

**CODE-436**

**Trade - Fitter**

**Unit II: Basic Fitting**

**CLASS-1**



# Linear Measurement

## Definition:

**Linear measurement is the process of measuring length or distance between two points. It is the most basic form of measurement used in engineering, manufacturing, construction, and daily life.**

## 1. Base Unit of Linear Measurement

- **The base unit of linear measurement in the International System of Units (SI) is the metre (m).**

## 2. Systems of Units of Measurement

There are three main systems of units used for measurement:

### a) Metric System (International System of Units – SI):

**Widely used globally.**

**Based on multiples of 10.**

**Base unit: metre (m)**

| Unit       | Symbol | Equivalent |
|------------|--------|------------|
| Millimetre | mm     | 1/1000 m   |
| Centimetre | cm     | 1/100 m    |
| Decimetre  | dm     | 1/10 m     |
| Metre      | m      | Base unit  |
| Kilometre  | km     | 1000 m     |

**b) Imperial System (British System):**

- **Used mainly in the USA and UK.**
- **Base unit: inch or foot**

| Unit | Symbol | Equivalent          |
|------|--------|---------------------|
| Inch | in     | 1 inch = 25.4 mm    |
| Foot | ft     | 1 foot = 12 inches  |
| Yard | yd     | 1 yard = 3 feet     |
| Mile | mi     | 1 mile = 1760 yards |

### c) CGS System (Centimetre-Gram-Second system):

- An older system used in physics.
- Base unit: centimetre (cm)

### Summary Table



| Measurement    | Metric Unit | Imperial Unit |
|----------------|-------------|---------------|
| Small lengths  | mm, cm      | inch          |
| Medium lengths | m           | foot, yard    |
| Long distances | km          | mile          |

### 3. Multiples and Submultiples of Metre

**The metric system uses prefixes to denote multiples and submultiples of a metre:**

| Name         | Symbol        | Factor    | Value in metres |
|--------------|---------------|-----------|-----------------|
| Kilometre    | km            | $10^3$    | 1000 m          |
| Hectometre   | hm            | $10^2$    | 100 m           |
| Decametre    | dam           | $10^1$    | 10 m            |
| <b>Metre</b> | m             | $10^0$    | 1 m             |
| Decimetre    | dm            | $10^{-1}$ | 0.1 m           |
| Centimetre   | cm            | $10^{-2}$ | 0.01 m          |
| Millimetre   | mm            | $10^{-3}$ | 0.001 m         |
| Micrometre   | $\mu\text{m}$ | $10^{-6}$ | 0.000001 m      |
| Nanometre    | nm            | $10^{-9}$ | 0.000000001 m   |

# Steel Rule

## ✓ Purpose of Steel Rule

**A steel rule is a basic linear measuring instrument used in workshops and mechanical industries to measure length or straight distances with moderate accuracy.**

- **Used to measure up to 0.5 mm or 0.02 inches.**
- **Commonly used in fitting, machining, inspection, and layout work.**
- **Made of hardened and tempered stainless steel for durability and accuracy.**

# Types of Steel Rule

**Steel rules are classified based on length, graduation system, and edge design.**

## **1. Based on Graduation System**

- **Metric Steel Rule – Graduated in millimetres and centimetres (SI units).**
- **Imperial Steel Rule – Graduated in inches and fractions (1/8, 1/16, etc.).**
- **Combination Rule – Has both metric and imperial graduations.**

## **2. Based on Length**

- **Common lengths: 150 mm, 300 mm, 600 mm, 1000 mm, etc.**

## **3. Based on Edge Design**

- **Plain Rule – Straight flat rule with one or two graduated edges.**
- **Narrow Rule – Thin and flexible, used for measuring inside narrow slots.**
- **Hook Rule – Has a hook at one end for better alignment.**
- **Centre Finding Rule – Has zero at the centre; used to find the midpoint.**

## **4. Steel Rule with Sliding Head (Depth Gauge)**

- **Comes with an adjustable sliding head to measure depth or height.**

## **Precautions While Using Steel Rule**

**To ensure accuracy and long life, the following precautions must be observed:**

### **1.Avoid Parallax Error**

**View the scale perpendicularly to avoid incorrect readings.**

### **2.Do Not Use as a Scribber**

**Using the steel rule as a scribe or screwdriver damages edges.**

### **3.Store Properly**

**Keep the steel rule in a case or pouch to avoid bending or rusting.**

### **4.Use Proper Light and Surface**

**Ensure proper lighting and a clean, flat surface while measuring.**

### **5.Do Not Drop**

**Dropping the rule can lead to bent edges and inaccurate readings.**

### **6.Clean Before and After Use**

**Wipe off oil, dirt, or coolant to maintain visibility and prevent corrosion.**

### **7.Do Not Use on Moving Parts**

**Avoid using a steel rule on moving or rotating machinery for safety.**

### **8.Avoid Excessive Force**

**Don't press too hard while aligning or marking.**

# Summary

| Feature     | Description                              |
|-------------|------------------------------------------|
| Purpose     | Basic linear measurement tool            |
| Material    | Hardened stainless steel                 |
| Accuracy    | Moderate (up to 0.5 mm)                  |
| Types       | Plain, Narrow, Hook, Centre-finding      |
| Precautions | Avoid parallax, store safely, keep clean |

# 1. Scriber

## ✓ Features:

- **A sharp-pointed steel tool, usually made of hardened and tempered high-carbon steel.**
- **Available in straight or hooked types.**
- **The tip angle is typically 30°–60°.**

## ✓ Uses:

- **Used to mark straight lines on metal surfaces.**
- **Used with steel rule or try square as a guide.**
- **Gives fine, sharp markings that are visible even after machining.**

## ✓ Types:

- **Straight Scriber – Most commonly used.**
- **Bent or Hook Scriber – Used to mark in narrow or difficult-to-reach places.**
- **Double-Ended Scriber – One straight and one bent tip.**

## **2. Caliper (Marking/Transfer Type)**

### **✓ Features:**

**Made of mild steel or stainless steel.**

**No graduation; not used for measurement but for transferring dimensions.**

### **✓ Uses:**

**Used to transfer internal or external dimensions from a workpiece to another surface for marking.**

### **✓ Types:**

**Outside Caliper – For transferring outer dimensions.**

**Inside Caliper – For transferring internal dimensions (holes, slots).**

**Odd-leg Caliper / Jenny Caliper – One leg pointed (for marking), one leg with a bent end (as a guide on the edge).**

### 3. Punches

#### ✓ Features:

- **Made from high-carbon steel.**
- **Tapered body with a hardened point at one end and flat head at the other for striking.**

#### ✓ Uses:

- **Used to create small indentations on surfaces to guide drilling, prevent slipping of tools, or mark reference points.**

#### ✓ Types:

- **Centre Punch – 60° point, used to mark drill centres.**
- **Dot Punch – 90° point, used to mark light layout points/lines.**
- **Prick Punch – 30°–60° point, for very fine layout lines.**

## 4. Hammer

### ✓ Features:

- **Consists of a head (steel) and handle (wood, fibre, or steel).**
- **The head has a striking face, peen, and eye hole.**

### ✓ Uses:

**Used for striking punches, chisels, adjusting workpieces, or shaping metal.**

### ✓ Types:

- **Ball Peen Hammer – Used for general metalwork.**
- **Cross Peen Hammer – Peen is across the handle; used for riveting and forging.**
- **Straight Peen Hammer – Peen is in line with the handle.**
- **Soft Face Hammer – Has rubber or plastic ends to avoid surface damage.**

## 5. "V" Block

### ✓ Features:

**Block-shaped tool with a central "V" groove (usually at 90°).**

**Made from cast iron or hardened steel.**

**May include clamps to hold cylindrical parts.**

### ✓ Uses:

**Used to hold round jobs during marking, drilling, grinding, or inspection.**

**Helps to maintain proper alignment.**

**Ensures stability for marking on cylindrical workpieces.**

# Summary Table

| Instrument     | Material             | Key Use                        | Types                            |
|----------------|----------------------|--------------------------------|----------------------------------|
| <b>Scriber</b> | High-carbon steel    | Marking lines on metal         | Straight, Bent, Double-ended     |
| <b>Caliper</b> | Mild/Stainless steel | Transferring dimensions        | Inside, Outside, Odd-leg (Jenny) |
| <b>Punches</b> | High-carbon steel    | Indenting for marking/drilling | Centre, Dot, Prick               |
| <b>Hammer</b>  | Steel (head)         | Striking, shaping              | Ball Peen, Cross Peen, Soft Face |
| <b>V-Block</b> | Cast iron/Steel      | Holding round work for marking | With or without clamp            |

## **6. Try Square**

### **Purpose:**

**Used to check and mark 90° angles on metal or wood.**

### **Parts:**

- **Blade: Flat steel rule**
- **Stock: Thick base, usually made of steel or cast iron**

### **Applications:**

**Checking squareness of components**

**Marking perpendicular lines on workpieces**

### **Example Use:**

**Place the stock along the edge of the workpiece and mark along the blade.**

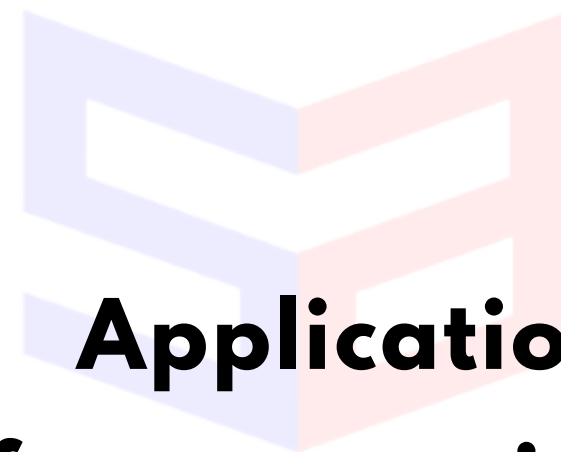
## **7. Bevel Gauge (or Sliding T-Bevel)**

### **Purpose:**

**Used to transfer and measure angles other than 90°.**

### **Parts:**

- **Handle (stock)**
- **Adjustable blade**
- **Locking screw**



### **Applications:**

- **Transferring angles from one piece to another**
- **Useful in fitting and pattern making**

### **Example Use:**

**Set it against an existing angle, lock it, and mark the same on another piece.**

## **8.Bevel Protractor**

### **Purpose:**

**Used for measuring and laying out angles with high accuracy (0–360°).**

### **Parts:**

- **Protractor head with a scale**
- **Adjustable blade**
- **Vernier scale (in some models for precise reading)**

### **Applications:**

- **Angle inspection**
- **Layout in fabrication and machining**

### **Accuracy:**

**Can read angles up to 5 minutes or  $1/12^\circ$  with Vernier.**

## 9. Combination Set

**A multipurpose tool combining three main heads:**

### **a) Square Head:**

- **Used like a Try Square (90° and 45° angles)**
- **Has spirit level and scribe**

### **b) Protractor Head:**

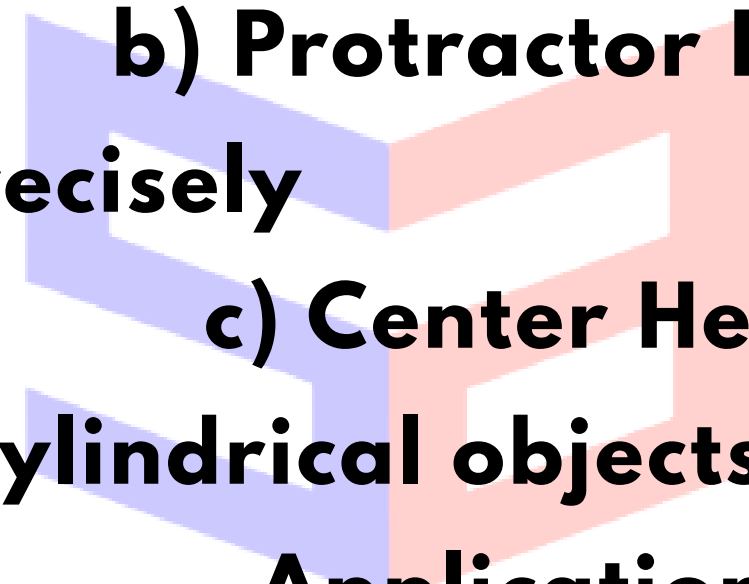
- **Measures angles precisely**

### **c) Center Head:**

- **Locates centers of cylindrical objects**

### **Applications:**

- **Checking angles**
- **Measuring depth**
- **Marking centers and midpoints**



## 10.Surface Gauge

### Purpose:

**Used to mark lines parallel to a reference surface and check alignment.**

### Parts:

- Heavy base (often with V-slot for cylindrical jobs)
- Vertical spindle
- Scriber arm
- Fine adjustment screw

### Applications:

- Transferring measurements
- Checking flatness and alignment
- Used with surface plate for layout marking



## 11.Surface Plate

### Purpose:

- Provides a reference flat surface for inspection and marking.

### Material:

- Cast iron
- Granite (for higher accuracy)

### Applications:

- Base for scribing lines
- Accuracy reference for checking flatness and straightness
- Used in conjunction with surface gauge, dial indicator
- Note: Must be handled carefully to avoid damage to its flatness.

## 12.Angle Plate

### Purpose:

**Used to hold workpieces at 90° angle during marking, inspection, or machining.**

### Material:

**Cast iron or steel with precision-machined faces.**

### Types:

- **Plain angle plate**
- **Slotted angle plate (for clamping)**

### Applications:

- **Holding jobs vertical on surface plates**
- **Holding parts on machine tables**
- **Ensures accurate right-angle positioning**

Summary Table

| Tool             | Primary Use         | Special Feature                |
|------------------|---------------------|--------------------------------|
| Try Square       | Check 90°           | Simple L-shape                 |
| Bevel Gauge      | Transfer angles     | Adjustable blade               |
| Bevel Protractor | Measure angles      | High precision, with vernier   |
| Combination Set  | 90°, angle, center  | 3 tools in 1                   |
| Surface Gauge    | Mark lines parallel | With fine adjustment           |
| Surface Plate    | Reference surface   | Very flat, used for inspection |
| Angle Plate      | Hold jobs at 90°    | L-shaped, heavy duty           |

## Types of Marking Tools & Their Uses



Marking Table



Surface Gauge



Odd Leg Caliper



Divider



Mortise Gauge



Centre Punch



"V" Block



Bevel Square



Parallels



Pencil



Trammel



Try Square



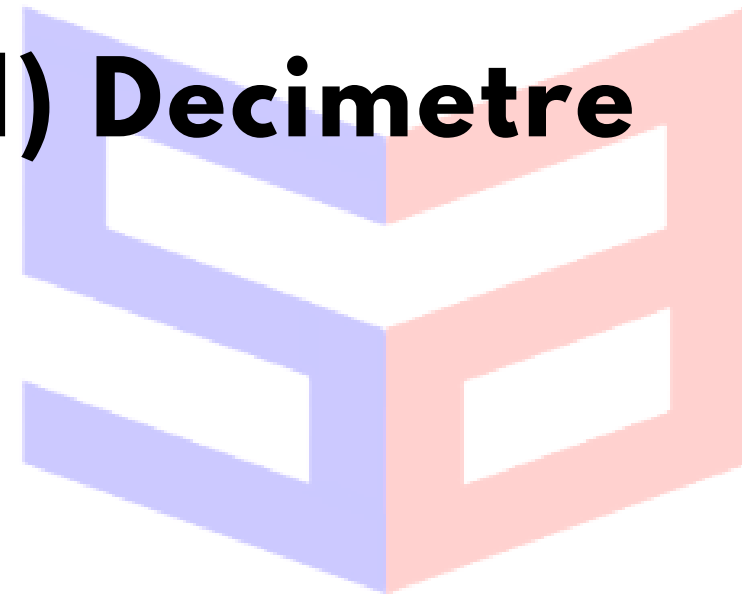
Prick Punch



Scriber

**1. Which of the following units is the largest?**

- a) Decametre**
- b) Centimetre**
- c) Millimetre**
- d) Decimetre**



**2. Which system uses the centimetre as a base unit?**

**a) MKS**

**b) SI**

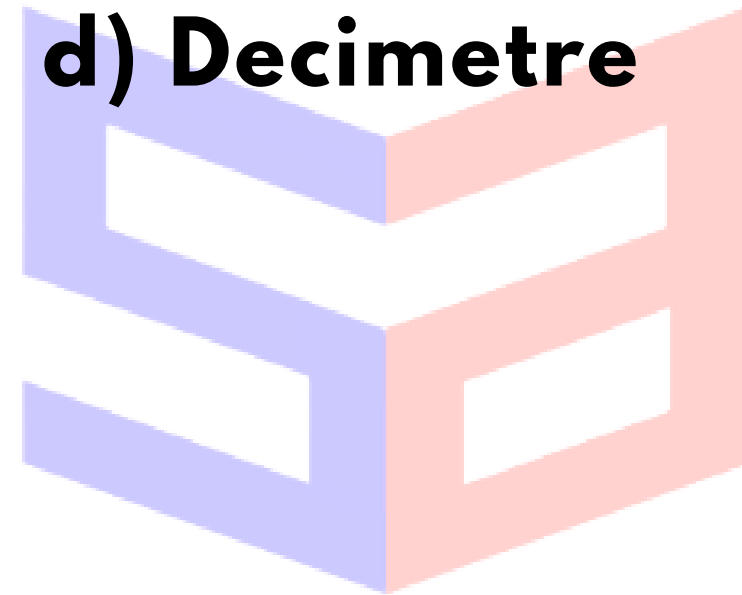
**c) CGS**

**d) FPS**



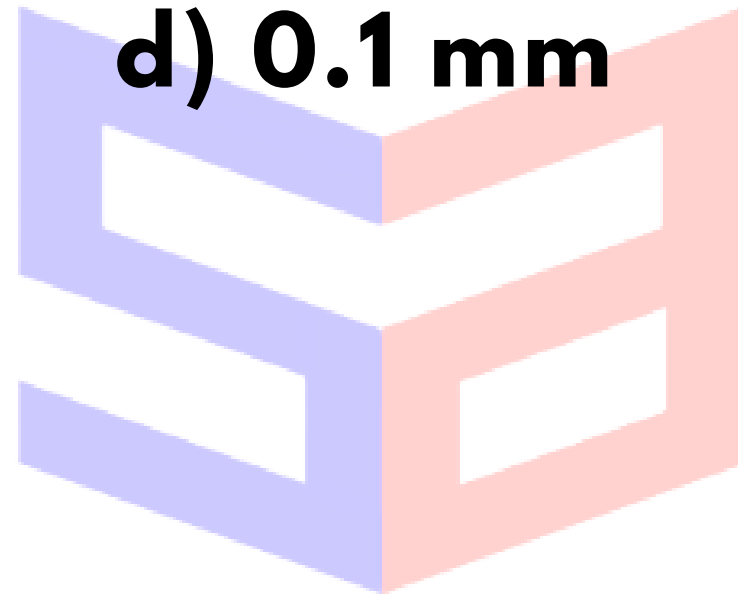
**3. Which of the following is NOT a unit of length in the metric system?**

- a) Inch**
- b) Kilometre**
- c) Centimetre**
- d) Decimetre**



**4. Which of the following is the least count of a steel rule?**

- a) 1 mm**
- b) 0.5 mm**
- c) 0.01 mm**
- d) 0.1 mm**



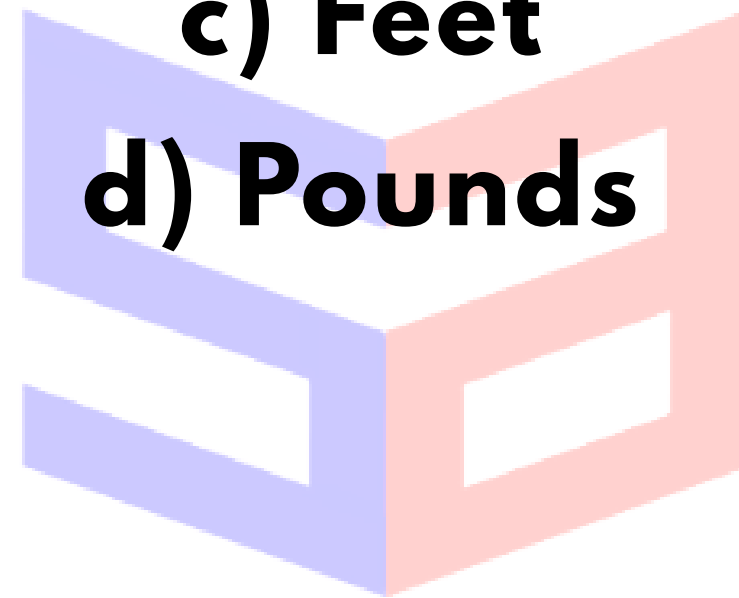
**5.What is the unit used in a metric steel rule?**

**a) Inches**

**b) Millimetres**

**c) Feet**

**d) Pounds**



**6.What should be avoided to prevent parallax error when using a steel rule?**

- a) Looking from the side**
- b) Looking from above**
- c) Using gloves**
- d) Measuring in light**



## **6.What should be done before and after using a steel rule?**

- a) Wash with soap**
- b) Sharpen it**
- c) Clean and wipe it**
- d) Polish it with oil**



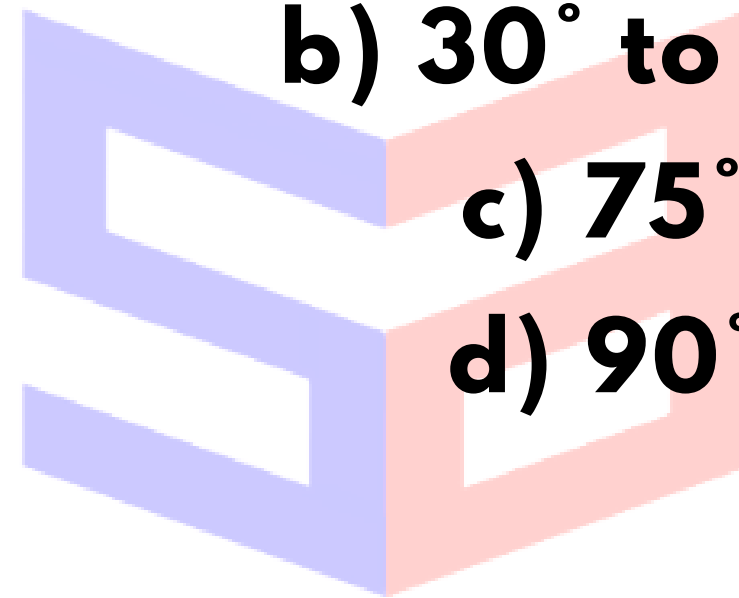
**7. What is the typical angle of a scribe point?**

**a)  $15^\circ$**

**b)  $30^\circ$  to  $60^\circ$**

**c)  $75^\circ$**

**d)  $90^\circ$**



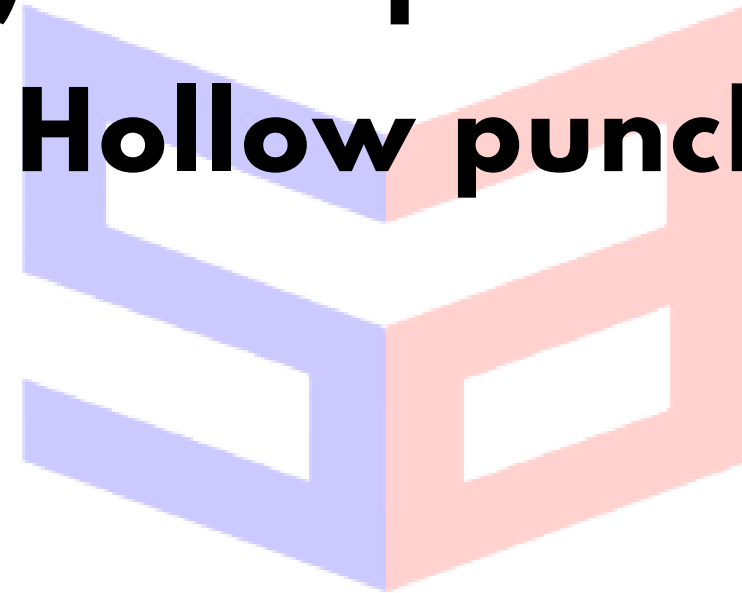
**8. Which type of caliper is used to measure internal diameters?**

- a) Outside caliper**
- b) Jenny caliper**
- c) Inside caliper**
- d) Hook caliper**



**9. Which punch is used for marking drill hole centres?**

- a) Dot punch**
- b) Centre punch**
- c) Prick punch**
- d) Hollow punch**



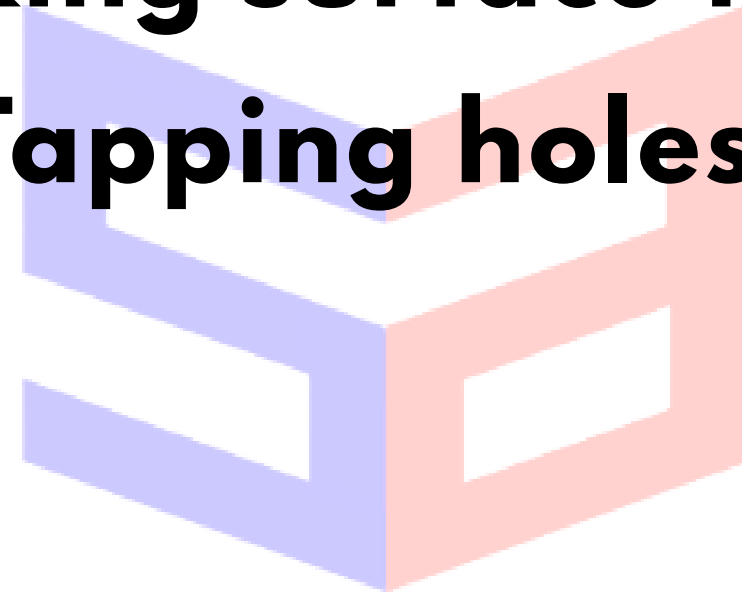
**10. Which hammer is commonly used in metal work?**

- a) Mallet**
- b) Ball peen hammer**
- c) Wooden hammer**
- d) Claw hammer**



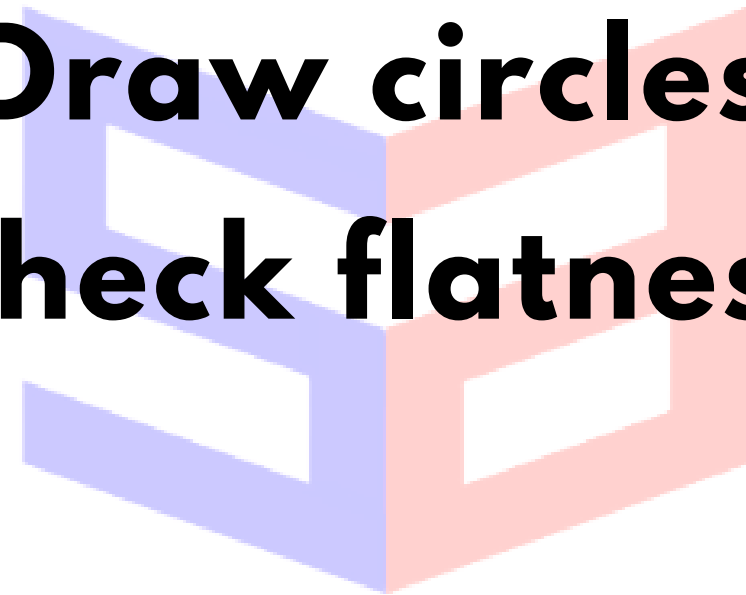
**11.What is the primary purpose of a V-block?**

- a) Measuring threads**
- b) Holding cylindrical jobs**
- c) Checking surface finish**
- d) Tapping holes**



**12. Bevel gauge is used to:**

- A) Measure only  $90^\circ$**
- B) Transfer or copy angles**
- C) Draw circles**
- D) Check flatness**



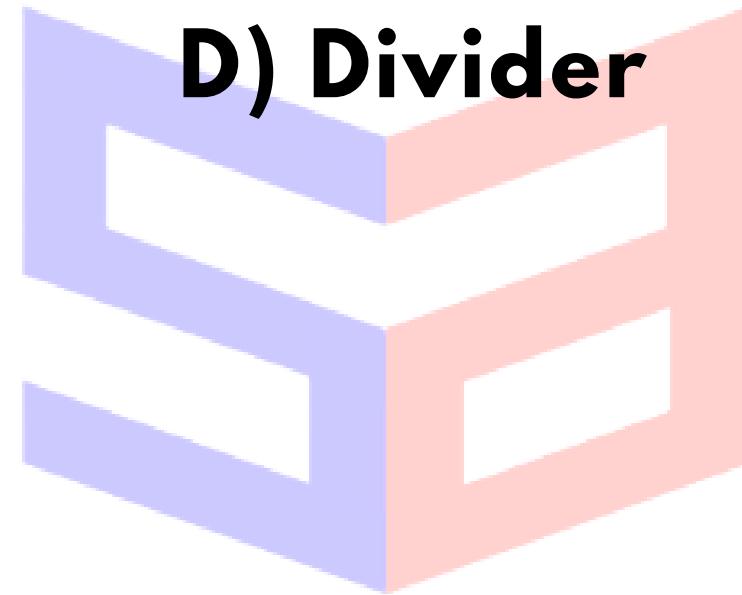
**13. Which of the following tools can measure angles up to  $360^\circ$ ?**

- A) Try Square**
- B) Protractor**
- C) Vernier caliper**
- D) Spirit level**



**14. Which tool ensures precise marking using a scribe and fine adjustment?**

- A) Surface gauge**
- B) Try square**
- C) Vernier caliper**
- D) Divider**



**15. The main use of a surface gauge is:**

- A) Drawing arcs**
- B) Punching holes**
- C) Scribing parallel lines**
- D) Thread cutting**



*Thank*  
*You*

