



MODEL ANSWER

SUMMER- 17 EXAMINATION

Subject Title: Elements of Mechanical engineering

Subject Code:

17413

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 judgement 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.

Q. No.	Sub Q.	Answer	Marking Scheme
1	a	<p>Following are the applications of compressed air in industry</p> <ol style="list-style-type: none"> 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. 	½ for each any four
	b	<p>Classification of pumps.</p> <p>A) Centrifugal pumps 1- Axial flow pump 2- Radial flow pump</p> <p>B) Positive displacement pumps 1- Rotary gear pump 2- Rotary vane pump 3- Rotary lobe pump 4- Rotary screw pump 5- Reciprocating pump</p>	02
	c	<p>Compressor capacity – It is defined as the volume delivered by the compressor in cubic metre per minute.</p> <p>Swept Volume – It is the volume swept through by the first stage piston in cubic metre per minute.</p>	01+01



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d	<p>Following are the methods of energy saving in air compressor.</p> <ol style="list-style-type: none"> 1) Inter – stage cooling 2) Water jacketing 3) Multi stage compression 4) By using regenerative air dryer, this uses the heat of compressed air to remove moisture. 	½ for each any four
e	<p>Define the term boiler efficiency.</p> <p>Ans. Boiler efficiency is the fraction of energy input that actually goes into raising steam. Thus it could be given by the ratio of heat actually used for steam generation and total heat available due to combustion of fuel in boiler.</p> <p style="text-align: center;">OR</p> $\text{Boiler efficiency} = \frac{\text{Heat used in steam generation}}{\text{Total heat available due to fuel burning}}$ $= \frac{m(h - h_w)}{m_f \times C.V.}$	02
f	<p>Where m_f is the mass of fuel burnt per hour, C.V. is calorific value of fuel used (kJ/kg), m is mass of steam generated per hour and enthalpies h and h_w are that of final steam and feed water, kJ/kg. Generally high heating value of fuel is used as calorific value of fuel.</p> <p>Define suction head & delivery head of centrifugal pump. (1 mark each)</p> <p>Ans. Suction Head – It is the vertical height of the centre line of the centrifugal pump above the water surface in the tank or pump from which water is to be lifted. It is denoted by ‘h_s’.</p> <p>Delivery head – The vertical distance between the centre line of the pump and the water surface in the tank to which water is delivered is known as delivery head. It is denoted by ‘h_d’.</p>	01+01
g	<p>Provisions under boiler act for remedial measures are</p> <p>No owner of a boiler shall use the boiler or permit it to be used</p> <ol style="list-style-type: none"> 1. Unless it has been registered in accordance with the provision of this act 2. In the case of any boiler which has been transferred from one state to another, until the transfer has been reported in the prescribed manner 3. Unless certificate or provisional order authorizing the use of the boiler is for the time being in force under this act 4. At a pressure higher than the maximum pressure recorded in such certificate or 	01 for each any two



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	<p>h</p>	<p>provisional order</p> <p>5. Where the State Government has made rules requiring that boilers shall be in charge of persons holding certificates of proficiency or competency unless the boiler is in charge of a person holding the certificate required by such rules.</p> <p>Define brake power & indicated power.</p> <p>Ans. The power developed by an engine and measured at the output shaft is called the brake power (bp) and is given by,</p> $bp = \frac{2\pi N\tau}{60}$ <p>where:</p> <p>τ is the torque, in Newton meter (N.m),</p> <p>N is the rotational speed, in minutes,</p> <p>bp is the brake power, in watt.</p> <p>Indicated Power (ip) is defined as the power developed by combustion of fuel in the cylinder of engine. It is always more than brake power.</p>	<p>01+01</p>
	<p>i</p>	<p>Purpose of Morse test: Morse test is used for measurement of friction power of multicylinder IC Engines . It is calculated as a difference between the indicated power and the brake power.</p> <p>Other methods for measurement of frictional power are ;</p> <ol style="list-style-type: none"> 1. Wilans line method 2. Motoring test 3. Difference between IP and BP 	<p>01+01</p>
	<p>j</p>	<p>Function of foot valve : The function of foot valve is to allow flow of water or liquid in the centrifugal pump to take place from suction pipe to delivery pipe and keep all time liquid or water filled in the casing and suction pipe of pump i.e The one way foot valve keeps the suction line and the pump casing filled with water.</p>	<p>02</p>
	<p>k</p>	<p>Sources of heat losses in Boiler :</p> <ol style="list-style-type: none"> 1. Chimney of the boiler carrying exhaust gases 2. Combustible heat loss caused by unburned fuel 3. Furness walls (Radiation heat loss) 4. Heat exchangers like air preheater , economizer etc 5. Boiler shell walls 	<p>01 for each any two</p>

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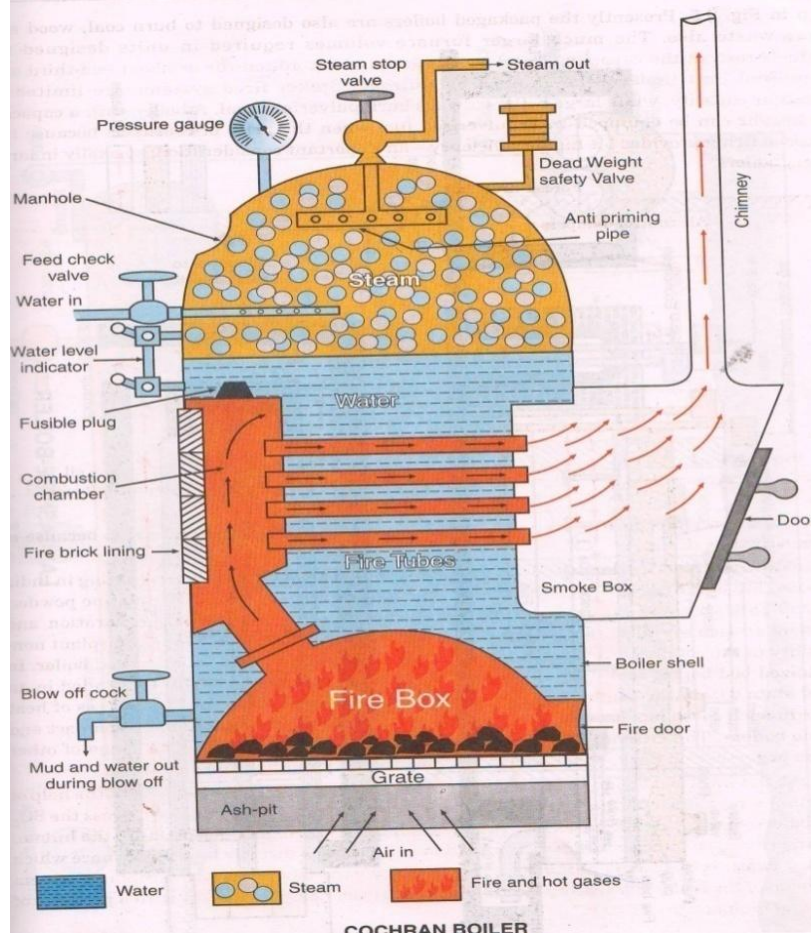
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2

a



Cochran boiler

04

b

Priming in centrifugal pump :

It is defined as the operation in which the suction pipe, casing of the pump and the portion of the delivery pipe up to the delivery valve is completely filled up from outside source with the liquid to be raised by the pump before the starting the pump.

This means that when there is no water in the pump, it is running in air. The pressure head developed is in terms of meters of air. Whereas when there is water, pressure head developed is in terms of meters of water. But as the density of water is low, the pressure head developed by air is negligible than that developed by water. Due to this water will not be sucked by the pump. To avoid this, priming is necessary.

04

c

Staging and its advantages in compressors:

Multistaging of air compressors : If pressure development of air is carried out in more than one cylinder, it is known as multistaging of air compressors. E. g. two stage , three stage reciprocating compressors

01



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Advantages

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

03
Any
three

Comparison between two –stroke & four stroke engines.

Four stroke engines	Two stroke engines
1) Cycle is completed in two revolutions of crank shaft.	1) Cycle is completed in one revolutions of crank shaft.
2) One power stroke is obtained in every two revolution of crank shaft.	2) One power stroke is obtained in every revolution of crank shaft.
3) Because of one power stroke for two revolutions, power produced for same size engine is small or for same power engine is bulky.	3) Because of one power stroke for one revolution, power produced for same size engine is more. Theoretically twice but in actual practice 1.7 to 1.8 times or for same power, engine is light and compact.
4) Engine contains valves & valve mechanism.	4) Do not contain valves but only ports are present.
5)Heavier flywheel required	5) Lighter flywheel required.
6) Initial cost is high because of heavy weight and complicated valve mechanism.	6) Initial cost is low because of light weight and no valve mechanism.
7) Thermal efficiency is more.	7) Thermal efficiency is less.
8) Used where efficiency is important. e.g. bus , truck, tractor	8) Used where light and compact engine is required. e.g. scooters, lawn movers.

01 for
each any
four

Difference between impulse and reaction turbine

Impulse turbine	Reaction turbine
1. Steam completely expands in nozzle and pressure remains constant during flow	1. Steam expands partly in nozzle and further expansion take place in rotor blade



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<p>through the blade passage.</p> <p>2. Relative velocity of steam passing over blade of impulse turbine is constant.</p> <p>3. Pressure is same at inlet and outlet.</p> <p>4. Steam velocity is very high.</p> <p>5. Lesser number of stages required.</p> <p>6. It occupies less space per unit power.</p> <p>7. Blades are symmetrical profile type.</p> <p>8. Blade passage of const. cross section</p>	<p>passage.</p> <p>2. Relative velocity increases as steam passing over the blade expands.</p> <p>3. Pressure is different at inlet and outlet.</p> <p>4. Steam velocity is not very high.</p> <p>5. More numbers of stages required.</p> <p>6. It occupies more space per unit power.</p> <p>7. The blades are aerofoil & non symmetrical type.</p> <p>8. Blade passage or variable cross sectional area.</p>	01 for each Any two
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Applications: Impulse turbine : used in micro and small power plants

Reaction turbine : used in medium and high capacity power plants

01
+01

Faults and remedies in centrifugal pump :

Sr. No	Faults	Remedies
01	Foot valve leak or jammed	Clean or replace foot valve
02	Shaft gland damaged	Replace the gland
03	Suction pipe or bend leak	Repair the pipe and bend leakages
04	No delivery of water or liquid	Check for electric supply, check for priming

01 for each any four

Causes and remedies of IC engines:

Sr. No	Causes	Remedies
01	Bearing wear	Replace the bearing and check the alignment
02	Irregular discharge	Check discharge valve wear, else replace it
03	Suction problems	Check suction line , inlet valve, leakages
04	Excessive vibrations	Check wear of crankschaft bearing

01 for each

3

f

a

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b

Q.3 (b) Given,

$$W = 200 \text{ N} \quad S = 30 \text{ N}$$

Effective brake wheel dia. = 630 mm

$$\text{b.p.} = 2\pi NT$$

$$= 2\pi N(W-S) \cdot r$$

$$= 2\pi \times \frac{430}{60} \times (200-30) \times \frac{0.630}{2}$$

$$= \underline{2.4123 \text{ kW}} \quad - \quad (2 \text{ marks})$$

Indicated mean effective Pressure (P_m) = $\frac{\text{Area of Indicator diagram}}{\text{Length of Indicator diagram}} \times \text{Spring Constant}$

$$= \frac{420}{60} \times 1.1$$

$$= \underline{7.7 \text{ bar}} \quad - \quad (1 \text{ mark})$$

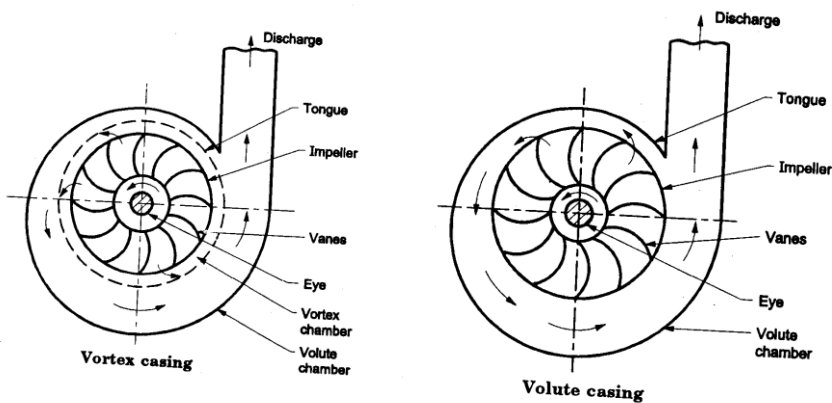
$$\text{I.P.} = P_m \cdot L \cdot A \cdot \frac{N}{n} \quad n=2 \text{ for four stroke cycle}$$

$$= 7.7 \times 10^5 \times 0.15 \times \frac{\pi}{4} (0.1)^2 \times \frac{430}{2 \times 60}$$

$$= \underline{3.251 \text{ kW}} \quad - \quad (1 \text{ mark})$$

c

Draw labeled sketch of casing of centrifugal pump.



2

1

1

02 marks each
Any two



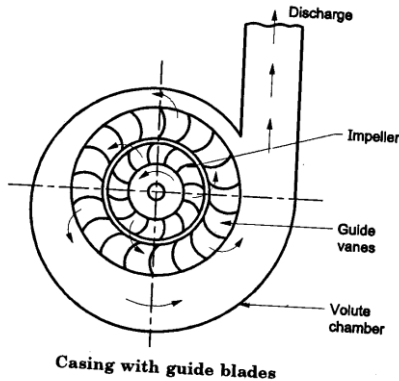
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Super heater and preheater in supercritical boilers:

d

Superheater : in supercritical boilers the function of superheater is to increase the temperature of steam above the saturation point. Super heater is known as boiler accessory which increases its efficiency . It produces complete dry and super heated high pressure steam. There are two types of superheaters

1. Convective super heater
2. Radiant superheater

Air pre heater : In all supercritical boilers air preheater is used to increase the temperature of air before entering into furnace. Usually air pre heater is located after the economizer . it is a accessory and it increases efficiency of boiler .

Following are its types

1. Plate type
2. Tube type
3. Storage type

Compressed air preparation stages: the compressed air is available for application when it is prepared through following stages.

e

1. Cleaning and filtering of atmospheric air
2. Suction of this air into cylinder
3. Compression of air
4. Delivery and storage of air in receiver

02

02

01 for each



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f	Differentiate between fire tube boilers and water tube boilers			01 for each any four
	Sr. No	Fire tube boilers	Water tube boilers	
	01	Hot flue gases flow in the tubes surrounded outside by the water	Water flows in the tubes surrounded outside hot gases	
	02	Slower in operation and have low evaporation rates	faster in operation and have low evaporation rates	
	03	Failure due to Temperature stress causing failure of feed water arrangement is minimum	Failure due to Temperature stress causing failure of feed water arrangement is more	
	04	It can work upto 20 bar pressure only	It can work upto 200 bar pressure	
	05	Simple and rigid construction	Complex construction	
	06	More maintenance and operation cost	less maintenance and operation cost	
	07	Smaller sizes and hence not suitable for large power houses	Bigger sizes and hence suitable for large power houses	
	08	Installation is difficult	Installation is easy	
	09	Requires less floor area	Requires more floor area	