



**Class: 9th**

**Subject: Physics**

**Chapter 1: Physical Quantities and**



**Measurements**

**Exercise MCQs:**

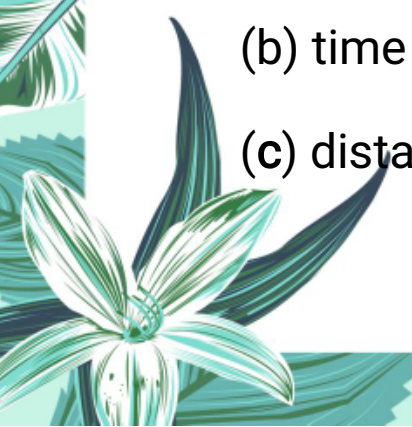
1.1. The instrument most suitable for measuring the thickness of a few sheets of cardboard is a:

- (a) metre rule
- (b) measuring tape
- (c) Vernier Callipers
- (d) micrometer screw gauge

1.3. A lightyear is a unit of:

- (a) light
- (b) time
- (c) distance

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(d) speed


**1.4. Which one is a non-physical quantity?**

(a) distance

(b) density

(c) colour

(d) temperature



**1.5. When using a measuring cylinder, one precaution to take is to:**

(a) check for the zero error

(b) look at the meniscus from below the level of the water surface

(c) take several readings by looking from more than one direction

(d) position the eye in line with the bottom of the meniscus

**1.6. Volume of water consumed by you per day is estimated in:**

(a) millilitre

(b) litre





(c) kilogram

(d) cubic metre


**1.7. A displacement can is used to measure:**

(a) mass of a liquid

(b) mass of a solid

(c) volume of a liquid

(d) volume of a solid



**1.8. Two rods with lengths 12.321 cm and 10.3 cm are placed side by side, the difference in their lengths is:**

(a) 2.02 cm



(b) 2.0 cm

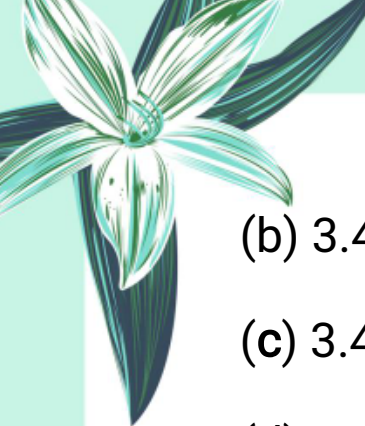
(c) 2 cm

(d) 2.021 cm

**1.9. Four students measure the diameter of a cylinder with Vernier Callipers. Which of the following readings is correct?**

(a) 3.4 cm





(b) 3.475 cm

(c) 3.47 cm

(d) 3.5 cm

1.10. Which of the following measures are likely to represent the thickness of a sheet of this book?



(a)  $6 \times 10^{-25}$  m

(b)  $1 \times 10^{-4}$  m

(c)  $1.2 \times 10^{-15}$  m

(d)  $4 \times 10^{-2}$  m

1.11. In Vernier Callipers, ten smallest divisions of the Vernier scale are equal to nine smallest divisions of the main scale. If the smallest division of the main scale is half millimetre, the Vernier constant is equal to:

(a) 0.5 mm

(b) 0.1 mm

(c) 0.05 mm


(d) 0.001 mm






## Important MCQs:

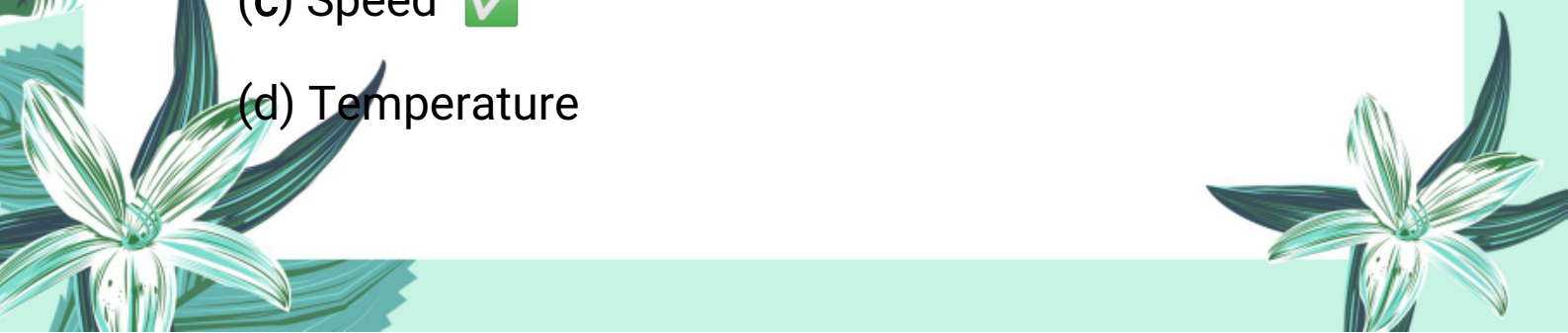
1. Which of the following can be measured using an instrument?

- 
- (a) Fear
  - (b) Affection
  - (c) Time
  - (d) Wisdom

2. Which quantity is considered a base physical quantity?

- 
- (a) Volume
  - (b) Mass
  - (c) Speed
  - (d) Density


3. Which one is a derived physical quantity?

- 
- (a) Length
  - (b) Time
  - (c) Speed
  - (d) Temperature



4. A non-physical quantity is mainly used to:

- (a) Perform experiments
- (b) Understand human behavior
- (c) Measure physical changes
- (d) Record temperatures



5. What is the standard method to express a measurement?

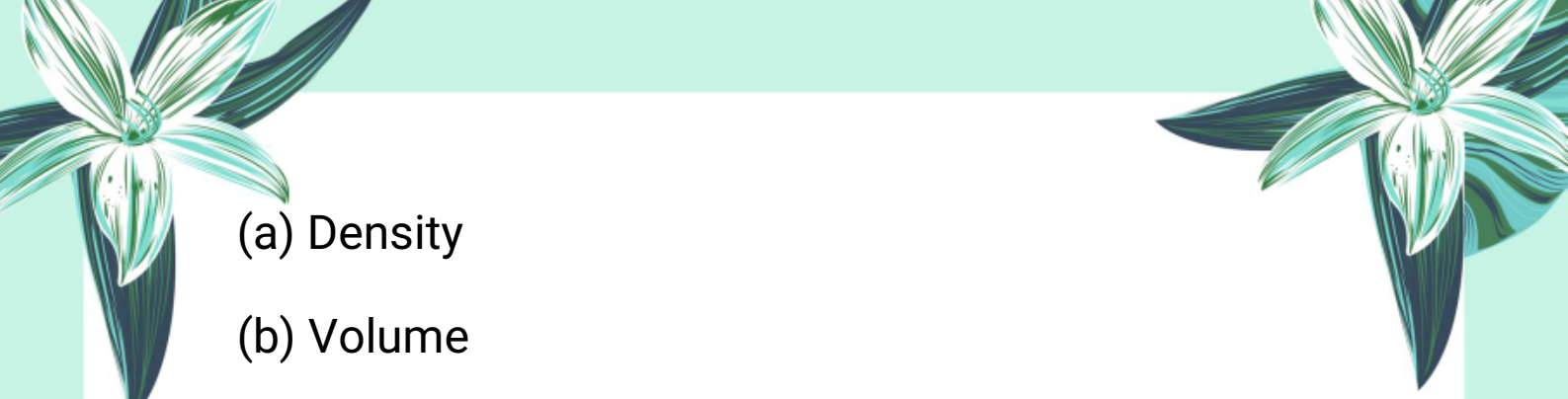
- (a) Unit only
- (b) Number only
- (c) Opinion-based
- (d) Number with unit

6. Physical quantities are the foundation of:

- (a) Biology
- (b) Chemistry
- (c) Psychology
- (d) Physics

7. Which of the following is NOT a physical quantity?



- 
- (a) Density
  - (b) Volume
  - (c) Love
  - (d) Temperature



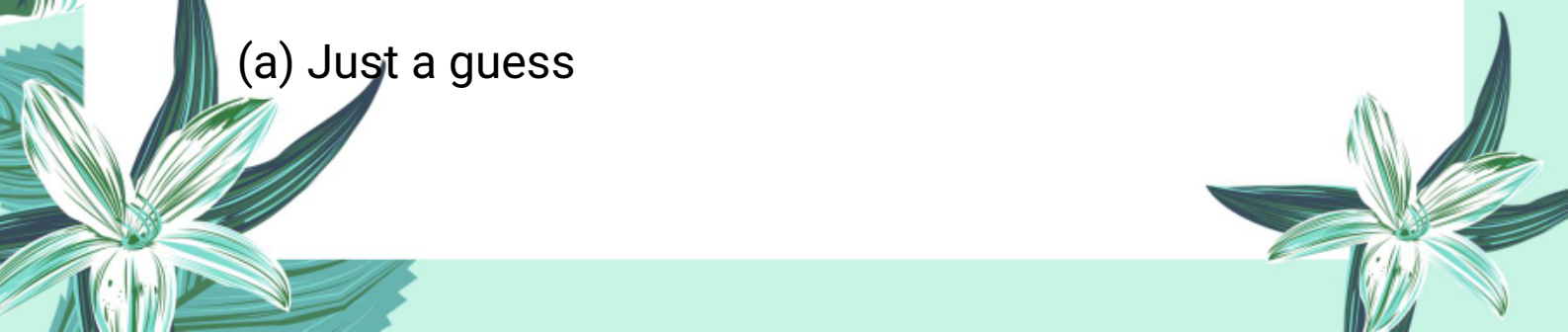
**8. What is the purpose of using standard units?**

- (a) To increase confusion
- (b) To make local trade easier
- (c) To compare results internationally
- (d) To make measurements longer

**9. Which instrument is used to measure temperature?**

- (a) Stopwatch
- (b) Ruler
- (c) Thermometer
- (d) Balance

**10. The number and unit in a measurement represent:**

- (a) Just a guess
- 

(b) Quantity and its standard

(c) Opinion and idea

(d) Survey and feedback

**11. How many base units are there in the SI system?**

(a) 5

(b) 6

(c) 7

(d) 8

**12. What does SI stand for?**

(a) Standard Input

(b) Systematic International

(c) Scientific Integration

(d) International System

**13. Which of the following is a derived unit?**

(a) Kilogram

(b) Second

(c) Speed



(d) Mole

**14. What is the SI derived unit for area?**

(a) m

(b)  $m^2$

(c)  $m^3$

(d) m/s

**15. Which of these is an example of a SI prefix?**

(a) Inch

(b) Gram

(c) Milli

(d) Pound

**16. The prefix 'kilo' represents which power of 10?**

(a)  $10^2$

(b)  $10^3$

(c)  $10^6$

(d)  $10^{-3}$

**17. What is the scientific notation for 0.00004 m?**

(a)  $4 \times 10^4$

(b)  $4 \times 10^{-5}$  ✓

(c)  $0.4 \times 10^{-3}$

(d)  $40 \times 10^{-6}$

18. Which instrument is used to measure the length of a small object with more accuracy than a ruler?

(a) Meter rod

(b) Vernier Callipers ✓

(c) Stopwatch

(d) Spring balance

19. What is the least count of a metre rule?

(a) 1 cm

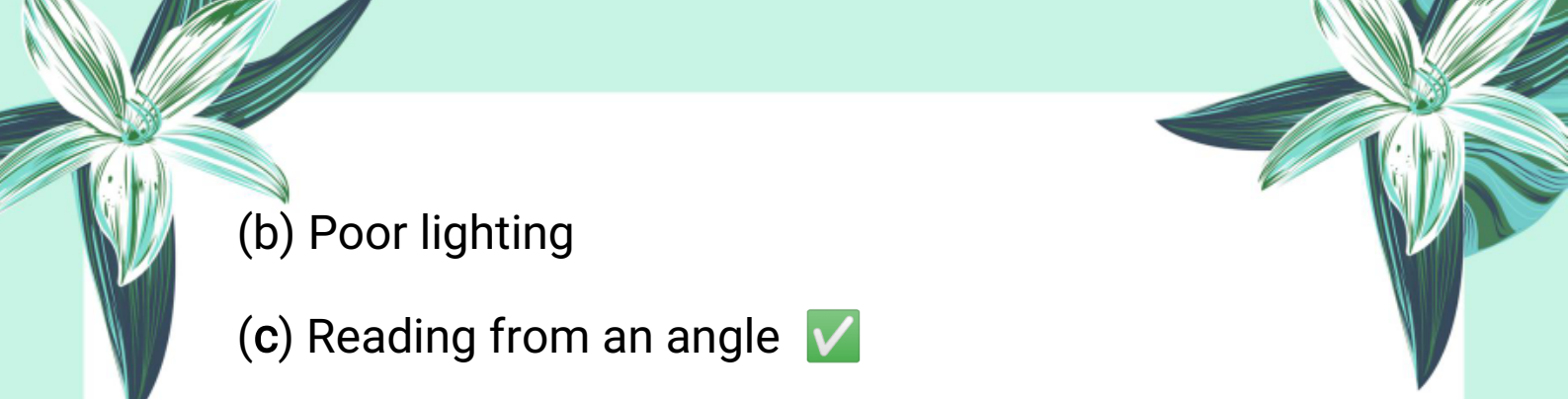
(b) 0.1 mm

(c) 1 mm ✓


(d) 0.01 mm

20. What causes parallax error while using a meter rule?


(a) Faulty scale

- 
- (b) Poor lighting
  - (c) Reading from an angle
  - (d) Wrong units

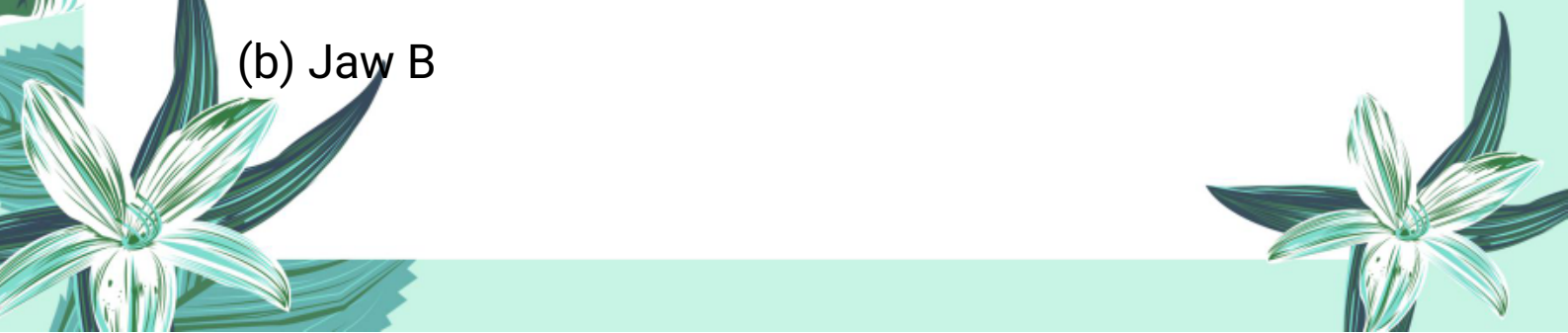
**21. What is the least count of Vernier Callipers?**

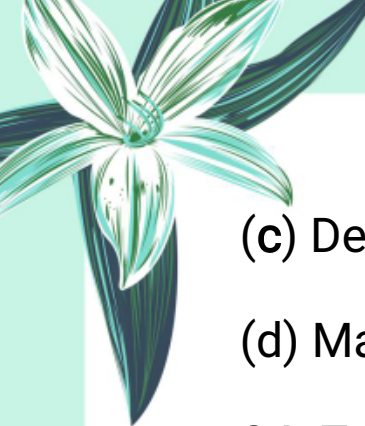
- 
- (a) 0.1 cm
  - (b) 0.5 mm
  - (c) 0.1 mm
  - (d) 1 mm

**22. What is the total number of divisions on the Vernier scale of Vernier Callipers?**

- 
- (a) 9
  - (b) 10
  - (c) 12
  - (d) 15

**23. Which part of Vernier Callipers is used to measure the depth of an object?**

- 
- (a) Jaw A
  - (b) Jaw B




(c) Depth gauge

(d) Main scale

**24. Zero error in Vernier Callipers occurs when:**

(a) The scale is scratched



(b) The zero marks do not coincide when jaws are closed

(c) Battery is low

(d) Vernier scale is missing

**25. Scientific notation helps in:**

(a) Writing opinions

(b) Expressing small or large numbers conveniently



(c) Increasing values

(d) Solving equations

**26. When the zero of the Vernier scale is to the right of the zero of the main scale, the zero error is:**

(a) Positive and must be added to the reading

(b) Positive and must be subtracted from the



reading

(c) Negative and must be added to the reading

(d) Negative and must be subtracted from the reading

**27. How is the zero error calculated in a Vernier caliper?**

(a) By noting the division of the main scale aligned with zero of the Vernier scale

(b) By multiplying the division number of Vernier scale coinciding with main scale by least count

(c) By adding main scale and Vernier scale readings

(d) By subtracting Vernier reading from main scale reading

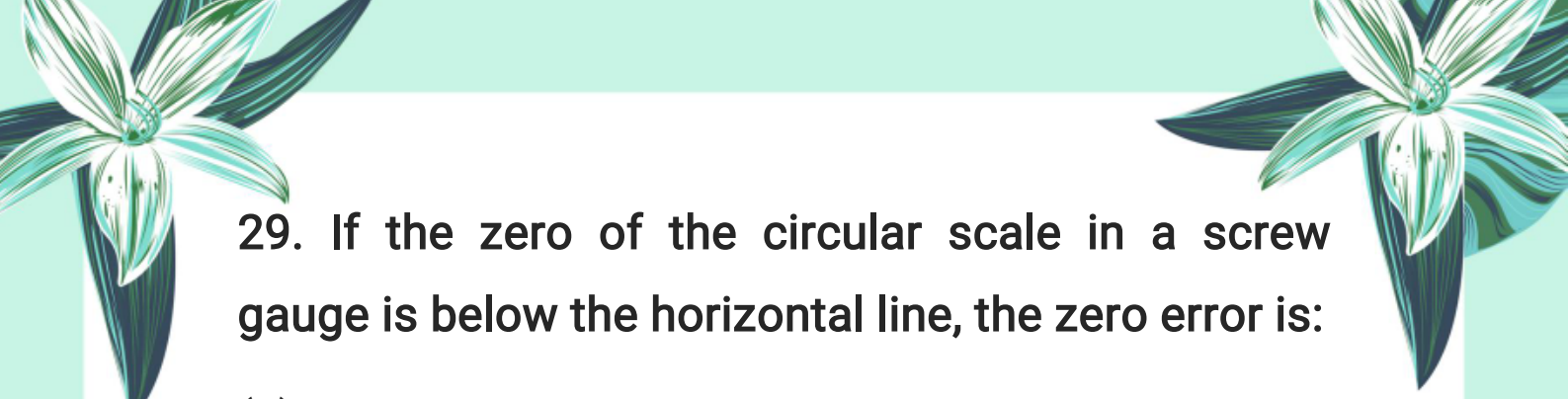
**28. The least count of a screw gauge with pitch 0.5 mm and 50 circular divisions is:**

(a) 0.01 mm

(b) 0.05 mm


(c) 0.1 mm

(d) 0.5 mm



29. If the zero of the circular scale in a screw gauge is below the horizontal line, the zero error is:

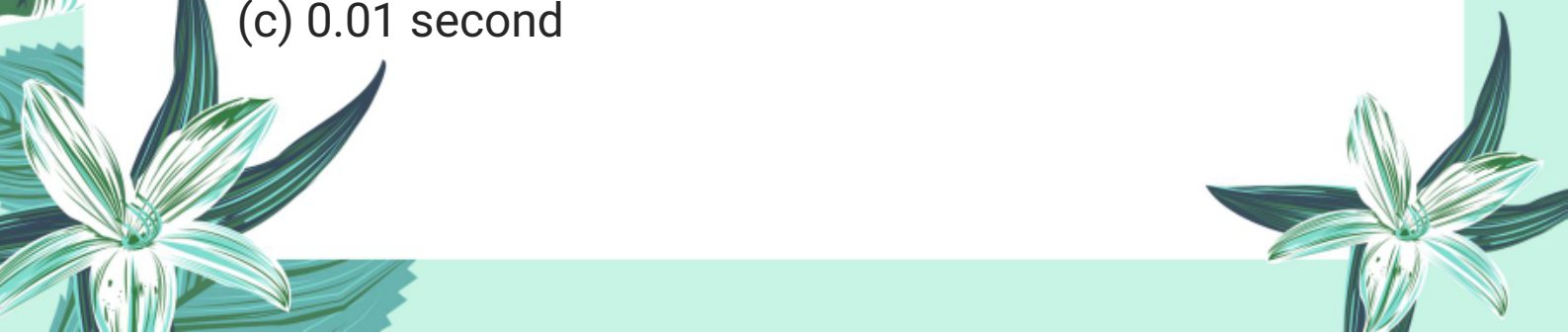
- (a) Negative and added to the reading
- (b) Positive and added to the reading
- (c) Positive and subtracted from the reading
- (d) Negative and subtracted from the reading



30. Which of the following is the correct way to measure mass using a physical balance?

- (a) Place the object on the right pan and adjust weights on the left pan
- (b) Place the object on the left pan and adjust weights on the right pan
- (c) Place object and weights on the same pan
- (d) Use spring balance instead of physical balance

31. The least count of a mechanical stopwatch is:

- (a) 1 second
  - (b) 0.1 second
  - (c) 0.01 second
- 



(d) 10 seconds

**32. What should you do before handling any chemical in the laboratory?**

(a) Smell the chemical directly

(b) Taste a small amount

(c) Check the label on the container carefully

(d) Mix with water

**33. What precaution must be taken when using electrical equipment in the laboratory?**

(a) Use it near water

(b) Tamper with electrical fittings

(c) Avoid working with electricity near water

(d) Use wet hands

**34. When using a screw gauge, if the circular scale zero is above the horizontal line, the zero error is:**

(a) Subtracted from observed reading

(b) Added to observed reading

(c) Ignored





(d) Multiplied by least count


**35. The pitch of a screw gauge is:**

(a) The distance the spindle moves in one complete rotation

(b) Number of divisions on main scale

(c) Number of divisions on circular scale

(d) The thickness of the object measured



**36. What is the correct way to read the volume of liquid in a measuring cylinder?**

(a) Eye above the meniscus level

(b) Eye below the meniscus level

(c) Eye level with the meniscus bottom edge

(d) Eye level with the meniscus top edge

**37. The surface of water in a measuring cylinder is:**

(a) Convex

(b) Flat

(c) Concave

(d) None of these





38. For mercury in a measuring cylinder, the reading is taken at the:

(a) Bottom edge of the meniscus

(b) Top edge of the meniscus

(c) Middle of the meniscus

(d) Any point on the meniscus

39. Which instrument is used to find the volume of irregular solids that do not fit in a measuring cylinder?

(a) Measuring cylinder

(b) Displacement can

(c) Vernier caliper

(d) Screw gauge

40. When a solid body is lowered into a displacement can filled with water, the volume of water displaced is equal to:

(a) Volume of water in the can

(b) Volume of solid body

(c) Volume of water remaining in can

The page features decorative illustrations of white flowers with green leaves in the corners and a blue and white butterfly on the left side. A faint watermark 'StudyNotes360.com' is visible in the center.

(d) None of these

**41. Which type of error is caused by personal mistakes or limitations such as poor observation or reaction time?**

(a) Systematic error

(b) Random error

(c) Human error

(d) Instrumental error

**42. Systematic errors are:**

(a) Random and unpredictable

(b) Consistent and due to faulty calibration

(c) Caused by environmental fluctuations

(d) Caused by operator's reaction time

**43. How can random errors be reduced in measurements?**

(a) By ignoring them

(b) By using only one measurement


(c) By taking multiple measurements and



calculating average

(d) By using faulty instruments

**44. Which of the following is NOT a cause of systematic errors?**



(a) Zero error of instrument

(b) Poor calibration

(c) Environmental fluctuations

(d) Incorrect markings on the instrument

**45. What should be done to reduce human errors during measurement?**

(a) Use automated instruments

(b) Use faulty instruments

(c) Avoid multiple readings

(d) Measure as fast as possible

**46. What is uncertainty in a digital instrument mainly caused by?**

(a) User error

(b) Fluctuation of the last digit on the digital scale





(c) Instrument breakage

(d) Environmental noise

47. If a line length lies between 10.3 cm and 10.4 cm on a metre rule, what is the maximum uncertainty?

(a)  $\pm 0.1$  cm

(b)  $\pm 0.05$  cm

(c)  $\pm 0.5$  cm

(d)  $\pm 1$  cm

48. Which of the following is NOT true about significant figures?

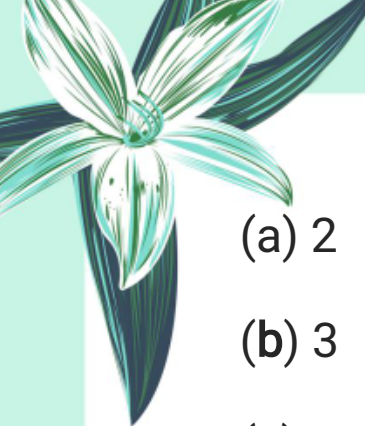
(a) Zeros between two digits are significant

(b) Leading zeros are significant

(c) Zeros to the right of a decimal point are significant

(d) Digits 1 to 9 are significant

49. How many significant figures are in  $3.50 \times 10^4$ ?



(a) 2

(b) 3

(c) 4

(d) 1

50. Accuracy in measurement means:



(a) Closeness of measured value to the true value



(b) Closeness of measurements to each other

(c) The number of times a measurement is taken

(d) None of these

51. Which timing device measures very short intervals of about  $10^{-10}$  seconds?

(a) Analog stopwatch

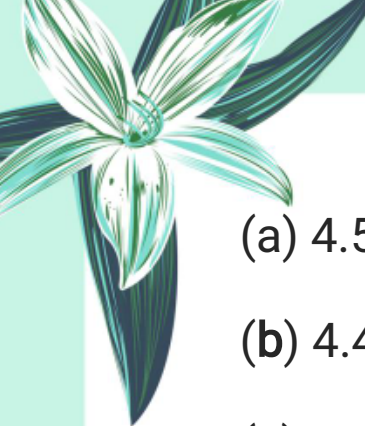
(b) Atomic clock

(c) Pendulum clock

(d) Ticker-tape timer

52. When rounding off to 2 significant figures, how is the number  $4.45 \times 10^2$  rounded?





(a)  $4.5 \times 10^2$

(b)  $4.4 \times 10^2$

(c)  $4.6 \times 10^2$

(d)  $4.0 \times 10^2$



53. If the last digit is more than 5 during rounding off, what happens?

(a) The retained digit increases by one

(b) The retained digit stays the same

(c) The retained digit decreases by one

(d) The number is dropped

54. How can uncertainty in measuring small lengths or time intervals be reduced?

(a) Using less precise instruments

(b) Taking multiple readings and averaging

(c) Using bigger instruments


(d) Ignoring doubtful digits





## Exercise Short Questions:

1.1. Can a non-physical quantity be measured? If yes, then how?



No, a non-physical quantity like color or feelings cannot be measured directly by instruments because they do not have a physical magnitude. However, they can be described qualitatively or measured indirectly using scales or sensors related to physical properties.

1.2. What is measurement? Name its two parts.

Measurement is the process of comparing an unknown quantity with a standard unit of the same kind to find its value.

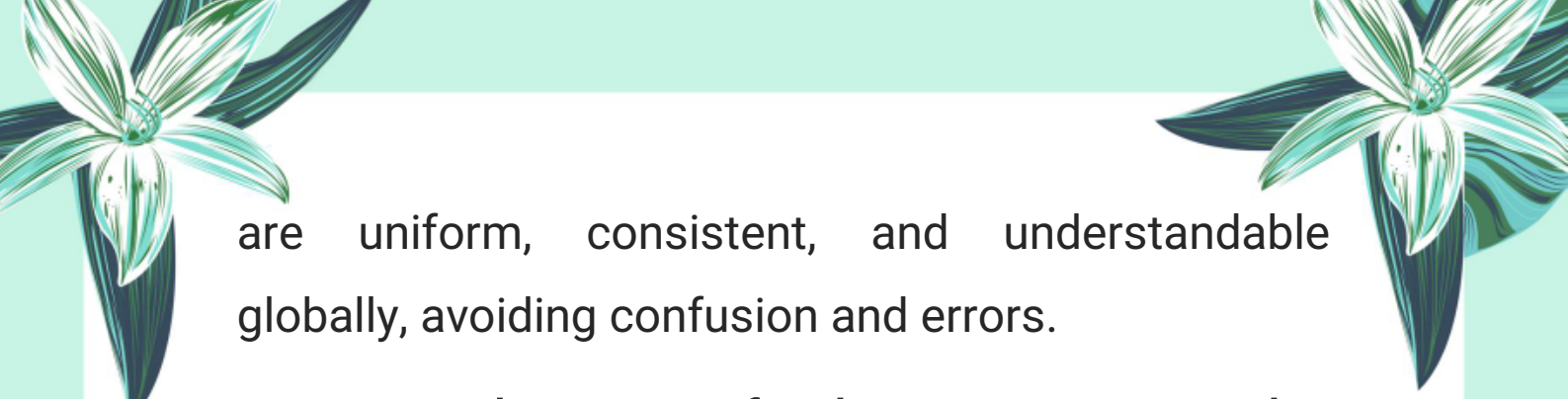
Two parts of measurement are:

1. Numerical value
2. Unit

1.3. Why do we need a standard unit for measurements?

We need a standard unit to ensure measurements






are uniform, consistent, and understandable globally, avoiding confusion and errors.

**1.4. Write the name of 3 base quantities and 3 derived quantities.**

**Base quantities:** Length, Mass, Time

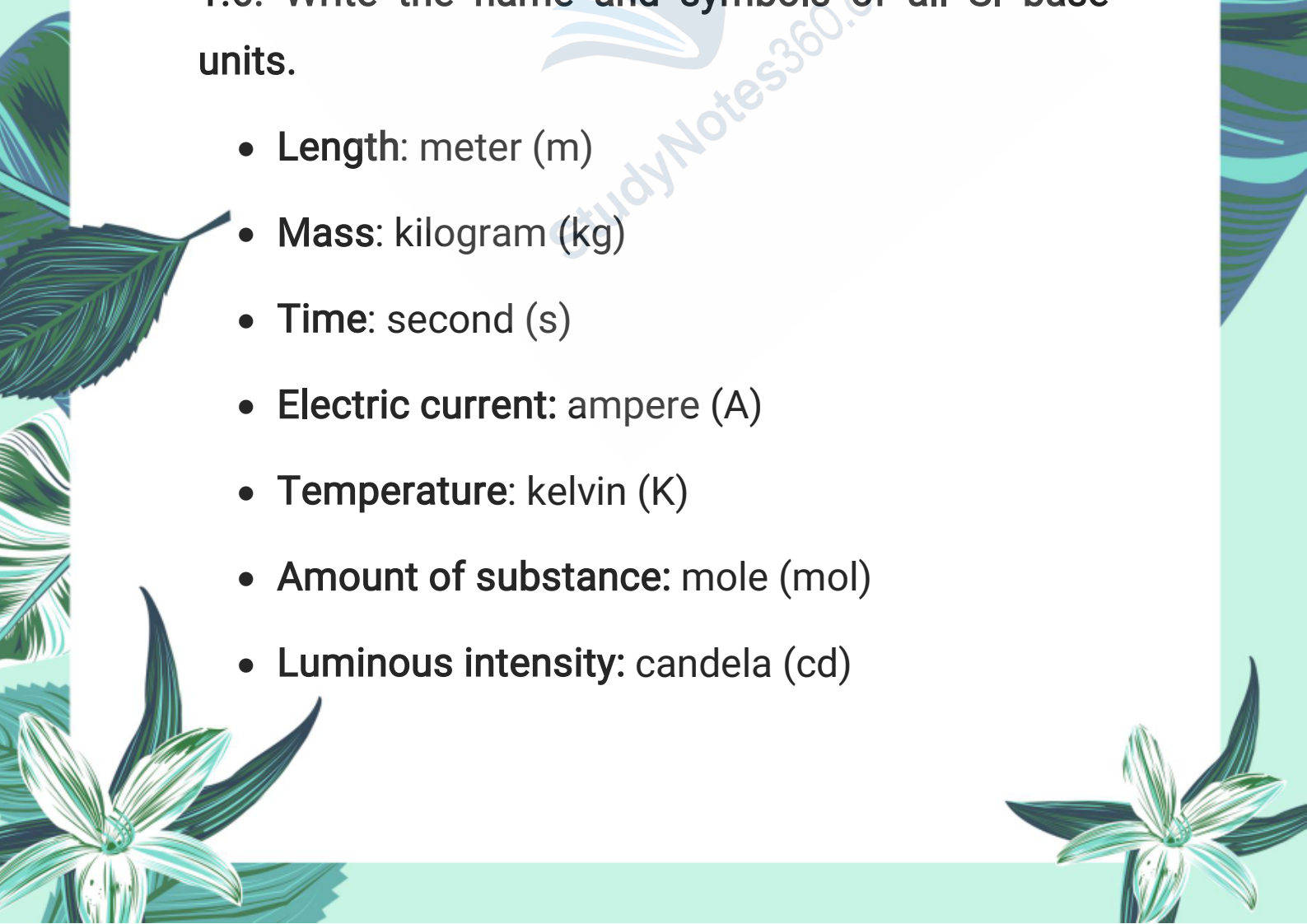
**Derived quantities:** Speed, Volume, Density

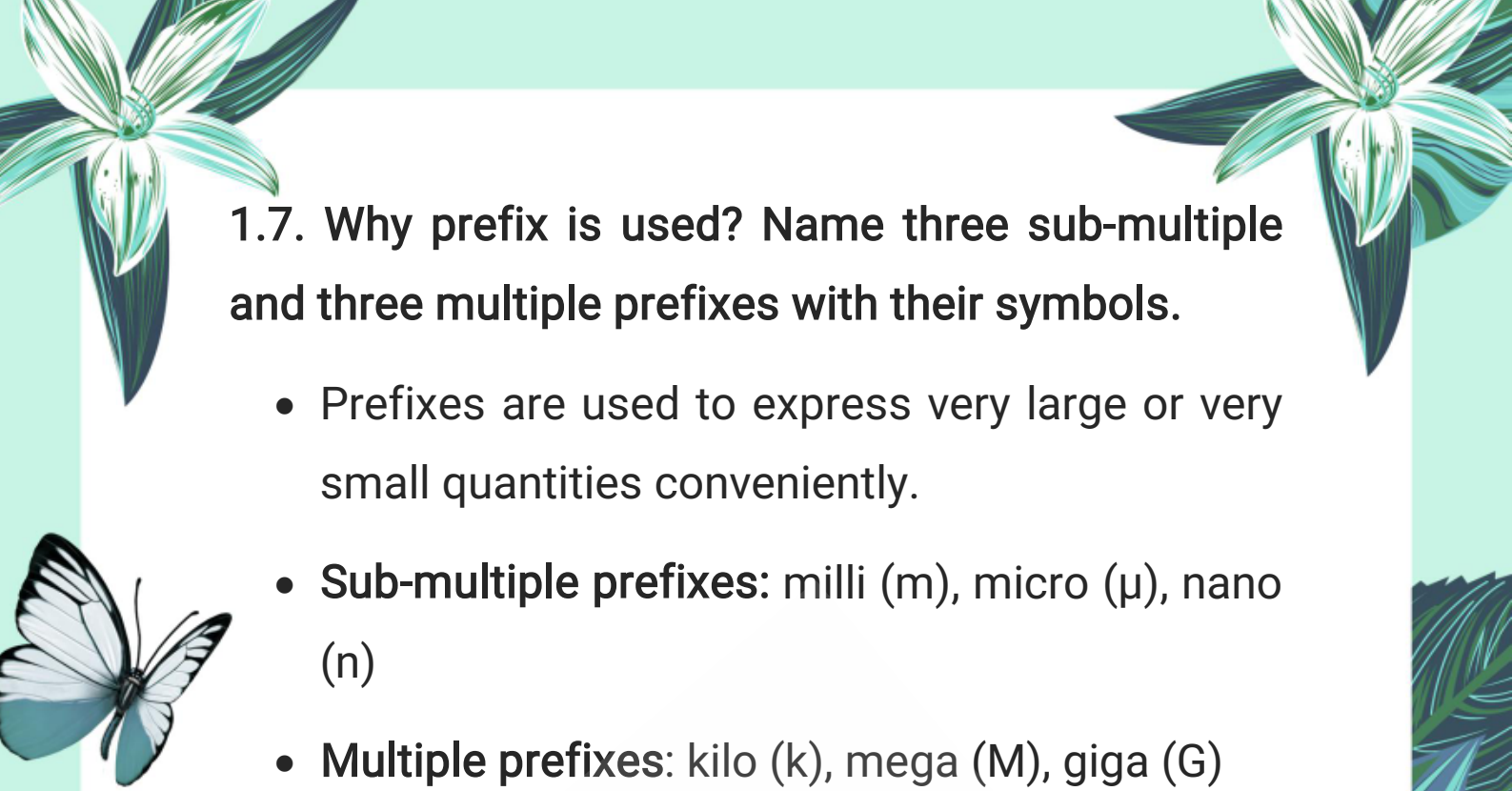


**1.5. Which SI unit will you use to express the height of your desk?**

Meter (m)

**1.6. Write the name and symbols of all SI base units.**

- **Length:** meter (m)
  - **Mass:** kilogram (kg)
  - **Time:** second (s)
  - **Electric current:** ampere (A)
  - **Temperature:** kelvin (K)
  - **Amount of substance:** mole (mol)
  - **Luminous intensity:** candela (cd)
- 



**1.7. Why prefix is used? Name three sub-multiple and three multiple prefixes with their symbols.**

- Prefixes are used to express very large or very small quantities conveniently.
- **Sub-multiple prefixes:** milli (m), micro ( $\mu$ ), nano (n)
- **Multiple prefixes:** kilo (k), mega (M), giga (G)

**1.8. What is meant by:**

- (a) 5 pm – 5 picometers ( $5 \times 10^{-12}$  m)
- (b) 15 ns – 15 nanoseconds ( $15 \times 10^{-9}$  s)
- (c) 6  $\mu$ m – 6 micrometers ( $6 \times 10^{-6}$  m)
- (d) 5 fs – 5 femtoseconds ( $5 \times 10^{-15}$  s)

**1.9.**

**(a) For what purpose is a Vernier Callipers used?**

To measure internal and external dimensions and depths of objects with high accuracy.

**(b) Name its two main parts.**

Main scale and Vernier scale.



(c) How is least count found?

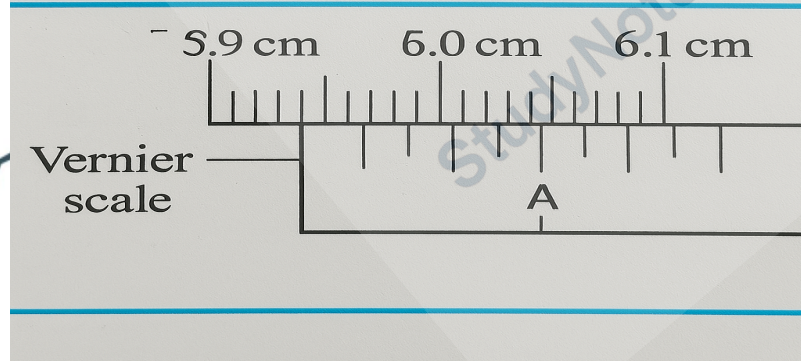
Least count = value of one main scale division – value of one Vernier scale division.

(d) What is meant by zero error?

Zero error is the error when the instrument does not read zero when the measurement is zero, affecting accuracy.

1.10. State least count and Vernier scale reading as shown in figure and hence find the length.

Q. State least count and Vernier scale reading as shown in figure and hence find the length.



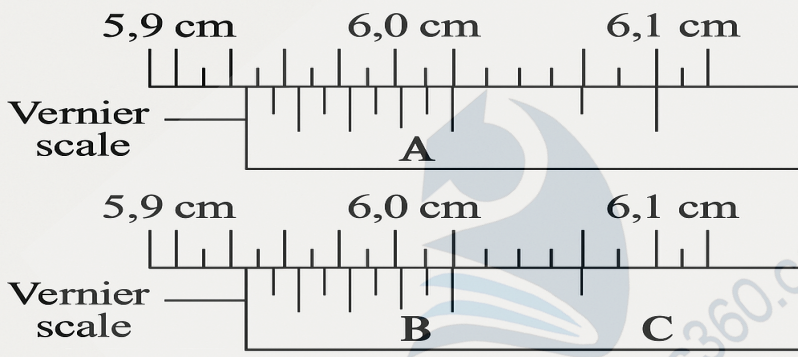
**Least count:** It depends on the specific Vernier calipers used. If you know the scale details, we can calculate it using the formula given earlier.

**Vernier scale reading:** Based on the provided

information, the reading needs to be derived from the alignment between the **main scale** and **Vernier scale** markings in the figure.

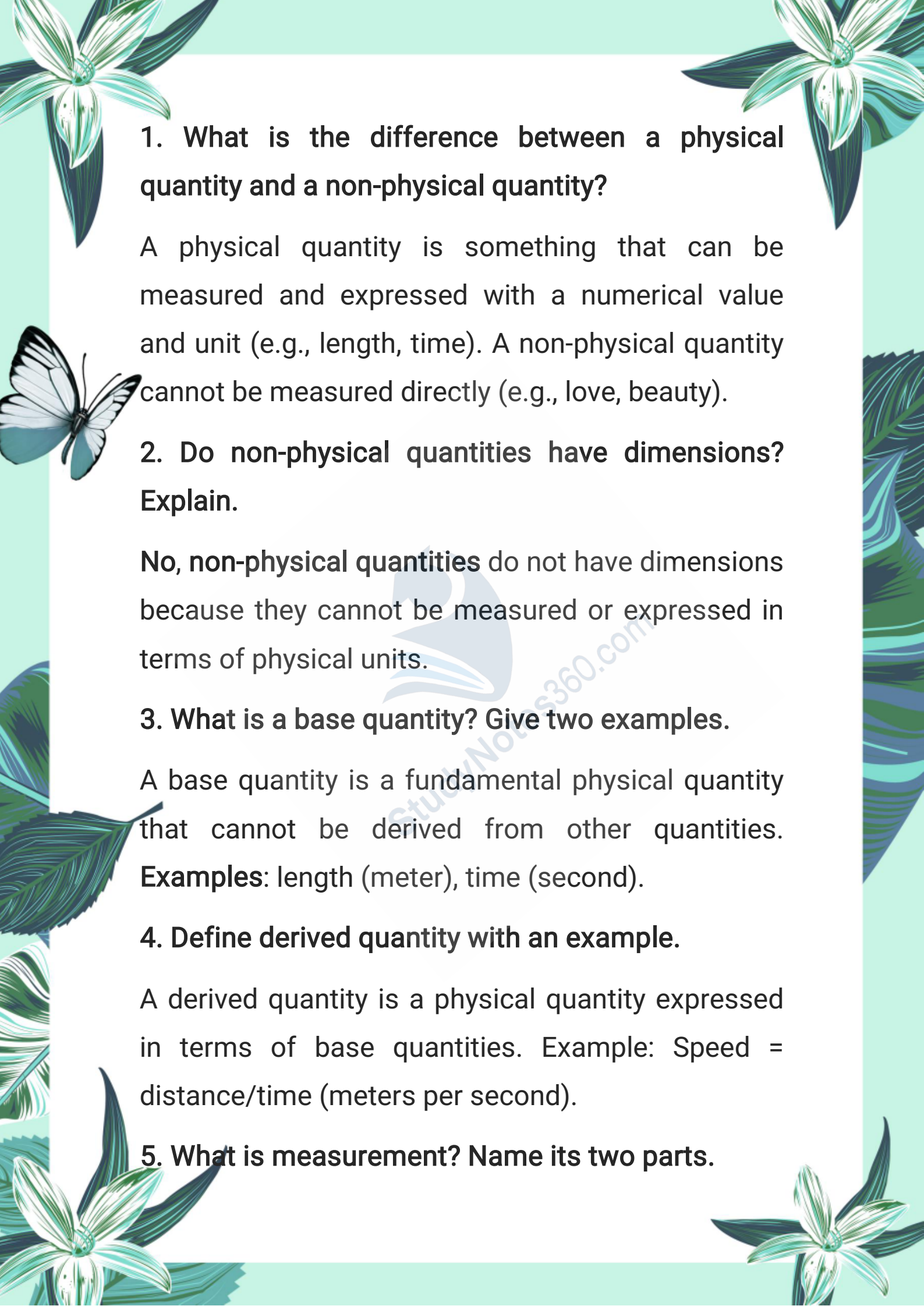
1.11. Which reading out of A, B, and C shows the correct length and why?

1.11. Which reading out of A, and C shows the correct length and why?



Among readings A, B, and C, the correct length is determined by the alignment of the **Vernier scale** marking with the **main scale** reference line. The correct reading must follow the principle that the Vernier marking closest to the main scale reference gives the correct value.

**Important Short Questions:**

The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners; a white butterfly with black markings on its wings on the left side; and a large green leaf on the right side. The background is a light green color.

**1. What is the difference between a physical quantity and a non-physical quantity?**

A physical quantity is something that can be measured and expressed with a numerical value and unit (e.g., length, time). A non-physical quantity cannot be measured directly (e.g., love, beauty).

**2. Do non-physical quantities have dimensions? Explain.**

**No, non-physical quantities** do not have dimensions because they cannot be measured or expressed in terms of physical units.

**3. What is a base quantity? Give two examples.**

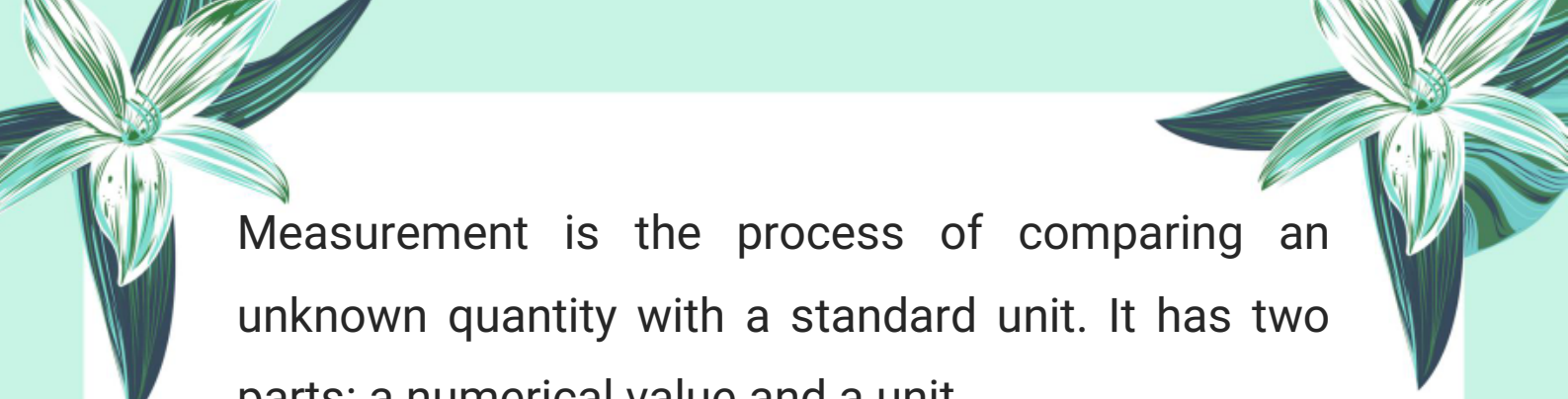
A base quantity is a fundamental physical quantity that cannot be derived from other quantities.

**Examples:** length (meter), time (second).

**4. Define derived quantity with an example.**


A derived quantity is a physical quantity expressed in terms of base quantities. Example: Speed = distance/time (meters per second).

**5. What is measurement? Name its two parts.**



Measurement is the process of comparing an unknown quantity with a standard unit. It has two parts: a numerical value and a unit.

**6. Why is there a need for standard units in measurement?**



Standard units ensure that measurements are consistent and comparable worldwide, avoiding confusion caused by different local units.

**7. What is the SI system? How many base units does it have?**

The International System of Units (SI) is a globally accepted system for measurements, consisting of seven base units.

**8. What are the SI units of length, mass, and time?**

Length - meter (m), Mass - kilogram (kg), Time - second (s).

**9. What are derived units? Give an example.**

Derived units are units formed by combining base units. **Example:** Newton (N) for force =  $\text{kg}\cdot\text{m}/\text{s}^2$ .

**10. What are the SI units of area and volume?**






Area - square meter ( $\text{m}^2$ ), Volume - cubic meter ( $\text{m}^3$ ).

**11. How is speed expressed in terms of base units?**

Speed = distance/time = meters per second ( $\text{m/s}$ ).



**12. What is the unit of pressure and how is it defined?**

Pressure is measured in pascal (Pa), defined as one newton per square meter ( $\text{N/m}^2$ ).

**13. What are SI prefixes and why are they used?**

SI prefixes are symbols added before units to denote multiples or submultiples of 10, making very large or small quantities easier to express.

**14. Explain the prefixes milli and kilo with their symbols.**

Milli (m) means one-thousandth ( $10^{-3}$ ), and kilo (k) means one thousand ( $10^3$ ).

**15. How do you express 50,000,000 meters in scientific notation?**

50,000,000 meters =  $5 \times 10^7$  meters.

**16. What is scientific notation? Why is it used?**



The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom right corners; a white butterfly with black markings on its wings on the left side; and a large green leaf on the right side. The background is a light green color.

**Answer:**

Scientific notation is a method of writing very large or very small numbers in a compact form as a product of a number between 1 and 9 and a power of 10. It is used to simplify the representation, reading, and calculation of extremely large or small values.

**17. How do you write a number in scientific notation?**

**Answer:**

To write a number in scientific notation, move the decimal point so that only one non-zero digit remains on the left. Then multiply by 10 raised to the number of places the decimal has moved. If moved left, the exponent is positive; if moved right, it is negative.

**18. Write the average distance from the Sun to the Earth in scientific notation.**

**Answer:**

The average distance is 138,000,000 km. In



scientific notation, it is written as:

$$1.38 \times 10^8 \text{ km}$$

19. Explain the significance of positive and negative exponents in scientific notation with examples.

Answer:

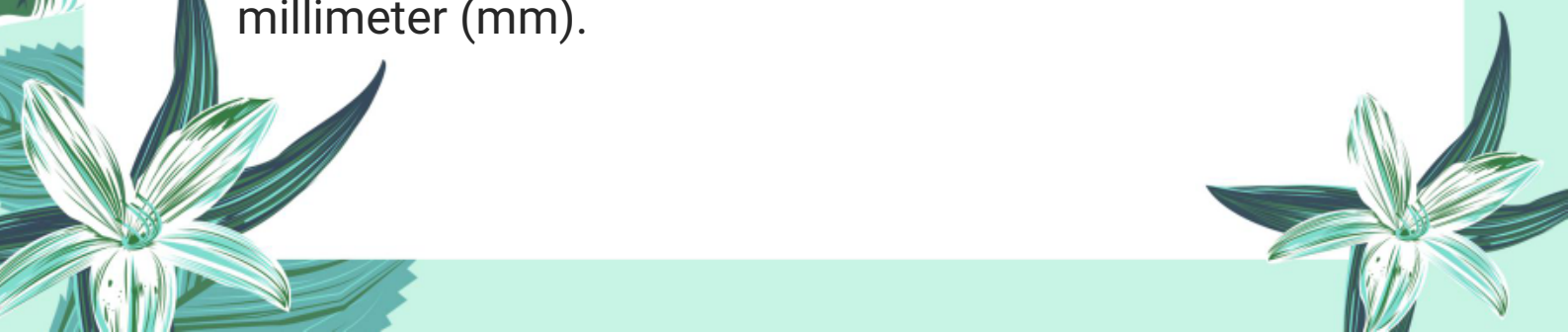
- Positive exponent means the decimal point is moved to the left, indicating a large number (e.g.,  $1.38 \times 10^8 = 138,000,000$ ).
- Negative exponent means the decimal point is moved to the right, indicating a very small number (e.g.,  $5.2 \times 10^{-11} = 0.0000000000052$ ).

20. What is the least count of a measuring instrument? Give an example.

Answer:

The least count is the smallest measurement that can be accurately taken with an instrument.

**Example:** The least count of a metre rule is 1 millimeter (mm).



The page is decorated with various illustrations: a white butterfly with black markings on its wings is on the left side. There are several green and white flowers with long, narrow leaves, some in the top corners and some at the bottom. The background is a light green color with a subtle pattern of leaves and flowers.

**21. What is parallax error and how can it be avoided when using a metre rule?**

**Answer:**

Parallax error occurs when the scale is read from an angle, causing incorrect measurements. It can be avoided by ensuring the eye is directly above the scale while reading.

**22. What are the two scales on a Vernier caliper?**

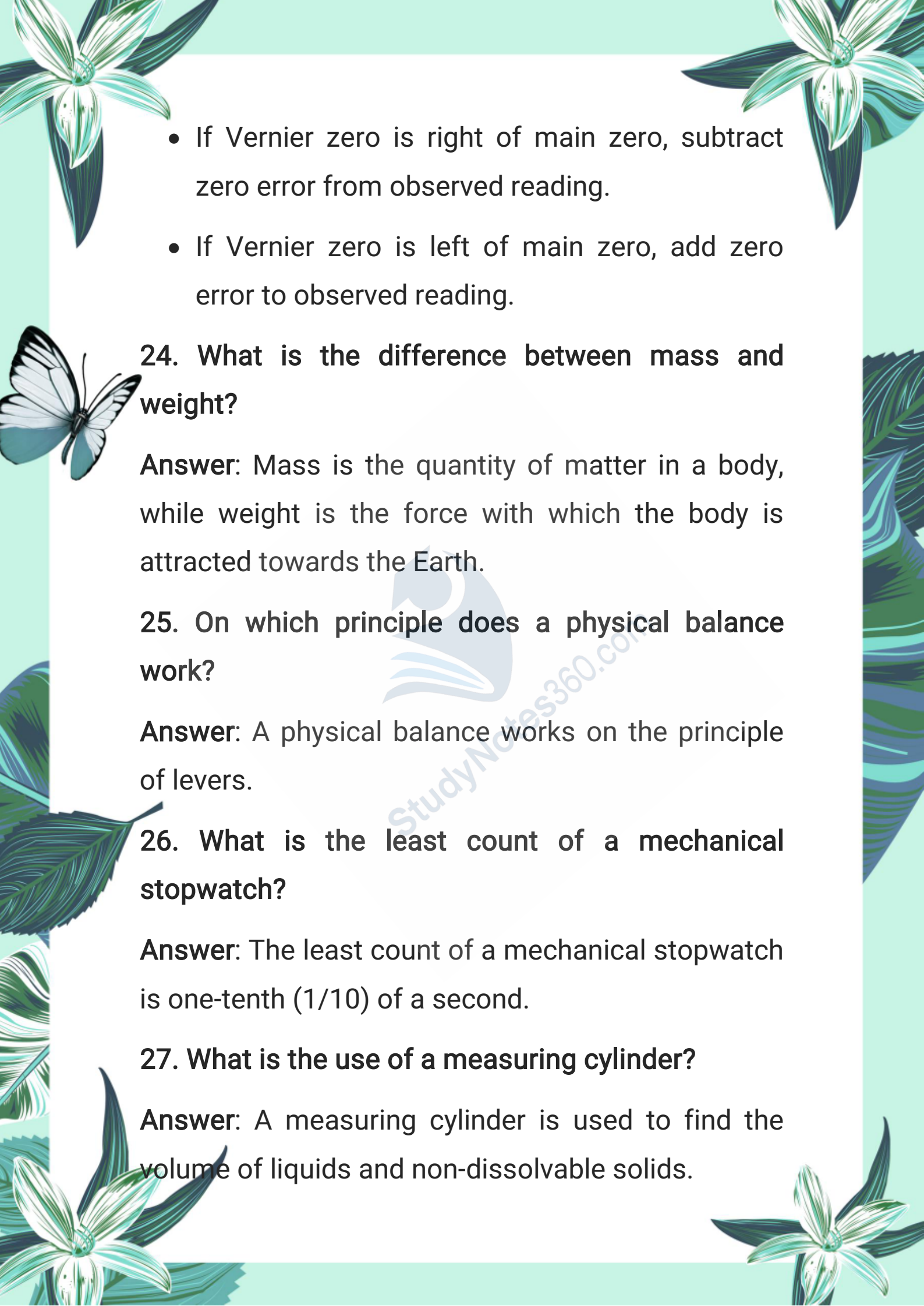
**Answer:**

- The Vernier caliper has two scales:
- The main scale marked in millimeters (mm)
- The Vernier scale (sliding scale) divided into equal parts for finer measurements

**23. What is zero error in Vernier calipers? How do you correct it?**

**Answer:**

- Zero error occurs if the zero marks of the main scale and Vernier scale do not coincide when the jaws are closed.

- 
- The page is decorated with various illustrations: a white butterfly with black markings on its wings is on the left side. There are several green and white flowers with long, narrow leaves, some in the top corners and some at the bottom. The background is a light green color with a white central area where the text is located.
- If Vernier zero is right of main zero, subtract zero error from observed reading.
  - If Vernier zero is left of main zero, add zero error to observed reading.

**24. What is the difference between mass and weight?**

**Answer:** Mass is the quantity of matter in a body, while weight is the force with which the body is attracted towards the Earth.

**25. On which principle does a physical balance work?**

**Answer:** A physical balance works on the principle of levers.

**26. What is the least count of a mechanical stopwatch?**

**Answer:** The least count of a mechanical stopwatch is one-tenth ( $1/10$ ) of a second.

**27. What is the use of a measuring cylinder?**

**Answer:** A measuring cylinder is used to find the volume of liquids and non-dissolvable solids.



**28. How can the volume of an irregular solid be measured?**

**Answer:** The volume of an irregular solid can be measured using a displacement (overflow) can and a measuring cylinder.



**29. What are the three types of experimental errors?**

**Answer:** The three types of experimental errors are:

- (i) Human errors,
- (ii) Systematic errors,
- (iii) Random errors.

**30. What is meant by human error in measurement?**

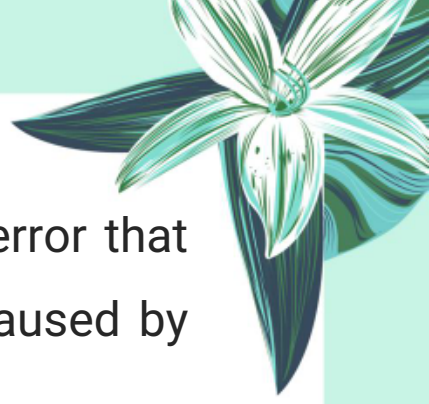
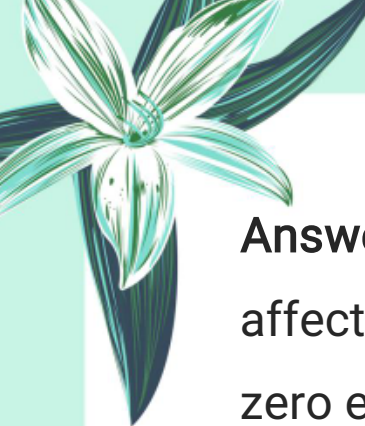
**Answer:** Human error occurs due to limitations of human perception or faulty reading techniques, such as parallax error or reaction delay.

**31. How can human errors be minimized?**

**Answer:** Human errors can be reduced through proper training, correct procedures, and using digital instruments.


**32. What is a systematic error?**





**Answer:** Systematic error is a consistent error that affects all measurements equally, often caused by zero error or faulty calibration.

### 33. What are random errors?



**Answer:** Random errors are unpredictable variations in measurement due to unknown factors like temperature or voltage fluctuations.

### 34. How can the effect of random errors be reduced?


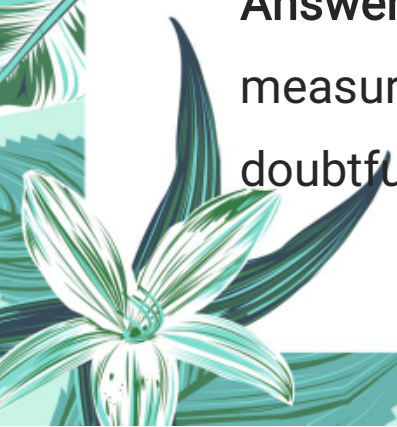
**Answer:** Random errors can be reduced by taking multiple readings and calculating their average value.

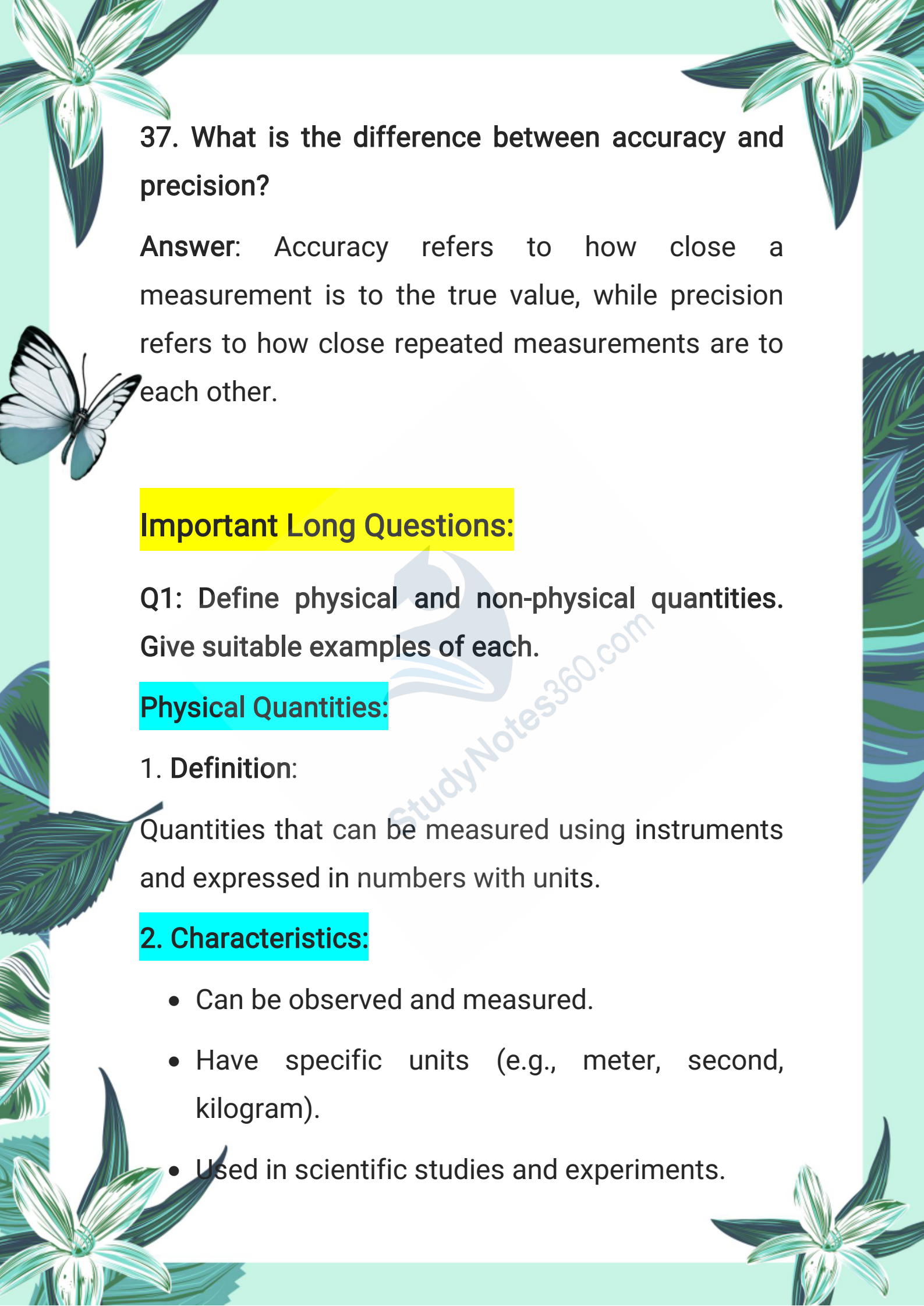
### 35. What is uncertainty in measurement?

**Answer:** Uncertainty is the doubt about the exactness of a measurement, often caused by the limitations of the measuring instrument.

### 36. What are significant figures?

**Answer:** Significant figures are the digits in a measurement that are known reliably plus the first doubtful digit.



37. What is the difference between accuracy and precision?

**Answer:** Accuracy refers to how close a measurement is to the true value, while precision refers to how close repeated measurements are to each other.

### Important Long Questions:

Q1: Define physical and non-physical quantities. Give suitable examples of each.

#### Physical Quantities:

##### 1. Definition:

Quantities that can be measured using instruments and expressed in numbers with units.

##### 2. Characteristics:

- Can be observed and measured.
- Have specific units (e.g., meter, second, kilogram).
- Used in scientific studies and experiments.

The page is decorated with various illustrations: a large white flower with green leaves in the top-left and bottom-left corners, a white butterfly in the middle-left, and a large green leaf in the middle-right. The background is a light green color.

### 3. **Examples:**

- Length (measured using ruler or meter rod)
- Time (measured with a stopwatch or clock)
- Temperature (measured with a thermometer)
- Mass (measured with a balance)

### **Non-Physical Quantities:**

#### 1. **Definition:**

Quantities that cannot be measured directly using instruments.

#### 2. **Characteristics:**

- Subjective in nature.
- Do not have units or dimensions.
- Cannot be used in scientific calculations directly.

### 3. **Examples:**

Love, fear, happiness, beauty, intelligence

**Q2: Explain why physical quantities are important in physics.**



## 1. Foundation of Physics:

All physical laws and theories are based on measurable quantities. Physics studies nature through physical quantities.



## 2. Measurement and Comparison:

Physical quantities allow us to measure and compare different phenomena (e.g., comparing speeds, temperatures).

## 3. Expression in Formulas:

Formulas in physics (like  $F = ma$  or  $v = s/t$ ) are made using physical quantities only.

## 4. Conducting Experiments:

All experiments require measurement of physical quantities to check accuracy and consistency.

## 5. Objective and Universal:

Unlike emotions or opinions, physical quantities provide reliable and repeatable results anywhere in the world.

**Q3: What is the International System of Units (SI**



The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners, a white butterfly with black markings on its wings on the left side, and a large green leaf on the right side. The background is a light green color.

**Units)? Explain its advantages and base units.**

### **1. Definition:**

The International System of Units (SI) is a globally accepted system of measurement introduced by the International Committee on Weights and Measures in 1961.

### **2. Purpose:**

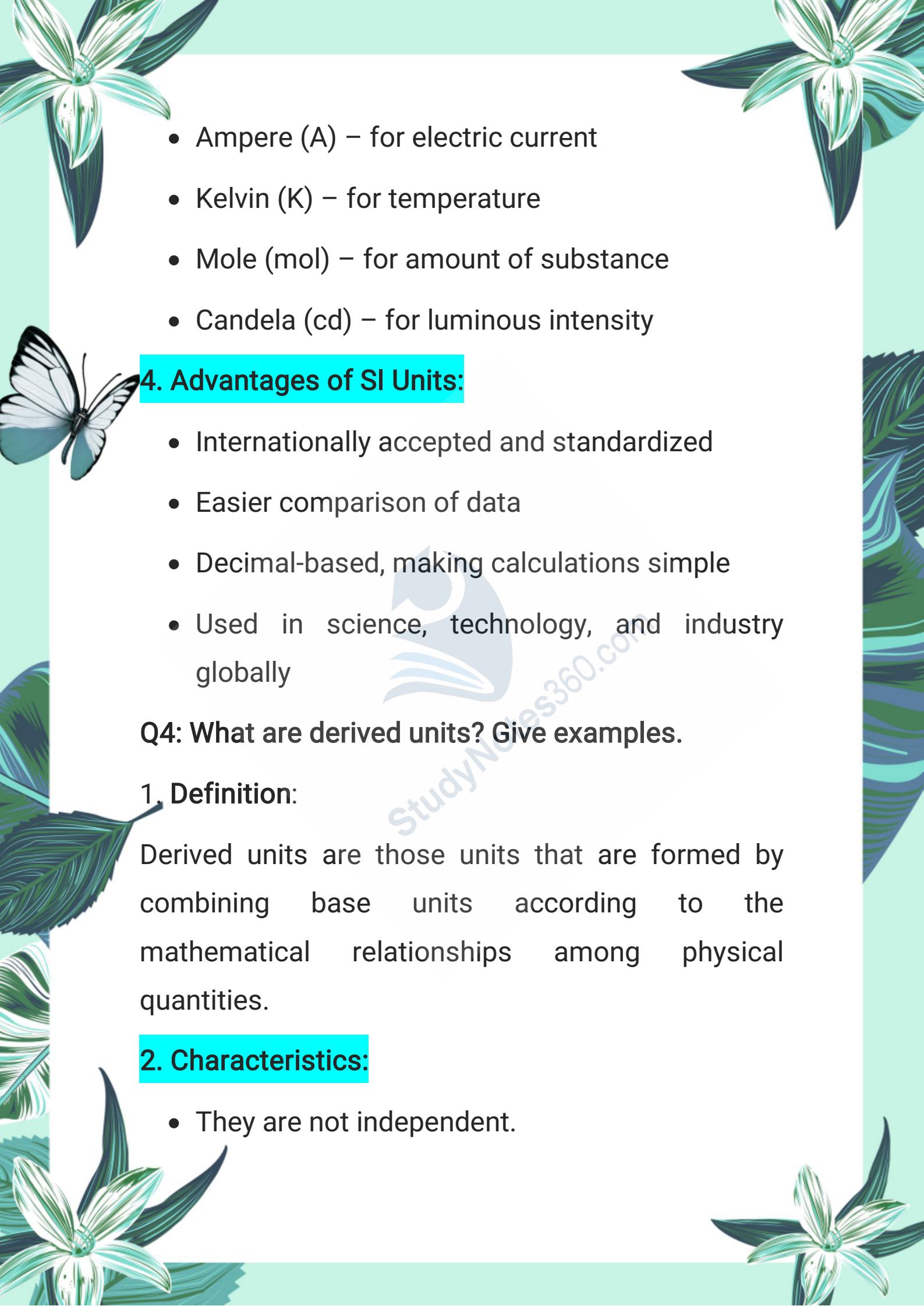
It ensures uniformity in measurements and allows scientists and engineers worldwide to share and compare their results accurately.

### **3. Base Units:**

There are seven base units in the SI system. These base units are independent and cannot be derived from one another. They are used to define all other physical quantities.

### **Examples:**

- Metre (m) – for length
- Kilogram (kg) – for mass
- Second (s) – for time

- 
- The page is decorated with various illustrations: a large white flower with green leaves in the top-left and bottom-left corners, a white butterfly on the left side, and a large green leaf on the right side. The background is a light green color.
- Ampere (A) – for electric current
  - Kelvin (K) – for temperature
  - Mole (mol) – for amount of substance
  - Candela (cd) – for luminous intensity

#### 4. Advantages of SI Units:

- Internationally accepted and standardized
- Easier comparison of data
- Decimal-based, making calculations simple
- Used in science, technology, and industry globally

**Q4: What are derived units? Give examples.**

##### 1. Definition:

Derived units are those units that are formed by combining base units according to the mathematical relationships among physical quantities.

##### 2. Characteristics:

- They are not independent.

- They depend on base units.
- Used to measure quantities like area, volume, speed, force, etc.

### 3. Examples:

- Area = length  $\times$  breadth =  $m \times m = m^2$
- Speed = distance / time =  $m / s = m \cdot s^{-1}$
- Force = mass  $\times$  acceleration =  $kg \cdot m/s^2 =$  newton (N)
- Pressure = force / area =  $N / m^2 =$  pascal (Pa)

**Q5: What are SI prefixes? Explain with examples.**

#### 1. Definition:

SI prefixes are symbols or words added before a unit to indicate multiples or sub-multiples of 10.

#### 2. Purpose:

They make it easier to write and understand very large or very small measurements.

#### 3. Common Prefixes:

### Common SI Prefixes with Examples

Prefix	Symbol	Multiplier	Example
Kilo	k	$10^3 = 1000$	1 kilometre (km) = 1000 metres
Mega	M	$10^6$	1 megawatt (MW) = 1,000,000 watts
Giga	G	$10^9$	1 gigabyte (GB) = 1,000,000,000 bytes
Centi	c	$10^{-2} = 1/100$	1 centimetre (cm) = 0.01 metres
Milli	m	$10^{-3} = 1/1000$	1 milligram (mg) = 0.001 grams
Micro	u	$10^{-6}$	1 micrometre ( $\mu\text{m}$ ) = 0.000001 metres

#### 4. Examples:

$$1. 50,000,000 \text{ m} = 5 \times 10^7 \text{ m} = 50 \text{ Mm} \\ \text{(megametres)}$$

$$2. 0.00004 \text{ m} = 4 \times 10^{-5} \text{ m} = 40 \mu\text{m} \text{ (micrometres)}$$

**Q6: What is Scientific Notation? Explain with examples.**

#### 1. Definition:

Scientific notation is a way of expressing very large or very small numbers using powers of 10.

#### 2. Purpose:

It simplifies numbers for ease in reading, writing, comparing, and calculations.



### 3. Format:

- A number is written as:
- $N \times 10^n$
- Where  $1 \leq N < 10$  and  $n$  is an integer.



### 4. For Large Numbers:

- Move the decimal point to the left.
- Example:
- $138,000,000 \text{ km} = 1.38 \times 10^8 \text{ km}$

### 5. For Small Numbers:

- Move the decimal point to the right.
- Example:
- $0.000000000052 \text{ m} = 5.2 \times 10^{-11} \text{ m}$

### 6. Advantages:

- Saves space
- Easy visualization
- Efficient calculations in physics

Q7: What is a Vernier Callipers? How is it used to



The page is decorated with various illustrations: a large white flower with green leaves in the top-left and bottom-left corners, a white butterfly in the middle-left, and a large green leaf in the middle-right. The background is a light green gradient.

measure length?

### 1. Definition:

A Vernier Callipers is used for measuring small lengths accurately (up to 0.1 mm).

### 2. Main Parts:

- Main Scale: Has 1 mm divisions.
- Vernier Scale: 9 mm long with 10 divisions.

### 3. Least Count:

- L.C. =  $1 \text{ mm} / 10 = 0.1 \text{ mm}$

### 4. Measurement Steps:

**Step 1:** Note the main scale reading before the zero of the Vernier scale.

**Step 2:** Find the division on Vernier scale which aligns with a main scale division.

**Step 3:**

**Length** = Main scale reading + (L.C × Vernier scale reading)

**Example:**  $4.3 + (0.1 \times 4) = 4.34 \text{ cm}$

## 5. Zero Error:

- If zero of Vernier and main scale don't match when jaws are closed, apply correction.
- If zero is to the right, subtract the error.
- If zero is to the left, add the error.

Q8: What is a Screw Gauge? Explain its working and zero error.

Answer:

### 1. Purpose:

Used to measure very small lengths like diameter of wires or thickness of sheets.

### 2. Scales:

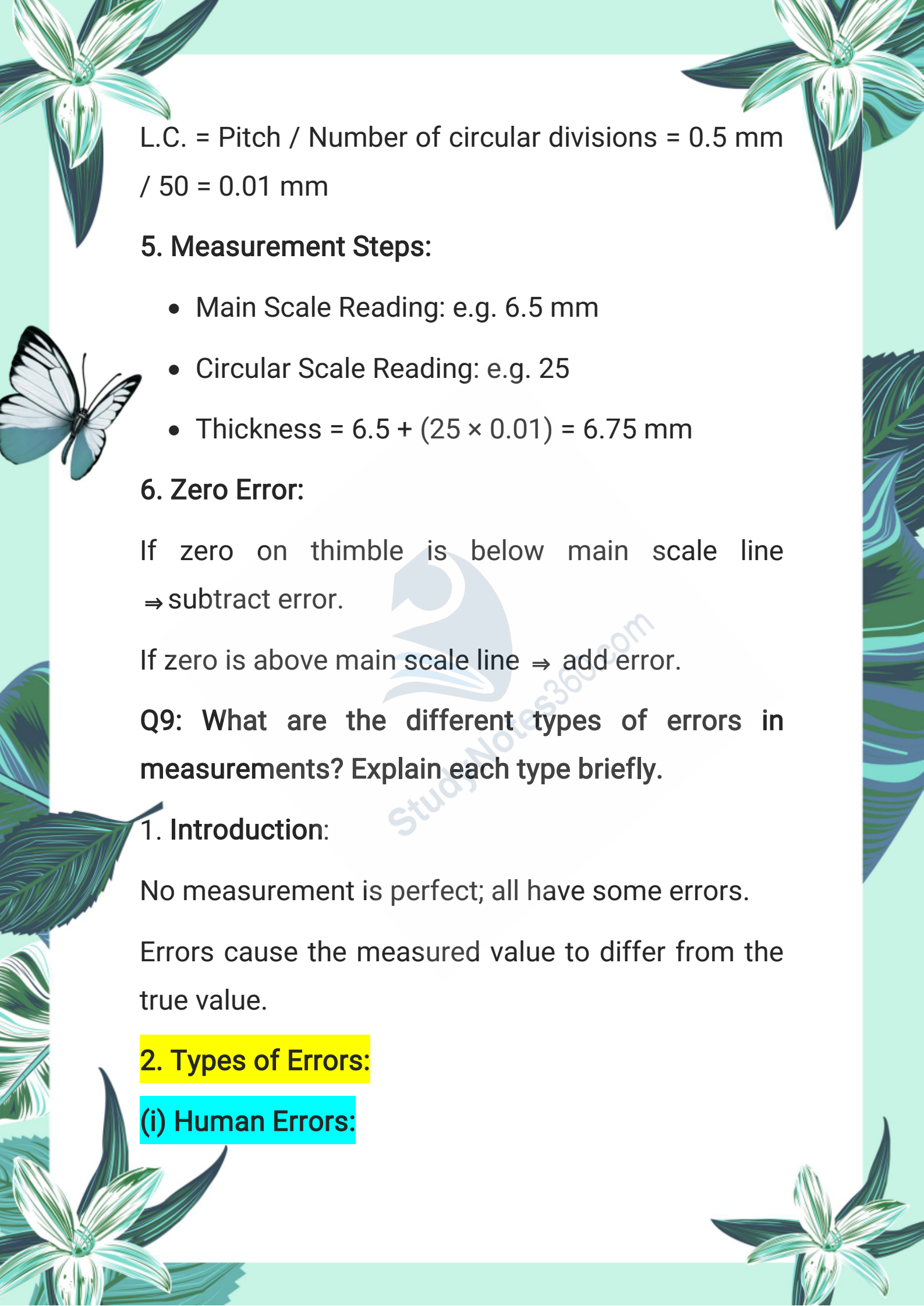
Main Scale: 0.5 mm divisions

Circular Scale: 50 divisions on thimble

### 3. Pitch:

The distance spindle moves in one full rotation = 0.5 mm

### 4. Least Count:



L.C. = Pitch / Number of circular divisions = 0.5 mm  
/ 50 = 0.01 mm

### 5. Measurement Steps:

- Main Scale Reading: e.g. 6.5 mm
- Circular Scale Reading: e.g. 25
- Thickness =  $6.5 + (25 \times 0.01) = 6.75$  mm

### 6. Zero Error:

If zero on thimble is below main scale line  
⇒ subtract error.

If zero is above main scale line ⇒ add error.

**Q9: What are the different types of errors in measurements? Explain each type briefly.**

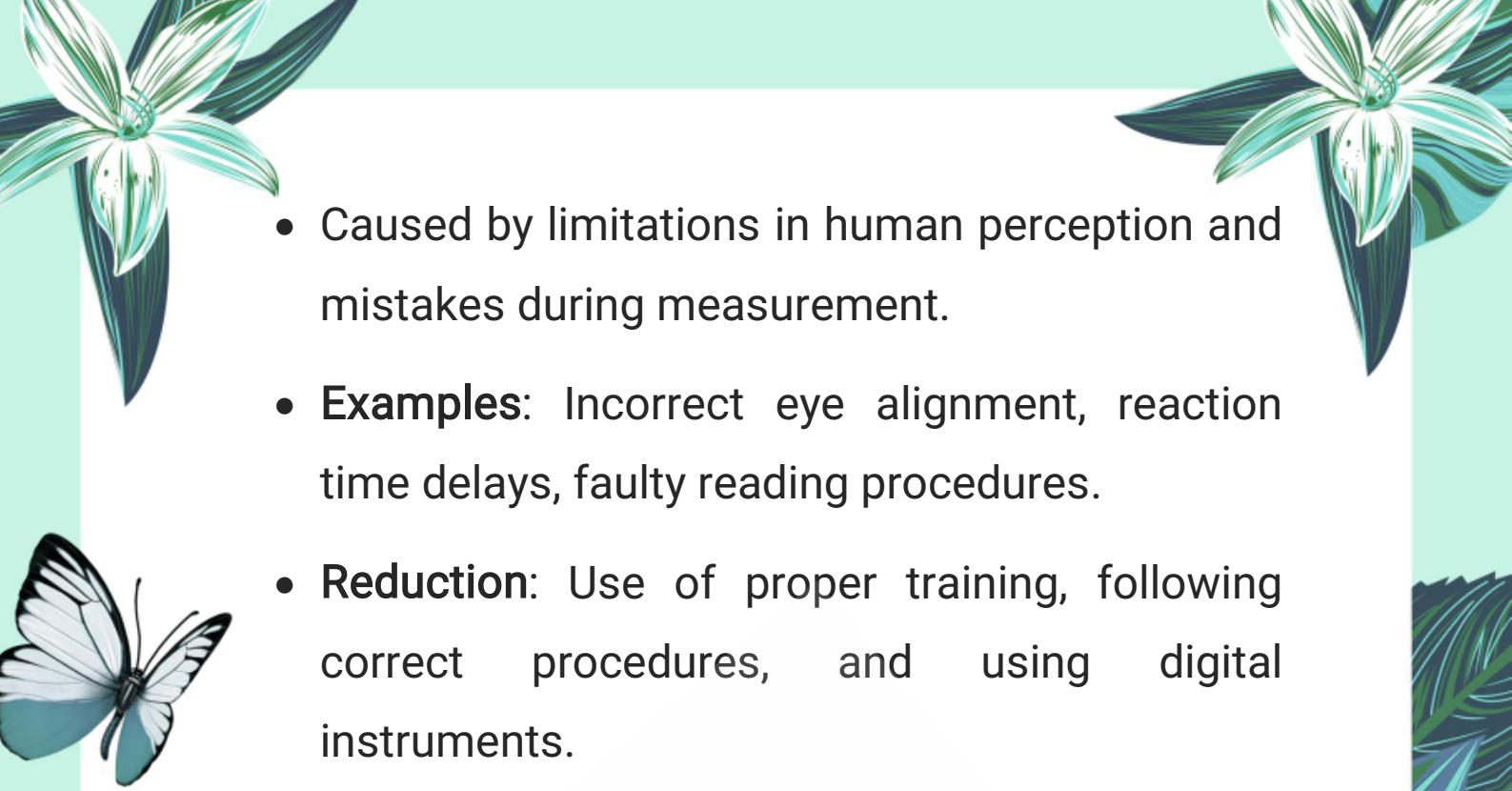
#### 1. Introduction:

No measurement is perfect; all have some errors.

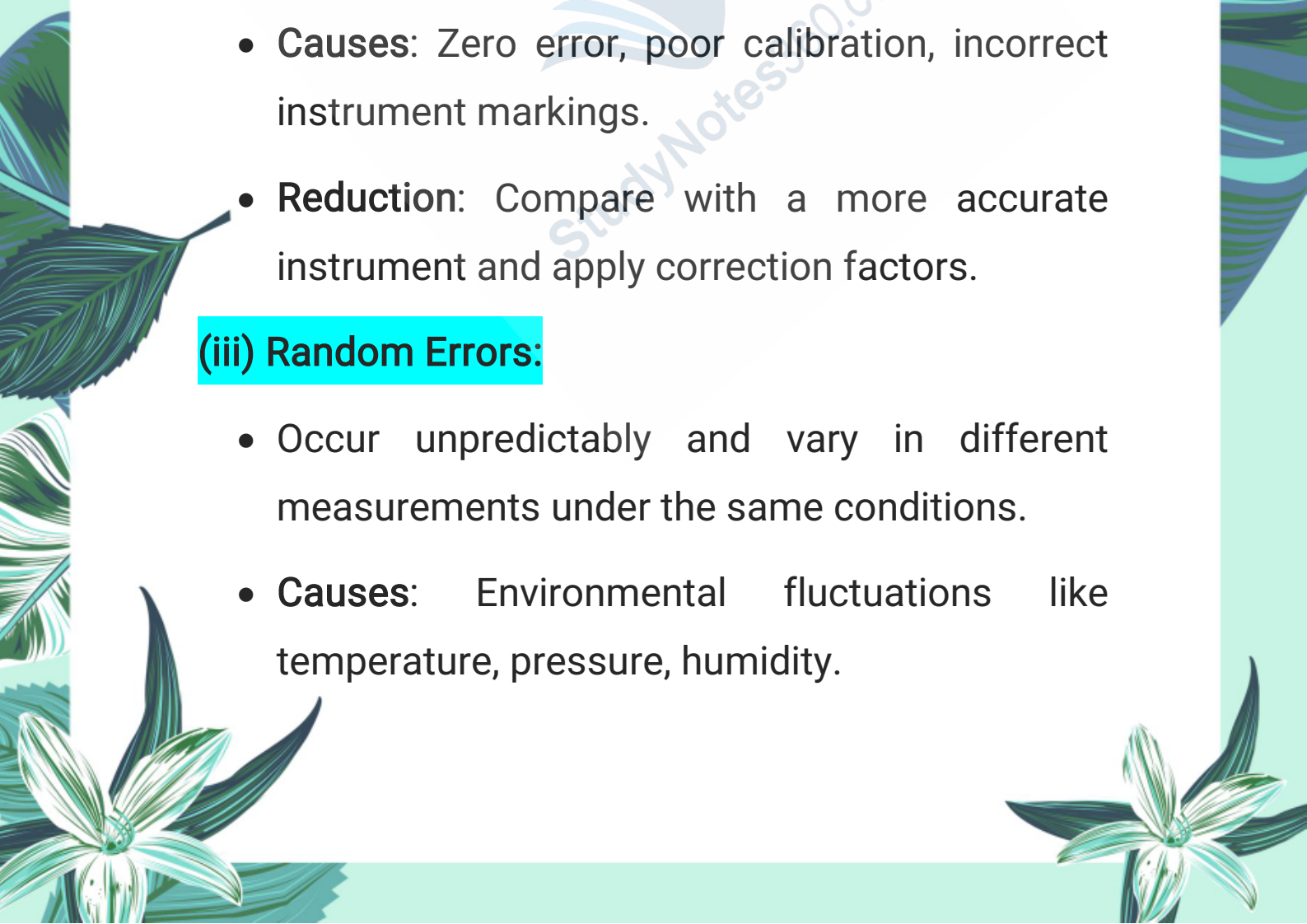
Errors cause the measured value to differ from the true value.

#### 2. Types of Errors:

##### (i) Human Errors:


- 
- Caused by limitations in human perception and mistakes during measurement.
  - **Examples:** Incorrect eye alignment, reaction time delays, faulty reading procedures.
  - **Reduction:** Use of proper training, following correct procedures, and using digital instruments.

### **(ii) Systematic Errors:**

- 
- Occur consistently in the same direction for all measurements.
  - **Causes:** Zero error, poor calibration, incorrect instrument markings.
  - **Reduction:** Compare with a more accurate instrument and apply correction factors.

### **(iii) Random Errors:**

- Occur unpredictably and vary in different measurements under the same conditions.
- **Causes:** Environmental fluctuations like temperature, pressure, humidity.

- 
- **Reduction:** Take multiple readings and use their average to minimize error.

**Q10: Explain human errors in measurements and how they can be minimized.**

Answer:



### 1. Human Errors Definition:

Errors due to personal limitations or mistakes during measurement.

### 2. Examples:

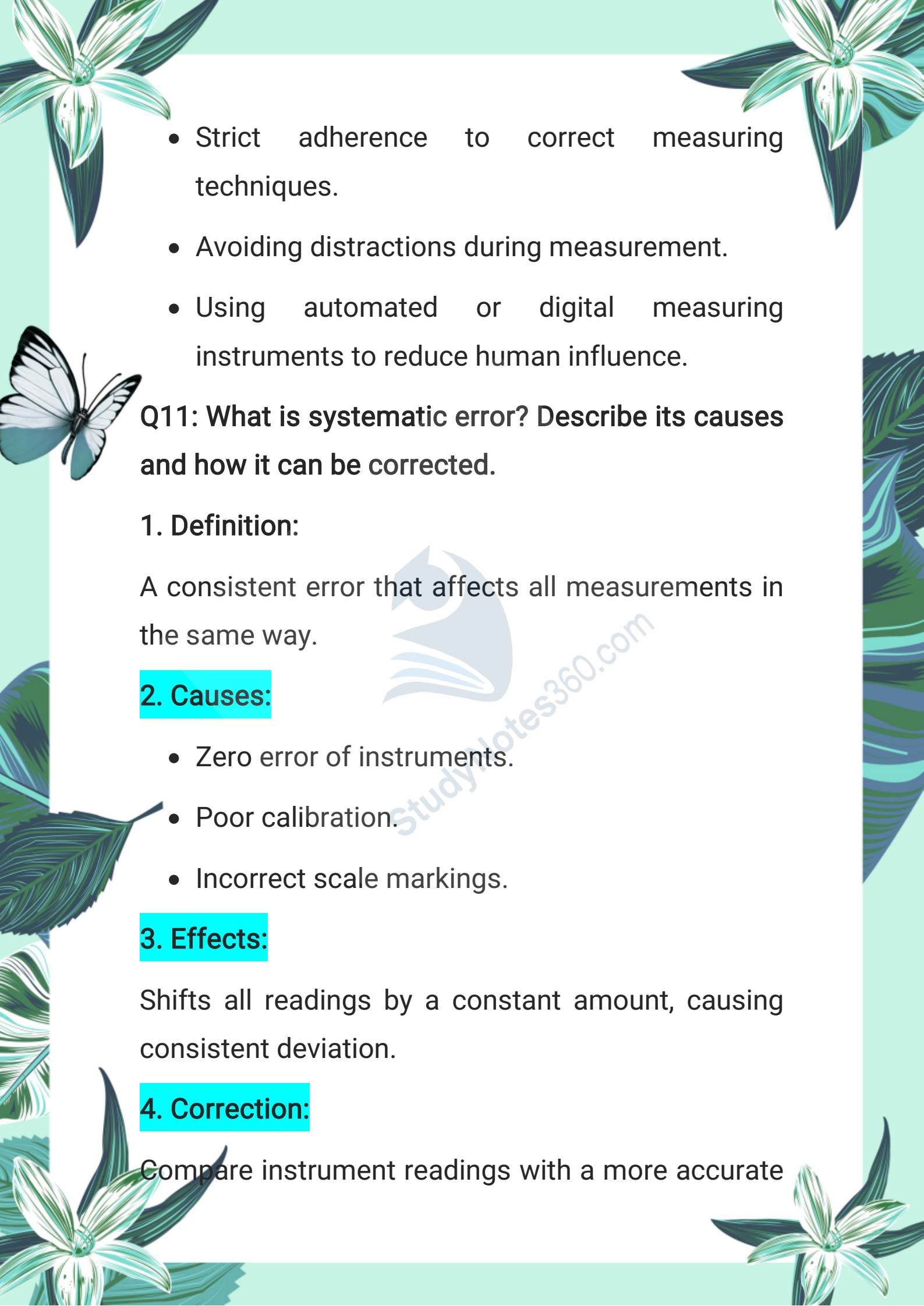
- Misalignment of the eye while reading a scale.
- Delays in starting or stopping timing devices due to reaction time.
- Faulty reading or incorrect procedure.

### 3. Causes:

- Inability to estimate the exact pointer position.
- Environmental distractions affecting concentration.

### 4. Minimization:

- Proper training of personnel.
- 

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- The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners, a white butterfly on the left side, and a large green leaf on the right side. The background is a light green color.
- Strict adherence to correct measuring techniques.
  - Avoiding distractions during measurement.
  - Using automated or digital measuring instruments to reduce human influence.

**Q11: What is systematic error? Describe its causes and how it can be corrected.**

### **1. Definition:**

A consistent error that affects all measurements in the same way.

### **2. Causes:**

- Zero error of instruments.
- Poor calibration.
- Incorrect scale markings.

### **3. Effects:**

Shifts all readings by a constant amount, causing consistent deviation.

### **4. Correction:**

Compare instrument readings with a more accurate

The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners, a white butterfly with black markings on its wings on the left side, and a large green leaf on the right side. The background is a light green color.

standard.

Calculate and apply a correction factor to all measurements.

**Q12: Define random errors and explain how to reduce their effect in measurements.**

### **1. Definition:**

Errors that cause fluctuations in repeated measurements under the same conditions.

### **2. Causes:**

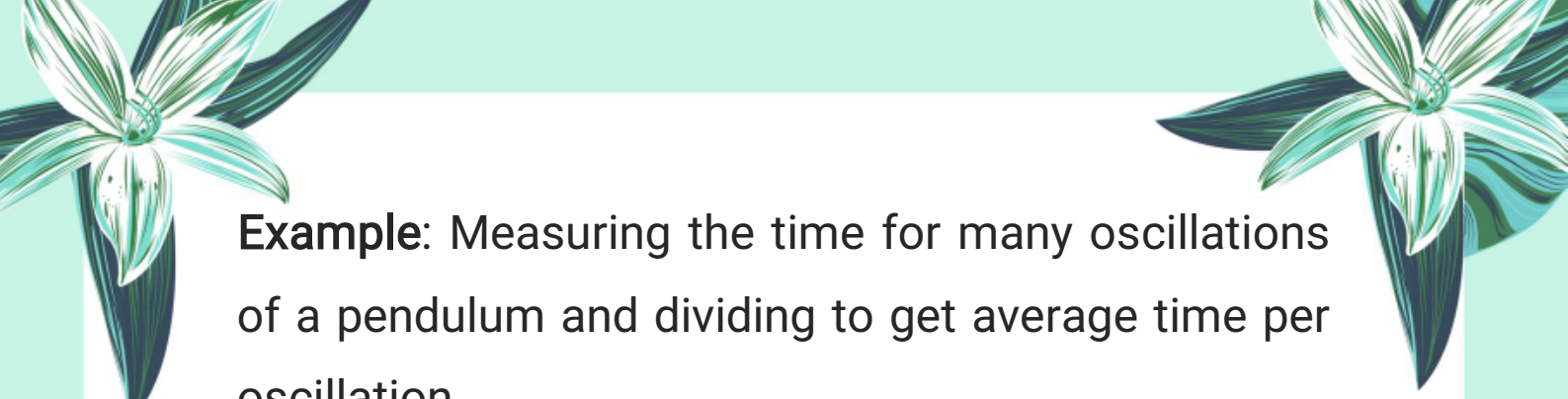
Unpredictable changes in environmental factors such as temperature, pressure, humidity, and voltage.

### **3. Effect:**

Measurements vary randomly, making results inconsistent.

### **4. Reduction Methods:**

- Take multiple readings of the same quantity.
- Calculate the average (mean) value to minimize the impact of random fluctuations.



**Example:** Measuring the time for many oscillations of a pendulum and dividing to get average time per oscillation.



### **C: Constructed Response Questions:**

1.1. In what unit will you express each of the following?

(a) Thickness of a five-rupee coin: Millimeters (mm)

(b) Length of a book: Centimeters (cm) or meters (m)

(c) Length of football field: Meters (m)

(d) The distance between two cities: Kilometers (km)

(e) Mass of five-rupee coin: Grams (g)

(f) Mass of your school bag: Kilograms (kg)

(g) Duration of your class period: Minutes (min) or seconds (s)

(h) Volume of petrol filled in the tank of a car: Liters (L)

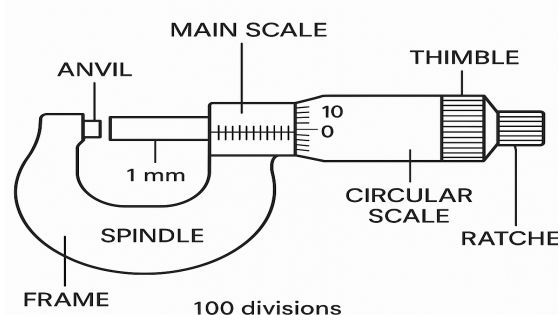


(i) **Time to boil one litre milk:** Minutes (min) or seconds (s)

**1.2. Why might a standard system of measurement be helpful to a tailor?**

A standard system of measurement ensures that the tailor takes accurate and consistent measurements of body dimensions. This helps in making clothes that fit properly and meet customers' expectations. Without a standard system, measurements would vary, leading to ill-fitting garments.

**1.3. The minimum main scale reading of a micrometer screw gauge is 1 mm and there are 100 divisions on the circular scale. When the thimble is rotated once, 1 mm is its measurement on the main scale.**





(a) What is the least count of the instrument?

$$\text{Least count} = (1 \text{ mm}) / 100 = 0.01 \text{ mm}$$

(b) The reading for thickness of a steel rod is shown as main scale reading 6.5 mm and circular scale reading 25 divisions. What is the thickness of the rod?

Thickness = Main scale reading + (Circular scale reading  $\times$  Least count)

$$= 6.5 \text{ mm} + (25 \times 0.01 \text{ mm})$$

$$= 6.5 \text{ mm} + 0.25 \text{ mm} = 6.75 \text{ mm}$$


1.4. You are provided a metre scale and a bundle of pencils; how can the diameter of a pencil be measured using the metre scale with the same precision as Vernier Callipers? Describe briefly.

- To measure the diameter of a pencil accurately using a metre scale:
- Take a bundle of several pencils (e.g., 10 pencils) together and measure the total length of the bundle using the metre scale.
- Divide the total length by the number of pencils



to find the diameter of one pencil.

- This method increases precision by reducing the error in measuring very small lengths.



**1.5. The end of a metre scale is worn out. Where will you place the pencil to find the length?**

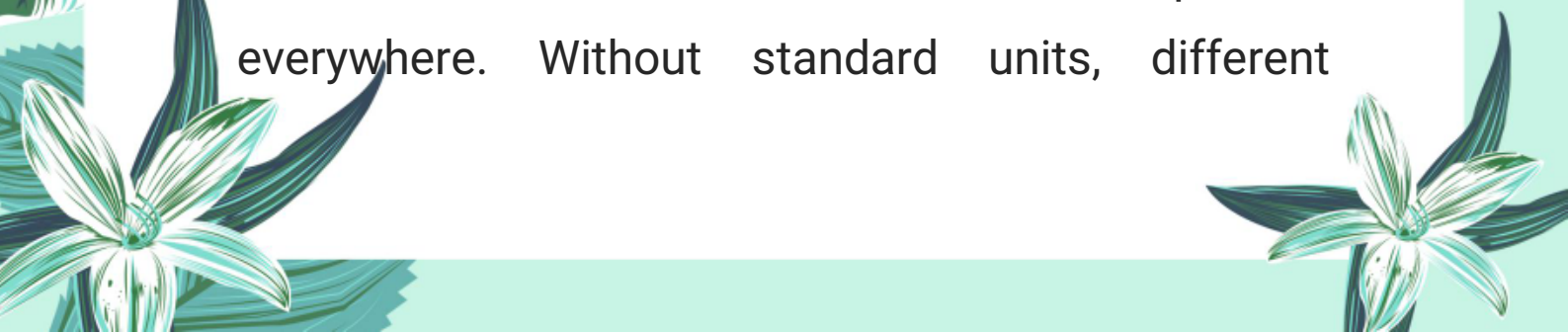
If the end of the metre scale is worn out, place the pencil at the zero mark (not the physical edge) of the metre scale to find its length accurately.

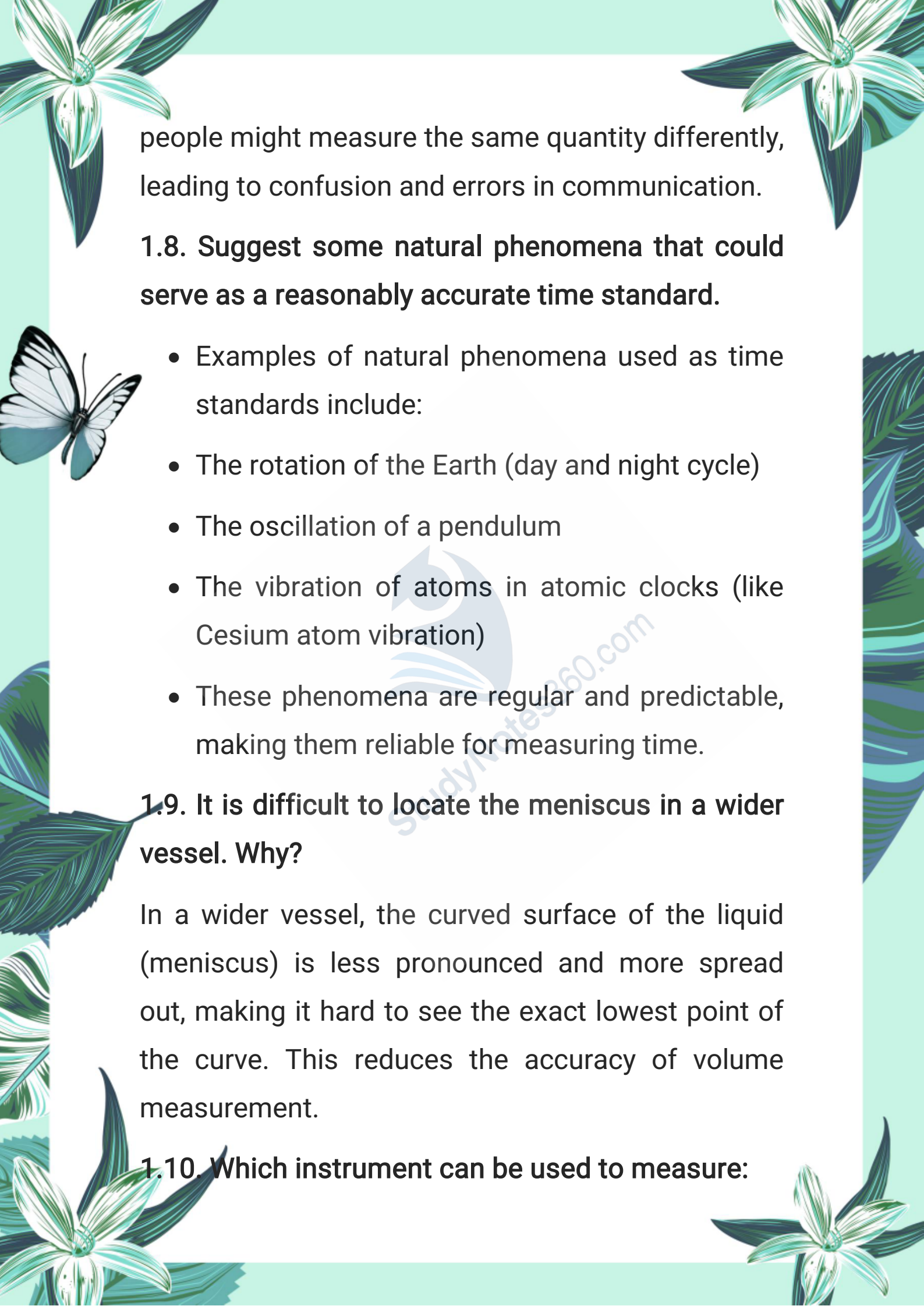
**1.6. Why is it better to place the object close to the metre scale?**

Placing the object close to the metre scale reduces parallax error, which occurs when the eye is not properly aligned with the scale reading. This ensures accurate measurement by avoiding incorrect readings caused by viewing angles.

**1.7. Why is a standard unit needed to measure a quantity correctly?**

A standard unit is needed so that measurements are uniform, consistent, and comparable everywhere. Without standard units, different



The page is decorated with various illustrations: a white butterfly with black markings on its wings is on the left side. There are several green and white flowers with long, narrow leaves scattered around the edges. A large, stylized green leaf is on the right side. The background is a light green color.

people might measure the same quantity differently, leading to confusion and errors in communication.

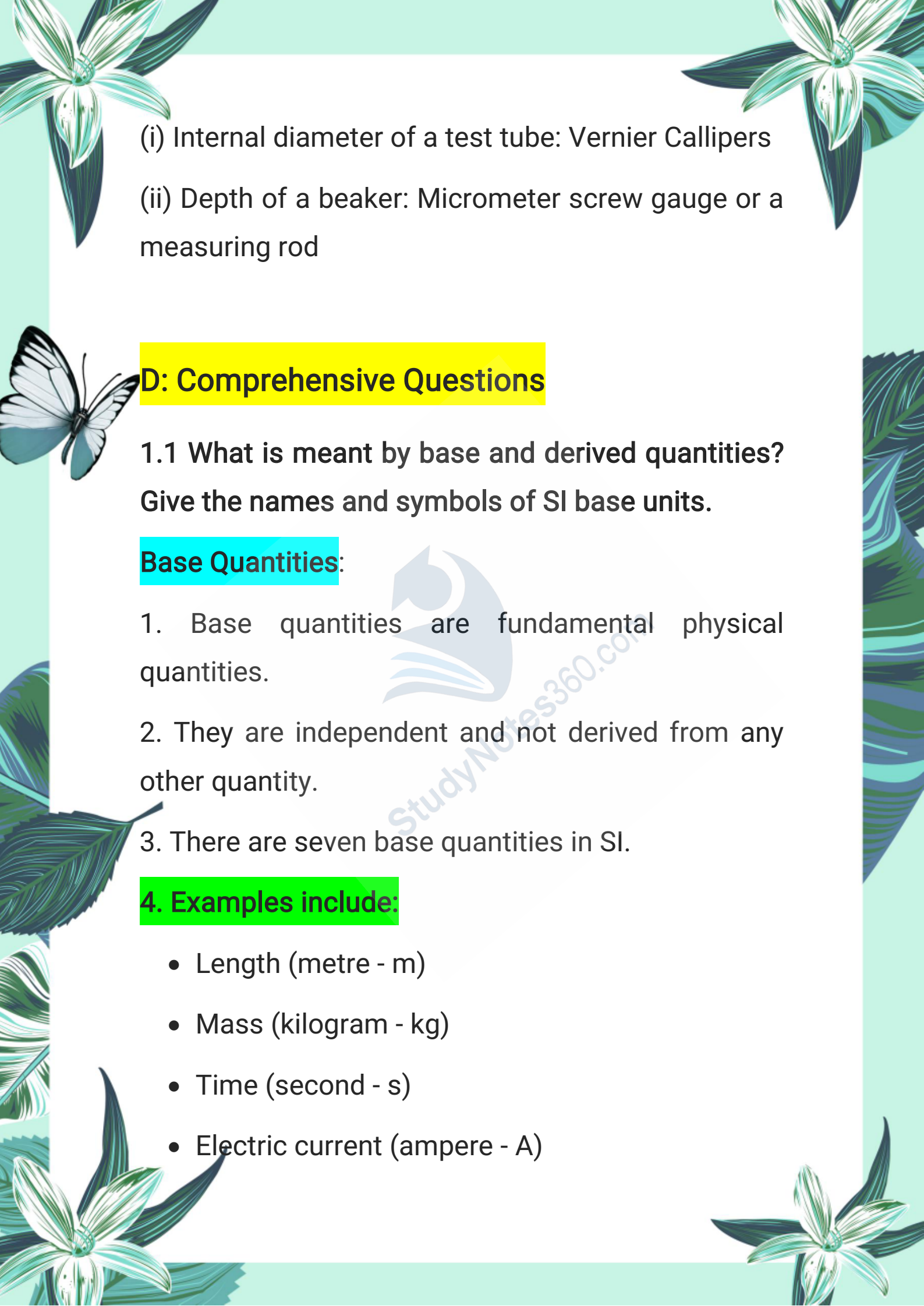
**1.8. Suggest some natural phenomena that could serve as a reasonably accurate time standard.**

- Examples of natural phenomena used as time standards include:
- The rotation of the Earth (day and night cycle)
- The oscillation of a pendulum
- The vibration of atoms in atomic clocks (like Cesium atom vibration)
- These phenomena are regular and predictable, making them reliable for measuring time.

**1.9. It is difficult to locate the meniscus in a wider vessel. Why?**

In a wider vessel, the curved surface of the liquid (meniscus) is less pronounced and more spread out, making it hard to see the exact lowest point of the curve. This reduces the accuracy of volume measurement.

**1.10. Which instrument can be used to measure:**

- 
- (i) Internal diameter of a test tube: Vernier Callipers  
(ii) Depth of a beaker: Micrometer screw gauge or a measuring rod

## D: Comprehensive Questions

1.1 What is meant by base and derived quantities?  
Give the names and symbols of SI base units.

### Base Quantities:

1. Base quantities are fundamental physical quantities.
2. They are independent and not derived from any other quantity.
3. There are seven base quantities in SI.

### 4. Examples include:

- Length (metre - m)
- Mass (kilogram - kg)
- Time (second - s)
- Electric current (ampere - A)

- Temperature (kelvin - K)
- Amount of substance (mole - mol)
- Luminous intensity (candela - cd)

### Derived Quantities:

1. These are obtained by combining base quantities using mathematical operations.
2. Derived quantities depend on base quantities.
3. **Examples:** Speed, Force, Volume, Density, etc.
4. For example, speed = distance/time (metre/second).

**1.2 Give three examples of derived units in SI. How are they derived from base units? Describe briefly.**

#### 1. Area:

- Formula: Area = length  $\times$  breadth
- Derived unit: square metre ( $\text{m}^2$ )

#### 2. Speed:

- Formula: Speed = distance / time
- Derived unit: metre per second ( $\text{m/s}$  or  $\text{m s}^{-1}$ )

### 3. Force:

- Formula: Force = mass  $\times$  acceleration
- Derived unit: kilogram metre per second squared ( $\text{kg}\cdot\text{m}/\text{s}^2$ ) = newton (N)

#### Explanation:

- All these units are combinations of base units.
- They help in measuring more complex physical quantities.

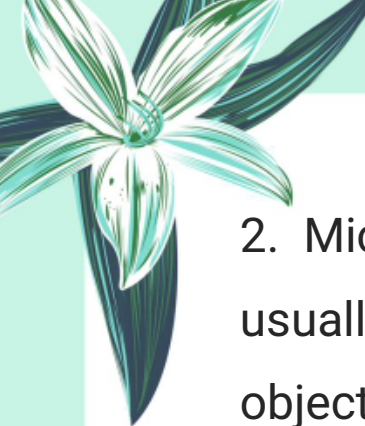
### 1.3 State the similarities and differences between Vernier Callipers and Micrometer Screw Gauge.

#### Similarities:

1. Both are used to measure small lengths precisely.
2. Both provide readings in millimetres or smaller units.
3. They have two scales – a main scale and a smaller/vernier scale for accurate measurement.


#### Differences:

1. Vernier Callipers can measure internal and external diameters and depth.



2. Micrometer Screw Gauge is more precise and usually measures thickness or diameter of small objects.

3. Least count of vernier callipers is usually 0.1 mm; micrometer has a finer least count (0.01 mm).




4. Vernier callipers are faster for general use; micrometers are better for detailed measurements.

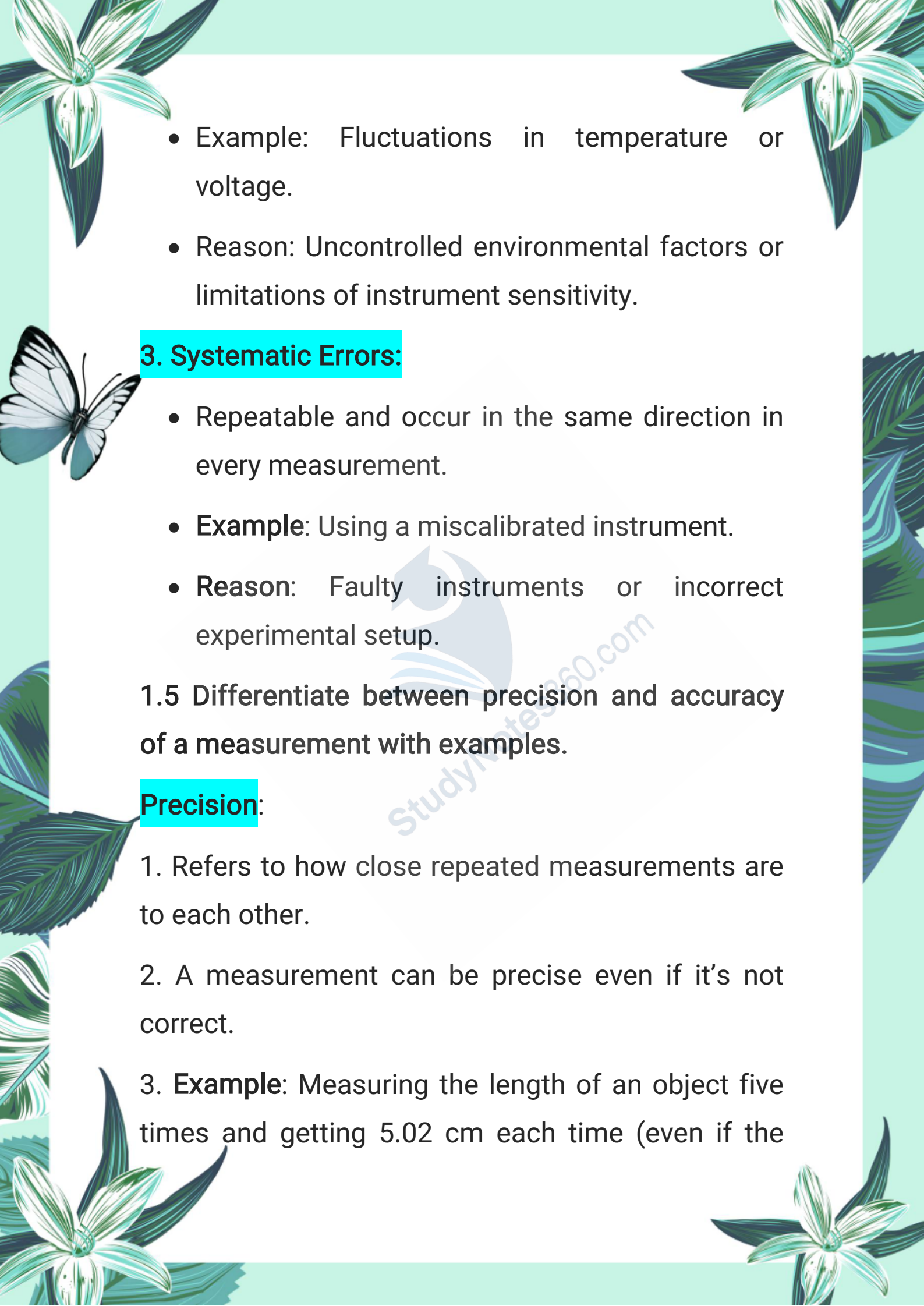
1.4 Identify and explain the reasons for human errors, random errors, and systematic errors in experiments.

### 1. Human Errors:

- Caused by mistakes made by the person conducting the experiment.
- **Example:** Misreading a scale or using faulty technique.
- **Reason:** Lack of attention, fatigue, or improper instrument handling.

### 2. Random Errors:

- Occur unpredictably and vary from one measurement to another.
- 

- 
- The page is decorated with various botanical and nature-themed illustrations. In the top corners, there are stylized flowers with long, pointed petals. On the left side, a butterfly with white wings and dark markings is shown in flight. The bottom corners also feature floral designs. The background is a light, solid color.
- Example: Fluctuations in temperature or voltage.
  - Reason: Uncontrolled environmental factors or limitations of instrument sensitivity.

### 3. Systematic Errors:

- Repeatable and occur in the same direction in every measurement.
- **Example:** Using a miscalibrated instrument.
- **Reason:** Faulty instruments or incorrect experimental setup.

1.5 Differentiate between precision and accuracy of a measurement with examples.


#### Precision:

1. Refers to how close repeated measurements are to each other.
2. A measurement can be precise even if it's not correct.
3. **Example:** Measuring the length of an object five times and getting 5.02 cm each time (even if the

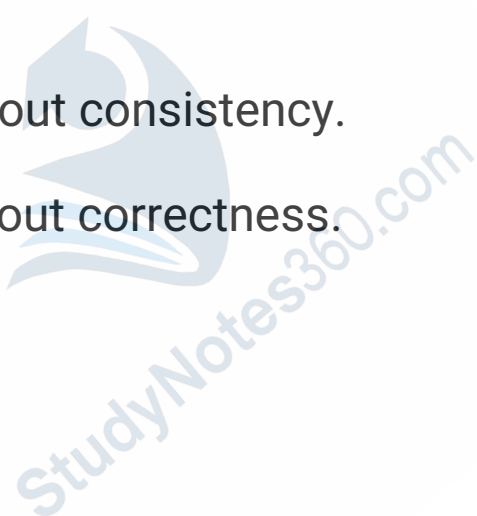


actual length is 5.50 cm).

### **Accuracy:**



1. Refers to how close a measurement is to the true value.
  2. A measurement can be accurate but not precise.
  3. **Example:** Measuring an object's actual length as 5.50 cm and getting 5.49 cm (close to true value).
- 

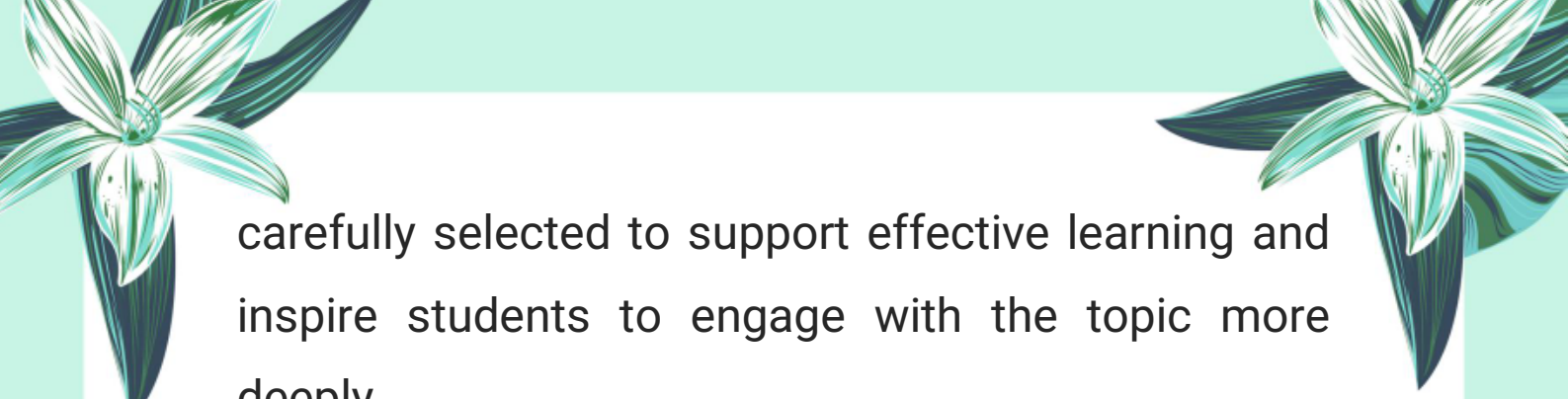
### **Summary:**

- Precision is about consistency.
  - Accuracy is about correctness.
- 

### **Note:**


This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been





carefully selected to support effective learning and inspire students to engage with the topic more deeply.

**Author: Muhammad Asghar**



**Purpose:** To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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