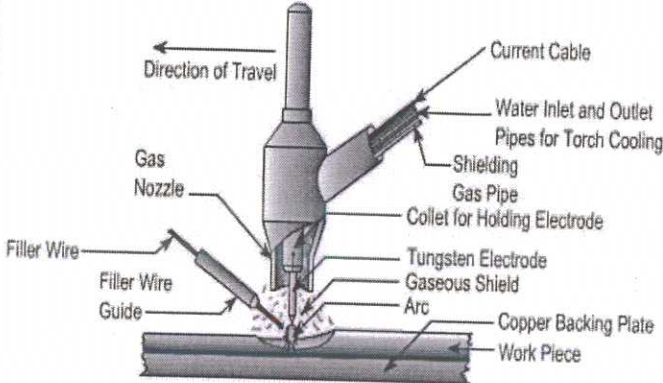


Revision: 2015

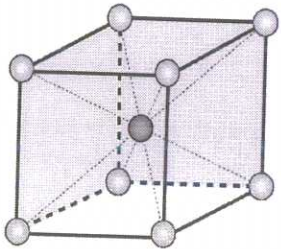
Course Code: 3023

Course Title: Manufacturing Process

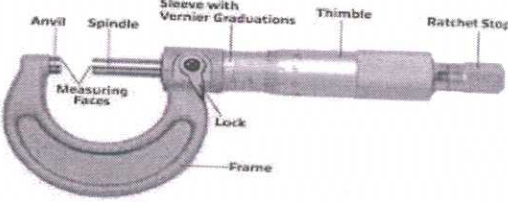
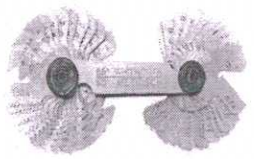
Qst No.	Scoring Indicator	Split up score	Sub Total	Total
<b>PART A</b>				
I(1)	Welding is the process of joining metals by heating them to a suitable temperature with or without the application of pressure and with or without the application of filler material.		2	
I(2)	Gauge is a tool used to check the size, shape and relative positions of various parts. They are used to determine whether the size of some component exceeds or is less than the size of the gauge itself.		2	
I(3)	<ul style="list-style-type: none"> <li>i. Wood</li> <li>ii. Metals and Alloys</li> <li>iii. Plastic and rubber</li> <li>iv. Plasters</li> <li>v. Waxes</li> </ul>	(1/2)x 4	2	
I(4)	It is a metal working process by which metals and alloys are plastically deformed to the desired shape by the application of a compressive force.		2	
I(5)	Porosity, Plasticity, adhesiveness, cohesiveness, Refractoriness, Collapsibility	(1/2)x 4	2	
				10
<b>PART B</b>				
II(1)	<p>Also known as <u>Gas Tungsten Arc Welding (GTAW)</u>. It is an arc welding in which tungsten is used as the electrode. The electrode is non consumable. The weld zone is shielded from the atmosphere by inert gas like helium or argon. Separate filler rod is used to add filler metal.</p> 	<p>Explanation : 3</p> <p>Fig. - 3</p>	6	

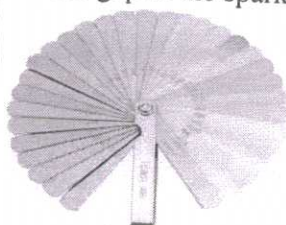
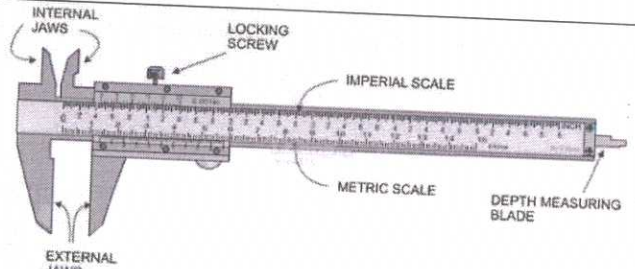
II(2)	<p><b>Soldering</b></p> <p>1. Base metals do not melt for making joint.</p> <p>2. Joint is made by melting soldering metal having melting point less than 450 degree Celsius.</p> <p>3. Soldering metal (known as Solder) is used as filler metal</p> <p>4. Solder material composition is different from that of base metals.</p> <p>5. Strength of joint is lower than that of welding and brazing.</p> <p>6. Applications: For connections in electrical and electronic instruments.</p>	<p><b>Brazing</b></p> <p>Base metals do not melt for making joint.</p> <p>Joint is made by melting brazing metal having melting point above 450 degree Celsius.</p> <p>Brazing material (known as spelter) is used as filler metal</p> <p>Brazing material composition is different from that of base metals.</p> <p>Strength is higher than soldering but lower than welding.</p> <p>Applications: Brazing car radiator fins, carbide tips on tools, etc.</p>	Each diff. - 1	6
II(3)	<p><b>Merits:</b></p> <ul style="list-style-type: none"> <li>i. In hot working, refinement of grains (crystals) occurs.</li> <li>ii. Impurities in the form of inclusions are broken up and distributed through the metal.</li> <li>iii. Physical properties are improved due to grain refinement.</li> <li>iv. Energy requirement is low compared to cold working.</li> <li>v. Unidirectional fibre structure is obtained.</li> <li>vi. It is a rapid and economic process.</li> </ul> <p><b>Demerits:</b></p> <ul style="list-style-type: none"> <li>i. Close tolerances cannot be maintained.</li> <li>ii. Tooling and handling cost is high.</li> <li>iii. Rapid oxidation or scale formation takes place on the metal surface <u>leading to poor surface finish.</u></li> <li>iv. Reduced tool life.</li> </ul>	<p><b>Merits:</b> 1 x 3 = 3</p> <p><b>Demerits:</b> 1 x 3</p>	6	

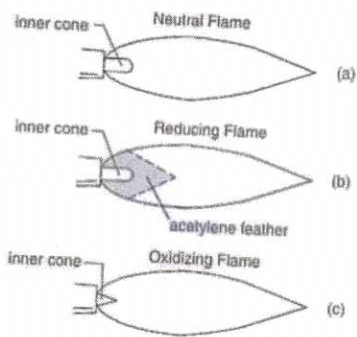
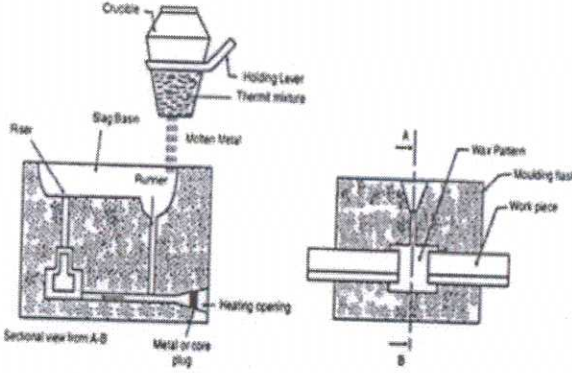
II(4)	<ul style="list-style-type: none"> <li>i. To feed the molten metal to compensate the shrinkage during solidification.</li> <li>ii. It permits the escape of air and mould gases.</li> <li>iii. Risers promote directional solidification.</li> <li>iv. A riser with full molten metal applies sufficient feeding pressure.</li> </ul>	Each use: 1.5	6	
II(5)	<p>One atom at each corner and one atom at the body centre. Lattice Parameters are  <math>a=b=c</math> and <math>\alpha = \gamma = \beta = 90</math> degree          Number of atoms per unit cell = 2.          Eg: Fe at room temperature, V, Ba, Mo, W, Cr, etc</p>	<p>Explanation - 3  Figure - 3</p>	6	
II (6)	<p>Drawing, Bending, Squeezing, Shearing, Extrusion, Shot Peening, Hobbing</p>	Each process - 1	6	
II(7)	<ul style="list-style-type: none"> <li>• A comparator indicates the difference in size between the standard and the work piece being measured.</li> <li>• It does not measure the actual dimension, but indicates how much it differs in size from basic dimension.</li> <li>• The purpose of a comparator is to detect and display the small differences between the unknown dimensions and the standards.</li> <li>• Comparators are used in mass production to inspect the components with high degree of precision and speed.</li> <li>• Using Comparators multiple dimensions can be checked quickly.</li> </ul> <p><u>Classification of Comparators:</u></p> <ol style="list-style-type: none"> <li>1. Mechanical Comparators</li> <li>2. Electrical and Electronic Comparators</li> <li>3. Pneumatic Comparators</li> <li>4. Optical Comparators</li> </ol>	<p>Explanation - 3 classification - 3</p>	6	



**PART C**

<p>III(a)</p>	<p><u>Precision Instruments:</u>          These possess high degree of accuracy. Are able to measure parts within an accuracy of 0.01 mm or more.          Examples: Vernier Caliper, Micrometer, etc.</p> <p><u>Non – Precision Instruments:</u>          They are limited to measurement of parts with reference to visible line graduation on the instrument used.          Examples: Steel Rule, dividers, etc.</p> <p><u>Direct Measuring Instruments:</u>          The actual dimension of the work piece can be directly read from the instrument.          Examples: Graduated Steel Rule, Micrometer, Vernier caliper, etc.</p> <p><u>Line Standard:</u>          In a line standard measuring device, the ends of a dimension being measured are aligned with the graduations of the scale, from which the length is directly measured.          Example: Steel Rule</p> <p><u>End Standard:</u>          In an End Standard Measuring device, the measurement is taken between two ends.          Example: Micrometer, Slip gauge, etc.</p>	<p>2 x 4</p>	<p>8</p>	
<p>III(b)</p>		<p>Figure – 4          Labelling -          3</p>	<p>7</p>	
<p>IV(a)</p>	<p><u>Screw Pitch Gauge:</u>          Also known as thread gauge. It is used to measure the pitch or lead of a screw thread. It allows the user to determine the profile of the given thread. Screw pitch gauge saves time as it removes the need for the user to measure and calculate the thread pitch of the threaded item.</p>  <p><u>Feeler Gauge:</u>          It is a tool used to measure gap widths. It is used to measure the clearance between two parts. They have number of small lengths of steel (leaves or blades) of</p>	<p>Fig +          Expalnation          – 2 + 2</p>	<p>8</p>	

	<p>different thicknesses with measurements marked on each blade. One application of the feeler gauge is to set the gap in the spark plugs to the correct size.</p> 	<p>Fig+ Explanation - 2+ 2</p>		
<p>IV (b)</p>		<p>Fig. + label - 4+3</p>	<p>7</p>	
<p>V(a)</p>	<p><u>1. Neutral Flame:</u></p> <ul style="list-style-type: none"> <li>• It has one to one ratio of oxygen and acetylene.</li> <li>• It has inner luminous cone and a bluish outer envelope.</li> <li>• Temperature at inner cone tip is approximately 3232<sup>0</sup>C.</li> <li>• Used to weld steel, cast iron, stainless steel, copper, aluminium, etc.</li> </ul> <p><u>2. Carburising flame (Reducing flame):</u></p> <ul style="list-style-type: none"> <li>• It has excess of acetylene.</li> <li>• Its flame consists of three distinct zones- bluish white inner cone, white intermediate cone and bluish envelope.</li> <li>• Used in welding monel metal, high carbon steel, nickel.</li> <li>• Temperature at inner cone tip is approximately 3149<sup>0</sup>C</li> <li>• It has a carburizing effect on steel, causing hard, brittle and weak weld.</li> </ul> <p><u>3. Oxidising Flame:</u></p> <ul style="list-style-type: none"> <li>• The flame burns excess of oxygen than acetylene.</li> <li>• The inner cone is less luminous and shorter.</li> <li>• Has oxidising effect on metals.</li> <li>• Temperature at inner cone tip is approximately 3428<sup>0</sup>C</li> <li>• Used for welding brass, bronze and for brazing of zinc coated sheets.</li> </ul>	<p>Explanation + Figure - ( 5 + 3)</p>	<p>8</p>	

				
<p>V(b)</p>	<p>Thermit welding is a chemical welding process in which the heat required to melt and join the metals is obtained from an exothermic chemical reaction. The reaction involves the burning of thermit which is a mixture fine aluminium powder and iron oxide in the ratio of about 1:3 by weight. The chemical reaction is as follows:</p> $8 \text{Al} + 3 \text{Fe}_3\text{O}_4 \rightarrow 9 \text{Fe} + 4 \text{Al}_2\text{O}_3 + \text{heat}$ <p>The reaction generates large amount of heat (around 3000 degree Celsius) and we get molten iron and aluminium oxide (slag).</p> 	<p>Explanation - 4 Figure-3</p>	<p>7</p>	
<p>VI (a)</p>	<ul style="list-style-type: none"> <li>• Also known as Gas Metal Arc Welding (GMAW).</li> <li>• In MIG welding consumable electrode is used.</li> <li>• DCRP is generally used.</li> <li>• The wire is fed through the welding gun at a controlled speed with an inert gas.</li> </ul> <p><u>Merits:</u></p> <ol style="list-style-type: none"> <li>1. Fast and economical.</li> <li>2. No requirement of flux.</li> <li>3. Metal thickness of about 40 mm can be weld.</li> </ol>	<p>Explanation + figure – (5+3)</p>	<p>8</p>	

4. Weld in all positions can be performed.

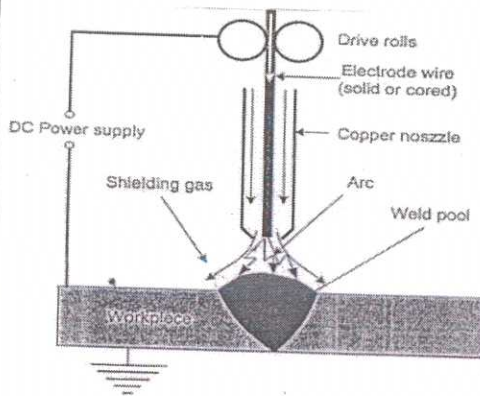
Limitations:

1. Costly.
2. Less portable.
3. Less suitable for outdoor work.

Applications:

1. Almost all commercially available metals can be welded.
2. Deep groove welding of plates and castings can be performed.

Metal inert gas welding (MIG)



VI (b)

- In SAW arc is formed between consumable electrode and welding job under a heap of granular flux.
- The electrode feed is continuous and automatic.
- The heat of the arc melts the electrode, flux and some base material to form a welded joint.
- Sufficient flux shields the arc column from atmosphere.

Merits:

1. Less electrode consumption.
2. High welding speed.
3. Weld spatter is eliminated.
4. Low power consumption.

Demerits:

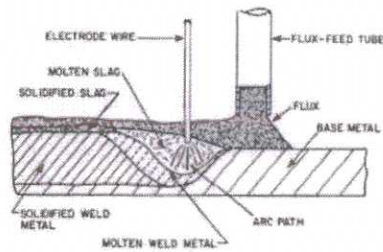
1. Heat can be controlled only by measuring the arc voltage and current since arc is invisible.
2. Difficult to weld cast iron because of high heat input.
3. Plates less than 5 mm thick is difficult to weld

Explanation

- 4

Figure - 3.

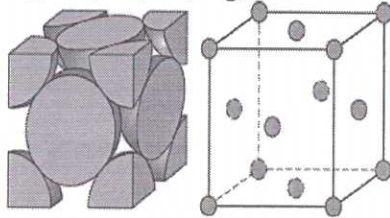
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VII  
(a)

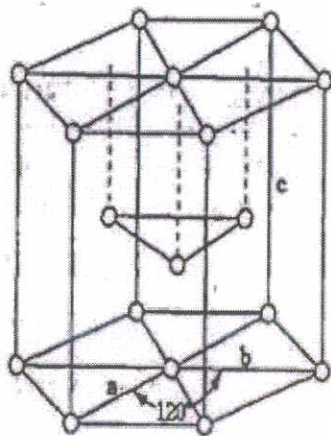
Face Centred Unit Cell (FCC):

- Atoms are located at the corners of the cube and centre of each face.
- More densely packed than bcc
- Number of atoms per unit cell = 4.
- Lattice parameters are  $a=b=c$  and  $\alpha = \gamma = \beta = 90$  degree
- Eg: Cu, Al, Pb, Ag, etc.



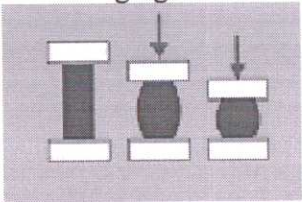
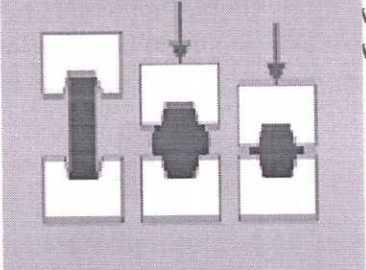
Hexagonal Close Packed:

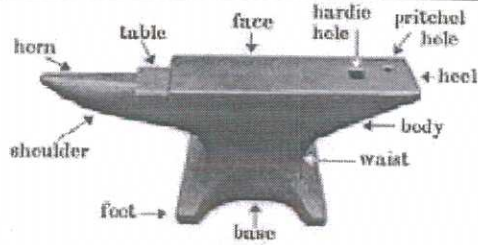
- One atom at each corner of the hexagon, one atom at centres of the two hexagonal faces and one atom at the centre of the line connecting the perpendiculars in the three rhombuses which combine and form the hexagonal close packed structure.
- Number of atoms per unit cell = 6.
- Lattice Parameters are  $a = b \neq c$  and  $\alpha = \beta = 90^\circ$  and  $\gamma = 120^\circ$
- Eg: Mg, Be, Ca, Zn, Cd, Ti



explanation  
of f.c.c  
+ fig  
- 3+1

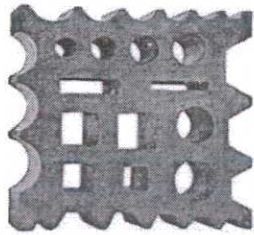
explanation  
of  
H.C.P + 8  
fig  
- 3+1

<p>VII (b)</p>	<p><u>Open Die Forging:</u></p> <ul style="list-style-type: none"> <li>• Also called Smith Die Forging or Flat Die Forging.</li> <li>• It is the process of deforming a piece of metal between multiple dies that do not completely enclose the material.</li> <li>• Types of open die forging:             <ol style="list-style-type: none"> <li>Hand Forging</li> <li>Hammer Forging</li> <li>Press Forging</li> </ol> </li> </ul>  <p><u>Closed Die Forging:</u></p> <ul style="list-style-type: none"> <li>• <u>In closed die forging, cavities or impressions are cut in the die block, in which the metal is forced to take its final shape and dimensions.</u></li> <li>• <u>Closed die forging is further subdivided into:</u> <ol style="list-style-type: none"> <li><u>Drop Hammer forging</u></li> <li><u>Press Forging</u></li> <li><u>Upset machine Forging</u></li> </ol> </li> </ul> 	<p>Difference  <math>\rightarrow 1.5 \times 4 = 6</math>  <math>\frac{1 \times 2}{2} = 1</math></p> <p>+</p>	<p>7</p>	
<p>VIII (a)</p>	<p><u>Anvil:</u></p> <ul style="list-style-type: none"> <li>• Used for supporting the work while hammering.</li> <li>• Usually made of cast steel, wrought iron or mild steel.</li> <li>• Has a hardened top known as <u>face</u>.</li> <li>• <u>Horn (beak)</u> is used for bending .</li> <li>• <u>Chipping block</u> is used to support jobs during cutting.</li> <li>• <u>Hardie hole</u> is used to secure square shank tools.</li> <li>• <u>Pritchel hole</u> is used for bending small diameter rods or used as die for punching operations.</li> </ul>			



**Swage Block:**

- It has round, square, rectangular and round grooves.
- Used for squaring, bending, heading, and forming operations.
- Also used as a support.
- Made of cast steel or cast iron.

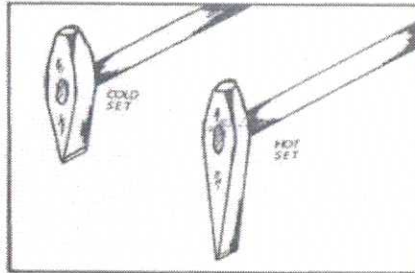


**Chisels:**

- Used to cut metals in cold or hot state.
- Chisel Types:

Cold Chisel: It is forged thick and cutting edge is hardened and tempered with included angle of 60 degree.

Hot Chisel: It is thinner in section with included angle of 30 degree.

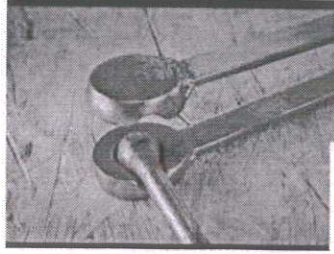


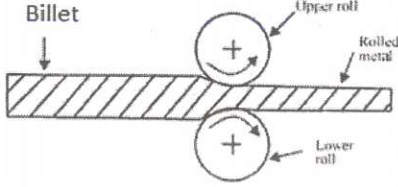
**Swages:**

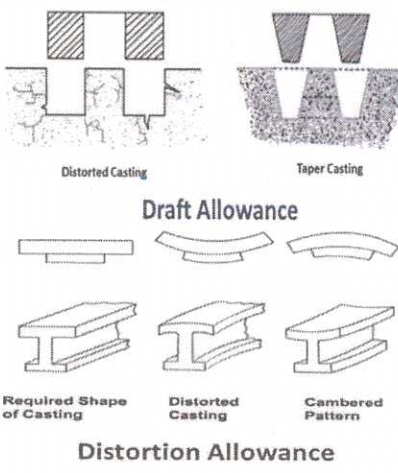
- These are tools used for shaping and finishing of forgings.
- They are made in pairs – top and bottom swages.
- The top swage has a handle and the bottom has a square shank which fits in the hardie hole of the anvil.

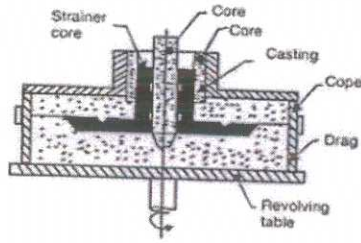
Each  
tool - 2  
(4 x 2 = 8)

8



VIII (b)	<ul style="list-style-type: none"> <li>Hot rolling is a hot working process and hence the temperature is above recrystallization temperature.</li> <li>In hot rolling, hot billet is passed through rolls rotating in opposite directions.</li> <li>The space between rolls is adjusted to get the desired thickness of the rolled section.</li> <li>The billets are squeezed by the rolls to reduce the cross section and increase the length.</li> </ul> 	<p>Explanation - 4 fig-3</p>	7	
IX (a)	<p><u>1. Shrinkage Allowance:</u> Allowance to be added in the size of pattern to compensate the contraction of the metal during casting. Master pattern from which metal patterns are made are having double shrinkage allowances. Expressed in mm per m.</p> <p><u>2. Draft Allowance:</u> Taper given on the vertical surfaces of the pattern, for easy removal of the pattern from the sand, without damaging the mould is called draft allowance. Expressed in mm per m or in degrees. Draft varies from 10 to 25 mm per m on external surfaces and 40 to 65 mm per m on internal surfaces.</p> <p><u>3. Machining Allowance:</u> This allowance is provided for machining and finishing the casting. Machining allowance varies from 1.5 to 12mm. It is given in addition to shrinkage allowance.</p> <p><u>4. Rapping Allowance:</u> The rapping (shaking) of the pattern to withdraw it from the mould may lead to slight enlargement of the mould cavity.</p>	<p>Each allow. - 2 (4 × 2 = 8)</p>	8	

	<p>Rapping allowance is a negative allowance provided in which the pattern is made slightly smaller to compensate this effect.</p> <p><u>5. Distortion Allowance:</u>          Castings having irregular shape and uneven thickness contract non uniformly and tend to warp or distort during cooling.          To avoid the distortion, the pattern is initially distorted in the opposite direction so that after cooling the casting acquires correct shape. This is called distortion (camber) allowance.          For example, the legs of a pattern for U shaped casting are made in a converging shape so that the final casting will be perfectly U shaped.</p> 			
IX (b)	<ul style="list-style-type: none"> <li>• In centrifugal casting, the mould is rotated at a very high speed and the molten metal is poured in to the cavity by a ladle.</li> <li>• The centrifugal force directs the fluid metal to inner surface of the mould with high pressure.</li> <li>• The solidification of the metal leads to the formation of hollow castings.</li> <li>• The mould is covered by water bath for quick cooling of the metal.</li> <li>• The amount of the liquid metal poured determines the thickness of the casting.</li> <li>• Advantages of centrifugal casting process are:             <ol style="list-style-type: none"> <li>i. It is quick and economical.</li> <li>ii. Use of cores, gates, risers, etc. can be eliminated.</li> <li>iii. Both ferrous and non ferrous metals can be cast by this method.</li> <li>iv. Shrinkage free castings can be produced.</li> </ol> </li> </ul>	<p>Explanation          - 4          Fig-3</p>	7	



X(a)	<p><u>Thermoplastics</u></p> <ol style="list-style-type: none"> <li>1. They are composed of chain molecules.</li> <li>2. They are produced by addition polymerization.</li> <li>3. They can be repeatedly softened by heat and hardened by cooling.</li> <li>4. Comparatively softer and less strong.</li> <li>5. Less heat resistant.</li> </ol> <p>Examples: P.V.C., Polythene, Teflon, Polystyrene, etc.</p>	<p><u>Thermosetting Plastics</u></p> <ol style="list-style-type: none"> <li>1. They are composed of cross linked molecules.</li> <li>2. They are formed by condensation polymerization</li> <li>3. They do not soften with heat.</li> <li>4. They are stronger and harder.</li> <li>5. More heat resistant.</li> </ol> <p>Examples: Polyesters, Urea formaldehyde, Bakelite, Epoxides, etc.</p>	<p>Each diff. - 1.5 each ex- -mple - 1 <math>(1.5 \times 4) + (1 \times 2)</math> = 8</p>	8	
X(b)	<ul style="list-style-type: none"> <li>• Also known as sheet moulding.</li> <li>• It consists of heating a thermoplastic sheet until it softens and then forcing it to conform to some mould either by differential pressure or by mechanical means.</li> <li>• <u>Advantages:</u> <ol style="list-style-type: none"> <li>i. Different shapes can be produced by changing the shape of the mould.</li> </ol> </li> <li>• <u>Disadvantages:</u> <ol style="list-style-type: none"> <li>i. Thickness of the part is limited.</li> </ol> </li> </ul> <p>Close tolerances are difficult to achieve.</p>	<p>Explanation + fig → 3+4</p>	7		

