

Q1) Explain the plastic in details R 6/24

Ans:- Plastic is a material consisting of a wide range of synthetic or semisynthetic organic compounds that are malleable and, therefore, can be ~~not~~ molded into solid objects. Plasticity is the general property of all materials that involves permanent deformation without breaking.

### Classifications

- (i) Polyethylene terephthalate :- PET is a type of clear, durable and versatile plastic. In fact, it is the most recyclable and recycled plastic in US.
- (ii) HDPE :- This is plastic is usually opaque and is used in containers for milk, motor, oil, shampoos etc.
- (iii) Polyvinyl chloride :- Polyvinyl chloride (PVC) is a highly versatile, flexible and strong thermoplastic material.
- (iv) Polypropylene :- Polypropylene (PP) is a type of polyolefin that is slightly harder than polyethylene. It is a commodity plastic with low density and high heat resistance.
- (v) Polystyrene :- Polystyrene (PS) is a rigid and lightweight plastic commonly used in foam insulation for housing, takeaway food packaging.



- (v) Polycarbonate :- Polycarbonate (PC) is a transparent thermoplastic polymer with carbonate as a functional group.
- (vi) Poly (methyl methacrylate) :- Polymethyl methacrylate (PMMA), is a transparent and versatile synthetic resin widely known as acrylic or plexiglass.
- (vii) Nylon 6 :- Nylon 6 is a synthetic plastic with the chemical formula  $(C_6H_{11}NO)_n$ .
- (viii) Polylactic acid :- Polylactic acid (PLA) is a type of aliphatic polyester obtained by ring opening polymerization of lactide monomer.

### Advantages

- (i) Low production cost.
- (ii) Corrosion resistance.
- (iii) Possibility of reuse.
- (iv) Wide range of color options.
- (v) Ecological materials (many biodegradable plastics)

### Disadvantages

- (i) Limited thermal resistance.
- (ii) Difficulty in disposal (Pollute environment)
- (iii) Petroleum based (such as PET plastic)
- (iv) Some plastics have toxic properties.
- (v) Plastic is a non-renewable resource.

Uses

- (i) Packaging material.
- (ii) For making bottles.
- (iii) Construction industry.
- (iv) Automotive and Transport.
- (v) Sports Safety Gear.

~~Q1) Geographical idea,~~

Q2) Describe screw thread in detail.

Ans:- A screw thread is a helical structure used to convert b/w rotational and linear movement or force. A screw thread is a ridge wrapped around a cylinder or cone in the form of a helix, with the former being called a straight thread and the latter called a tapered thread.

Composition

- The pitch.
- Thread angle.
- Depth.
- Major and minor diameters.
- Pitch diameter.
- Root.
- Crest.
- Helix angle.

## Uses

- (i) It is used for attachment, b/w a bolt and nut of a threaded fastener in an Assembly.
- (ii) It is used for clamping or tightening b/w two components such as by means of a Bolt and nut if a threaded fastener.
- (iii) used for adjustment or travel by translating Rotary motion into linear motion for  
 Example, Lead screw of machine tool.

~~Q3)~~

Q3) What is Copper write in details of its Alloy & ores.

Ans:- Copper is a metal with atomic number 29 and symbol (Cu). It has reddish brown colour. It is face-centered cubic Crystalline structure. It reflects red and orange light and absorbs other frequencies in the visible spectrum, due to its band structure. It is soft, malleable and ductile. It has melting point 1385 K. It allows both electricity and heat to pass through it.

## Applications

- Used for making utensils containers.
- Used for making alloys.
- Used for making coins & wire.
- Used for electroplating and electrotyping.

The ore of copper is Chalcopyrite ( $\text{CuFeS}_2$ )

### Alloys

(i) Brass :- It is an alloy of copper and zinc of historical and enduring importance because of its hardness and workability. Different amounts of copper (Cu) and zinc (Zn) can achieve various mechanical and electrical qualities.

(ii) Bronze :- It is an alloy consisting of copper (Cu) with 12-12.5% tin (Sn). It is more hardened & tough than its composition.

(iii) Cupronickel :- It is an alloy of copper and nickel usually along with small quantities of other elements added for strength.



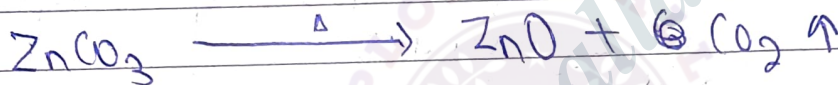
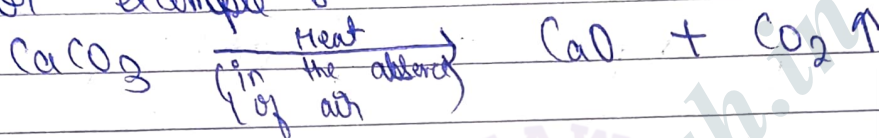
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→ \* Calcination and Roasting :

\* Calcination : The process of converting ore into an oxide by heating it strongly either in the absence of air or limited supply. This method is commonly used for converting carbonates and hydroxides to their respective oxides.

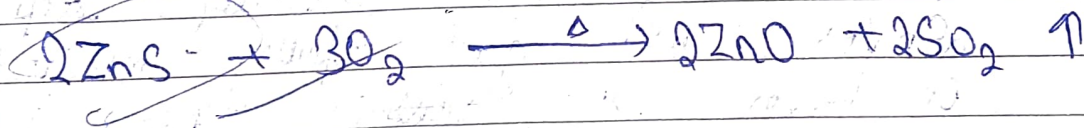
For example :-



( $\Delta$  → Below melting point).

\* Roasting

In this process, the ore is heated strongly in the presence of air. In this process, sulphide ore is converted into metal oxide.  $\text{SO}_2$  is given off.



\* Shaft :- It is a mechanical rotating element or parts of a machine which is used to transfer the motion of power.

→ Types of shafts ~~on the basis of~~ <sup>their</sup> shape.

There are many types of shafts which are used in machines.

(i) Axle shafts :- It is used for a shaft that supports the rotating elements like wheel, hoisting drums which is fitted to the housing by means of bearing.

(ii) Transmission shafts :- These shafts are used to transfer from ~~to~~ source to machine that absorbs the power. They are generally stepped shafts with gears, pulley mounted on them to ~~transfer~~ transmit the transfer motion.

(iii) Spindle shafts :- Spindle is a short rotating shaft. It is used in all machine tools such as a small drive shaft of a length of spindle.



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Of a drilling machine.

(ii) Counter shaft :- It is a secondary shaft, which is driven by the main shaft and from which the power is supplied to the machine component.

(iv) Line shafts :- A line shafts consist of a number of shafts, which are connected in axial direction by means of coupling.

Coupling → Connect the shaft to <sup>other</sup> shaft.

→ Types of shafts on the basis of their shape.

① Straight / uniform shaft :-

② Stepped shaft :-



varying diameter

③ Tapered shaft :-



(4) Splined shafts

(5) Cam shaft

(6) Crank shaft

(7) Prop shaft

### Advantages

- (i) Shaft is a prime element is used to transfer the motion with least friction.
- (ii) Less maintenance than chain system.
- (iii) Hollow shafts is used in solid shaft for the same torque transmission. Due to low weight.
- (iv) The shaft is strong and it has a low failure chance.
- (v) It has high polar moment of inertia.



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### Disadvantage

- (i) It produced a constant noise.
- (ii) It can vibrate during rotation.
- (iii) The manufacturing process is difficult.
- (iv) The maintenance and production cost is high.
- (v) The loss of power is due to loose coupling.

### → Material used in shafts

The shafts is generally made up of mild steel but for the improvement of the strength of the shaft, it is made up of chromium steel, high speed steel (tungsten, itself etc).

### \* Keys

It is a mechanical machine element which is used to connect the shaft to the rotating machine elements like gear, sprocket or flywheel.

The key fits in stress concentration on the shaft.

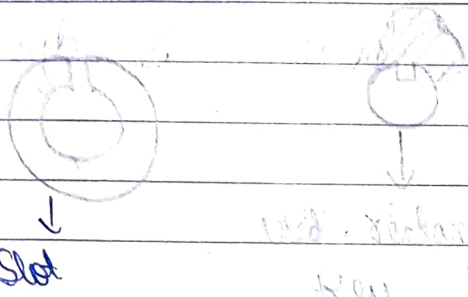
### Function of Keys

- (i) The primary function of the key is to transmit torque from the shaft to the rotating member.

Machine element to other machine element.

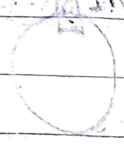
(ii) It is also used to prevent relative motion between the shaft and joined machine element like gear, pulley, etc.

(iii)



## Types of Keys

(i) Sunk Key :- Sunk key is a key in which half the thickness of key is fixed into the key way on the shaft and the remaining half of the key is in the hub. In the sunk key power is transmitted due to shear resistance of the key.



(ii) Saddle Key :- It is a key which fits in the key way of the hub only. In this case there is no key way on the shaft.

### The Shaft -

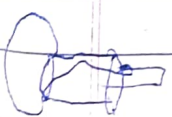
In this, the friction b/w the shaft key and hub prevents the relative motion b/w the shaft and the hub. The power is transmitted due to friction it is suitable for light duty or low power transmission.

(iii) Feather Key :- A feather key is a parallel key which is fixed either to the shaft or to the hub and which permits relative axial movement b/w them.

It is a type of sunk key which is of uniform width and height. It is used where parts mounted on the shaft are required to slide along the shaft such as clutch or gear shifting devices.



(iv) Woodruff Key :- It is a sunk key in the form of a semi-circular disc of uniform thickness.



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## \* Coupling Advantages of Woodruff Key

- (ii) It can be used in tapered shape.
- (iii) The extra depth of key in the shaft prevents its tendency to slip over the shaft.

## → \* Disadvantages of Wood

- (i) It weakens the shaft due to the depth of key way.
- (ii) It cannot be as a feather key.

## \* Coupling

A coupling can be defined as a mechanical device that permanently joins two rotating shafts to each other.

### Types of coupling

(i) Muff / Sleeve Coupling :- It consists of a slip or a hollow cylinder, which is fitted over the ends of input or output shaft by means of a sunk key.

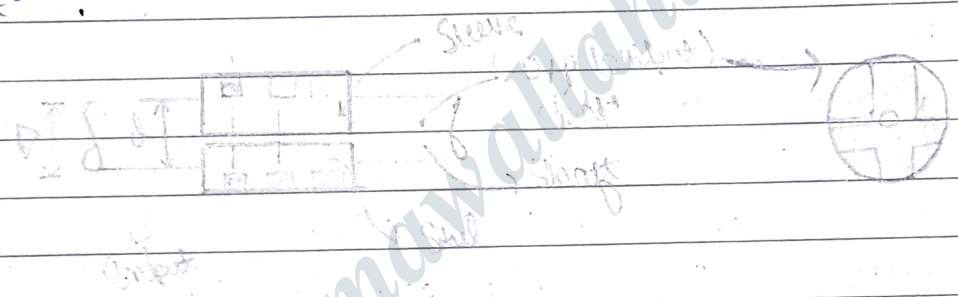
Here,

$d$  = diameter of shaft.

$L$  = Length of sleeve.

$D$  = outer diameter of sleeve.

(ii) Clamp Coupling :- It is a rigid type of ~~(or) Compression~~ Coupling in this coupling, the sleeve is made up of two halves, which are split along a plane passing through the axis of the shaft.



$$D = (2d + 13) \text{ mm}$$

$$L = 35d \text{ mm}$$

(iii) Flange Coupling :- It consists of having ~~two~~ separate flanges. Each flange is mounted on the shaft end and keyed to it (or joined).

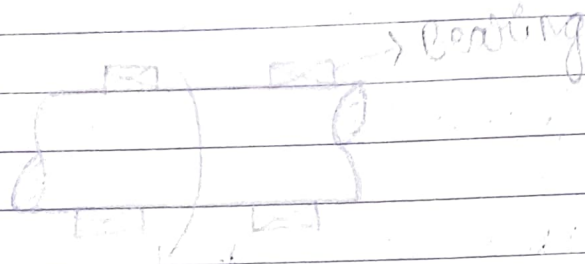
The flanges are fastened together by means of bolts. The number and the size of the bolt depends upon the power transmitted and shaft rotation.

# Coupling with detachable flange, Solid Flange Coupling

**Oldham Coupling :-** It is used to connect two parallel shaft whose axes are at a small distance of quad. Two flanges, each having a rectangular slot, are fixed, horn on each shaft. The two flanges are positioned such that the slot is one at right angle to the slot of other.

To make the coupling a circular disk with a rectangular projection <sup>(or section)</sup> on each side and at right angle to each other, is placed b/w the two flanges. During motion, the central disk, which is turning, slides in the slot of the flanges. Power transmission takes place b/w the shaft, because of the positive connection b/w the flanges and central disk.

## \* Bearings



Balls in Steel →

Bearing is mechanical machine component that support and guide the machine rotating parts with less friction example :-

## \* Types of Bearing

- (i) Sliding <sup>Contact</sup> Bearing
- (ii) Rolling Bearing

(1) Sliding bearing :- It is also called plane bearing or general bearing. In this surface of the shaft slides over the surface of the bush. To reduce friction this two surfaces are separated by a film of lubricating oil.

### Advantages of Sliding Bearing

- (i) Simplicity of design it has less part compared to rolling contact bearing making them easier in manufacturing & repair.

- (ii) Load distribution :- It can distribute loads over a large surface area
- (iii) Cost effective :- It is less expensive to produce
- (iv) Less noise in operation :- Sliding Contact Bearing is less noise compared to
- (v) High load capacity They can handle heavy load and that can suitable for high radial load. It is compact in size.

### Disadvantage of sliding bearing:

- (i) It has high friction compared to rolling bearing, this can lead to increase the heat and energy loss.
- (ii) It is not suitable for high speed because high speed can lead to over heating and failure.
- (iii) Proper lubrication is essential to reduce the heat & prevent over heating.

### \* Thermal

Due to change in temperature which is generated from the friction, effect the clearness and fit of the gap b/w shaft & bearing

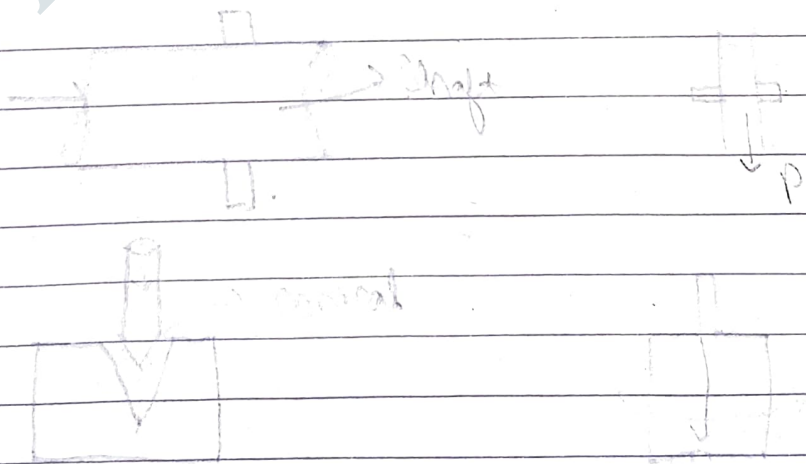
## Sliding Bearing.

- (2) Rolling Contact bearing :- It is also called anti-friction bearing. Due to less contact area rolling friction is much lesser than sliding friction. Hence this bearing is known as anti-friction bearing. ex:- Bearing used in machine tools, spindle, automobile wheel, gear box, small size electric motor.

Depending upon the force applied

(i) Radial bearing :- It supports the load which is perpendicular to the axis of shaft.

(ii) Thrust bearing :- It supports the load which act along the axis of the shaft.



\* Power

Power is generated by multiple of sources which is used

\* Engine

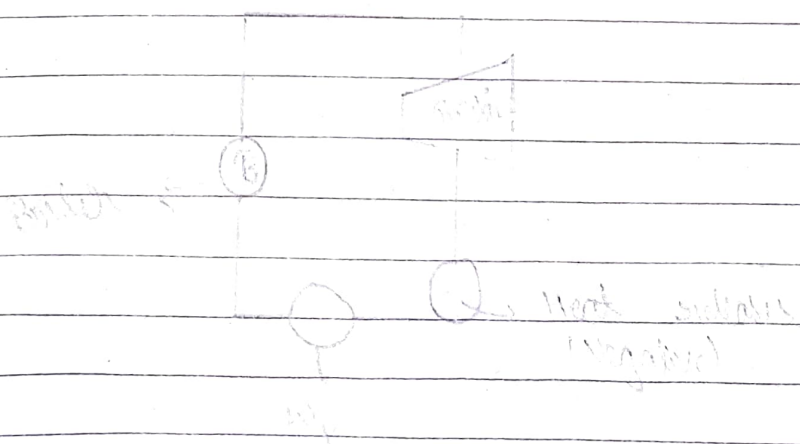
Engine is a device which is used to convert available energy into useful work

\* Types of Engine

- ① Internal Combustion engine (I.C engine)
- ② External Combustion engine (E.C engine)

→ External Combustion engine (E.C.E)

External combustion engines are those in which combustion takes place outside of the engine. example: steam engine, boiler engine



→ Internal Combustion Engine (IC engine)  
IC engine are those in which combustion of ~~fuel~~ fuel takes place inside of the engine.  
Example:- SI engine, CI engine, ~~etc~~ Diesel engine etc.

### Classification of IC engine

→ On the basis of fuel

- ① Petrol.
- ② Diesel.
- ③ Gasoline.

→ On the basis of stroke

- ① 2 stroke engine
- ② 4 stroke engine.

→ On the basis of Ignition.

- ① SI engine (Self ignition engine)
- ② CI engine (Combustion ignition engine)

On the basis of ~~cylinder~~

- ① Auto-diesel
- ② ~~Multi-diesel~~

On the basis of cylinder

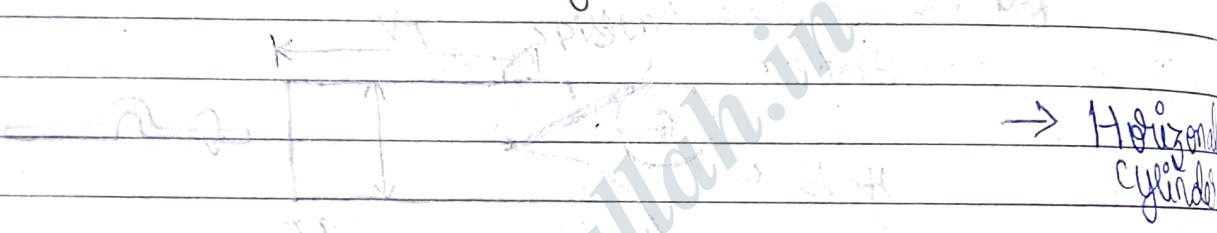
- ① Single cylinder.
- ② Multi cylinder.

on the basis

Air Cooled  
Water Cooled

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Components / Parts of IC.



$$V_T = V_C + V_S$$

**Bore** :- The inner diameter of the working cylinder is called Bore or Cylindrical Bore. It is represented by 'D' the unit of Bore is mm, cm, etc.

**Stroke** :- It is represented by L. It is the permissible distance of the piston movement. It is distance between TDC and BDC. Its unit is in mm, cm, m etc.

Note:  $\frac{L}{D}$  ratio

- (i)  $D > L \rightarrow$  undersquare engine.
- (ii)  $D = L \rightarrow$  Square engine.
- (iii)  $D < L \rightarrow$  oversquare engine.

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