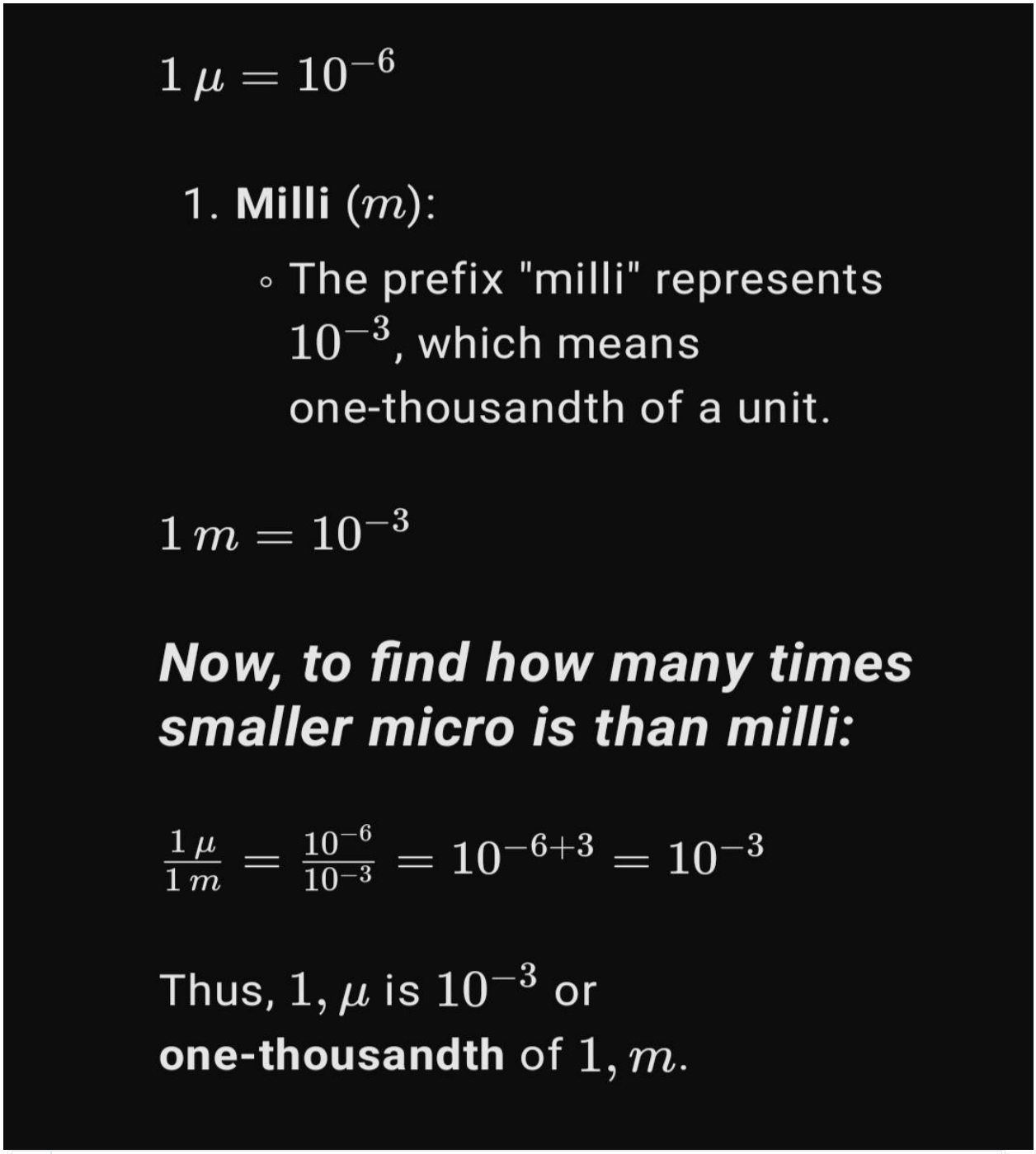
Chapter 1: Physical Quantities and Measurements

1. **How does basic physics play an important role in our lives?**
    - Basic physics helps us understand the fundamental principles that govern the natural world. It explains how things move, how energy is transferred, and how forces interact. This knowledge is crucial for developing technology, improving healthcare, and solving environmental issues. For example, advancements in medical imaging technologies like MRI rely on principles of physics.
2. **Estimate your age in minutes and seconds.**
    - To estimate your age in minutes and seconds, you can use the following calculations:
        - Age in years × 365.25 (days per year, accounting for leap years) × 24 (hours per day) × 60 (minutes per hour) for minutes.
        - Age in minutes × 60 (seconds per minute) for seconds.
        - For example 15×365.25×24×60×60=The result of is 473,364,000 seconds.
3. **What quantities are involved in these physical quantities: force, pressure, power, and charge?**
    - Force: Mass and length and time
    - Pressure: mass time and and length
    - Power: Work done and time.
    - Charge: Electric current and time.
4. **Show that the prefix micro is a thousand times smaller than the prefix milli.**



5. **Justify that specific heat is a more extensive quantity than the calorific value of a substance.**

- Specific heat is the amount of heat required to raise the temperature of a unit mass of a substance by one degree Celsius. Calorific value is the amount of energy produced by the complete combustion of a substance. Specific heat is an extensive property because it depends on the amount of substance, while calorific value is an intensive property.

6. **Screw gauge can give more precise length measurements than vernier calipers. Briefly explain why.**
    - A screw gauge can measure smaller dimensions with higher precision because it has a finer pitch and smaller least count compared to vernier calipers, allowing for more accurate readings.
7. **Differentiate between a mechanical stopwatch and a digital stopwatch.**
    - A mechanical stopwatch uses gears and springs to measure time, while a digital stopwatch uses electronic components and displays time on an LCD or LED screen.
8. **How is a measuring cylinder used to measure the volume of an irregularly shaped stone?**
    - A measuring cylinder is used by filling it with water and noting the initial volume. The stone is then submerged in the water, and the new volume is recorded. The difference between the initial and final volumes gives the volume of the stone based on the principle of water displacement.
9. **What precautions should be kept in mind while taking measurements using a measuring cylinder?**
    - Ensure the cylinder is on a level surface, read the meniscus at eye level to avoid parallax errors, use clean equipment, and handle the cylinder carefully to avoid spills or breakage.
10. **Why do we need to consider significant digits in measurements?**
    - Significant digits reflect the precision of a measurement. Considering them ensures accuracy and consistency in calculations and comparisons.
11. **How can random error be reduced?**
    - Random error can be reduced by taking multiple measurements and averaging the results, using precise instruments, and maintaining consistent experimental conditions.
12. **Differentiate between precision and accuracy.**
    - Precision refers to the consistency of repeated measurements, while accuracy refers to how close a measurement is to the true value.

Chapter 2: Kinematics

1. **In a park, children are enjoying a ride on a Ferris wheel as shown. What kind of motion does the big wheel have and what kind of motion do the riders have?**
    - The big wheel has rotational motion, while the riders experience circular motion around the center of the wheel.
2. **A boy moves for some time; give two situations in which his displacement is zero but the distance covered is not zero.**
    - Walking around a circular track and returning to the starting point.
    - Walking to a point and then walking back to the starting point.
3. **A stone tied to a string is whirling in a circle. What is the direction of its velocity at any instant?**
    - The direction of the stone's velocity is tangential to the circle at any given point.
4. **Is it possible to accelerate an object without speeding it up or slowing it down?**
    - Yes, it is possible. For example, an object moving in a circular path at constant speed is accelerating because its direction is continuously changing.
5. **Can a car moving towards the right have its acceleration towards the left?**
    - Yes, if the car is decelerating or slowing down, its acceleration will be in the opposite direction of its motion.
6. **With daily life examples, describe situations in which:**
    - **a. Acceleration is in the direction of motion:** A car speeding up on a highway.
    - **b. Acceleration is against the direction of motion:** A car coming to a stop at a red light.
    - **c. Acceleration is zero and the body is in motion:** A car moving at constant speed on a straight road.
7. **Examine the distance-time graph of a motorcyclist (as shown). What does this graph tell us about the speed of the motorcyclist? Also, plot its velocity-time graph.**

- The distance-time graph shows whether speed is constant or changing; if it's a straight line, speed is constant; if curved, speed changes over time. The velocity-time graph can be plotted based on changes in slope from distance-time data.

8. **Which controls in the car can produce acceleration or deceleration?**
    - The accelerator pedal increases speed (acceleration), while the brake pedal decreases speed (deceleration). The steering wheel also affects acceleration when turning.
9. **If two stones of 10 kg and 1 kg are dropped from a 1 km high tower, which will hit the ground with greater velocity? Which will hit first? (Neglect air resistance)**
    - Both stones will hit the ground with the same velocity and at the same time because acceleration due to gravity is constant for all objects regardless of their mass when neglecting air resistance.
10. **A 100 g ball is just released (from rest), and another is thrown downward with a velocity of 10 m/s. Which will have greater acceleration? (Neglect air resistance)**
    - Both balls will have the same acceleration due to gravity, which is approximately 9.8 m s29.8m s2.

Chapter 3: Dynamics

1. **When a motorcyclist hits a stationary car, he may fly off his motorcycle while the driver may get neck injuries; explain why this happens.**
    - When a motorcyclist collides with a stationary car, inertia causes him to be thrown forward due to sudden deceleration upon impact with an immovable object like another vehicle; this may lead to injury from being thrown off balance or impact forces.
2. **In autumn, when you shake a branch, why do leaves detach?**
    - When you shake a branch, leaves experience forces that overcome their attachment due to inertia; they fall due to gravity once detached from their holding force.
3. **Why is it not safe to apply brakes only on one front wheel of a bicycle?**
    - Applying brakes only on one front wheel can cause instability leading to flipping forward due to sudden deceleration which shifts weight distribution dangerously toward that side.

4. **Deduce Newton's first law from Newton's second law of motion:**
    - Newton's second law states that F=ma$F=ma$. If net force FF equals zero (no external forces), then acceleration aa must also equal zero; hence an object remains at rest or continues moving uniformly—this embodies Newton's first law.
5. **Action-reaction forces are equal but opposite; do they balance each other? Can bodies move under this action-reaction pair?**
    - Action-reaction forces do not balance each other since they act on different bodies; yes, bodies can move under these forces as seen with rockets propelling forward when exhaust gases push downward.
6. **A man slips on an oily floor; he throws his bag to escape this area alone; why does he do this?**
    - By throwing his bag forward, he exerts force on it which creates an equal reaction force pushing him backward away from slippery ground—this utilizes Newton's third law effectively for movement.
7. **Explain rocket motion using Newton's third law and conservation of momentum:**
    - According to Newton's third law for every action there's an equal opposite reaction; expelling gas downwards generates upward thrust propelling rockets into space while conservation states momentum before expulsion equals momentum after expulsion ensuring balanced motion dynamics.
8. **Why are cricket batter gloves padded with foam?**
    - Cricket gloves are padded with foam material designed specifically for shock absorption during impact with fast-moving balls minimizing injury risk by reducing force transmitted directly onto hands during play.
9. **Where will your weight be greater—near Earth or near Moon? What about mass?**
    - Your weight will be greater near Earth due to stronger gravitational pull; however your mass remains unchanged regardless of location since mass measures matter quantity independent from gravitational effects.
10. **When Ronaldo kicks ball at full force why doesn't ball move towards Earth equally as Earth moves towards ball?**
    - Both exert equal-opposite forces upon contact but Earth's massive size results in negligible acceleration compared with ball leading it instead

towards ground under gravitational influence while ball accelerates significantly away due primarily lighter mass ratio involved here.

Chapter 4: Dynamics II

1. Why are door knobs fixed at the edge of the door? What will happen if the door knob is at the middle of the door?

- Answer: Door knobs are fixed at the edge of the door to maximize torque, making it easier to open or close the door. If the knob were in the middle, it would require more force to achieve the same effect because the distance from the pivot point (hinges) would be shorter, reducing leverage.

2. Why is a long spanner used to open or tighten nuts of a vehicle's tire? Why is an extra-long wrench not suitable for tightening a small nut?

- Answer: A long spanner provides greater leverage, making it easier to apply the necessary torque to loosen or tighten nuts. An extra-long wrench can apply excessive force on small nuts, potentially damaging them or stripping the threads.

3. If you drop a feather and a bowling ball from the same height, which one will reach terminal velocity first? Which one of them will hit the ground first?

- Answer: The feather will reach terminal velocity first due to its lower mass and higher air resistance relative to its weight. The bowling ball will hit the ground first because it is less affected by air resistance and accelerates faster under gravity.

4. Why do ice skaters effortlessly slide on ice, while your shoes cause skidding?

- Answer: Ice skaters slide effortlessly because the thin layer of water created by the pressure of the skate blade reduces friction. Shoes have more surface area and different materials, causing more friction and skidding.

5. Explain why it's easier to push a car on flat tires than inflated ones. What happens to the frictional force between the tires and the road?

- Answer: It's easier to push a car on flat tires because they create a larger contact area with the ground, which reduces pressure and frictional force between the tires and road. Inflated tires have a smaller contact area, increasing frictional force, making them harder to push.

6. When standing on a crowded school bus, which stance would provide better stability and prevent you from being pushed over: legs together or legs spread apart?

- Answer: Standing with legs spread apart provides better stability because it lowers your center of gravity and increases your base of support, making it harder to be pushed over.

7. Why is a moving bicycle easier to balance? Relate this to principles of rotational motion.

- Answer: A moving bicycle is easier to balance due to the gyroscopic effect of rotating wheels, which creates angular momentum that stabilizes the bicycle and helps maintain its upright position.

8. Why is a pencil standing on its tip unstable, and what factors affect the stability of an object balanced on a point?

- Answer: A pencil standing on its tip is unstable because its center of gravity is high and its base of support is small. Stability is affected by both the height of the center of gravity and the size of the base of support; a lower center of gravity or wider base increases stability.

9. While driving, what happens if the driver takes a curve too fast? How does centripetal force play a role in keeping the car from skidding off the road?

- Answer: If a driver takes a curve too fast, insufficient centripetal force may cause the car to skid off the road. Centripetal force is provided by friction between tires and road; if this force is not enough to counteract inertia pulling outward during turns, loss of control occurs.

10. Consider a situation where you swing a ball connected to a string in a circle. How does tension in the string vary as the ball moves across different points in its circular path, and what forces are involved?

- Answer: The tension in the string is greatest at the lowest point due to gravitational force acting downward plus centripetal force needed for circular motion. At higher points in its path (like at top), tension decreases as some centripetal force requirement is met by gravitational pull acting downward.

11. Why is it important for communication satellites in geostationary orbit to maintain a specific speed?

- Answer: Communication satellites in geostationary orbit must maintain a specific speed equal to Earth's rotation speed (about 3.07 km/s) so they remain fixed over one point on Earth's surface; this ensures consistent communication signals without interruption.

Chapter 5: Pressure and Deformation in Solids

1. Why does walking on sharp stones hurt more than walking on sand?

- Answer: Walking on sharp stones hurts more because pressure exerted on your feet is higher due to smaller contact area with stones compared to sand; sand distributes pressure more evenly across larger areas, reducing pain.

2. How does the shape of a thumbtack help it penetrate surfaces easily?

- Answer: The sharp point of a thumbtack concentrates applied force over a very small area, increasing pressure which allows it to penetrate surfaces more easily.

3. If you blow up a balloon and then let it go, why does it fly off instead of just staying still?

- Answer: When you let go of an inflated balloon, air rushes out creating an action force that propels balloon in opposite direction according Newton's third law; this results in upward motion as air escapes downward.

4. Why is an inner airtight layer of a spacesuit designed to maintain constant pressure around astronauts?

- Answer: The airtight layer maintains constant pressure so that astronauts' bodily functions operate normally in vacuum conditions encountered in space; this prevents decompression sickness and other pressure-related issues.

5. If a liquid has twice Mercury's density, what will be its height in barometer measurement?

- Answer: The height h of this liquid column will be half that of mercury's height (approximately 760 mm) since pressure exerted by liquid column remains constant; thus if density doubles height halves due relation:

$$P = h \cdot d$$

Where P = pressure exerted by column.

6. Why wouldn't we be able to sip water with a straw on the moon?

- Answer: On Moon there's no atmosphere creating necessary pressure difference required for drawing liquid up through straw; without atmospheric pressure water cannot be forced upwards against gravitational pull effectively.

7. How are we able to break metal wire by bending it repeatedly?

- Answer: Bending metal wire repeatedly causes fatigue weakening material at bend points until it eventually breaks; this occurs due stress concentration leading fracture propagation through material structure over time.

8. A spring having spring constant k when loaded with mass m is cut into two equal parts. One part loaded with same mass m again; what will be its new spring constant now?

- Answer: When spring cut into two equal parts each part's spring constant doubles; thus new spring constant becomes $2k$ when loaded with same mass m.

9. Why do static fluids always exert force perpendicular to surfaces?

- Answer: Static fluids exert forces perpendicular due isotropic nature fluid pressure which acts equally in all directions regardless orientation encountered within contained environment present here!

10. How can small car lifters lift loads heavier than themselves?

- Answer: Small car lifters utilize hydraulic systems based upon Pascal's law which multiplies input forces allowing small effort applied lift much larger weights effectively through principle fluid mechanics governing behavior observed here!

Chapter 6: Work and Energy

1. A car is moving with constant speed along a straight road; is there any work done on the car?

- Answer: No net work is done if speed remains constant since kinetic energy doesn't change indicating no external forces acting upon system altering energy state experienced here!

2. Does work done raising box up building depend upon how fast raised or path taken? To how much height?

- Answer: Work done depends solely upon height raised not speed or path taken; calculated using formula:

W = mgh

Where m = mass, g = gravitational acceleration, h = height raised above reference level considered here!

3. How much work has been done by external forces on an orbiting satellite?

- Answer: For stable orbiting satellites no net work performed by external forces since gravitational pull acts perpendicular direction motion preventing energy change within system dynamics observed here!

4. A car has kinetic energy 'E'. By what factor would its kinetic energy change if velocity doubled?

- Answer: If velocity doubled kinetic energy increases by factor four since kinetic energy:

E = $\frac{1}{2}mv^2$

Implies doubling velocity quadruples resultant energy value produced here!

5. A bullet fired from gun penetrates into sand wall stopping there; where does its kinetic energy go?

- Answer: Kinetic energy converts into heat generated sound produced deformation energy absorbed bullet/sand wall upon impact resulting dissipated energies observed during collision events encountered regularly!

6. An LED light bulb has efficiency of 80%. Does it violate conservation principle energy principle?

- Answer: No violation occurs since remaining 20% lost as heat indicates total output less than input confirming conservation laws upheld throughout system interactions experienced regularly!

7. How does using renewable sources compare non-renewable regarding environmental impact?

- Answer: Renewable sources typically exhibit lower environmental impact producing less pollution/greenhouse gases compared non-renewable fossil fuels contributing significantly climate change effects observed globally today!

8. How will renewable sources eventually contribute reducing environmental impacts compared non-renewable resources used today?

- Answer: Renewable sources reduce reliance fossil fuels decreasing greenhouse gas emissions/pollution levels contributing positively towards mitigating climate change effects experienced globally today!

9. How can increasing power machine impact energy consumption overall system performance metrics evaluated regularly here!

- Answer: Increasing power generally raises overall energy consumption since power represents rate at which work performed indicating greater inputs required achieving desired outputs effectively!

10. A perpetual engine has efficiency equal one (100%). Why will it not work under any circumstances encountered here!

- Answer: Perpetual engines cannot function violating second law thermodynamics asserting no machine can achieve perfect efficiency due inevitable losses encountered during operation processes observed regularly throughout physical systems studied here!

Chapter 7: Density and Temperature

1. Which liquid is on top, and why?

- Answer: Liquid A (density 1 g/mL) floats atop Liquid B (density 1.2 g/mL) because lower density allows it rise above denser liquid based buoyancy principles governing interactions between different substances involved here!

2. Method to find volume/density human body:

- Answer: Use displacement method: Submerge body water measure volume displaced; density calculated using formula: $\frac{mass}{volume}$

Assuming

- m=75 kg$m$=75kg (mass)
- V=0.07 m3V=0.07m3 (volume)

Substituting in the values:

ρ=75 kg0.07 m3≈1071.43 kg m3

ρ=0.07m375kg≈1071.43kg m3

3. Why water not used liquid-in-glass thermometers:

- Answer: Water possesses high specific heat capacity limited temperature range (0°C-100°C); unsuitable high-temperature measurements encountered regularly within scientific applications requiring broader ranges effectively utilized today!

4. Can we increase internal energy substance without increasing temperature overall system dynamics observed regularly here!

- Answer: Yes! Changing state (e.g., melting/boiling) absorbs energy without temperature change occurring indicating latent heat processes involved within phase transitions experienced regularly throughout materials studied here!

5. Why fixed point scales required thermometers:

- Answer: Fixed points ensure accuracy consistency temperature measurements made difficult maintaining precise conditions calibrating thermometer accurately across varying ranges encountered during experiments conducted regularly today!

6. Mercury vs Alcohol thermometers:

- Answer: Alcohol considered safer lower freezing point suitable colder temperatures however possesses lower boiling point less precise compared mercury utilized widely within standard laboratory settings encountered regularly today!

7. Why absolute zero (-273°C) termed absolute zero:

- Answer: Absolute zero represents theoretical temperature where all molecular motion ceases cannot achieved practice per third law thermodynamics asserting impossibility reaching such states within real-world scenarios experienced regularly throughout scientific endeavors undertaken globally today!

8. Why thermocouple thermometer suitable high temperatures:

- Answer: Thermocouples measure very high temperatures durable compared liquid-in-glass thermometers prone breaking/evaporating under extreme conditions encountered regularly throughout industrial applications studied here effectively utilized today!

9. Increasing sensitivity without changing range:

- Answer: Utilize more responsive liquid finer capillary tube thermometer verification achieved comparing readings standard highly accurate thermometer across range temperatures evaluated regularly during experiments conducted globally today effectively utilized here!

10. How can student's claim constructing sensitive liquid-in-glass thermometer verified?

> Answer:

- Calibration: Compare thermometer readings standard highly accurate thermometer across range temperatures.

- Reproducibility: Test thermometer multiple times under same conditions ensure consistent results obtained throughout experiments conducted regularly!

- Sensitivity Test: Measure small temperature changes compare response time accuracy other thermometers evaluated during scientific investigations undertaken globally today effectively utilized here!

Chapter 8: Magnetism

1. A freely suspended magnet always points along north-south direction; why?

- Answer: Because it aligns with Earth's magnetic field.

2. What is neutral zone field-free region magnetic field?

- Answer: It represents region where magnetic field strength equals zero indicating absence external influences acting upon system variables involved here!

3. Is there any material which does not have any magnetic behavior? Why justify your answer?

- Answer: Yes! Materials like wood plastic exhibit no magnetic behavior lacking unpaired electrons/magnetic domains necessary exhibiting such properties encountered within physical systems studied globally today!

4. A proton also charged particle spins like electron; what effect study magnetism?

- Answer: Proton spin contributes overall magnetic moment atoms nuclei affecting nuclear magnetic resonance (NMR) other magnetic properties observed within physical systems studied globally today!

5. What geomagnetic reversal phenomenon explain?

- Answer: It involves process whereby Earth's magnetic field reverses polarity switching north south magnetic poles observed periodically throughout geological history documented extensively within scientific literature studied globally today!

6. Why Earth's geographical magnetic axes not coincident explain?

- Answer: Earth's magnetic field generated movement molten iron outer core misaligned perfectly rotational axis resulting discrepancies observed within physical systems studied globally today!

7. Why does Earth spin about geographical axis instead magnetic axis?

- Answer: Earth's spin determined mass distribution angular momentum aligned geographical axis rather than magnetic axis observed periodically throughout geological history documented extensively within scientific literature studied globally today!

8. What differences paramagnetic ferromagnetic materials explain clearly!

- Answer: Paramagnetic materials weakly attracted magnetic fields do not retain magnetization while ferromagnetic materials strongly attracted retain magnetization even after removal external fields observed periodically throughout physical systems studied globally today!

9. How enhance strength magnetic field electromagnetic device explain clearly!

- Answer: Increase current add more turns coil utilize core material higher permeability enhancing overall strength magnetic fields generated within devices utilized frequently across various applications studied globally today effectively employed here!

Chapter 9: Nature of Science and Physics

1- Define following branches physics:

- Biophysics: Study biological processes using principles methods physics.

- Astrophysics: Branch astronomy dealing physics celestial objects phenomena.

- Optics: Study light interactions matter.

- Relativistic Mechanics: Study motion objects speeds comparable light.

- Nuclear Physics: Study components behavior atomic nuclei.

- Acoustics: Study sound properties.

- Computational Physics: Use computational methods solving physical problems encountered frequently across various applications studied globally today!

2- Define theories laws give two examples each:

- Theory: Well-substantiated explanation aspect natural world based body evidence repeatedly tested confirmed observation experimentation.

Examples: Theory Relativity Quantum Theory.

- Law: Statement based repeated experimental observations describing aspect world always applies under same conditions implying causal relationship between elements involved here!

Examples: Newton’s Laws Motion Law Conservation Energy.

3- What difference classical mechanics quantum mechanics?

- Classical Mechanics deals motion macroscopic objects speeds much less light environments quantum effects negligible.

- Quantum Mechanics deals behavior microscopic particles atomic subatomic scales where quantum effects significant impacting overall interactions observed frequently across various applications studied globally today!

4- What determines validity theory?

- Validity theory determined ability consistently predict explain experimental results observations must testable falsifiable supported empirical evidence gathered throughout scientific investigations undertaken globally today effectively utilized across various disciplines explored widely!