1. Higher air pressures are achievable by multi-staging (about 175 PSI against 120 PSI in single stage) 2. It requires less power for running 3. Light weight cylinders can are used 4. Leakages are less 5. Overall discharge temperatures are lower 6. Intercooler increases the efficiency of unit 7. It has a greater durability 8. Many multi-stage air compressors have the crankcase cast separate from the pump cylinders, which makes it easier to repair. 9. Multi-stage compressors Air compressors can perform (are suitable) many different functions in industrial applications ----------

Examination: 2016 WINTER

Que.No	Marks	
Q)	4	Question: **Explain with neat sketch working of lobe type air compressor.** Answer: Lobe type air compressor: it is a rotary type of compressor consisting of two rotors which are driven externally. One rotor is connected to drive and second is connected to gear. These two rotors have two or three lobes having epicycloids, hypocycloid or involutes profiles. In the figure two lobes compressor is shown with a inlet arrangement and receiver. A very small clearance is maintained between surfaces so that wear is prevented. Air leakage through this clearance decreases efficiency of this compressor. During rotation a volume of air V at atmospheric pressure is trapped between left hand rotor and casing . this air is positively displaced with change in volume until space is opened to high pressure region. At this instant some high pressure air rushes back from the receiver and mixed with the blower air until both pressure are equalized .  ----------

Que.No	Marks	
Q 1a)(b)	4	Question: **A two stage air compressor with perfect intercooling takes in air at 1 bar pressure and 27 °C. The law of compression in both the stages is Pv1.3 = constant. The compressed air is delivered at 9 bar from the H.P. Cylinder to an air receiver. Calculate per kg. of air i) The minimum work done. ii) The heat rejected to the intercooler.** Answer:  i) The minimum work for two stage air compressor $W = \frac{2n}{n-1} \frac{P_1 V_1}{mRT_1} \left[\left(\frac{P_3}{P_1} \right)^{\frac{n-1}{2n}} - 1 \right]$ $= \frac{2 \times 1.3}{1.3-1} \times 1 \times 0.287 \times 300 \left[\left(\frac{9}{1} \right)^{\frac{1.3-1}{1.3 \times 2}} - 1 \right]$ $= 8.667 \times 86.1 \times (0.2886)$ $= 215.36 \text{ KJ/Kg}$ $PV^n = C$ Consider process 1-2' $\frac{T_2'}{T_1} = \left(\frac{P_2}{P_1} \right)^{n-1/n}$ $\frac{T_2'}{300} = \left(\frac{3}{1} \right)^{\frac{1.3-1}{1.3}}$ $T_2' = 386.56^\circ K$ Saving in work Heat Rejected to intercooler $= m C_p (T_2' - T_1)$ $= 1.005 (386 - 300)$ $= 86.99 \text{ KJ/Kg}$ ----------

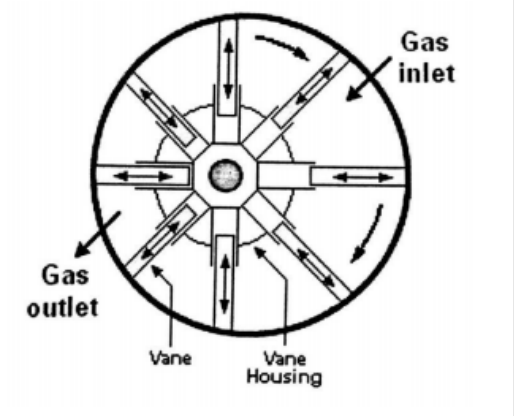
Que.No	Marks	
Q 2 b)	8	Question: **A single stage reciprocating air compressor has a swept volume of 2000 cm3 and runs at 800 rpm. It operates on a pressure ratio of 8 with a clearance 5% of the swept volume. Assume NTP room conditions at inlet (p = 101.3 kPa t = 15°C) and polytropic compression and expansion with n = 1.25 calculate i) Indicated power, ii) Volumetric efficiency, iii) Mass flow rate iv) Isothermal efficiency** Answer:  Q 2 b) Let V_s = swept volume $V_c = V_3$ = clearance volume We have $V_s = V_1 - V_3$ $V_s = V_1 - 0.05 V_s$ $V_1 = 1.05 V_s$ Indicated Power $= \frac{n}{n-1} P_1 V_1 \left(\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right) \times \frac{N}{60}$ $= \frac{1.25}{1.25-1} \times 0.013 \times 10^5 \times 0.05 \times 2000 \times \left[\left(\frac{8}{1} \right)^{\frac{0.25}{1.25}} - 1 \right] \times \frac{800}{60}$ $= 7.313$ KW Isothermal Power $= P_1 V_1 \log \left(\frac{P_2}{P_1} \right) \times \frac{N}{60}$ $= \left(1.013 \times 10^5 \times 1.05 \times \frac{2000}{10^6} \times \log \frac{8}{1} \right) \times \frac{800}{60}$ $= 5.8978$ kW Isothermal efficiency $= \frac{\text{Isothermal Power}}{\text{Indicated Power}}$ $= \frac{7.313}{8} = \frac{5.8978}{7.313} = 80.6\%$ ----------

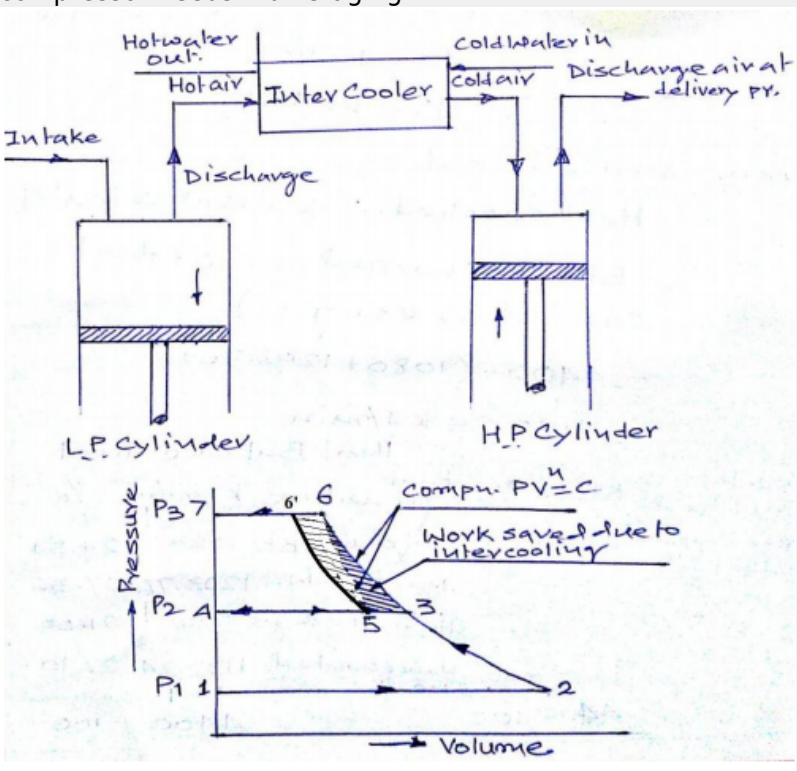
Que.No	Marks	
Q 5 b)	8	Question: **A single cylinder reciprocating compressor has a bore of 120 mm and a stroke of 150 mm. and is driven at a speed of 1200 rpm. It is compressing CO2 gas from a pressure of 120 Kpa and temp. of 20°C to a temp. of 215°C. Assuming polytropic compression with n = 1.3, no clearance and volumetric efficiency of 100% calculate (i) pressure ratio, (ii) Indicated power, (iii) shaft power with mech. efficiency 80%, (iv) mass flow rate** Answer: $\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^{n/n-1}$ $P_2 = 1.2\left(\frac{488}{293}\right)^{\frac{1.3}{1.3-1}}$ $P_2 = 10.92$ bar Pressure Ratio $= \frac{P_2}{P_1} = 9.1$ $V_s = \frac{\pi}{4} d^2 l \times N$ $= \frac{\pi}{4} \times (0.12)^2 \times 0.15 \times \frac{1200}{60}$ $V_1 = 2.036\ m^3/min$ $I.P. = \frac{n}{n-1} P_1 V_1 \left(\left(\frac{P_2}{P_1}\right)^{n-1/n} - 1\right)$ $= \frac{1.3}{1.3-1} \times 1.2 \times 10^5 \times \frac{2.036}{60}\left[(9.1)^{\frac{1.3-1}{1.3}} - 1\right]$ $= 11.68$ KW Shaft power when mech efficiency 80%. Shaft Power $= \frac{I.P.}{\eta_{mech}} = \frac{11.68}{0.8}$ $= 14.6$ KW $P_1 V_1 = m R T_1$ $m = \frac{P_1 V_1}{R T_1} = \frac{1.2 \times 10^5 \times 2.036}{287 \times 293}$ $= 2.9054$ kg/min ----------

Que.No	Marks	
Q 6 a)	4	Question: **What is the necessity of purification of air in compressor and how it is done ?** Answer: Necessity of purification of air in compressor : Air contains dust and dirt particles which are dangerous to the compressor valves and operation . so purification of air is necessary. It is the process of separating emulsified, suspended and separate oil as well as other contaminations from water phase of compressed air. Air cleaners are used for purification process of air . it reduces noise level also. Following are different types of air cleaners 1. Oil bath type air cleaner 2. Dry type air cleaner 3. Oil wetted type air cleaner 4. Paper pleated type air cleaner 5. Centrifugal type air cleaner ----------

Examination: 2015 SUMMER

Que.No	Marks	
Q 1a)(b)	4	Question: **Define : i) Compression ratio (Rc) ii) Swept volume (vs) iii) Cut off ratio iv) Clearance volume (vc)** Answer: **b)** i) Compression Ratio R_c – It's a ratio of total cylinder volume to the clearance volume. $R_c = \frac{V_c+V_s}{V_c}$ ii) Swept Volume V_S – It is the volume swept by piston when travelled from one dead centre to the other. V_s = A x L A – Piston area cm^2, L – Length of stroke cm iii) Cut off Ratio – It is the ratio of volume at the end of combustion to the clearance ratio $\alpha_c = \frac{V_3}{V_2}$ ***volume*** $\rho = v_3/v_2$ iv) Clearance Volume V_C = The nominal volume of the space on the combustion side of the piston of TDC ----------
Q 1a)(c)	4	Question: **Write uses of compressed air.** Answer: Uses of compressed air:- 1. Cleaning automobiles 2. Pneumatic tools 3. Supercharging in I.C. engines 4. Cooling of large building 5. Construction of bridges, roads etc. 6. Spraying points 7. Spraying fuel in high speed diesel engine 8. Starting of I.C. engines ----------

Que.No	Marks	
Q 1a)(d)	4	Question: **Draw a neat sketch of vane compressor and label the different parts.** Answer:  ----------

Que.No	Marks	
Q 2 b)	8	Question: **What is the necessity of multistage compression ? Explain the working of two stage reciprocating air compressor with intercooler, with the help of p-v diagram.** Answer: Necessity of multistage compression i) As index of compression 'n' increases it increases compression work. ii) Increase in pressure ratio (P2/P1) it increases work as well as size of cylinder. iii) Increment in pressure ratio (P2/P1) beyond certain limit, volumetric efficiency decreases while it increases leakage loss on either sides the piston and valves. Due to above pointes and for higher pressure ratio compressor needs multistaging.  Fig. shows arrangement of two stage reciprocating air compressor with inter cooler and its working shown on P.V. diagram plane. Processes occurred in the cycle □ - 1 – 2 – suction process by LP cylinder to draw atmospheric pressure □ - 2 – 3 – compression process by LP cylinder up to pressure P2 □ - 3 – 4 – delivery of compressed air into the air cooler □ - 4 – 5 – during this process air rejects the heat to the cold water and at the same time suction process by HP cylinder to draw air from air cooler. □ - 5 – 6 – compression pressure by HP cylinder up to required pressure P3 □ - 6 – 7 – delivery of compressed air at required pressure to the point of use. This completes the process and system has shown saving in work shown by shaded portion. ----------

Que.No	Marks	
Q 5 a)	8	Question: **Differentiate between reciprocating and rotary compressors** Answer: **Reciprocating compressor** vs **Rotary compressor** 1. Compressor of air take place with help of piston and cylinder arrangement with reciprocating motion of piston. — 1. Compression of air take place due to rotary motion of blades. 2. Delivery of air intermittent. — 2. Delivery of air is continuous. 3. Delivery pressure is high i.e. pressure ratio is high. — 3. Delivery pressure is low, i.e. pressure ratio is low. 4. Flow rate of air is low. — 4. Flow rate of air is high. 5. Speed of compressor is low because of unbalanced forces. — 5. Speed of compressor is high because of perfect balancing. 6. Reciprocating air compressor has more number of moving parts. — 6. Rotary air compressor has less number of moving part. 7. It needs proper lubrication and more maintenance. — 7. It required less lubrication and maintenance. 8. Due to low speed of ration it can't be directly coupled to prime mover but it requires reduction of speed. — 8. Rotary air compressor can be directly coupled to prime mover. 9. It is used when small quantity of air at high pressure is required. — 9. It is used where large quantity of air at lower pressure is required. ---

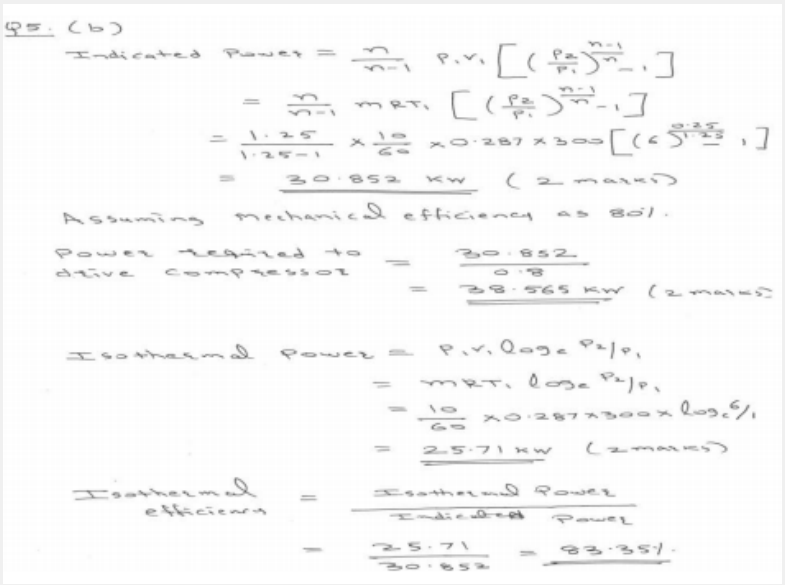
Examination: 2015 WINTER

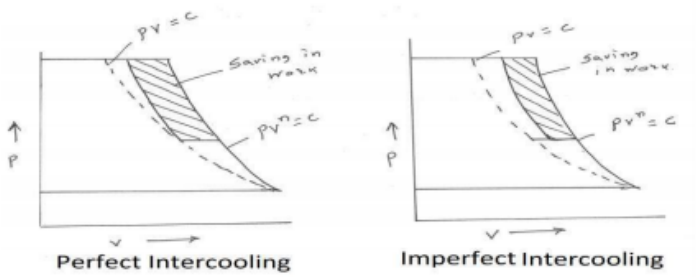
Que.No	Marks	
Q 1a)(b)	4	Question: **State any four industrial uses of compressed air.** Answer: 1) To drive air motors in coal mines. 2) To inject fuel in air injection diesel engines. 3) To operate pneumatic drills, hammers, hoists, sand blasters. 4) For cleaning purposes. 5) To cool large buildings. 6) In the processing of food and farm maintenance. 7) For spray painting in paint industry. 8) In automobile & railway braking systems. 9) To operate air tools like air guns. 10) To hold & index cutting tools on machines like milling / cnc machines. ---
Q 1a)(c)	4	Question: **Define the following terms related to compressor. i) Compressor capacity ii) Free air delivered iii) Volumetric efficiency iv) Mechanical efficiency** Answer: i] Compressor capacity:- □ It is the volume of air delivered by the compressor in m3 per minute □ It is express in m3 /min ii) FAD:- □ It is the volume of air delivered by compressor under the intake conditions of temperature and pressure. □ Capacity of compressor is generally given in terms of free air delivery. □ Unit = m3 /cycle iii) Volumetric Efficiency: It is the ratio of actual volume of air delivered at standard atmospheric condition discharge in one delivery stroke to the swept volume by the piston during the stroke.iv) Mechanical Efficiency: It is the ratio of Indicated power to shaft (brake) power. ---

Que.No	Marks	
Q 2 a)	8	Question: **Compare Reciprocating air compressor and Rotary air compressor mentioning the basis of comparison (any 8 points)** Answer:

Reciprocating compressor	Rotary compressor
1. Compression of air takes place with help of piston and cylinder arrangement with reciprocating motion of piston.	1. Compression of air takes place due to rotary motion of blades.
2. Delivery of air intermittent.	2. Delivery of air is continuous.
3. Delivery pressure is high i.e. pressure ratio is high.	3. Delivery pressure is low, i.e. pressure ratio is low.
4. Flow rate of air is low.	4. Flow rate of air is high.
5. Speed of compressor is low because of unbalanced forces.	5. Speed of compressor is high because of perfect balancing.
6. Reciprocating air compressor has more number of moving parts.	6. Rotary air compressor has less number of moving part.
7. It needs proper lubrication and more maintenance.	7. It required less lubrication and maintenance.
8. Due to low speed of ration it can't be directly coupled to prime mover but it requires reduction of speed.	8. Rotary air compressor can be directly coupled to prime mover.
9. It is used when small quantity of air at high pressure is required.	9. It is used where large quantity of air at lower pressure is required.

Q 5 b)	8	Question: **A pneumatic rock drill requires 10 kg/min of air at 6 bar pressure. Find the power required to drive the single acting single stage reciprocating compressor receiving air at 1 bar and 27°C. Assume mechanical efficiency as 80% and value of index, n as 1.25. Take Cp = 1.005 kJ/kgk and Cv = 0.718 kJ/kgk for air. Also estimate isothermal efficiency of compression.** Answer:

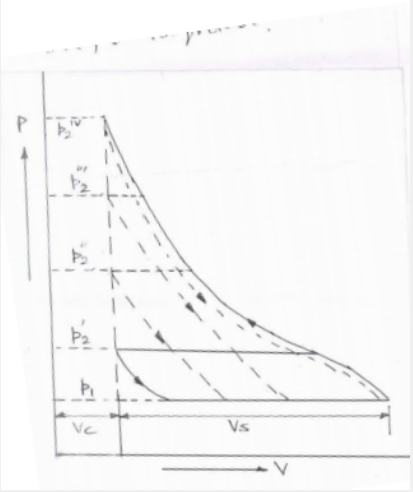


Que.No	Marks	
Q 6 b)	4	Question: **Define perfect and imperfect inter-cooling in air compressor and show it by graph also** Answer: **Perfect cooling:** In this process the temperature of air after passing out of intercooler is same as that of temperature of air before compression in LP cylinder. The respective figure is shown. **Imperfect cooling:** In this process the temperature of air after passing out of intercooler is between the temperature of air before & after compression in LP cylinder. The respective figure is shown.  ----------

Examination: 2014 WINTER

Que.No	Marks	
Q 1a)(ii)	4	Question: **Define following efficiencies related to compressors: 1) mechanical efficiency 2) polytropic efficiency 3) compressor efficiency 4) overall volumetric efficiency** Answer: ii) Efficiencies related to compressor i) Mechanical Efficiency $\eta_m = \frac{Indicated\ Power}{ShaftPower}$ ii) Polytropic Efficiency – It is nothing but the isentropic efficiency of one small stage of a multistage compressor this small stage efficiency is supposed to be constant for all stages of compressor with infinite number of stages. $\eta_{poly} = \frac{n(y-1)}{y(n-1)}$ iii) Compressor efficiency or isothermal efficiency $\eta_{iso} = \frac{Isothermal\ Power}{Indicated\ Power}$ iv) Overall volumetric efficiency η_{ovol} - Mass of fluid actually discharged in one revolution - Mass of fluid at suction line condition - Mactual (ms) at suction condition *Volumetric efficiency = Actual quantity of air taken in the compressor / stroke volume of the compressor* ----------

<table>
<tr><th>Que.No</th><th>Marks</th><th></th></tr>
<tr><td>Q 1a)(iii)</td><td>4</td><td>Question:
Show the effect of increase of compression ratio in a single stage reciprocating compresor on PV diagram and give its physical significance.

Answer:
Effect of Compression ratio in a single stage reciprocating compressor on PV diagram
 

Physical Significance:-
If compression in increased (usually it varies from 5 to 8) the final temperature increases and volumetric efficiency decreases flow and it compression ratio increases beyond usual value, compression ratio P2/P1 becomes zero as it can be observed from the figure. Increment in compression ratio will increase leakage past the piston and will need robust cylinder. If will also affect the operation of delivery valve and if will reduce lubricating properties of oil. It may increase the risk of ignition in piping and receiver.
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<tr><td>Q 2a)(i)</td><td>8</td><td>Question:
The criterion of the thermodynamic efficiency of a reciprocating compressor is isothermal compression while for rotory compressor it is isentropic compression. Discuss the reason for this.

Answer:
The compression process in reciprocating compressor may approach to low speed of compression and cylinder cooling. Therefore isothermal efficiency is used in reciprocating compressor. But in rotary compressor there is high friction and eddies formation due to high velocity air through the compressor. This causes heating of air during compression process. Therefore temperature of air leaving the impeller is higher than the isentropic compression. The compressor may be as high as 1.7 (n>t). Therefore isentropic efficiency is used in rotary compressor.
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<tr><td>Q 2a)(ii)</td><td>8</td><td>Question:
Compare reciprocating compressors and centrifugal compressors on the basis of the following parameters: 1) adaptability 2) suitability 3) mechanical efficiency 4) capacity of delivering volume.

Answer:
<table>
<tr><td>Parameter</td><td>Reciprocating compressor</td><td>Centrifugal compressor</td></tr>
<tr><td>Adaptability</td><td>To low speed</td><td>To high speed</td></tr>
<tr><td>Suitability</td><td>Suitability for low medium and high pressure and low medium gas volumes
Small quantity of air or gas is required at high pressure.</td><td>Suitability for low and medium pressure and large gas volumes
Large quantity of air or gas is required at relatively low pressure</td></tr>
<tr><td>Mechanical efficiency</td><td>Low</td><td>High</td></tr>
<tr><td>Capacity of delivering volume</td><td>Small volume</td><td>Large volume</td></tr>
</table>
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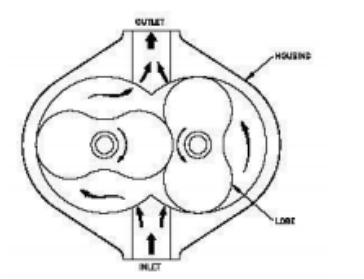
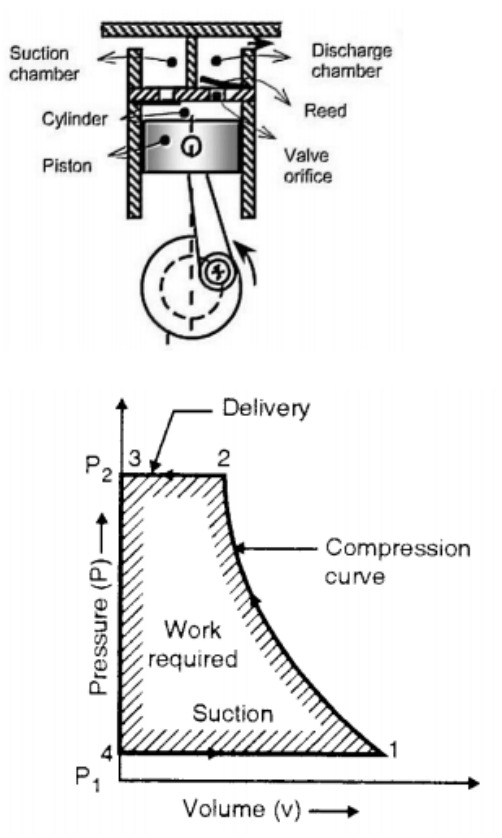
</table>

Que.No	Marks	
Q 5 b)	8	Question: **A single stage single acting air compressor delivers 0.6 kg of air per minute at 6.1 bar. The temperature and presure at the end of suction stroke are 28°C and 1.1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3 % of the swept volume. Assuming index of compression and expansion as 1.25, find: (i) volumetric efficiency of compressor (ii) power required if mechanical efficiency is 85% (iii) speed of compressor in rpm** Answer: $m = 0.6\ kg/min$ $= \frac{0.6}{60} kg/min$ =0.01 kg/sec. $P_1 = 1.1\ bar$ =1.1 x 10^5 N/m^2 $T_1 = 28 + 273$ = 301 ^{0}k 1. Assume R = 0.287 kJ/kgk for air Indicated power $= \frac{n}{n-1} mRT_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right]$ $= \frac{1.25}{1.25-1} \times 0.01 \times 0.287 \times 301 \left[\left(\frac{6.1}{1.1}\right)^{\frac{1.25-1}{1.25}} - 1\right]$ $= 5 \times 0.01 \times 0.287 \times 301[(5.5)^{0.2} - 1]$ $= 5 \times 0.01 \times 0.287 \times 301[1.41 - 1]$ $= 5 \times 0.01 \times 0.287 \times 301[0.41]$ $IP = 1.77 \frac{kJ}{g}\ 02\ kw\ 02\ 1770 \frac{J}{g}\ 02\ w$ If the mechanical efficiency is 85^0/0 Power required $= \frac{1.77}{0.85}$ Power required = 2.08 kW. It is not affected by clearance volume. 2. $IP = \frac{n}{n-1} P_1 r_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1\right] \times N/60$ $1770 = \frac{1.25}{1.25-1} \times 1.1 \times 10^5 \times 0.00118 \left[\left(\frac{6.1}{1.1}\right)^{\frac{1.25-1}{1.25}} - 1\right] \times \frac{N}{60}$ $1770 = 5 \times 1.1 \times 10^5 \times 0.00118[(5.55)^{0.2} - 1]N/60$ $= 5 \times 1.1 \times 10^5 \times 0.0018[0.41] \times N/60$ $= 406 \times N/60$ $N = \frac{1770 \times 60}{406}$ $N = 262\ r.p.m.$ $r_1 = \frac{\pi}{4} d_1^2 l$ $= \frac{\pi}{4} \times (0.1)^2 \times 0.15$ $= 0.00118\ m^3$ 3. Clearance volume =0.03 v_s $\therefore$ volumetric efficiency $= 1 - \frac{VC}{VS}\left[\left(\frac{P_2}{P_1}\right)^{\frac{1}{1.25}} - 1\right]$ $= 1 - \frac{0.03\ VS}{VS}\left[\left(\frac{6.1}{1.1}\right)^{\frac{1}{1.25}} - 1\right]$ $= 1 - 0.03[(5.55)^{0.8} - 1]$ $= 1 - 0.03[3.93 - 1]$ $= 1 - 0.088$ $volumetric = 0.91 = 91\%$ ----------

Que.No	Marks	
Q 6 b)	4	Question: **Define displacement of compressor for two stage compressor. Why is free air delivered less than displacement of compressor?** Answer: Displacement is the product of piston displacement and working stroke per minute is bared on low pressure only and the amount air passing through the other cylinder for two stage compressor. When free air wave from low pressure cylinder to high pressure cylinder through intercooler there is reduction of volume of air because of perfect cooling so free air delivered is less than displacement of compressor. (Pl check) ----------

Examination: 2018 SUMMER

Que.No	Marks	
Q 1a)(c)	4	Question: **Give the classification of air-compressors** Answer: **Classification of Air compressors: 1. According to principle:** a. Reciprocating air compressors b. Rotary air compressors **2. According to the capacity** a. Low capacity air compressors b. Medium capacity air compressors c. High capacity air compressors 3. According to pressure limits a. Low pressure air compressors b. Medium pressure air compressors c. High pressure air compressors 4. According to method of connection a. Direct drive air compressors b. Belt drive air compressors c. Chain drive air compressors ----------
Q 1a)(d)	4	Question: **Explain with neat sketch working principle of Lobe compressor** Answer: **Rotary Lobe type Air Compressor has two mating lobe-type rotors mounted in a case.** The lobes are gear driven at close clearance, but without metal-to-metal contact. The suction to the unit is located where the cavity made by the lobes is largest. As the lobes rotate, the cavity size is reduced, causing compression of the vapor(air) within. The compression continues until the discharge port is reached, at which point the vapor exits the compressor at a higher pressure.  ----------

Que.No	Marks	
Q 2 b)	8	Question: **Explain construction and working of single stage reciprocating air compressor with neat sketch. Also represent it on P-V diagram.** Answer: In single stage reciprocating air compressor, the entire compression is carried out in a single cylinder. The opening & closing of a simple check valve (plate or spring valve) depends upon the difference in pressure, if mechanically operated valves are used for suction & discharge then their functioning is controlled by cams. The weight of air in the cylinder will be zero when the piston is at top dead centre. At this position, you have to neglect clearance volume. When piston starts moving downwards, the pressure inside the cylinder falls below atmospheric pressure& suction valve/inlet valve opens. The air is drawn into the cylinder through a suction filter element. This operation is known as suction stroke. When the piston moves upwards, compresses the air in cylinder & inlet valve closes when the pressure reaches atmospheric pressure. Further compression follows as the piston moves towards the top of its stroke. Until when the pressure in the cylinder exceeds that in the receiver. This is compression stroke of a compressor. At the end of this stroke discharge/delivery valve opens & air is delivered to a receiver  ----------

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<tr><th>Que.No</th><th>Marks</th><th></th></tr>
<tr><td>Q 5a)(i)</td><td>8</td><td>Question:
Compare reciprocating and rotary compressors (any four).

Answer:
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<tr><th>Reciprocating compressor</th><th>Rotary compressor</th></tr>
<tr><td>1. Compression of air takes place with help of piston and cylinder arrangement with reciprocating motion of piston.</td><td>1. Compression of air takes place due to rotary motion of blades.</td></tr>
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<tr><td>9. It is used when small quantity of air at high pressure is required.</td><td>9. It is used where large quantity of air at lower pressure is required.</td></tr>
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<tr><td>Q 5a)(ii)</td><td>8</td><td>Question:
Write any four applications of compressed air.

Answer:
Following are the applications of compressed air:-
1) To drive air motors in coal mines.
2) To inject fuel in air injection diesel engines.
3) To operate pneumatic drills, hammers, hoists, sand blasters.
4) For cleaning purposes.
5) To cool large buildings.
6) In the processing of food and farm maintenance.
7) For spray painting in paint industry.
8) In automobile & railway braking systems.
9) To operate air tools like air guns.
10) To hold & index cutting tools on machines like milling.
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<tr><td>Q 6 b)</td><td>4</td><td>Question:
Define : i) Isothermal efficiency. ii) Volumetric efficiency with respect to air compression.

Answer:
i) Isothermal efficiency – It is defined as the ratio of isothermal power to the indicated or actual power. Isothermal efficiency = Isothermal power / Indicated power.

ii) Volumetric efficiency – It is the ratio of actual volume of the free air delivered at standard atmospheric condition at discharge in one delivery stroke to the swept volume by the piston during the stroke.
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