



**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.
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**Q. 1 a) Attempt any SIX of the following**

**(i) Write name of different type of patterns.**

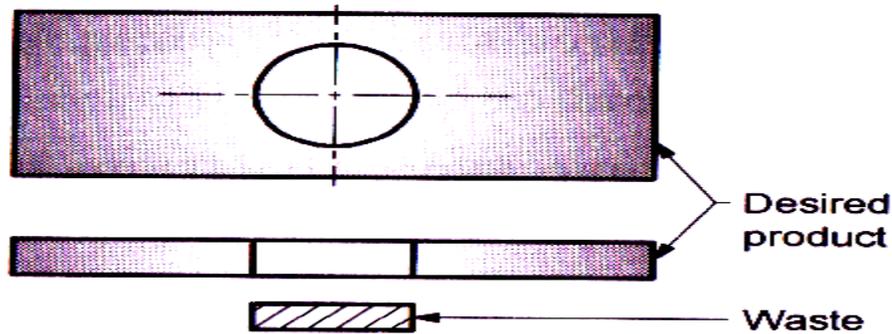
- |                                  |                          |                     |
|----------------------------------|--------------------------|---------------------|
| 1. Solid or single piece pattern | 2. Split pattern         | 3. Gated pattern    |
| 4. Match plate pattern           | 5. Cope and drag pattern |                     |
| 6. Loose piece pattern           | 7. Sweep pattern         | 8. Skeleton pattern |
| 9. Master pattern                | 10. Shell pattern        |                     |
| 11. Segmental pattern            | 12. Legged up pattern    |                     |
| 13. Follow board pattern         |                          |                     |

**(Any four types of patterns 2 marks)**

**ii) Explain piercing operation with the neat sketch in press working.**

- It is also called as punching operation.
- It is the operation of producing various shaped holes on sheet metal by punch and die.
- Hole is desired product and the metal removed from the hole is waste in piercing process.

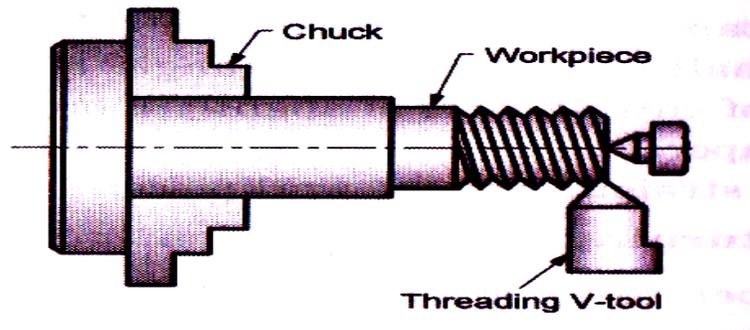
**(Diagram 1mark, explanation 1mark)**



**Fig. Piercing operation**

**(iii) Explain thread cutting operation on lathes machine.**

Producing threads of different types and pitches on cylindrical jobs is called thread cutting operation. In this operation helical grooves are produced by feeding the tool along the job axis. **(Diagram 1mark, explanation 1mark)**



**Fig. Thread cutting operation**

**(iv) Enlist different forging operation.**

1. Drop forging
  2. Press forging
  3. Hot bar forging
  4. Upset forging
  5. Swing forging
  6. Cored forging
  7. Rotary forging
- (Any four types 2 marks)**

**(v) State different types of dies in press working operation.**

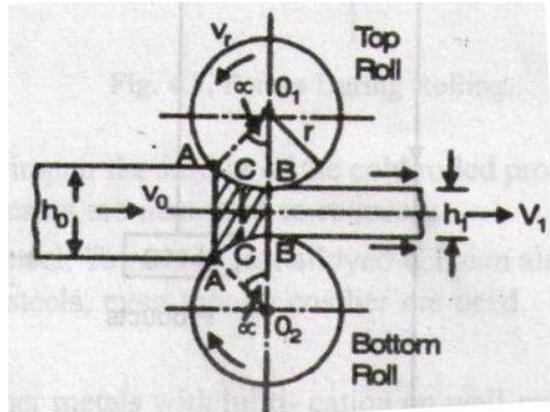
1. Simple Dies
  2. Compounding Dies
  3. Transfer Dies
  4. Combination Dies
  5. Progressive Dies
  6. Rubber Dies
  7. Hydraulic Dies
- (Any four types of dies 02 marks)**

**vi) State principle of rolling with a neat sketch.**



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**Ans-** Rolling is the process in which metal and alloys are plastically deformed into semi-finished or finished condition by passing them between circular or contoured cylinders. The deforming metal is subjected to high compressive force from squeezing action of the rolls.



(Description 01 mark, sketch 01 mark)

(vii) Write classification of different types of drilling machines.

**1. Based on construction:**

- Portable drilling machines
- Sensitive drilling machine
- Radial drilling machine
- Automatic drilling machine
- Gang drilling machine
- Up right drilling machine

**2. Based on feed:**

- Hand driven

(any four types 2 marks)

viii) What is core and core-prints?

**Core:** A core is sand or metal body which is set into the prepared mould before closing and pouring it for formation of holes, recesses, projection and internal cavities.



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**Core prints:** When a core is kept in the moulding box. It should have a seat for proper positioning of the mould. A suitable projection is made on the pattern which will create a cavity or seat when the pattern is rammed in the moulding sand. The suitable projection on the pattern is known as core-print. **(1 marks each)**

**Q. 1 b) Attempt any TWO of the following:**

**i) Enlist different types of allowance provided on pattern. Explain shrinkage allowance.**

**Ans- Types:**

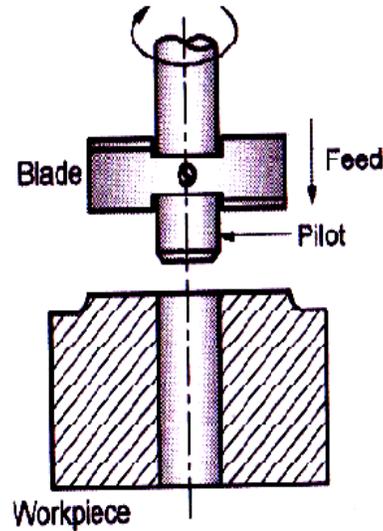
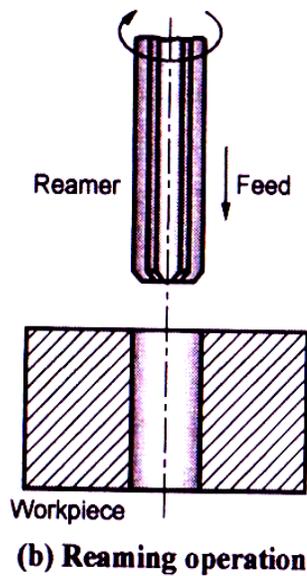
1. Shrinkage Allowance
2. Draft allowance
3. Machining Allowance
4. Rapping allowance

**Shrinkage Allowance:-** as metal solidifies and cools, it shrinks and contracts in size. To compensate for this, a pattern is made larger than the finished casting by means of shrinkage or contraction allowance. In laying measurements for the pattern the patternmakers allows for this by using shrink or contraction rule which is slightly longer than the ordinary rule of the same length. Different metals have different shrinkages; therefore there is a shrink rule for each type of metal used in a casting **(2 mark types and 2 marks explanation)**

**(iii) Describe reaming and spot facing operation on drilling machine.**

**Ans- Reaming operation: (2 marks each)**

- A operation reaming is used to produce a hole of greater accuracy than can be obtained using drill.
- The tool used for reaming is called reamer. The hole is drilled undersize by an amount depending upon diameter and required size is then obtained with the reamer.
- Care should be taken with the position and alignment of drilled hole, since reamer will correct size, roundness and surface finish but will not correct error in alignment.



**Fig. Spot facing operation**

**Spot facing operation:**

- A spot face cutter is used to provide a flat and square seating for screw, bolt or nut on the surface of the work piece.
- The spot face is similar to counter bore cutter. It will cut to only a very limited depth and cannot be used to counter bore.

**(iii) Describe back-ward extrusion process with neat sketch.**

- In this process, the metal flows in the opposite direction of the ram.
- The ram in this process is hollow one. Die is mounted over hollow ram which is referred as punch.
- The die is attached to the ram and pushed into the billet which is stationary inside the container.
- During process there is no friction between the metal billet and cylinder walls.
- Extrusion force required less as compared to direct extrusion but the press machine is complicated as compared to direct extrusion.
- As compared to direct extrusion, this method finds limited application.

**(2mark diagram and 2mark explanation)**

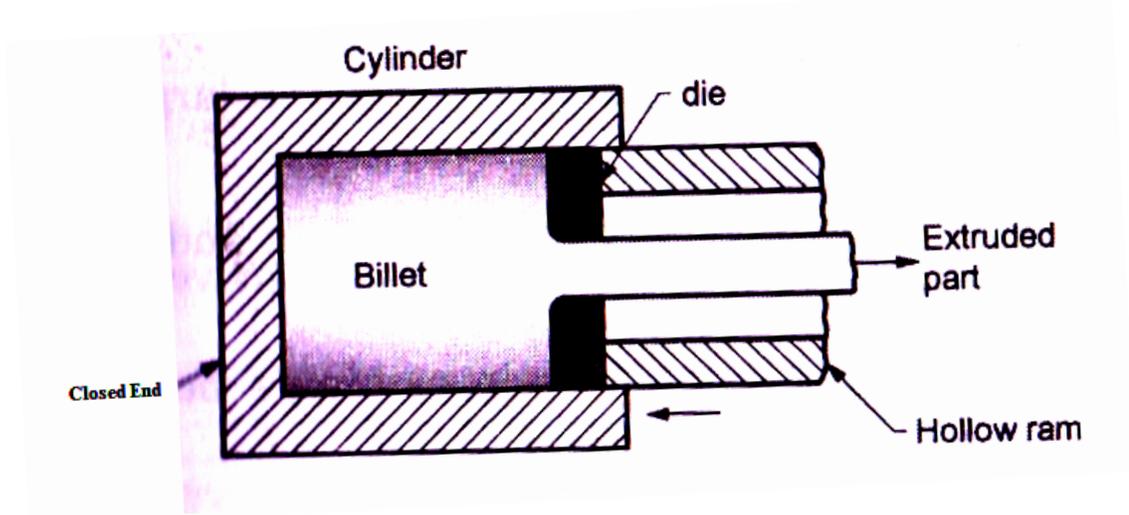


Fig. Back-ward extrusion process

Q. 2. Attempt any FOUR of the following:

a) Explain four high roll mill with a neat sketch. (2mark diagram and 2mark explanation)

- This type of machine consist of four rolls, two smaller in size and other two bigger in size
- The actual rolling is done by small size wheels and other two bigger wheels provide backup and necessary rigidity to the smaller rolls.
- This mill is commonly used for hot as well as cold rolling of plates and sheets. By this rolling process different types of shapes are formed. Those are I-section, T-section, etc.

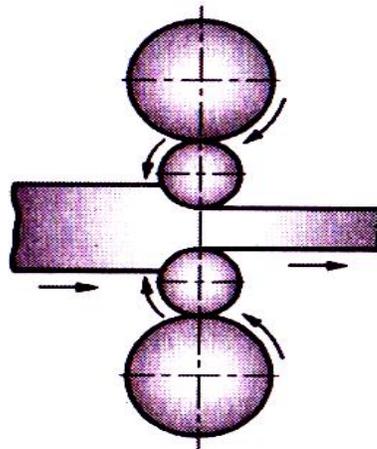


Fig. Four high roll mill



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b) Draw block diagram of die set component and label it. ( diagram 3 and label 1marks)

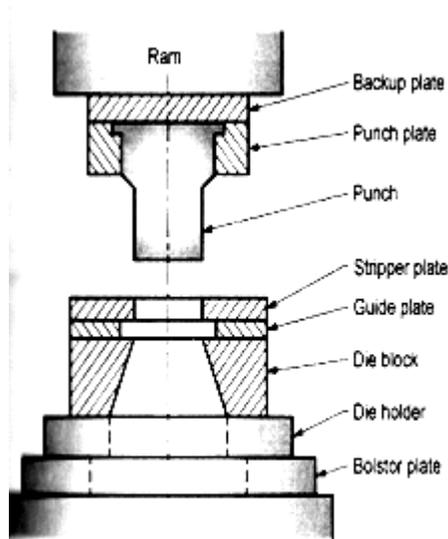


Fig. Die set component

c) Draw the sketch of gating system of casting process and show all the part on it.

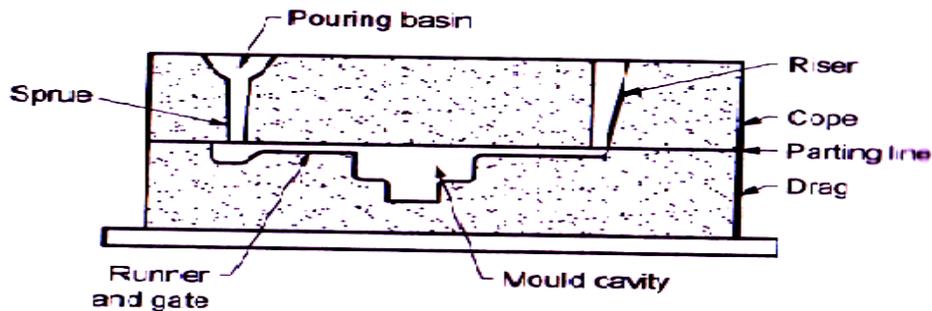


Fig. Gating system of casting process (4marks)

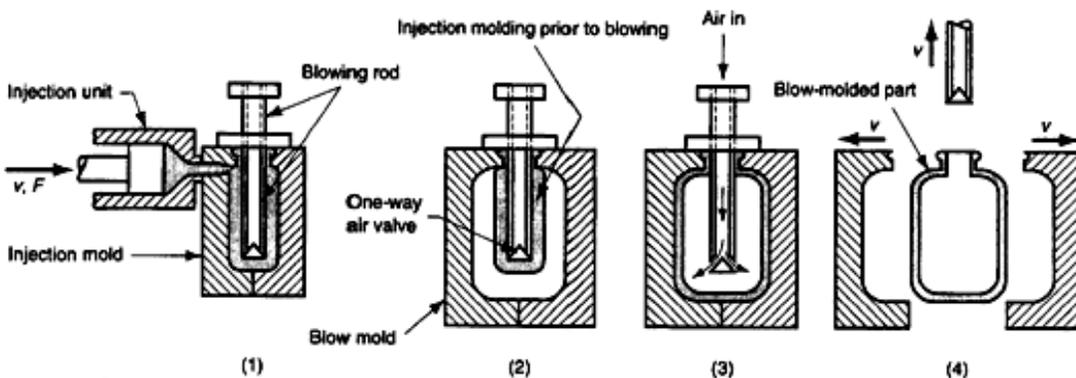
d) Explain blow moulding with neat sketch.

- Blow moulding is manufacturing process by which hollow plastic part formed. In general there are three main type of blow moulding :

- a) Extrusion blow moulding
- b) Injection blow moulding

## c) Injection stretch blow moulding

- The blow moulding process begins with melting down the plastic and forming it into parison or in the case of injection and injection blow moulding perform.
- The parison is tube like piece of plastic with hole in one end through which compressed air can pass.
- The parison is then clamped into a mould and air is blown into it. The air pressure then pushes the plastic out to match the mould. Once the plastic has cooled and hardened the mould opens up and part is ejected.

**Fig. Blow moulding process**

(2mark diagram and 2mark explanation)

**e) What is taper? Enlist different method of taper turning and describe any one in brief.**

**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.

**Common methods of taper turning on lathe are:**

- 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



**Taper Turning by a Form Tool with broad nose:** A broad nose tool having straight cutting edge (form tool) is set on to the work at half taper angle, and is fed straight into the work to generate a tapered surface. In this method the tool angle should be properly checked before use. This method is limited to turn short length of taper only. Tool will require excessive cutting pressure, which may distort the work due to vibration and spoil the work surface.

(Define one mark, list of methods one marks, Explanation of any one method Two marks)

f) Write application of rolling and forging operation.

**Rolling operation:**

1. Different types of shapes are formed such as I-section, T-section, L-section, Channel section etc.
2. Special section such as railway wagon wheels is produced by rolling.
3. Bars of all shapes, rods, sheets etc.
4. Several metals are rolled into variety of shapes. (any four points 2marks )

**Forging operation:**

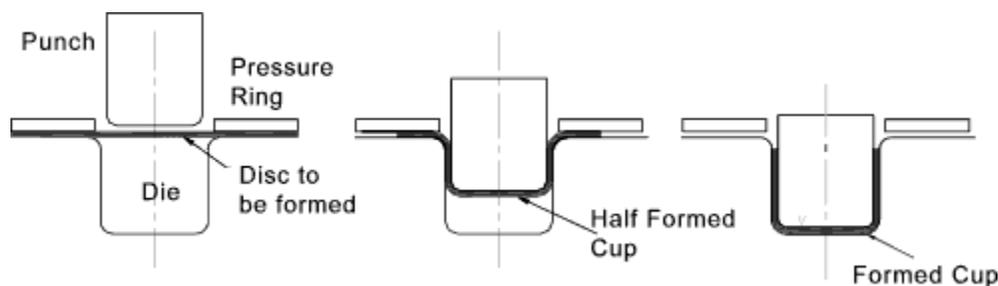
1. Forge are used in mechanism and machines wherever a component require high strength.
2. Various automotive application including crankshaft, connecting rod, piston etc.
3. Used in mining, agricultural equipment as well as in aircraft.
4. Used in steam turbine, food processing etc. (any four points 2marks )

**Q. 3. Attempt any FOUR.**

**16 M**

**a. Drawing Operation in Press working (Fig. 2m and explanation 2m)**

**4 M**



Drawing is one of the widely used sheet metal forming operations. Cup shaped objects, utensils, pressure vessels, gas cylinders, cans, shells, kitchen sinks etc are some of the products of drawing. In this process, a sheet metal called blank is placed on a die cavity, held in position using a holding plate or holding ring and pressed against the die cavity using a solid punch. The



sheet metal attains the shape of the die cavity with flat bottom. Both die and punch should be provided with corner radius in order to avoid shearing of the sheet. During drawing of sheet into the die, there is thickening of the sheet up to 12%. Therefore, clearance is provided between the punch and die.

The radial clearance therefore is equal to the sheet thickness plus the thickening of sheet. Punch pushes the bottom of the sheet into the die cavity. The flat portion of the sheet under the holding plate moves towards the die axis, then bends over the die profile. After bending over the die profile the sheet unbends to flow downward along the side wall. The vertical portion of the sheet then slips past the die surface. More metal is drawn towards the center of the die in order to replace the metal that has already flown into the die wall. Friction between holding plate and blank and that between die and blank has to be overcome by the blank during its horizontal flow.

**b. Properties of moulding sand (2marks) and Explanation of collapsibility (2marks)**

Following are the properties of moulding sand: (any four)

- |                      |                   |                         |
|----------------------|-------------------|-------------------------|
| 1. Strength          | 2. Permeability   | 3. Grain size and shape |
| 4. Thermal stability | 5. Refractoriness | 6. Flow ability         |
| 7. Collapsibility    | 8. Adhesiveness   | 9. Reusability          |

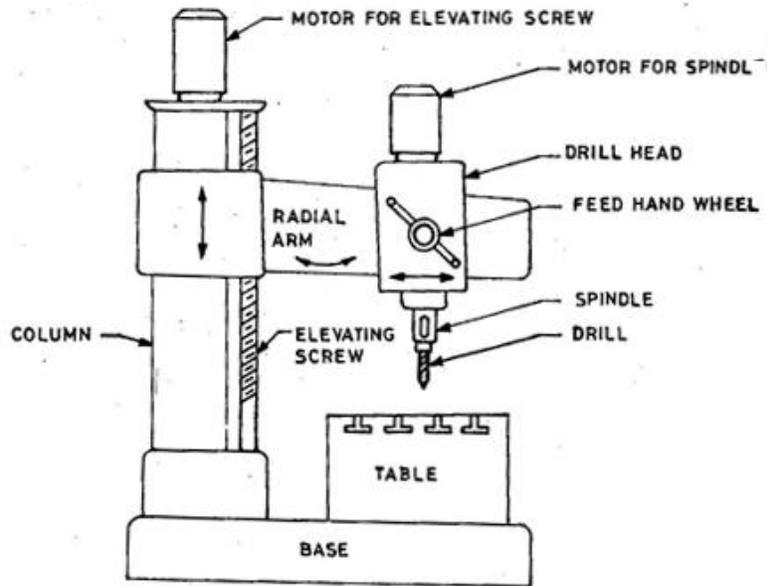
**Collapsibility:**

**2 M**

The moulding sand should collapse during the contraction of the solidified casting it does not provide any resistance, which may result in cracks in the castings. Besides these specific properties the moulding material should be cheap, reusable and should have good thermal conductivity.

**c. Sketch of radial drilling machine with labeled parts**

**(3 mark diagram and label 1marks)**



**d. Difference between open die and closed die forging (any four points)**

**4 M**

Sr. No.	Open die forging	Closed die forging
1	Open die forging is the process of deforming a piece of metal between multiple dies that do not completely enclose the material.	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.
2	Products formed through open forging often need secondary machining and refining to achieve the tolerances required for the finished specifications.	The type of material, tightness of tolerances and need for heat treatment can determine the number of passes the product requires through the dies.
3	Continuous compressive force required to shape the products	One time compressive force required to shape the products
4	Open die forging technique is more suitable for large parts in a number of tons	Closed die forging technique is more suitable for small parts
5	Open dies are not too much expensive	Closed dies are expensive



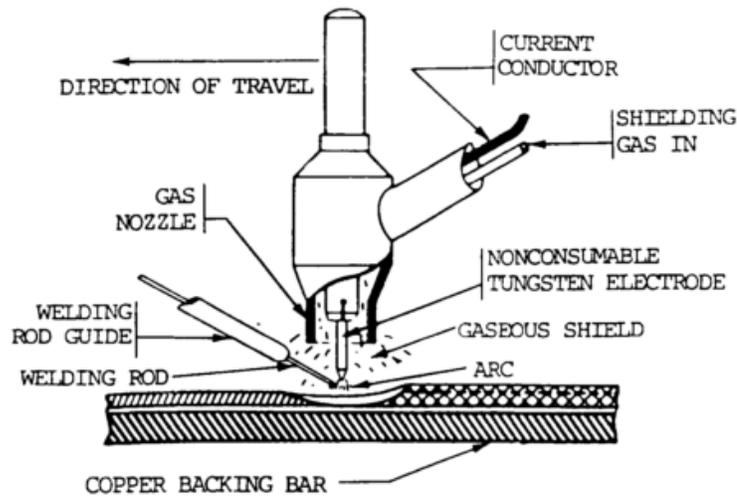
**e. Classifications of Lathe Machine (any four points)**

**4 M**

Centre Lathe	Production Lathe	Special Purpose Lathe
HAND LATHE	CAP STUN LATHE	WHEEL TURNING LATHE
FOOT TRADEL LATHE	TURRET LATHE	COPPING LATHE
BENCH LATHE	AUTOMATIC LATHE	VERTICAL TURNING LATHE
ENGINE LATHE	MULTI SPINDLE	RELIVING TURNING LATHE.
TOOL ROOM LATHE	CNC	ROLLER TURNING LATHE
		CAM SHAFT TURNING LATHE
		CRANK SHAFT TURNING LATHE

**f. TIG Welding (Fig. 2m and explanation 2m)**

**4 M**



- TIG stands for Tungsten Inert Gas welding process.
- Also referred to as GTAW (Gas Shielded Tungsten Arc Welding)
- In TIG welding, a tungsten electrode heats the metal you are welding and gas (most typically Argon) protects the weld from airborne contaminants
- TIG welding uses a non-consumable tungsten
- Filler metal, when required, is added by hand
- Shielding gas protects the weld and tungsten

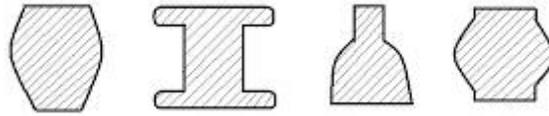
**Q. 4. Attempt any FOUR.**

**a. Upsetting and Fullering (2m each)**

**4 M**

**Upsetting:**

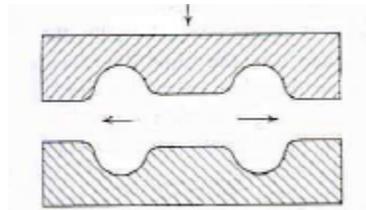
**2m**



This applied to increase the cross sectional area of the stock at the expense of the length. To achieve the length of upsetting force is applied in a direction parallel to the length axis. For example forming of a head.

**Fullering:**

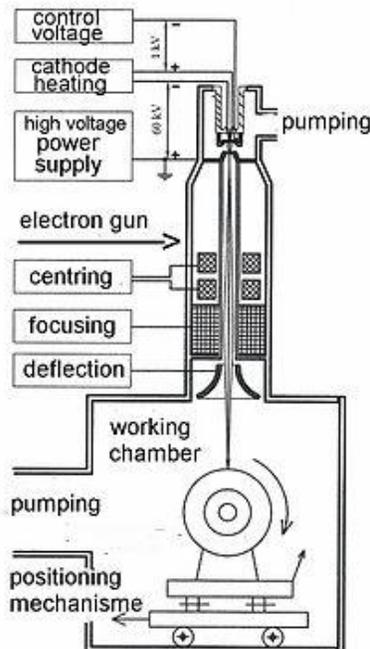
**2m**



Fullering is used to reduce the cross-sectional area of a portion of the stock. The metal flow is outward and away from the centre of the fuller. i.e., forging of connecting rod for an internal combustion engine.

**b. Electron Beam Welding (EBM) (Fig. 2m and explanation 2m)**

**4 M**





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Electron beam welding (EBW) is a fusion welding process in which a beam of high velocity electrons is applied to the materials being joined. The workpieces melt as the kinetic energy of the electrons is transformed into heat upon impact. Electron beam welding (EBW) is used mainly for fabricating structures that have stringent quality, strength, and joint reliability requirements. For more than 45 years this process has been applied in aerospace, shipbuilding, and instrument manufacturing.

Apart from the expensiveness of the equipment that is necessary as well as the professional personnel, Electron beam welding responds with high quality results. And can be used with all kind of steel, aluminium, magnesium, copper, nickel, Cobalt alloys as well as with dissimilar materials.

**c. Press Operations (2m) and explanation of any one (2m) 4 M**

The sheet metal operations done a press may be grouped into two categories.

1: Cutting operations and 2: Forming operations

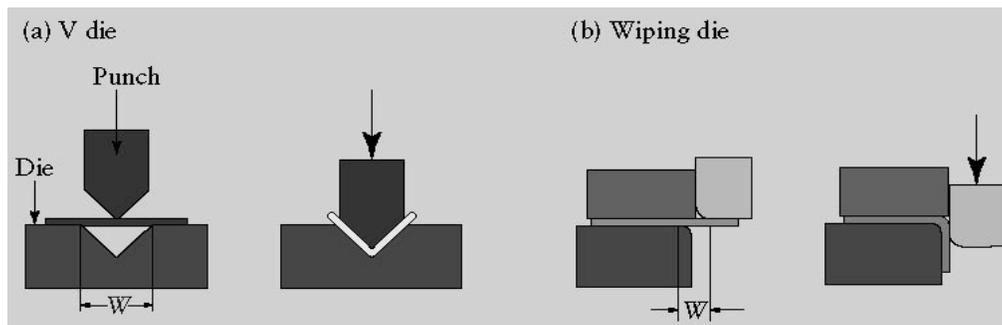
In cutting operations the work piece is stressed by its ultimate strength. The stresses caused in the metal the applied forces will be shear stresses. The cutting operations include:

- (a) Blanking (b) Punching (c) Notching (d) Perforating (e) Trimming (f) Shaving  
(g) Slitting (h) Lancing

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



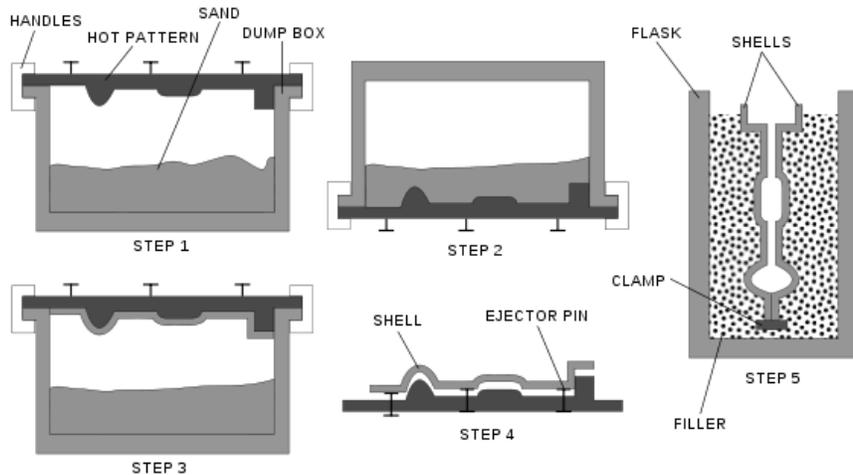
**Explanation of any one of the above**



**Bending:** forming process causes the sheet metal to undergo the desired shape change by bending without failure

**d. Shell Moulding Process (Fig. 2m and explanation 2m)**

**4 M**



**Shell moulding**, also known as **shell-mould casting** is an expendable mold casting process that uses a resin covered sand to form the mold. As compared to sand casting, this process has better dimensional accuracy, a higher productivity rate, and lower labor requirements. It is used for small to medium parts that require high precision. Shell mold casting is a metal casting process similar to sand casting, in that molten metal is poured into an expendable mold. However, in shell mold casting, the mold is a thin-walled shell created from applying a sand-resin mixture around a pattern. The pattern, a metal piece in the shape of the desired part, is reused to form multiple shell molds. A reusable pattern allows for higher production rates, while the disposable molds enable complex geometries to be cast. Shell mold casting requires the use of a metal pattern, oven, sand-resin mixture, dump box, and molten metal.

The shell mold casting process consists of the following steps:

**Pattern creation** - A two-piece metal pattern is created in the shape of the desired part, typically from iron or steel. Other materials are sometimes used, such as aluminum for low volume production or graphite for casting reactive materials.

**Mold creation** - First, each pattern half is heated to 175-370 °C (350-700 °F) and coated with a lubricant to facilitate removal. Next, the heated pattern is clamped to a dump box, which contains a mixture of sand and a resin binder. The dump box is inverted, allowing this sand-resin mixture



to coat the pattern. The heated pattern partially cures the mixture, which now forms a shell around the pattern. Each pattern half and surrounding shell is cured to completion in an oven and then the shell is ejected from the pattern.

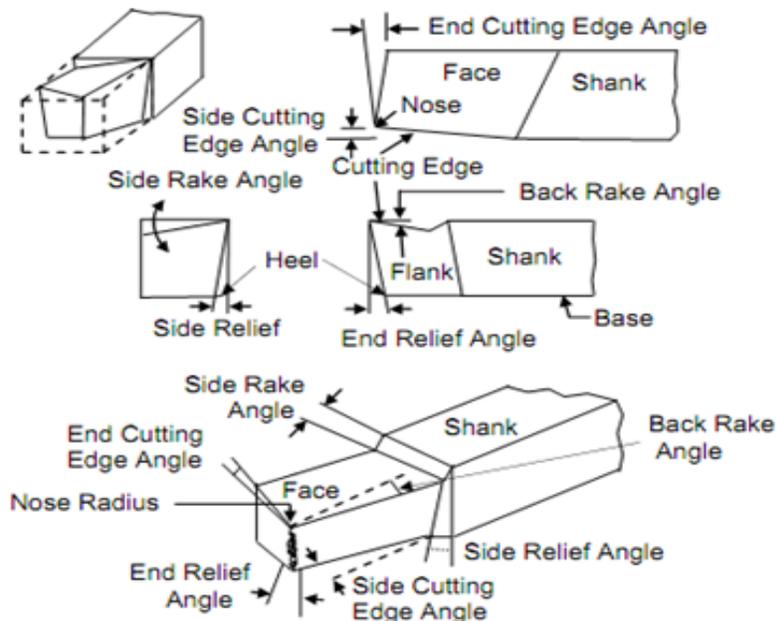
**Mold assembly** - The two shell halves are joined together and securely clamped to form the complete shell mold. If any cores are required, they are inserted prior to closing the mold. The shell mold is then placed into a flask and supported by a backing material.

**Pouring** - The mold is securely clamped together while the molten metal is poured from a ladle into the gating system and fills the mold cavity.

**Cooling** - After the mold has been filled, the molten metal is allowed to cool and solidify into the shape of the final casting.

**Casting removal** - After the molten metal has cooled, the mold can be broken and the casting removed. Trimming and cleaning processes are required to remove any excess metal from the feed system and any sand from the mold.

**e. Nomenclature of Single Point Cutting Tool (sketch 2m and label 2m)**



**f. Causes and remedies of blow hole defect in casting**

**4 M**

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: (any four 2m)**

- Inadequate core venting
- Excessive release of gas from core
- Excessive moisture absorption by the cores
- Low gas permeability of the core sand
- Moisture content of sand too high, or water released too quickly
- Gas permeability of the sand too low
- Sand temperature too high
- Bentonite content too high
- Too much gas released from lustrous carbon producer

**Remedies: (any four 2m)**

- Improve core venting, provide venting channels, and ensure core prints are free of dressing
- Reduce amounts of gas. Use slow-reacting binder. Reduce quantity of binder. Use coarser sand if necessary.
- Apply dressing to cores, thus slowing down the rate of heating and reducing gas pressure.
- Dry out cores and store dry, thus reducing absorption of water and reducing gas pressure.
- Reduce moisture content of sand. Improve conditioning of the sand. Reduce inert dust content.
- Improve gas permeability. Endeavour to use coarser sand. Reduce bentonite and carbon carrier content.
- Reduce sand temperature. Install a sand cooler if necessary. Increase sand quantity.
- Reduce bentonite content. Use bentonite with a high montmorillonite content, high specific binding capacity and good thermal stability.

**Q 5) Attempt any FOUR of Following: (16 Marks)**

**a) Compare Notching and Lancing. (Any four points 01 mark each)**

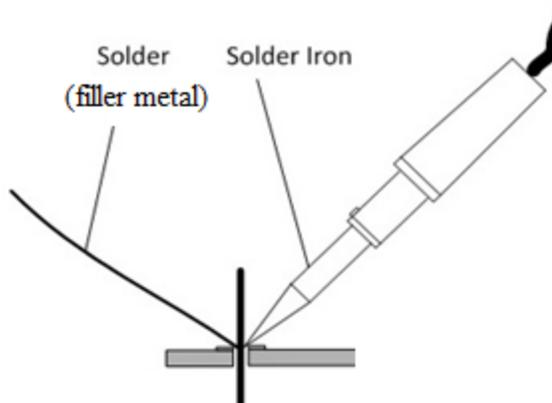
Sr.	Notching operation	Lancing operation
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No.		
1	It is the operation of removing desired shape from the edge of a plate	It is operation of cutting a sheet through part of its length & then bending the cut portion.
2	Complete portion of cut portion is removed, thus scrap is produced	As the cut portion is not removed rather it is further bent producing, thus no scrap is produced
3	Bending and cutting is separate	Bending and cutting is combined
4	More cutting force is required	Less cutting force is required
5	Less costly die	Cost of die is more
6	It uses a single operation die (Cutting only) also known as simple die.	It uses a multi operation die (cutting & non cutting operation) known as combination die.
7	To remove the scrap produced, it is necessary to provide knockout in the die.	It is necessary to provide pressure pad to provide proper shape to bend portion rather than knockout.
8	Being a cutting operation, punch & die clearance provided is less similar to piercing or punching die.	Out of the two edges of the punch the edge used for cutting operation is provided less clearance to perform shearing operation and the other edge that produces bending operation requires more clearance to produce bending operation.

b) With a neat sketch explain soldering process.

----- (Sketch 2 Marks, Explanation 02 Marks)



**Figure: Soldering Process**

[1] Soldering is a method of joining similar or dissimilar metals by means of a filler metal whose melting point is less than  $427^{\circ}\text{C}$ .

[2] The metal or alloy used for this purpose is known as solder.



- [3] A solder is an alloy of lead and tin to which some other metals are sometimes added to lower its melting point.
- [4] Before starting the operation the metal pieces should be properly cleaned / prepared.
- [5] To remove the oxides from the joint surface and to prevent the filler metal from oxidizing, fluxes are generally used in soldering.
- [6] The most commonly used soldering method is with soldering iron, the soldering iron is a copper rod with thin tip which can be used for flattening the soldering material.
- [7] The soldering iron can be heated by keeping in a furnace or by means of an internal electrical resistance.
- [8] Most of the electronic marvels are joined by soldering.
- [9] In designing a joint, care is needed to ensure that whole load falls on the base structure and not on the solder as a soldered joint isn't capable of withstanding heavy load.

**c) What are different types of plastics and write useful properties of plastics.**

----- (Types 2 Marks, Any four properties 02 marks)

Types of Plastics are

- i) Thermoplastics
- ii) Thermosetting

**Useful properties of plastics are**

- i) Transparency
- ii) Flexibility
- iii) Elasticity
- iv) Permeability
- v) Water Resistance
- vi) Electrical Resistance
- vii) Solubility
- viii) Chemical Resistance
- ix) Thermal Stability
- x) Flammability

**d) What is cutting speed and feed in case of lathe machine?**

**Cutting Speed (V):** - 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.

If D= Diameter of Job in mm & N= spindle or job speed in RPM then cutting speed (V) is given by

$$V = \pi DN / 1000 \text{ m/min.}$$

----- (2 Marks)



**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.

----- (2 Marks)

e) Compare hot rolling and cold rolling. (Any four points, 01 mark each)

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

f. Write classification of press machines.

----- (1 mark each)

**Press may be classified as**

- Manually operated presses
- Power operated presses

**Power Press may further be classified as follows**

**1. On the basis of source of power**

- Electrical motor
- Pneumatic system
- Hydraulic system

**2. On the basis of design of press frames**

- Inclined
- Inclinable
- Gap
- Arch
- Straight side
- Hone

**3. On the basis of the drive mechanisms**

- Crank
- Eccentric
- Rack and gear



- d) Hydraulic / pneumatic
- e) Knuckle joint
- f) Toggle drive
- g) Screw

**4. On the basis of number of slides**

- a) Single acting presses
- b) Double acting presses
- c) Triple acting presses

**Q 6) Attempt any TWO of the following: (16 Marks)**

**a) Write different welding defects and their causes in detail.**

----- (Any Eight defects with their causes, 1/2 mark for each defects and 1/2 mark for concerned causes)

Defects in welding joints and their causes are

1. **Lack of penetration:** It is the failure of the filler metal to penetrate into the joint. It is due to
  - i) Inadequate de-slagging
  - ii) Incorrect edge preparation
  - iii) Incorrect welding technique
2. **Lack of fusion:** lack of fusion is the failure of the filler metal to fuse with the parent metal. It is due to
  - i) Too fast a travel
  - ii) Incorrect welding technique
  - iii) Insufficient heat
3. **Porosity:** It is the group of small holes throughout the weld metal. It is caused by the trapping of gas during the welding process, It is due to
  - i) Chemical in the metal
  - ii) Dampness
  - iii) Too rapid cooling of the weld
4. **Slag inclusion:** It is the entrapment of slag or other impurities in the weld. It is caused by
  - i) Slag from previous runs not being cleaned away,
  - ii) Insufficient cleaning and preparation of the base metal before welding commences.
5. **Undercuts:** These are grooves or slots along the edges of the weld caused by
  - i) Too fast a travel
  - ii) Bad welding technique
  - iii) Too great a heat build-up

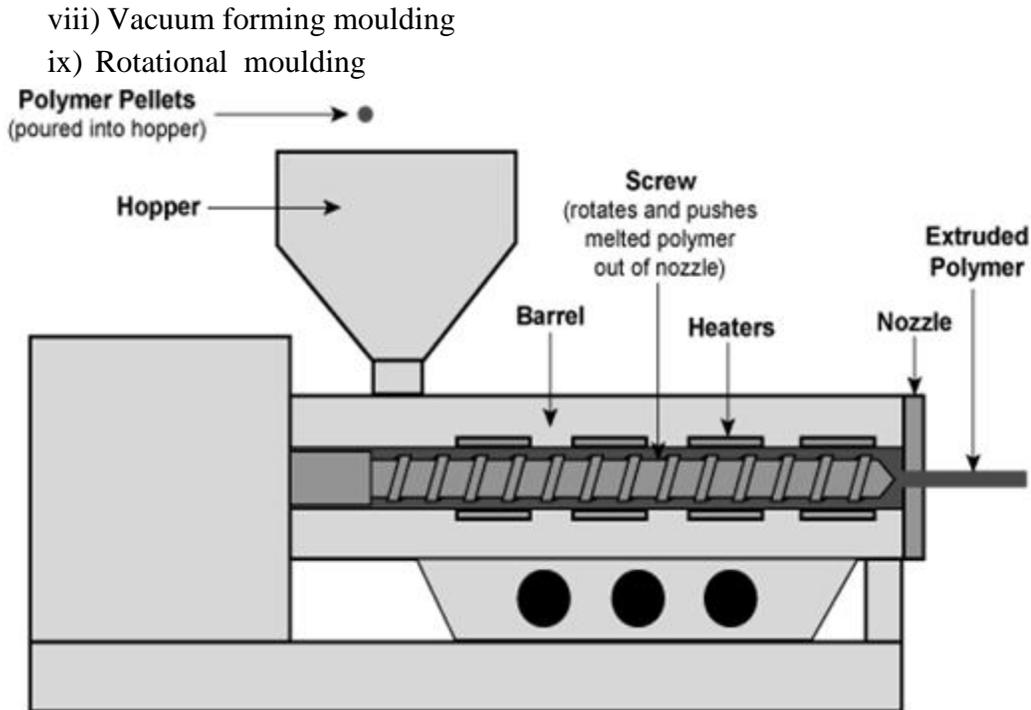


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6. **Cracking:** It is the formation of cracks either in the weld metal or in the parent metal. It is due to
- Unsuitable parent metals used in the weld
  - Bad welding technique
7. **Poor weld bead appearance:** If the width of weld bead deposited is not uniform or straight, then the weld bead is termed as poor. It is due to
- Improper arc length
  - Improper welding technique
  - Damaged electrode coating, poor electrode and earthing connection
8. **Distortion:** Distortion is due to high cooling rate, small diameter electrode, poor clamping and slow arc travel speed.
9. **Overlays:** These consist of metal that has flowed on the parent metal without fusing with it. The defect is due to
- Contamination of the surface of the parent metal
  - Insufficient heat
10. **Blowholes:** These are large holes in the weld caused by
- Gas being trapped, due to moisture
  - Contamination of either the filler or parent metals.
11. **Burn through:** It is the collapse of the weld pool due to
- Too great a heat concentration
  - Poor edge preparation
12. **Excessive penetration:** It is where the weld metal protrudes through the root of the weld. It is caused by
- Incorrect edge preparation
  - Too big a heat concentration
  - Too slow a travel
- b) **Write different types of plastic moulding processes and explain extrusion moulding process with a neat sketch.**

----- (Types 02 marks, Explanation 03 marks, Sketch 03 marks)

**Types of plastic moulding processes are**

- Compression moulding
- Transfer Moulding
- Injection moulding
- Blow moulding
- Extrusion moulding
- Calendaring
- Thermoforming



**Figure: Extrusion Moulding Process**

**Extrusion Moulding Process:**

- [1] The extrusion machine can make solid rods, pipe or tubing, U, J, Y or other sections.
- [2] Extruders are generally designed so that the die may be changed to suit the shape required.
- [3] Granular material is fed by hopper into a heating cylinder through screw into a heated die.
- [4] As continuous pressure is required, the driving force is provided by a screw.
- [5] Continuous lengths of extruded sections are produced at a rate of 150 to 300 meters per hour, the hot material after extruded through the die cools and hardens on the take-off belts.
- [6] Generally, thermoplastic materials are the only ones extruded.

**Extrusion Moulding Process Advantages**

- [1] Material thickness can be controlled.
- [2] Production rate is high.

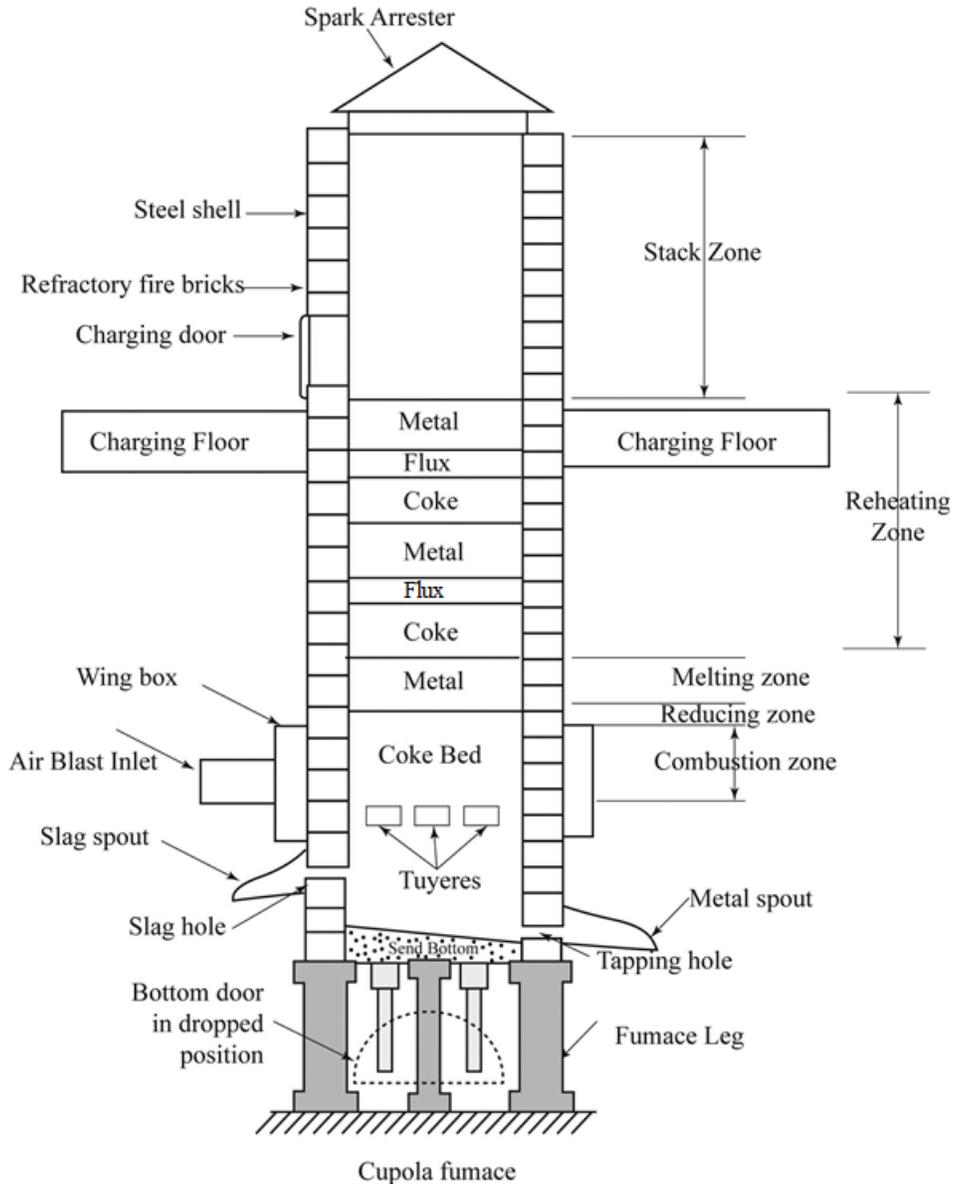
**Extrusion Moulding Process Disadvantages**

- [1] Internal profiles such as cavities, slots are difficult to create.
- [2] Large components cannot be manufactured easily.



c) Explain with a neat sketch, construction and working of cupola furnace.

----- (Sketch 04 marks, Explanation 04 marks)



----- [Give full credit to any suitable labeled sketch of cupola]

**Cupola Furnace:** The cupola furnace has several unique characteristics which are responsible for its widespread use as a melting unit for 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 tuyeres 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 tuyeres through 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 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.
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