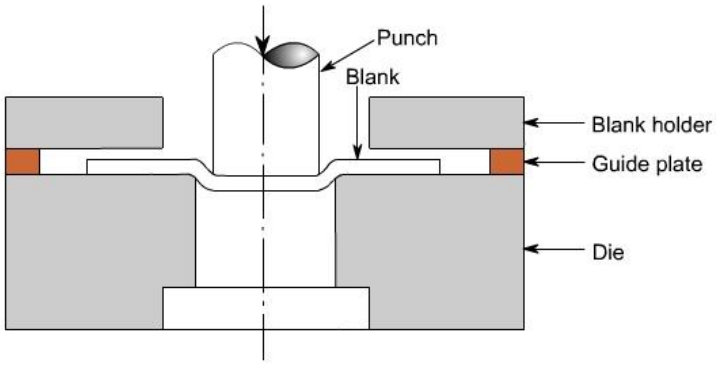
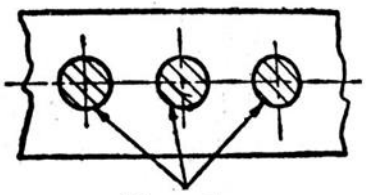
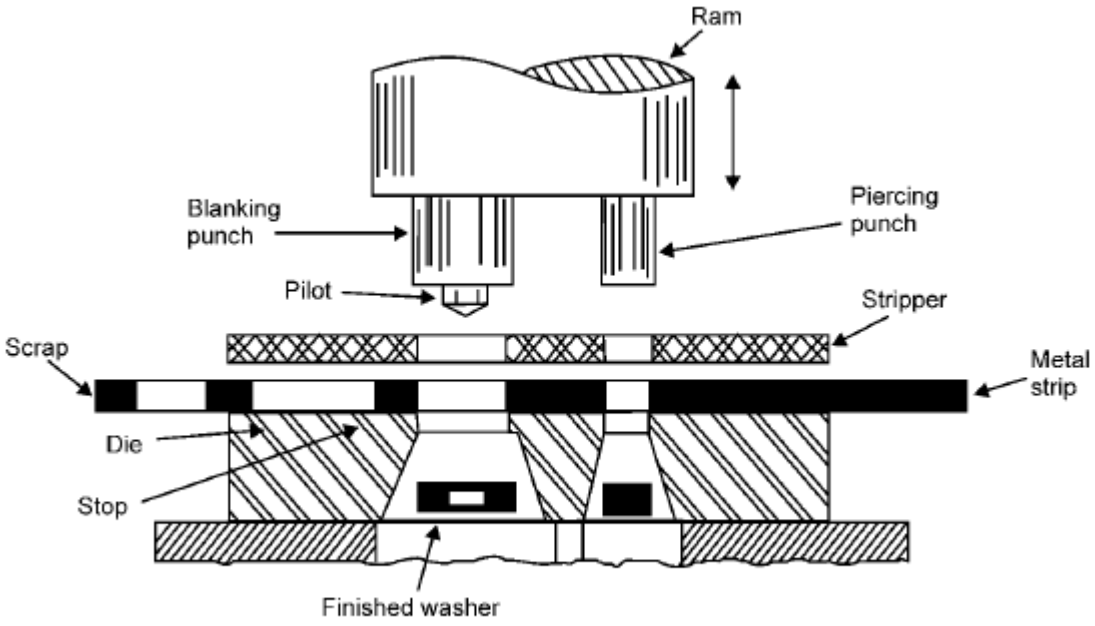
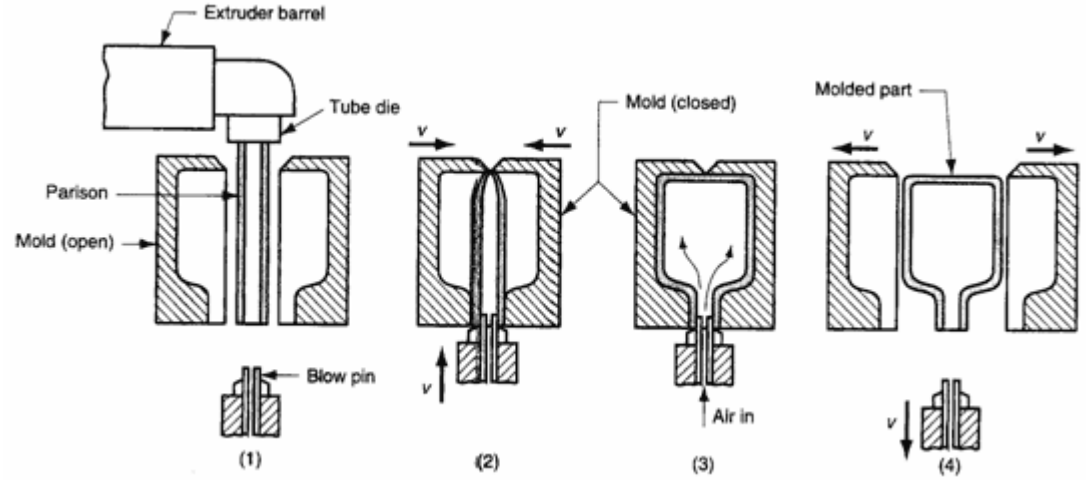
Important Instructions to examiners:

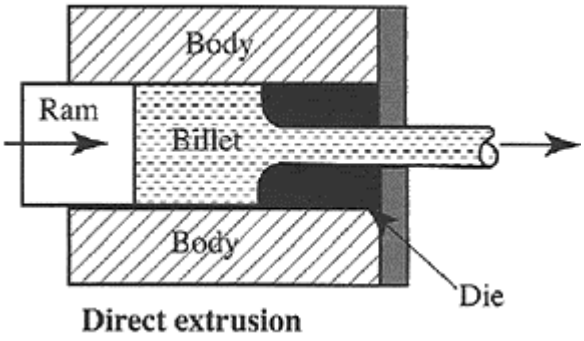
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.	Answer	Marking Scheme
1	**a)** i	**Forging-** Forging is defined as controlled plastic deformation of metals at elevated temperatures into a pre-determined size or shape using compressive forces exerted through some type of die by a hammer or press. **Types of forging method:** 1. Drop forging, 2. Press forging, 3. Hot bar forging, 4. Upset forging, 5. Swing forging 6. Cored forging, 7. Rotary forging.	**1mark definition, 1mark types**
	ii	**Drawing:-** Drawing is a metal working process in which tensile forces are uses to stretch metal . As the metal is drawn (pulled), it stretches thinner, into a desired shape and thickness. Drawing is classified in two types: sheet metal drawing and wire, bar, and tube drawing of making cups, shells, and similar articles from metal blanks. Typical tools used for drawing are shown.  	**1mark-definition, 1mark sketch**

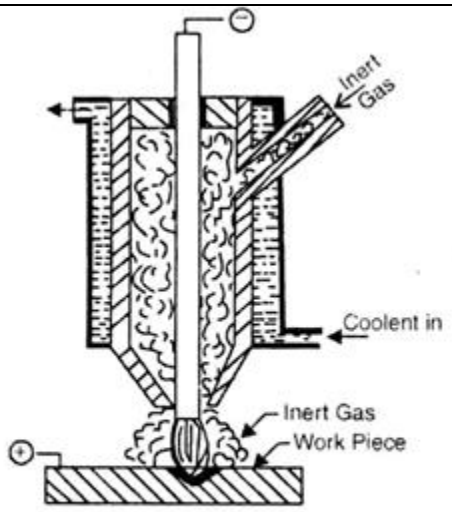
	iii	**Punching:-** Punching is the operation of production of hole in a sheet metal by the punch and the die. The material punched out to form the hole constitutes the waste.  Punches	**1mark-definition, 1mark - sketch**
	iv	**Why colour coding of pattern is required.** Color coding is used to indicating different types of surfaces and parts of the patterns and core boxes. For example 1. Surfaces to be left unfinished are shown by Black color. 2. Surface to be machined shown by Red color. 3. Core prints are shown by Yellow color. 4. Loose pieces and seats are shown by Red strips on yellow back ground. 5. Stip offs are shown by Diagonal black strips on yellow base. 6. Parting surfaces are shown with no color or clear surface. By color coding operator is able to identify the operation to be performed on pattern. Frequently, a print of finished part is not furnished with pattern. As a result the foundry man is not able to take the necessary precautions to produce the best results. Many mistakes can be eliminated by indicating the functions of various parts of pattern with proper color.	**Description 02 marks**
	v	**Metals used for making pattern** 1. Cast iron, 2. Brass, 3. Aluminum, 4. white metal, 5. Magnesium 6. Steel; 7. Bronze 8. Tin 9. Copper 10. Bronze	**Any four ½ mark for each**
	vi	**Applications of spot welding.** 1. Automobile industry. 2. Dental Prosthesis. 3. Batteries manufacturing. 4. Sheet Metal working 5. Fabrication and Repair Shops. 6. Electronics industry.	**Any four ½ mark for each**
	vii	**What is knurling operation and why it is performed?** Knurling is the operation of producing deep impressions of diamond shaped pattern on the surface f work piece in lathe work. Knurling is performed on the handles of tools and gauges for providing effective grip. It is performed by a knurling tool which consists of a set of hardened steel rollers in the holders. The tool is rigidly held in the tool post and the rollers are pressed against the rotating work to produce the depressions in a regular pattern. It must be done at slower speeds and rollers should be lubricated during thr operation. The feed used is 1 to 2 mm per revolution of the work piece. The distance between the lines and	**Description 02 marks**

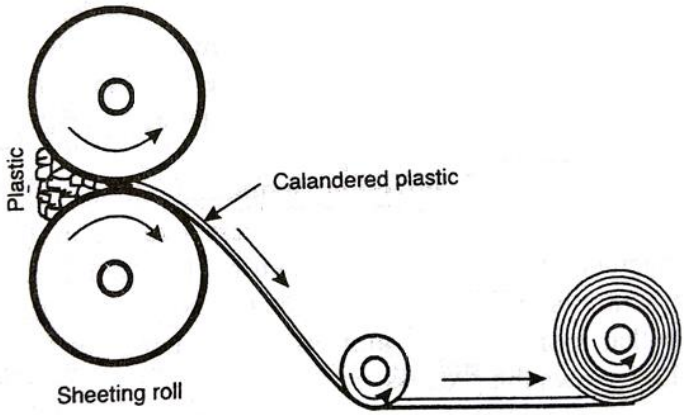
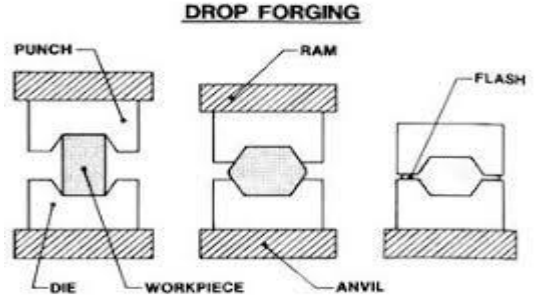
		angle on rollers are specified for the operation.	
	viii	**Write any four properties of plastics** 1. Light in weight. 2. Easy workability. Easy to shape and mould. 3. Highly resistant to corrosion. 4. Highly resistant to abrasion., moistuer and greases. 5. Good thermal and electrical insulators. 6. Good strength and rigidity. 7. Absorbent of vibrations and sound. 8. Good resistant to most of the chemicals. 9. Impermeable to water. 10. Low fabrication cost. 11. Good dimensional stability. 12. Can be made transparent or coloured.	**Any four ½ mark for each**
	b) i	**Progressive Dies:** These are used for making parts requiring multiple operations, such as punching, bending and blanking, at high production rates. The progressive dies perform two or more operations simultaneously in a single stroke of a punch press, so that a complete component is obtained for each stroke. The place where each of the operations are carried out are called stations. The stock strip moves from one station to other undergoing the particular operation. When the strip finally leaves the last station, a finished component isready. Fig. shows a schematic illustration of the making of a washer in a progressive die. While the piercing punch cuts a hole in the stock, the blanking punch blanks out a portion of the metal in which a hole had been pierced at a previous station. Thus, after the first stroke, when only a hole will be punched, each stroke of the press produces a finished washer.  Fig. Progressive Die	**02 marks for explanation,** **02 marks for sketch**

	ii	<table><tr><th>Brazing</th><th>Soldering</th></tr><tr><td>The process of joining two metal surfaces by heating and adding a non-ferrous alloy with melting point above 400°C is known as **brazing process.**</td><td>Soldering is a process of joining two metals by using another low temperature metal alloy.</td></tr><tr><td>The melting temperature of filler metal is above 400°C.</td><td>The melting temperature of filler metal is between 150°C – 350°C.</td></tr><tr><td>Strength of joint is more.</td><td>Strength of joint is Less.</td></tr><tr><td>Filler metals used are Copper or Silver.</td><td>Filler metals used are Tin and lead alloy and Zinc chloride.</td></tr><tr><td>Cost is more.</td><td>Cost is less.</td></tr><tr><td>Used in refrigeration systems.</td><td>Used in electrical and electronics Systems.</td></tr></table>	**01 mark each any four points**
	iii	**Blow moulding :-** In this process, a hot extruded tube of plastic, called a parison, is placed between two part open mould. The two halves of the mould move towards each other so that mould closes over the tube. The tube gets pinch off and welded the bottom by the closing moulds. The tube is then expanded by internal pressure, usually by hot air, which forces the tube against the walls of the mould. The component is cooled and the mould opens to release the component.  	**02 marks for explanation,** **02 marks for sketch**
2	a	**Direct (forward) extrusion:** In this process a ram forces the preheated billet through the die. With application of ram pressure, the metal first plastically fills the cylinder shape, and it is then forced out through the die opening until a small amount remains in the container. It is then sawed off next to the die and the butt end removed. The billet slides relative to the container wall; the wall friction increases the ram force considerably. A dummy block or pressure plate is placed at the end of the ram in contact with the billet.	**02 marks for explanation,**

		 Direct extrusion	**02 marks for sketch**
	b	**Die Block:** It is the female working member which contains a die cavity. **Guide of die:** These are used to hold the punch and die members in proper alignment during an operation.	**02 mark each**
	c	**Properties of Moulding Sand** **1.Porosity or permeability:** It is that property of sand which permits the steam and other gases to pass through the sand mould. When hot molten metal is poured into the sand mould, it evolves a great amount of other gases while coming in contact with the moist sand. If these gases do not escape completely through the mould, the casting will contain gas holes and pores. Thus, the sand from which the mould is made must be sufficiently porous or permeable. The porosity of sand depends upon its grain size, grain shape, and moisture and clay contents in the moulding sand. The extent of ramming of sand directly affects the porosity of the mould. If the sand is too fine, its porosity will be low. **2. Plasticity:** It is that property of sand due to which it flows to all portions of the moulding box and acquires a predetermined shape under ramming pressure and retain this shape when the pressure is removed. The sand must have sufficient plasticity to produce a good mould. The plasticity is increased by adding water and clay to sand. **3. Adhesiveness:** It is the property of sand due to which it adhere or cling to the sides of the moulding box. Good sand must have sufficient adhesiveness so that heavy sand masses can be successfully held in moulding box without any danger of its falling out when the box is removed. **4. Cohesiveness:** It is that property of sand due to which the sand grains stick together during ramming. It may be defined as the strength of the moulding sand. It is of the following three types, **(a) Green strength:** The green sand, after water has mixed to it, must have adequate strength and plasticity for making and handling of mould. The green strength depends upon the grain shape and size, amount and type of clay and the moisture content. **(b) Dry strength:** When the molten metal is poured, the sand adjacent to the hot metal quickly loses water content as steam. The dry sand must have the strength to resist erosion and also the metallostatic pressure of the molten metal, otherwise the mould may enlarge. **© Hot strength:** After the moisture has evaporated, the sand may be required to possess strength at some elevated temperature, above 100°c.If the sand does not possess hot strength, the metallostatic pressure of the liquid metal bearing against the mould	**01 mark each any four**

		walls may cause mould enlargement or if metal is still flowing, it may cause erosion, cracks or breakage. **5. Refractoriness:** It is that property of the sand which enables it to resist high temperature of the molten metal without breaking down or fusing. The higher pouring temperature, such as those for ferrous alloys, requires great refractoriness of the sand. The degree of refractoriness depends upon the quartz contents, and the shape and grain size of the particles. The higher the quartz content and rougher the granulometric composition, the higher is the refractoriness of the sand. The refractoriness is measured by the sinter point of the sand rather than its melting point. The sinter point of the sand must be higher than the temperature at which the molten metal is poured into the sand mould. **6. Flow ability:** It is the property of sand due to which it behaves like a fluid so that, when rammed, it flows to all portions of a mould and distributes the ramming pressure evenly. Generally, sand particles resist moving around corners or projections. In general, flow ability increases with decrease in green strength and decrease in grain size. It also varies with moisture content. **7. Collapsibility:** It is the property the sand due to which the sand mould collapses automatically after the solidification of the casting in order to allow free contraction of the metal. This property of sand is dependent upon the amount and type of binder, the temperature to which it is heated in contact with the metal and the time of contact.	
	d	Tungsten Inert Gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenously welds, do not require it. A constant-current welding power supply produces electrical energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma. TIG is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminum, magnesium, and copper alloys. The process grants the operator greater control over the weld than competing processes such as shielded metal arc welding and gas metal arc welding, allowing for stronger, higher quality welds. However, GTAW is comparatively more complex and difficult to master, and furthermore, it is significantly slower than most other welding techniques. A related process, plasma arc welding, uses a slightly different welding torch to create a more focused welding arc and as a result is often automated.	**02 marks for explanation, 02 marks for sketch**

		 **Tungsten Inert Gas Welding**	
	e	**Cutting Speed** In Lathe, cutting speed is defined as the speed at which the metal is removed by a tool from the work piece. It is the circumferential speed of the work against the cutting tool. It is expressed in meters per minutes. $\frac{\Pi D N}{1000}$ mm/min. Where D= Diameter of the work in mm, N= RPM of the work **Feed (f)** In lathe, it is the advancement of tool per revolution of job parallel to the surface being machined. It is given in mm/rev of the job. The feed is depends on the shape, size and material composition of the work. Greater feed is used for stock removal and smaller feed is used for finishing work. There are three types of feeds used in lathe work. 1. Longitudinal feed 2.Cross feed 3.Angular feed. **Depth of Cut** It is the perpendicular distance measured between machined surface and unmachined surface in case of lathe machine. It is expressed as follows Depth of cut t=(d1-d2)/2 Where d1= diameter of the before machining d2= diameter of the machined surface Greater the cutting speed lesser the depth of cut and vice a versa.	**01 mark to list the parameters,** **1 mark each for explanation**
	f	**Calendaring Process:-** Calendaring is a process in which heat and pressure are applied to a fabric by passing it between heated rollers, imparting a flat, glossy, smooth surface. During calendaring process rolls of the materials are passed between several pairs of heated rollers, to give shiny surface. Luster (i.e. finishing) increases when the degree of heat and pressure is increased. Calendaring is applied to fabrics in which a smooth, flat surface is desirable, such as most cotton. Many linens and silks and various man made fabrics. Calendaring is also used for polymer materials. Extruded PVC Sheets are produced by this method.	**02 marks for explanation,** **02**

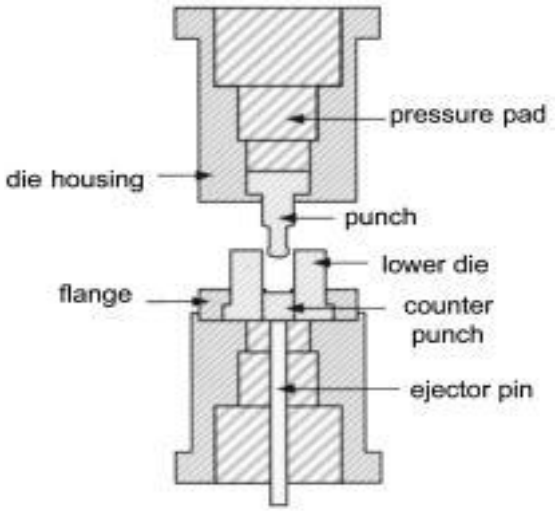
		 **Fig Forming sheet by calendering**	**marks for sketch**
3	a	**Drop forging:** It gets its name from the fact that the upper half of the die is dropped onto the lower half. Drop forgings are made by squeezing the metal at forging heat into shaped impressions cut in heavy steel blocks called dies. The job is divided equally in upper and lower die block. When the upper die block falls on the lower die, block metal is squeezed in the die cavity due to impact force. The die block falls from a height of 3 to 5 m. The bottom die block is held by set screws on to the base and top is raised by certain mechanism after its free fall. A work piece may be forged by a series of punch and die operations (or by several cavities in the same die) to gradually change its shape. The process involves several steps: 1. The first two steps are called fullering and edging. Here, the cross-sectional area of the metal is reduced in some areas and gathered in other areas. This also starts the fibrous grain flow. 2. The third step is referred to as blocking. The shape of the part is not pronounced hence, it may take several drops in the blocking cavity of the die. In step three, flash begins to appear. This is a thin fin of metal that is squeezed between the dies. 3. The fourth step is called finishing. Here, the final shape of the part is completed. 4. The last step is called trimming. Holes are cleared and the flash is removed from the forging. Drop forging requires machining to obtain dimensional tolerances and good surface finish. 	**02 marks for explanation,** **02 marks for sketch**

b

Open die forging	Close die forging
In Open-die forging metal is shaped by hammering or pressing between flat or simple contoured dies . In open die forging the dies do not completely cover the workpiece.	In closed-Die Forging, the workpiece is completely surrounded by the dies. Closed die forging (also referred to as impression die forging) is a metal deformation process that uses pressure to compress a piece of metal to fill an enclosed die impression.
Better fatigue resistance and improved microstructure Increases strength and longer part life	The internal grain structure formation increases the tightness and strength of the products.
Machining is often required to achieve desired dimensions	Less or no machining required for its close tolerances
Economical for short run (batch production)	economical for mass production due to the high cost of die production
Used for forging of long and simple parts	Used for forging of complex parts
Application : forged long shafts, forged rollers, and forged cylinders used for the application of railway and aircraft industry	forged fittings, forged lifting & rigging hardware, forged automotive parts used for Oilfield, automotive, forestry & agriculture, and mining industry

01 mark each, any four points

c



02 marks for sketch,

02 marks for labeling

d

Centrifugal Casting:

In this process, a mould is rotated about its central axis when the molten metal is poured into it. A centrifugal force acts on molten metal due to this rotation, which forces the metal at outer wall of mould. The mould rotates until the whole casting solidifies. The slag oxide and other inclusion being lighter, gets separated from metal and segregate towards the center. Solidification progresses from the outer surface inwards. The grain is refined and the castings are completely free from any porosity defect by the forced movement of the molten metal, thus making dense and sound castings.

02 marks for explanation,

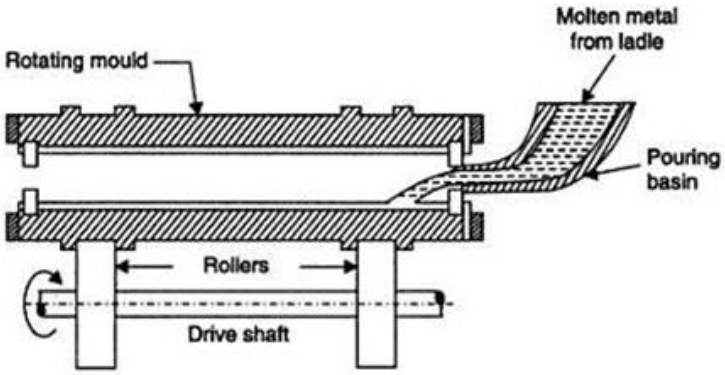


Fig Centrifugal Casting Process

Note:- Two types of centrifugal castings are there if explained any one either of two, give advantage.

02 marks for sketch

e

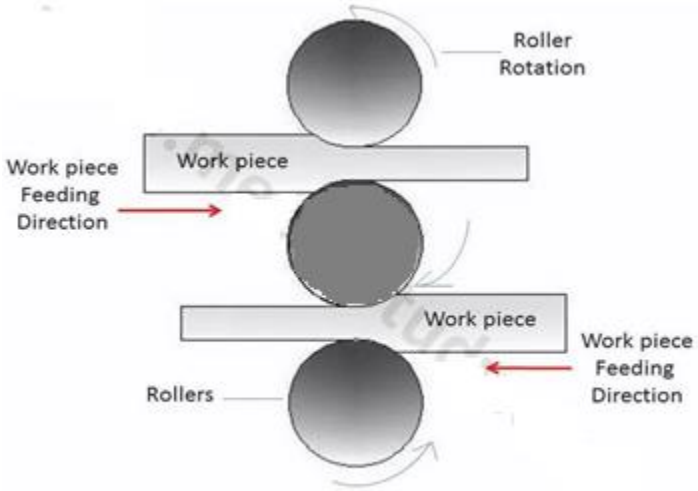
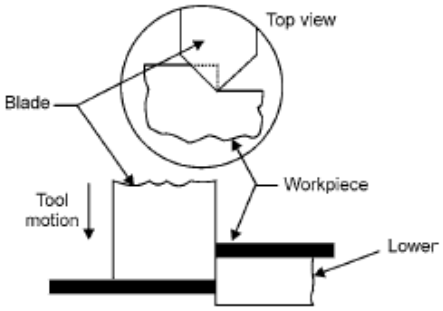
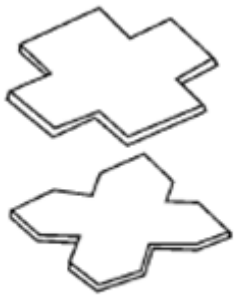
Hot chambered die casting	Cold chambered die casting
The molten metal is forced in the die cavity at pressures. The pressure may be obtained by the application of compressed air, or by a hydraulically operated plunger through gooseneck	In cold chamber die casting machine, the melting unit is usually separate and molten metal istransferred to injection mechanism by ladle.
The pressures on the casting metal is from 7 to 14 MPa.	The pressure on the casting metal in cold chamber diecasting machine may vary from 21 to 210MPa.
The production rate is high	The production rate is low. As cycle time is high
Initial set up cost is low	Initial set up cost is high
Material with low melting points are processed	Material with high melting points are processed
The hot chamber die casting machine is used for casting zinc, tin lead ect alloys.	This process is used for casting aluminum, magnesium, copper base ect alloys

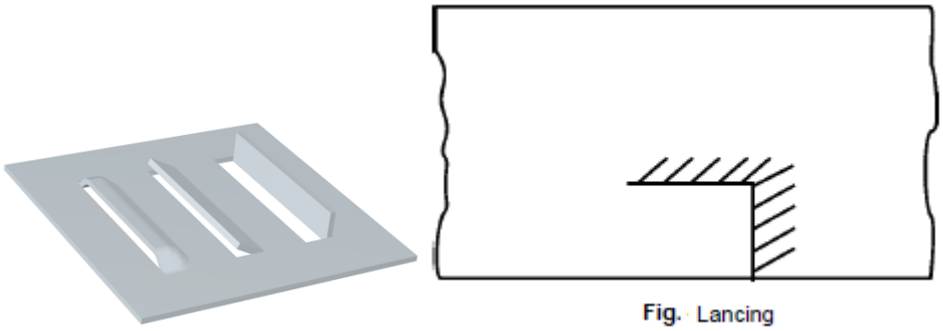
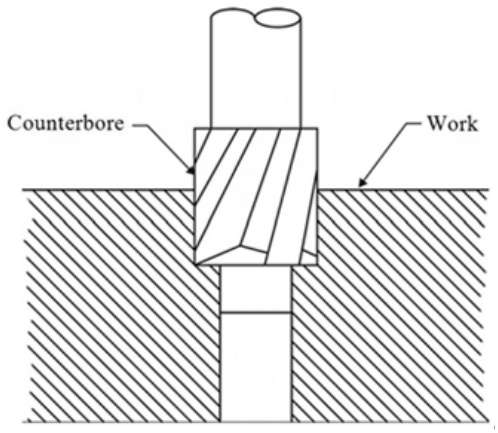
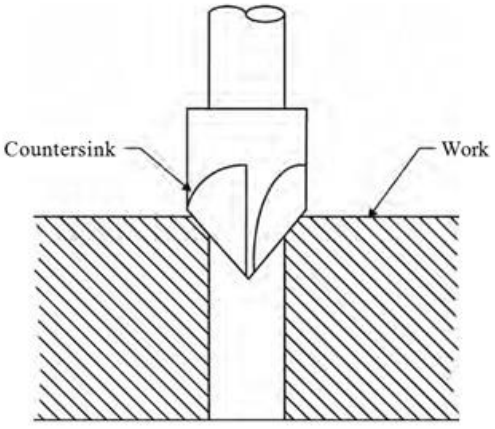
01 mark each, any four points

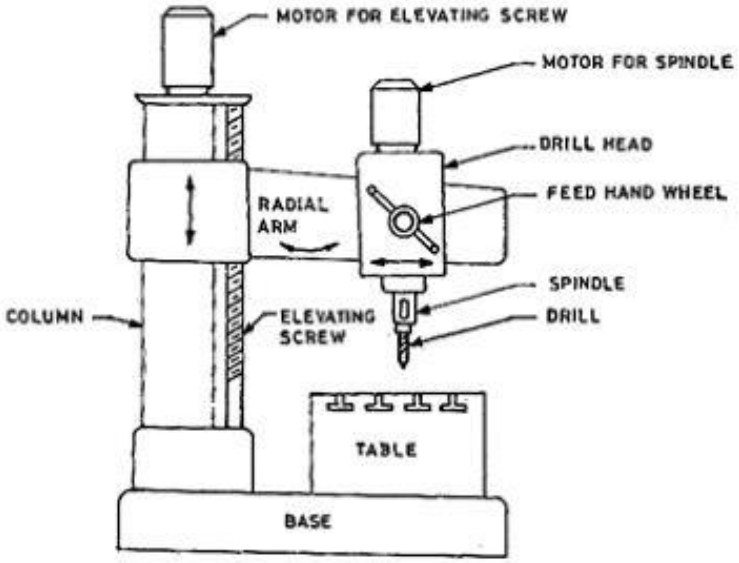
f

Cutting tool signature for single point cutting tools:
The shape of a tool is specified in a special sequence and this special sequence is called tool signature. The tool signature is given below
(i) Back rake angle
(ii) Side rake angle
(iii) Clearance or End Relief angle
(iv) Side Relief angle
(v) End cutting edge angle

01 mark for definition, 1 mark for exampl

		(vi) Side cutting edge angle (vii) Nose radius A typical tool signature of single point cutting tool is 0-7-7-7-15-15-0.8. It means that back rake angle 0 degree, Side rake 7 degree, End relief 7 degree, Side relief 7 degree, End cutting edge angle 15 degree ,Side cutting angle, 15 degree and 0.8 mm nose radius.	**e, 02 marks for explanation**
4	a	 **THREE HIGH ROLLING MILL**	**02 marks for sketch, 02 marks for labeling**
	b	**Notching:** Notching is the operation of metal to the desired shape from the edge of the plate. It is similar to punching and piercing. It is low-production process. During a notching operation, the metal work piece has an outside edge removed by the use of multiple shear blades that are set at right angles to each other.  Fig. Notching  Fig workpiece after the notching **Lancing:** It is a cutting operation in which a hole is partially cut and then one side is bent	**02 marks each (1 mark for explanation,** **1 mark for sketch)**

		down to form a shape such as tab, vent or louver.  Fig. Lancing	
	c	**Cores :-**cores are separate shapes of sand that are generally required to form the hollow interior of the casting or a hole through the casting. **Types of cores:-** 1) Horizontal cores 2) Vertical cores 3) Balanced cores 4) Hanging and cover cores 5) Wing cores 6) Ram up cores	**02mark for definition, 02 marks for types (any four types ½ mark each)**
	d	**Counter boring :-**Counter boring is the operation of enlarging the end of a hole with a hole cylindrically. Counter bores provide a shoulder to accommodate the heads of bolts, studs, and pins. The tool used for counter boring is called a counterbore.the cutting edges may have straight or spiral teeth. The cutting speed for countersinking is 25% less than that of drilling operation.  Fig Counterboring Operation  Fig Countersinking Operation **Countersinking:-**Countersinking is the operation of producing a taper or cone shape surface at the entrance of a hole for the purpose of having the head of a flat head screw,	**02 marks each (1 mark for explanation, 1 mark for sketch)**

		aviation rivet or other similar fastener sit flush or below a surface. This cone shape is machined with tool called countersink. Countersinks are available as a single flute or multi flute. A variety of sizes and included angles of: 60°, 82°, 90°, 100°,110°, and 120° are available. The cutting speed for countersinking is 25% less than that of drilling operation.	
	e		**02 marks for sketch, 02 marks for labeling**
	f		**01 mark each, any four points**

Thermosetting plastics	Thermoplastic materials
The thermosetting plastics are those plastics which are formed into shape under heat and pressure and results in a permanently hard product.	The thermoplastic plastics are those plastics which do not become hard with the application of heat and pressure and no chemical change occurs. They remain soft at elevated temperatures and become hard on cooling.
These are formed by condensation polymerization	These are formed by addition polymerization
These have three- dimensional network structure with number of cross links	They are long chain linear polymer with negligible cross links
They cannot be softened and reshaped again once again.	They can be softened and reshaped and reused.
They are practically insoluble, fireproof ,hard, strong and more brittle	They are soft, weak , brittle
Ex. Epoxy resins, amino resins, phenolics, silicones	Ex. Nylons, polyethylene resins, polystyrene, polycarbonate.

5 a

Sr. No.	Hot Rolling	Cold Rolling
1	It is carried out above the recrystalization temperature	It is carried out below the recrystalization temperature
2	No internal or residual stresses are set up	Residual or internal stresses are setup in the metal
3	No cracks and blow holes are develops in the work piece.	Existing cracks propagates and new cracks may developed
4	Dimensional accuracy is less	Dimensional accuracy is more
5	It requires less power/force	It requires more power/force.
6	It is used for structural, sections, channels production etc	It is used for rods, sheets, plates, bars etc

01 mark each, any four points

b **Upsetting:** it is also known as jumping operation

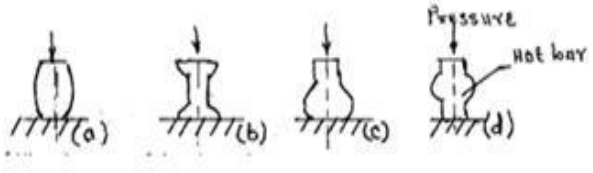
a. In this process the cross section of metal piece is increased with corresponding reduction in length

b. Metal is sufficiently heated so that it acquires the plastic stage it become soft

c. Then pressure is applied by some means like hammering or dropping from height

d. The metal swells or increased its dimensions at right angles to direction of application of force with reduction in length

e. After swiveling the desired shape is given the processing operation



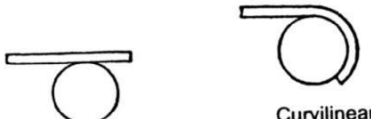
ii) **Bending:**These operations are done in smithy shop the bend with sharp corner angle can be made by hammering the metal over the edge of anvil face or swage block.

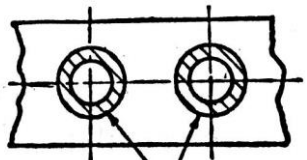
a. For making a right angle bend that particular portion of the stock which is subjected to bending is heated and jumped on the outer surface.

b. This provides an extra material at th particular place which compensate for elongation for outer surface due to hammering during bending, after bending the out sold bulging is finished by means of flatter and inside by means of setsquare curved shapes of bends are formed on the horn of anvil or brick iron.

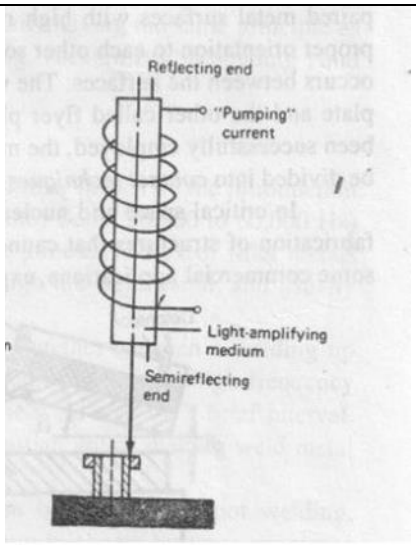
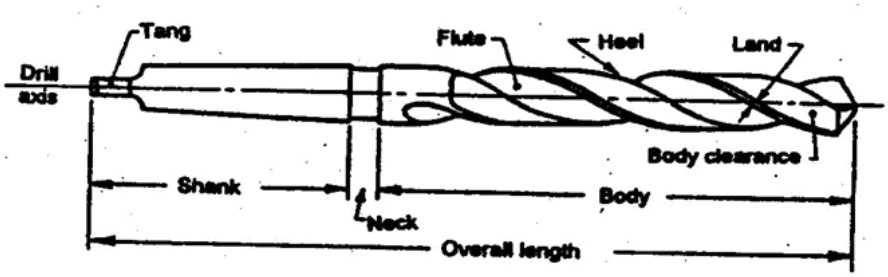
02 marks each (01 mark for sketch,

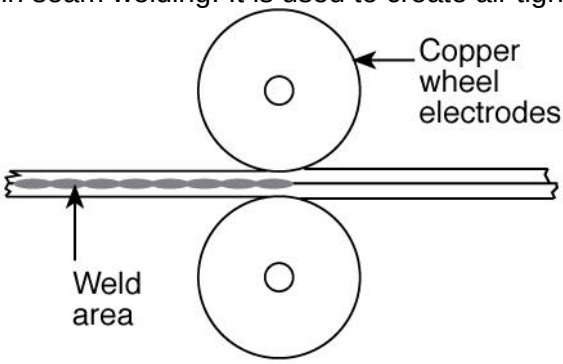
01 mark for explanation)

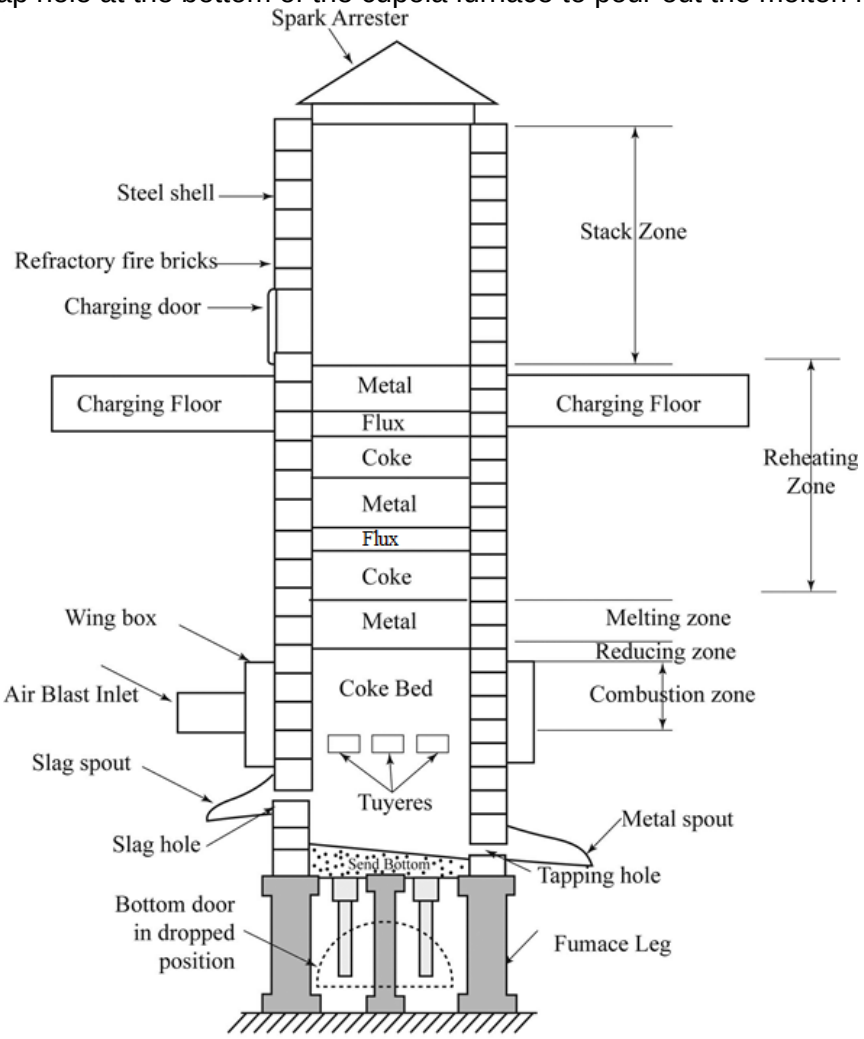


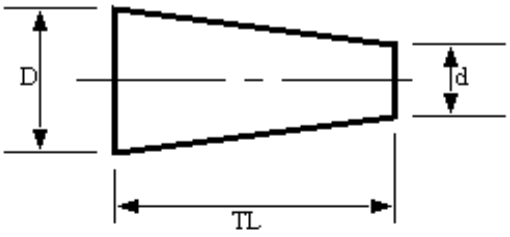
	c	**Enlist the Press operations. Explain blanking operation in detail.** The sheet metal operations done a press may be grouped into two categories. 1. Cutting operations and 2. Forming operations In cutting operations the work piece is stressed by its ultimate strength. The stresses caused in the metal the applied forces will be shear stresses. The cutting operations include: (a) Blanking (b) Punching (c) Notching (d) Perforating (e) Trimming (f) Shaving (g) Slitting (h) Lancing.(i)shearing (j) Bending and forming (k)Curling (l) Coining (m) Embossing (n)Flattening and planishing In forming operations, the stresses are below the ultimate strength of the metal, in this operation, there is no cutting of the metal but only the contour of the work piece is changed to get the desired product. The forming operations include: (a) Bending (b) Drawing (c) Squeezing **Blanking Operations:** The blanking is the operation of cutting of flat sheet to the desired shape. The metal punched out is the required product and the plate with the whole left on the die goes as waste. While blanking the size of the blank is governed by the size of the die and the clearance is left on the punch.  Figure: Blanking operation **Blanks**	**03 Mark for description,** **01 Mark for figure**
	d	**State the causes and remedies of the following defects:** **Blowhole** is a kind of cavities defect, which is also divided into pinhole and subsurface blowhole. Pinhole is very tiny hole. Subsurface blowhole only can be seen after machining. Gases entrapped by solidifying metal on the surface of the casting, which results in a rounded or oval blowhole as a cavity. Frequently associated with slag's or oxides. The defects are nearly always located in the cope part of the mould in poorly vented pockets and undercuts. **Causes:** a. Inadequate core venting b. Excessive release of gas from core c. Excessive moisture absorption by the cores d. Low gas permeability of the core sand e. Moisture content of sand too high, or water released too quickly f. Gas permeability of the sand too low	**02 marks each (01 mark for causes any two,** **01**

		g. Sand temperature too high h. Bentonite content too high i. Too much gas released from lustrous carbon producer **Remedies:** a. Improve core venting, provide venting channels, and ensure core prints are free of dressing b. Reduce amounts of gas. Use slow-reacting binder. Reduce quantity of binder. Use coarser sand if necessary. c. Apply dressing to cores, thus slowing down the rate of heating and reducing gas pressure. d. Dry out cores and store dry, thus reducing absorption of water and reducing gas pressure. e. Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust content. f. Improve gas permeability. Endeavour to use coarser sand. Reduce bentonite and carbon carrier content. g. Reduce sand temperature. Install a sand cooler if necessary. Increase sand quantity. **Misrun:** Misrun defect is a kind of incomplete casting defect, which causes the casting uncompleted. The edge of defect is round and smooth. When the metal is unable to fill the mould cavity completely and thus leaving unfilled portion called misrun. A cold shunt is called when two metal streams do not fuse together properly. **Possible Causes** a. Lack of fluidity in molten metal b. Faulty design c. Faulty gating **Remedies** a. Adjust proper pouring temperature b. Modify design **c.** Modify gating system.	**marks for remedies any two)**
	e	**Explain laser beam welding with neat sketch.** Lasers are devices which are capable of generating a very intense beam of optical radiation. The word “laser” is an acronym of Light Amplification by the Stimulated Emission of Radiation. An even more concentrated beam is produced, but at a lower overall efficiency, with the laser beam. A CO2 laser pumped with 500w emits far-infrared light and develops a peak energy density of 80KW/mm2, yet the heat affected zone is only 0.05 to 0.1mm wide. Oxygen blown on the surface of the metals reduces the heat reflection and increases material removal rates by oxidation; inert gas increases heat transfer for nonmetals. The laser has the advantage that vacuum is not necessary and it is finding limited but growing application, particularly for thin gauge metals. Lasers using for work such as welding very small wires to electronic devices and similar work is called micro welding. Welding speed of about 2500mm/min is achieved on steel sheet 1.5mm thick. In practice, numerical control is used to move the work piece; and lasers use in heavy production work is still limited.	**02 marks for explanation**

			**02 marks for sketch**
	f	**Draw the nomenclature of twist drill showing various elements on it.**  **Twist drill nomenclature**	**2 marks for sketch and** **2 marks for labeling**
6	a	**State the principle of resistance welding and state its types. Explain seam welding with neat sketch.** All resistance welding like spot welding, seam welding, projection welding etc. are worked on same principle of heat generation due to electric resistance. When a current passes through electric resistance, it produces heat. This is same principle which is used in electric coil. The amount of heat produced is depends on resistance of material, surface conditions, current supplied, time duration of current supplied etc. This heat generation takes place due to conversion of electric energy into thermal energy. The heat generation formula is $$H = I^2RT$$ Where H = Heat generated in joule I = Electric current in ampere R = Electric resistance in Ohm T = Time of current flow in second This heat is used to melt the interface metal to form a strong weld joint by fusion. This process produces weld without application of any filler material, flux and shielding gases. **ii) There are four main type of resistance welding:** Seam welding.	**02 marks for principle, 02 marks for types,** **02 marks for explanation,**

		Projection welding. Flash butt welding. Spot welding. **iii) Seam welding:** Seam welding is also called continuous spot welding in which a roller type electrode is used to flow current through work pieces. First the rollers are brought in contact with work piece. A high ampere current is passed through these rollers. This will melt the interface surfaces and form a weld joint. Now the rollers start rolling at work plates. This will create a continuous weld joint. The timing of the weld and movement of electrode is controlled to assure that the weld overlap and work piece does not get too hot. The welding speed is about 60 in/min in seam welding. It is used to create air tight joints.  **seam welding**	**02 marks for sketch**
	b	**Explain with neat sketch, construction and working of cupola furnace.** The cupola furnace has several unique characteristics which are responsible for its widespread use as a melting unit fore cast iron. These are as follows 1) The cupola is the only method of melting which is continuous in its operation. 2) It also has high melt rates. 3) At the same time it also has relatively low operating costs. 4) It enables ease of operation. **Construction and Working of cupola furnace:** 1. The cupola furnace consists of a tall vertical cylindrical shell made of steel plates 6 to 12 mm thick, riveted together. It is lined inside with refractory bricks. 2. The shell is mounted either on a brickwork foundation or on steel column. 3. The tubers are situated at a height of between 450 to 500 mm above the bed of the cupola. 4. The charge is introduced into the furnace body by means of an opening approximately half way up the vertical shaft. 5. A charging door is situated 3 to 6 m above the tubers though which metal, coke and flux are fed into the furnace. 6. The purpose of adding the flux is to eliminate the impurities and protect the metal from oxidation. 7. The shell is usually continued for 4.5 to 6 m above the charging door to form a chimney. A conical spark arrester is provided at the top of the chimney. The spark arrester cools down the sparks and allows only smoke to escape from the chimney. 8. It will also prevent the explosion of the cupola furnace due to the creation of high pressure inside. 9. A wind box is provided around the shell. The air required for combustion of fuel is supplied to the wind box from the blower by means of a wind pipe. Numbers of tuyeres (4, 6 or 8) are provided in the wind box to supply the air in to the furnace. 10. An air blast is introduced through the wind box and tuyeres. The air reacts chemically with	**4 marks labeled sketch,** **2 marks construction,** **2 marks working**

		the fuel thus producing heat of combustion. 11. The fuel is burnt in air which is introduced through tuyeres positioned above the hearth. The hot gases generated in the lower part of the shaft ascend and preheat the descending charge. 12. Cupolas have a drop bottom type water cooled grate with hinged doors under the hearth, which filter the molten metal and the metal is dropped to the bottom chamber. 13. There is tap hole at the bottom of the cupola furnace to pour out the molten metal.  Cupola fumace	
	c	**Define taper. Explain taper angle calculation with neat sketch. State the four methods of taper turning on lathe.** **Taper:** It is defined as a uniform increase or decrease in diameter of a work piece measured along its length such that the tapered surface when extended forms a cone.	**02 marks for definition,**



where,
TL = taper length
D = the large diameter
d = the small diameter

In Imperial:

$$tpf = \frac{D-d}{TL} \times 12$$

where,

D = large diameter (in.)
d = small diameter (in.)
TL = the taper length (in.)
tpf = taper per foot (in./ft.)

In Metric:

Specified as a ratio of mm change in diameter to length in mm
For example, a 20cm long bar that changes in diameter from 3cm to 2.2cm would result in,

$$\Delta D : TL = (30-22) : 200 = 8 : 200 = 1 : 25$$

Common methods of taper turning on lathe are: (3 Marks)

a. By swiveling the Compound rest method
b. By setting over Tail stock center method
c. By Taper attachment method
d. By Form tool with broad nose method
e. By combining longitudinal & cross feed

01 mark for sketch,

02 marks for explanation,

03 marks for types