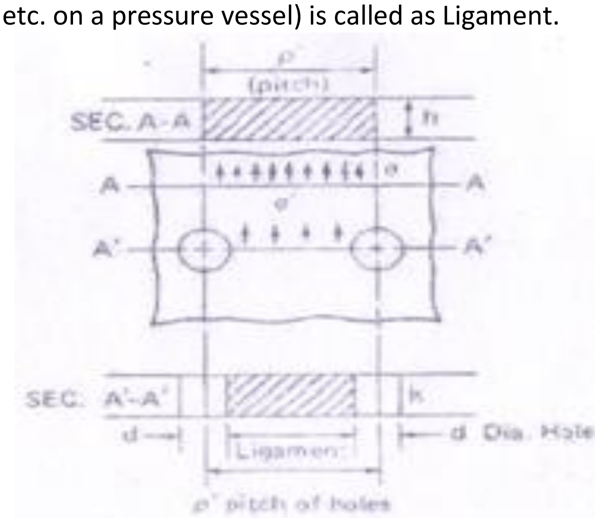
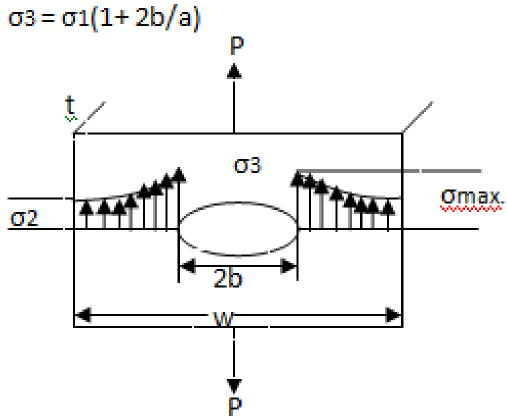
WINTER – 14 EXAMINATIONS

Subject Code: **17457** **Model Answer** Page No: ____/ N

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.

Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1.	**Attempt any <u>TEN</u> of the following:**		**20**
a)	The boiler mountings are the part of the boiler and are required for proper functioning. In accordance with the Indian Boiler regulations, the boiler mountings are essential fittings for safe working of a boiler. The boiler accessories are mounted on the boiler to increase its efficiency. These units are optional on an efficient boiler. With addition of accessories on the boiler, the plant efficiency also increases.	1m 1m	2m
b)	For a thin walled cylindrical pressure vessel subjected to internal pressure 'P'; Pressure is defined as the load exerted by the operating fluid per unit area. Stress is defined as the resistence of the material of the cylindrical pressure vessel to the exerted load.	 1m 1m	 2m
c)	Forces applied on the pressure vessels or structural attachments are called as Load. Types are: • Dead load • Design pressure (external/internal) • Temperature/thermal load • Wind load • Earthquake/seismic load • Piping load • Snow load • Other loads like weight of cover, operator's weight • Impact load • Cyclic load	1m 1m (any 2)	2m
d)	The minimum material remaining between openings/holes (e.g. in nozzles, tubesheets, etc. on a pressure vessel) is called as Ligament. 	1m 1m	2m
e)	Datas: Spherical shell Diameter, D_i = 3m		

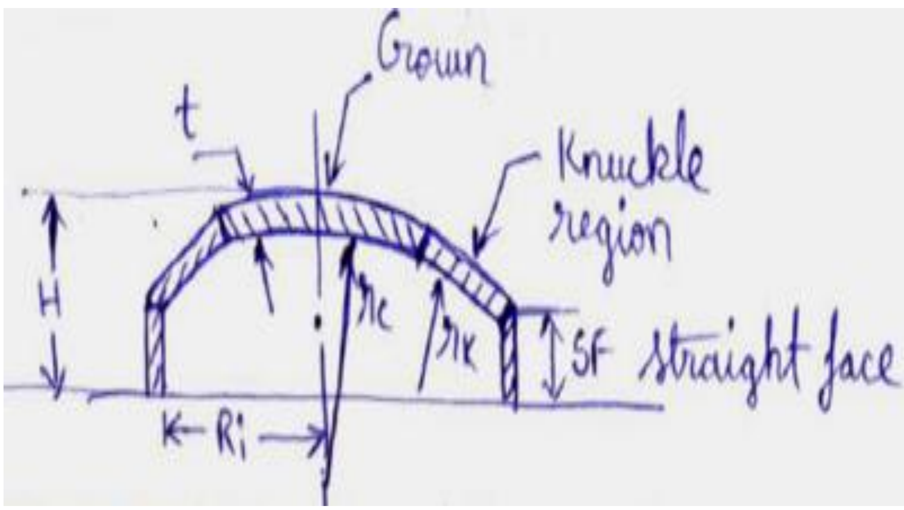
	R_i = 1.5m = 1500mm P = 1.5N/mm^2 S = 90MPa ϵ = 75% t = ? Thickness, t = PR_i/(2Sϵ - 0.2P) + CA = (1.5*1500)/[(2*90*0.75) – (0.2*1.5)] + CA (Assume CA = 3mm) = (2250) / [135 – 0.3] + 3 = 16.70 +3 = 19.70 ~ 20mm	1m 1m	2m
f)	Mechanical parts and structural elements often have features that cause sudden changes in geometry. Under loads, these changes in geometry increase the local stress fields of the parts quite significantly, and they usually represent locations from which parts start to fail. This localization of high stresses is called stress concentration.	2m	2m
g)	Nozzles may be classified on the basis of; • Shape: Circular, Elliptical and Oval • Placement: Single (Radial, non – radial) ; Multiple • Fabrication: Integral, Fabricated, Formed	2m (any 2)	2m
h)	Stress concentrations produced by irregularities are damaging in case of fluctuating stresses. All failures as a result of fatigue are in the areas of high localised stresses. Hence all stresses including localised stresses should be taken into account when designing the pressure vessel.	2m	2m
i)	$K_t = \sigma 3 / \sigma_{av}$; where $\sigma_{av} = P/t(w-2b)$ $\sigma 1 = P/tw$ $\sigma 3 = \sigma 1(1+2b/a)$  Where, b/a = 1 refers to circular opening b/a = 1/2 refers to vertical ellipse with least stress concentration, Kt	2m	2m

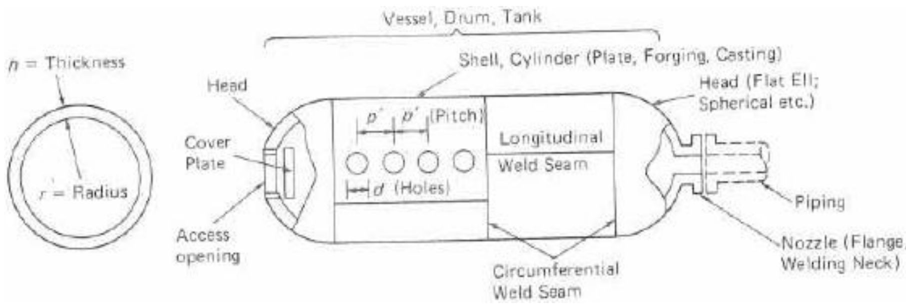
b/a	Kt
1	2.5
2	4.5
3	6.5
1/2	1.5
1/3	2.5
1/4	3.5
1/5	4.5

j)i)		1m	2m
ii)		1m	
k)	Metals are classified as; • Ferrous metals e.g. Wrought iron, Cast iron, Steel, Stainless steels (any one types in them will do) etc. • Non-ferrous metals e.g. Aluminium, Copper, Nickel, Chromium, Lead, Titanium, Beryllium, Zirconium, Tantalum, etc. (and any one of their alloys will do)	1m (any 1) 1m (any 1)	2m
l)	'Stainless' means more resistant to rust, staining and corrosion than regular steel. The classification of Stainless Steels are; • Austenitic stainless steels • Martensitic stainless steels • Ferritic stainless steels • Ferritic – Austenitic stainless steels	1m 1m	2m
m)	Design considerations in the selection of materials for pressure vessel construction are: • Design pressure • Design temperature • Corrosion resistence • Types of load • Mechanical properties of material • Fabricability • Availability in the market • Cost/Economy • Quality of future maintenance • Life of product	2m (any 2)	2m
n)	Many high temperature petroleum refining processes are carried out under high partial pressures of hydrogen. Therefore steps for material selection in vessel construction for such service so as to withstand hydrogen which causes deterioration of the material and subsequent failure depends upon identifying some factors like; • Temperature • Hydrogen pressure • Time, • Composition of materials, • etc.	2m (any 2)	2m

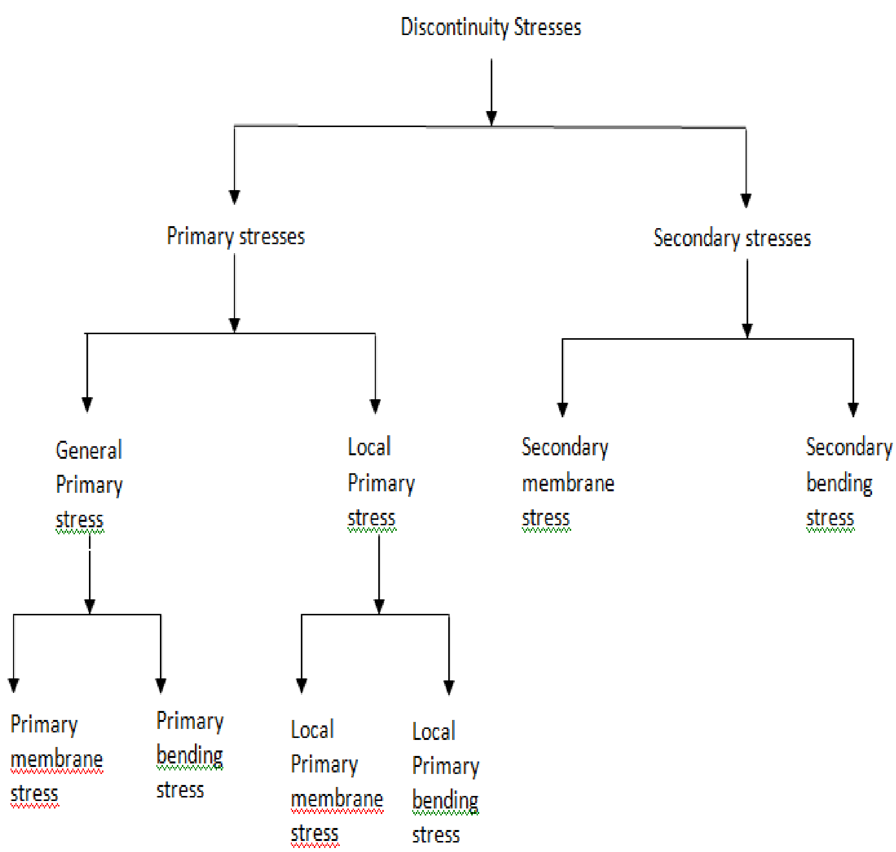
o)	• To make the material more resistant to weather • Inhibit corrosion for a period of time • Extended life of the metallic body or component • Make it more durable and possibly aesthetically attractive • Provide the machines or products of better quality • etc.	2m (any 2)	2m
2.	**Attempt any <u>TWO</u> of the following:**		**16**
a)	Boiler mountings: • Water level Indicator Water level indicator is located in front of boiler in such a position that the level of water can easily be seen by attendant. Two water level indicators are used on all boilers. • Pressure Gauge A pressure gauge is fitted in front of boiler in such a position that the operator can conveniently read it. It reads the pressure of steam in the boiler and is connected to steam space by a siphon tube. The most commonly, the Bourdon pressure gauge is used. • Safety Valve Safety valves are located on the top of the boiler. They guard the boiler against the excessive high pressure of steam inside the drum. If the pressure of steam in the boiler drum exceeds the working pressure then the safety valve allows blow-off the excess quantity of steam to atmosphere. Thus the pressure of steam in the drum falls. The escape of steam makes a audio noise to warm the boiler attendant. There are four types of safety valve. 1. Dead weight safety valve. 2. Spring loaded safety valve 3. Lever loaded safety valve 4. High steam and low water safety valve. • Fusible Plug It is very important safety device, which protects the fire tube boiler against overheating. It is located just above the furnace in the boiler. It consists of gun metal plug fixed in a gun metal body with fusible molten metal. During the normal boiler operation, the fusible plug is covered by water and its temperature does not rise to its melting state. But when the water level falls too low in the boiler, it uncovers the fusible plug. The furnace gases heat up the plug and fusible metal of plug melts, the inner plug falls down. The water and steam then rush through the hole and extinguish the fire before any major damage occurs to the boiler due to overheating. • Blow-Off Cock The function of blow-off cock is to discharge mud and other sediments deposited in the bottom most part of the water space in the boiler, while boiler is in operation. It can also be used to drain-off boiler water. Hence it is mounted at the lowest part of the boiler. When it is open, water under the pressure rushes out, thus carrying sediments and mud.	4m (any one expln.)	8m

	• Feed Check Valve The feed check valve is fitted to the boiler, slightly below the working level in the boiler. It is used to supply high pressure feed water to boiler. It also prevents the returning of feed water from the boiler if feed pump fails to work. • Steam Stop Valve The steam stop valve is located on the highest part of the steam space. It regulates the steam supply to use. The steam stop valve can be operated manually or automatically. **OR** Boiler accessories: • Economizer An economizer is a heat exchanger, used for heating the feed water before it enters the boiler. The economizer recovers some of waste heat of hot flue gases going to chimney. It helps in improving the boiler efficiency. It is placed in the path of flue gases at the rear end of the boiler just before air pre-heater. • Super heater It is a heat exchanger in which heat of combustion products is used to dry the wet steam, pressure remains constant, its volume and temperature increase. Basically, a super heater consists of a set of small diameter U tubes in which steam flows and takes up the heat from hot flue gases. • Air Pre-heater The function of an air pre-heater is similar to that of an economizer. It recovers some portion of the waste heat of hot flue gases going to chimney, and transfers same to the fresh air before it enters the combustion chamber. Due to preheating of air, the furnace temperature increases. It results in rapid combustion of fuel with less soot, smoke and ash. The high furnace temperature can permit low grade fuel with less atmospheric pollution. The air pre-heater is placed between economizer and chimney. • Feed Water Pump It is used to feed the water at a high pressure against the high pressure of steam already existing inside the boiler. • Steam Injector A steam injector lifts and forces the feed water into the boiler. It is usually used for vertical and locomotive boilers and can be accommodated in small space. It is less costly. It does not have any moving parts thus operation is salient. Block diagram only of the mounting/accessory:	4m (any one expln.) 4m	
b)	• Proper selection of Factor of Safety (FOS) • Proper material selection There is no one pressure vessel material suitable for all environments, but	2m 2m	8m

	material selection must match application and environment. This is especially important in chemical reactors because of the embrittlement effect of gaseous absorption and in nuclear reactors because of the irradiation damage from neutron bombardment (attack). Material selection will change depending upon the applications like chemical reactors, nuclear reactors, space vehicles, deep driving submarines, etc. • Need of heat treatment Proper heat treatment is used to improve qualities/properties of materials by reducing their cost for e.g. thickness of the material can be reduced by proper heat treatment. • Economy Design engineers should be cautious to control the cost of the product.	2m 2m 2m	
c)	Membrane stress analysis in Torispherical heads: Torispherical heads has a region formed by two circular areas, a knuckle section with radius r_k and a spherical crown with crown radius r_c. The local stresses of the thin torispherical head will occur in the knuckle region. The knuckle radius is generally 6% of the crown radius i.e. $r_k = 0.06\ r_c$  If r_c is not given, assume $r_c = R_i$ $S\varepsilon = (P*r_c*M / 2t) + 0.1P$ $S\varepsilon - 0.1\ P = (P*r_c*M / 2t)$ $t = (P*r_c*M) / (2S\varepsilon - 0.2\ P)$ where, r_c = crown radius M = Correction Factor = 1.77 for torispherical head	2m 4m 2m	8m
3.	**Attempt any <u>TWO</u> of the following:**		**16**
a)			

<table>
<tr>
<td></td>
<td>

Pressure components vary widely in shape and complexity according to the functions that they must perform. However, they generally consist of a few basic parts such as cylinders, rings and various shaped closure heads. The figure above shows the construction features and terminology of a simple metal vessel fabricated by a welding process. When the vessel diameter is in the size range of procurable tubular products, the cylindrical part is normally so selected, however when diameters exceed these rolled plate, partial forgings or castings welded into cylinders are employed.</td>
<td>4m

4m</td>
<td>8m</td>
</tr>
<tr>
<td>b)</td>
<td>Stress categories are as shown in the diagram below;


Primary general stress: These stresses act over a full cross section of the</td>
<td>2m</td>
<td>8m</td>
</tr>
</table>

	vessel. They are produced by mechanical loads (load induced) and are the most hazardous of all types of stress. The basic characteristic of a primary stress is that it is not self-limiting. Primary stresses are generally due to internal or external pressure or produced by sustained external forces and moments. Thermal stresses are never classified as primary stresses. Primary general stresses are divided into membrane and bending stresses. The need for divilng primary general stress into membrane and bending is that the calculated value of a primary bending stress may be allowed to go higher than that of a primary membrane stress. Primary stresses that exceed the yield strength of the material can cause failure or gross distortion. Local primary stress: Local primary membrane stress is not technically a classification of stress but a stress category, since it is a combination of two stresses. The combination it represents is primary membrane stress plus secondary membrane stress produced from sustained loads. These have been grouped together in order to limit the allowable stress for this particular combination to a level lower than allowed for other primary and secondary stress applications. It was felt that local stress from sustained (unrelenting) loads presented a great enough hazard for the combination to be "classified" as a primary stress. A local primary stress is produced either by design pressure alone or by other mechanical loads. Local primary stresses have some self-limiting characteristics like secondary stresses. Since they are localized, once the yield strength of the material is reached, the load is redistributed to stiffer portions of the vessel. However, since any deformation associated with yielding would be unacceptable, an allowable stress lower than secondary stresses is assigned. The basic difference between a primary local stress and a secondary stress is that a primary local stress is produced by a load that is unrelenting; the stress is just redistributed. In a secondary stress, yielding relaxes the load and is truly self-limiting. The ability of primary local stresses to redistribute themselves after the yield strength is attained locally provides a safety valve effect. Thus, the higher allowable stress applies only to a local area. Primary local membrane stresses are a combination of membrane stresses only. Thus only the "membrane" stresses from a local load are combined with primary general membrane stresses, not the bending stresses. The bending stresses associated with a local loading are secondary stresses. Secondary stress. The basic characteristic of a secondary stress is that it is self-limiting. As defined earlier, this means that local yielding and minor distortions can satisfy the conditions which caused the stress to occur. Application of a secondary stress cannot cause structural failure due to the restraints offered by the body to which the part is attached. Secondary mean stresses are developed at the junctions of major components of a pressure vessel. Secondary mean stresses are also produced by sustained loads other than internal or external pressure. Radial loads on nozzles produce secondary mean stresses in the shell at the junction of the nozzle.	2m 2m 2m	

Secondary stresses are strain-induced stresses. Secondary stresses are divided into two additional groups, membrane and bending.

c) 2m 8m

Sr. No.	Parameters	DESIGN APPROACH1 (ASME)	DESIGN APPROACH2 (DESIGN THEORY)	Denotations
A /B	SHELL /HEAD			
1	Cylindrical shell	t= [PRi/(SЄ - 0.6P)] + CA	T= [PDi/(2SЄ - P)] + CA	P=Design pressure Di=Internal diameter S=Design/Permissible stress at design temperature Є=Joint efficiency CA=Corrosion allowance
2	Torispherical	t=[(PrcM)/(2SЄ - 0.2P)] + CA M=constant based on ratio of crown and knuckle radius(rc/rk) from charts	t=[PrcM/2SЄ] + CA M=Stress intensification factor =1/4[3+SQRT(rc/rk)]	rc=Crown radius; rk=Knuckle radius

C) Design of skirt: 1m

$$t_s = \frac{W}{D_i \pi S \epsilon} + C.A$$

where, W = Weight of the shell with its operating fluid / contents

D_i = Internal dia. of skirt

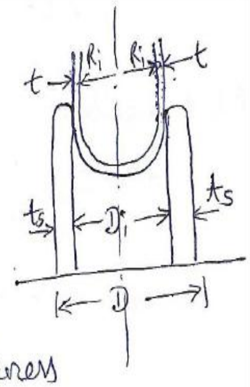
= Outside dia. of vessel.

= (Inner dia. of vessel + 2t)

= $2R_i + 2t$

$D_i = 2(R_i + t)$

(R_i is the internal radius of shell)

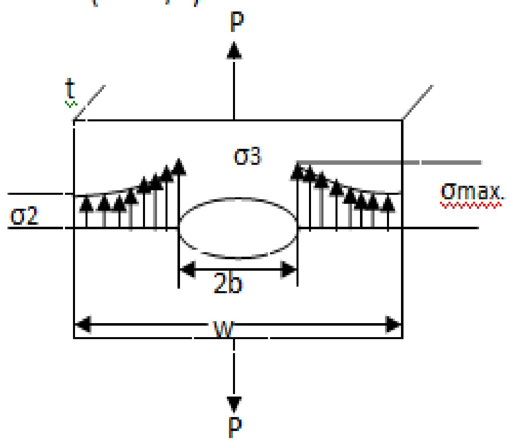
	D) Design of Anchor bolts :- $n = \frac{D}{600}$ where, n = No. of bolts D = ϕ of the skirt = Outside dia. of shell + 2 thickness of skirt  d_c = Core dia. of the bolt f_c = crushing stress for the bolt material n = no. of bolts $\therefore d = \frac{d_c}{0.84}$ for d_c = ——— mm from (i) $\therefore$ d = ——— mm where, d = outside dia. of bolt.	2m	
	E) Design of nozzle :- $t = \frac{PR}{SE + 0.4P} + C.A$ where, t = thickness of nozzle R = Internal radius of nozzle P = Pressure in the nozzle	1m	

<table>
<tr><td></td><td>(Assume same pressure as the pressure in vessel if not given)
S = Permissible stress in nozzle matl.

F) Ligament effeciency :—
G) Dilation in vessel :—</td><td>1m

1m</td><td></td></tr>
<tr><td>4.</td><td>Attempt any <u>TWO</u> of the following:</td><td></td><td>16</td></tr>
<tr><td>a)</td><td>

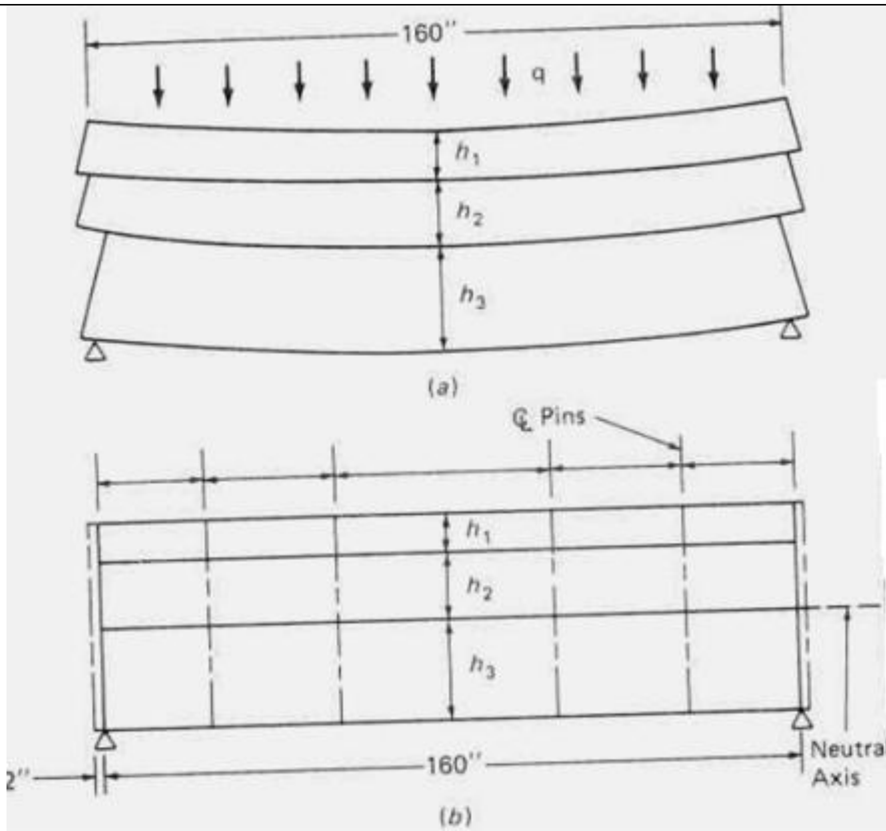
$K_t = \sigma_3 / \sigma_{av}$; where
$\sigma_{av} = P/t(w-2b)$
$\sigma_1 = P/tw$
$\sigma_3 = \sigma_1(1+2b/a)$



b/a	Kt
1	2.5
2	4.5
3	6.5
1/2	1.5
1/3	2.5
1/4	3.5
1/5	4.5

Where, b/a = 1 refers to circular opening
b/a = 1/2 refers to vertical ellipse with least stress concentration, Kt
</td><td>8m</td><td>8m</td></tr>
<tr><td>b)</td><td>Most common weld defects found are:
1. Poor weld shape due to misalignment of parts being welded
2. Cracks in welds due to thermal shrinkage
3. Pin holes on the weld surface
4. Slag inclusion when slag covering a run is not totally removed after every run before the following run.
5. Porosity in the form of voids (cavity) when gases are trapped in the solidifying weld metal
6. Incomplete fusion between the weld and base metal resulting from too little heat input and / or too rapid traverse of the welding torch (gas or electric).</td><td>4m
(any 4)</td><td>8m</td></tr>
</table>

	7. Undercutting groove adjacent to the weld left unfilled by weld metal due to incorrect settings / procedure 8. Insufficient penetration of the weld metal in joints arises from too high a heat input and / or too slow traverse of the welding torch (gas or electric) Cause and remedy for the four defects	 4m	
c)	Copper and their alloys: Properties: • Good ductility and malleability • Good electrical and thermal conductivity • Good mechanical strength and fabricability • Good resistance to atmospheric attack, strong alkalies and organic solvents • etc. Applications: • Manufacturing of evaporators, steam condensers, heat exchangers, etc. • Brass is used for tubes, wires, sheets, etc. • Bronze is used for castings of pumps, valves/valve seats, pipe fittings, etc. • Steels cladded with nickel is used in the production of vessels for caustic soda and alkalies • Monel is used in the food industry to prevent contamination of the contained fluid. • Inconel is used in manufacturing of evaporators and heat exchangers • etc. Aluminium and their alloys: Properties • Light in weight • Easy to fabricate • Better mechanical properties than Mild Steel • Retains ductility at sub zero temperatures • Resists attack of acid • etc. Applications: • Used for low temperature service upto -150^{0}C • Used for handling organic solvents, food stuffs, hydrogen peroxide, HNO_3, • sea water, inorganic salts, etc. • Used in fabrication of storage vessels, reaction vessels, heat exchangers, absorption columns, etc.	2m (any 2) 2m (any 2) 2m (any 2) 2m (any 2)	8m
5.	**Attempt any TWO of the following:**		**16**

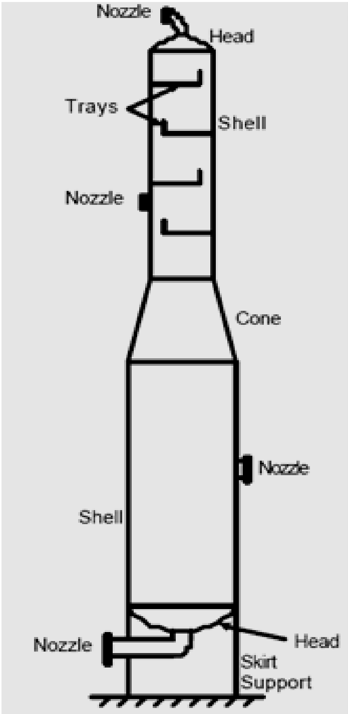
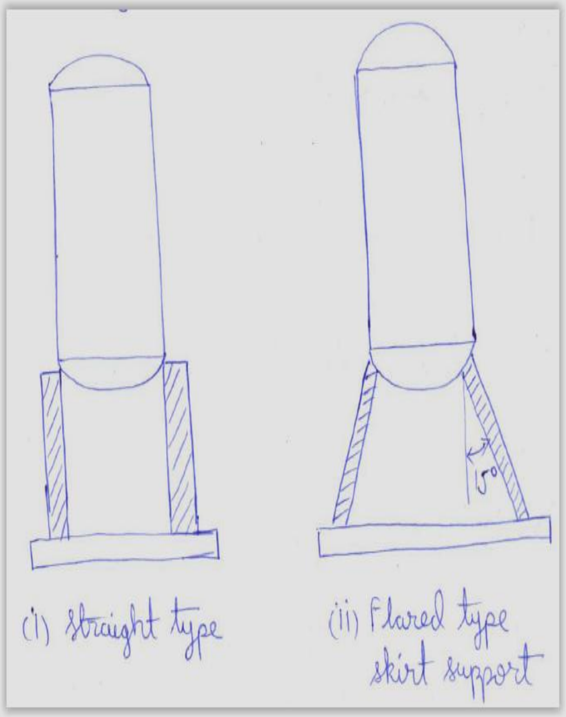
<table>
<tr>
<td>a)</td>
<td>


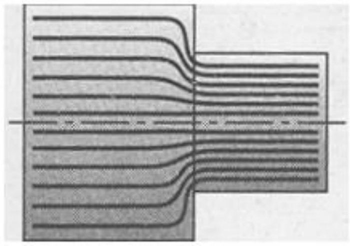
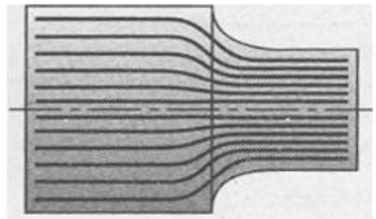
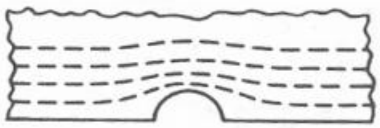
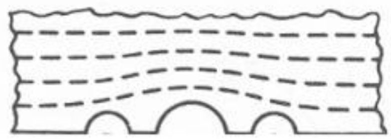
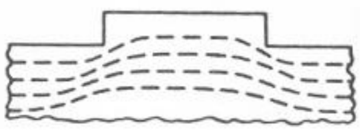
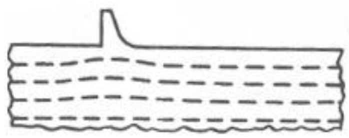
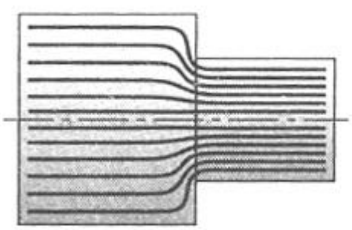
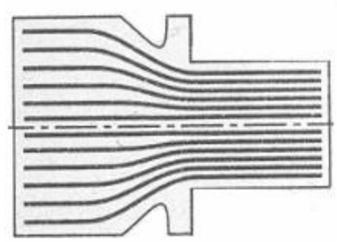
Stacked Plates:
Flat plates stacked one on top of the other are frequently used to support loads. This may be done because the construction arrangement does not permit a single plate of equivalent thickness to be used or because a single plate of sufficient thickness is not obtainable. The fig. a) shows three stacked circular plates of different thickness simply supported at the edge and subject to a uniform load. No friction is assumed between the plates and bending of each is independent of that of the other. The load is transmitted from the top to successive lower plates by deflection. Each plate has essentially the same deflection curve and curvature.

Built Up Plates:
If the differential sliding of one stacked plate on another is prevented through the use of pins, rivets, bolts or keys to take inplane shear at the plate interfaces; the result is a built up plate which is stiffer and stronger than the same stacked plates as in fig. b). The stresses in a built up plate are calculated on the assumption that its individual plates are rigidly connected i.e. i) it is a solid plate ii) the size, shape and spacing of the uniting elements (pins/rivets/bolts/keys) fulfil this requirement.
</td>
<td>4m
(diagm.)

2m

2m</td>
<td>8m</td>
</tr>
<tr>
<td>b)</td>
<td>Various supports for pressure vessels are:
• Bracket support/Lug support</td>
<td>2m
(any 2)</td>
<td>8m</td>
</tr>
</table>

	• Leg support • Skirt support • Saddle support		
	 	2m (any 2 diagm.)	
	Support skirt: Tall vertical vessels are supported by cylindrical shell called as skirt. The skirt is a suitable supporting structure for tall vessels which are subjected to wind load, seismic load and other load. The skirt is welded to the bottom dish end from the outside of the shell. A bearing plate/ base plate/ support plate is attached to the bottom of the skirt. The plate is made to rest on a concrete foundation and is securely anchored to foundation by means of anchor bolts embedded in concrete to prevent overturning due to wind load or earthquake load. The commonly used materials for skirt supports are carbon steels.	2m	
	1) Straight type skirt support is used for tall vessels. The centre line of cylindrical skirt and shell are coincident. This type is more difficult to fabricate and is used mainly for high external loads, high design temperatures or cyclic operating temperatures. A good fit between the outside diameter of the shell and inside diameter of skirt is a must.	1m	
	2) Flared type skirt support is used for very high columns with high external moments. The angle of skirt is maximum 15°.	1m	

c)	  (a) Force flow around a sharp corner; Force flow around a corner with fillet: Low stress concentration.   (b) Force flow around a large notch; Force flow around a number of small notches: Low stress concentration.   (c) Force flow around a wide projection; Force flow around a narrow projection: Low stress concentration.   (d) Force flow around a sudden change in diameter in a shaft; Force flow around a stress relieving groove.	2m 2m 2m 2m	8m
6.	**Attempt any <u>TWO</u> of the following:**		**16**
a)			

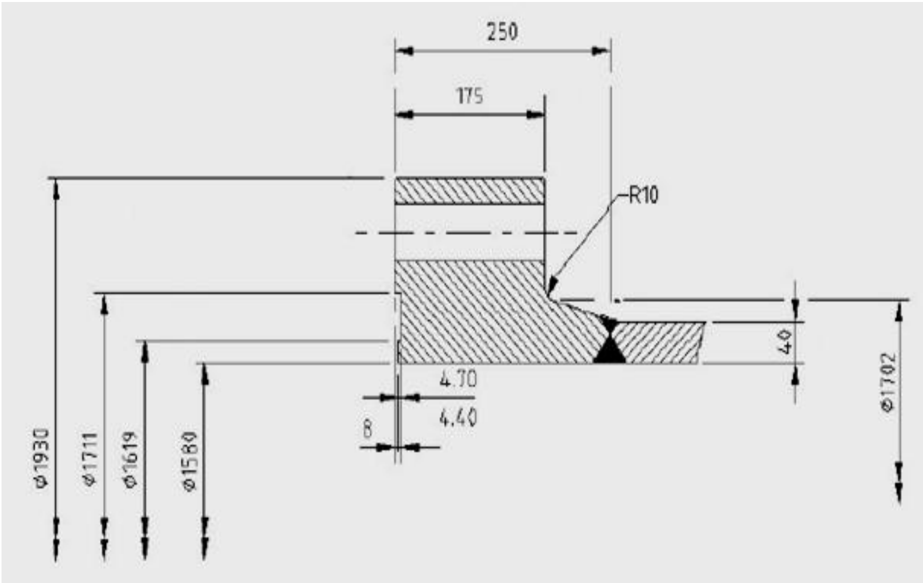
<table>
<tr>
<td></td>
<td>
<table>
<tr><th>Sr. No.</th><th>Parameters</th><th>Cylindrical pressure vessel</th><th>Spherical pressure vessel</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Stress</td><td>$\sigma L=\frac{Pr}{2t}$
(Put unit values for P, r, t)
$\sigma L=$</td><td>$\sigma L=\frac{Pr}{2t}$
(Put unit values for P, r, t)
$\sigma L=$</td></tr>
<tr><td>$\sigma h=\frac{Pr}{t}$
(Put unit values for P, r, t)
$\sigma h=$</td><td>$\sigma h=\frac{Pr}{2t}$
(Put unit values for P, r, t)
$\sigma h=$</td></tr>
<tr><td>2</td><td>Thickness</td><td>$t=Pr/(S\varepsilon - 0.6P)$
(Put unit values for P, r, S, ε)
$t=$</td><td>$t=Pr/(2S\varepsilon - 0.2P)$
(Put unit values for P, r, S, ε)
$t=$</td></tr>
<tr><td>3</td><td>Dilation</td><td>$\delta=\frac{Pr^2(2-\mu)}{2tE}$
(Put unit values for P, r, μ, t, E)
$\delta=$</td><td>$\delta=\frac{Pr^2(1-\mu)}{2tE}$
(Put unit values for P, r, μ, t, E)
$\delta=$</td></tr>
<tr><td>4</td><td>Storage capacity</td><td>$V=\pi r^2 h$
(Put unit values for r, h)
$V=$</td><td>$V=\frac{4}{3}\pi r^3$
(Put unit value for r)
$V=$</td></tr>
<tr><td>5</td><td>Surface area</td><td>$A=2\pi rh + 2\pi r^2$
(Put unit values for r, h)
$A=$</td><td>$A=4\pi r^2$
(Put unit value for r)
$A=$</td></tr>
</table>

From the above it is clear that spherical pressure vessel advantages outweigh that for cylindrical pressure vessels, theoretically.

But, fabrication problems associated with a spherical pressure vessel makes it less attractive as an usable option unless the design rigidly favors its use.
</td>
<td>4m (any 4)

2m

2m</td>
<td>8m</td>
</tr>
<tr>
<td>b)</td>
<td>Stresses in flanges and flanged joints:
For understanding of design and stress analysis of flange, integral weld neck flange has been taken in to consideration. In which, flange is divided into three sections with various loads and moments on each viz.</td>
<td>2m</td>
<td>8m</td>
</tr>
</table>

	i. Annular ring section: Overturning moment Internal hydrostatic pressure ii. Tapered hub section Shear force and bending moment Internal hydrostatic pressure iii. Shell ring section Discontinuity shear force and bending moment 	4m	
	Types of gaskets according to the properties and shapes used in pressure vessels are; • Flat ring • Serrated • Laminated • Corrugated • etc. For low temperature services; rubber, plastic, paper, cork, asbestos, fibre, etc. are used as gasket materials e.g. Most common is 'O' ring which is used in flanges, cylindrical end caps, fittings, plugs, etc. Pressures upto 30000 PSI can be sealed by using 'O' rings. For high temperature service; flat metallic materials like Cu, Ag, Au, etc. are used as gasket materials. They are available in variety of shapes e.g. oval, octagonal, hexagonal.	2m	
c)	Visual-weld-inspection represents the immediate critical observation of the external features visible on all welds. It is the first and most important assessment of quality to be performed as soon as the welding operations	4m (any 4)	8m

	are accomplished: • Other inspection procedures may be required to detect discontinuities not visible to the eye or present below the external surface. Whatever additional non destructive inspection methods are applied, they are performed **only after** visual inspection is successfully completed as any defect visible to the eye needs to be attended first so as to correspond to engineering drawing requirements and to be evaluated in comparison with that of the best obtainable practice. • Assess the welders job in following WPS (Welding Procedure Specification) • Assess the Welding Consumable **storage and control** • Addresses **completeness** of welding performed, including eventual post weld heat treatments required, all dimensions and tolerances, visual indications of discontinuities and features of the weldments to determine if they are within the approved limits • Enable preparation of a suitable **Nonconformance Report** if needed to be submitted to the person responsible for quality approval. A proper weld is produced as the rod is moved across the material, and the flame at the end of the rod cuts a path in the material and that path is refilled by the material of the rod. It flows back into the cut out filling it and joining the materials. If the weld is too hot, or the persons technique is incorrect, or they are moving the rod to fast, the the path cut by the flame on the end of the rod is not properly filled, and the result is an undercut running along the side of the weld. This undercut causes the weld to be weak and makes it susceptible to failing. Undercutting is easy to correct and requires practice by the welder to get the flame temperature and the speed right so as to fill the path that is cut until full. The opposite being going to slow and making a humped up weld. A proper weld will be slightly over the surface of the original part, smooth with no pits or holes, and no undercutting.	4m	