CHAPTER 4

ROD JOINTS

All of you have seen a tractor and its trolley/ trailer. The trolley can be easily joined or removed from the tractor as per the need. Have you ever noticed that how this trolley is joined or detached from the tractor? This work is made so simple by a joint between the tractor and the trolley using a pin or a cotter. A fork end is there at the back of the tractor and an eye end is there in front of the trolley and a round rod is inserted in between these two to make the joint. In industry also different cotter joints are used some of these we shall learn in the following paragraphs. First of all we shall learn about the cotter.

Fig 4.1

COTTER:

A cotter is a flat rectangular cross section wedge-shaped piece or bar of mild steel block which is uniform in thickness but tapering in width on one side in general. It is used to connect rigidly two rods, whose axes are collinear and which transmit motion in the axial direction (tensile or compressive forces) without rotation. The cotter is inserted perpendicular to the axes of the shafts which are subjected to tensile forces. Cotter provides rigid joint support.

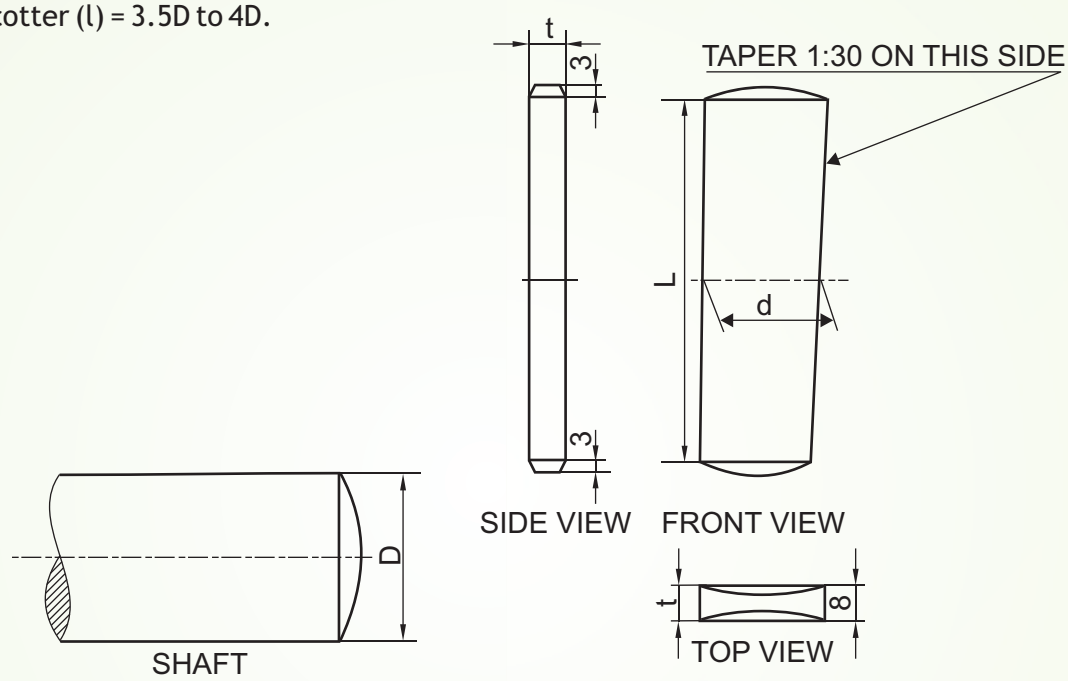
DIMENSIONS OF A COTTER:

Let 'D' be the diameter of connecting rods.

Average dimension of the cotter (d) = 1.3D

Thickness of cotter (t) =0.3D

Length of cotter (l) = 3.5D to 4D.



COTTER

Fig 4.2

These types of joints are simple in design and need very less application of tools. These are used to connect the end of a rod of a shaft. The end of the bar has a hole in it and it is called a lug. The shaft carries a hole. This shaft is locked in place by a smaller pin that passes through the side of the lug and partly or completely through the shaft itself. This locking pin is named as a cotter, which sometimes is also applied to the whole joint. The cotter joint is a temporary fastening, which allows the assembly and disassembly of a unit without damaging the fastened elements of connecting components. In this type of joint the parts are held together by frictional force.

The obvious example is of a bicycle where both pedal bars separately locked by a cotter pin, on their common driving shaft having the sprocket to the wheel.

Steel is the most common material used for this application.

Examples: Typical applications of the cotter joint are fastening of piston rods and cross heads in steam engines, yokes in rods, tool fixtures and for services of similar kinds etc.

USE OF COTTER JOINT

The joint is useful in the following conditions:

(i) To connect a rod directly with a machine, so as to transmit a force to the machine through the rod or vice- versa.

(ii) When it is desired to increase the length of the rod.

(iii) To connect two rods rigidly in the direction of their length.

USE OF TAPER IN COTTER JOINT:

The taper in the cotter is provided to take the advantage of wedging action (friction locking). The taper also keeps the joint alive even after some wear in the joint has taken place as the gap generated due to the wear automatically filled up by the self travel of the cotter. This travel is assisted due to the taper given in the cotter. Taper helps in insertion into the position and withdrawal and lateral adjustment of connected parts. The taper should not be too large causing self removal of the cotter under the external load, but if the large taper is essential, in a case when frequent disassembly is required, locking devices such as set screw/lock pin etc. become necessary to secure the cotter in position against the slackening or removal of the cotter from its position. Generally, the taper of 1: 30 is given and is decided on the basis of the angle of friction between cotter and rods material. The taper angle should not be greater than the angle of friction. The thickness of the cotter is generally kept equal to one fourth and one fifth of its width in the centre. The width of the slot is made 3 to 5 mm bigger than the cotter. When the cotter fits into the slot, the central portion of the cotter comes in contact with spigot and pushes it into the socket. These forces on the contacting surfaces prestress the joint and provide the required force for friction locking of the bearing surfaces. Finally, the edges of the cotter and the edges of the slot are rounded.

In our syllabus the assembly and disassembly of cotter joints for circular and square rod are there.

We shall learn that there are three cotter joints for connecting the circular rods:

a. Sleeve and Cotter joint

b. Socket and Spigot joint and

c. Knuckle joint (only sectional front view is in our syllabus).

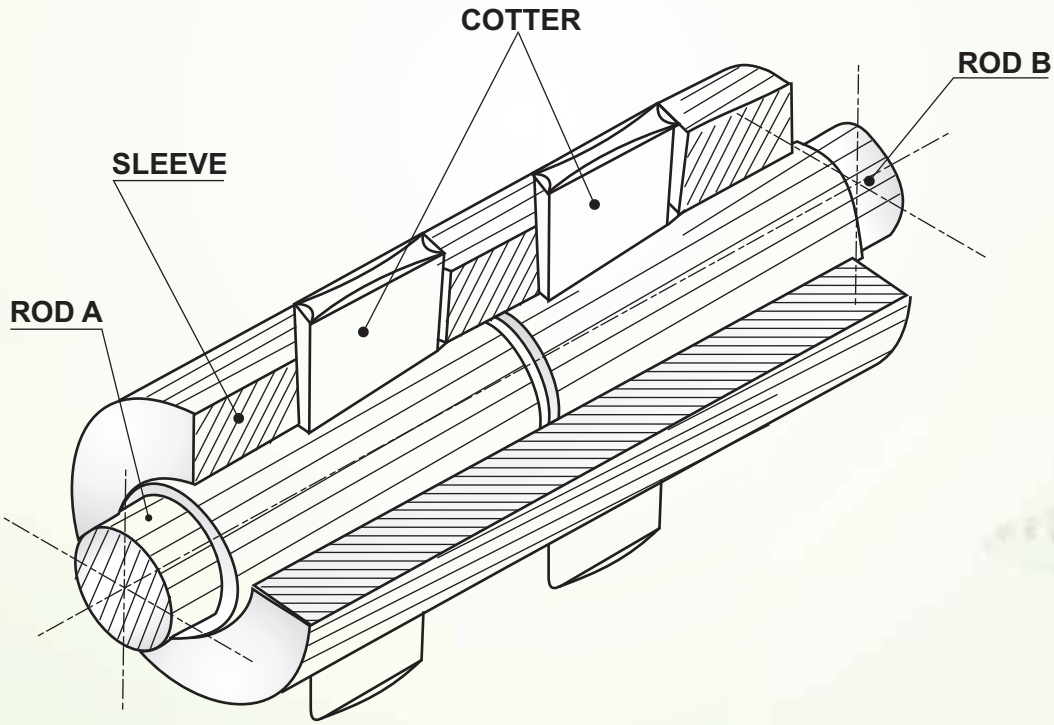
Also in our syllabus there is only one cotter joint for joining square or rectangular rods and it is called:

d. Gib and cotter joint.

Now, let us learn more about the Sleeve and Cotter Joint

SLEEVE AND COTTER JOINT:

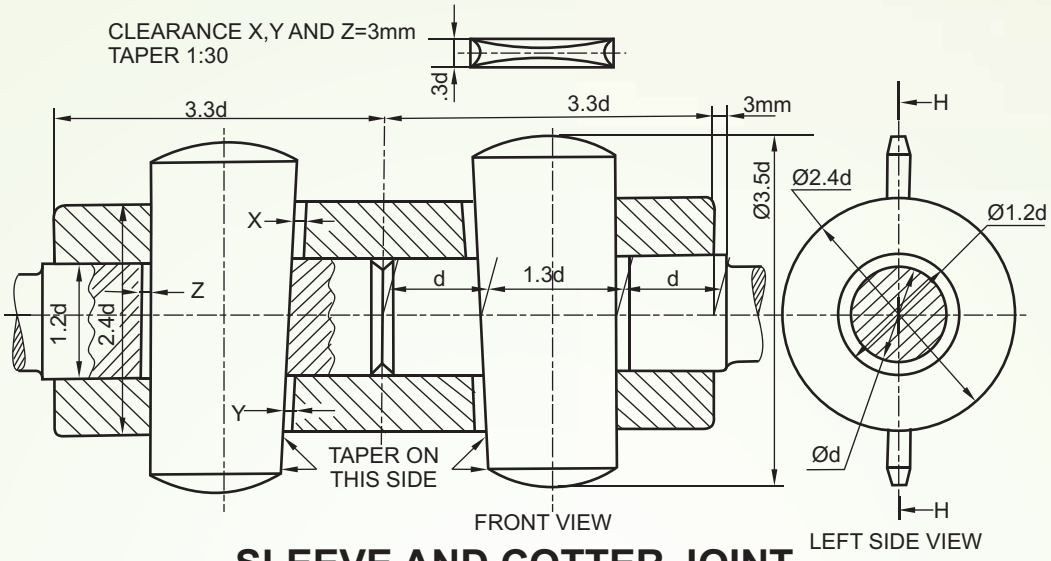
Sleeve and cotter joint is used to connect two round rods or sometimes to connect two pipes/tubes. The rods are forged and increased in diameter to some length just to compensate for the loss of material, for making rectangular hole, accommodate the rectangular tapered cotter in each rod. The ends of both the rods are chamfered to avoid burring and easy insertion in the hollow steel sleeve (socket/cylinder/muff). Both the rods are of the same dimensions. A hollow sleeve is passed over both the rods and has two rectangular holes for the insertion of cotter at right angle to the axes of the rods. The cotters are automatically adjusted due to the extra margin given for the clearance in the rod and the sleeve. The relative position of slots is such that the driving in of the cotters tends to force the rods towards each other in socket or hollow sleeve. When sleeve and rods are subjected to axial tensile force then the cotter is subjected to shearing force, these joints are useful for light transmission of axial loads.



SLEEVE AND COTTER JOINT

Fig 4.3

Dimensions of a Sleeve and Cotter Joint in terms of diameter of the rods (d)



SLEEVE AND COTTER JOINT

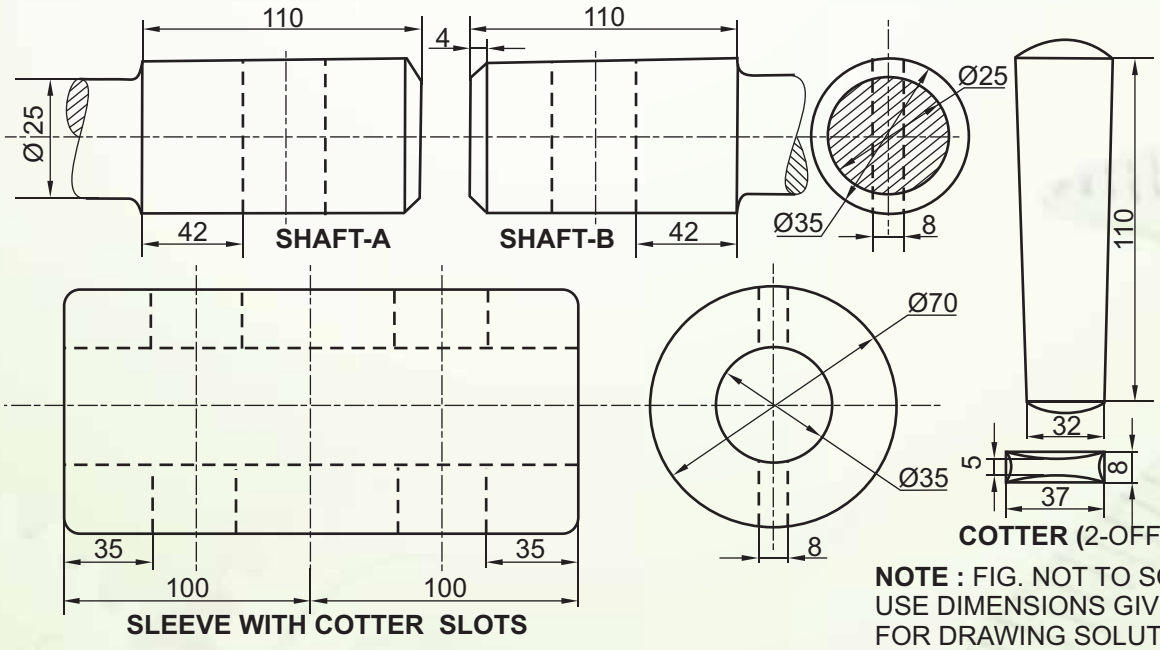
Fig 4.4

Question: Figure given below (fig : 4.5) shows the parts of a Sleeve and Cotter Joint. Assemble the parts correctly and then draw the following views to a scale 1 : 1

(a) Front view, upper half in section.

(b) Side view, viewing from the left.

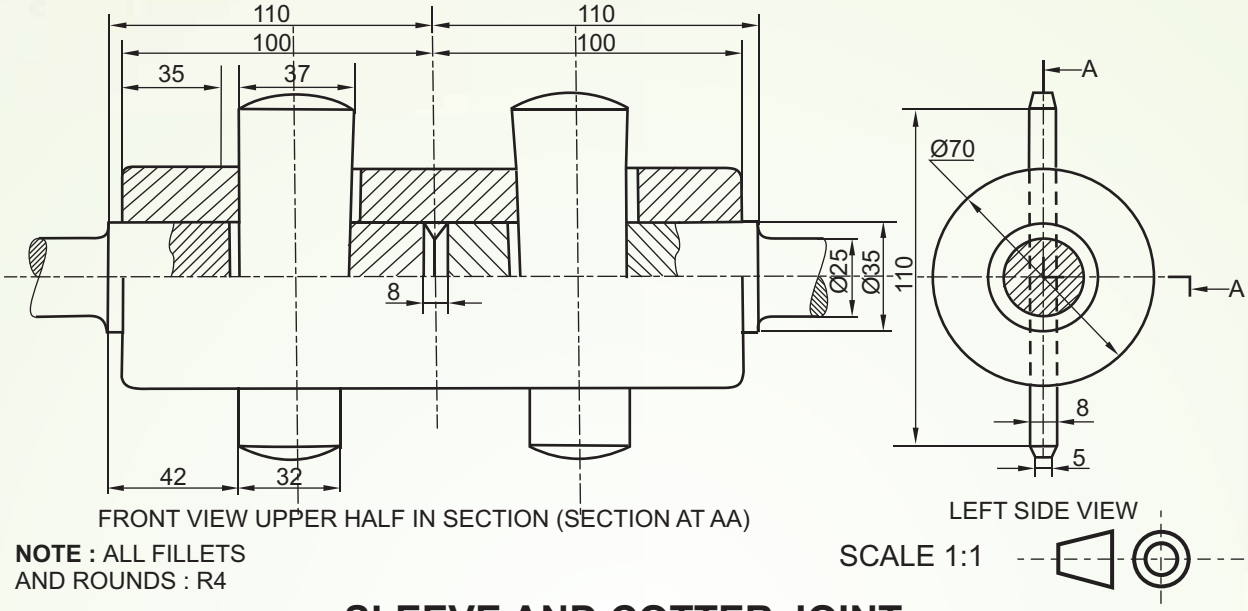
Print title and scale used. Draw the projection symbol. Give '8' important dimensions.



SLEEVE AND COTTER JOINTS

Fig 4.5

Solution of fig : 4.5



NOTE : ALL FILLETS AND ROUNDS : R4

SLEEVE AND COTTER JOINT

Fig: 4.6

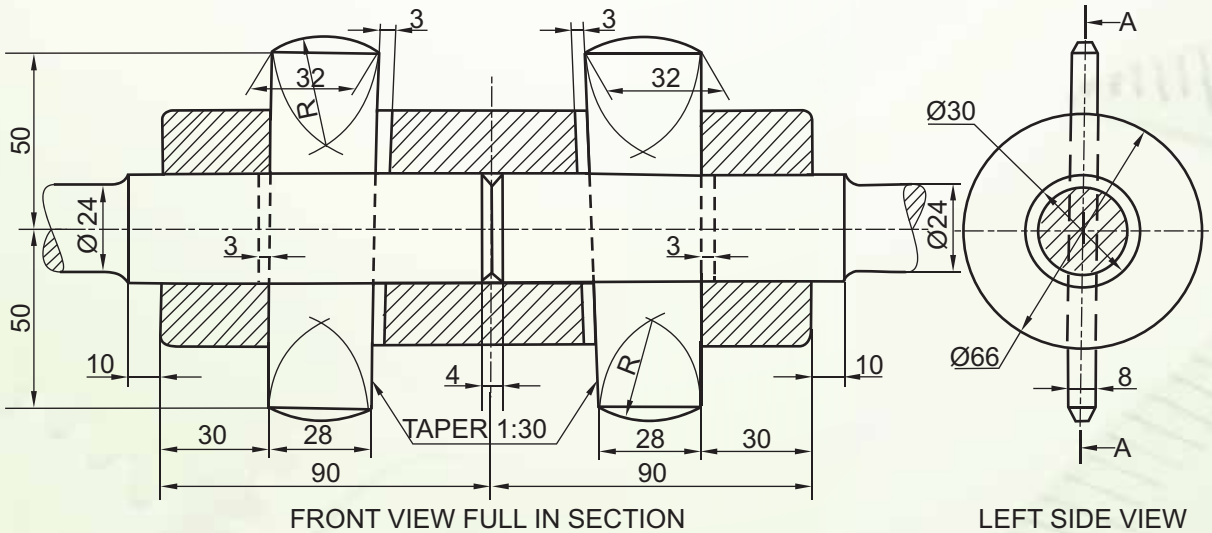
Question: The figure given below (fig: 4.7) shows the assembly of a Sleeve and Cotter Joint Disassemble the following parts and draw the following views to a full size scale.

(a) F.E. of the sleeve and S.E. viewing from left.

(b) F.E. of Rod A and Rod B and S.E. viewing from left.

(c) F.E. of cotter in vertical position and the plan.

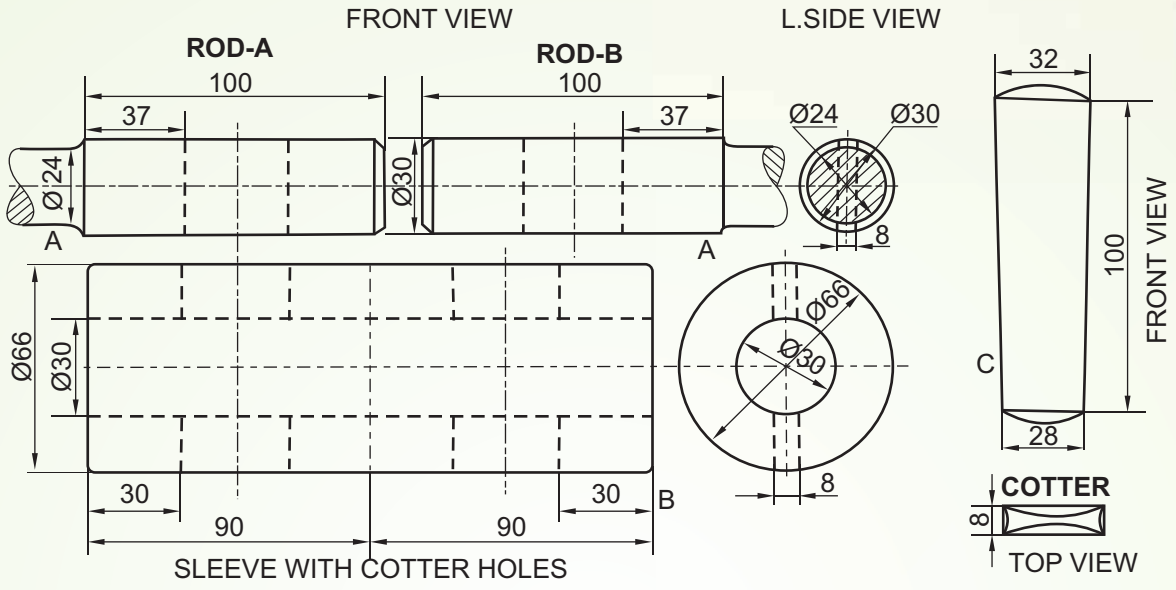
Print titles and scale used. Draw the projection of symbol. Give 8 important dimensions.



SLEEVE AND COTTER JOINT ASSEMBLY

Fig 4.7

Answer of fig 4.7



SLEEVE AND COTTER JOINT

Fig 4.8

Question: Figure given below (fig: 4.9) shows the exploded drawing of a Sleeve and Cotter Joint. Assemble the parts correctly and then draw the following views to scale 1:1

(a) Front view full in section.

(b) Side view, viewing from the left.

Print title and scale used. Draw the projection symbol. Give '8' important dimensions.

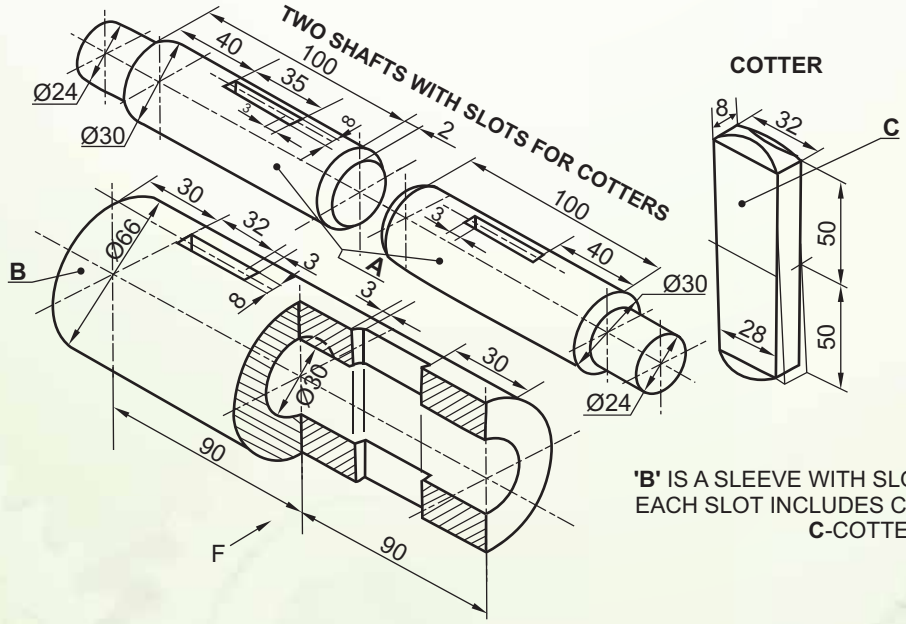
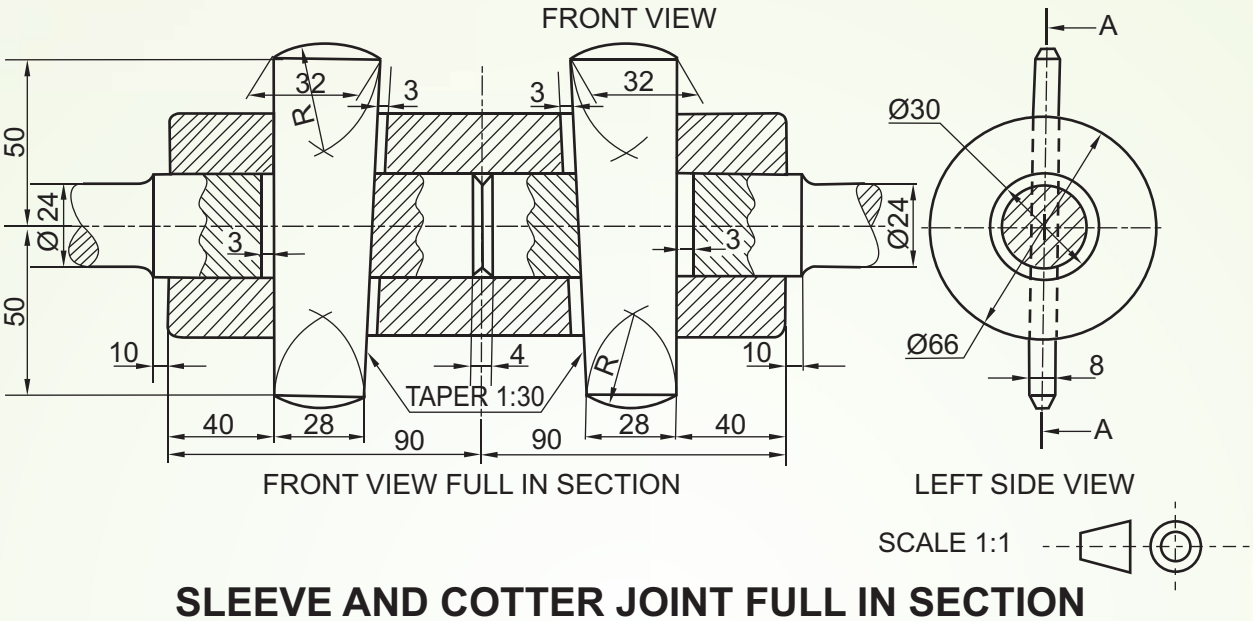


Fig 4.9

Answer of fig. 4.9

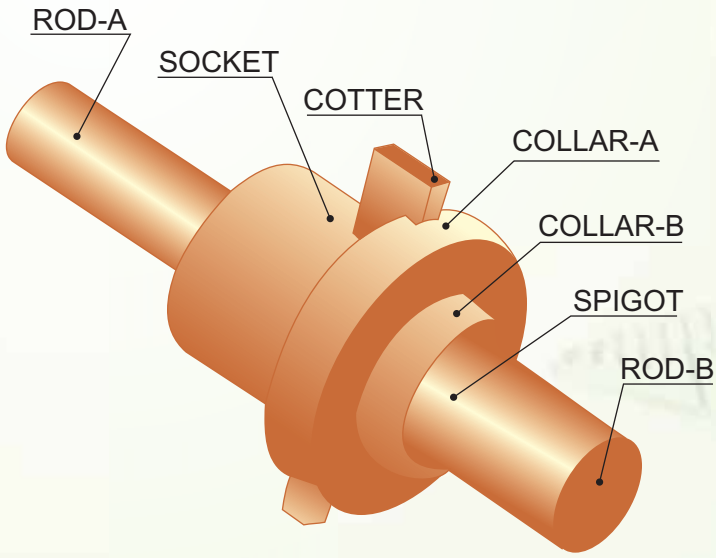


SLEEVE AND COTTER JOINT FULL IN SECTION

Fig 4.10

SOCKET AND SPIGOT JOINT

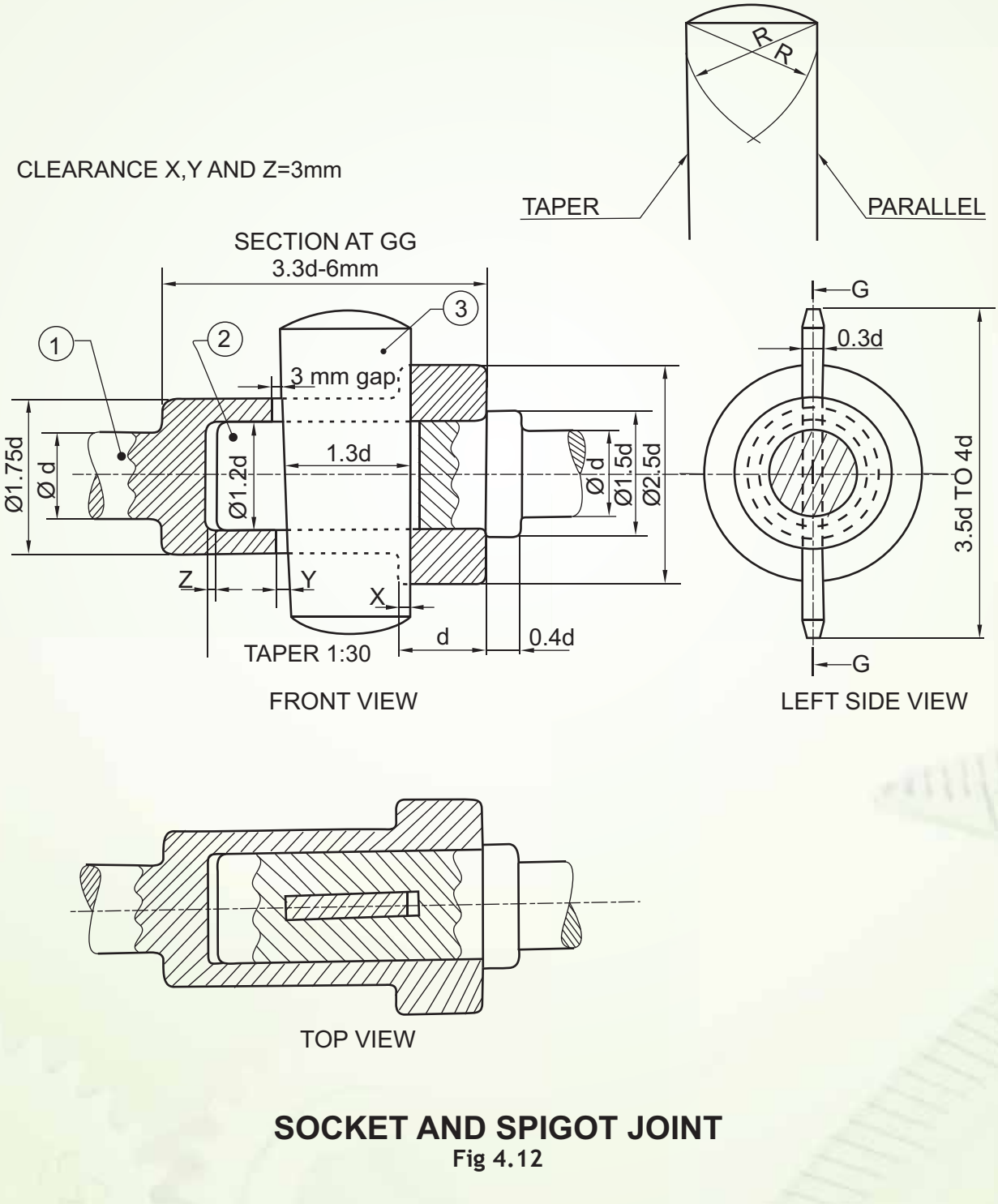
Socket and Spigot Cotter Joint is connecting two rods in such a way that it can transfer axial compression or tensile load. In this case one end of the first rod is enlarged in diameter to some length, just to compensate the loss of material due to rectangular hole made in it to accommodate a cotter. A collar is provided at the end of the enlarged end of the spigot. The one end of the second rod is formed into a socket or box having an appropriate inner diameter to fit the spigot along with a collar, for a very simple construction socket can be considered as a hollow pipe having one side solid and the other hollow, while the spigot is a solid rod, the solid spigot is nearly of the size of the internal radii of the socket, where it can fit. Once they are fit, consider that a rectangular cavity of tapering construction through both the parts, i.e., spigot and socket. This cavity or slot is kept slightly out



SOCKET AND SPIGOT JOINT

Fig 4.11

of alignment so that driving in of the cotter tends to pull the slots in a line, thus making the joint perfectly tight and rigid. A clearance of 2 to 3 mm is made in these joints for the proper functioning of the cotter.



SOCKET AND SPIGOT JOINT

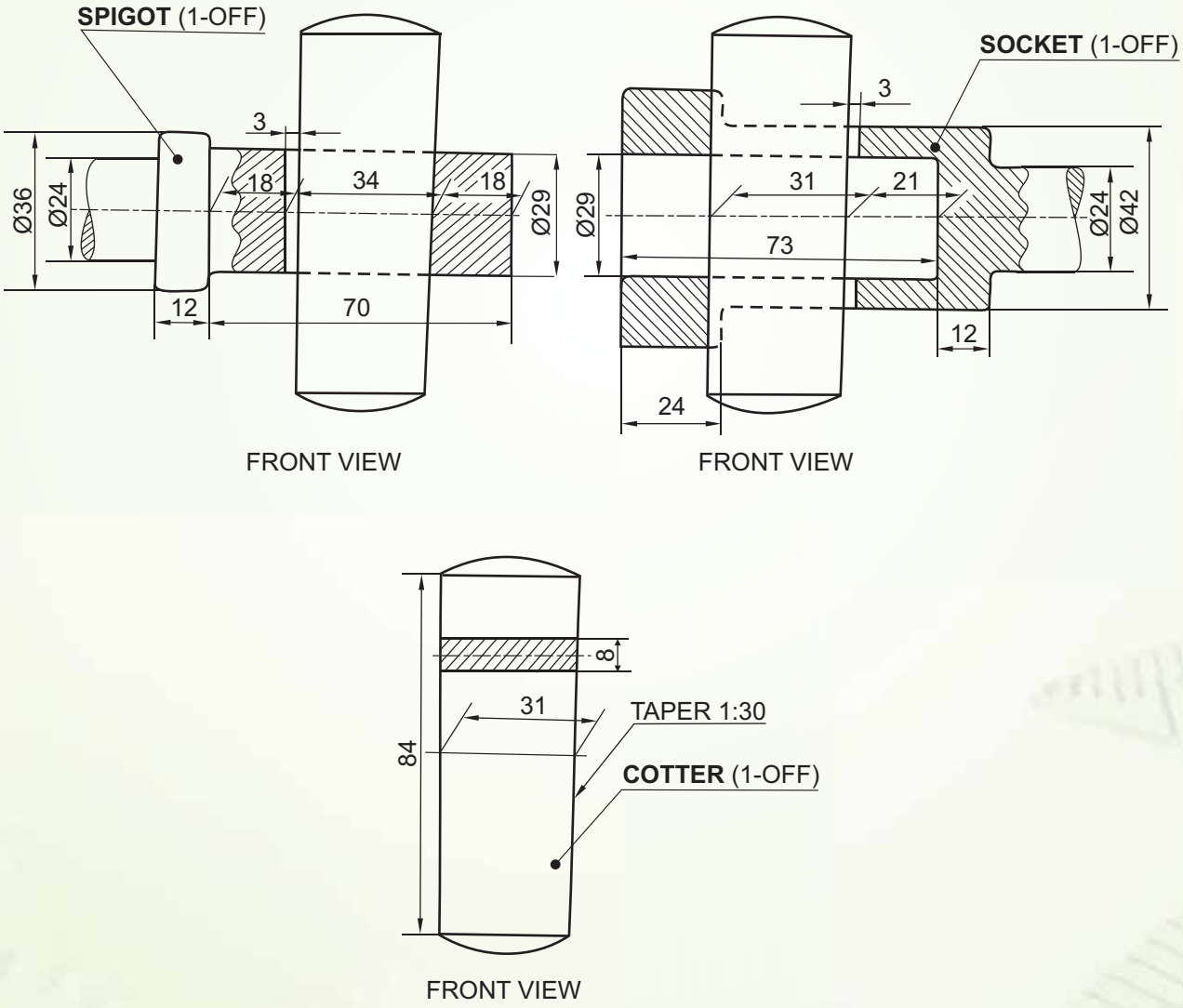
Fig 4.12

Question: The details of a socket and spigot joint are shown in fig 4.13. Assemble these parts correctly and then draw its following views to scale full size.

(a) Front view upper half in section.

(b) Side view, as viewed from right.

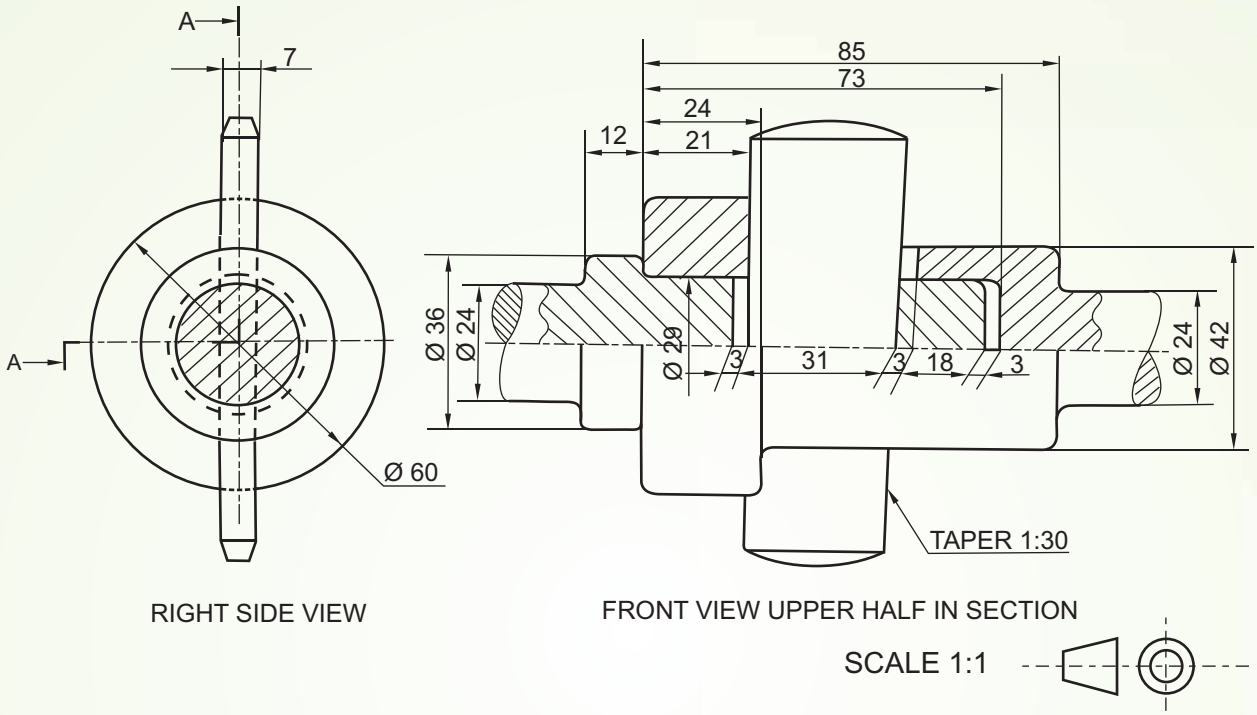
Print heading and scale used. Draw projection symbol. Give six important dimensions



DETAILS OF A SOCKET AND SPIGOT COTTER JOINT

Fig 4.13

Answer of fig. 4.13



RIGHT SIDE VIEW

FRONT VIEW UPPER HALF IN SECTION

SCALE 1:1

SOCKET AND SPIGOT JOINT

Fig 4.14

Exercise: The three views of a Sleeve and Cotter Joint are given. Disassemble the parts as given below and draw the following views :

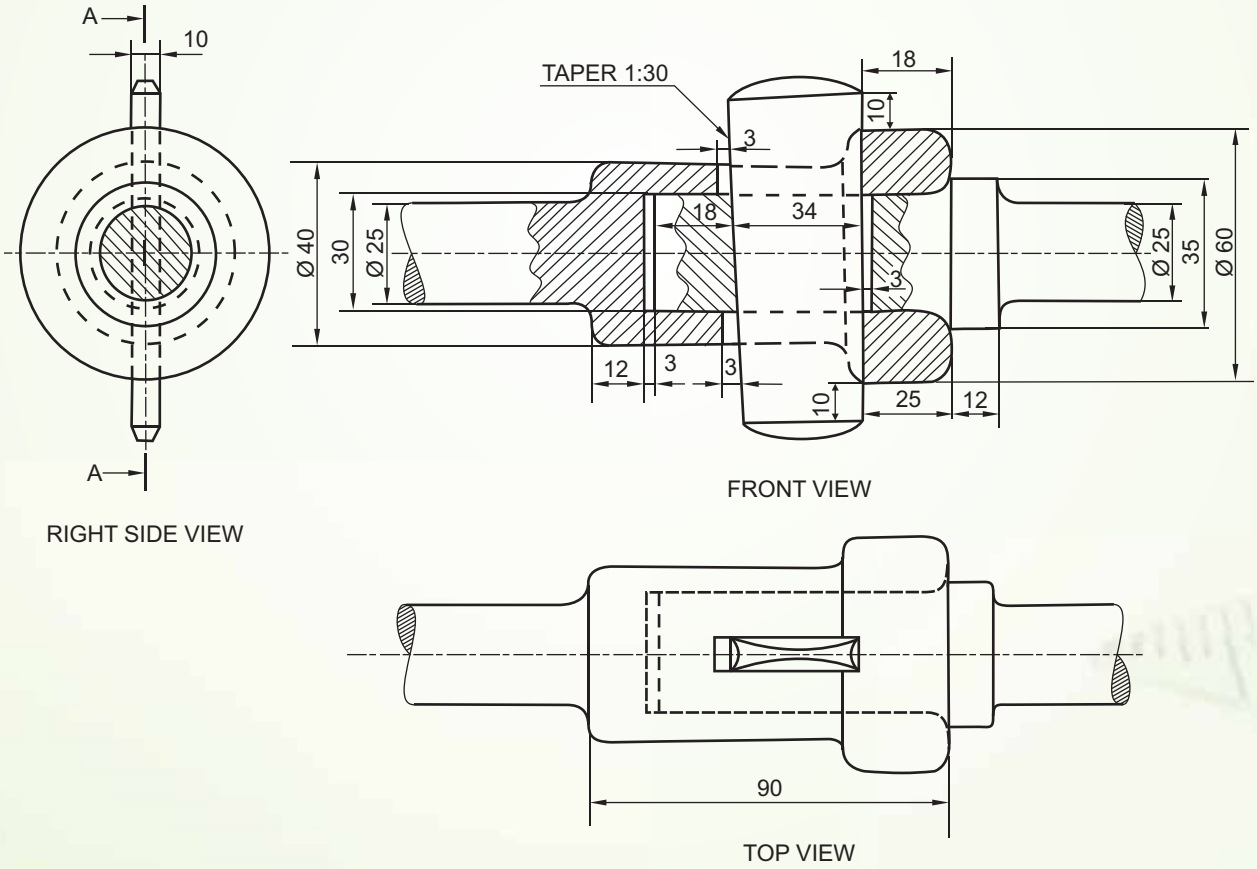
(a) SPIGOT

(i) Front view. (ii) Side view from right

(b) SOCKET

(i) Front view (ii) Right side view.

Print headings and scale used. Draw projection symbol. Give 8 important dimensions



SLEEVE AND COTTER JOINT

Fig 4.15

Exercise: The pictorial views of a Socket and Spigot Joint are given .Disassemble the parts as given below and draw the following views. Refer Fig. 4.16

(a) SPIGOT

(i) Front view lower half in section (ii) Side view from left

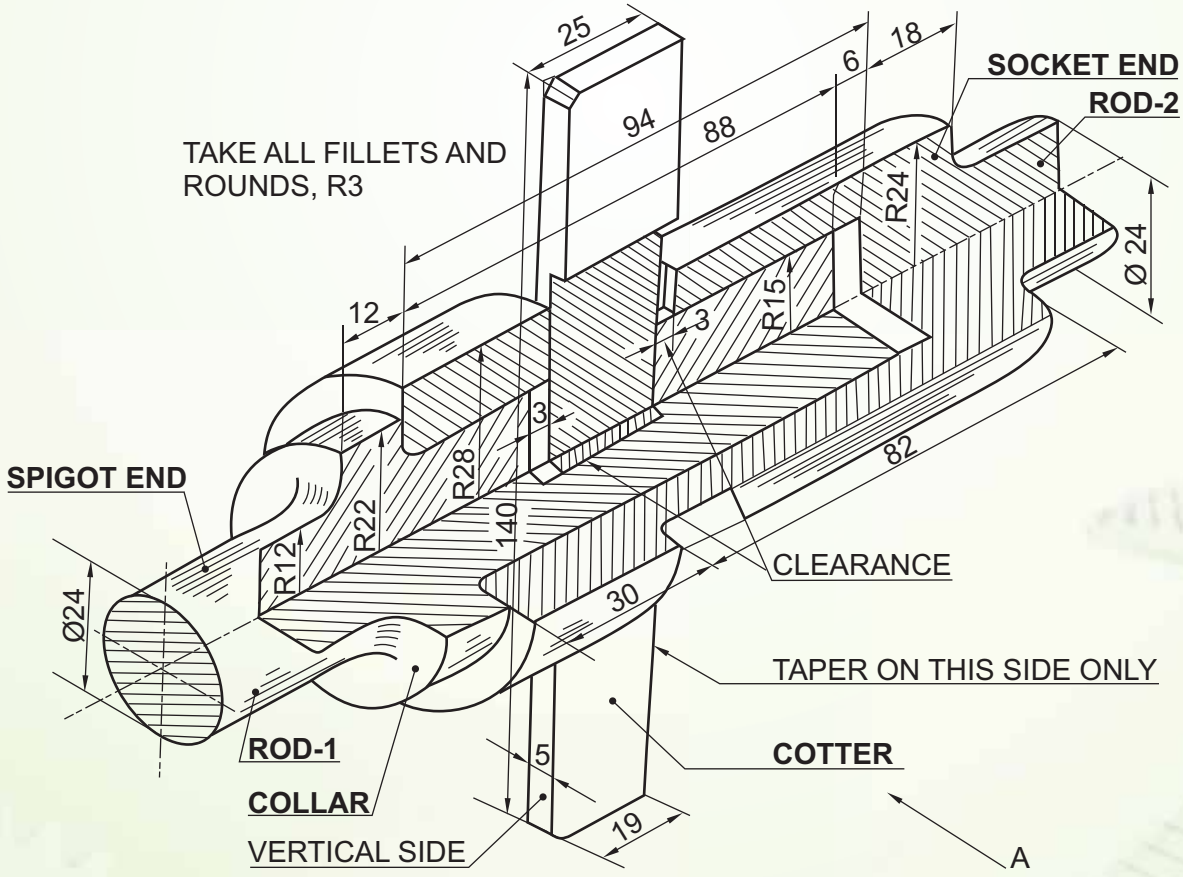
(b) SOCKET

(i) Front view upper half in section (ii) Left side view.

(c) COTTER

(i) Front View (ii) Top View

Print headings of the above and scale used. Draw projection symbol. Give 8 important dimensions.

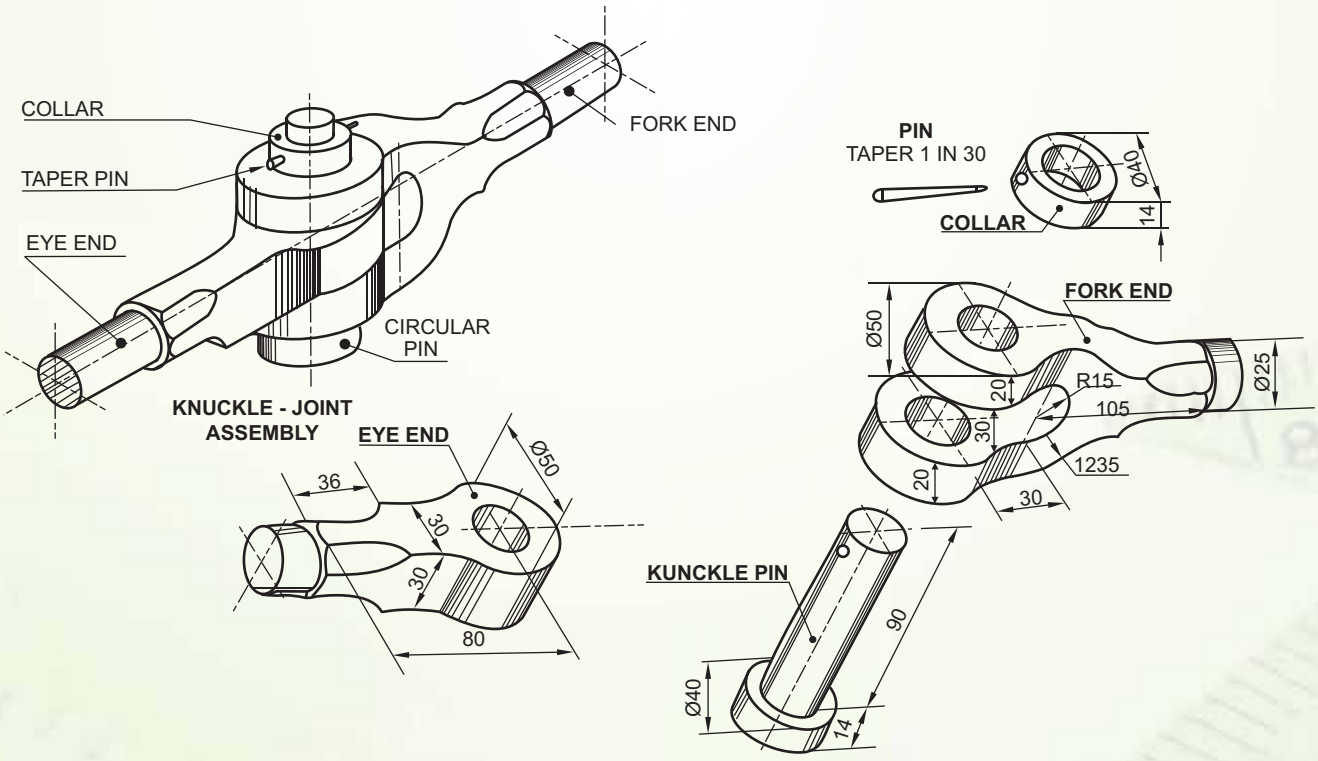


SPIGOT AND SOCKET JOINT

FIG : 4.16

KNUCKLE JOINT OR PIN JOINT

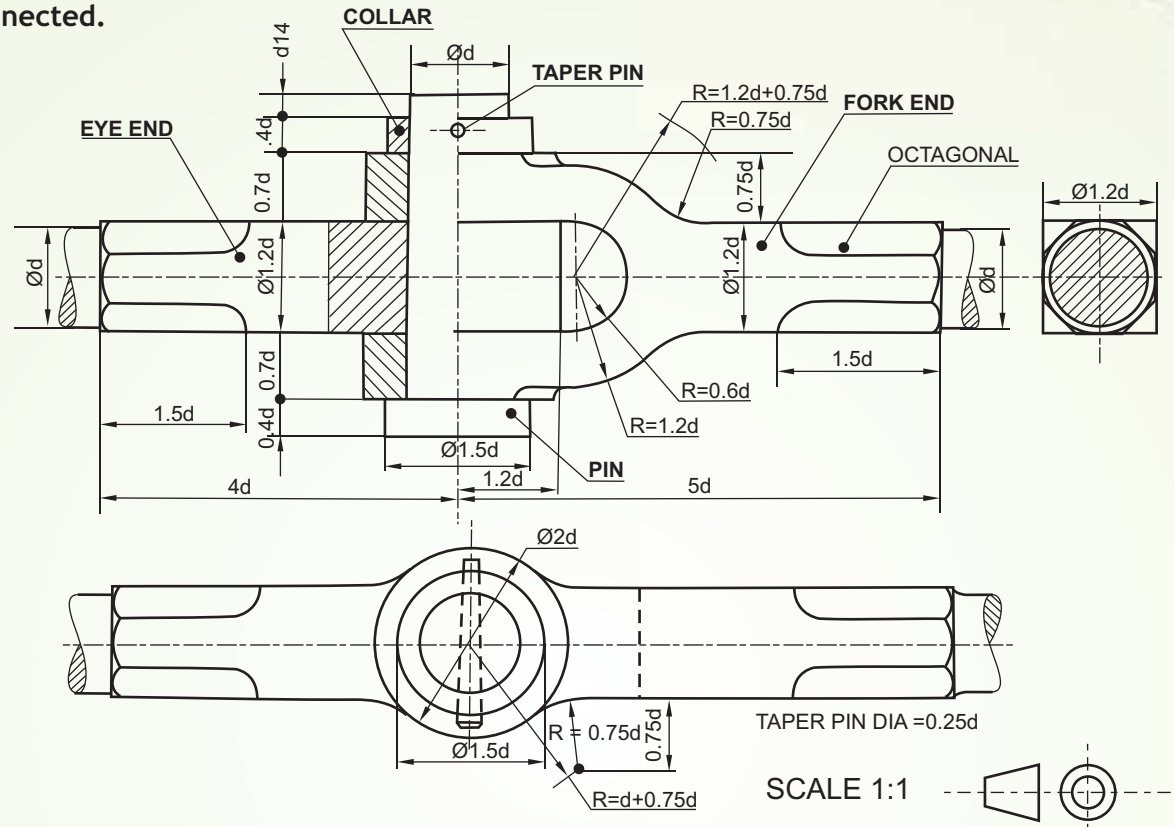
A knuckle joint is generally used to connect rods not positioned in a straight line and subjected to axial tensile load. This joint is not rigid. Sometimes, if it is required to be used to support compressive loading, a guide may be provided to constrain the motion of two fastened components (rods). In this joint the end of one rod is forged to form an eye while the other is made in the form of a fork having double eyes and this is called as eye end and fork end respectively. Eye end is inserted in fork end and a cylindrical pin is inserted through common holes in them. The cylindrical pin is kept in position by a round collar through which a transverse taper pin is inserted. The rods are quite free to rotate about the cylindrical pin. The end of the rods is made rectangular to some distance for firm grip and then these are made into a hexagonal or octagonal in shape (for an easy adjustment with the help of a spanner or a wrench), before it is forged into eye and fork shapes. This type of joint is widely used in practice to connect rods, which, for various reasons, cannot be fitted with a rigid joint. It is commonly used when a reciprocating motion is to be converted into a rotary motion or vice-versa. This joint is used for connecting D-slide valve, and eccentric rod of a steam engine, air brake of locomotives and many kinds of levers and rod connections, tie bars of trusses, links of suspension chains and many other links. The knuckle joint is also used for fastening more than two rods intersecting at a single points.



KNUCKLE JOINT OR PIN JOINT PARTS

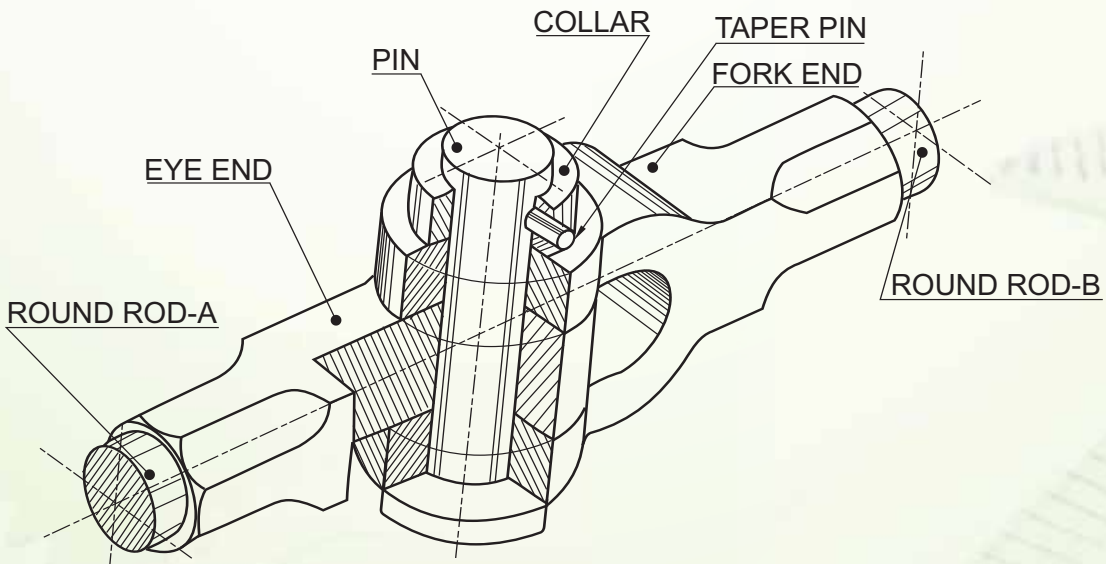
Fig: 4.17

Dimensions of a Knuckle Joint or Pin Joint in terms of the diameter(d) of the rods to be connected.



KNUCKLE JOINT

Fig: 4.18

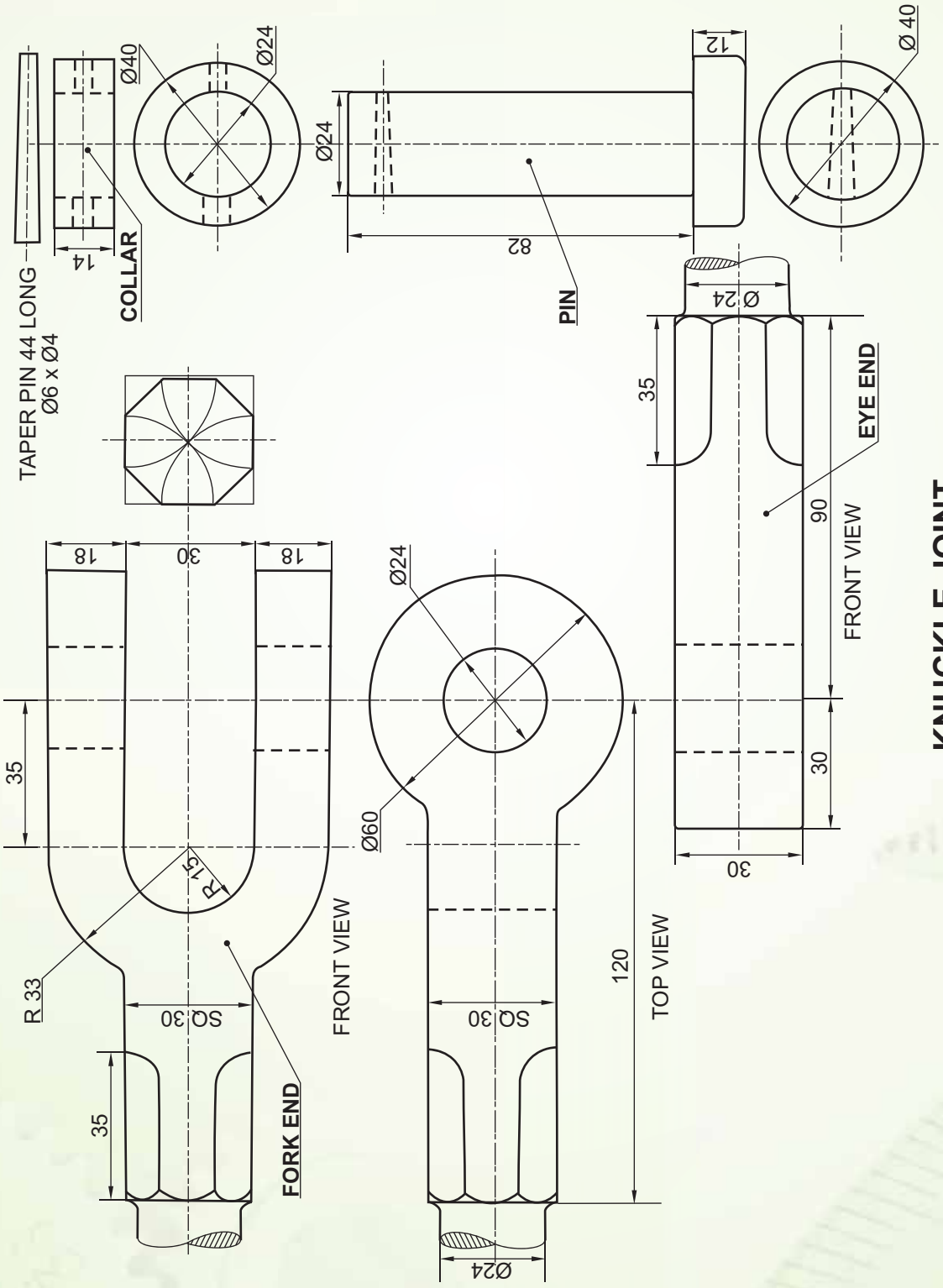


SECTIONAL ASSEMBLY OF A KNUCKLE JOINT

Fig: 4.19

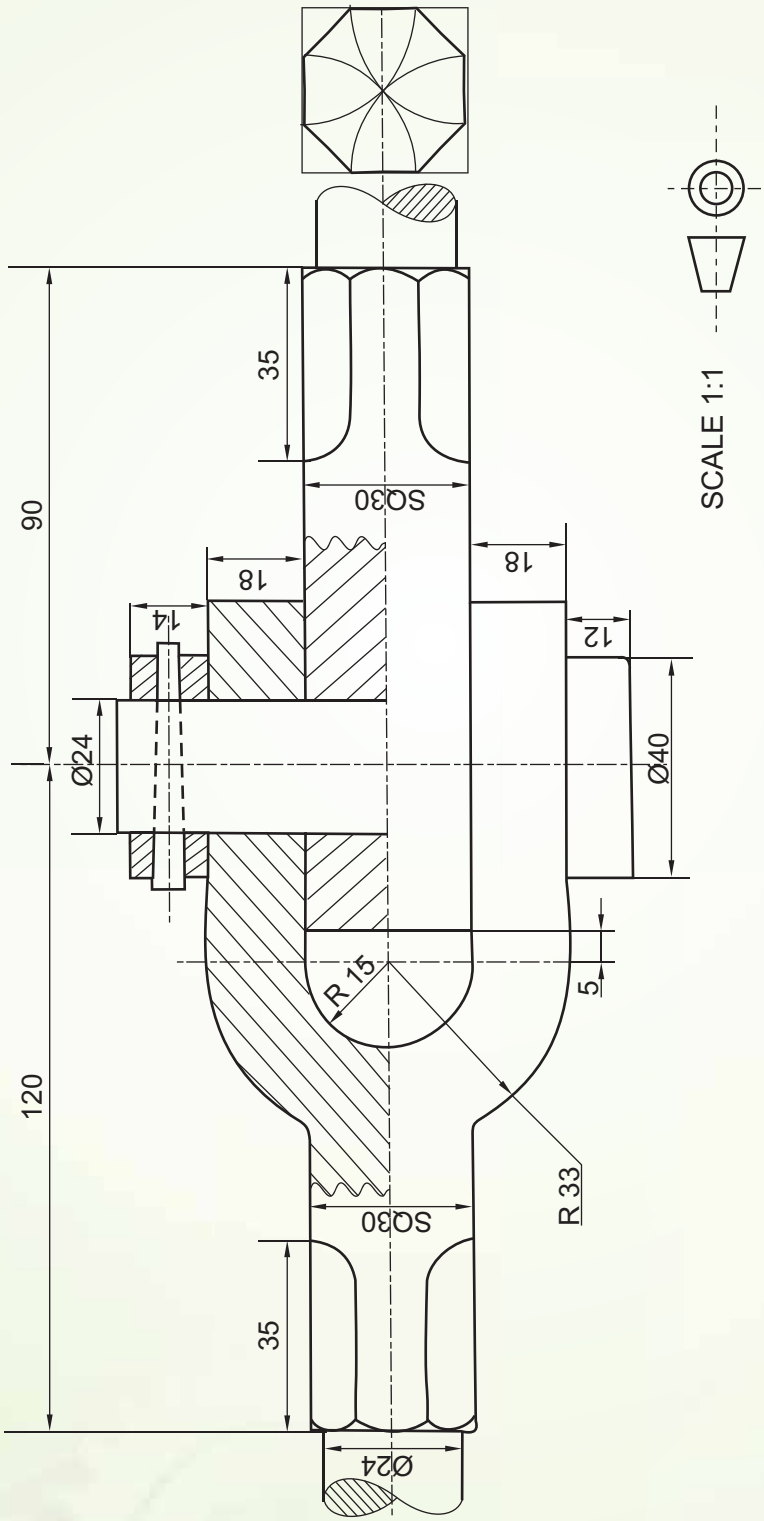
Question: fig 4.19(a) shows the parts of a KUNCKLE JOINT. Assemble the parts correctly and then draw the front view, showing upper half in section using the scale 1:1

Print title and scale used. Give 6 important dimensions.



KNUCKLE JOINT
Fig: 4.19(a)

Answer of fig 4.19 (a)

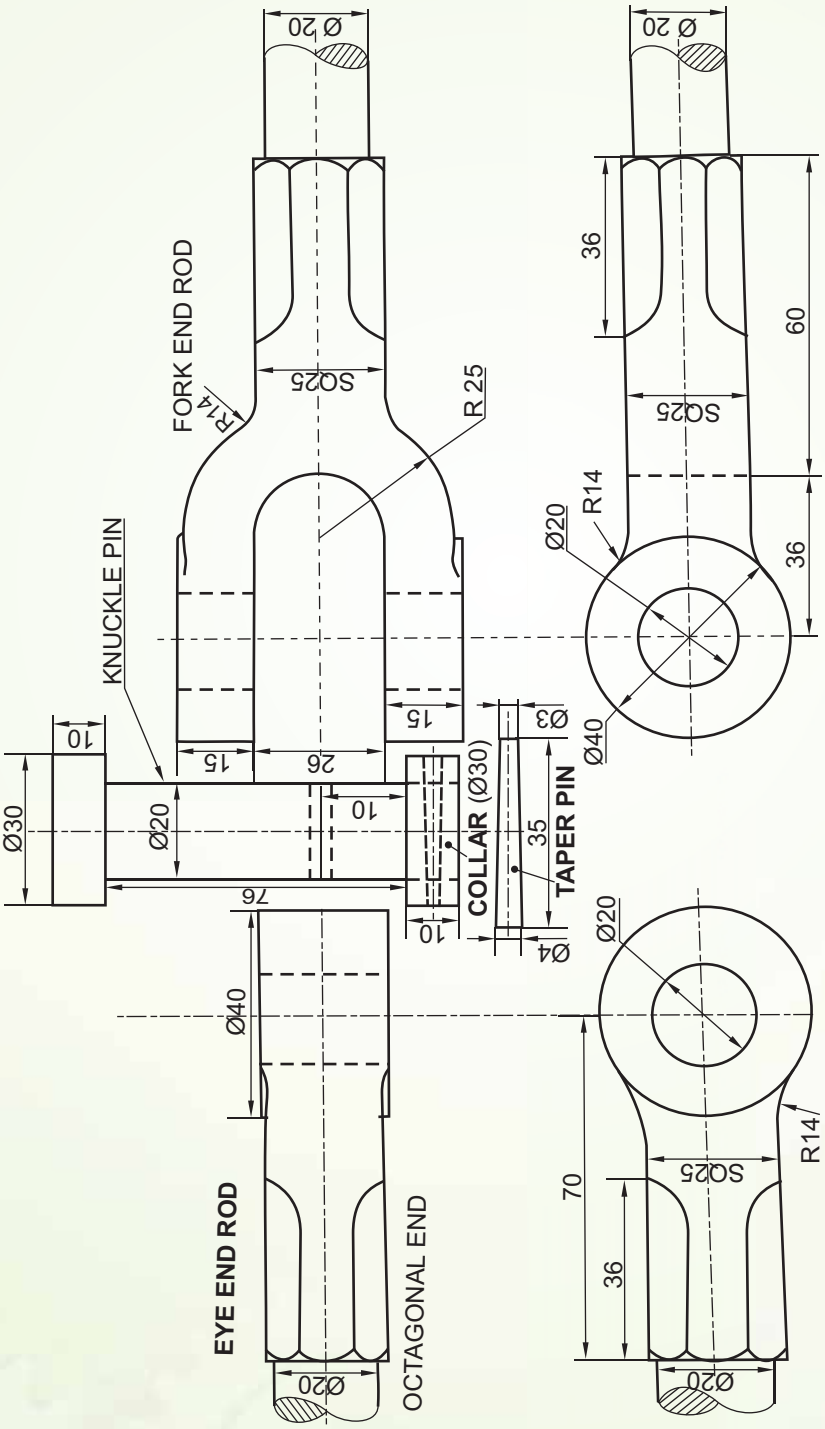


KNUCKLE JOINT

Fig: 4.20

Question: The figure 4.21 shows the parts of a Knuckle joint. Assemble these parts correctly and then draw the Front view, bottom half in section, to a scale full size.

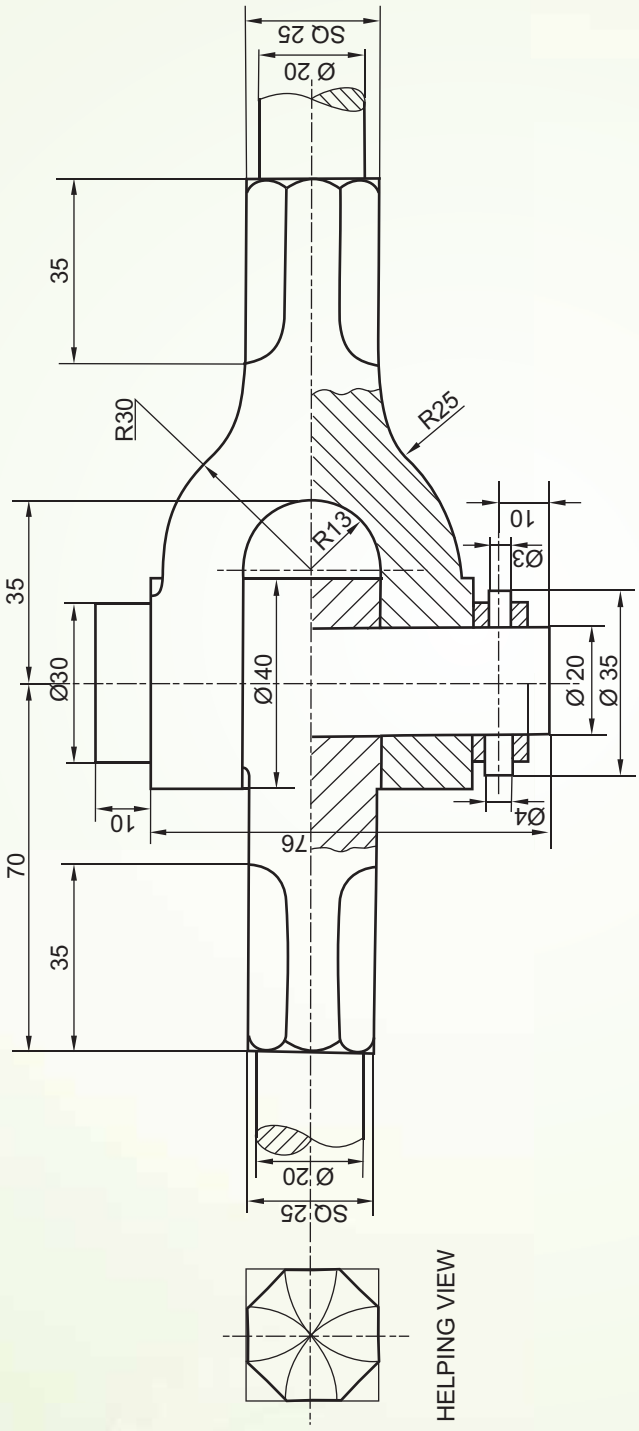
Print title and scale used. Give six important dimensions.



KNUCKLE-JOINT

Fig: 4.21

Answer of fig 4.21



KNUCKLE JOINT

Fig: 4.22

Exercises: The three views of a Knuckle Joint are given in (fig.4.23). Disassemble and draw the parts as given below.

(a) FORK END

(i) Front view upper half in section

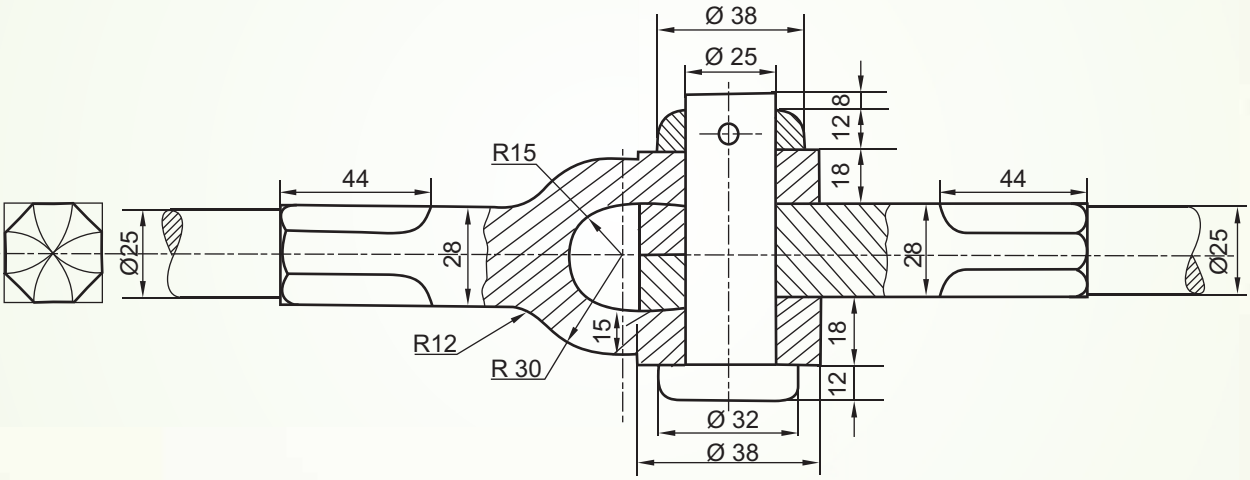
(b) EYE END

(i) Front view lower half in section

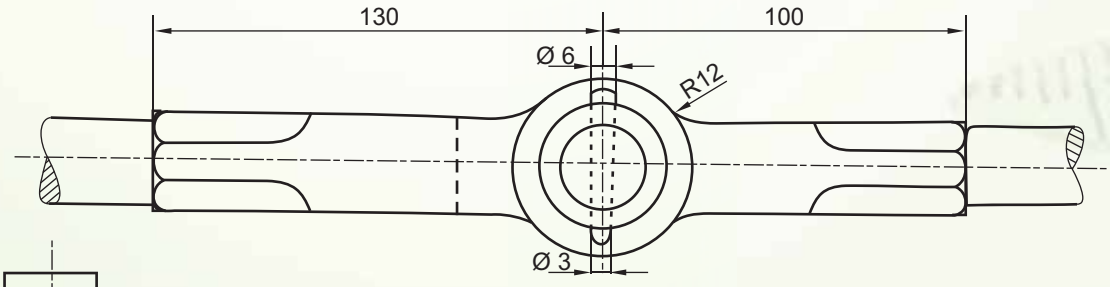
(c) CIRCULAR PIN

(i) FRONT VIEW

Print headings of the above views and scale used. Draw projection symbol. Give six important dimensions

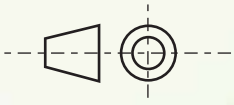


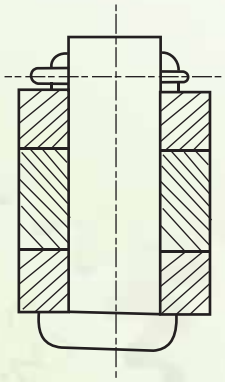
FRONT VIEW FULL IN SECTION



TOP VIEW

SCALE 1:1





ASSEMBLY OF KNUCKLE JOINT

Fig 4.23

GIB AND COTTER JOINT

This joint is used to join two rods of square or rectangular in cross section. The end of one rod is forged in the from of a fork or strap. The height of the other rod is increased for compensating the loss of material in making the slot for cotter. The Gib is made up of mild steel and has the same thickness as that of the cotter. the Gib has projections at the top and bottom ends which act like hooks. While connecting two rods the Gib is inserted first and pushed towards the end of the fork and then the cotter is hammered over. The tapering sides of the Gib and the cotter mate with each other, while their outer sides are parallel to each and perpendicular to the common axis of the rods. Hence, when a Gib is used with a cotter, the opposite faces of the slots in the rods are parallel to each other. The Gib acts like a counter part of the socket/strap. The Gib increases the tearing area of the cotter and prevents slackening of the joint besides holding the jaws of the strap or fork from opening wide when the cotter is inserted. The use of Gib and Cotter enables the parallel holes to be used. When Gib is used the taper is provided in the Gib. This joint is useful to fasten connecting rod of a steam engine or marine engine.

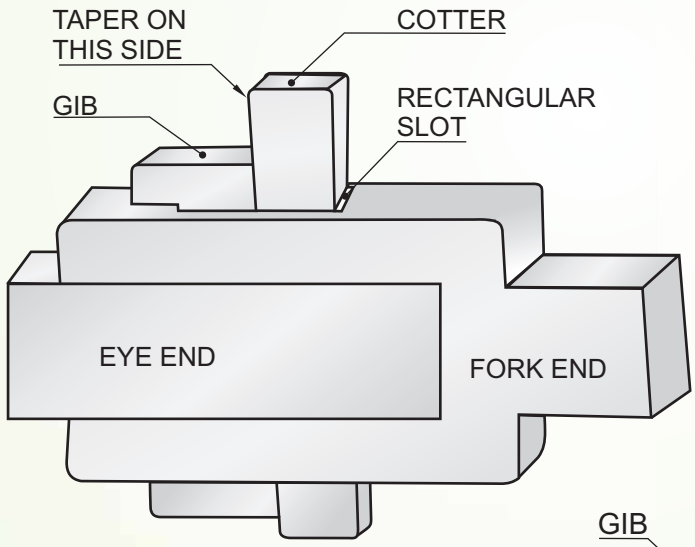
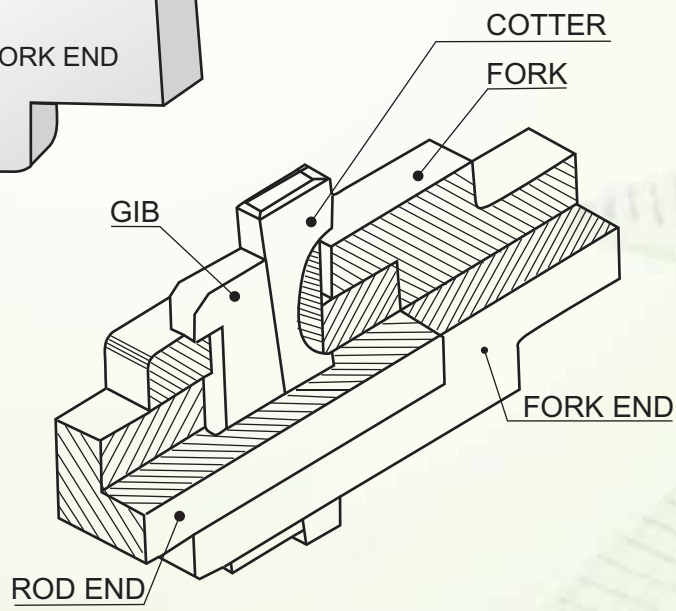


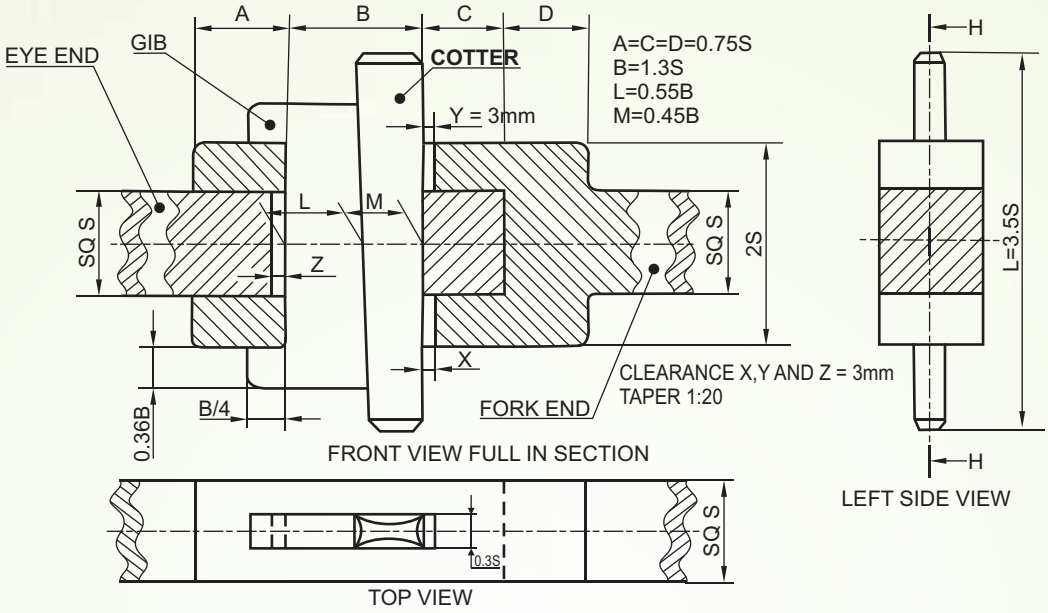
Fig. 4.24



SECTIONAL VIEW OF GIB AND COTTER JOINT

Fig. 4.25

Dimensions of a Gib and Cotter Joint in terms of the side (s) of the rods to be connected.



GIB AND COTTER JOINT FOR SQUARE RODS

Fig. 4.26

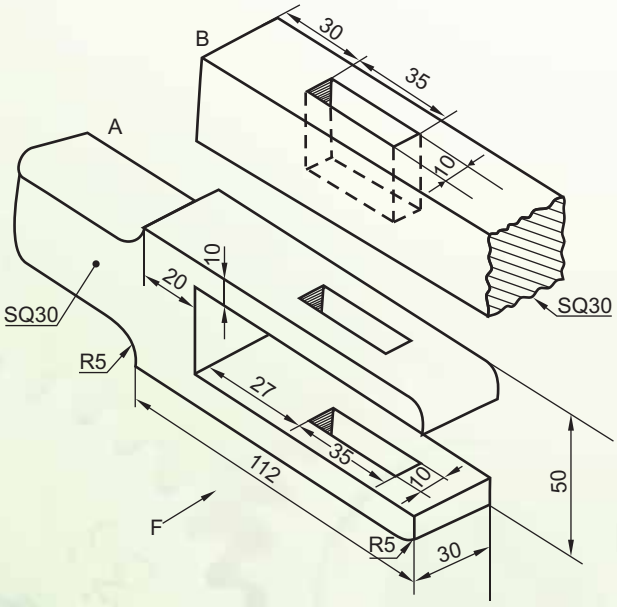
Question: The figure 4.27 shows the exploded pictorial View of a Gib and Cotter Joint. Assemble these parts correctly and then draw the following views to scale 1:1.

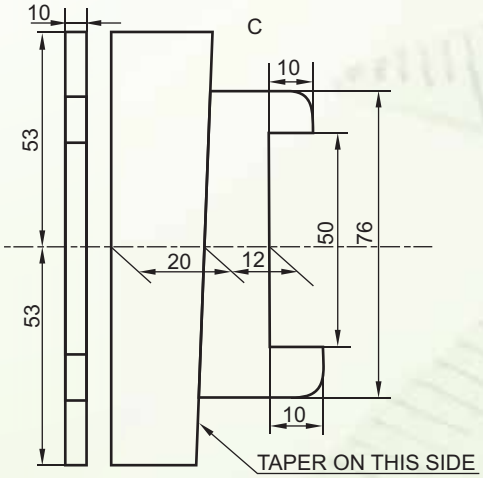
(a) Front View, full in section

(b) Right side view

(c) Top view.

Print title and scale used. Give six important dimensions.

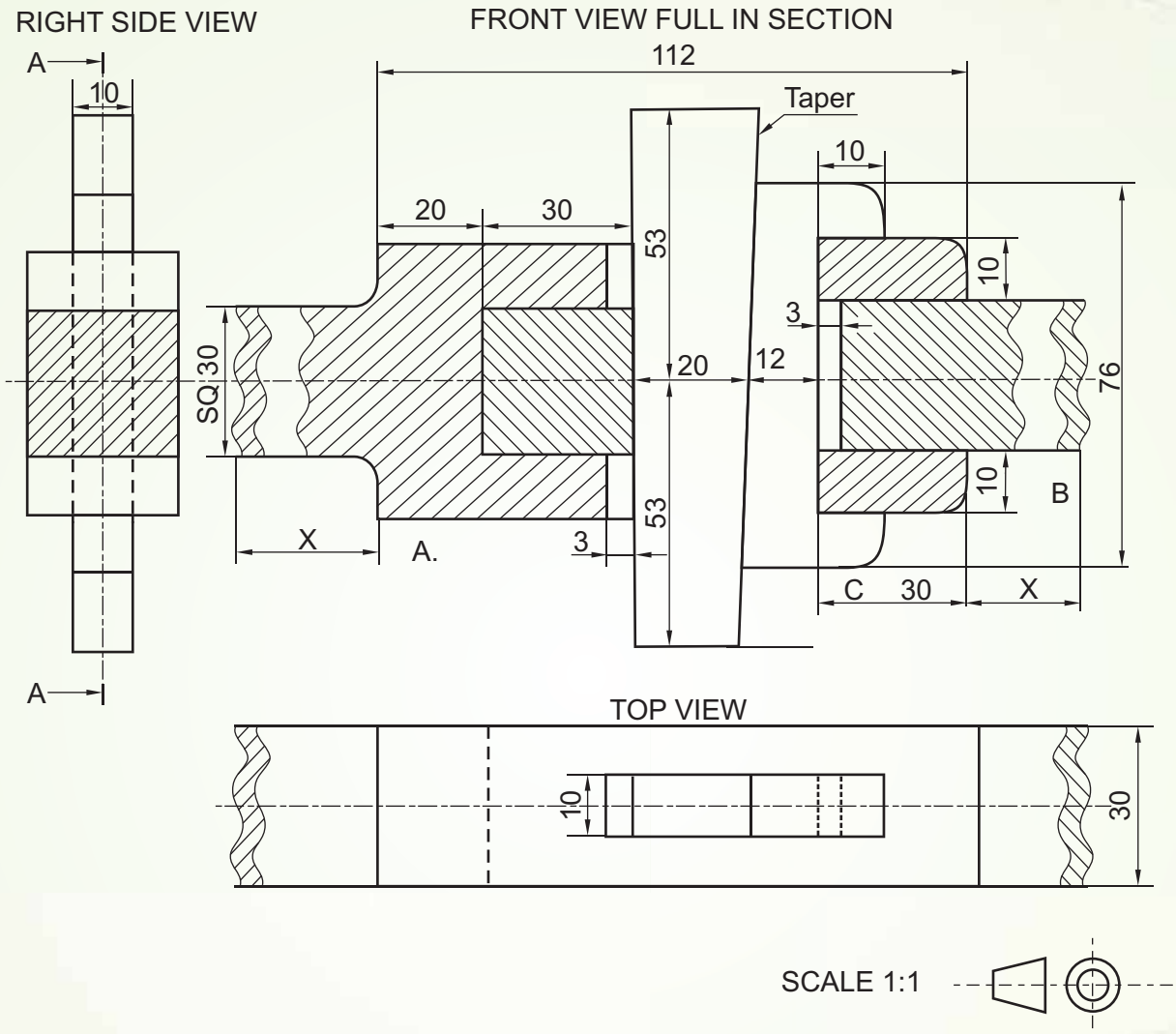




DETAILS OF GIB AND COTTER JOINT

Fig : 4.27

Answer: of fig (4.27)



ASSEMBLY OF A GIB AND COTTER JOINT

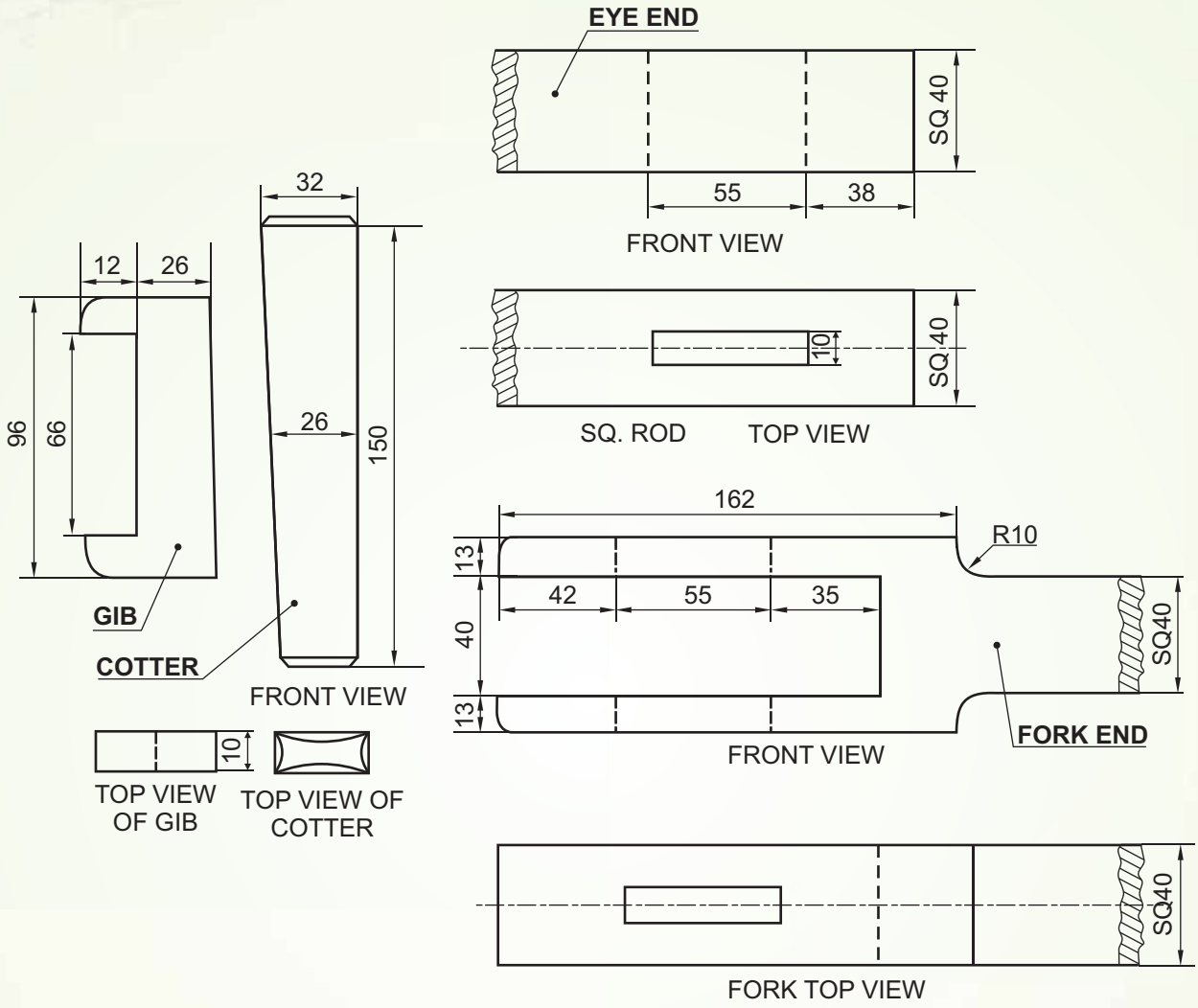
Fig. 4.28

Question: The figure 4.29 shows the detail drawings of different parts of a Gib and Cotter Joint for joining two square rods. Assemble all the parts correctly and draw the following views to scale 1:1

(a) Front view, upper half in section.

(b) Side view, viewing from the left hand side.

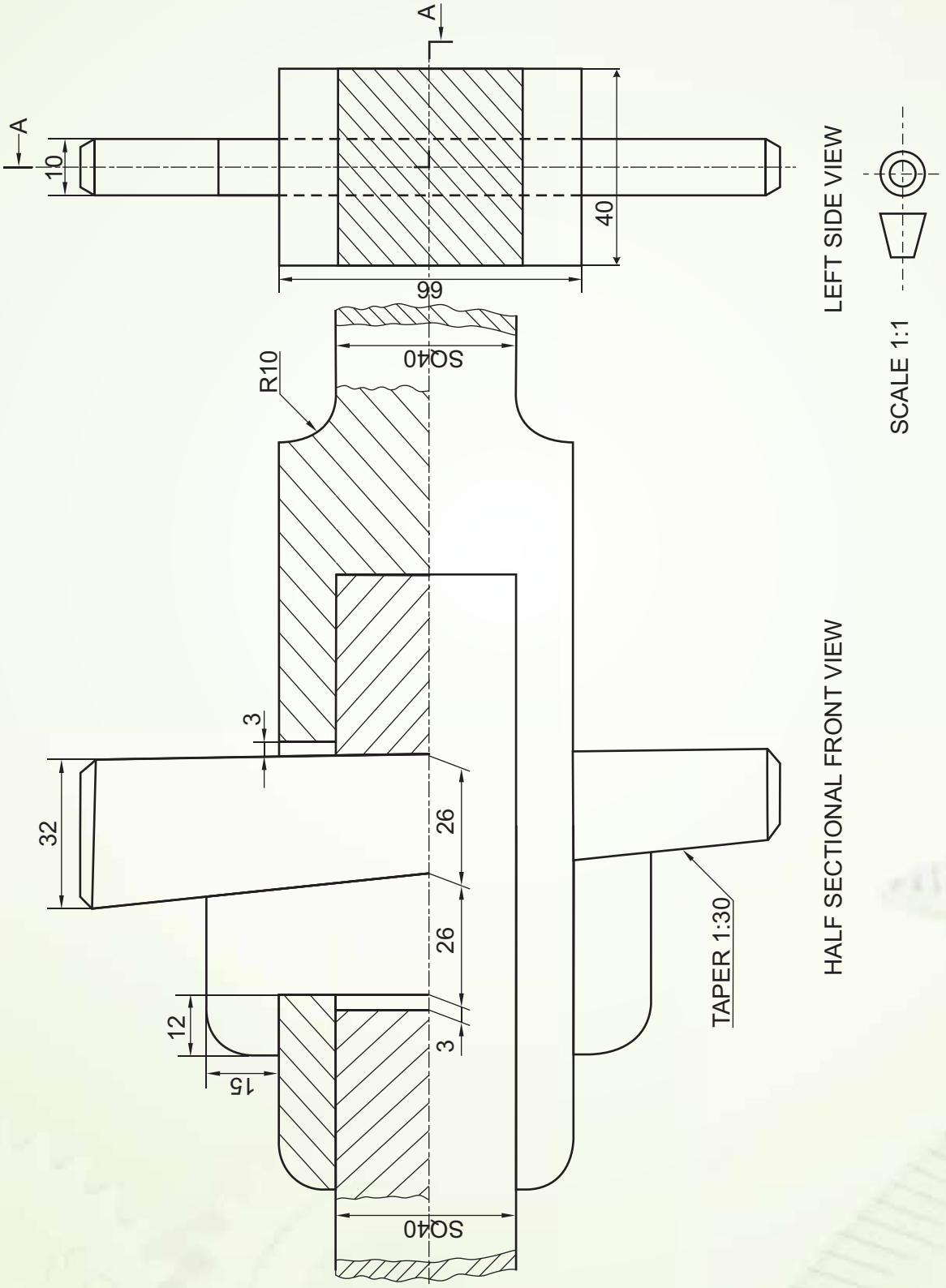
(c) Print title, scale used and draw the projection symbol. Give '6' important dimensions.



DETAILS OF A GIB AND COTTER JOINT

FIG: 4.29

Answer of fig 4.29



ASSEMBLY OF A GIB AND COTTER

FIG: 4.30

Exercise: The two views of a Gib and Cotter Joint are given. Disassemble the parts as give below: Fig : 4.31

(a) FORK END

(i) Front view upper half in section and top view without section.

(b) EYE END

(i) Front lower half in section and top view.

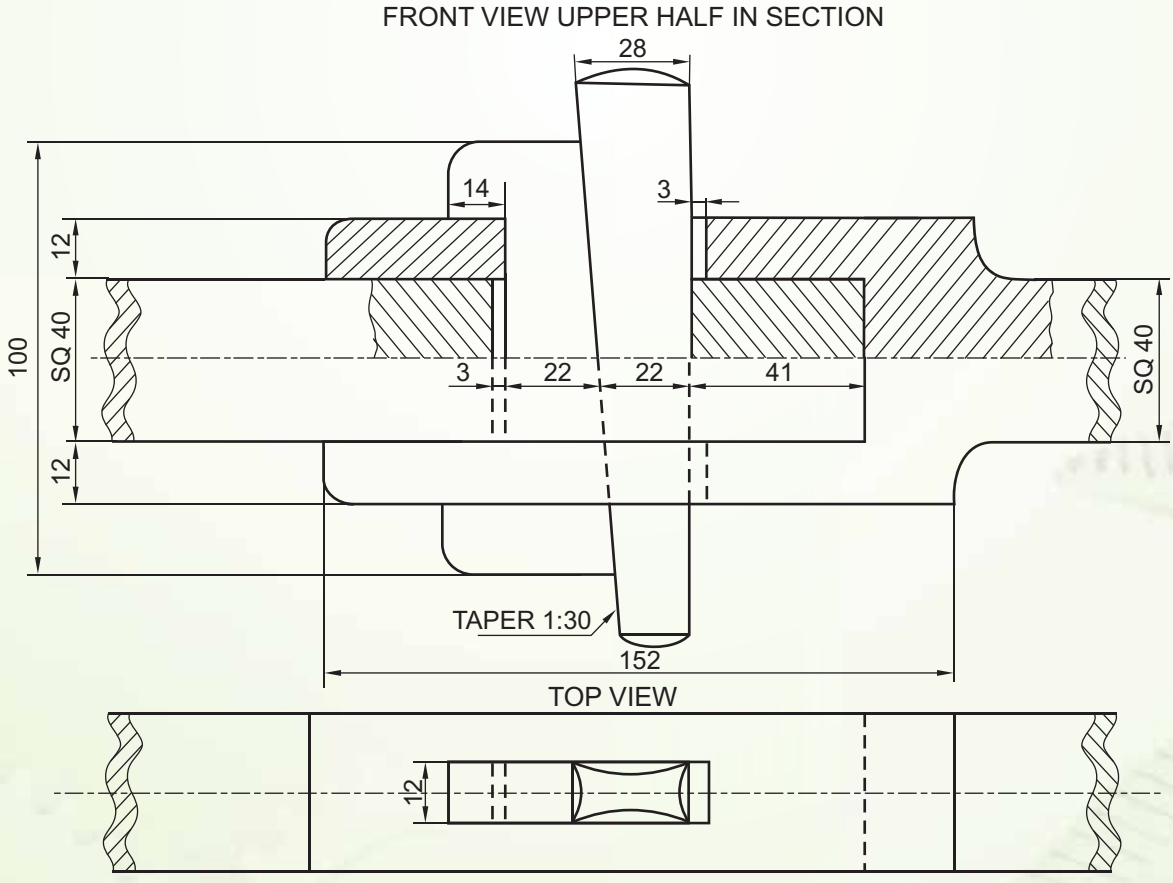
(c) GIB

(i) Front view and top view

(d) COTTER

(i) Front and top view.

Print headings of the above views and scale used. Draw projection symbol. Give six important dimensions.



GIB AND COTTER JOINT

Fig 4.31

Exercises

Q.1. What is cotter?

Q.2. What are dimensions of a cotter in terms of the diameter of the shafts to be joined?

Q.3. Why clearance is necessary in a cotter joint?

Q.4. What do you understand by the self locking of the cotter?

Q.5. Why a Gib is used along with a cotter in a Gib and cotter joint?

Q.6. Where knuckle joint is used?