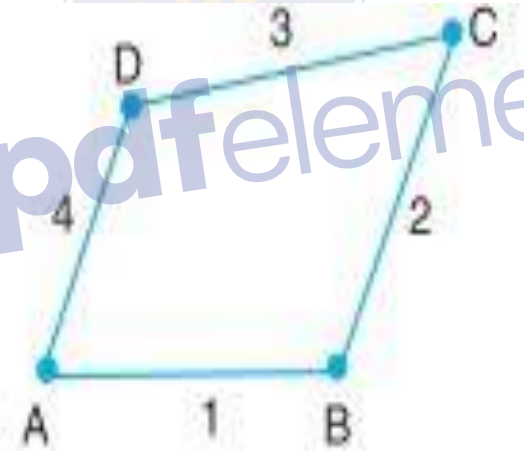
Types of Joints in a Chain

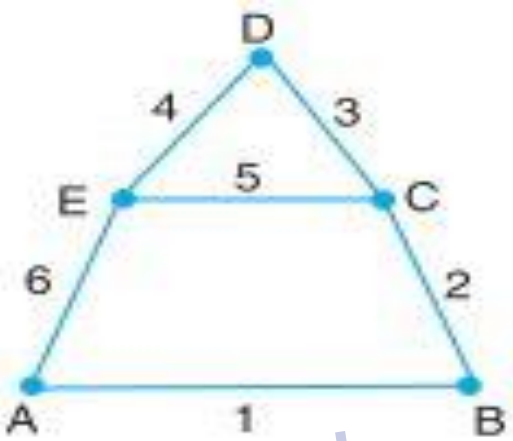
:1. Binary joint.

When two links are joined at the same connection, the joint is known as binary joint. For example, a chain as shown in Fig, has four links and four binary joins at A, B, C and D.



2. Ternary joint.

When three links are joined at the same connection, the joint is known as ternary joint. It is equivalent to two binary joints as one of the three links joined carry the pin for the other two links

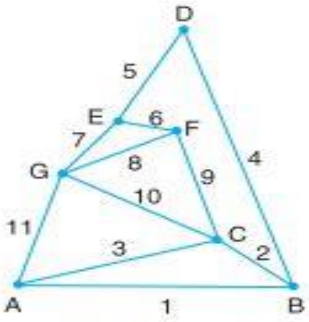


3. Quaternary joint.

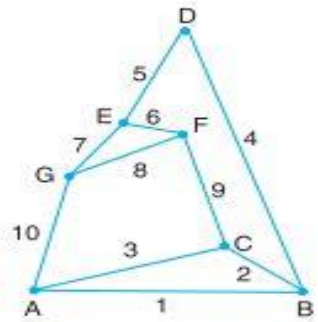
When four links are joined at the same connection, the joint is called a quaternary joint.

It is equivalent to three binary joints.

In general, when l number of links are joined at the same connection, the joint is equivalent to (l – 1) binary joints.



(*a*) Looked chain having binary, ternary and quaternary joints.



(*b*) Kinematic chain having binary and ternary joints.

Mechanism

When one of the links of a kinematic chain is fixed, the chain is known as mechanism.

•It may be used for transmitting or transforming motion e.g. engine indicators, typewriter etc.

•The differential of an automobile requires that the angular velocity of two elements be fixed in order to know the velocity of the remaining elements.

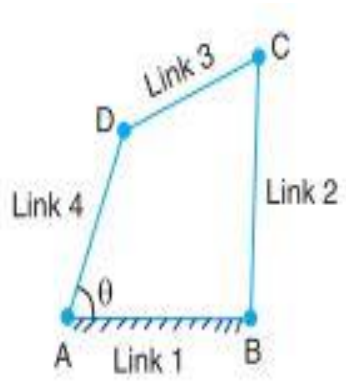
•The differential mechanism is thus said to have two degrees of freedom. Many computing mechanisms have two or more degrees of freedom.

•A mechanism with four links is known as simple mechanism, and the mechanism with more than four links is known as compound mechanism. When a mechanism is required to transmit power or to do some particular type of work, it then becomes a machine. In such cases, the various links or elements have to be designed to withstand the forces (both static and kinetic) safely

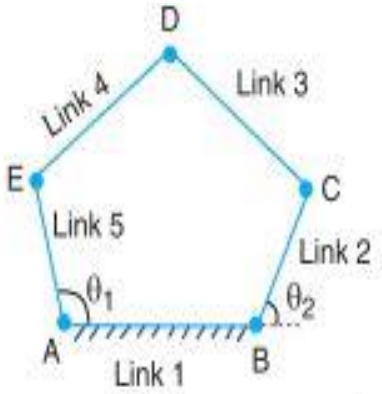
Number of Degrees of Freedom for Plane Mechanisms

•In the design or analysis of a mechanism, one of the most important concern is the number of degrees of freedom (also called movability) of the mechanism.

•It is defined as the number of input parameters (usually pair variables) which must be independently controlled in order to bring the mechanism into a useful engineering purpose.



(a) Four bar chain.



(b) Five bar chain.

•It is possible to determine the number of degrees of freedom of a mechanism directly from the number of links and the number and types of joints which it includes.

Grubler's Criterion for Plane Mechanisms

The Grubler's criterion applies to mechanisms with only single degree of freedom joints where the overall movability of the mechanism is unity. Substituting n = 1 and h = 0 in Kutzbach equation, we have $1 = 3 (l – 1) – 2 j$ or $3l – 2j – 4 = 0$ This equation is known as the Grubler's criterion for plane mechanisms with constrained motion.

a plane mechanism with a movability of 1 and only single degree of freedom joints can not have odd number of links. The simplest possible machanisms of this type are a four bar mechanism and a slider-crank mechanism in which l = 4 and j = 4.

Inversion of Mechanism

when one of links is fixed in a kinematic chain, it is called a mechanism. So we can obtain as many mechanisms as the number of links in a kinematic chain by fixing, in turn, different links in a kinematic chain. This method of obtaining different mechanisms by fixing different links in a kinematic chain, is known as inversion of the mechanism.

Types of Kinematic Chains

1. Four bar chain or quadric cyclic chain,
2. Single slider crank chain, and
3. Double slider crank chain.