SUMMER – 14 EXAMINATIONS

Subject Code: **17456** **Model Answer** Page No: ____/ N

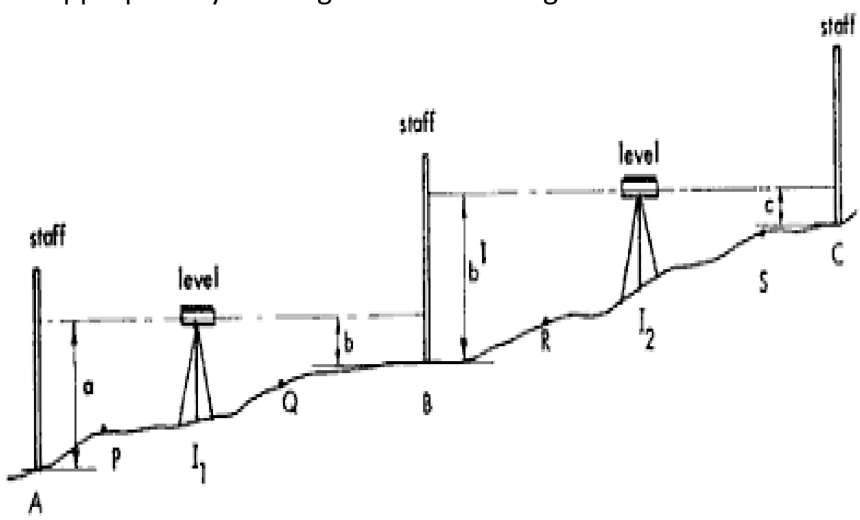
Important Instructions to examiners:

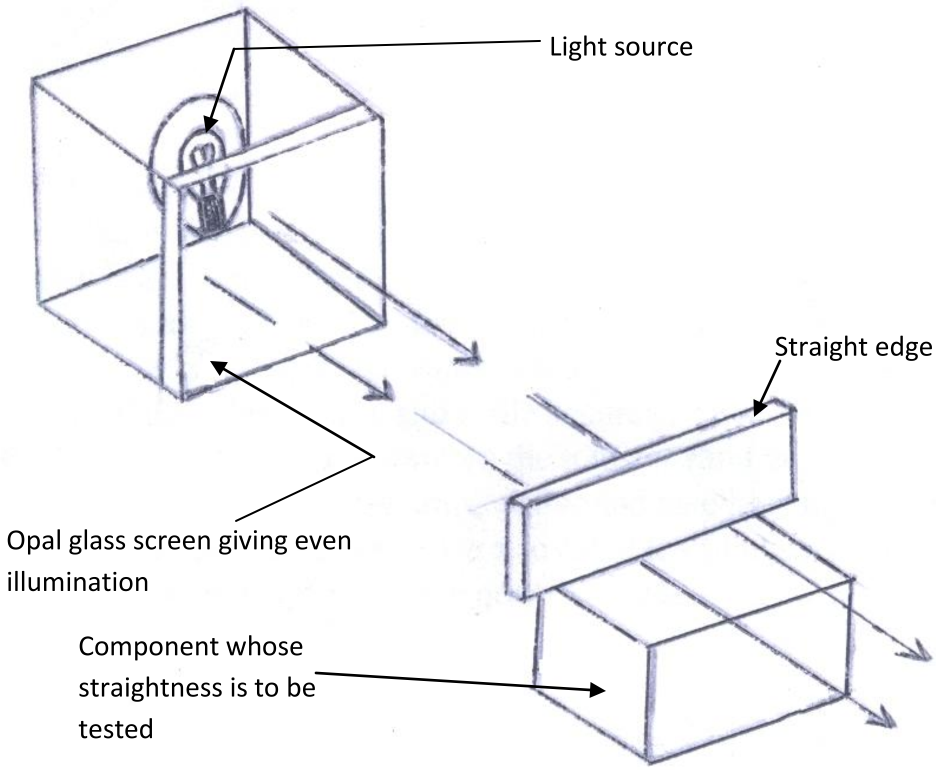
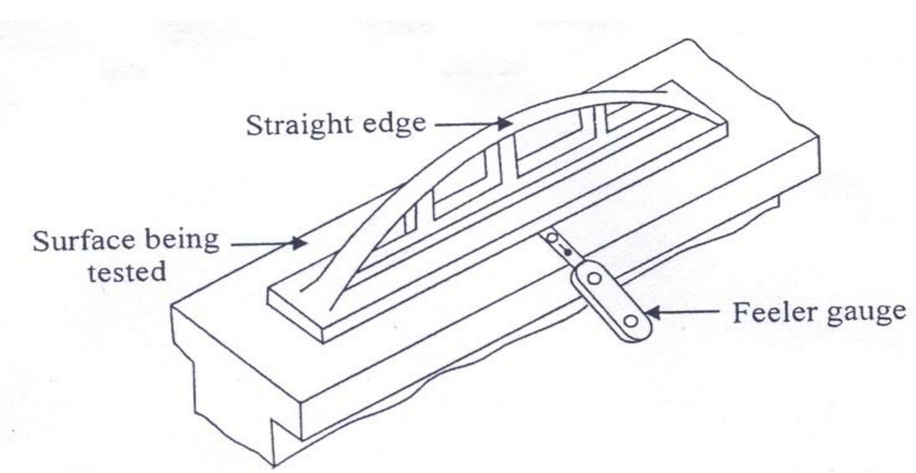
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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
1.	**Attempt any five of the following**	**5*4**	**20**
a)i)	Precision is concerned with a process or a set of measurements and not a single measurement. It tells us as to how well the various measurements performed by the same instrument on the same component agree with each other. Precision is defined as the repeatability of a measuring process.	01 mark	**04**
a)ii)	It is defined as the ability of a measuring system to re-produce output readings when the same measurand value is applied to it consecutively, under the same conditions and in the same direction.	01 mark	
a)iii)	It refers to the process usually carried out by making adjustments such that readout device produces zero output for zero measurand input and similarly it should display an output equivalent to the known measurand input near the full-scale input value.	01 mark	
a)iv)	Readability refers to the susceptibility of a measuring device to having its indications converted to a meaningful number. A micrometer instrument can be made more readable by using verniers. Very finely spaced lines on a scale become more readable when a microscope is used; but for the unaided eye, the readability is poor. Amplification or the magnification is enlarging the output signals from the measuring instruments, so as to make them better readable.	01 mark	
b)	(see table below)	04 marks (any 4)	**04**

Characteristics	Line standards	End standards
Accuracy of measurement	Limited to + 0.2mm. For high accuracy, scales have to be used along with microscopes.	Highly accurate for measurement of close tolerances, up to + 0.001mm.
Time of measurement	Quick and easy.	Time consuming.
Effect of use	Scale markings are not subjected to wear but end of scale is worn. Thus, it may be difficult to assume zero of scale as datum.	Measuring faces get worn out. To take care of this, end pieces can be hardened. Built in datum is provided.
Other errors	Parallax errors can occur.	Improper wringing of slip gauge may introduce error. Change in laboratory temperature may lead to some errors.
Manufacture	Simple and low.	Complex and high.

and cost of equipment			
Examples	Yard, metre	Slip gauges, ends of of micrometer anvils, length bars, etc.	
Etc.			

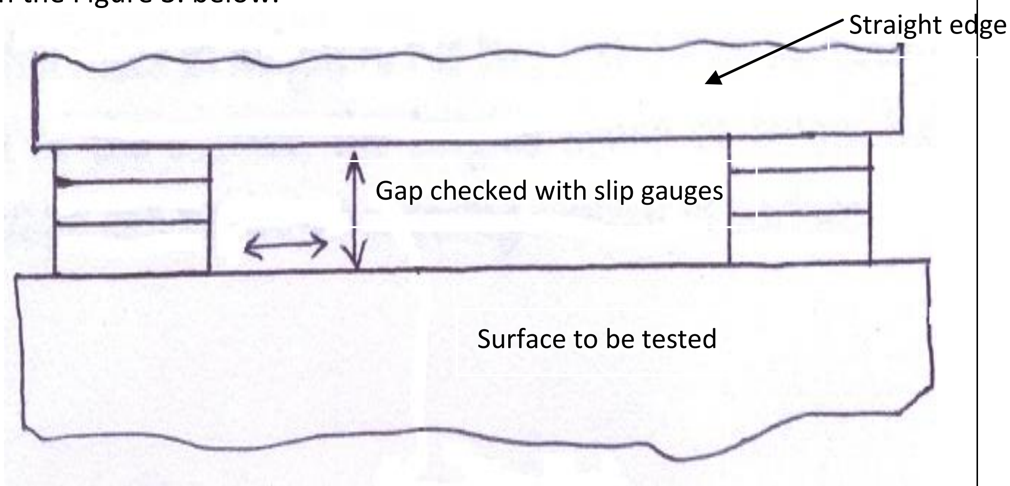
c)	Surveyor's level is an instrument used in surveying to measure the height of distant points in relation to a bench mark (a point for which the height above sea level is accurately known). It consists of a telescope fitted with a spirit level and generally mounted on a tripod. It is used in conjunction with a graduated rod placed at the point to be measured and sighted through the telescope as shown below. It then is used for levelling points A, B and C appropriately and align them in a straight line.  	02 marks (expln.) 02 marks (diag.)	**04**
d)	A line is said to be straight over a given length, if its deviations with respect to the ideal reference line are within specified tolerance limits. It is also said that the variations of the distances of its points from two planes perpendicular to each other and parallel to the general direction of the line remain within the specified tolerance limits; the reference planes being so chosen such that their intersection is parallel to the straight line joining two points suitably located on the line to be tested and the two points being close to the ends of the lengths to be measured. i) For checking the straightness, the straight edge is placed on the surface to be checked and the two are viewed against the light, which clearly indicates the straightness. If these two surfaces are perfectly straight then the gap between them will be negligible. The measurement of straightness is done by observing the colour of light due to interference caused by diffraction of light while passing through the small gap. If the colour of light is red then it indicates a gap of 0.0012 to 0.0017mm, while for blue light, the gap is approximately 0.0075mm.	02 marks 01 mark (expln.)	**04**

	 Use of straight edge with light source **OR** ii) For determining the straightness of engineering components in workshop by straight edge, it is placed against the work as shown in the figure below. The feeler gauges are then used to find any possible error.  Use of straight edge with feeler gauge	01 mark (diag.) 01 mark (expln.) 01 mark (diag.)	

OR

iii) A more accurate method is to support the straight edge on equal slip gauges at the correct points for minimum deflection and measure the uniformity of the space under the straight edge with slip gauges as shown in the Figure 3. below.

01 mark (expln.)



Use of straight edge with slip gauges

01 mark (diag.)

e)

Template material	Protection / Storage
Template paper	Likely to get folds on usage. Use appropriate handling method while using and store in sheath covers after use.
Hardboard	It cannot be used outside because it absorbs water. Use appropriate handling method while in use and also store in covers away from moisture.
Timber	Solid timber will shrink, warp, cup, crown, twist and swell (caused by moisture/humidity). Creative jointing becomes a must along with high quality glues. Colours darken with age. Needs ongoing care in the form of wood oils, etc and stored away from wet place. The timber matures when exposed to direct and indirect sunlight.
Sheet metal	Likely to get rust on its surfaces. Edge needs to be wired or hemmed to provide a protective edge for handling purpose. Should be stored in covers after coating anti corrosive paints on it.
Steel plate	Likely to be heavy in use compared to sheet metals. Needs appropriate holding and clamping device when used. Stored under grease coating

02 marks (any 2)

04

	away from damp areas to prevent rusting.
Etc.	

Tools	Protection / Storage
Marking	Tool box also called toolkit, tool chest or workbox away from moisture, mechanical damage, etc.
Measuring	Tool box also called toolkit, tool chest or workbox away from moisture, mechanical damage, etc.
Cutting	Controlled conditions of temperature, humidity, etc. in AC tool rooms.
Punch/Dies	Controlled conditions of temperature, humidity, etc. in AC tool rooms.
Etc.	

02 marks (any 2)

f)

Parameters	Manual straightening	Machine straightening
Cost	Less cost	High cost
Time	More time	Less time
Ease of evaluation	Difficult to evaluate the job done	Easy to evaluate the job done
Labor wage Clamps or dogs	Difficult to fix the wage rate due to inconsistency in job performance	Easy to fix the wage rate as per specification of machine used in job performance
Quality of straightening	Poor	Good
Labor skill	Semi – skilled to skilled	Unskilled to semi – skilled
Etc.		

04 marks (any 4) — **04**

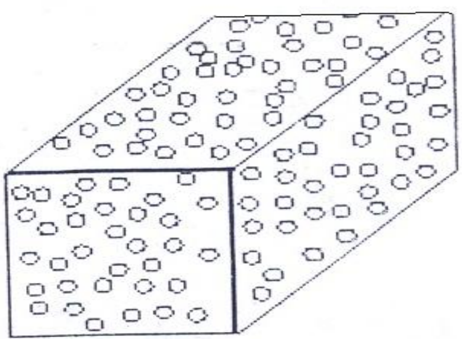
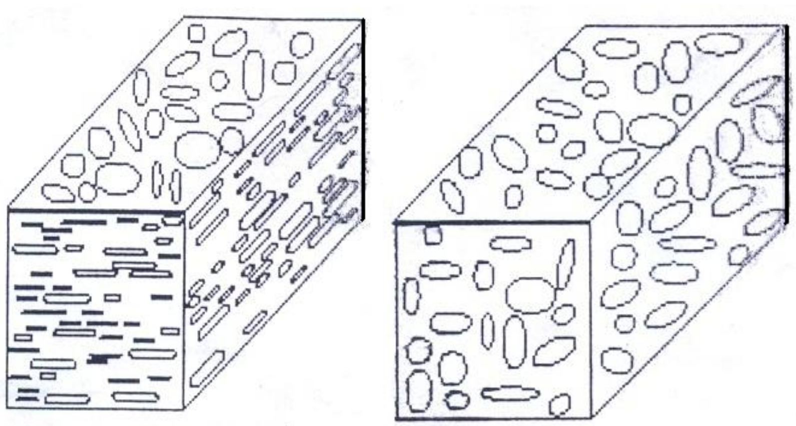
g) A typical composite material is a system of materials composing of two or more materials (mixed and bonded) on a macroscopic scale. Generally, a composite material is composed of reinforcements (fibres, particles, flakes and/or fillers, additives) embedded in a matrix (polymer/resins, metals or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mech. properties of the matrix. — 01 mark — **04**

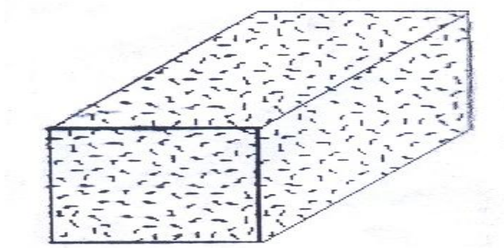
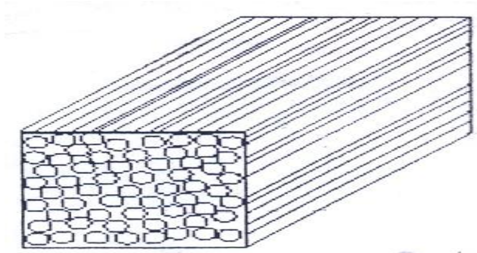
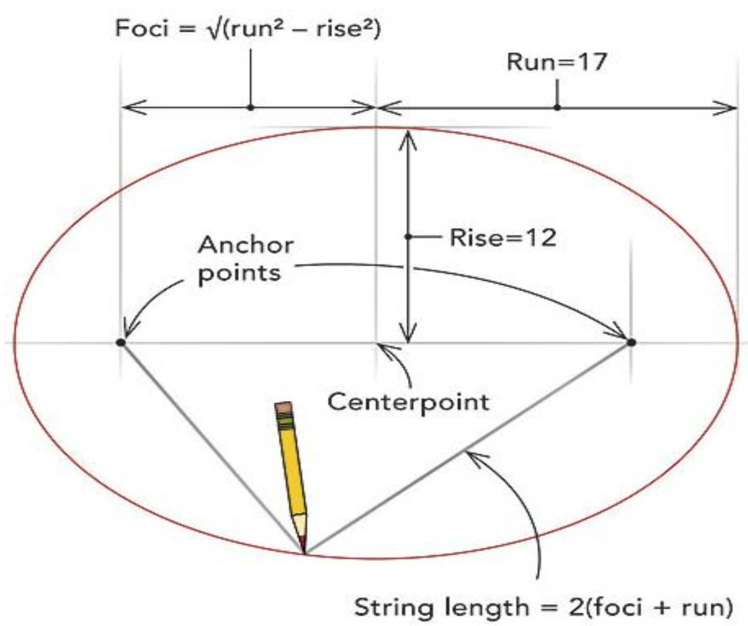
Classification of composites:

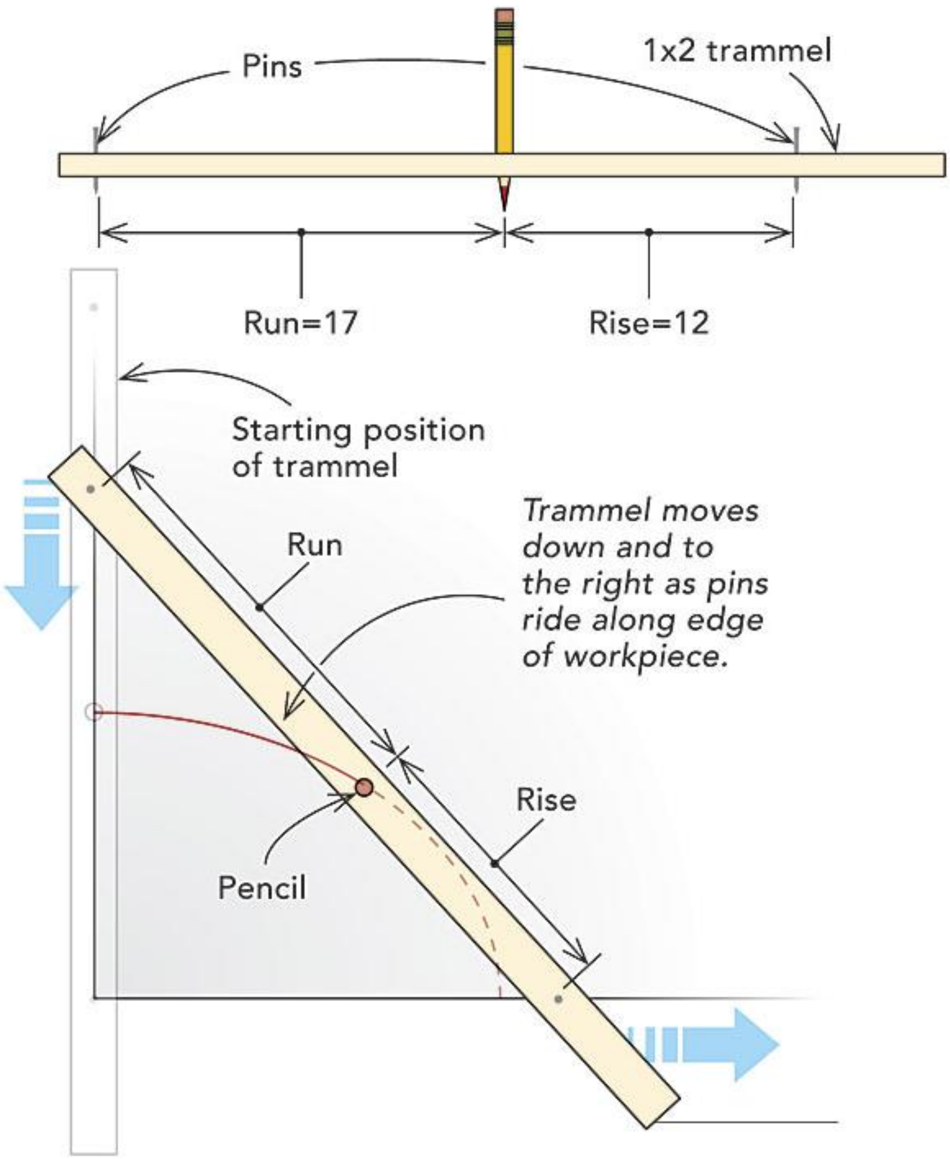
Based on matrix material

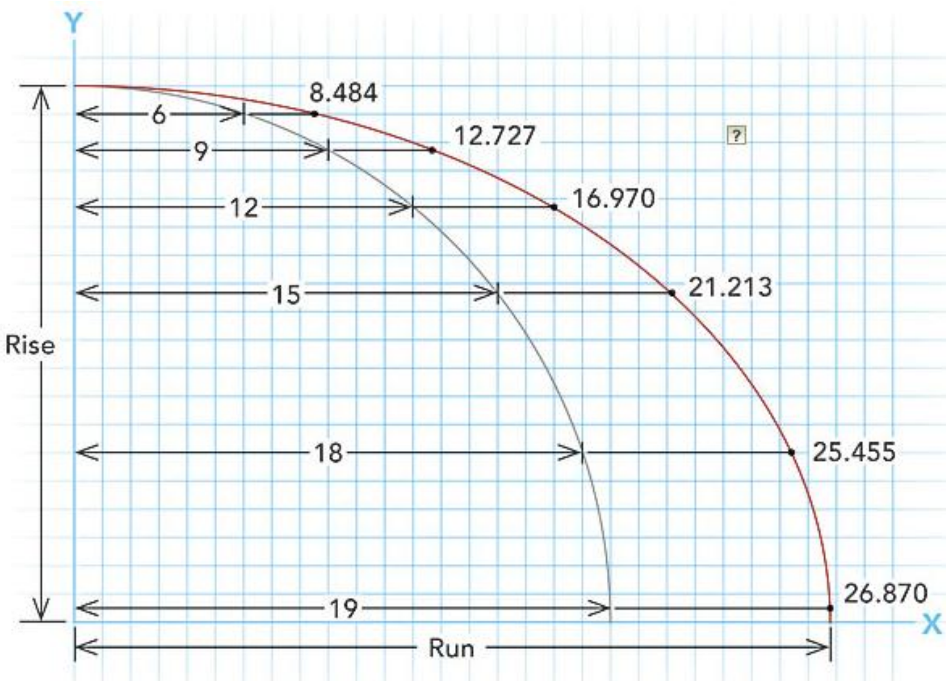
1)Metal Matrix Composites (MMC): Metal Matrix Composites are composed of a metallic matrix (aluminum, magnesium, iron, cobalt, copper) and a dispersed ceramic (oxides, carbides) or metallic (lead, tungsten, molybdenum) phase. — 01 mark

2) Ceramic Matrix Composites (CMC): Ceramic Matrix Composites are — 01 mark

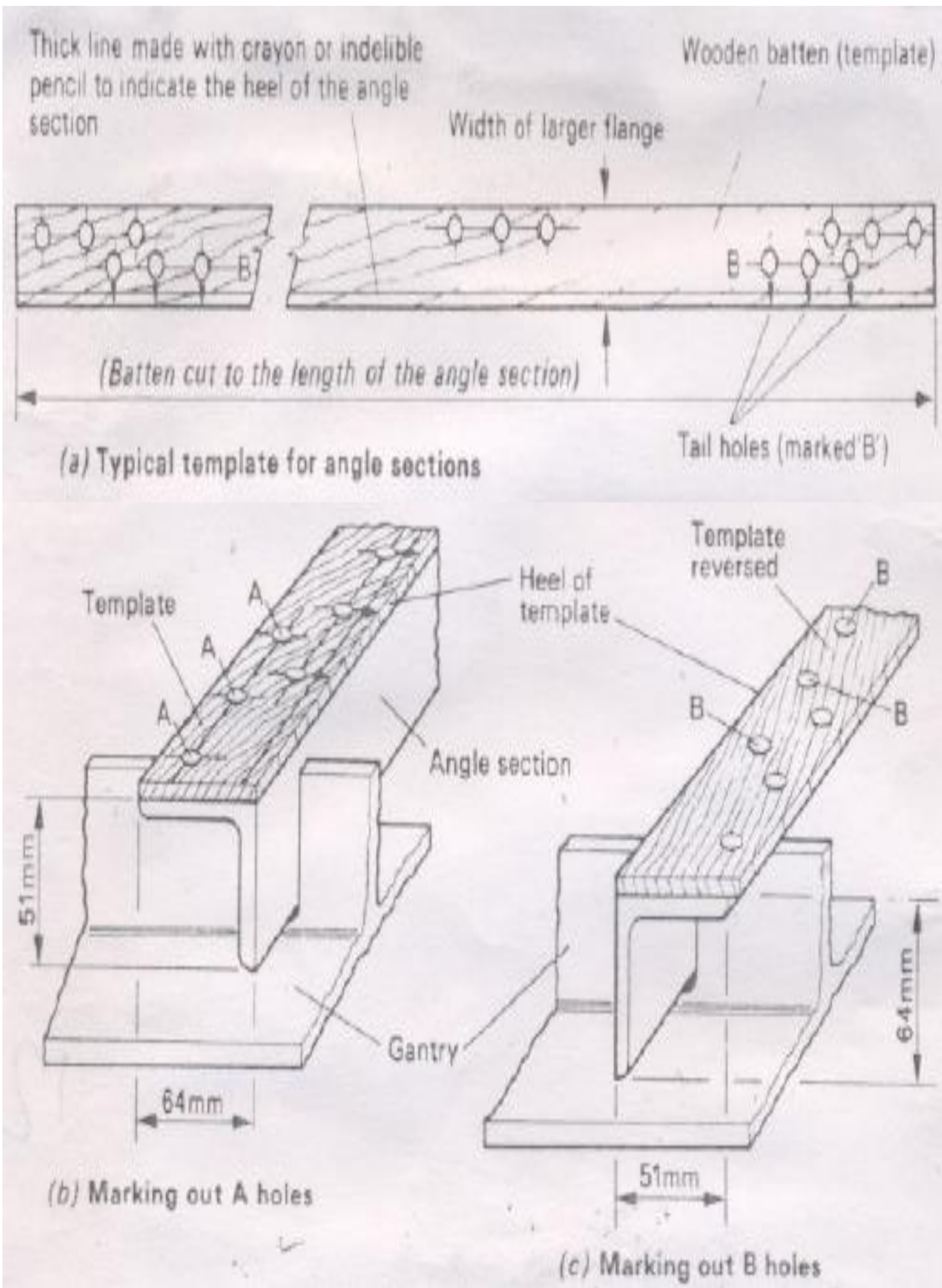
	composed of a ceramic matrix and embedded fibers of other ceramic material (dispersed phase). 3) Polymer Matrix Composites (PMC): Polymer Matrix Composites are composed of a matrix from thermoset (Unsaturated Polyester (UP), Epoxy (EP)) or thermoplastic (Polycarbonate (PC), Polyvinylchloride, Nylon, Polystyrene) and embedded glass, carbon, steel or Kevlar fibers (dispersed phase).	01 mark	
	OR		
	<u>Based on reinforcing material structure</u> 1)Particulate Composites Particulate Composites consist of a matrix reinforced by a dispersed phase in form of particles. 1. Composites with random orientation of particles.  2. Composites with preferred orientation of particles. Dispersed phase of these materials consists of two-dimensional flat platelets (flakes), laid parallel to each other. 	01 mark (any one with diag.)	
	2)Fibrous Composites 1. Short-fiber reinforced composites. Short-fiber reinforced composites consist of a matrix reinforced by a dispersed phase in form of discontinuous fibers (length < 100*diameter).	01 mark (any one with diag.)	

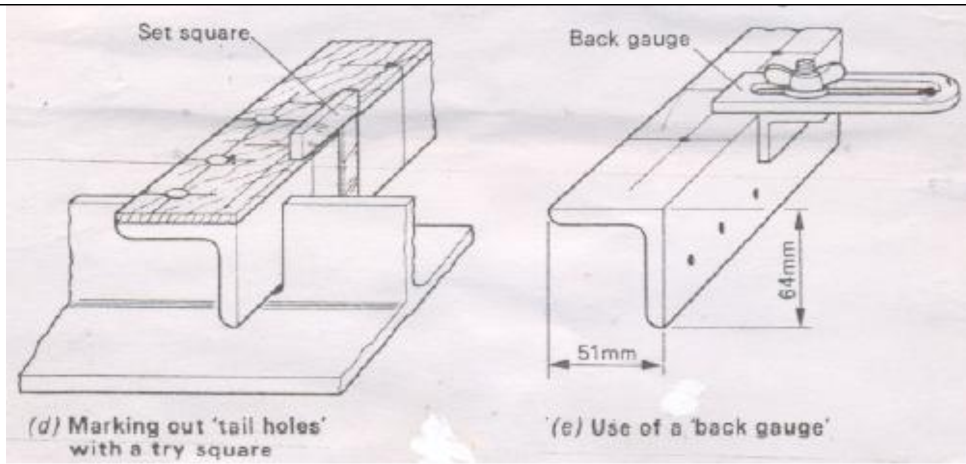
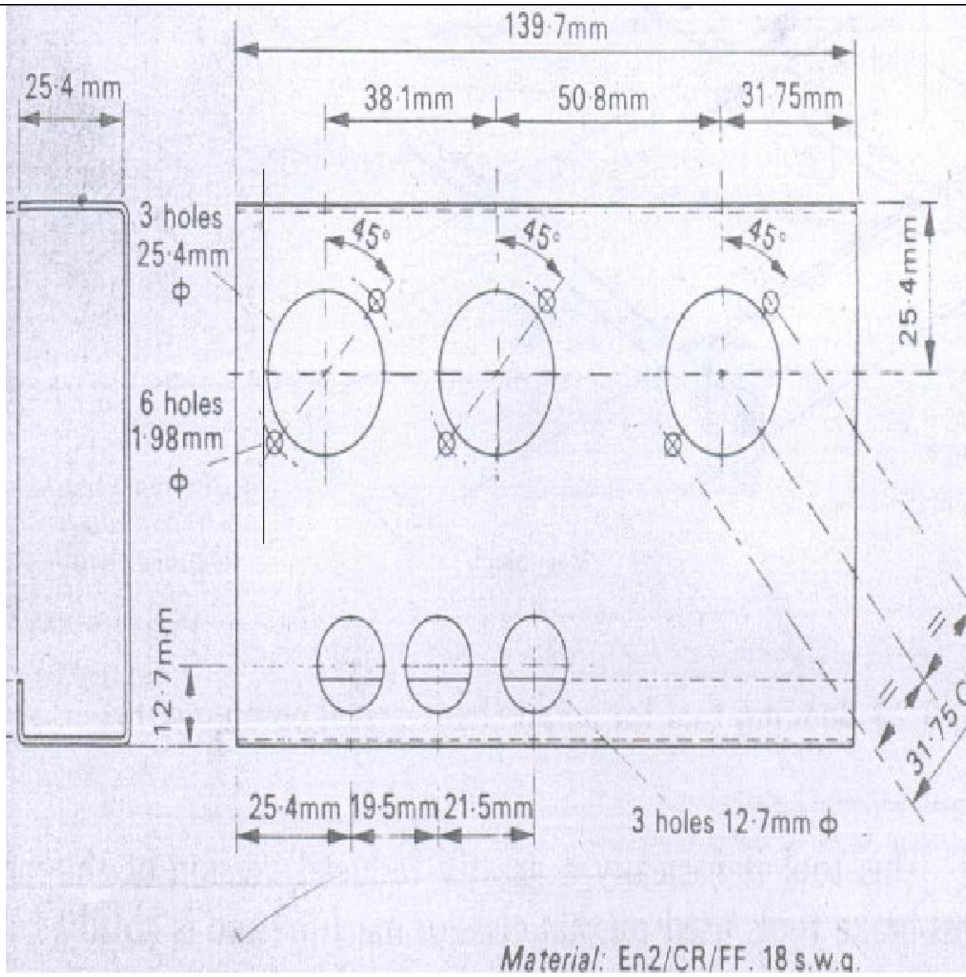
	1. Composites with random orientation of fibers. 2. Composites with preferred orientation of fibers.  2. Long-fiber reinforced composites. Long-fiber reinforced composites consist of a matrix reinforced by a dispersed phase in form of continuous fibers. 1. Unidirectional orientation of fibers. 2. Bidirectional orientation of fibers (woven).  3)Laminate Composites When a fiber reinforced composite consists of several layers with different fiber orientations, it is called multilayer (angle-ply) composite.	01 mark	
2.	**Attempt any two of the following**	**2*8**	**16**
a)	i) Use of string method:  	02 marks (diag.) & 02 marks (expln.)	**08**

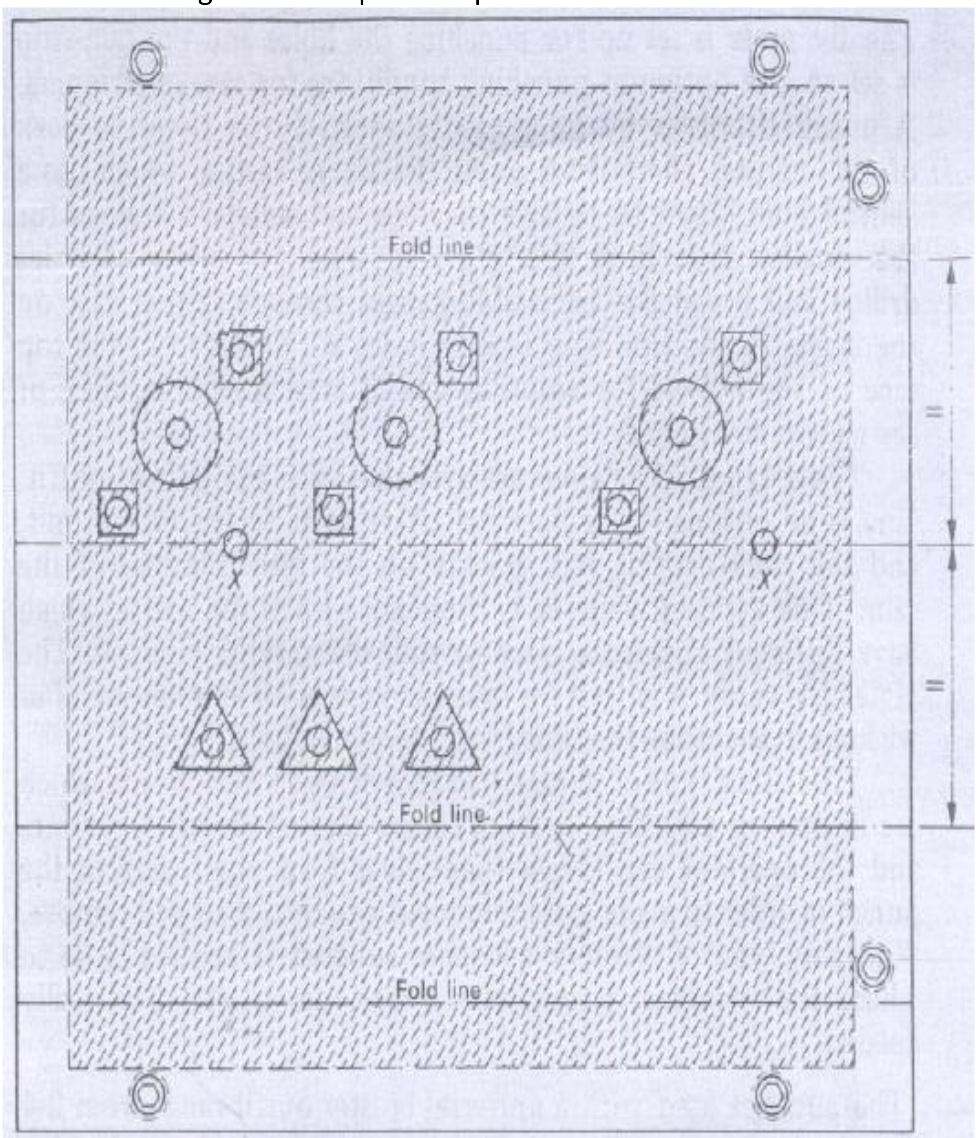
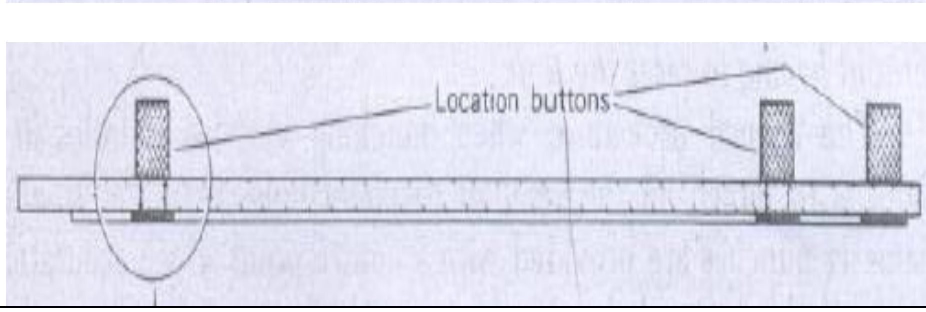
	Draw an ellipse with a string, two pins, and a pencil. First, draw a horizontal line and mark a centerpoint. Next, determine the rise and run of the ellipse. The string's anchor points, called the foci, are located with the following equation: foci= $\sqrt{(run^2 - rise^2)}$. The string length can be calculated this way: string length = 2(foci + run). After finding the centerpoint and foci, attach a non stretching string of the correct length to nails or screws driven in at the foci. Using the string to restrain the pencil, draw the ellipse. ii) Use of stick method: 	02 marks (diag.) & 02 marks (expln.)	

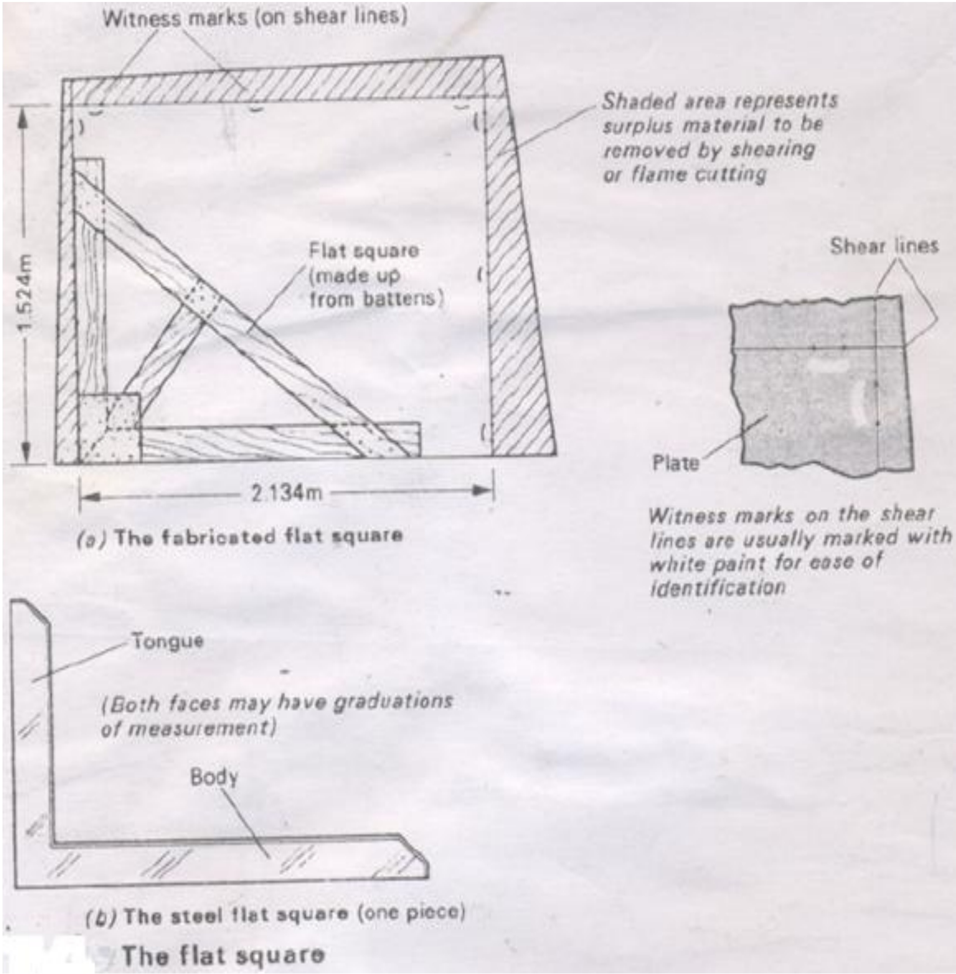
	Drill a hole for a pencil in the middle of a 1x2. From the pencil's centerline, measure the distance of the desired rise (the y coordinate) of the ellipse (for example, 12 in.), and drive a screw or nail through the trammel. In the opposite direction, measure the distance of the run (the x coordinate; 17 in., for example), and set another screw or nail. (For accuracy, the pins should be just outside the measured point.) To draw the ellipse, align the pins and pencil along the vertical edge of the workpiece. While keeping the pins tight to the plywood edges, move the bottom pin (the rise) to the right as the top pin (the run) descends the vertical. iii) Use of grid method:  If an ellipse is too big to lay out with a trammel, it can be drawn using an algebraic formula. Begin by drawing a grid on an appropriately sized piece of paper, a sheet of plywood, or the subfloor. If you divide the horizontal axis into 20 parts, you'll be plenty accurate. To draw the companion hip or valley to a curved common rafter, you'll want first to draw the common. For the sake of illustration, we'll use a quarter radius to describe the common, which can be drawn by swinging an arc from the intersection of the x axis and y axis. The elliptical hip or valley is laid out as an extension of the common, in a ratio of 12:17. On the grid, although each unit of rise remains the same, every 12 in. of run gets stretched to 17 in. to describe regular hips or valleys. To elongate the radius into an ellipse, multiply each point on the x axis (which represents the run) by the square root of 2, which is 1.414. The y axis (representing the rise) stays the same.	02 marks (diag.) & 02 marks (expln.)	

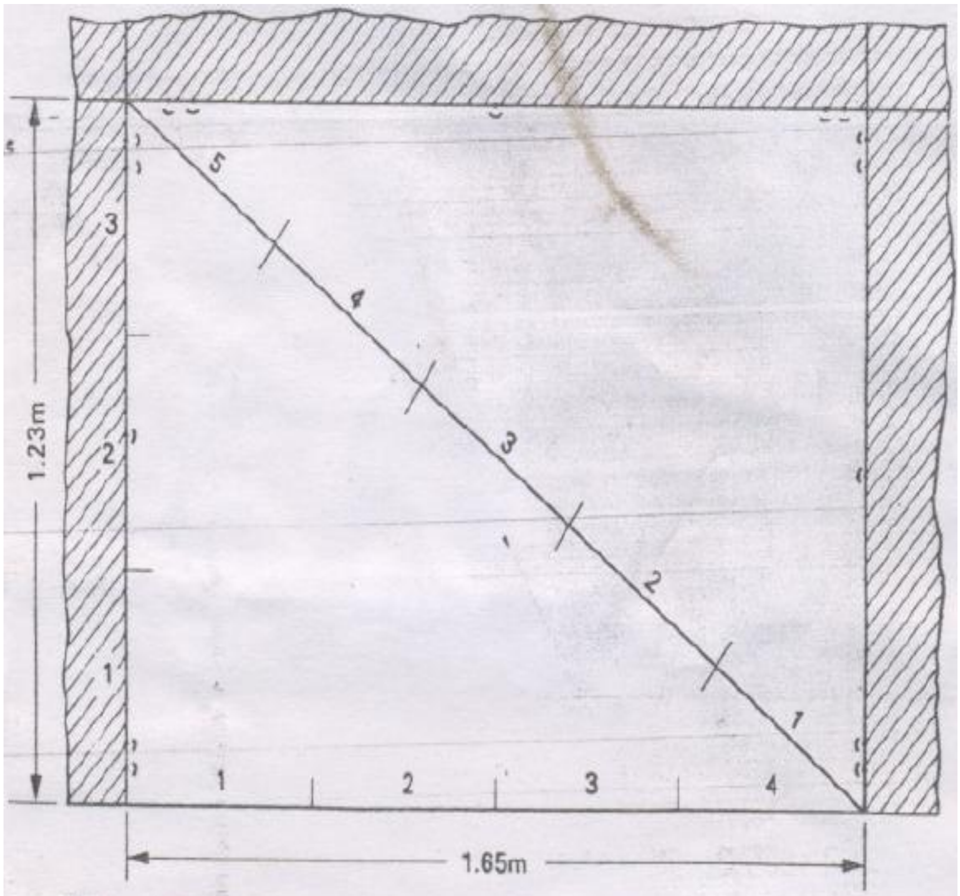
	After the coordinates are laid out, tack a flexible strip of wood at each point of the stretched grid to describe the elongated curved line. Now the ellipse can be transferred onto the stock. iv) Etc.		
b)	Scriber, beam trammels with steel tapes, bevel, pipe square, scratch gauge, centre punch, dot or nipple punch, etc.	02 marks (any 4)	**08**
b)i)	Marking of holes in angle sections:	01 mark for diagram (a) & 02 marks for self expln. diagrams (b), (c), (d) & (e)	



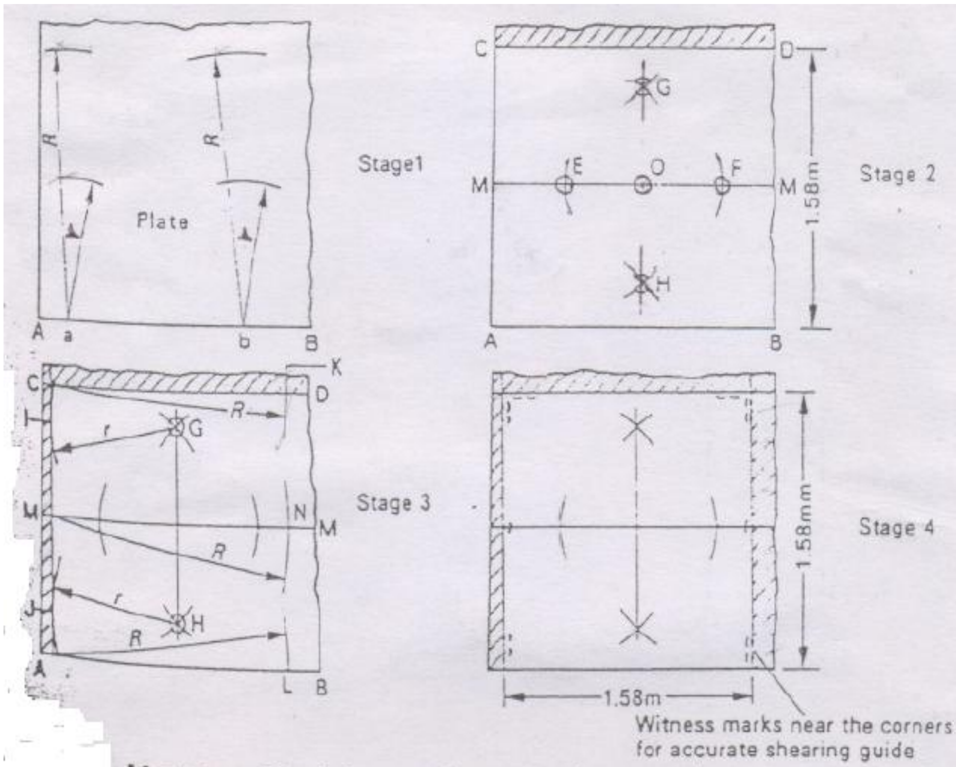
	(d) Marking out 'tail holes' with a try square (e) Use of a 'back gauge'		
b)ii)		01 mark (with/ without dimension of job)	
	The sequence of operations for marking of holes may be as follows: A template is used to mark the positions of all the holes. Such a template is usually marked out on 10 s.w.g. mild steel plate on a surface table using a vernier height gauge and an angle plate. Small pilot holes are drilled, and once the template has been passed by inspection these are opened out	01 mark (expln.)	

	with the correct size drill to suit the diameter of a nipple punch. The template is provided with location buttons to give an accurate location for the blanks. Figure below shows the template positioned over the blank ready for transferring the hole positions with a nipple punch. The use of such a template is a fool proof system which not only provides identical hole positions on each blank, but dispenses with the use of guides and locations having to be set up on the press.   	01 mark (template)	

c)	Marking methods for large size plates **(any one)**:  (a) The fabricated flat square (b) The steel flat square (one piece) The flat square Method1: Use of square and steel tape A Flat square is used for marking out on large flat surfaces. The flat square differs from an Engineer's try-square in that it is laid on the flat surface of the sheet metal or plate to be marked out. It is larger than the try-square and is made in one piece, consisting of a long arm termed the 'body' and a short arm termed the 'tongue'. In many fabrication workshops use is made of a simple made-up square of either wood or light gauge steel. A suitable steel tape is used in conjunction with the flat square. Before commencing to mark out a large plate: 1. Always check for squareness. 2. Where possible, select one straight edge and use as a base datum. Figure1 showed how square and steel tapes are used for marking-off a steel plate for cutting. Figure 2 shows how squareness may be checked. **OR**	02 marks (diag.) 02 marks (expln.)	**08**

	Use of the steel tape for marking off Method2: Use of steel tape Figure3 illustrates the use of a steel tape for marking-off a plate to measure 1.65m by 1.23m. Select one straight edge on the plate for straightness and use as a baseline, otherwise mark a datum line with the aid of a chalkline. The method employed has been explained in Fig1. In this case a most suitable measurement to be used for the 3:4:5 ratio of the sides of a 90^{o} triangle will be 410 mm, giving the following dimensions to be used for the steel tape: 1230 mm (3 x410) : 1640 mm (4 x 410) : 2050 mm (5 x 410) Once a line has been constructed at 90^{o} to the base datum, the dimensions of the sides are measured with the steel tape, the outlines made with a chalkline and witness marked. The outline is checked for true squareness as explained in Fig2. Arcs may be swung with a steel tape by holding the French Chalk in the hook at the zero end of the tape.	02 marks (diag.) 02 marks (expln.)	

OR



Marking-off with a steel tape and trammels

02 marks (diag.)

Method3: Use of steel tape and trammels

Figure4 illustrates the method of marking-off a steel plate which is required to be 1.58 m x 1.58 m with square corners, using a steel tape and trammels.

Stage1;

A suitable straight edge is selected and used as a baseline as shown at A-B. The trammels are set to the full width of the plate (R=1.58m) and with any two points ‘a' and ‘b’ (on the base line A-B) as centres, arcs are struck. With the same centres and the trammels set to approximately half this dimension (radius r) two other arcs are shown struck as in Fig.4

THE STEELTAPE IS USED FOR ALL MEASUREMENTS

02 marks (expln.)

Stage 2;

Parallel lines, C-D and 'M-M are marked with the chalkline held tangential to each pair of equal arcs, in turn. A light centre punch mark is made at 0 which is approximately half the width M-M.

From the point O on M-M construct a perpendicular G-H, and mark with the chalkline. Lightly centre-punch mark the points G and H.

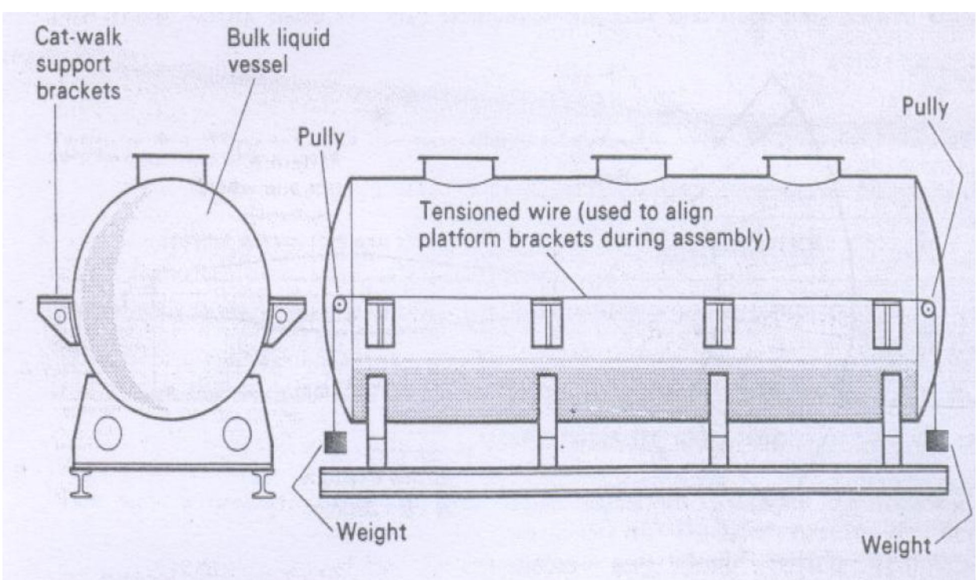
The points G, Hand 0 are used to check whether the edges of the plate are straight and parallel to this line of points, to enable use to be made of them.

Stage3;
If both edges prove unsuitable for use, the trammels are set to radius r, and with centres G and H, arcs are struck to provide a suitable shearing margin at points I and J.
The end shear line is made with the chalk line held at a tangent to these arcs.
The plate edge measurements for the length of the plate are made from this line (through I and J). The trammels are set to R = 1.58 m, and a chalkline is made at a tangent to the arcs at points K, N and L, as shown in Fig.4
Stage 4;
The shear lines are witness marked with a centre punch, and white paint marks are made near them.
The finished outline is checked for SQUARENESS by measuring the diagonal lengths.

Marking out bracket from a datum surface:

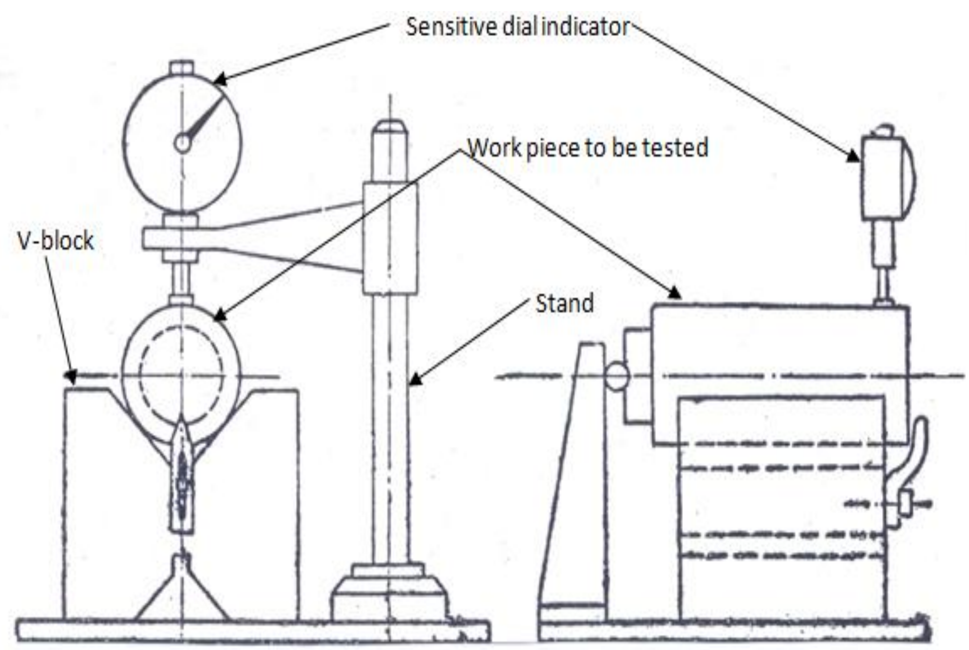
02 marks (expln.)

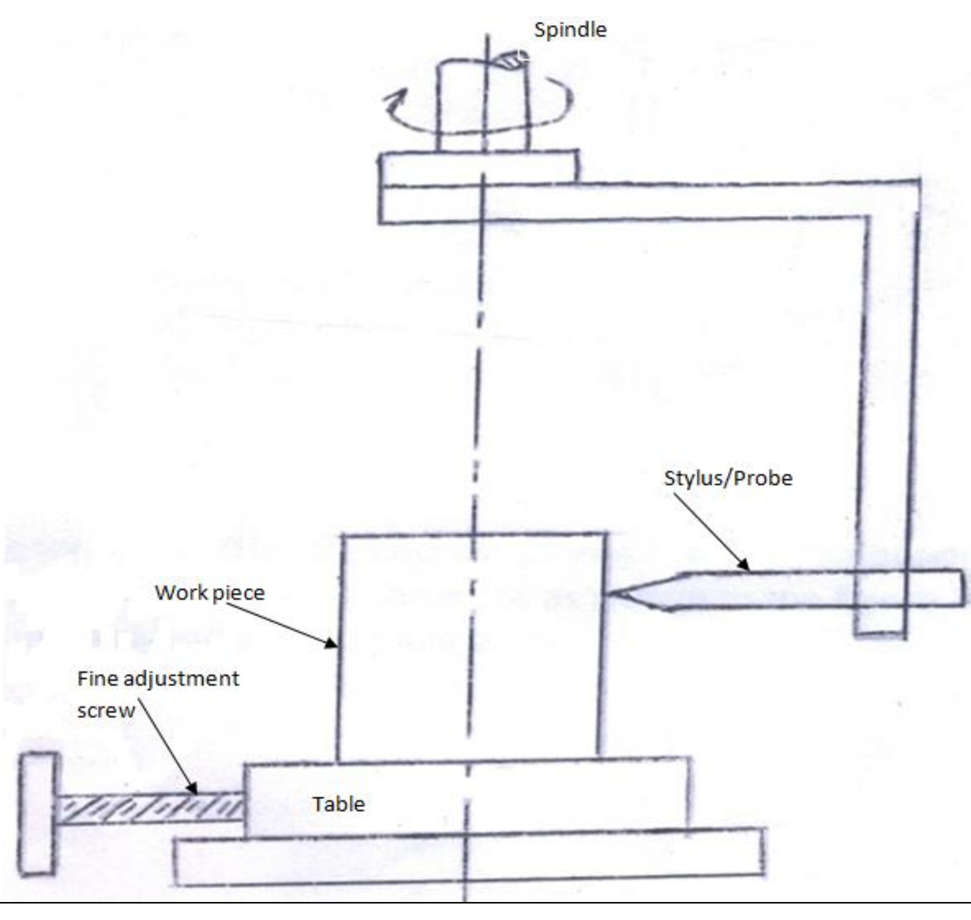
On large fabricated components, a tensioned wire may be used to check straightness and for checking alignment.
Piano wire or stainless steel wire of about 0.55 mm in diameter is used for this purpose, and when not in use should be kept on a suitable reel.
When in use for measuring or checking, both ends of the wire are hung over supports which are rounded, such as round bar section or pulleys, and weighted sufficiently to keep the wire in TENSION.
Alternatively the wire may be secured by means of adjustable clamping devices.
The figure below illustrates the use of a tensioned wire method.

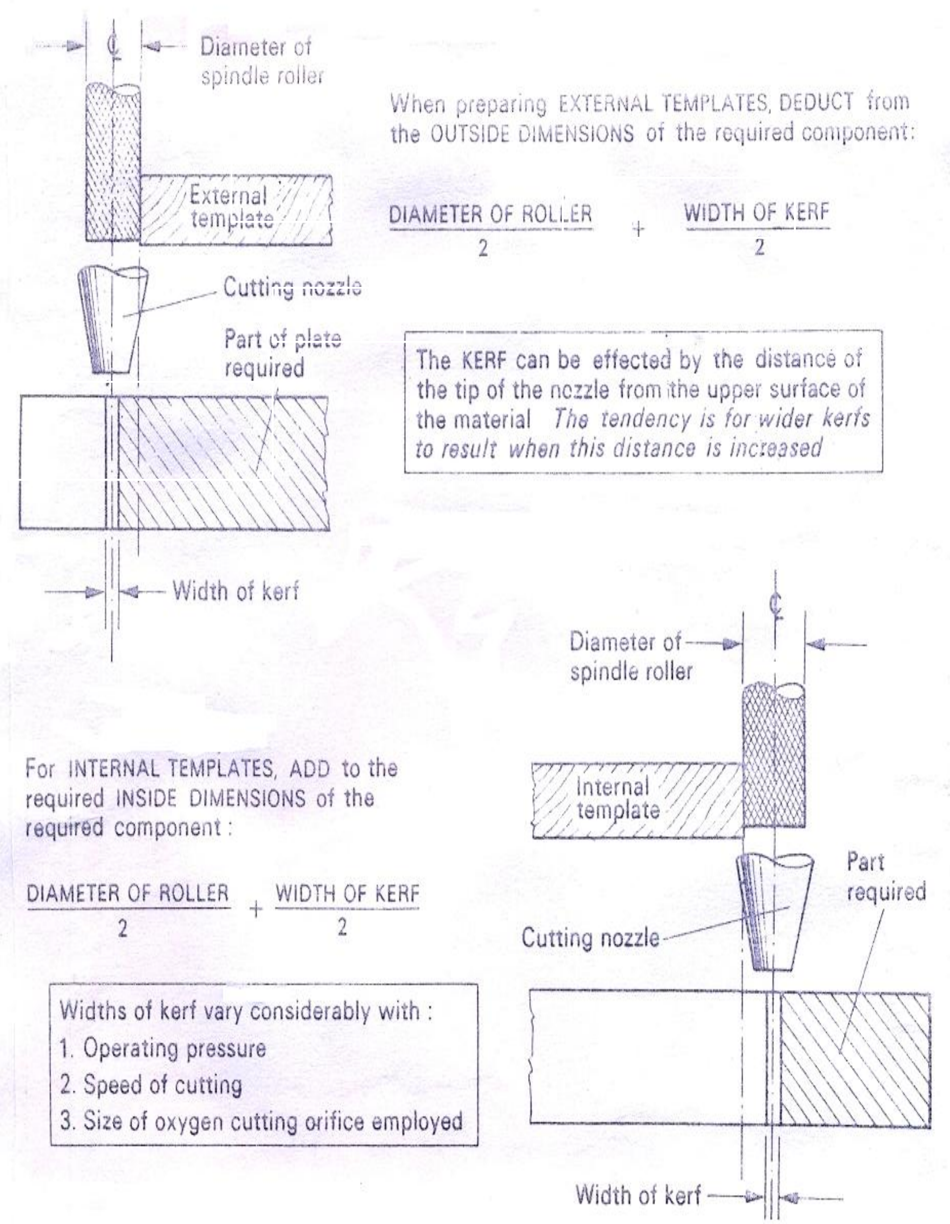


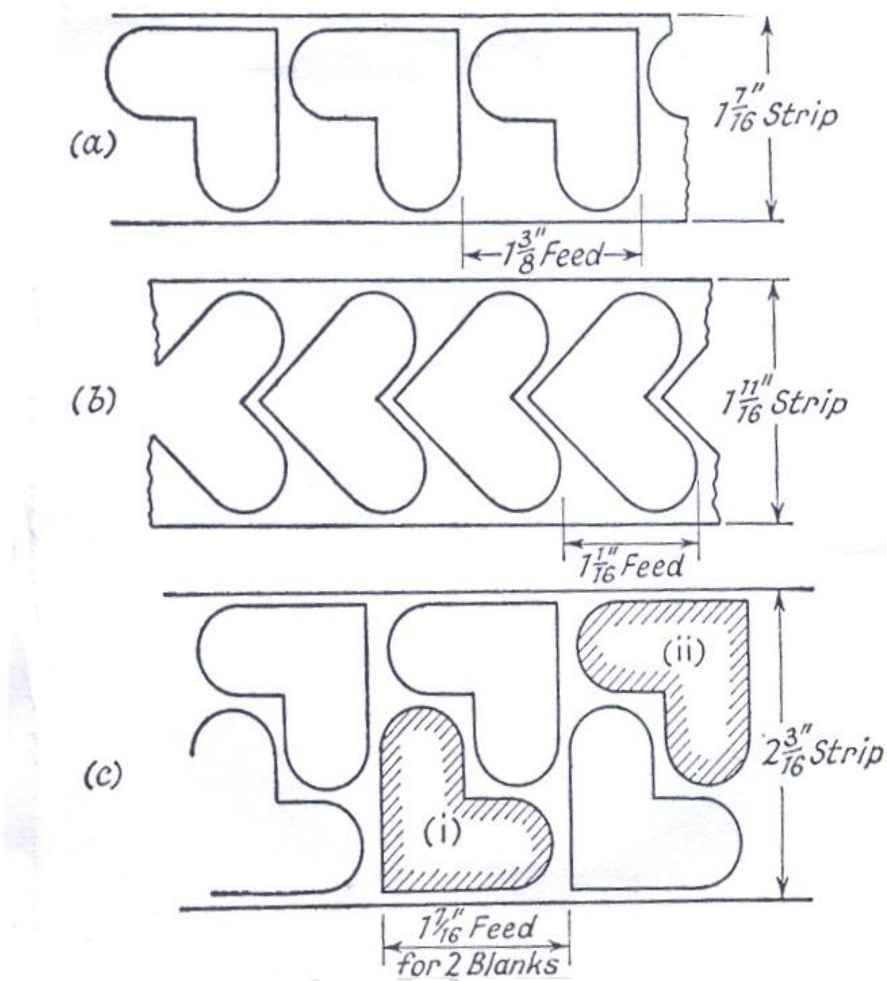
02 marks (diag.)

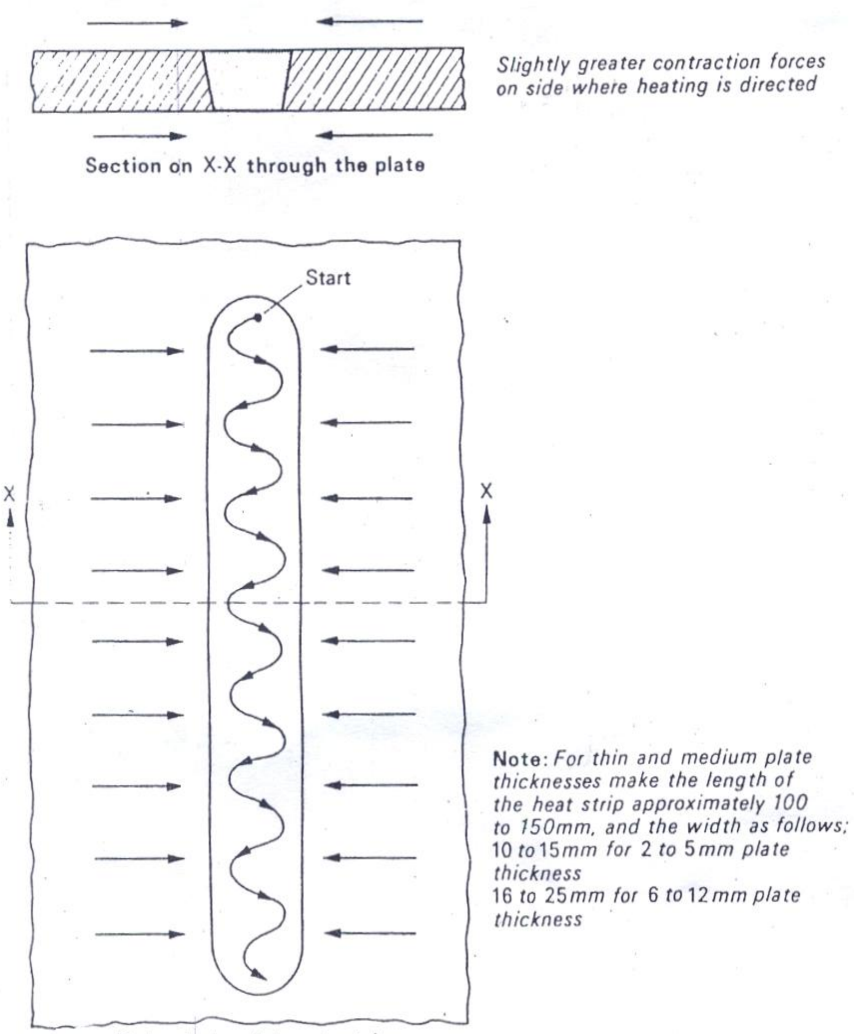
Use of the tensioned wire

3.	**Attempt any <u>two</u> of the following**	**2*8**	**16**
a)	Necessity of roundness measurement: In the assembly of circular parts, only the dimensional tolerances on diameter will not suffice the requirements, but it is the geometrical accuracy (accuracy of form) that needs closer attention. If cylindrical parts are measured from devices having diametrically opposite contacts such as micrometer etc., though they may be found to be within the dimensional tolerances but still may not be perfectly circular, which would be noticed during the assembly of parts. Thus the method of circularity measurement has to be such which detects the various possible errors of circularity and this is always done by rotating a part as in various roundness measurements and not simply measuring the static diameter alone. Sources of; i) Out-of-roundness include clamping distortion, spindle run-out, presence of dirt and chips on clamping surfaces, imbalance, heat and vibration, etc. ii) Circularity errors at a cross-section could be due to Ovality, Lobing, etc. **Two methods for roundness measurements:**  i) Assessment using a V-block --- The set up employed for assessing the circularity error (lobing) by using a V-block is shown in the figure below. i.e. the V-block is placed on a surface plate and the work to be checked is	02 marks 1 ½ marks (diag.) 1 ½ marks (expln.)	**08**

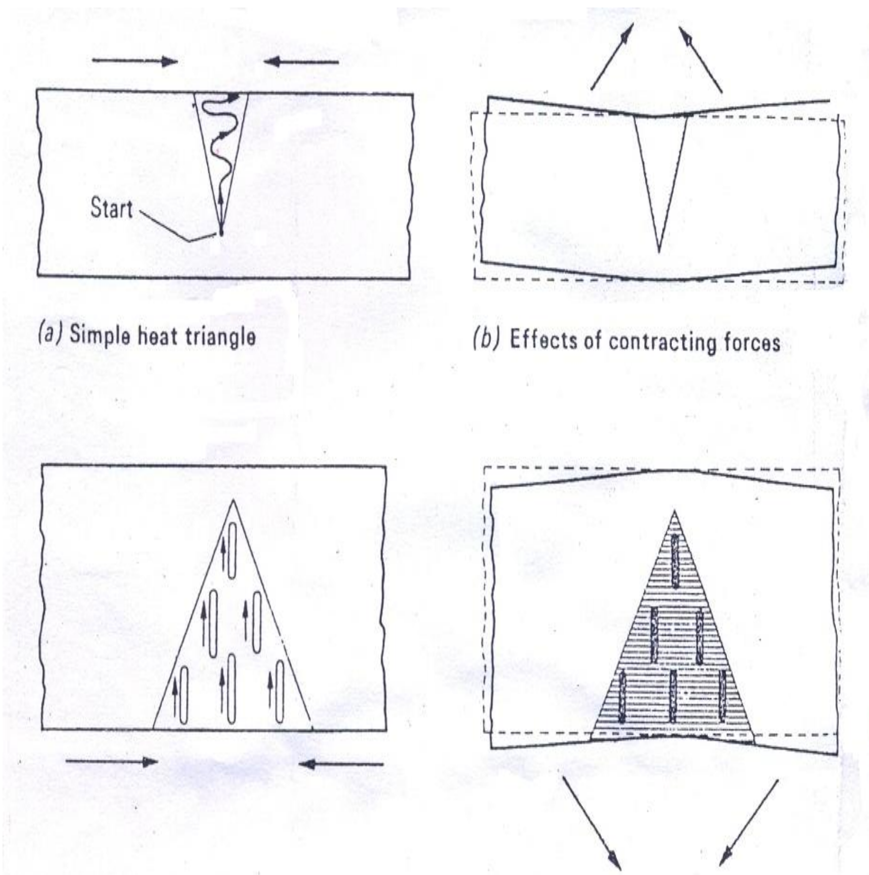
	placed upon it. A sensitive dial indicator is firmly fixed in a stand and its feeler is made to rest against the surface of the work. The work is rotated to measure the rise and fall of the work piece. For determining the number of lobes on the work piece, the work piece is first tested in a 60° V-block and then in a 90° V-block. The number of lobes is then equal to the number of times the indicator pointer deflects during rotation of the work piece through 360°.		
	ii) Using roundness measuring machine --- The figure shows the basic principle used in most of roundness measuring machines. When roundness measurement is required it is important to measure external and internal surface like cylinder. To measure roundness a measuring stylus or probe is carried on a rotating spindle of the machine. The axis of this spindle should be aligned with the axis of work piece to be tested. The work piece is placed on a table provided with fine adjustment screw for adjusting the work piece axis so that it will align with spindle axis. The stylus of the machine is then moved around the profile of the work piece. The machine has an electronic magnification system so that the variation in roundness can be detected on polar graph or polar chart.	1 ½ marks (expln.)	
		1 ½ marks (diag.)	

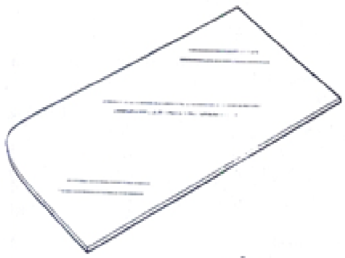
b)i)	Templates as a guide for cutting processes; Profile templates with regard to oxy-fuel gas cutting are as shown in the figures below. In general, an external template is used when the piece to be cut from the plate is the component and an internal template when the piece cut from the plate is not required for the component. 	02 marks (expln.) 02 marks (diag.)	**08**
b)ii)	Templates as a means to provide an economical arrangement of layout for press-work: Very often, when marking a full-size layout directly on to a sheet or plate, from information given on a drawing, it is almost impossible to anticipate exactly where to begin in order that the complete layout can be economically accommodated. Consequently, large-size layouts tackled in	02 marks (expln.)	

	this manner generally result in an extravagant waste of material.  	02 marks (diag.)	
c)	What is heat straightening? Thermal/Heat straightening is a repair procedure in which a limited amount of heat is applied in specific patterns to the plastically deformed regions of damaged steel in repetitive heating and cooling cycles to produce a gradual straightening of the material. The process relies on internal and external restraints that produce thickening (or upsetting) during the heating phase and in-plane contraction during the cooling phase. Heat straightening is distinguished from other methods in that force is not used as the primary instrument of straightening. Rather, the thermal expansion/contraction is an unsymmetrical process in which each cycle leads to a gradual straightening trend. Use of heat strips: The figure below shows the use of heat strips for the 'hot straightening' and 'hot shrinking' of plate and wide sections. The shrinking forces will be approximately equal for both sides of the plate. The figure above shows the application of a heat strip which, upon cooling, causes the metal to	02 marks 1 ½ marks (expln.)	**08**

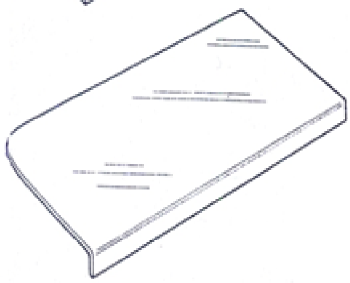
<table>
<tr><td></td><td>become compressed, because the contraction forces come in at right angles to the strip.
Heating is commenced at one end of the strip, making sure that the correct heat goes right through the plate (cherry red 750°C). The whole heating operation is a continuous one, employing a zigzag movement of the heating torch towards the opposite end. On cooling the plate will be shorter in length in the locally heated area.
The length and width of a particular heat strip can be determined by the thickness of the plate. As a general guide: for thicknesses from about 10mm to 30mm, the width of the heat strip should be between 20mm and 30mm, the length of the heat strip between 130mm and 200mm.


Principle of heat strips</td><td>1 ½ marks (diag.)</td><td></td></tr>
<tr><td></td><td>Use of heat triangles:
The use of heat triangles for straightening thin angle and flat sections, and the use of ‘triangles’ of heat strips for the bending and straightening of</td><td>1 ½ marks (expln.)</td><td></td></tr>
</table>

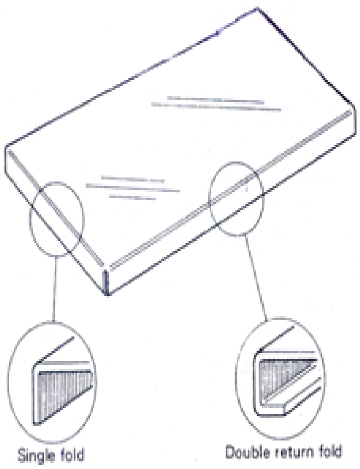
	plate and wide sections are as shown in the figures below. Simple heat triangles may be used as shown in figure a) below by starting with the heating torch at the apex of the triangle and working towards the base with a gradually widening zigzag movement. When allowed to cool, the base of the heat triangle will start to contract the most, and the contracting forces tend to cause the plate to bend, as shown in figure b) below. The resultant effects of using triangles of heat strips are exactly the same as for the simple heat triangles. Simple heat triangles are used for straightening of thin plate and light sections. Triangles of heat strips are preferred when bending or straightening thick plate and heavy sections. The order, in which the heat strips are applied, in the triangle, is shown below in figure c). Heating with the torch is commenced a short distance in from the edge of the plate, progressively heating from the outside inwards.  (a) Simple heat triangle (b) Effects of contracting forces (c) Sequence of heating strips (d) Effect on cooling Use of heat triangles	1 ½ marks (diag.)	
4.	**Attempt any <u>two</u> of the following**	**2*8**	**16**
a)	The following figures show the methods of stiffening sheet metal components;		



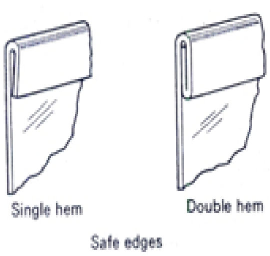
a)Little rigidity --- A flat sheet metal panel possesses little rigidity



b)Strength and rigidity --- This can be imparted to the panel by making right-angled folds along the two longest edges

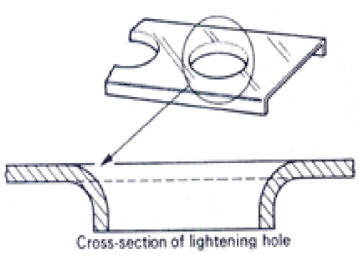


c)Greater strength and rigidity --- This can be imparted to the panel by folding all four edges. Greater strength has been given to the longest sides of a double fold



d)Return fold or single hem --- The raw edge of a sheet metal may be stiffened and at the same time made safe by means of a return fold or single hem

e)Double hem --- Greater stiffness is achieved by folding a double hem

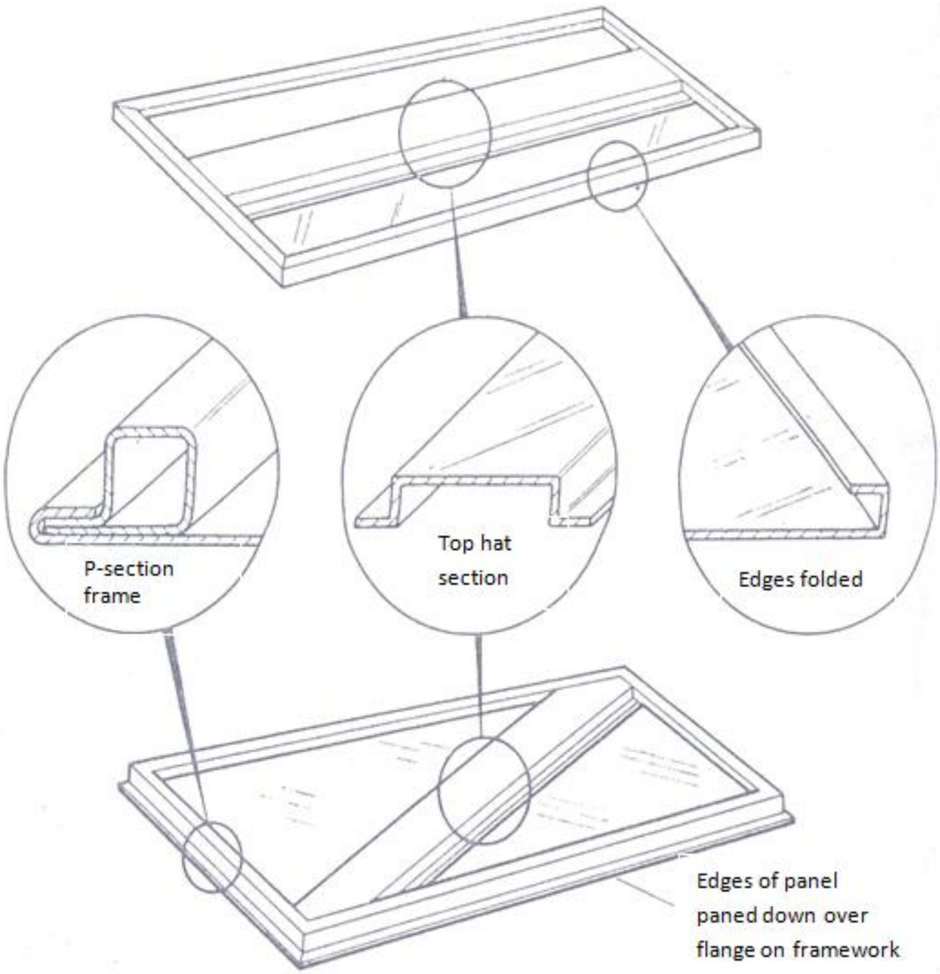


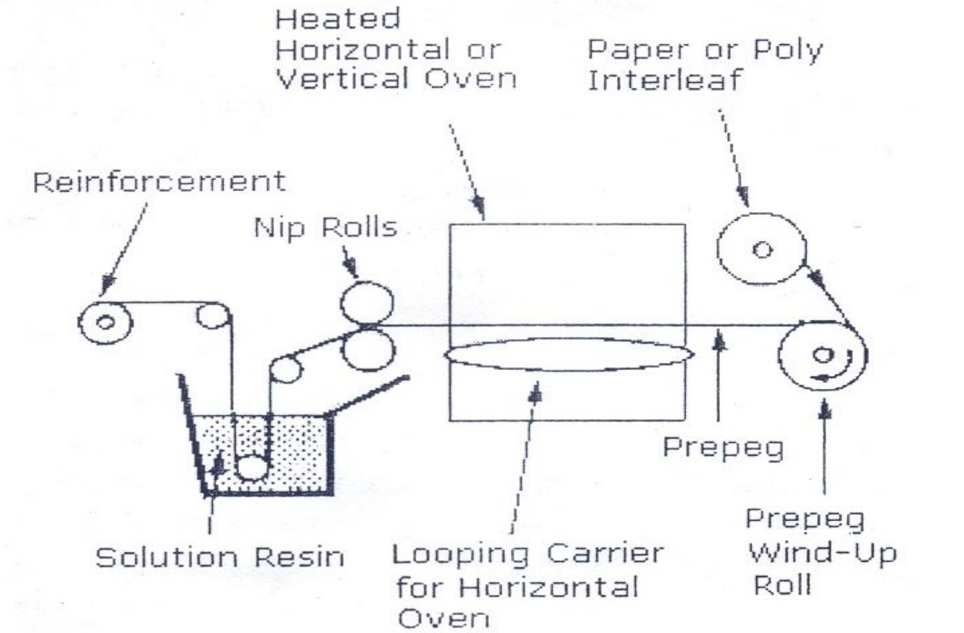
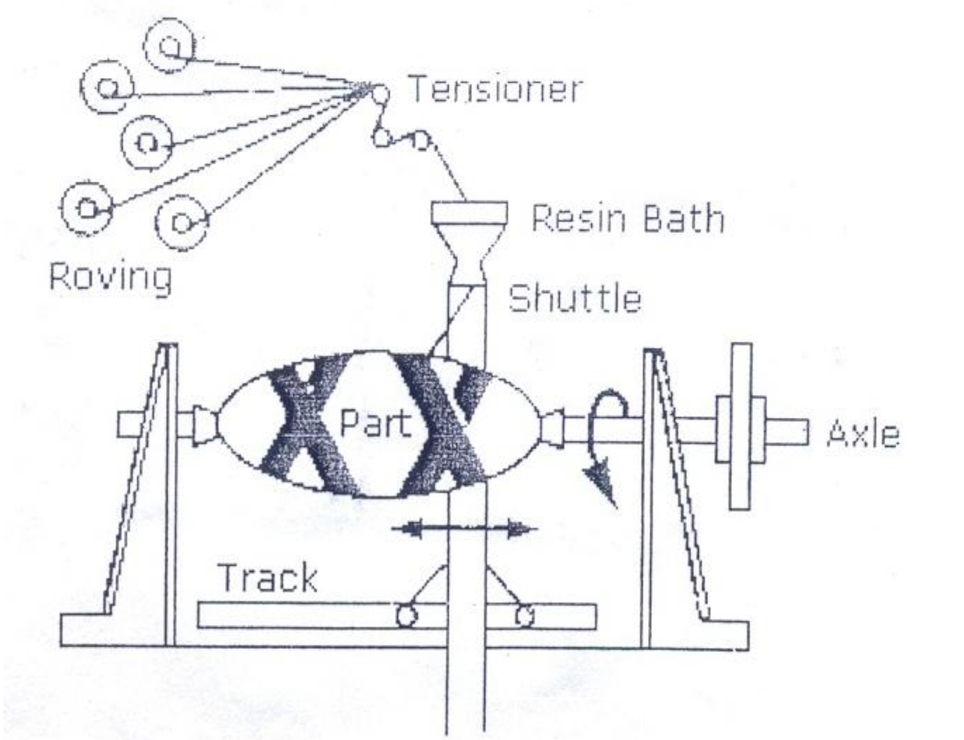
f)Lightening holes --- Lightening holes in sheet metal support brackets are stiffened by means of a flange. Usually the holes are punched and flanged in one operation, using a specially designed punch and die.

03 marks

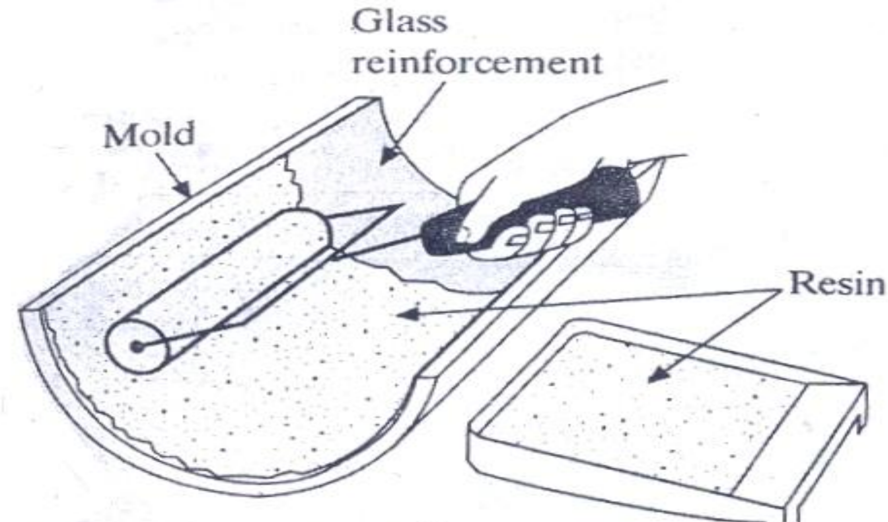
(½ mark each for a), b), c), d), e), f) with diag.)

08

	The stiffening of large panels is shown in the figures below;  	03 marks (diag.)	
	A large sheet metal panel may be stiffened with all four edges made rigid by folding. 'Top hat section' is used to stiffen the centre section of the panel and is usually secured in position by spot welding. Another method of stiffening large sheet metal panels is to attach them to a rigid frame-work. The welded frame is fabricated from lengths of 'P-section' which has a very high Strength/weight ratio for a sheet metal section. All four edges of the panel are folded at 90^0 to a suitable width. The panel is then placed in position over the frame and the edges 'paned-down' over the flange on the 'P-section'. The centre of the panel is stiffened by means of a diagonal top-hat section.	02 marks (expln.)	
b)	Description of processes: A brief description of each process with neat sketches is as follows; • Prepegging --- It involves the application of formulated resin products, in solution or molten form, to a reinforcement such as carbon, fibreglass or aramid fibre or cloth. The reinforcement is saturated by dipping through the liquid resin. In an alternative method called a Hot Melt Process the resin is impregnated through heat and pressure. The Hot Melt System uses resins with a very low percentage of solvents.	03 marks (1½ marks for **any one** process sketch	**08**

	 • Wet filament winding --- In this process, continuous fibre reinforcement materials are drawn through a container of resin mixture and formed onto a rotating mandrel to achieve the desired shape. After winding, the part is cured in an oven. This process can also be used as preimpregnated fibre tows called towpregs.  • Hand lay-up or contact moulding --- This involves coating a mould or	and 1½ marks **for process expln.**)	

form with a layer of resin; a layer of glass reinforcement is applied, and the reinforcement is thoroughly saturated with resin. The process is repeated until the desired composite thickness is achieved (the maximum thickness is usually 9mm). The polymer matrix is usually a polyester or epoxide.



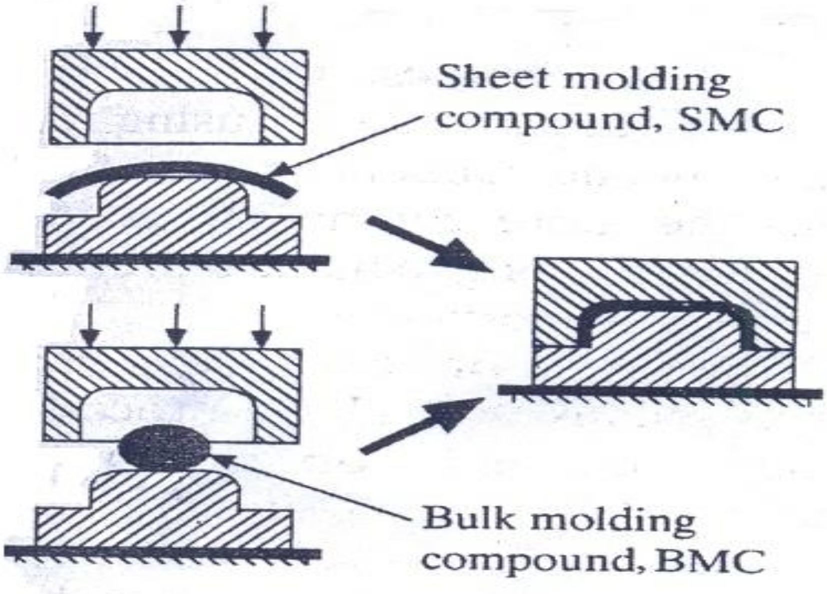
Hand lay-up

- Compression moulding --- It is similar to the process described for unreinforced thermosets, except that special techniques are required to introduce the glass reinforcement into resins that have to be catalyzed and have a limited pot life after catalyzation.

  In the sheet moulding process, catalyzed polyester or epoxy resin is kneaded into the glass reinforcement by rollers. Special fillers are added to keep the resin from being tacky and inhibitors are added to increase the pot life of the catalyzed resin. The finished sheet, called sheet moulding compound (SMC), consists of resin and reinforcement and this sheet can be cut to an appropriate size and pressed in a matched mould to make the finished part. The moulds are heated to complete the cross-linking of the resin.

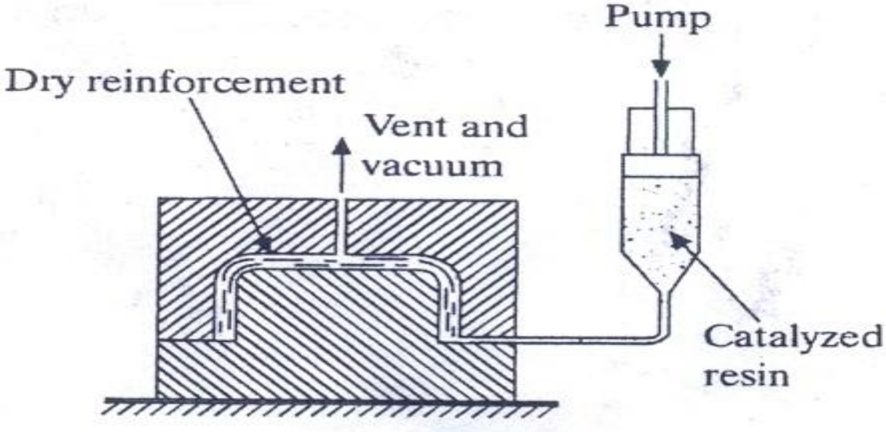
  A similar product, called bulk moulding compound (BMC), is produced by adding thickeners to the resin; it is kneaded like dough with chopped fibres to make a compression moulding charge that resembles a glob of dough. The heating and pressing are the same as in sheet moulding.

  Both processes can be used for large mouldings such as automobile fenders.



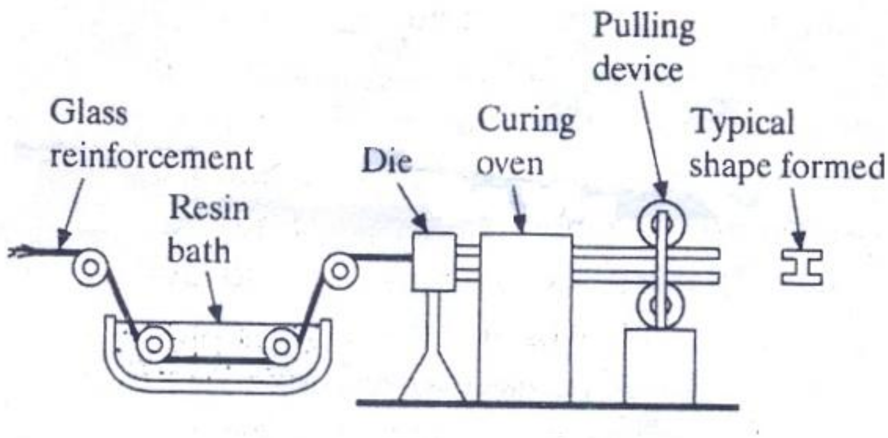
Compression molding

- Resin transfer moulding --- This process has evolved as a way to speed up contact and to improve the part by having two finished surfaces instead of one. This process requires a close fitting mould. Glass reinforcement is cut and shaped to the desired thickness in the open mould. The mould is then closed and evacuated and catalyzed resin is pumped into the bottom of the mould. When the mould is filled, the pump is shut off, the resin line is stopped off and the part is allowed to cure. This is becoming an important process for the production of large RTP boats. It is replacing hand lay-up.



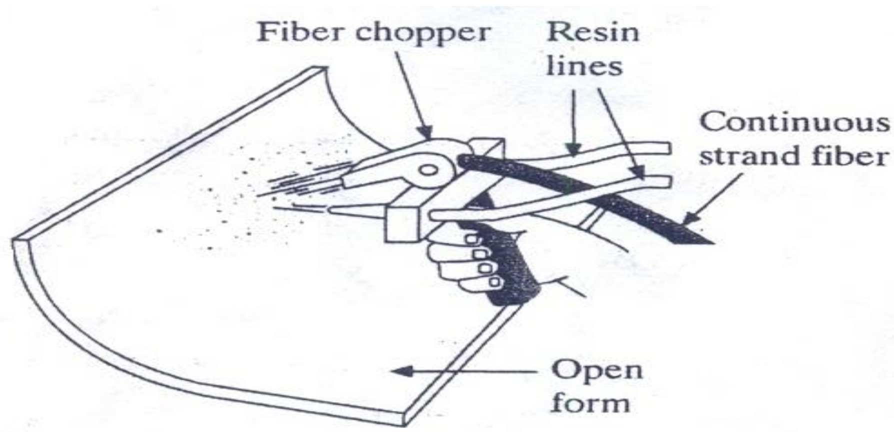
Resin transfer molding

- Continuous pultrusion --- It is a process for making glass-reinforced shapes that can be generated by pulling resin-impregnated glass strands through a die. The glass is pulled through a resin bath; it is shaped as it goes through a heated bath and the resin cross-links in the heated die and combined curing section. Pipes, channels, I-beams and similar shapes can be generated. Pultrusion structural shapes are frequently used for decking and structural members around corrosive chemical tanks.



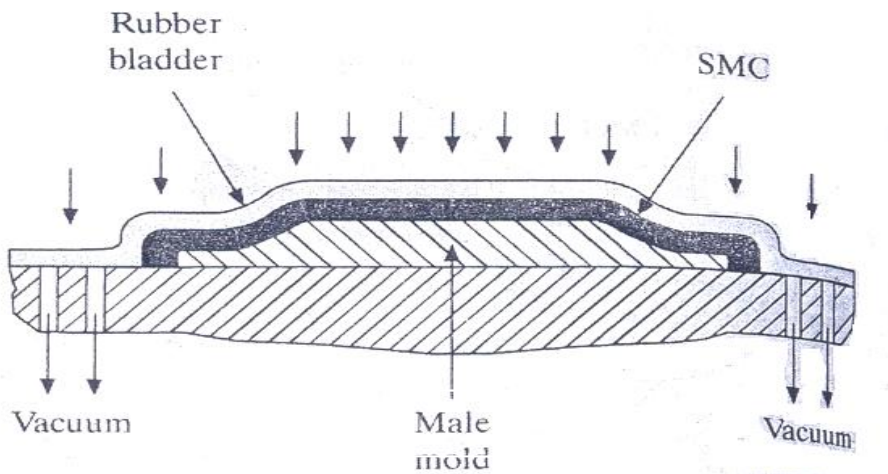
Continuous pultrusion

- Chopped fibre spraying --- It performs the same job as hand lay-up, but it is much faster. Two component resins are mixed in a hand-held gun and sprayed at a mould surface. A chopper is incorporated in the gun. It chops continuous strands of glass into short lengths to act as reinforcement in the composites. This process can be used to make large reinforced composites such as boats, shower stalls and bathtubs. Chopped fibre reinforcements, however are not as strong as hand lay-ups that are reinforced with mat or woven roving.

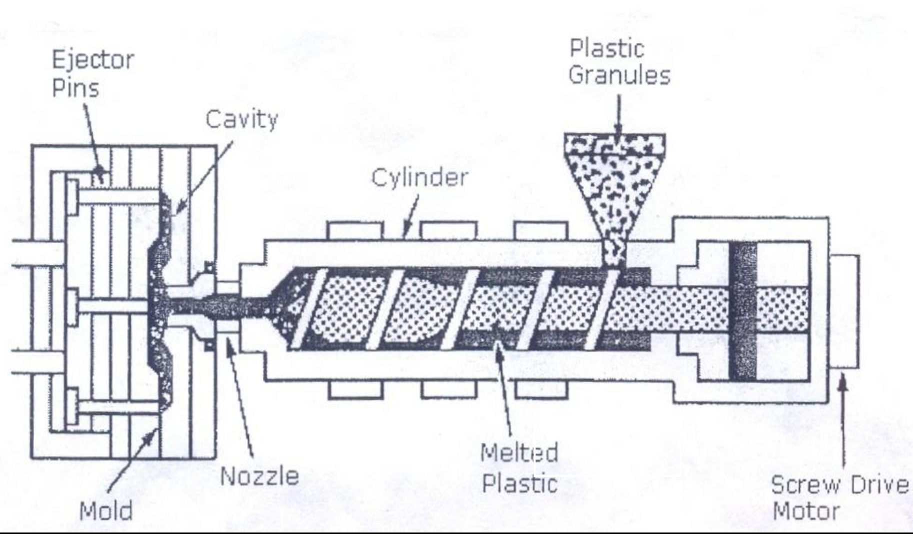


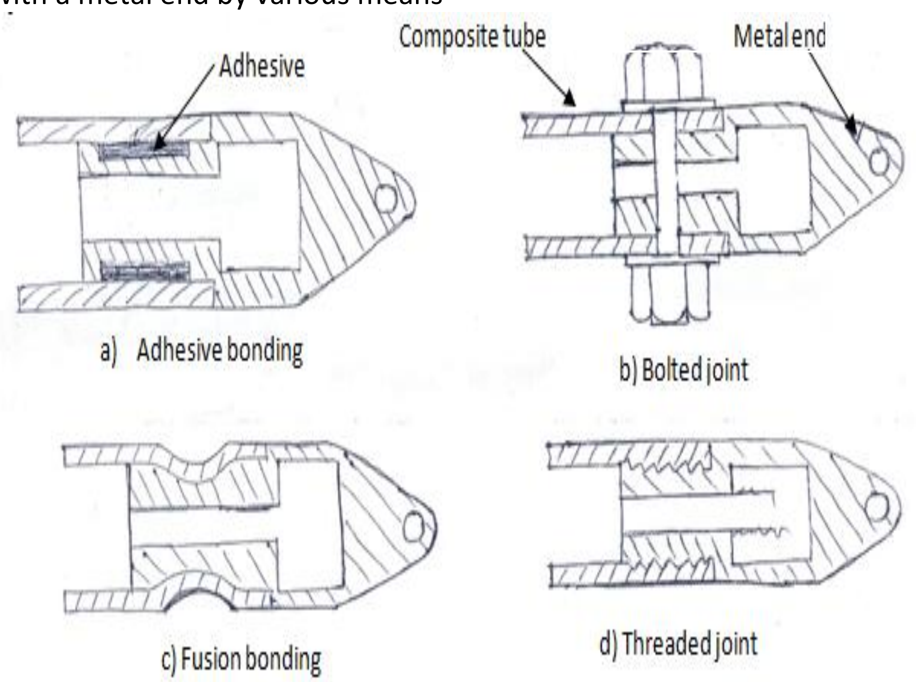
Chopped fiber sprayer

- Vacuum bag forming --- It is used to shape sheet moulding compounds to complex shapes. This process uses atmospheric pressure to do the forming, thus eliminating the high cost of matched metal moulds. It is possible to cure the SMC in the vacuum bag rig using temperature-resistant silicone rubbers for the forming bladder, but the more common practice is to use vacuum-bag forming to make a preform and cure the preform in another mould.



- Injection moulding --- Chopped fibres and particulate reinforcements are blended into the moulding pellets/granules. However this method is not normally used in PMC processes due to fibre damage in the plasticating barrel. Thermoplastic granules are fed via a hopper into a screw-like plasticating barrel where melting occurs. The melted plastic is injected into a heated mould where the part is formed. This process is often fully automated.



	Joining Composites: Introduction: In any product, there are generally several parts or components joined together to make the complete assembly. These parts are interconnected with each other to make the final product. The purpose of the joint is to transfer loads from one member to another, or to create relative motion between two members. Joints are but usually avoided in a structure as a good design policy. In any structure, a joint is the weaker area and most failures emanate from joints. Because of this, joints are eliminated by integrating the structure. In an ideal product, there is only one part. Fibre-reinforced composites provide the opportunity to create large, complicated parts in one shot and reduce the number of parts in a structure. There are two types of joints used in the fabrication of composite products: • Adhesive bonding • Mechanical joints Adhesive bonding is the more common type of joint used in composites manufacturing. In adhesive bonding, two substrate materials are joined by an adhesive. Mechanical joints for composites are similar to the mechanical joints of metals. In mechanical joints: rivets, bolts and / or screws are used to form the joints. Fusion bonding is also used for joining purposes. It is used to join thermoplastic parts by means of heat. The figures below show an application in which a composite tube is joined with a metal end by various means 	03 marks (1½ marks for any one joining sketch and 1½ marks for joining expln.)	

	Applications: Composites are the fastest growing materials market segment. Sporting goods, air-craft, automobiles, ship-building, are just a few examples. Tennis rackets, golf clubs, bumpers, door panels, dashboards and even engine components of modern automobiles, etc.	02 marks (any four)	
c)	Need for surface coating: Some of the properties of engineering components sharply depend on the surface quality of the components. The properties largely affected by surface quality and type of surface are: Corrosion resistance, wear resistance, abrasion resistance, reflectivity, hardness, conductivity, etc. To achieve these properties, many times the surface of a component is coated or covered with another material, which changes the physical, mechanical and electrical properties of the component. The material at the surface provides a physical barrier between the environment and the surface of the component. Need for surface cleaning: The need to provide the above mentioned physical barrier for a long period of time, such materials should have inherently certain desired properties, be continuous and uniform in thickness. These requirements are fulfilled only if there exist an excellent adhesion between the surface and the coated layer. Pre-treatment is therefore the preparation of the substrate surface, by chemical and / or physical means, so that it becomes optimized to accept the powder coating finish. To do so, it is essential to ensure that the substrate is free of dirt, grease, oil and metal oxides, such as rust and mill scale. Chemical Cleaning (Removal of Oxide Scales and Surface Defects): Chemical cleaning is divided into two distinct groups: • Organic solvent based • Alkaline and acid aqueous method Emulsifiable Solvent and Emulsion Cleaning The component is either sprayed or immersed in an organic solvent which contains emulsifying agents. After comprehensive coverage, the component is rinsed with water to emulsify the solvent together with contaminating oil or grease. Another advantage is that treatment is usually at ambient temperature, although cleaning efficiency is directly related to physical agitation over the component surface during the water rinsing stage. Alkaline and Acid Cleaners Alkaline cleaners are the most extensively used chemical cleaners for substrate pre-treatment, primarily on grounds of economics, safety, and	02 marks 02 marks 02 Marks 02 marks	**08**

<table>
<tr><td></td><td>resistance of steels to attack. They are also commonly used before metal undergoes conversion coating. The degree of alkalinity is known to effect phosphate conversion coatings (particularly zinc), with higher the pH, coarser the resulting crystal structure. In general, a finer structure is preferred for improved mechanical strength of the phosphating and gloss of the applied powder coating. Acid cleaners have a relatively restricted application, limited to mainly light rust removal. They are generally inefficient for oil and grease removal, and if the component is soiled as well as rusty, then acid cleaning is usually a follow-on to solvent or alkaline.</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td>Attempt any <u>two</u> of the following</td><td>2*8</td><td>16</td></tr>
<tr><td>a)</td><td>Dynamics of plant layout:
Plant layout is a dynamic rather than a static concept meaning thereby if once done if is not permanent in nature rather improvement or revision in the existing plant layout must be made by keeping a track with development of new machines or equipment, improvements in manufacturing process, changes in materials handling devices etc. But any revision in layout must be made only when the savings resulting from revision exceed the costs involved in such revision.

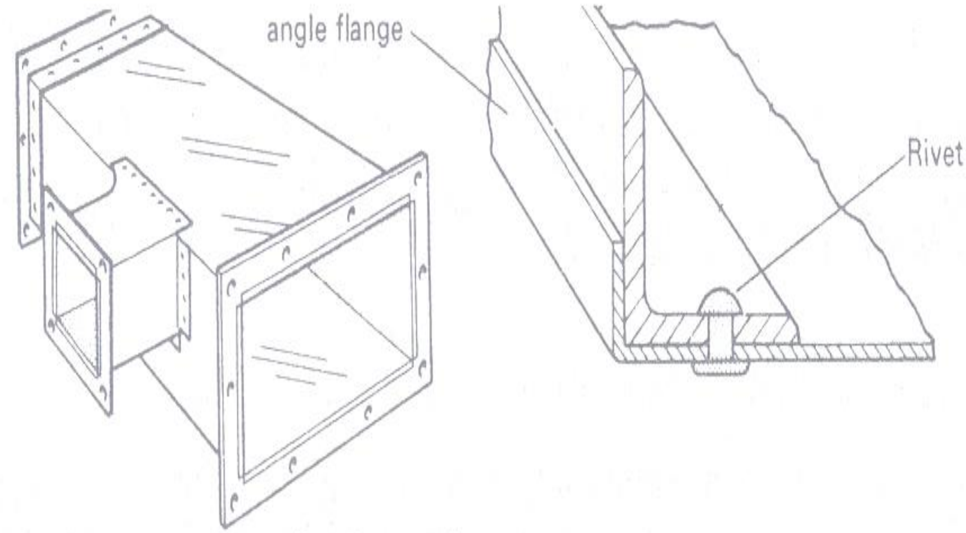
Revision in plant layout may become necessary on account of the following examples:
a) Increase in the output of the existing product
b) Introduction of a new product and diversification
c) Technological advancements in machinery, material, processes, product design, fuel etc.
d) Deficiencies in the layout unnoticed by the layout engineer in the beginning.
e) Etc.</td><td>04 marks (expln.)

04 marks (any four)</td><td>08</td></tr>
<tr><td>b)</td><td><table>
<tr><th>Parameters</th><th>Mechanical methods</th><th>Thermal methods</th></tr>
<tr><td>Process</td><td>Device or machine oriented</td><td>Manual i.e. labor oriented</td></tr>
<tr><td>Methods</td><td>Mechanical methods are widely used in pre-treatment and involve scouring of the substrate surface by both abrasive blasting, scraping, vibratory and tumble abrading, grinding or sanding.</td><td>Thermal methods are widely used in pre-treatment and involve heating the soiled surface with flame torch and wire brush the surface.</td></tr>
<tr><td>Labor skill</td><td>Semi – skilled to skilled</td><td>Unskilled to semi - skilled</td></tr>
</table></td><td>08 marks (any four)</td><td>08</td></tr>
</table>

Cost	High cost	Low cost
Time	Less time	More time
Suitability	Large no. of jobs	As per requirement
Etc.		

c) The figures below show the use of angle stiffeners for duct work:

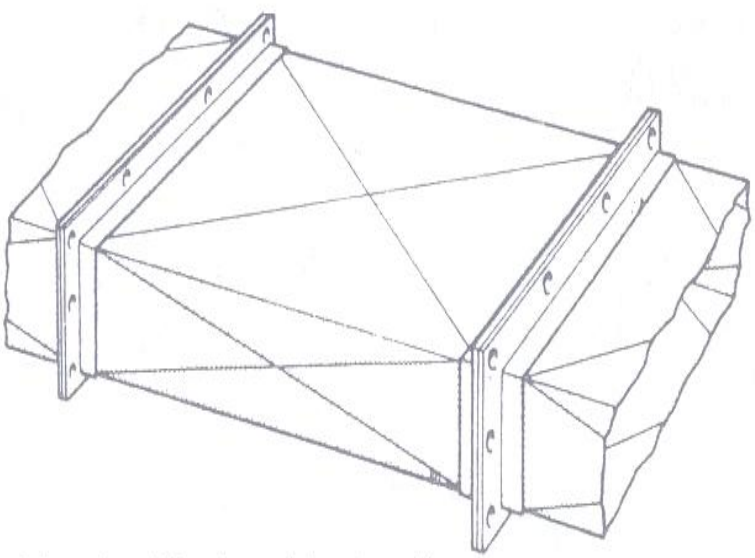
02 marks (for two diag.) | **08**



(a) Section of rectangular ductwork

Welded angle frames are widely used as a means of stiffening and supporting rectangular ducts for high velocity systems. They also serve as a joining media when assembling sections together by bolting as shown in the figures above.

01 marks (expln.)



01 marks (diag.)

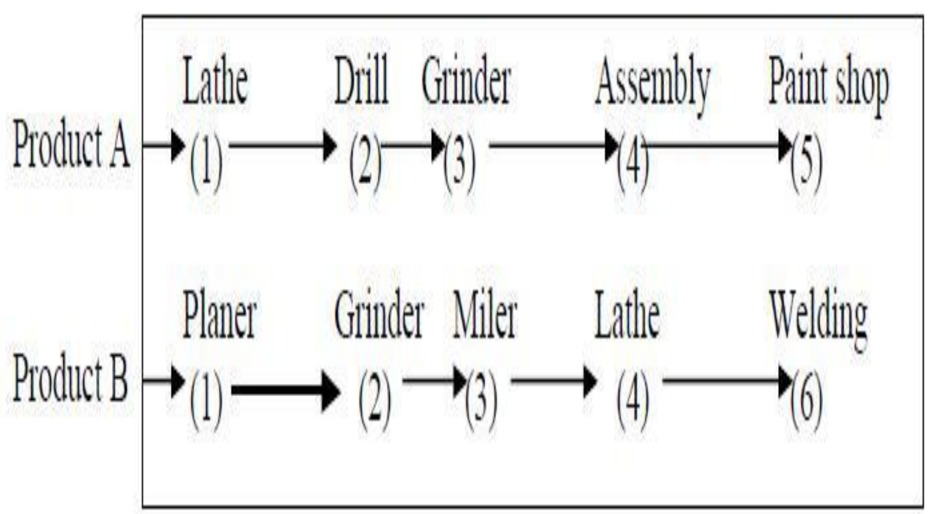
(b) Diamond-break stiffening of duct walls
Slight diagonal fold from corner to corner

<table>
<tr><td></td><td>The large sizes of square or rectangular ducting tend to drum as the air pressure passing through them varies. To overcome this drumming it is necessary to provide adequate stiffening to the walls of the duct. This may be achieved by use of swaging, but often a ‘diamond-break’ is used as shown in the figure above.

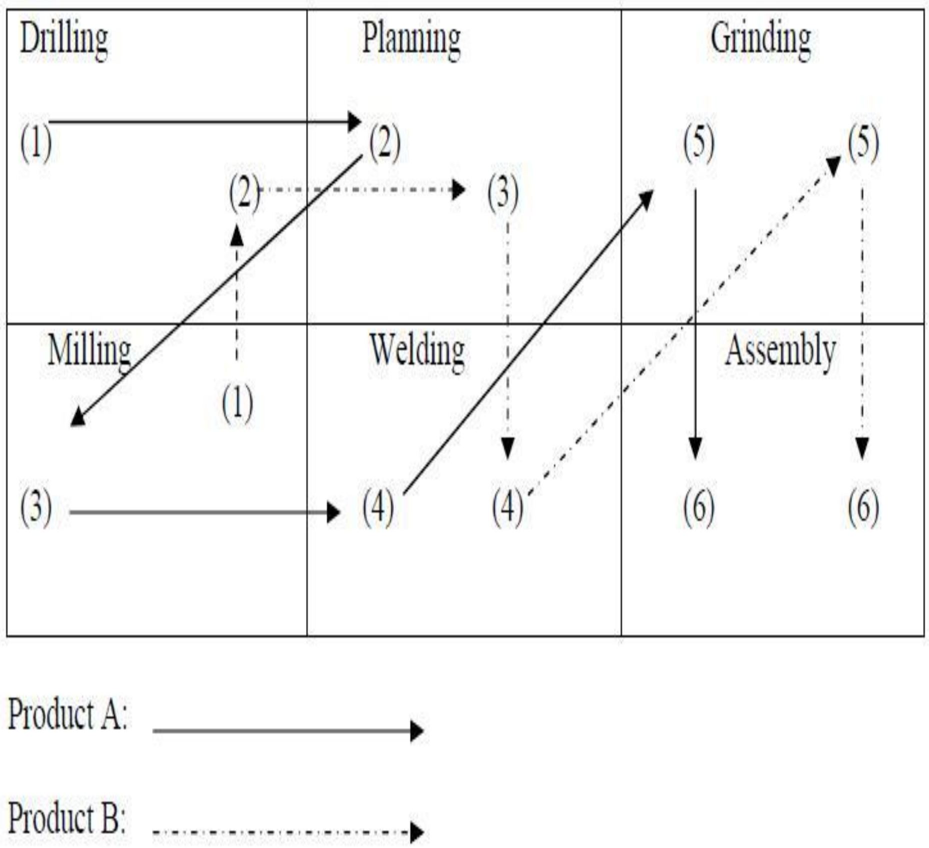
Reasons for stiffening:
The three main reasons for stiffening sheet metal are;
• To give strength and rigidity to the material.
• To produce a safe edge.
• For decorative purposes.</td><td>01 marks (expln.)

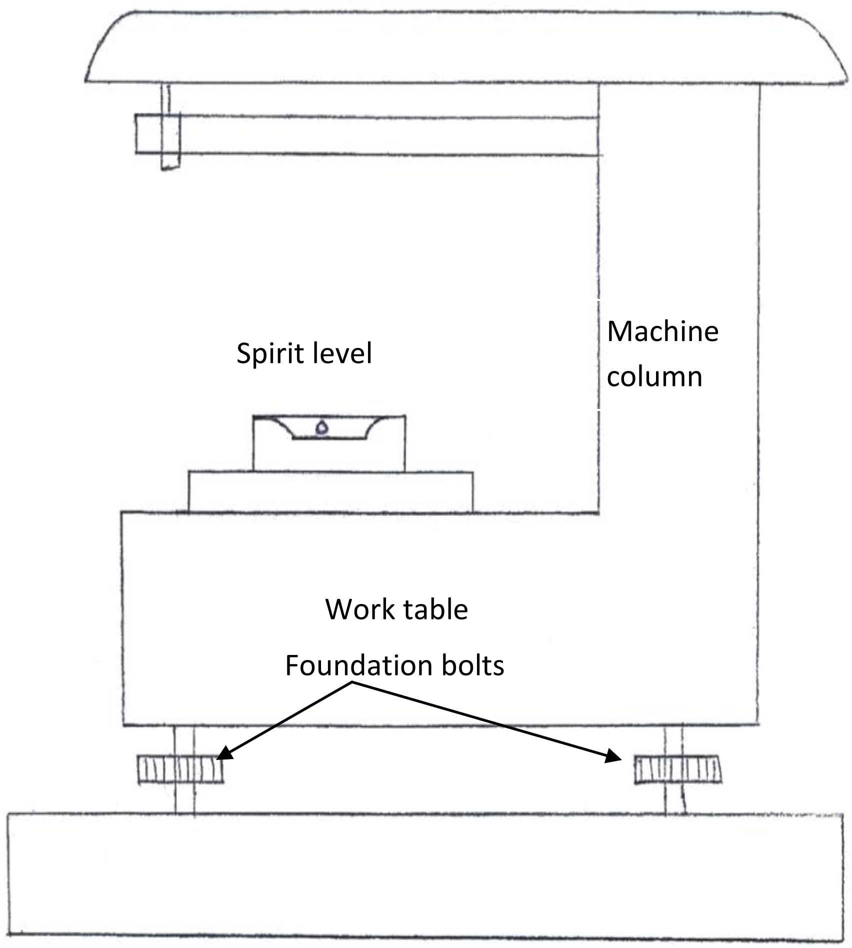
03 marks</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>Attempt any <u>four</u> of the following</td><td>4*4</td><td>16</td></tr>
<tr><td>a)</td><td>Essentials of plant layout:
An efficient factory layout is one that can be instrumental in achieving the following objectives;
a) Proper and efficient utilization of available floor space
b) To ensure that work proceeds from one point to another point without any delay
c) Provide enough production capacity
d) Reduce material handling cost
e) Reduce hazards to personnel
f) Utilize labor efficiently
g) Increase employee morale
h) Reduce accidents
i) Provide for volume and product flexibility
j) Provide ease of supervision and control
k) Provide for employee safety and health
l) Allow ease of maintenance
m) Allow high machine or equipment utilization
n) Improve productivity</td><td>04 marks (any four)</td><td>04</td></tr>
<tr><td>b)</td><td><table>
<tr><th>Parameters</th><th>Product layout</th><th>Process layout</th></tr>
<tr><td>Constructional description</td><td>Under this, machines and equipments are arranged in one line depending upon the sequence of operation required for the product .</td><td>In this type of layout machines of similar type are arranged together at one place. e.g. Machines performing drilling operations are arranged in the drilling department, etc.</td></tr>
</table></td><td>02 marks (any two points)</td><td>04</td></tr>
</table>

Precaution in planning the layout	The materials move form one workstation to another sequentially without any backtracking or deviation. Under this, machines are grouped in one sequence	The job/s move from one department to another without creating bottlenecks.
To avoid complete shut down	All the machine tools or other items of equipments must be placed at the point demanded by sequence of operations especially spare parts, tools, periodic maintenance, etc.	Other machines tools or other items of equipments in each department must have periodic maintenance.
Travel restrictions	There should no points where one line crosses another line.	The distance between departments should be as short as possible for avoiding long distance movement of materials
Inspection and supervision	Inspection and supervision is easy.	The arrangement should be convenient for inspection and supervision.
Etc.		



02 marks (for two diag.)

			
c)	Horizontal datum Spirit- level: Alignment of surface in horizontal and vertical plane is very important for installation of machine tool and fabrication of pressure vessels, building structures and material handling equipments. Horizontal datum can be measured and alignment can be done by spirit level. For this the level is placed on the table of the machine to be aligned and for other types of work such as frame and structure. It may be suitably placed on horizontal surface under test. The surface under test is divided into horizontal and vertical lines with spacing equal to the length of the spirit level. The level is then placed along this line all over the surface and bubble readings are noted. Any surface deviation from the horizontal is noted and same can be corrected by using foundation bolts.	02 marks (expln.)	**04**

<table>
<tr><td></td><td>
</td><td>02 marks (diag.)</td><td></td></tr>
<tr><td>d)</td><td>Materials used for templates:
Template paper, Hardboard, Timber, Sheet metal, Steel plate, etc.</td><td>04 marks (any four)</td><td>04</td></tr>
<tr><td>e)</td><td>Factors ınfluencıng layout: While deciding his factory or unit or establishment or store, a small-scale businessman should keep the following factors in mind:
a) Factory building: The nature and size of the building determines the floor space available for layout. While designing the special requirments, e.g. air conditioning, dust control, humidity control etc. must be kept in mind.
b) Nature of product: Product layout is suitable for uniform products whereas process layout is more appropriate for custom-made products.
c) Production process: In assembly line industries, product layout is better. In job order or intermittent manufacturing on the other hand, process layout is desirable.
d) Type of machinery: General purpose machines are often arranged as</td><td>04 marks (any four)</td><td>04</td></tr>
</table>

	per process layout while special purpose machines are arranged according to product layout. e) Repairs and maintenance: Machines should be so arranged that adequate space is avaible between them for movement of equipment and people required for repairing the machines. f) Human needs: Adequate arrangement should be made for cloakroom, washroom, lockers, drinking water, toilets and other employee facilities, proper provision should be made for disposal of effluents, if any. g) Plant environment: Heat, light, noise, ventilation and other aspects should be duly considered, e.g. paint shops and plating section should be located be in another hall so that dangerous fumes can be removed through proper ventilation etc. Adequate safety arrangement should also be made. Thus, the layout should be conducive to health and safety of employees. It should ensure free and efficient flow of men and materials. Future expansion and diversification may also be considered while planing factory layout.		
f)	Dry processes of surface cleaning: i) Thermal degreasing: Work pieces soiled with oil are blow dried with hot air at a temperature of about 250^oC. This degreasing principle is based on the evaporation of oil by correspondingly applying energy. The oil vapors are subsequently condensed and separated from the laden air. Following processing, the oils can be reused in production (recycling rate up to 80%). **OR** ii) Vacuum thermal degreasing: Before heating the work pieces, the system is evacuated to less than 1mbar and the pressure then increased again with N_2. After heating in conjunction with extensive inerting, the oil is evaporated in a vacuum of approximately 10 mbar at a temperature of 150^oC to 200^oC. The oils are condensed and can be reused. **OR** iii) Degreasing with CO_2: Supercritical CO_2 has been used successfully for many years in the food and pharmaceutical industries for the purpose of solvent – free dry extraction. Work pieces are cleaned with super – critical CO_2 in high pressure systems at approximately 500 bar and an operating temperature of 190^oC	04 marks (any one)	**04**