



ERRORS IN MEASUREMENT



Dynamic Characteristics of Instruments



CONTENT-CLASS-6



**Review Answers
for worksheet-5**

**Errors in
Measurement**

**Video Show-
World's funniest
Engineering Fails**

**Group Discussion
Errors in Human
Life**

Summary

Worksheet-6



TYPES OF ERRORS



- **No matter how carefully the measurements are taken**
- **No matter how accurate the instruments that are used**
- **Some error will always be present**

- 1. Gross Errors**
- 2. Systematic Errors**
- 3. Random Errors**



A. GROSS ERRORS



- ❖ Human mistakes in reading or using instruments and in recording and calculating measured values.
- ❖ Complete elimination is not possible.

How to reduce?

- ❖ Greater care required
- ❖ Multiple reading by multiple experimenters



B. SYSTEMATIC ERRORS



1. Instrumental Errors

- **Inherent short comings of instruments**
- **Misuse of instruments**
- **Loading effects**

2. Environmental Errors

3. Observational Errors



1. INSTRUMENTAL ERROR



Inherent shortcomings

- Because of mechanical structure of instruments
- Due to construction or operation
- Read too low or too high

Example :

- Spring in Permanent magnet instrument



INSTRUMENTAL ERROR



Misuse of instruments

- Due to the fault of the operator
- Good instrument used in unintelligent way

Example :

- Failure to adjust zero
- Poor initial adjustment
- Using leads of too high resistance



INSTRUMENTAL ERROR



Loading effects

Example:

- A well calibrated voltmeter may give a misleading voltage reading when connected across a high resistance circuit.
- When connected in a low resistance circuit, may give a more dependable reading.
- Alters the actual circuit conditions by measurement process.



VIDEO SHOW



World's funniest Engineering Fails

<https://www.youtube.com/watch?v=qPhVZExcGXg>



2. ENVIRONMENTAL ERROR



Due to the effects of

- Temperature
- Humidity
- Dust
- Vibrations
- External magnetic or electrostatic fields

Overcome by

- Shielding
- Temp. controlled enclosure
- Sealing the instruments
- Applying Computed corrections



3. OBSERVATIONAL ERROR



Due to the effects of

- Observer's physical response
- Plane of pointer and scale
- Parallax error
- Observation by observer

Overcome by

- Using digital displays



3. RANDOM ERRORS



1. Rounding Error

- Occurs when reading is rounded up or down to the nearest value.

2. Periodic Error

- When analog meters swings or fluctuates

3. Limiting Error

- Percentage Error
- Relative Limiting Error



limiting error = accuracy \times full-scale value.

On the other hand, the percentage error of the actual meter reading is computed from

$$\text{Percentage error} = \frac{\text{maximum error}}{\text{scale reading}} \times 100\%$$

Actual value of the quantity $A_a = \text{nominal value } A_s \pm \text{limiting error } \delta A$

$$\text{i.e., } A_a = A_s \pm \delta A \quad \dots (1.37)$$

- **Relative (fractional) limiting error**

The relative (fractional) limiting error is defined as the ratio of the limiting error to the nominal (specified) magnitude of a quantity.

$$\therefore \text{Relative limiting error } E_r = \frac{\delta A}{A_s}. \text{ Also } \delta A = A_a - A_s$$

$$\therefore E_r = \frac{A_a - A_s}{A_s} \quad \dots (1.38)$$

$$\text{i.e., Relative limiting error} = \frac{\text{Actual value} - \text{nominal value}}{\text{nominal value}}$$



GROUP DISCUSSION



ERRORS IN HUMAN LIFE



SUMMARY

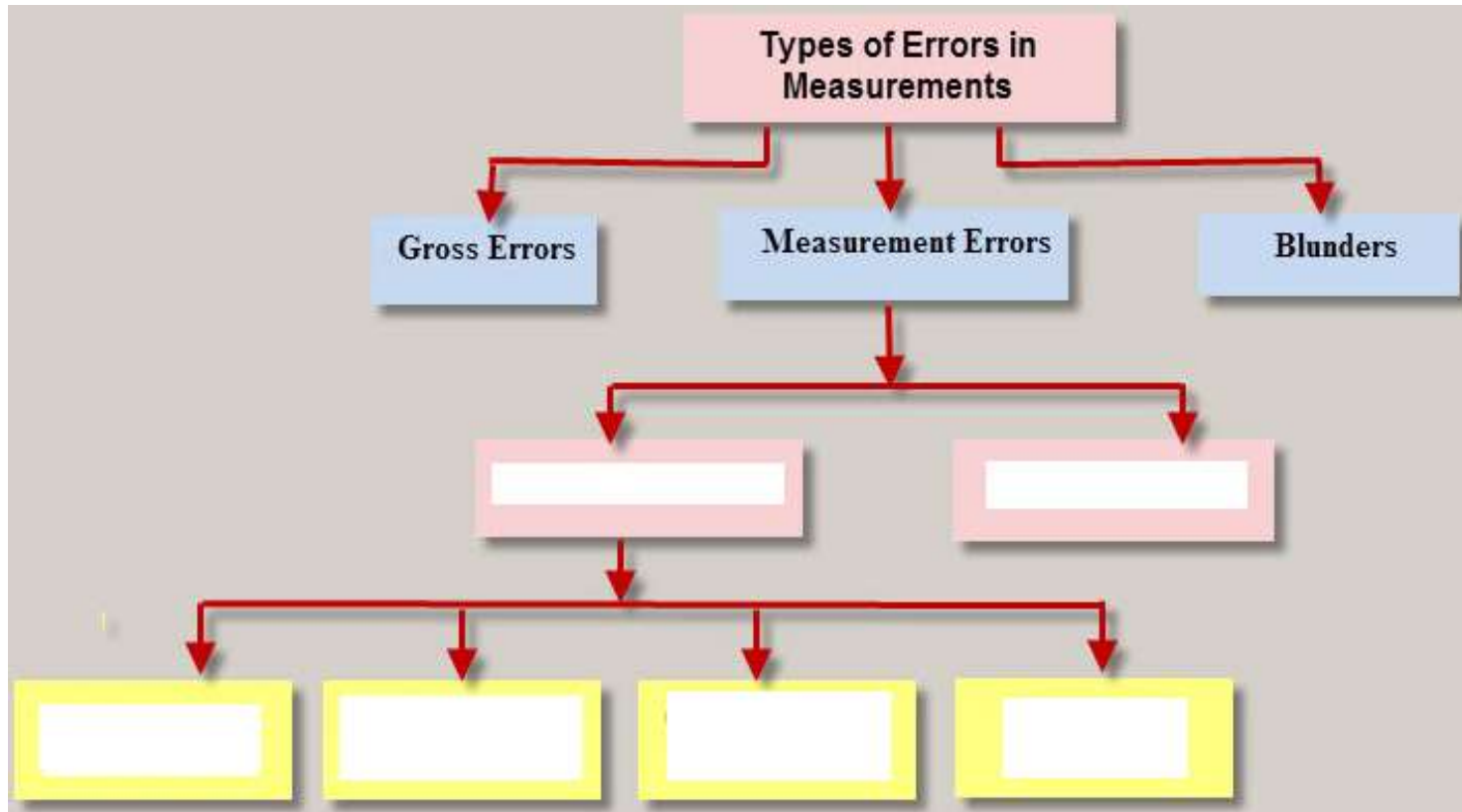


STUDENT'S CORNER



Work sheet

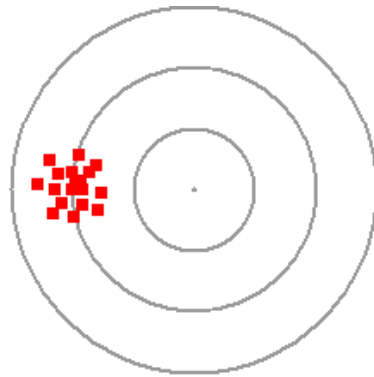
1. Fill in the blanks

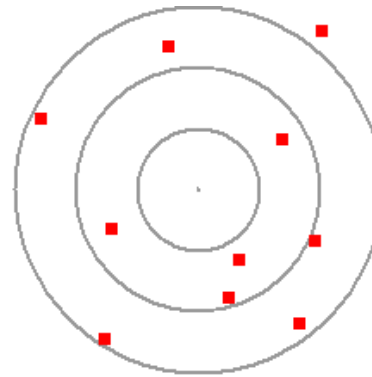




Work sheet

2. Name the errors.







THANK YOU