CLASS 9th PHYSICS:

SIDE BOXES FROM FULL BOOK:

Chapter 1:Physical Quantities and Measurements

(National Book Foundation)

Do you know?

Which unit was used by ancient Egyptians while building pyramids?

Ans: The ancient Egyptians used the "cubit" as their primary unit of measurement while building pyramids. The cubit was equivalent to the length of the human forearm, approximately 52.37 centimeters (20.62 inches). This unit was used to measure the pyramids' dimensions, including the base, height, and slope.

POINT TO PONDER:

Measurement is a comparison between an unknown physical quantity (like length, mass, time etc) and standard to see how large or small it is compared to that standard. Unit is the standard with which physical quantities are compared.

(CANTAB)

Do you know?

Mass

SI unit: kilogram (kg)

One kilogram is the mass of one liter of water, or about the mass of an average sized pineapple.

Do you know?

LENGTH

SI unit: meter (m)

1.9 meters is about the average height of a 3½ year old child, or five steps up a typical staircase.

- Micrometer (µm): A millionth of a meter is equal to the length of a bacterium.

-Millimeter (mm): A thousandth of a meter is equal to the diameter of a pinhead.

Do you know?

Temperature SI Unit : kelvin (k)

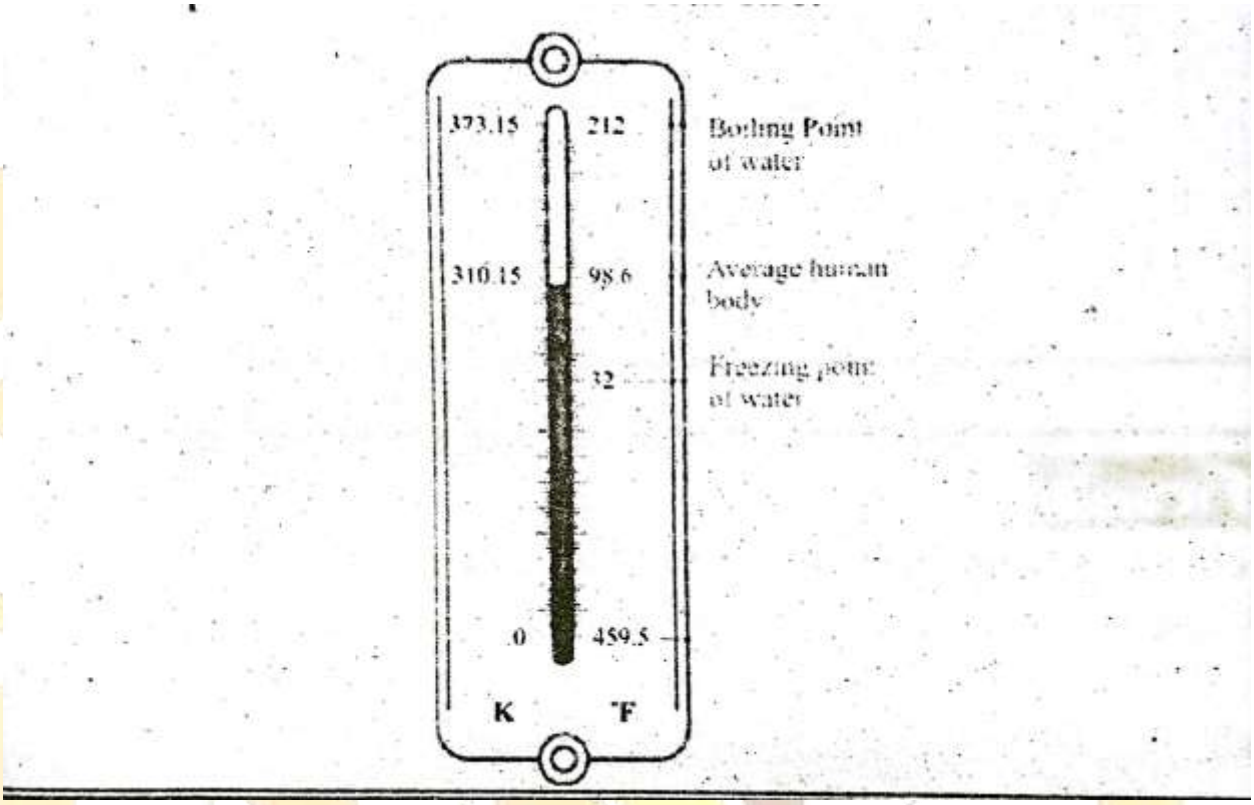
Just one degree rise in temperature can make you feel hot and feverish

Temperature Scales:

In the USA, an everyday temperature scale uses a degree Fahrenheit (°F) where the freezing point of water is 32°F. Kelvin measures all the way down to absolute zero where heat energy does not exist.

- 0 kelvin absolute zero, when all objects and their particles are still.
- I kelvin the coldest known object in the universe, the Boomerang Nebula.

- 1,000 kelvin the temperature inside a charcoal fire.



Do you know?

TIME

SI unit: second (s)

One second is the duration of 9,162,631,770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium-133 atom.

- A minute is 60 seconds.
- An hour is 3,600 seconds
- A day is 86,400 seconds
- A week is 604,800 seconds
- A year (other than leap years) is 31,536,000 seconds.
- A (Georgian) century averages 3,155,695,200 seconds.

Do you know?

Amount of a substance

SI unit: mole (mol)

One mole is a set number of atoms, molecules or other particles. Because substances all have different atomic structures, one mole of one may be very different that of another.

- A tenth of a mole of iron atoms = the amount of iron in the human body
- 1,000 molles of carbon atoms is the amount of carbon in the human body.

- 10 million trillion moles of oxygen molecules is the amount of oxygen in Earth's atmosphere.

Do you know?

Light Intensity

SI Unit: candela (cd)

One candle is the light intensity given off a candle flame.

- A millionth of a candela is the lowest light intensity perceived by human vision.
- Thousands of candles a typical night sky away from city lights.
- I can see the intensity of the sun when viewed from Earth.

(NBF)

Do you know?

Volume is a derived quantity

IL=1000 mL

1L=1 dm^3 = $(10\ cm)^3$ = 1000 cm^3

1 mL = 1 cm^3

Can You Tell?

Can you write the number in power of ten and choose prefix to the following numbers

a) The mass of sun is about 1,970,000,000,000,000,000,000,000,000,000 kg

Solution: **Given data:**

Mass of Sun = M, = 1,970,000,000,000,000,000,000,000,000,000 kg

Required data:

(i) Power of ten = ?

(ii) In prefix

Calculation:

Now in power of 10.

M_s=197000000000000000000000000000000, kg

$M_s = 1.97\times10^{30}$ kg

Now for prefix

$M_s = 1.97\times10^{30} \times 10^3$ g

$M_s = 1.97\times10^{33}$ g

Highest Prefix Yotta Y = 10^{24}

$M_s = 1.97\times10^{9+24}$ g

$M_s = 1.97\times10^{9} \times10^{24}$ g

$M_s = 1.97 \times 10^9$ g

b) radius of a hydrogen atom is about 0.00000000005 m

Solution: **Given data:**

Radius of hydrogen R_H = 0.00000000005 m

Required data:
(i) In scientific notation
(ii) In prefix
Calculation:

R_H = 0.000000000005m
R_H= 5 ×10^{-11}m
In prefix,the closest prefix is Pico = p = 10^{-12})
So. R_H = 50 × 10^{-12} m
R_H= 50 pm

c) The age of earth is about 143,300,000,000,000,000 s.
Solution: **Given data:**
Age of earth = 143,300,000,000,000,000 s
Required data:
Age of earth in scientific form and choose a prefix

Calculation:
In scientific form,
Age of earth 143,300,000,000,000,000 s Age of earth = 1.433 × 10^{17} s
For choosing a prefix
Now closest prefix is 10^{18} = Exa = E
Age of earth = 0.1433 ×10^{18}s
Age of earth = 0.1433 Es

Can you express the following in terms of power of 10.
a). The thickness of the sheet of paper is about 100,000 nanometers.
Solution: **Given data:**
Thickness of sheet T = 100 nanometers

Required data:
In terms of power of 10
Calculation:
T = 100000 nanometer
T = 100000 × 10^{-9} m
T = 1 × 10^{5} × 10^{-9} m
T = 1 × 10^{5-9} m
T = 1 × 10^{-4} m

b) Pakistan has a total installed power generation capacity of over 40,000 megawatt.
Solution: **Given data:**
Power 40,000 megawatt
Required:
In terms of power of 10

Calculation:

P = 40000 Megawatt

$P = 40000 \times 10^6$ W

$P = 4 \times 10^4 \times 10^6$ W

$P = 4 \times 10^{4+6}$ W

$P = 4 \times 10^{10}$ W

c) A single hard disk capacity of computers has exceeded 30 terabytes.

Solution: **Given data:**

Hard disk capacity = 30 terabyte

Required:

In terms of power of 10

Calculation:

Capacity= 30 terabyte

As = T = 10^{12}

Capacity = 30×10^{12} byte

Capacity = 3×10^{13} byte.

(CABTAB)

Do You Know?

Use of scientific notation in p

Physics,Chemistry and Engineering.

Scientific notation is used in various fields to express large or small numbers concisely. In erance from Earth to the Sun. In Physics. astronomy represents vast distances, such as the distance it's used for small measurements like the mass of an electron. Chemistry uses it for quantities like the Avogadro's number, while engineering applies it in measurements like capacitance. In medicine it helps express tiny quantities such as the size of the viruses. Overall, it simplifies calculations and communication in science and engineering.

Do you know? (NBF)

Standard form or scientific notation represents a number as the product of a number greater than I and less than 10 (called the mantissa) and a power of 10 (termed as exponent):

number mantissa x $10^{exponent}$

POINT TO PONDER (NBF)

Does vector addition depend on the order? Will it make any difference if we add vector A with vector Bor vector A with vector B.

Ans: No vector addition does not depend on the order in which the vectors are added. It will not make any difference whether we add vector A with vector Bor or vector B with vector A, the resultant will be the same. This property is known as the commutative property of vector addition.

CAN YOU TELL? (NBF)

What is the length of the object measured by meter rod if it is 20.14 cm measured by vernier calipers?

Ans: As we know, the least count of vernier calipers is 0.01 cm, but the least count of meter rule is 0.1 cm. So, the length of the object measured by the meter rod will be 20.1 cm. The reason being that the least count of meter rod which is 0.1 cm.

Can you tell?(NBF)

You have to measure the thickness. of the page and internal diameter of a beaker. Which instrument would you use: vernier caliper or screw gauge? Why?

Ans: To measure the thickness of the page I would like to use a screw gauge because screw gauge gives good results as compared to vernier calipers.

To measure the internal diameter of the beaker I would like to use vernier calipers because only by using vernier calipers can we measure internal diameter.

For you information (NBF)

Least count of the ruler is 1 mm. It is 0.1 mm for Vernier calipers and 0.01 mm for micrometer screw gauge.

Thus measurements taken by micrometer screw gauge are more precise than the other two.

Point to Ponder (NBF):

Can you measure distances smaller than 1 mm on meter rule? Why?

Ans: No, you cannot measure distances smaller than 1 mm on a meter rule. This is because the least count of a meter rule is 1 mm, which means it can only measure distances to the nearest millimeter.

Least Count of meter rule = 0.1 cm or 1 mm

The least count of an instrument is the smallest unit of measurement that it can accurately detect. In the case of a meter rule, the markings are usually 1 mm apart, so it can only measure distances to the nearest 1 mm. Trying to measure distances smaller than 1 mm would require an instrument with a smaller least count, such as a vernier caliper or a micrometer.

Can you tell? (NBF)

Some meter rulers like the one shown in the figure below are marked with inches and feet? What is the least count of meter rule on this scale?

Ans:

Least count of the measuring meter rule is **0.1 cm or 1 mm.**

Do you know?(Cantab)
To reduce random error, averaging multiple readings is effective because positive and negative errors cancel each other out, bringing the average closer to the true value.

Chapter 2:Kinematics

Point To Ponder (NBF)
Interestingly objects can be at rest and in motion at same time. It looks simple to distinguish the rest from motion, for example a car starts, it changes its position with reference to its surroundings, we say that the car is moving.

However, we know that Earth is spinning on its axis, so the car along with its road is also in motion. Not only this but Earth is also moving around the sun and the sun along with the rest of the solar system are also moving through our milky way galaxy. Apart from this our galaxy is also traveling through space. How can we say that we are at rest? This is why when we state an object to be at rest or motion, we specify its reference to some observer.

Do you know?(Cantab)
Position vs displacement

Position tells us where something is from origin.

Displacement tells us how much and in which direction it has moved from its initial position.

Point to Ponder (NBF)
Here we used symbol A(Greek letter delta) for change in position; however, it is used. to represent a change in any quantity. For example elapsed time At is the change in (or the difference between) the ending time ty and beginning time t,

Can you tell? (NBF)

If on a 400 m running track your starting point and ending point is the same. How much distance have you covered? What is your displacement?

Ans: In a scenario where you start and end at the same point on a 400 m running track, your total distance covered would be 400 meters, as you've traversed the entire circumference of the track.

However, your displacement would be zero because displacement refers to the shortest distance between the initial and final points, regardless of the actual path taken. Since you've returned to your starting point, your displacement is the straight-line distance from the starting point to the ending point, which is zero.

Can you tell? (NBF)

Can displacement be greater than distance?

Ans: Displacement is the shortest distance between the initial and final positions, measured along a straight line. In any physical scenario, the shortest distance between two points cannot be greater than any alternative path between those points. Therefore, displacement cannot exceed distance.

Can distance and displacement be equal?

Ans: Yes, distance and displacement can be equal, but only when the object moves in a straight line, without changing direction. In this case, the shortest distance between the initial and final positions (displacement) is the same as the total length of the path traveled (distance).

For example:

If you walk 5 kilometers north, your distance traveled (5 km) is equal to your displacement (5 km north).

If you walk in a circle and end up back at the starting point. your distance traveled (circumference of the circle) is not equal to your displacement (zero. since you ended up back at the starting point).

Point to Ponder (National Book Foundation)

Some interesting speed facts

Who is the fastest man on earth?

Yes Usain Bolt. He finished a **100-meter** sprint in just **9.58 seconds back in 2009.** In that instance, his speed was **10.44 m/s or 37.58 km/h.**

The slowest animal in the world, the crown goes to the 3-toed sloth. And, the average speed of them is about **0.00134112 m/s or 0.0048 km/h.** You would have seen garden snails or turtles move faster than this rate.

The fastest animal in the world is Peregrine Falcon, it can attain a maximum speed of up to **108.333 m/s or 390 km/h.** Cheetah is the fastest animal in the land and can reach a fastest speed of **33.33 m/s or 120 km/h.**

Do you know? (National Book Foundation)
When it comes to the fastest measured speed, the limit is set by the laws of physics themselves as the Need of light Albert Einstein realized that a light ray appears to move at the same speed wardless of whether it's moving towards us or away from us. No matter how fast you used on in what direction, all light always moves at the same speed. Moreover, anything' Aa's made of matter can only approach, but never reach, the speed of light. If you don't have one, 10 must move at the speed of light if you do have mass, you can never reach it.
lambda = 10

The speed of vacuum is about 299,792,458 m/s or 299, 792 km/s (which is pinnately j * 10^{8}* m * s^{-1}) At this speed, you can revolve around the earth 7.5 times in a and a comparison the speed of sound in the air is roughly 343 m/s or 767 mph or 1235 an. That means the speed of light is so much faster than the speed of sound.

Point to Ponder (National Book Foundations

The first scientist to measure speed as distance over time was Galileo. He dropped various objects of different masses from the leaning tower of Pisa. He found that all of them reached the ground at the same time. The acceleration of freely falling bodies is called gravitational acceleration or acceleration due to gravity denoted by 'g'.

Do you know? (Cantab Publishers)
Speed Gun:
Police Radar speed guns use radio waves to detect if drivers are speeding. These devices send out radio waves that bounce back off moving vehicles. The speed of the vehicle affects the characteristics of the reflected waves. Speed gun receives the return signal and determines the speed using changes in characteristics of reflected waves. This allows the radar gun to accurately identify vehicles that are exceeding speed limits.

Reflected waves are compressed, resulting in shorter wavelength and higher frequency,

Do you know? (Cantab Publisher)
When you sit on a chair, your speed is zero relative to Earth but 30 km/s relative to the sun.

Do you know? (Cantab Publishers)

When observation is taken for extremely small time that approaches zero, then we say observations are taken at an instant of time.

Do you know? (Cantab Publishers)
The car on the circular track may have a constant speed, but its velocity is changing every instant. Why?

Ans: The car on the circular track has a constant speed because it is moving at a constant rate (e.g., 60 km/h). However, its velocity is changing every instant because its direction is constantly changing. Velocity is a vector quantity that includes both magnitude (speed) and direction. Since the car is moving in a circular path, its direction is constantly changing, which means its velocity is also changing, even though its speed remains constant.

In other words, the car's velocity vector is constantly being redirected as it moves around the circular track, resulting in a change in velocity, even though its speed remains constant. This is why the car's velocity is changing every instant, despite its constant speed.

Chapter 3 : Dynamics- I

Important Information (Cantab)

Tides:

Tides are caused by the gravitational pull of the moon on Earth's oceans, resulting in periodic rises and falls in sea level. The moon's gravitational force pulls water towards it, creating high tides on the side of Earth nearest to the moon and on the opposite side due to the inertia of water.

Do you know? (Cantab)

Hydrofoil:

Drag in water is much greater than drag in air, some boats reduce drag by lifting their hulls out of the water. A hydrofoil is a boat with underwater "wings" that generate the force of lift raising the boat when it moves quickly.

Do you know? (Cantab)

Streamline Design:

Fast moving objects like sports cars or planes have shapes that reduce the drag force; we call these shapes streamlined. They are sleek with smooth surfaces, helping them move easily through air or water. Just like how sharks and dolphins, which swim fast, have streamlined bodies to glide through water with less resistance.

Do you know? (Cantab)

Tension vs Elastic Force:

Tension in an elastic material, like a rubber band, reflects the elastic force aiming to revert it to its original state. Elastic force depends on deformation, present only if the material is displaced. Tension, however, can exist in non-elastic materials like ropes, independent of deformation

Do you know? (Cantab)

Cyclists also try to be streamlined. They tuck in their arms and lean forward to face less air. They even wear special helmets to help them go faster against the air.

(Cantab)

Q- Why do we build up suspension bridges?

Ans: A suspension bridge is built to support its own weight and the weight of any traffic crossing it without collapsing. The bridge's weight pulls it down, but this force is balanced by upward forces from the pillars. A stretching force called tension in the steel cables and suspenders also pulls the bridge upward and supports its weight.

Do you know? (Cantab)

Touch Screens

The screens on many modern phones and tablets use electric charges. When you touch the screen, you change the electric charge at that spot, and the device senses this change to detect where you touched it.

Important Information (Cantab)

Compass:

A compass is simply a magnetized needle balanced on a point. The needle lines up with Earth's magnetic field to show which way is north, helping you find your way.

Do you know? (Federal Board)

As the bus starts moving with uniform speed, if we hold on to the pole, it supplies the force needed to give us the same motion as the bus, so we no longer feel pushed. But when the goes around a curve, again we feel a tendency to move to the side of the bus. The bus has changed its straight-line motion, but we tend to move straight ahead. The same principle is again at work when the bus starts to slow down or stops, we feel to move forward. Thus, the push, we feel, when the bus starts moving, speeds up, slows down or turns around a corner are a result of our tendency to remain at rest or follow a straight path.

POINT TO PONDER (Federal Board)

Experiment to demonstrate Inertia: We take a glass tumbler and place a thick square card on its mouth as shown in the figure (a) below. A coin is then placed above this card in the middle. Let us flick the card hard with our fingers. On flicking, the card moves away but the coin drops into the glass tumbler . We will now explain how it happens.

Initially, both the card and the coin. are in the same state of rest. Now, when we hit the card with our fingers, a force acts on the card and changes its state of rest to that of motion. Due to this, the card moves away from the mouth of the glass tumbler. The tence of our flick, however, does not act on the coin, so the coin continues to be in its state of rest due to inertia. And when the card (on which the coin had been placed) moves away, the coin falls into the glass tumbler because it prefers to maintain its state of rest due to inertia.

Expected SLO based Question: Mass of a body is the measure of its inertia. Comment on it.

Ans: If a body has more mass, it has more inertia. That is, heavier objects have more inertia than lighter objects. For example, a stone has more inertia than football. Similarly, a cricket ball has more inertia than a rubber ball of the same size. A cricket ball has more inertia because it has more mass (it is quite heavy). On the other hand, a rubber ball has less inertia because it has less mass (it is quite light). Thus the inertia of a body depends on its mass. having 20 kg mass will have more inertia. It is easier to move a body of mass I kg by pushing For example, if a body has mass of 1 kg and another body has a mass of 20 kg, then the body 4 of mass 20 kg by pushing it (because of its very high inertia).

POINT TO PONDER (Federal Board)

Ans: It is more difficult to push a large man on a swing compared to a small child because the Why is it more difficult to push a large man on a swing compared to a small child?

Jorger was of the man increases the mertia, requiring more force to overcome resistance and motion Additionally, the greater mass of the man results in a slower response to Replied force, making it harder to.

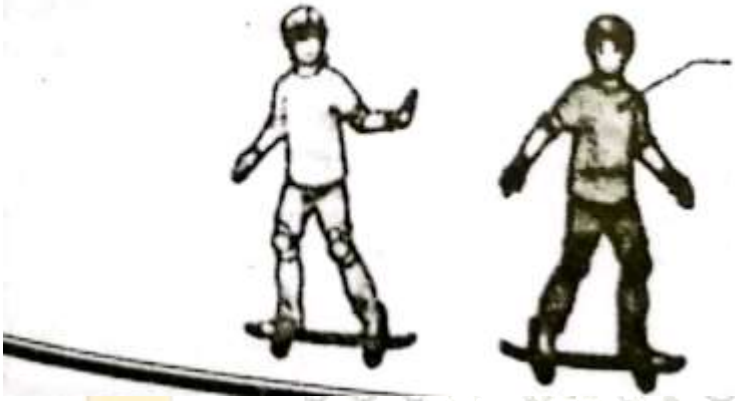
Do you know? (Cantab)

When external force acts on the system like push of the floor which is not part of the system. So, the system is not isolated in this case, then action and reaction force neither cancel for individual objects nor for the entire system.

Important concept (Cantab)

If a skateboarder pushes a wall, the wall pushes back with a reaction force that causes the skater to roll away from it but wall remains at rest.

If one skateboarder pushes another, action and reaction cause both skaters to roll away from each other.



Skateboarders move in opposite directions at same velocity.

What do you think? (Cantab)

Imagine two boxes of the same size. One is filled with cotton while the other is filled with sand. Which one would have more mass than the other?

Ans: The box filled with sand would have more mass than the box filled with cotton. Mass is a measure of the amount of matter in an object, and sand is denser than cotton, meaning that a given volume of sand contains more matter (and therefore more mass) than the same volume of cotton.

Even though the boxes are the same size, the one filled with sand would have a greater mass because it contains more matter.

Do you know?(Cantab)

Weight and mass are confused in a scenario when you want to measure your weight. Your weight is a force and should be me..sured in newtons, but often scales measure your weight in kilograms. Scientifically this is wrong.

Important Information (Cantab)

Timing is important especially when you change your momentum

Do you know? (Cantab)

Your hair acts like a crumple zone on your skull. A force of 5N might be enough to fracture your naked skull (cranium) but with a covering of skin and hair, needed. a force of 50 N would be.

Key Facts (Cantab)
The plot of force against time is called a force-time graph. The area under this graph, when measured against the time-axis represents the impulse experienced by an object

Do you know? (Cantab)
A motorcycle's safety helmet is padded so as to extend the time of any collision to prevent serious injury.