Class 7C - ICSE Physics

Paper 1: Physics Second Term Examination December 2025 - Solutions

Paper Date: 5th December 2025 | **Total Marks:** 80 | **Duration:** 2 hours

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SECTION A (40 marks)

Question 1 - Multiple Choice Questions [10]

Q3. A large cinema hall is being constructed. Which of the following would prevent the excessive echo and sound blurring for the audience?

Answer: c. Covering the walls and ceilings with thick, soft curtains.

Explanation: Soft materials like thick curtains, carpets, and acoustic panels **absorb sound waves** rather than reflecting them. This prevents multiple reflections (reverberation) and echo, making speech and music clearer for the audience.

Q4. What frequency range does a typical dog whistle use?

Answer: c. Above 20000Hz

Explanation: Dog whistles produce **ultrasonic sounds** with frequencies above 20,000 Hz. This is above the human hearing range (20 Hz to 20,000 Hz) but within the hearing range of dogs.

Q6. You want to record a sound that is extremely high pitched and feeble sound. Which combination of characteristics is true about the recorded sound.

Answer: a. High frequency and low amplitude

Explanation: - **High pitched** = High frequency (pitch depends on frequency) - **Feeble (soft)** = Low amplitude (loudness depends on amplitude)

Fill in the Blanks [6]

Q5. Multiple reflection of sound is called _____.

Answer: Reverberation

Explanation: Reverberation is the persistence of sound in an enclosed space due to multiple reflections from walls, ceiling, and floor.

Q6. The highest point from the mean position in a sound wave is called _____.

Answer: Crest

True or False [5]

Q1. Sound travels at the same speed in all the medium (solids, liquids and gases).

Answer: False

Explanation: Sound travels at **different speeds** in different media: - **Fastest in solids** (e.g., steel ~5100 m/s) - **Medium speed in liquids** (e.g., water ~1500 m/s) - **Slowest in gases** (e.g., air ~340 m/s)

Q5. Bimetallic strips are used in circuit breakers.

Answer: True

Explanation: Bimetallic strips are used in circuit breakers and thermostats. When heated by excessive current, the two metals expand at different rates causing the strip to bend, which breaks the circuit.

Question 3

Name the Following [6]

Q5. The sound that is heard by the observer after it is reflected from a rigid surface.

Answer: Echo

Explanation: An echo is a reflected sound wave that reaches the listener after being reflected from a hard surface. Minimum distance required is 17 metres.

Q6. The characteristics of sound which enables us to distinguish between the sounds of the same pitch and loudness.

Answer: Quality (or Timbre or Tone quality)

Define [5]

Q1. Frequency

Answer: Frequency is the number of oscillations (or vibrations) completed by a vibrating body in one second. - **SI unit:** Hertz (Hz) - **Formula:** f = 1/T

Q5. Time period

Answer: Time period is the time taken by a vibrating body to complete one full oscillation. - **SI unit:** second (s) - **Formula:** T = 1/f

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Differentiate (two points each) [3]

Q2. Infrasonic and ultrasonic sound

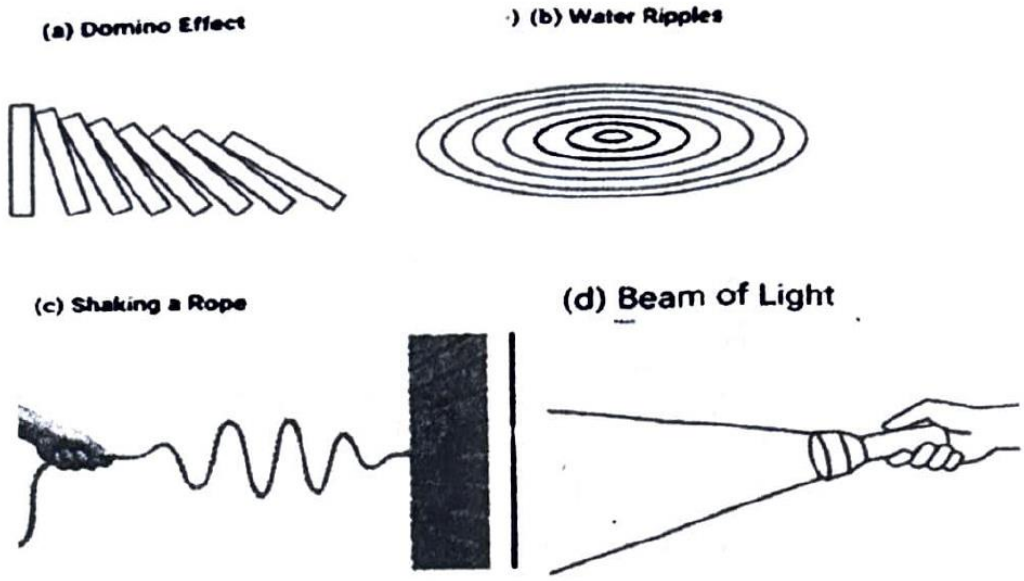
Infrasonic Sound	Ultrasonic Sound
Frequency **less than 20 Hz**	Frequency **greater than 20,000 Hz**
Heard by elephants, whales	Heard by dogs, bats, dolphins
Produced by earthquakes	Used in SONAR, medical imaging

SECTION B (40 marks)

Question 5 [4+3+3]

Q1. Observe the picture and answer the questions.

1. Observe the picture and answer the question that follows:



(Pictures showing: (a) Domino Effect, (b) Water Ripples, (c) Shaking a Rope, (d) Beam of Light)

a. Which of the image best describes the real world application of longitudinal waves? Define Longitudinal waves.

Answer: (a) Domino Effect best describes longitudinal waves.

Definition: A **longitudinal wave** is a wave in which the particles of the medium vibrate parallel to the direction of propagation of the wave. It consists of compressions and rarefactions. Sound waves are longitudinal waves.

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b. Name two pictures where the same type of wave is generated.

Answer: (b) Water Ripples and **(c) Shaking a Rope** - both generate **transverse waves**.

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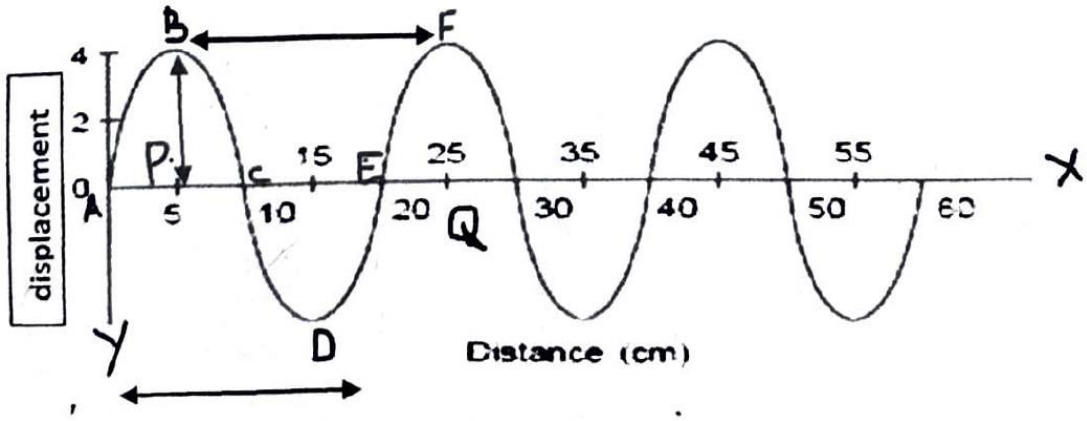
c. Picture D produces same type of wave as _____.

Answer: Picture (b) Water Ripples and **Picture (c) Shaking a Rope**

Q2. The figure given below shows the sound wave. ‘X’ axis represents the distance travelled by the sound wave and ‘Y’ axis represents the displacement of particles.



a. Name the distance ‘BF’ and define it.

Answer: The distance ‘BF’ is called **Wavelength (λ)**.

Definition: Wavelength is the distance between two consecutive crests (or two consecutive troughs) in a wave. - **SI unit:** metre (m)

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b. Which characteristics of sound is determined by the distance ‘BP’?

Answer: Amplitude

Explanation: BP represents the distance from the mean position to the maximum displacement (crest). Amplitude determines the **loudness** of sound.

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c. If ‘X’ axis represents time(s), then ‘AE’ denotes the _____.

Answer: Time Period (T)

Q3. A student plays music in a guitar with the frequency of 50Hz.

a. Calculate the time period.

Answer: - Frequency (f) = 50 Hz - Time period (T) = 1/f - **T = 1/50 = 0.02 seconds**

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b. If the student wants to increase the pitch of the sound which of the given below option, would she/he choose to perform the action.

Answer: ii. Press down on the string to shorten the vibrating length.

Explanation: Pitch depends on frequency. Shorter vibrating length = higher frequency = higher pitch.

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c. An echo is heard 3 seconds after a loud clap. If the speed of sound in air is 330 m/s. How far away is the reflecting surface?

Answer: - Time for echo = 3 seconds - Speed of sound = 330 m/s - Distance = (Speed × Time) / 2 - **Distance = (330 × 3) / 2 = 495 metres**

Question 7 [3+3+4]

Q1. Make a list of any 3 electrical equipment at home which convert electrical energy to heat energy.

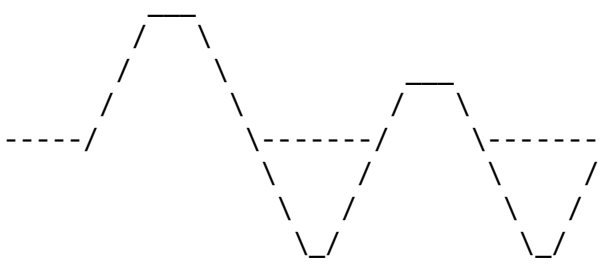
Answer: 1. **Electric iron** - for pressing clothes 2. **Electric heater / Room heater** - for warming rooms 3. **Electric kettle** - for boiling water

Other examples: Toaster, geyser, hair dryer, microwave oven

Q3. Draw two different sound waves based on the following description.

Answer:

Wave A: Large amplitude, Low frequency



- Produces **loud, low-pitched** sound (like a bass drum)

Wave B: Small amplitude, High frequency

- Produces **soft, high-pitched** sound (like a faint whistle)

Paper 2: Physics First Term Class Test II - Solutions

(Only Syllabus Topic: Energy)

Paper Date: 01.08.2025 | **Total Marks:** 40 | **Duration:** 45 minutes

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Section-A

I. Multiple Choice Questions [5]

Q1. The energy stored in matter is called _____.

Answer: b. Chemical energy

Justification: Chemical energy is the energy stored in the chemical bonds of matter (substances). When chemical reactions occur (like burning fuel or digesting food), this stored energy is released.

Q4. Atoms have lot of energy stored in their _____.

Answer: b. Nucleus

Justification: The nucleus of an atom contains an enormous amount of energy called **nuclear energy**. This energy holds protons and neutrons together.

II. Fill in the Blanks [5]

Q1. Greater the speed of a moving object, greater is the _____.

Answer: Kinetic energy

Q2. 1 kilocalorie = _____ joules.

Answer: 4200 (or 4186)

Q4. As the raindrops fall, potential energy is converted to _____.

Answer: Kinetic energy

Q5. _____ is the energy obtained from the rise and fall of tides.

Answer: Tidal energy

III. True or False [5]

Q1. The energy stored in an object by virtue of its change in shape is called potential energy.

Answer: True

Justification: This describes **elastic potential energy**, which is a type of potential energy.

Q2. Total energy changes at every point of the ride in roller coaster.

Answer: False

Justification: According to the Law of Conservation of Energy, **total mechanical energy remains constant** (ignoring friction).

Q5. Magnets can attract substance like steel and aluminium.

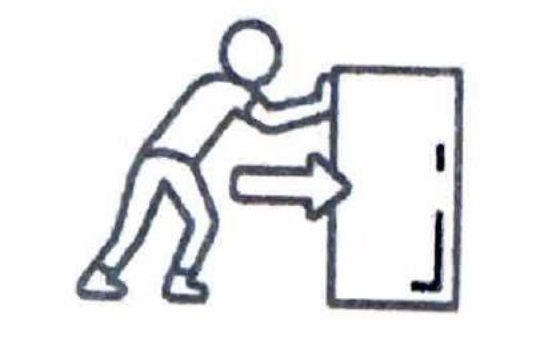
Answer: False

Justification: Magnets can attract **steel** but **NOT aluminium**. Aluminium is paramagnetic (extremely weakly attracted).

Section-B

V. Answer the Following [2×10=20]

Q1. You are applying a force of 20N on an object and it moves through a distance of 100 centimetre. [3]



i. Calculate the work done by you in SI unit.

Answer: - Force (F) = 20 N - Distance (d) = 100 cm = 1 m - Work = 20 N × 1 m = **20 Joules (J)**

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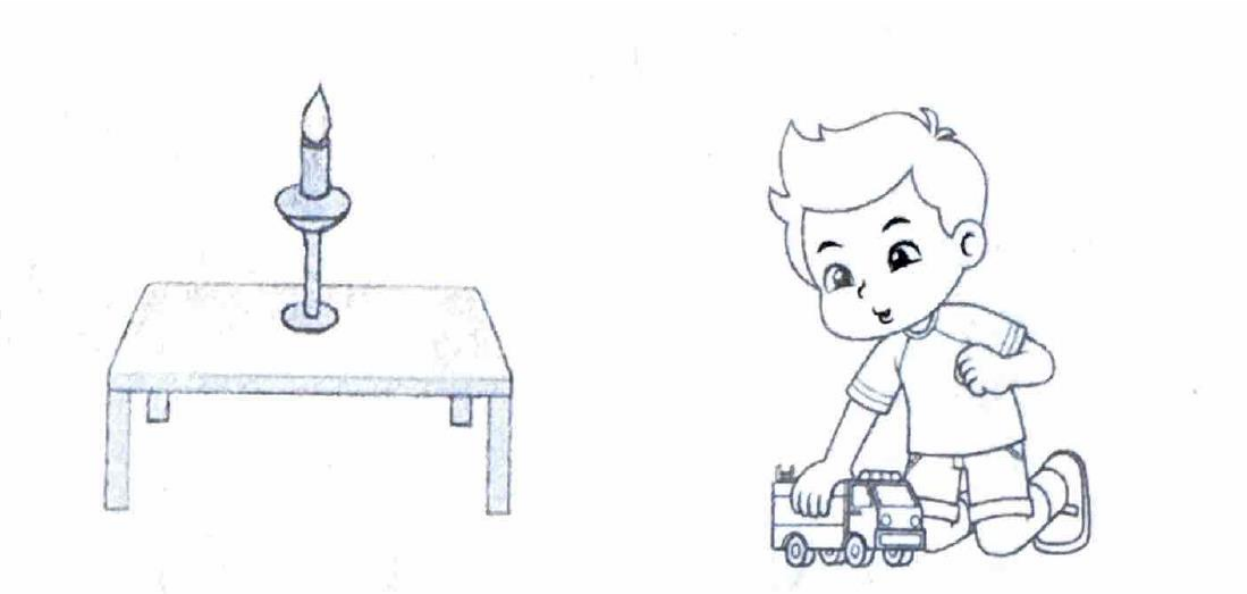
ii. Define the SI unit of work.

Answer: The SI unit of work is **Joule (J)**. One joule is the work done when a force of one newton moves an object through a distance of one metre in the direction of the force.

Q2. A child is playing with a toy car which works on battery when the power went off. [3]



i. Write at least two possible energy transformation related to the picture with example.

Answer: 1. **Chemical energy → Electrical energy** (in the battery) 2. **Electrical energy → Mechanical energy** (in the motor)

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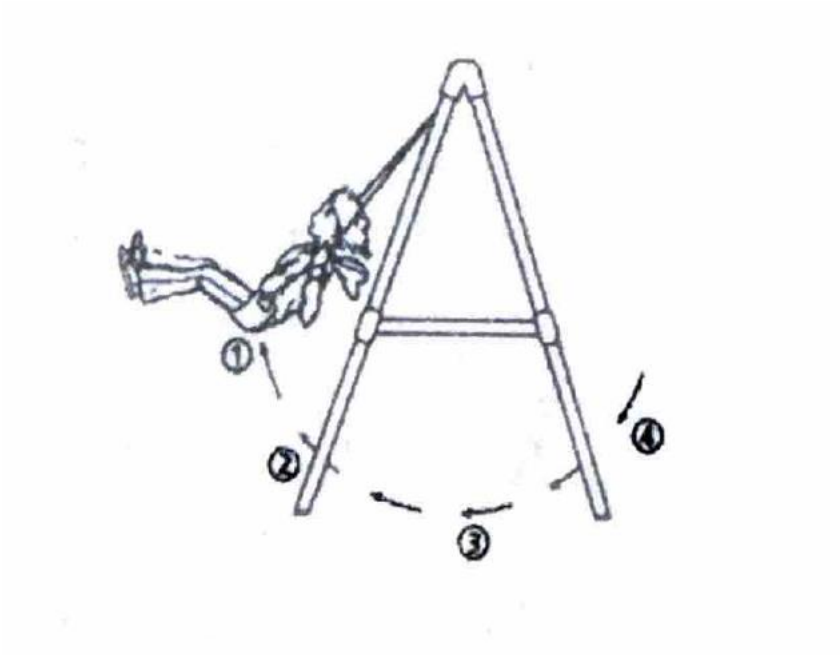
ii. State the law of conservation of energy.

Answer: "Energy can neither be created nor destroyed; it can only be transformed from one form to another. The total energy of an isolated system remains constant."

Q3. The picture shows a girl of 35 kg swinging. As the girl swings, the initial maximum potential energy at position 1 is 350 J. [4]



i. If the potential energy is 150J and thermal energy is 5J at position 2. What would be the kinetic energy at position 2?

Answer: - 150 + KE_2 + 5 = 350 - **KE_2 = 195 J**

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ii. Potential energy at position 4 is _____ as compared to position 1.

Answer: Potential energy at position 4 is **less than** that at position 1.

Justification: As the girl swings, some energy is lost to friction (thermal energy).

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iii. If the girl is replaced by a boy of 50 kg, how will the magnitude of potential energy change?

Answer: The potential energy will **increase** to **500 J**.

Paper 3: Physics First Term Class Test I - Solutions

(Syllabus Topic: Physical Quantities and Measurements)

Paper Date: 23.06.25 | **Total Marks:** 40 | **Duration:** 45 minutes

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SECTION A

I. Multiple Choice Questions [5]

Q1. The given below figure shows the cylinder of the same metal. Which quantity is the same for both the cylinders?

Answer: c. Density

Justification: Since both cylinders are made of the **same metal**, they have the same density.

Q2. A javelin thrown by an athlete is an example of _____ motion.

Answer: b. Curvilinear

Justification: When a javelin is thrown, it follows a curved path (parabola) due to the effect of gravity.

Q3. The speed of an earthworm moving is measured in _____

Answer: b. centimetre/second

Q4. The motion of a train as it approaches a station where it has to stop is an example of

- a. Uniform motion
- **b. non-uniform motion** ✓
- c. periodic motion
- d. oscillatory motion

Answer: b. non-uniform motion

Justification: When a train approaches a station where it has to stop, it gradually slows down (decelerates). This means its speed is constantly changing (decreasing). Since the train does not cover equal distances in equal intervals of time, this is **non-uniform motion**. The train's velocity changes until it comes to a complete stop.

Q5. Amiya travels with her father in a bike to her uncle's house which is 40km away from home. She takes 40 minutes to reach there.

Answer: a. Statement 1 alone is true

Calculation: - Speed = 40 km / 40 minutes = **1 km/minute** = 60 km/hour

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II. Fill in the Blanks [5]

Q1. The pendulum of a wall clock repeats one oscillation every _____ seconds.

Answer: 2 (or **1**, depending on the clock type)

Justification: Most standard wall clocks with pendulums have a time period of 2 seconds (1 second for each swing in one direction). The pendulum swings left in 1 second and right in 1 second, completing one full oscillation in 2 seconds.

Q2. Rest and motion are _____ terms.

Answer: Relative

Justification: Rest and motion are relative terms because an object can be at rest with respect to one reference point but in motion with respect to another. For example, a passenger sitting in a moving bus is at rest relative to the bus but in motion relative to a person standing on the road.

Q3. Graduated cylinders, graduated beakers, flasks are some of the apparatuses used to measure _____ of the liquid.

Answer: Volume

Justification: Graduated cylinders and measuring beakers have markings (graduations) on them that indicate the volume of liquid they contain. These are standard laboratory equipment for measuring liquid volumes, typically marked in millilitres (mL) or cubic centimetres (cm^3).

Q4. 1 kgf = _____ N

Answer: 9.8 N (or approximately 10 N)

Justification: - 1 kilogram-force (kgf) is the force exerted by gravity on a mass of 1 kg - Weight = mass × acceleration due to gravity - 1 kgf = 1 kg × 9.8 m/s^2 = **9.8 N**

This is the relationship between the gravitational unit (kgf) and the SI unit (Newton) of force.

Q5. Weight of an object can be measured using a _____.

Answer: Spring balance

Justification: A spring balance (also called a spring scale) measures weight by measuring the extension of a spring when an object is hung from it. According to Hooke's law, the extension is proportional to the force (weight) applied. Unlike a beam balance that compares masses, a spring balance directly measures the gravitational force on an object.

III. True or False [5]

Q1. 1000L = $1m^3$

Answer: True ✓

Justification: - 1 litre (L) = 1000 cm^3 = 1000 mL - 1 m^3 = 100 cm × 100 cm × 100 cm = 1,000,000 cm^3 - Therefore: 1 m^3 = 1,000,000 cm^3 ÷ 1000 = 1000 L

Conversion: 1 m^3 = 1000 litres

Q2. Motion of air particles in your room is random motion.

Answer: True ✓

Justification: Air particles (molecules) move in all directions without any fixed pattern or path. They collide with each other and the walls of the container, constantly changing direction. This unpredictable, patternless movement is called **random motion** or **Brownian motion**.

Q3. On heating a substance its density increases.

Answer: False ✗

Justification: When a substance is heated: - It expands (volume increases) - Mass remains constant - Density = Mass/Volume - Since volume increases and mass stays the same, **density decreases**

Exception: Water between 0°C and 4°C behaves anomalously - it contracts on heating.

Q4. The swinging of arms and legs of soldiers while marching is an example of periodic motion.

Answer: True ✓

Justification: Periodic motion is any motion that repeats itself at regular intervals of time. When soldiers march, they swing their arms and legs in a regular, rhythmic pattern that repeats with each step. This repetitive motion at regular intervals qualifies as periodic motion.

Q5. Volume of irregular solids can be found by measuring its length, breadth and height.

Answer: False ✗

Justification: The formula Volume = Length × Breadth × Height only works for regular solids like cubes and cuboids. For **irregular solids** (like a stone or a piece of metal), we use the **water displacement method**: 1. Note the initial water level in a measuring cylinder 2. Immerse the irregular solid in water 3. Note the final water level 4. Volume of solid = Final level - Initial level

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IV. Observing the Picture (Sewing Machine) [5]

a. Name the device shown in the figure.

Answer: Sewing Machine

Justification: The image shows a traditional sewing machine with visible parts like the needle, wheel, and footrest.

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b. Motion of the needle

Answer: Oscillatory motion (or Up and down motion)

Justification: The needle of a sewing machine moves up and down repeatedly about a mean position. This to-and-fro motion about a fixed point is called oscillatory motion.

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c. Motion of the wheel

Answer: Circular/Rotatory motion

Justification: The wheel of the sewing machine rotates about a fixed axis. Any motion where an object spins or rotates about a central axis is called rotatory or circular motion.

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d. Motion of the footrest

Answer: Oscillatory motion (or To and fro motion)

Justification: The footrest (pedal) of a sewing machine moves up and down as you press it, oscillating about a pivot point.

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e. The combined motion of all these three types can be termed as _____ motion.

Answer: Multiple motion (or Complex motion)

Justification: When an object exhibits more than one type of motion simultaneously, it is called multiple motion or complex motion. The sewing machine demonstrates oscillatory (needle and footrest) and rotatory (wheel) motions working together.

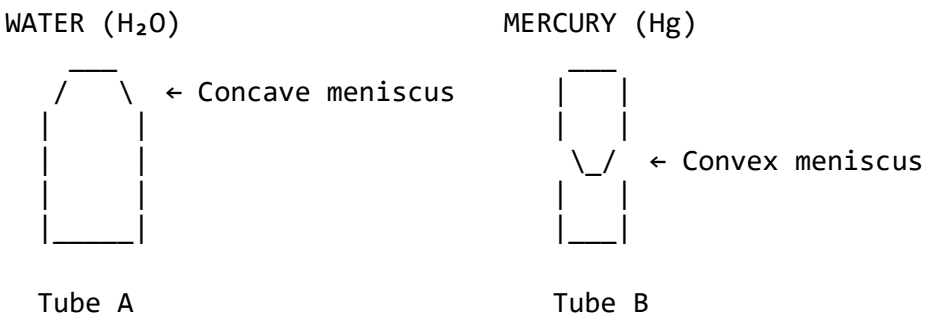
SECTION B

V. Answer the Following (2 × 10 = 20)

Q1. Jasmine pours mercury and water in two different narrow tubes A and B respectively [4]

a. Illustrate with the help of labelled diagram to show the shape of the surface of the mercury and water on pouring it in the narrow test tube.

Answer:



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b. Give reason: Shapes of liquid surfaces are different in both the tubes.

Answer: The shape of the liquid surface (meniscus) depends on the relative strengths of **cohesive forces** (between liquid molecules) and **adhesive forces** (between liquid and glass).

For Water: - Adhesive forces (water-glass) > Cohesive forces (water-water) - Water molecules are attracted more to the glass than to each other - Water rises up along the glass walls - Result: **Concave meniscus** (curves upward at edges)

For Mercury: - Cohesive forces (mercury-mercury) > Adhesive forces (mercury-glass) - Mercury molecules are attracted more to each other than to glass - Mercury curves down at the edges - Result: **Convex meniscus** (curves downward at edges)

Q2. Density Calculation from Measuring Cylinder [4]

Given: - Diagram 1: Empty measuring cylinder on balance shows 30g - Diagram 2: Measuring cylinder with liquid shows 50g, liquid level at 9 cm^3

a. Find the density of the liquid clearly stating its mass and volume.

Answer:

Finding Mass of Liquid: - Mass of cylinder with liquid = 50g - Mass of empty cylinder = 30g - **Mass of liquid = 50g - 30g = 20g**

Finding Volume of Liquid: - Reading from graduated cylinder = **9 cm^3**

Calculating Density: - Density = Mass / Volume - Density = 20g / 9cm^3 - **Density = 2.22 g/cm^3** (or 20/9 g/cm^3)

Q3. Speed Comparison - Ball Kicking Game [4]

Given: - Friend's kick: Ball moved 50 meters in 10 seconds - Your kick: Ball moved 25 meters in 5 seconds

Question: Compare the speeds. Justify your answer by calculation.

Answer:

Friend's Speed: - Speed = Distance / Time - Speed = 50m / 10s - **Speed = 5 m/s**

Your Speed: - Speed = Distance / Time - Speed = 25m / 5s - **Speed = 5 m/s**

Conclusion: Both speeds are equal (5 m/s)

Justification: Although the distances and times are different, when we calculate the speed (distance covered per unit time), both kicks result in the same speed of 5 metres per second. This means both kicks gave the ball the same velocity.

Q4. Mass and Weight on Different Planets [4]

Given: A box of mass 100 kg is carried from Earth to different planets.

Formula: Weight = Mass × Acceleration due to gravity (W = m × g)

Planet	Mass of the box	Acceleration due to gravity (N/kg)	Your weight on the planet
Planet 1	100 kg	4	(b) **400 N**
Planet 2	100 kg	9	(c) **900 N**
Earth	100 kg	(a) **9.8 N/kg**	(d) **980 N**

Calculations:

(a) Acceleration due to gravity on Earth = 9.8 N/kg (or approximately 10 N/kg)

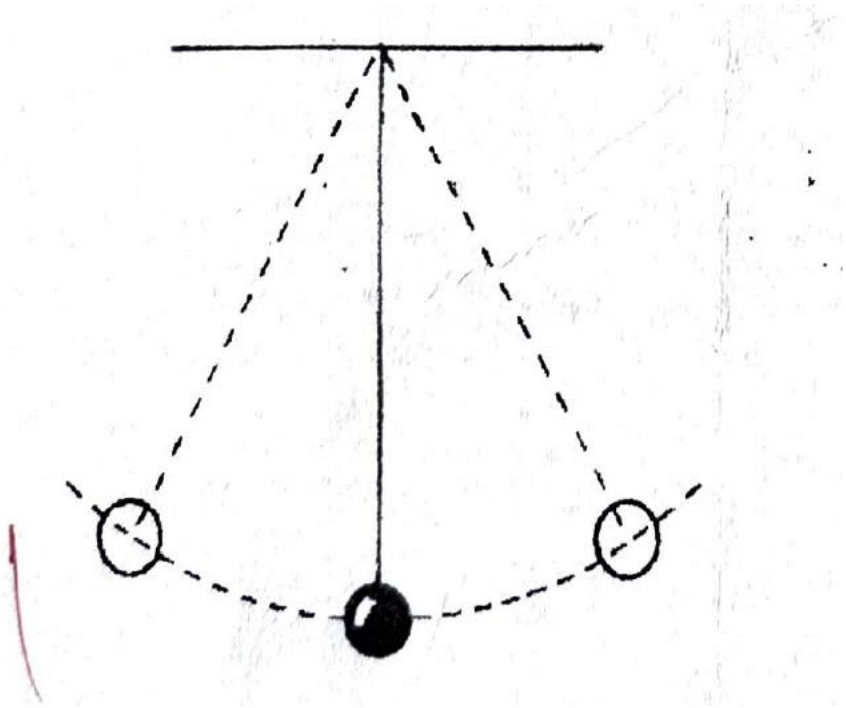
(b) Weight on Planet 1: - W = m × g = 100 kg × 4 N/kg = **400 N**

(c) Weight on Planet 2: - W = m × g = 100 kg × 9 N/kg = **900 N**

(d) Weight on Earth: - W = m × g = 100 kg × 9.8 N/kg = **980 N**

Important Note: Mass remains constant (100 kg) on all planets because mass is the amount of matter in an object. Weight changes because it depends on the gravitational pull of the planet.

Q5. Simple Pendulum [4]



a. The motion of a simple pendulum is an example of _____ motion.

Answer: Oscillatory (or Periodic) motion

Justification: A simple pendulum swings back and forth about its mean (equilibrium) position. This to-and-fro motion about a fixed point is called oscillatory motion. Since it repeats at regular intervals, it is also periodic motion.

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b. One complete to and fro motion of the pendulum about its mean position is called _____.

Answer: Oscillation (or One vibration)

Justification: When a pendulum moves from its mean position to one extreme, then to the other extreme, and back to the mean position, it completes one full oscillation. This is also called one complete vibration or one cycle.

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c. A simple pendulum takes 30 seconds to complete 15 oscillations. What is the time period of the pendulum?

Answer:

Given: - Total time = 30 seconds - Number of oscillations = 15

Formula: Time period = Total time / Number of oscillations

Calculation: - Time period (T) = 30 seconds / 15 oscillations - **Time period = 2 seconds**

Justification: The time period is the time taken to complete one full oscillation. If 15 oscillations take 30 seconds, then one oscillation takes 30/15 = 2 seconds.

Summary of Key Formulas Used:

Formula	Description
Density = Mass/Volume	$\rho = m/V$
Speed = Distance/Time	$v = d/t$
Weight = Mass × g	$W = m \times g$
Time period = Total time/Number of oscillations	$T = t/n$
1 kgf = 9.8 N	Weight conversion
1 m^3 = 1000 L	Volume conversion

Physics Sample Paper 4

Paper Date: 28.11.2024 | **Total Marks:** 80 | **Duration:** 2 hours

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SECTION A

Question 1: Multiple Choice Questions (15)

Q1. The mode of heat transfer through space, vacuum and air _____. [NOTFOREXAM - Heat topic not in syllabus]

- a. Conduction
- b. Convection
- c. Expansion
- **d. Radiation** ✓

Answer: d. Radiation

Justification: Radiation is the only mode of heat transfer that does not require a medium. Heat from the sun reaches Earth through the vacuum of space by radiation. Conduction requires direct contact, and convection requires a fluid medium.

Q2. A wave in which particles vibrate in the same direction as that of the sound.

- a. Electromagnetic wave
- b. Transverse wave
- **c. Longitudinal wave** ✓
- d. Radio wave

Answer: c. Longitudinal wave

Justification: In a longitudinal wave, particles of the medium vibrate parallel to (in the same direction as) the direction of wave propagation. Sound waves are longitudinal waves where air particles oscillate back and forth in the direction the sound travels.

Q8. The high-pressure region in longitudinal waves can otherwise be called as

- a. Rarefaction
- b. Expansion
- **c. Compression** ✓
- d. Transition

Answer: c. Compression

Justification: In a longitudinal wave, the region where particles are pushed close together (high pressure, high density) is called **compression**. The region where particles are spread apart (low pressure, low density) is called rarefaction.

Q10. Relation between time period (T) and frequency (f) is _____

- **a. f = 1/T** ✓
- b. f = T
- c. $f^2 = T$
- d. $f = T^2$

Answer: a. f = 1/T

Justification: Frequency and time period are inversely related. - Frequency (f) = Number of oscillations per second (unit: Hz) - Time period (T) = Time for one complete oscillation (unit: seconds) - **f = 1/T** or equivalently **T = 1/f**

Q11. Which of the following is an example of a bad conductor?

- a. Iron scrap
- **b. Plastic** ✓
- c. Aluminium wire
- d. Silver

Answer: b. Plastic

Justification: Plastic is an insulator (bad conductor of electricity and heat). Metals like iron, aluminium, and silver are good conductors of electricity because they have free electrons that can move easily.

Q12. The amplitude of vibration is doubled, the loudness of a sound increases by _____ times.

- a. two
- b. three
- **c. four** ✓
-

d. five

Answer: c. four

Justification: Loudness is proportional to the **square of amplitude** (Loudness $\propto A^2$). If amplitude is doubled (2A), loudness becomes $(2)^2$ = **4 times** the original.

Q14. The SI unit of frequency is _____

- a. decibel
- **b. hertz** ✓
- c. second
- d. metre

Answer: b. hertz (Hz)

Justification: The SI unit of frequency is **hertz (Hz)**, named after Heinrich Hertz. 1 Hz = 1 oscillation per second. Decibel is the unit of loudness/sound intensity.

Question 2A: Name the Following (5)

Q4. A pair of stretchable ligaments in larynx

Answer: Vocal cords (or Vocal folds)

Explanation: The vocal cords are two bands of elastic muscle tissue located in the larynx (voice box). When air passes through them, they vibrate to produce sound. The pitch of sound depends on the tension and length of these vocal cords.

Q5. An instrument made of steel used in laboratories for producing sound vibrations

Answer: Tuning fork

Explanation: A tuning fork is a Y-shaped steel instrument that produces a pure musical note of fixed frequency when struck. It is used in laboratories to study sound waves and in music to tune instruments.

Question 2B: True or False (5)

Q1. Vibrations of large amplitude or intensity produce soft sound.

Answer: False

Justification: Vibrations of large amplitude produce **loud** sound, not soft sound. Loudness is directly proportional to the square of amplitude (Loudness $\propto A^2$). Greater amplitude means the particles vibrate with greater displacement, producing louder sound.

Q2. Radiant energy travels in a straight line with the speed of 3×10^8 m/s.

Answer: True

Justification: Radiant energy (electromagnetic radiation, including light) travels in straight lines at the speed of light, which is approximately 3×10^8 m/s (300,000 km/s) in vacuum. This is the fastest speed in the universe.

Question 3A: Define the Following (5)

Q3. Time period

Answer: Time period is the time taken by a vibrating body to complete one full oscillation (or vibration).

- **SI unit:** second (s)
- **Formula:** T = 1/f (where f is frequency)
- **Example:** If a pendulum completes one swing in 2 seconds, its time period is 2 s.

Q5. Amplitude

Answer: Amplitude is the maximum displacement of a vibrating body from its mean (equilibrium) position.

- **SI unit:** metre (m) for mechanical waves
- **Significance:** Amplitude determines the loudness of sound - greater amplitude means louder sound.
- **Symbol:** A

Question 3B: Differentiate (Two Points Each) (10)

Q2. Wavelength and Frequency

Wavelength	Frequency
The distance between two consecutive compressions or two consecutive rarefactions in a wave.	The number of oscillations (vibrations) completed by a vibrating body in one second.
SI unit: metre (m)	SI unit: hertz (Hz)
Represented by λ (lambda)	Represented by f or ν (nu)

Relationship: $v = f \times \lambda$ (wave speed = frequency × wavelength)

Q3. Ultrasonic sound and Infrasonic sound

Ultrasonic Sound	Infrasonic Sound
Sound waves with frequency **greater than 20,000 Hz** (above human hearing range)	Sound waves with frequency **less than 20 Hz** (below human hearing range)
Cannot be heard by humans but can be heard by dogs, bats, dolphins	Cannot be heard by humans but can be heard by elephants, whales, rhinoceros
Used in SONAR, medical imaging (ultrasonography), cleaning jewelry	Produced by earthquakes, volcanic eruptions, elephants for communication

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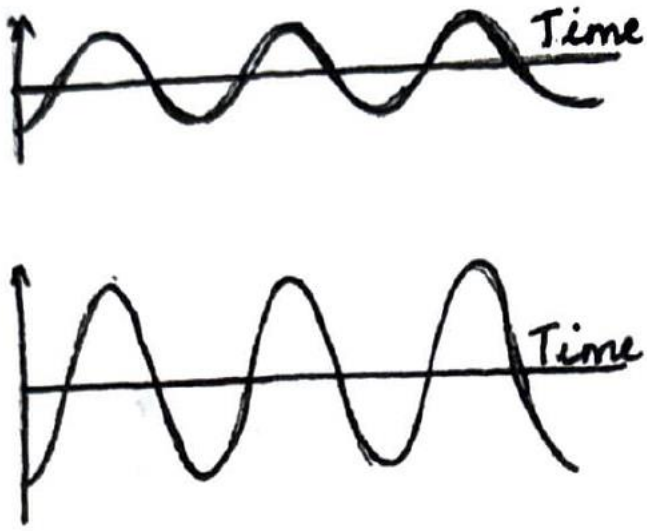
SECTION B - Answer the Following Questions

Question 6 - Sound Wave Analysis

Q7. Study the picture and answer the questions:



(Two waveforms shown - one with higher amplitude, one with lower amplitude)

i. In which case is the loudness of the sound greater and why? (2)

Answer: The loudness is **greater in the second (bottom) waveform** because it has a **larger amplitude**.

Explanation: Loudness of sound depends on amplitude. The waveform with taller peaks and deeper troughs has greater amplitude, which means the particles vibrate with greater displacement, producing a louder sound.

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ii. Name the factor based on which you drew the above conclusion. (1)

Answer: Amplitude

Explanation: Amplitude is the factor that determines loudness. Greater amplitude = Greater loudness.

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iii. Write any two factors other than the one mentioned in (ii) on which the loudness of a sound depends. (2)

Answer: 1. **Distance from the source** - Loudness decreases as distance from the source increases (inverse square law) 2. **Surface area of the vibrating body** - Larger vibrating surface produces louder sound (e.g., a tuning fork sounds louder when placed on a table)

Other factors: Density of medium, sensitivity of the ear

Q8. Speed of Sound in Materials

No	Material/Medium	Speed of sound (m/s)
1.	X	5100
2.	Y	250
3.	Z	1325

i. From the material X, Y, Z which one is a solid? (1)

Answer: X is a solid

Explanation: Sound travels fastest in solids, slower in liquids, and slowest in gases. Since X has the highest speed (5100 m/s), it is a solid. Y (250 m/s) is likely a gas, and Z (1325 m/s) is likely a liquid.

---

ii. Calculate the time taken for sound to travel 100 metres through the material 'Y'. (2)

Answer: - Speed of sound in Y = 250 m/s - Distance = 100 m - Time = Distance / Speed - **Time = 100 / 250 = 0.4 seconds**

---

iii. A sailor on a ship sees a lightning flash and hears the thunder 5 seconds later. If the speed of sound in air at 20°C is 343 meters/second. How far away is the lightning strike? (2)

Answer: - Speed of sound = 343 m/s - Time = 5 seconds - Distance = Speed × Time - **Distance = 343 × 5 = 1715 metres (or 1.715 km)**

Note: Light travels almost instantaneously (at 3×10^8 m/s), so we only consider the time taken by sound.

Question 7 - Case Study:

"A certain device 'X' is used to detect and locate objects underwater. It works by sending a wave 'Y' through water and receiving the echoes that bounces back from the objects. It provides the information such as objects distance. It is commonly used in submarines, fishing and ocean exploration to navigate and find underwater targets."

i. Name the device 'X' and the wave 'Y' mentioned in the passage. (2)

Answer: - **Device X:** SONAR (Sound Navigation And Ranging) - **Wave Y:** Ultrasonic waves (ultrasound)

---

ii. The submarine uses a device 'X' to detect an underwater object it emits a sound wave and receives the echo 2 seconds later. If the speed of sound in water is approximately 1500 m/s. What is the distance to the object? (2)

Answer: - Total time for echo = 2 seconds - Time to reach object = 2 ÷ 2 = 1 second (sound travels to object and back) - Speed of sound in water = 1500 m/s - **Distance to object = Speed × Time = 1500 × 1 = 1500 metres**

---

iii. Write any two uses of ultrasonic sounds. (2)

Answer: 1. **Medical diagnosis (Ultrasonography/Sonography)** - Used to examine internal organs, monitor fetus during pregnancy, detect tumors 2. **SONAR** - Used in submarines and ships to detect underwater objects, measure ocean depth, locate fish schools 3. **Cleaning** - Used to clean delicate jewelry, surgical instruments, and electronic components 4. **Industrial testing** - Used to detect cracks and flaws in metal structures

---

Q10. A pendulum oscillates 60 times in 10 s. Find: (2)

a) Time period

Answer: - Number of oscillations = 60 - Total time = 10 seconds - Time period (T) = Total time / Number of oscillations - **T = 10/60 = 1/6 second ≈ 0.167 seconds**

b) Frequency

Answer: - Frequency (f) = 1/T = 1/(1/6) = **6 Hz** - OR: f = Number of oscillations / Time = 60/10 = **6 Hz**

Q11. What is the range of frequency of: (2)

a) Audible sound

Answer: 20 Hz to 20,000 Hz

Human ears can detect sound waves with frequencies between 20 Hz and 20,000 Hz (20 kHz). This range is called the audible range or sonic range.

b) Infrasonic sound

Answer: Less than 20 Hz (below 20 Hz)

Infrasonic sounds have frequencies below the lower limit of human hearing. Examples include sounds produced by earthquakes, elephants, and whales.

Summary of Key Formulas Used:

Formula	Description
$K = °C + 273$	Celsius to Kelvin conversion
$°F = (9/5 \times °C) + 32$	Celsius to Fahrenheit conversion
$f = 1/T$	Frequency and Time period relationship
$v = f \times \lambda$	Wave equation
Distance = Speed × Time	Basic motion formula
Echo distance = (Speed × Time)/2	For echo calculations
Loudness $\propto A^2$	Loudness-Amplitude relationship

SAMPLE PAPER 5

Physics First Term Examination July 2024 - Solutions ## (Syllabus Topics: Physical Quantities and Measurements, Energy)

Paper Date: 24.7.2024 | **Total Marks:** 80 | **Duration:** 2 hours

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Question No. 1: Multiple Choice Questions (10)

Q1. The apparatus that does not measure the volume of a liquid is

- A. Measuring cylinder
- **B. Common balance** ✓
- C. Pipette
- D. Burette

Answer: B. Common balance

Justification: A common balance is used to measure **mass**, not volume. It compares the mass of an object with standard weights. Measuring cylinder, pipette, and burette are all graduated instruments used to measure the volume of liquids.

Q2. A measuring cylinder is used to measure the volume of a quantity of water. Which measuring technique would not improve the accuracy of the measurement?

- A. Making sure that the measuring cylinder is vertical.
- B. Making sure that the water surface is at eye level.
- C. Reading the top of the water meniscus.
- **D. Using the smallest measuring cylinder available that will contain all the water.** ✓

Answer: D. Using the smallest measuring cylinder available that will contain all the water.

Justification: Options A, B, and C are all correct techniques to improve accuracy. However, option D is incorrect because we should read from the **bottom** of the water meniscus (not top), as water forms a concave meniscus. Actually, re-reading the question: Option C says "Reading the top of the water meniscus" which would NOT improve accuracy - we should read from the bottom. But conventionally, using a smaller cylinder actually DOES improve accuracy due to finer graduations. The answer is **C** - reading from the top of meniscus is incorrect technique.

Correction: The answer should be **C. Reading the top of the water meniscus** - because water forms a concave meniscus and we should read from the bottom of the meniscus, not the top.

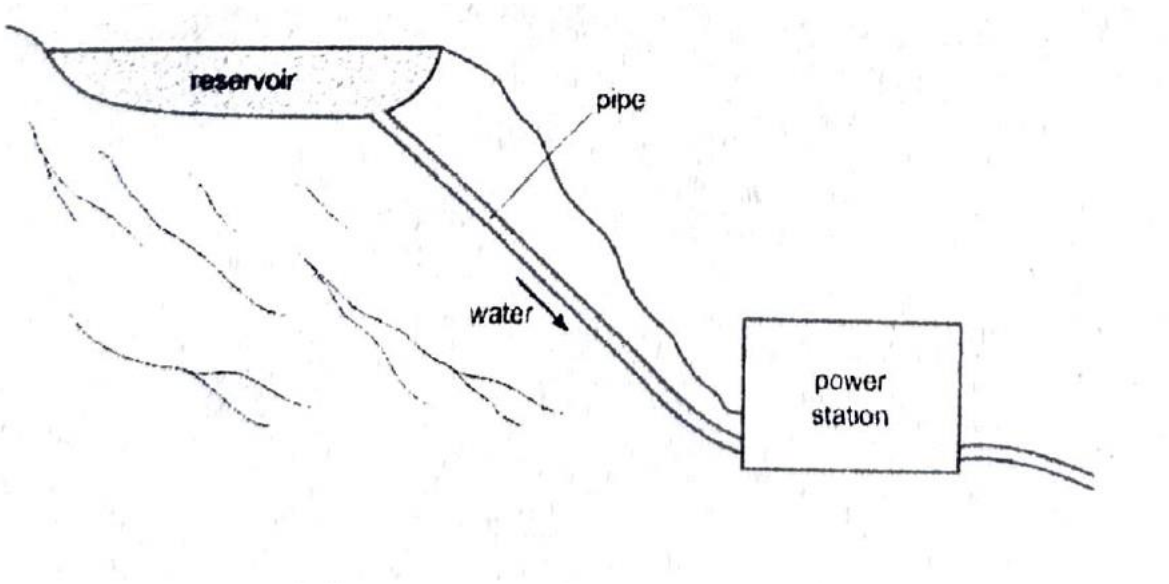
Q3. Which energy transfer takes place when a matchstick burns?

- **A. Chemical to thermal** ✓
- B. Chemical to nuclear
- C. Nuclear to chemical
- D. Thermal to chemical

Answer: A. Chemical to thermal

Justification: When a matchstick burns, the chemicals in the matchstick head (potassium chlorate, sulfur, etc.) undergo a chemical reaction with oxygen. The **chemical energy** stored in these substances is released as **heat (thermal energy)** and light energy. This is an exothermic combustion reaction.

Q4. The diagram shows a hydroelectric system. What are the main energy changes taking place?



- A. Chemical energy → kinetic energy → electrical energy
- B. Electrical energy → gravitational potential energy → kinetic energy
- **C. Gravitational potential energy → kinetic energy → electrical energy** ✓

- D. Kinetic energy → electrical energy → gravitational potential energy

Answer: C. Gravitational potential energy → kinetic energy → electrical energy

Justification: In a hydroelectric power station: 1. Water stored at height in the reservoir has **gravitational potential energy** (due to its position) 2. When water flows down through pipes, potential energy converts to **kinetic energy** (energy of motion) 3. The moving water spins turbines connected to generators, converting kinetic energy to **electrical energy**

Q5. Which option contains all apparatus that could be used to determine the volume of a small block of unknown material?

- **A. Measuring cylinder, metre rule** ✓
- B. Measuring cylinder, stopwatch
- C. Metre rule, balance
- D. Metre rule, stopwatch

Answer: A. Measuring cylinder, metre rule

Justification: To find the volume of a small block, you need: - **Measuring cylinder**: For water displacement method (if the block is irregular) - **Metre rule**: To measure length, breadth, and height (if the block is regular)

A stopwatch measures time, and a balance measures mass - neither measures volume directly.

Q6. The speed of a toy car is 5m/s. Its value in km/h is _____

- A. 16km/h
- **B. 18km/h** ✓
- C. 20km/h
- D. 10km/h

Answer: B. 18km/h

Justification:

Conversion: - 5 m/s = 5 × (1 km/1000 m) × (3600 s/1 hour) - 5 m/s = 5 × (3600/1000) km/h - 5 m/s = 5 × 3.6 km/h - **5 m/s = 18 km/h**

Quick formula: To convert m/s to km/h, multiply by 3.6 (or 18/5)

Q7. Motion of hands of a clock is _____ motion.

- A. Uniform and non-periodic
- **B. Uniform and periodic** ✓
- C. Non-uniform and periodic
- D. Non-uniform and non-periodic

Answer: B. Uniform and periodic

Justification: - **Uniform**: The hands of a clock move at a constant speed (the second hand takes exactly 60 seconds for one rotation, minute hand takes 60 minutes, etc.) - **Periodic**: The motion repeats at regular intervals (every 60 seconds for the second hand, every 12 hours for the hour hand)

Q8. The energy produced with the help of generators and chemical batteries is

- A. Magnetic energy
- B. Chemical energy
- **C. Electrical energy** ✓
- D. Nuclear energy

Answer: C. Electrical energy

Justification: - **Generators** convert mechanical energy into electrical energy through electromagnetic induction - **Chemical batteries** convert chemical energy into electrical energy through electrochemical reactions - Both devices produce **electrical energy** as their output, which can power various appliances

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Q9. If the mass of the substance is 1g and its volume is 1ml, its density is _____

- **A. $1g/cm^3$** ✓
- B. $1kg/m^3$
- C. $1g/m^3$
- D. $1mg/cm^3$

Answer: A. $1g/cm^3$

Justification:

Formula: Density = Mass / Volume

Calculation: - Mass = 1g - Volume = 1ml = $1cm^3$ (since 1ml = $1cm^3$) - Density = 1g / $1cm^3$ = **1 g/cm^3**

Note: This is the density of water at 4°C.

Q10. The mass of the body _____ as we go higher altitude.

- A. Increases
- B. Decreases
- **C. Remains the same** ✓
- D. Keeps changing

Answer: C. Remains the same

Justification: Mass is the amount of matter in an object and does not change with location. It remains constant whether you are on Earth, on the Moon, or at high altitude. Only **weight** (which depends on gravitational force) decreases at higher altitudes because the gravitational pull is slightly weaker farther from Earth's center.

Question No. 2

1. Fill in the Blanks (5)

A. When an object is moving with _____, it covers equal distance in equal intervals of time.

Answer: Uniform speed (or Uniform velocity)

Justification: Uniform speed means the object covers equal distances in equal intervals of time. For example, if a car travels 60 km every hour, it has uniform speed of 60 km/h.

B. Whether an object floats or sinks in a liquid that it is immersed in depends on its _____.

Answer: Density

Justification: An object floats if its density is less than the liquid's density, and sinks if its density is greater than the liquid's density. For example, wood (density ~0.6 g/cm^3) floats on water (density 1 g/cm^3), while iron (density ~7.8 g/cm^3) sinks.

C. Liquids such as mercury which has greater cohesive force forms _____ meniscus.

Answer: Convex

Justification: Mercury has stronger cohesive forces (attraction between mercury molecules) than adhesive forces (attraction to glass). This causes mercury to curve downward at the edges, forming a **convex meniscus**. Water, with stronger adhesive forces, forms a concave meniscus.

D. The energy harnessed during nuclear reaction is _____.

Answer: Nuclear energy

Justification: Nuclear reactions (fission or fusion) release enormous amounts of energy by converting a small amount of mass into energy ($E = mc^2$). This nuclear energy can be used to generate electricity in nuclear power plants.

E. 1 calorie = _____ joules.

Answer: 4.18 joules (or approximately 4.2 joules)

Justification: The calorie is a unit of heat energy. One calorie is the amount of heat required to raise the temperature of 1 gram of water by 1°C. In SI units: **1 calorie = 4.18 joules** (or 4.186 J more precisely).

---

2. True or False (5)

A. The SI unit of energy is calorie.

Answer: False

Justification: The SI unit of energy is the **joule (J)**, not calorie. Calorie is a CGS unit of heat energy. 1 calorie = 4.18 joules.

B. A book lying on a table has no energy.

Answer: False

Justification: A book lying on a table has **gravitational potential energy** due to its position above the ground. Potential energy = mgh (mass × gravity × height). Even if h is small (height of table), the book still possesses potential energy relative to the floor.

C. Distance can be zero even if the object is moving.

Answer: False

Justification: Distance is the total path length covered by an object and is always positive when the object moves. It cannot be zero if the object is moving. However, **displacement** (shortest distance between initial and final positions) can be zero if the object returns to its starting point.

D. 1kgf = 9.8N

Answer: True

Justification: 1 kilogram-force (kgf) is the force exerted by gravity on a 1 kg mass. - Weight = mass × g - 1 kgf = 1 kg × 9.8 m/s^2 = **9.8 N**

E. Uniform speed is also known as normal speed.

Answer: False

Justification: Uniform speed means constant speed (covering equal distances in equal time intervals). There is no term called “normal speed” in physics. Uniform speed is simply called **constant speed**.

---

3. Name the Following (5)

A. The capacity to do work.

Answer: Energy

Justification: Energy is defined as the capacity or ability to do work. It exists in various forms (kinetic, potential, thermal, chemical, etc.) and can be converted from one form to another.

B. The internal volume of the container.

Answer: Capacity

Justification: Capacity refers to the maximum amount of liquid a container can hold - essentially the internal volume of the container. It is measured in litres or millilitres.

C. The curve which is formed on the surface of the container on pouring a liquid into it.

Answer: Meniscus

Justification: When a liquid is poured into a container, the surface curves at the edges due to the interaction between cohesive forces (within the liquid) and adhesive forces (between liquid and container). This curved surface is called a **meniscus** - concave for water, convex for mercury.

D. The motion of an object along a curved line.

Answer: Curvilinear motion

Justification: When an object moves along a curved path (not a straight line), its motion is called curvilinear motion. Examples include a ball thrown in the air (parabolic path), a car turning a corner, or planets orbiting the sun.

E. No change in the position of an object with respect to time and its surroundings.

Answer: Rest

Justification: When an object does not change its position with respect to its surroundings over time, it is said to be at **rest**. Rest is a relative concept - an object may be at rest relative to one observer but in motion relative to another.

Question No. 3

4. Define (5)

A. Distance

Answer: Distance is the total length of the path travelled by a moving object, irrespective of direction.

Justification: Distance is a scalar quantity (has only magnitude, no direction). It is always positive and can never be zero for a moving object. SI unit: metre (m)

B. Speed

Answer: Speed is the rate of change of distance with respect to time. It tells us how fast an object is moving.

Formula: Speed = Distance / Time

Justification: Speed is a scalar quantity. SI unit: metre per second (m/s). Average speed = Total distance / Total time.

C. One joule of work

Answer: One joule of work is done when a force of one newton moves an object through a distance of one metre in the direction of the force.

Formula: Work = Force × Distance **1 Joule = 1 Newton × 1 metre = 1 N·m**

Justification: Joule is the SI unit of work and energy, named after James Prescott Joule.

D. Volume

Answer: Volume is the amount of three-dimensional space occupied by an object or substance.

Justification: Volume is measured in cubic units. SI unit: cubic metre (m^3). Other common units: cm^3, litre (L), millilitre (mL). 1 L = 1000 cm^3 = 1000 mL.

E. One oscillation

Answer: One oscillation is one complete to-and-fro motion of a vibrating body about its mean (equilibrium) position.

Justification: In a pendulum, one oscillation = movement from mean position to one extreme, to the other extreme, and back to the mean position. The time taken for one oscillation is called the **time period**.

---

5. Differentiate (2+2+1)

A. Kinetic energy and Potential energy

Kinetic Energy	**Potential Energy**
Energy possessed by an object due to its **motion**.	Energy possessed by an object due to its **position** or **configuration**.
Formula: KE = ½mv^2 (m = mass, v = velocity)	Formula: PE = mgh (m = mass, g = gravity, h = height)
Example: Moving car, flowing water, flying bird	Example: Water stored in dam, stretched spring, book on shelf

Kinetic Energy	Potential Energy
Depends on mass and velocity of the object	Depends on mass, height, and gravitational field strength

---

B. Mass and Weight

Mass	Weight
The amount of matter contained in an object.	The force with which gravity pulls an object towards the center of Earth.
Scalar quantity (has only magnitude).	Vector quantity (has magnitude and direction - always downward).
Remains **constant** everywhere in the universe.	**Changes** with location (less on Moon, more on Jupiter).
SI unit: kilogram (kg)	SI unit: newton (N)
Measured using a **beam balance**.	Measured using a **spring balance**.

Relationship: Weight = Mass × Acceleration due to gravity (W = m × g)

C. Rest and Motion

Rest	Motion
An object is at rest when its position does not change with respect to its surroundings over time.	An object is in motion when its position changes with respect to its surroundings over time.
Example: A book lying on a table, a parked car	Example: A moving car, a flying bird, flowing water

Note: Rest and motion are **relative** terms. An object may be at rest relative to one observer but in motion relative to another.

---

6. Give Reason (5)

A. Mayank travels in a straight road from home to school which is located at a distance of 5km. The total distance travelled by Mayank is 10 kilometres every day but, the displacement is zero.

Answer: The displacement is zero because Mayank returns to his starting point (home) at the end of the day.

Justification: - **Distance** = Total path length = 5 km (to school) + 5 km (back home) = **10 km** - **Displacement** = Shortest distance between initial and final positions - Since Mayank

starts from home and returns to home, the initial and final positions are the **same**. - Therefore, displacement = **0 km**

Distance is the total path travelled (always positive), while displacement considers only the start and end points.

B. Aarav puts sugar and an iron block of same mass in two containers and observes that sugar takes up a lot of space in the container whereas iron block does not.

Answer: This is because iron has a **higher density** than sugar.

Justification: - Both have the same mass - Density = Mass / Volume, so Volume = Mass / Density - **Iron** has higher density (~7.8 g/cm^3) → smaller volume for the same mass - **Sugar** has lower density (~1.5 g/cm^3) → larger volume for the same mass - Since iron is denser, the same mass of iron occupies less space than sugar.

C. Volume of a stone cannot be found using formula L × B × H.

Answer: A stone is an **irregular solid** with no defined length, breadth, or height.

Justification: - The formula V = L × B × H applies only to **regular solids** like cubes and cuboids with measurable dimensions. - A stone has an irregular shape with uneven surfaces. - To find the volume of a stone, we use the **water displacement method**: 1. Fill a measuring cylinder with water and note the initial level (V_1) 2. Immerse the stone completely 3. Note the new water level (V_2) 4. Volume of stone = $V_2 - V_1$

Section B

Question No. 1

A. Ball on Curved Surface (4)

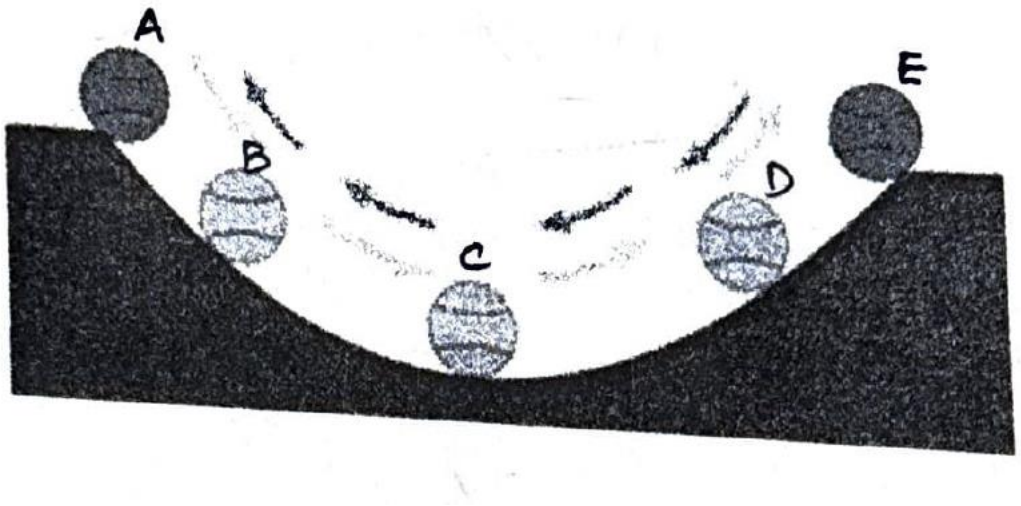


Figure shows a ball moving on a curved surface from point A to B to C to D to E

1. What type of energy is present when the ball is:

i) at the point 'A': Answer: Potential energy (maximum)

Justification: At point A (the highest point), the ball is at rest at maximum height. It has maximum gravitational potential energy (PE = mgh) and zero kinetic energy.

---

ii) at the point 'B': Answer: Both potential energy and kinetic energy

Justification: At point B, the ball is descending. It has some height (so some potential energy) and is moving (so some kinetic energy). Energy is being converted from potential to kinetic.

---

iii) at the point 'C': Answer: Kinetic energy (maximum)

Justification: Point C is at the lowest point of the curve. Here, the ball has maximum speed (maximum kinetic energy) and minimum height (minimum potential energy). Most of the potential energy has been converted to kinetic energy.

---

2. If the mass of the ball in the picture is increased, _____ energy increases.

Answer: Potential and **Kinetic** energy both increase.

Justification: - Potential energy = mgh (increases with mass) - Kinetic energy = ½mv^2 (increases with mass) - Both depend on mass, so increasing mass increases both forms of energy.

---

3. State the law of conservation of energy demonstrated by the above activity.

Answer: Law of Conservation of Energy: Energy can neither be created nor destroyed; it can only be transformed from one form to another. The total energy in an isolated system remains constant.

Justification: In this activity: - At A: Total energy = PE (max) + KE (0) = Total - At C: Total energy = PE (0) + KE (max) = Total - The potential energy at A converts to kinetic energy at C, but the total mechanical energy remains the same (ignoring friction).

B. Examples of Energy Interconversion (3)

i) Electrical to Magnetic

Answer: Electric motor or **Electromagnet**

Justification: When electric current flows through a coil, it creates a magnetic field. In an electric motor, electrical energy is converted to magnetic energy, which then produces mechanical motion.

---

ii) Mechanical to Heat energy

Answer: Rubbing hands together or **Brakes of a vehicle**

Justification: When you rub your hands, the friction converts mechanical energy (kinetic energy of motion) into heat energy. Similarly, when brakes are applied in a car, the kinetic energy is converted to heat due to friction.

---

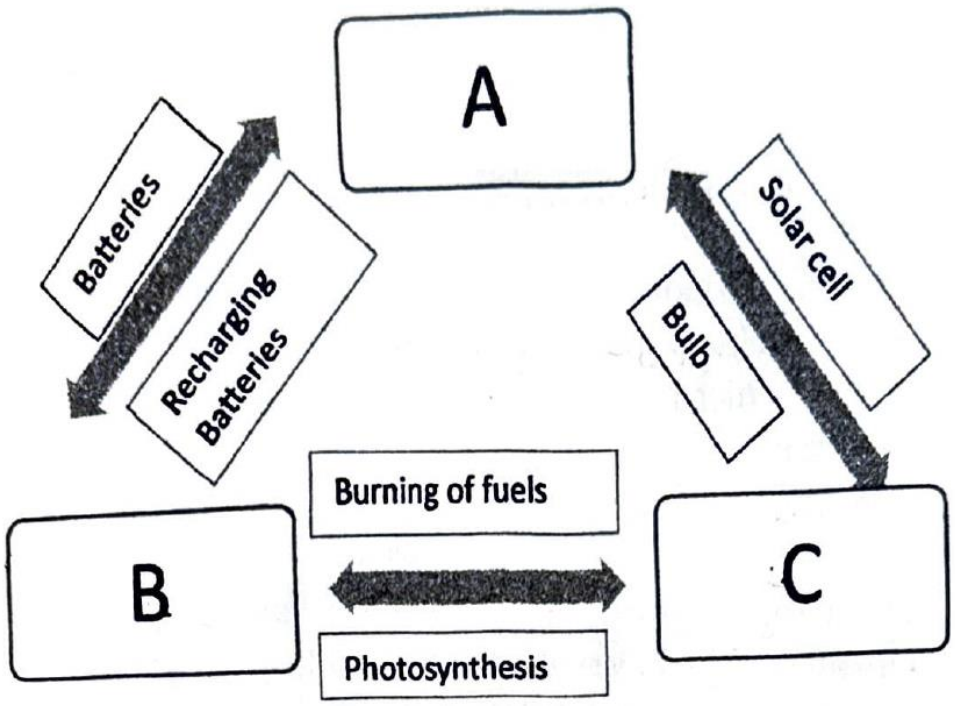
iii) Chemical to Mechanical

Answer: Muscles in our body or **Car engine burning petrol**

Justification: In our body, chemical energy from food (glucose) is converted to mechanical energy for movement. In a car engine, chemical energy from fuel combustion is converted to mechanical energy that moves the vehicle.

C. Energy Interconversion Diagram (3)

Diagram shows: Batteries → Recharging Batteries → A; Burning of fuels ↔ Photosynthesis; Solar cell → Bulb → B; → C



Name the type of energy in:

i) A: Answer: Electrical energy

Justification: Batteries store chemical energy and convert it to electrical energy when used. During recharging, electrical energy is converted back to chemical energy.

---

ii) C: Answer: Light energy

Justification: A bulb converts electrical energy into light energy (and some heat).

---

iii) B: Answer: Chemical energy

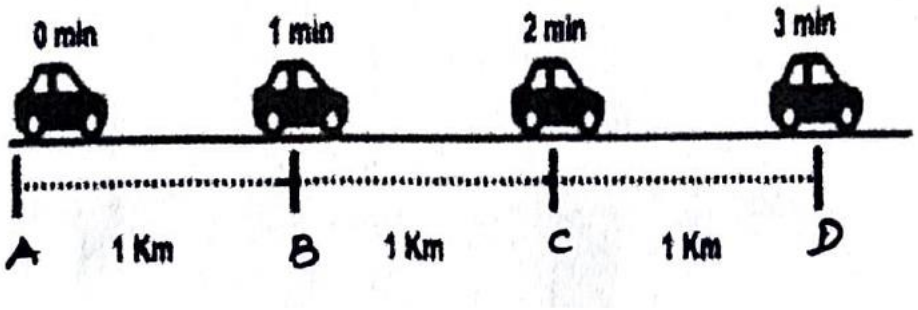
Justification: Photosynthesis in plants converts light energy (from sun) into chemical energy (stored in glucose/food). Burning of fuels releases this stored chemical energy.

Question No. 2

A. Motion of Cars (4)

Diagram shows 4 cars at positions A, B, C, D at 0, 1, 2, 3 minutes, each 1 km apart

1. ***Name the type of motion exhibited in the given picture.***



Answer: Uniform motion

Justification: The cars are covering equal distances (1 km each) in equal intervals of time (1 minute each). This is the definition of uniform motion.

---

2. Define the motion mentioned in part (1).

Answer: Uniform motion is the type of motion in which an object covers equal distances in equal intervals of time.

Justification: In uniform motion, the speed remains constant throughout the journey. The distance-time graph for uniform motion is a straight line.

---

3. If the distances from B to C and C to D change to 3 km and 7 km, what type of motion is exhibited by the car?

Answer: Non-uniform motion (or Variable motion)

Justification: Now the distances covered are: A to B = 1 km, B to C = 3 km, C to D = 7 km. Since unequal distances are covered in equal time intervals, this is non-uniform motion where speed keeps changing.

---

4. Give the SI unit and C.G.S unit of speed.

Answer: - **SI unit:** metre per second (m/s) - **CGS unit:** centimetre per second (cm/s)

B. Astronaut's Weight on Earth and Moon (3)

Given: - Mass of astronaut = 70 kg - Gravitational field strength on Earth = 10 N/kg - Gravitational field strength on Moon = 1.6 N/kg

1. Calculate the astronaut's weight on the Earth.

Answer: - Weight = Mass × Gravitational field strength - Weight = 70 kg × 10 N/kg - **Weight on Earth = 700 N**

---

2. State the astronaut's mass on the Moon.

Answer: 70 kg

Justification: Mass remains constant regardless of location. The astronaut's mass is 70 kg whether on Earth, Moon, or anywhere in the universe.

---

3. Calculate the astronaut's weight on the Moon.

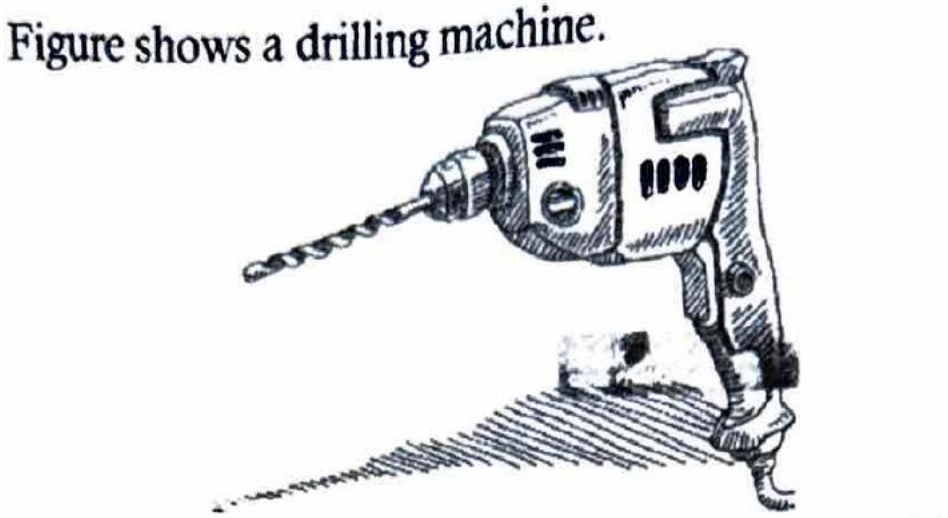
Answer: - Weight = Mass × Gravitational field strength - Weight = 70 kg × 1.6 N/kg - **Weight on Moon = 112 N**

Justification: The Moon has weaker gravity (about 1/6th of Earth's), so the astronaut weighs less on the Moon but has the same mass.

B. Drilling Machine (3)

C.

Figure shows a drilling machine.



1. What are two types of motion it undergoes when it is given an electric supply?

Answer: Rotatory motion and **Linear motion** (or Translatory motion)

Justification: The drill bit rotates about its axis (rotatory motion) and can also move forward into the material being drilled (linear motion).

---

2. Name the motion which is combination of two or more types of motion.

Answer: Multiple motion (or Complex motion)

Justification: When an object exhibits two or more types of motion simultaneously, it is called multiple motion. The drilling machine shows both rotation and translation together.

---

3. Name the motion in which an object does not follow a definite path and give one example for the same.

Answer: Random motion

Example: Motion of dust particles in air, movement of fish in water, or flight of a housefly.

Justification: In random motion, the object moves in an unpredictable, irregular path with no fixed pattern or direction.

Question No. 3

A. Measuring Density of an Irregular Object (4)

Steps to measure the density of an irregular object:

Step 1: Measure the mass - Place the irregular object on a compression balance (or beam balance) - Record the mass (m) in grams

Step 2: Find the volume using water displacement - Take a measuring cylinder and fill it with water - Record the initial water level (V_1) in cm^3

Step 3: Immerse the object - Carefully lower the irregular object into the water using a thread - Make sure it is completely submerged - Record the new water level (V_2) in cm^3

Step 4: Calculate volume and density - Volume of object = $V_2 - V_1$ (in cm^3) - Density = Mass / Volume = $m / (V_2 - V_1)$ g/cm^3

B. Reading the Meniscus (3)

Diagram shows a measuring cylinder with water level between 45-50 cm^3, with top and bottom of meniscus marked

i) What is the volume of the water?

Answer: b. 47.5 cm^3

Justification: For water (which forms a concave meniscus), we always read from the **bottom of the meniscus**. Looking at the diagram, the bottom of the meniscus is at the 47.5 cm^3 mark. Reading from the top would give an incorrect (higher) value.

---

ii) Among the units of volume cm^3, m^3 and litre, which is most suitable for measuring the volume of the following?

a. A bath tub: Answer: Litre (L) or **m^3**

Justification: A bath tub holds a large volume of water (typically 150-300 litres). Using cm^3 would give very large numbers, making litres or cubic metres more practical.

---

b. A football: Answer: cm^3 (or litres)

Justification: A football has a volume of approximately 5,000-6,000 cm^3 (or 5-6 litres). cm^3 gives manageable numbers for this size.

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c. A juice bottle: Answer: mL (millilitres) or **Litre (L)**

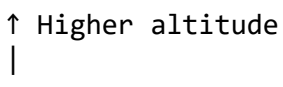
Justification: Juice bottles typically range from 200 mL to 2 L. These units are commonly used for liquid containers and give practical values.

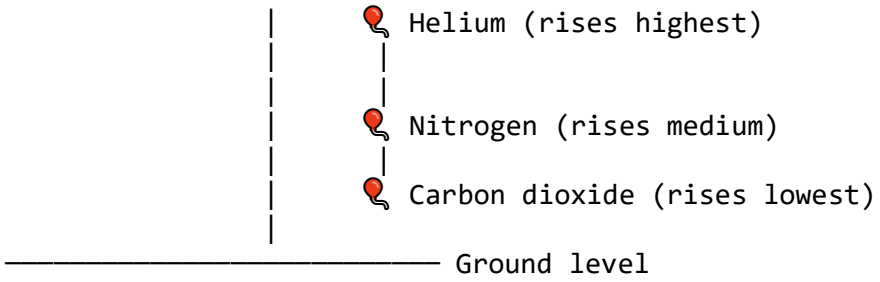
C. Balloons with Different Gases (3)

Given densities: | Gas | Density (kg/m^3) | |—-|————-| | Carbon dioxide | 1.8 | | Helium | 0.18 | | Nitrogen | 1.2 |

Question: Draw the picture of the balloons to illustrate the height up to which all three balloons will rise.

Answer:





Justification: - Balloons rise because the gas inside is **less dense** than air (air density ≈ 1.2 kg/m^3) - **Helium** (0.18 kg/m^3) is the lightest → rises **highest** - **Nitrogen** (1.2 kg/m^3) is equal to air → may not rise much - **Carbon dioxide** (1.8 kg/m^3) is heavier than air → will **sink** or stay low

Only helium balloon will float up effectively. CO_2 balloon will actually fall/sink since it's denser than air.

Question 4: Numerical

Q1. The mass of a wooden block is 200g and volume is 250 cm^3. Find the density of the wooden block in:

i) g/cm^3

Answer: - Density = Mass / Volume - Density = 200g / 250cm^3 - **Density = 0.8 g/cm^3**

---

ii) kg/m^3

Answer: Method 1: Direct conversion - 0.8 g/cm^3 = 0.8 × 1000 kg/m^3 = **800 kg/m^3**

Method 2: Converting units first - Mass = 200g = 0.2 kg - Volume = 250 cm^3 = 250 × 10^{-6} m^3 = 0.00025 m^3 - Density = 0.2 kg / 0.00025 m^3 = **800 kg/m^3**

Justification: Since the density (0.8 g/cm^3) is less than water (1 g/cm^3), this wooden block will **float** on water.

Q2. Calculate speed when distance is 142 km and time is 2 hours. Convert your answer into m/s.

Answer:

Step 1: Calculate speed in km/h - Speed = Distance / Time - Speed = 142 km / 2 hours - **Speed = 71 km/h**

Step 2: Convert to m/s - To convert km/h to m/s, multiply by (1000/3600) or divide by 3.6 - Speed = 71 × (1000/3600) m/s - Speed = 71 × (5/18) m/s - Speed = 355/18 m/s - **Speed = 19.72 m/s** (approximately 19.7 m/s)

Q3. A student determines the time period of a simple pendulum by making it oscillate 20 times and finds the total time to be 34 seconds. Calculate the time taken for one oscillation.

Answer:

Given: - Number of oscillations = 20 - Total time = 34 seconds

Formula: Time period = Total time / Number of oscillations

Calculation: - Time period (T) = 34 seconds / 20 oscillations - **Time period = 1.7 seconds**

Justification: The time period is the time taken for one complete oscillation of the pendulum. By timing multiple oscillations and dividing, we get a more accurate average value for the time period.

Summary of Key Formulas Used:

Formula	Description
Density = Mass / Volume	$\rho = m/V$
Speed = Distance / Time	$v = d/t$
Weight = Mass × g	$W = m \times g$
KE = ½mv^2	Kinetic energy
PE = mgh	Potential energy
Time period = Total time / Oscillations	$T = t/n$
1 calorie = 4.18 J	Energy conversion
1 kgf = 9.8 N	Force conversion
m/s to km/h: multiply by 3.6	Speed conversion

SAMPLE PAPER 6

Paper Date: 24.11.23 | **Total Marks:** 80 | **Duration:** 2 hours

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SECTION I - Multiple Choice Questions (5 × 1 = 5)

Q5. Mice communicate at 70,000 Hz with one another. Cats cannot detect this frequency because

- **a. Cats cannot hear such high frequencies.** ✓
- b. They can hear them only if they are close to the mice.
- c. The frequency is lesser than the lowest frequency a cat can hear.
- d. None of the above.

Answer: a. Cats cannot hear such high frequencies.

Justification: 70,000 Hz (70 kHz) is an ultrasonic frequency - above the human audible range (20 Hz to 20,000 Hz). While mice can produce and hear these ultrasonic sounds, cats have a hearing range of approximately 48 Hz to 85,000 Hz. However, 70,000 Hz is near the upper limit for cats, and they may not detect it clearly. The question implies cats cannot effectively hear such high frequencies.

SECTION II - Name the Following (5 × 1 = 5)

Q3. Sounds produced by vibrations with frequency between 20 Hz to 20,000 Hz.

Answer: Audible sound (or Sonic sound)

Explanation: The range of frequencies that can be heard by the human ear is called the audible range or sonic range. Sounds below 20 Hz are infrasonic, and sounds above 20,000 Hz are ultrasonic.

Q4. Method that uses high frequency sound waves to produce images of the cardiovascular system.

Answer: Echocardiography (or Ultrasonography/Sonography)

Explanation: Echocardiography uses ultrasonic waves (high-frequency sound waves above 20,000 Hz) to create images of the heart and blood vessels. The ultrasound waves bounce off heart structures and return as echoes, which are converted into images.

SECTION III - True or False (5 × 1 = 5)

SECTION IV - Fill in the Blanks (5 × 1 = 5)

Q5. _____ are used in laboratories for producing sound vibrations.

Answer: Tuning forks

Justification: A tuning fork is a Y-shaped steel instrument that produces a pure musical note of a fixed frequency when struck. It is commonly used in physics laboratories to study sound waves, demonstrate resonance, and in music to tune instruments.

SECTION V - Define the Following (5 × 2 = 10)

Q3. Frequency

Answer: Frequency is the number of oscillations (or vibrations) completed by a vibrating body in one second.

- **SI unit:** Hertz (Hz)
- **Formula:** f = 1/T (where T is the time period)
- **Relationship:** Frequency is inversely proportional to time period
- **Example:** If a tuning fork vibrates 256 times per second, its frequency is 256 Hz.

Q4. Longitudinal wave

Answer: A **longitudinal wave** is a wave in which the particles of the medium vibrate parallel to (in the same direction as) the direction of propagation of the wave.

Characteristics: - Consists of compressions (high-pressure regions) and rarefactions (low-pressure regions) - Sound waves are longitudinal waves - Requires a medium to travel (cannot travel through vacuum) - Example: Sound waves traveling through air, where air particles oscillate back and forth in the direction of sound travel

---

SECTION VI - Distinguish Between (3 × 2 = 6)

Q2. Conductors and Insulators

Conductors	Insulators
Materials that allow electric current to flow through them easily.	Materials that do not allow electric current to flow through them.
Have free electrons that can move easily.	Do not have free electrons; electrons are tightly bound.
Examples: Copper, silver, aluminium, iron, gold	Examples: Plastic, rubber, wood, glass, air
Used in making electrical wires and circuits.	Used for covering electrical wires for safety.

Q3. Light energy and Sound energy

Light Energy	Sound Energy
A form of electromagnetic energy that can travel through vacuum.	A form of mechanical energy that requires a medium to travel.
Travels at a speed of 3×10^8 m/s in vacuum (fastest known speed).	Travels at about 340 m/s in air at room temperature (much slower than light).
Light waves are transverse waves.	Sound waves are longitudinal waves.
Can be reflected, refracted, and dispersed.	Can be reflected (echo), refracted, and absorbed.
Detected by eyes.	Detected by ears.

SECTION VII - Answer the Following Questions in Short (7 × 2 = 14)

Q4. There is an explosion in the sea, underwater. A scuba diver deep in water and a boatman on the surface of the water hear the explosion.

a. Who would hear the explosion first? The boatman or the diver?

Answer: The **scuba diver** would hear the explosion first.

b. Why? Explain your answer.

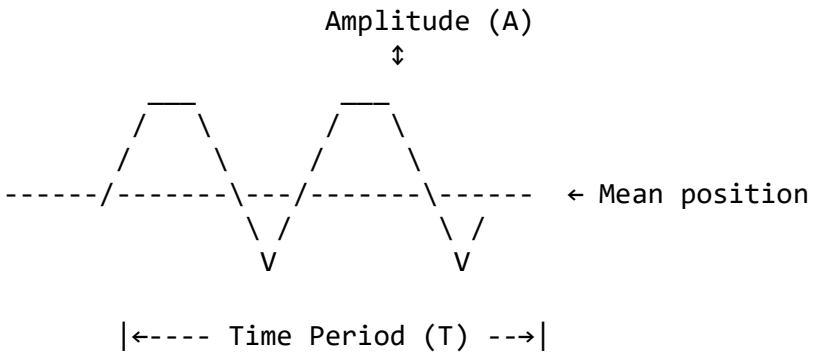
Answer: Sound travels faster in liquids (water) than in gases (air). - Speed of sound in water ≈ 1500 m/s - Speed of sound in air ≈ 340 m/s

Since the explosion occurs underwater, the sound waves traveling through water reach the diver much faster than the sound waves that travel through the water surface and then

through air to reach the boatman. Sound travels approximately **4-5 times faster in water than in air**.

Q7. Draw a sound wave and mark (i) amplitude and (ii) time period.

Answer:



Explanation: - **Amplitude (A):** The maximum displacement of the wave from its mean (rest) position. It determines the loudness of sound - greater amplitude means louder sound. - **Time Period (T):** The time taken to complete one full oscillation (one complete wave). It is related to frequency by T = 1/f.

SECTION VIII - Answer in Detail (3 × 10 = 30)

Question 3

a. A man fires a gun and hears an echo from a distant hill after 4 seconds. If the speed of sound in air is 340 m/s, what is the distance of the hill from the man? (2)

Answer:

Given: - Time for echo = 4 seconds - Speed of sound in air = 340 m/s

Note: The sound travels to the hill AND back to the man (round trip).

Calculation: - Time for sound to reach the hill = 4/2 = 2 seconds - Distance = Speed × Time - Distance = 340 × 2 - **Distance of hill from man = 680 metres**

Alternative formula: Distance = (Speed × Time for echo) / 2 Distance = (340 × 4) / 2 = 1360 / 2 = **680 m**

---

b. State any one condition for an echo to occur. (1)

Answer: For an echo to be heard distinctly, the minimum distance between the source of sound and the reflecting surface should be at least **17 metres** (or approximately 17.2 m).

Explanation: The human ear can distinguish two sounds only if there is a gap of at least 0.1 seconds between them. Using the formula: - Minimum distance = (Speed of sound × Time) / 2 - Minimum distance = (340 × 0.1) / 2 = 17 m

Other conditions: - There should be a large, hard surface (like a cliff, building, or wall) to reflect sound - The reflecting surface should be rigid and smooth

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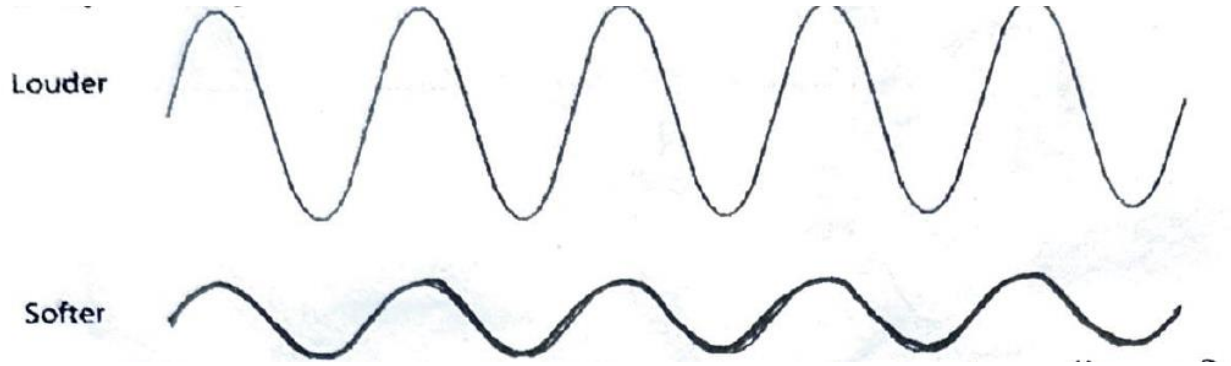
c. Study the diagram (showing two waveforms - one with larger amplitude labeled "Louder" and one with smaller amplitude labeled "Softer")



i. What factor decides the loudness of sound in the above diagram? (2)

Answer: Amplitude decides the loudness of sound.

Explanation: The diagram shows two waves with different amplitudes. The wave with larger amplitude (taller peaks and deeper troughs) produces a louder sound, while the wave with smaller amplitude produces a softer sound. Loudness is directly proportional to the square of amplitude (Loudness $\propto A^2$).

---

ii. Name one more factor that affects the loudness of sound. (2)

Answer: Distance from the source

Explanation: Loudness decreases as the distance from the source increases. This follows the inverse square law - when distance is doubled, loudness becomes one-fourth.

Other factors affecting loudness: - Surface area of the vibrating body (larger surface = louder sound) - Density of the medium - Sensitivity of the listener's ear

---

d. A pendulum makes 5 oscillations in 10 seconds, while a mosquito flaps its wings 400 times in one second.

i. Calculate the frequency of the pendulum and the mosquito. (2)

For Pendulum: - Number of oscillations = 5 - Time = 10 seconds - Frequency = Number of oscillations / Time - **Frequency of pendulum = 5/10 = 0.5 Hz**

For Mosquito: - Number of wing flaps = 400 - Time = 1 second - **Frequency of mosquito = 400/1 = 400 Hz**

---

ii. Which of them would you hear? Why? (1)

Answer: We would hear the **mosquito**, not the pendulum.

Explanation: The audible range for humans is 20 Hz to 20,000 Hz. - Pendulum frequency (0.5 Hz) is **infrasonic** - below 20 Hz, so we cannot hear it - Mosquito frequency (400 Hz) is within the **audible range** (between 20 Hz and 20,000 Hz), so we can hear the buzzing sound

---

iii. Give any two uses of ultrasonic sound waves. (2)

Answer: 1. **Medical diagnosis (Ultrasonography/Sonography):** Used to examine internal organs, monitor fetus during pregnancy, detect tumors, and create images of the heart (echocardiography).

2. **SONAR (Sound Navigation and Ranging):** Used in submarines and ships to detect underwater objects, measure ocean depth, and locate fish schools.

Other uses: - Cleaning delicate objects like jewelry, surgical instruments, and electronic components - Detecting cracks and flaws in metal structures (industrial testing) - Removing kidney stones (lithotripsy) - Pest control (ultrasonic pest repellers)

Summary of Key Formulas Used:

Formula	Description
K = °C + 273	Celsius to Kelvin conversion
°F = (9/5 × °C) + 32	Celsius to Fahrenheit conversion
f = 1/T	Frequency and Time period relationship
f = n/t	Frequency = oscillations/time

Formula	Description
Distance = Speed × Time	Basic motion formula
Echo distance = (Speed × Time)/2	For echo calculations
Loudness $\propto A^2$	Loudness-Amplitude relationship

SAMPLE PAPER 7

Paper Date: 21st July 2023 | **Total Marks:** 80 | **Duration:** 2 hours

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QUESTION NO 1 [5×1=5]

A. Fill in the Blanks

Q(a). The CGS unit of density is _____.

Answer: g/cm^3 (gram per cubic centimetre)

Justification: In the CGS (Centimetre-Gram-Second) system: - Mass is measured in grams (g) - Volume is measured in cubic centimetres (cm^3) - Density = Mass/Volume, so unit is g/cm^3 - SI unit of density is kg/m^3

Q(b). The volume of irregular solids can be found out by _____ method.

Answer: Displacement (or Water displacement)

Justification: For irregular solids, we cannot use the formula L × B × H. Instead: 1. Fill a measuring cylinder with water, note initial level (V_1) 2. Immerse the solid completely in water 3. Note the new water level (V_2) 4. Volume of solid = $V_2 - V_1$

The solid displaces water equal to its own volume.

Q(c). The actual length of the path covered by a moving object is called _____.

Answer: Distance

Justification: - **Distance** = Total length of the actual path traveled (scalar, always positive) - **Displacement** = Shortest distance between initial and final points (vector)

For example, if you walk around a circular track of circumference 400m and return to the starting point: - Distance = 400 m - Displacement = 0 m

---

Q(d). When the position of bus keeps on changing every instant it is said to be in _____ motion.

Answer: Non-uniform (or Variable)

Justification: When a bus travels on a road: - It speeds up, slows down, stops at signals - Its speed (and/or direction) changes continuously - This is non-uniform motion

In uniform motion, equal distances are covered in equal intervals of time, which is practically impossible for vehicles in traffic.

Q(e). Human beings use their _____ energy to lift objects.

Answer: Muscular (or Chemical)

Justification: When we lift objects: - Our muscles contract and do work - The energy comes from chemical reactions in our body - Food we eat provides chemical energy - This chemical energy converts to muscular/mechanical energy for lifting

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B. Choose the Best Option [6×1=6]

Q(i). An apple on a tree possesses _____.

- a) Magnetic energy
- b) Kinetic energy
- **c) Potential energy** ✓

Answer: c) Potential energy

Justification: An apple on a tree has **gravitational potential energy** because: - It is at a height above the ground - PE = mgh (mass × gravity × height) - This energy is stored due to its position - When the apple falls, this PE converts to KE

Q(ii). Which of the following is not a nuclear reaction?

- a) Fusion
- **b) Photosynthesis** ✓
- c) Fission

Answer: b) Photosynthesis

Justification: - **Nuclear Fusion:** Combining light nuclei to form heavier nuclei (releases nuclear energy, occurs in the Sun) - **Nuclear Fission:** Splitting heavy nuclei into lighter nuclei (releases nuclear energy, used in nuclear reactors) - **Photosynthesis:** A chemical reaction where plants convert CO_2 and water into glucose using sunlight - this involves electron transfer, not nuclear changes

---

Q(iii). Which of the following is an example of circulatory motion?

- a) Motion of a bullet fired from a gun
- b) Motion of a javelin thrown by an athlete
- **c) Motion of the hands of a clock** ✓

Answer: c) Motion of the hands of a clock

Justification: - Bullet: Rectilinear (straight line) motion - Javelin: Curvilinear (curved path/projectile) motion - Clock hands: **Circular/Rotatory motion** - they rotate around a fixed axis (the center of the clock)

Q(iv). Light year is a unit of _____.

- a) Time
- **b) Distance** ✓
- c) Speed

Answer: b) Distance

Justification: - 1 light year = Distance traveled by light in 1 year - Speed of light = 3×10^8 m/s - 1 light year ≈ 9.46×10^{12} km (about 9.46 trillion km) - Used to measure astronomical distances (distances between stars and galaxies)

Despite having "year" in its name, it measures distance, not time!

Q(v). Liquids which wet the sides of measuring cylinder form a _____ meniscus.

- a) Convex meniscus
- **b) Concave meniscus** ✓
- c) Plane meniscus

Answer: b) Concave meniscus

Justification: - Liquids that **wet** glass (like water) have stronger adhesive forces than cohesive forces - The liquid rises at the edges where it contacts glass - This creates a **concave** (curved inward) meniscus - For such liquids, read the level at the **bottom** of the meniscus

Mercury (which doesn't wet glass) forms a convex meniscus.

Q(vi). Three beakers A, B and C contain the same amount of water. The temperature of water in the beakers are 23°C, 41°C and 35°C respectively. The correct arrangement of the beakers in the descending order of their densities is _____.

- a) A, B, C
- b) B, C, A
- **c) A, C, B** ✓

Answer: c) A, C, B

Justification: - As temperature **increases**, water **expands** (volume increases) - Mass remains constant, but volume increases - Density = Mass/Volume, so density **decreases** with increasing temperature - Lower temperature = Higher density

Temperature order (ascending): A (23°C) < C (35°C) < B (41°C) **Density order (descending):** A > C > B

C. True or False [5×1=5]

Q(a). For liquids which form the convex meniscus the reading at lowermost level of meniscus should be taken as their correct reading.

Answer: False

Justification: For liquids with **convex** meniscus (like mercury): - Read at the **topmost** (highest) point of the meniscus - For **concave** meniscus (like water): Read at the lowermost point

---

Q(b). Weight of an object varies from one place to another.

Answer: True

Justification: - Weight = Mass × g (acceleration due to gravity) - The value of 'g' varies from place to place: - g at poles > g at equator (Earth is flattened at poles) - g decreases with altitude (mountains) - g on Moon ≈ 1/6 of g on Earth - Since g varies, weight varies, even though mass remains constant

---

Q(c). Speedometer displays the distance of a moving vehicle.

Answer: False

Justification: - **Speedometer** displays the instantaneous **speed** of a vehicle (in km/h or mph) - **Odometer** displays the total **distance** traveled by the vehicle

---

Q(d). The total amount of energy in the universe keeps changing.

Answer: False

Justification: According to the **Law of Conservation of Energy**: - Total energy of the universe is **constant** - Energy cannot be created or destroyed - Energy only transforms from one form to another - The total amount always remains the same

---

Q(e). Pressure cookers require less energy for cooking.

Answer: True

Justification: - Pressure cookers trap steam, increasing pressure inside - Higher pressure raises the boiling point of water (above 100°C) - Food cooks faster at higher temperatures - Less time cooking = Less energy used - Also, steam doesn't escape, so heat is retained better

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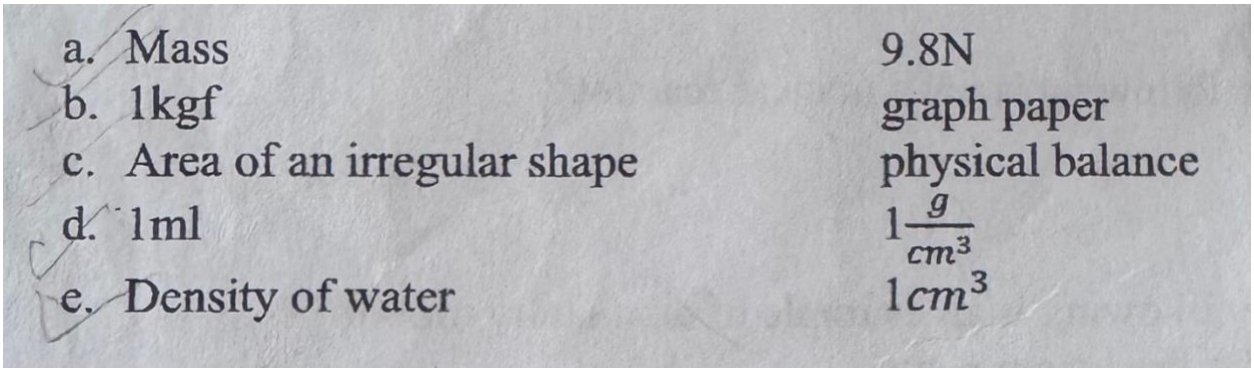
D. Match the Following [5×1=5]



Column A	Column B
a) Mass	Physical balance
b) 1 kgf	9.8 N
c) Area of an irregular shape	Graph paper
d) 1 ml	1 cm^3
e) Density of water	1 g/cm^3

Justification: - Mass is measured using a physical balance (or beam balance) - 1 kgf (kilogram-force) = 9.8 N (force due to gravity on 1 kg mass) - Area of irregular shapes is found by counting squares on graph paper - 1 millilitre = 1 cubic centimetre (by definition) - Density of pure water at 4°C = 1 g/cm^3 = 1000 kg/m^3

E. Name the Following [5×1=5]

Q(a). The heavy mass suspended in a simple pendulum.

Answer: Bob

Justification: A simple pendulum consists of: - A **bob** (heavy mass) at the bottom - A string or thread connecting the bob to a fixed point - The bob swings back and forth in oscillatory motion

---

Q(b). Force with which the earth attracts any object towards the center.

Answer: Gravity (or Gravitational force)

Justification: Gravity is the force of attraction between any two masses. Earth's gravity: - Pulls objects towards Earth's center - Gives objects their weight (W = mg) - Keeps the atmosphere around Earth - Keeps the Moon in orbit

---

Q(c). Energy obtained from sea waves.

Answer: Wave energy (or Ocean wave energy)

Justification: Wave energy is a renewable energy source that harnesses the kinetic and potential energy of ocean waves. Devices placed in the ocean capture wave motion to generate electricity. Not to be confused with tidal energy (from tides).

Q(d). Fuels that are formed from the remains of plants and animals buried under the earth millions of years ago.

Answer: Fossil fuels

Justification: Fossil fuels include: - Coal (from ancient plants) - Petroleum/Oil (from marine organisms) - Natural gas (from organic matter)

They are non-renewable and take millions of years to form.

Q(e). The form of energy which enables us to see objects around us.

Answer: Light energy

Justification: Light energy enables vision by: - Reflecting off objects - Entering our eyes - Being processed by the retina and brain - Sources: Sun, lamps, fire, LEDs

---

QUESTION NO 2 [5×2=10]

F. Define

Q(a). One calorie

Answer: One calorie is the amount of heat energy required to raise the temperature of 1 gram of water by 1°C (from 14.5°C to 15.5°C).

- 1 calorie = 4.186 joules (approximately 4.2 J)
- 1 kilocalorie = 1000 calories = 4186 J

Q(b). One joule

Answer: One joule is the work done when a force of one newton displaces an object through a distance of one metre in the direction of the force.

- 1 Joule = 1 Newton × 1 metre = 1 N·m
- Joule is the SI unit of work and energy

Q(c). Volume

Answer: Volume is the amount of three-dimensional space occupied by an object or substance.

- SI unit: cubic metre (m^3)
- CGS unit: cubic centimetre (cm^3)
- For liquids: measured in litres (L) or millilitres (mL)
- Formula for cuboid: V = L × B × H

Q(d). Periodic motion

Answer: Periodic motion is a motion that repeats itself at regular intervals of time.

- The time taken for one complete cycle is called the **time period (T)**
- Examples: pendulum swing, Earth's rotation, heartbeat, hands of clock
- Non-periodic motion does not repeat at regular intervals (e.g., car on road)

Q(e). Time period

Answer: Time period is the time taken by a vibrating or oscillating body to complete one full oscillation (or cycle).

- Symbol: T
- SI unit: second (s)
- Relationship with frequency: T = 1/f
- Example: If a pendulum takes 2 seconds for one complete swing, T = 2 s

---

G. Distinguish Between [2×2=4]

Q(a). Potential Energy and Kinetic Energy

Potential Energy	Kinetic Energy
Energy possessed by an object due to its **position** or **configuration**	Energy possessed by an object due to its **motion**
Formula: PE = mgh (gravitational)	Formula: KE = ½mv^2
Object is at rest relative to its position	Object is in motion
Stored energy	Energy of motion
Examples: Water in dam, stretched spring, raised hammer	Examples: Moving car, flowing water, flying bird

---

Q(b). Mass and Weight

Mass	Weight
Amount of matter contained in a body	Gravitational force acting on a body
Scalar quantity	Vector quantity (acts downward)
Constant everywhere	Varies with location (depends on g)
SI unit: kilogram (kg)	SI unit: newton (N)
Measured using beam balance	Measured using spring balance
Formula: m = ρ × V	Formula: W = m × g

QUESTION NO 3

H. Answer the Following [6×2=12]

Q(a). State the law of conservation of energy.

Answer: The **Law of Conservation of Energy** states that energy can neither be created nor destroyed; it can only be transformed from one form to another. The total energy of an isolated system remains constant.

Key points: - Total energy before = Total energy after (in any process) - Energy transforms between different forms - Examples: PE → KE (falling object), Chemical → Electrical (battery)

Q(b). Write two ways in which energy can be conserved.

Answer:

1. **Use energy-efficient appliances:** Replace incandescent bulbs with LED bulbs, use 5-star rated appliances, use solar water heaters
2. **Reduce wastage:** Switch off lights and fans when not needed, use public transport or carpool, insulate homes properly

Other examples: - Use renewable energy sources (solar, wind) - Avoid standby mode on electronics - Walk or cycle for short distances

---

Q(c). Write the principle on which a spring balance works.

Answer: A spring balance works on **Hooke's Law**.

Hooke's Law states: Within the elastic limit, the extension (or compression) of a spring is directly proportional to the applied force.

Formula: F = kx (Force = spring constant × extension)

Working: - When an object is hung, its weight stretches the spring - Greater weight → Greater extension - Scale is calibrated to show weight directly - Spring balance measures **weight**, not mass

---

Q(d). When do we find average speed? Write its formula.

Answer: We find **average speed** when: - An object travels with non-uniform (varying) speed - Different distances are covered at different speeds - There are stops or changes in speed during the journey

Formula:

$$\text{Average Speed} = \frac{\text{Total Distance Traveled}}{\text{Total Time Taken}}$$

Example: If a car travels 60 km in 1 hour and 40 km in the next hour: - Average speed = (60 + 40)/(1 + 1) = 100/2 = 50 km/h

---

Q(e). Write the formula and SI unit of:

i) Speed

- **Formula:** Speed = Distance / Time (v = d/t)
- **SI Unit:** metre per second (m/s)

ii) Density

- **Formula:** Density = Mass / Volume (ρ = m/V)
- **SI Unit:** kilogram per cubic metre (kg/m^3)

Q(f). Name two factors on which the kinetic energy of a moving object depends upon.

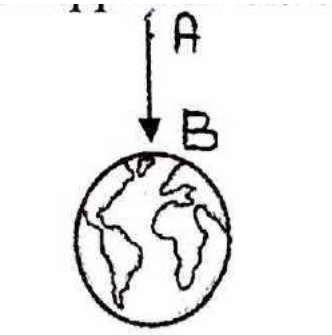
Answer: Kinetic energy depends on:

3. **Mass (m)** of the object
    - KE is directly proportional to mass
    - Doubling mass doubles KE
4. **Velocity (v)** of the object
    - KE is directly proportional to the square of velocity
    - Doubling velocity quadruples KE

Formula: $KE = ½mv^2$

I. Do as Directed [3×2=6]

Q(a). Explain: In the given picture both the points A and B lie inside the Earth's gravitational field. What will happen to the force of gravity as its weight travels from A to B?



(A is farther from Earth's surface, B is closer)

Answer: As the object travels from A (farther from Earth's center) to B (closer to Earth's center), the **gravitational force increases**.

Justification: - Gravitational force $F = GMm/r^2$ - Force is inversely proportional to the square of distance ($F \propto 1/r^2$) - As distance from Earth's center decreases (A to B), gravitational force increases - The weight of the object will also increase since Weight = mg, and g increases closer to Earth

---

Q(b). Give reason: A solid of mass 100 grams displaces 15 cm^3 of water when immersed in it, another solid of same mass displaces 22 cm^3 of water when immersed in it. Explain why both solids displace different quantities of water even though both have the same mass.

Answer: The two solids have **different densities** and therefore **different volumes**, even though their masses are the same.

Justification: - Volume of displaced water = Volume of the solid - First solid: Volume = 15 cm^3, Density = 100/15 = 6.67 g/cm^3 - Second solid: Volume = 22 cm^3, Density = 100/22 = 4.55 g/cm^3 - The solid with **lower density** has **larger volume** for the same mass - Displacement depends on **volume**, not mass - Since Density = Mass/Volume, same mass with different densities means different volumes

---

Q(c). Given statement is incorrect. Correct and rewrite: When ball falls from a height its potential energy increases and kinetic energy decreases.

Answer: The **corrected statement** is:

"When a ball falls from a height, its **potential energy decreases** and **kinetic energy increases**."

Justification: - As the ball falls, height (h) decreases → PE = mgh **decreases** - As the ball falls, velocity (v) increases → KE = ½mv^2 **increases** - By conservation of energy: Loss in PE = Gain in KE - Total mechanical energy (PE + KE) remains constant

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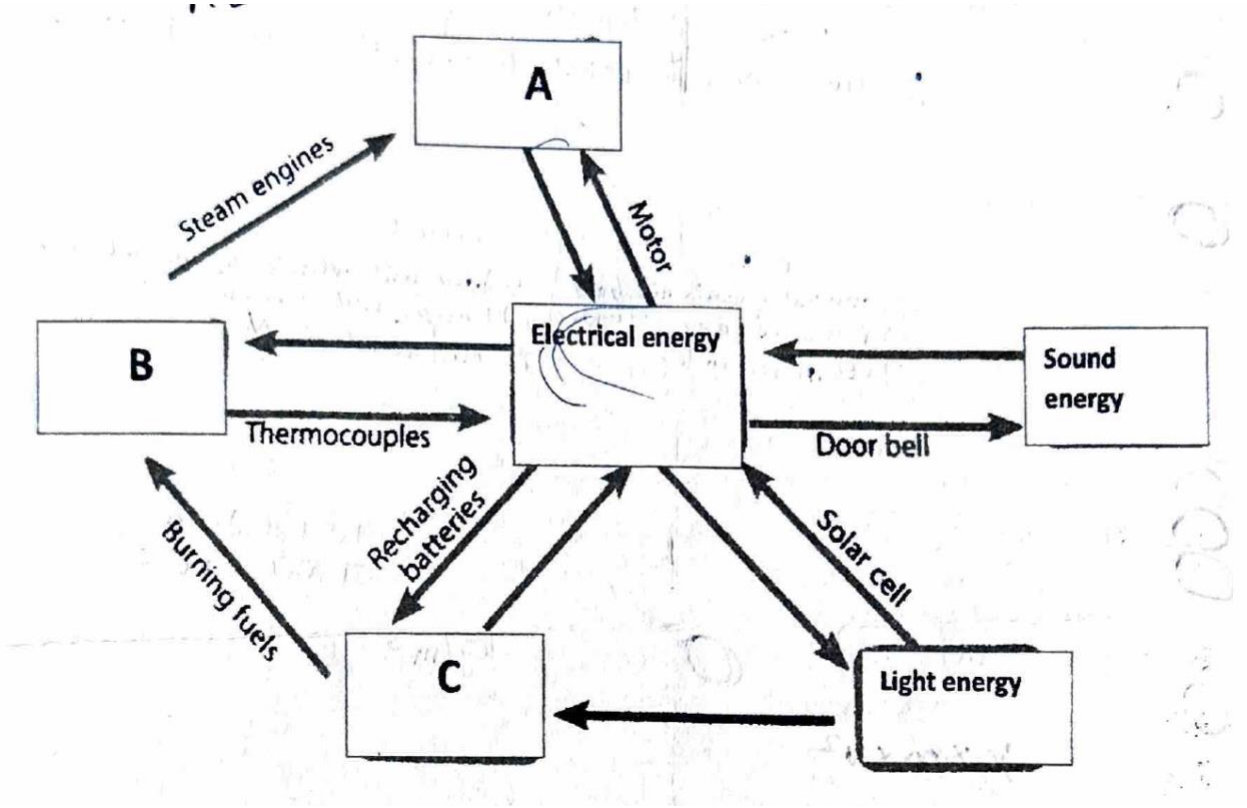
QUESTION NO 4

E. Question Based on Diagram

Q(a). Label A, B, and C marked in the energy conversion diagram [3]



(Flowchart showing energy conversions with Electrical Energy in center)

Answer: - **A = Mechanical Energy** (from steam engines, motors) - **B = Heat Energy** (from thermocouples, burning fuels) - **C = Chemical Energy** (from rechargeable batteries, stored in fuels)

Energy Conversion Chain: - Steam engines: Heat → Mechanical → Electrical - Motors: Electrical → Mechanical - Solar cells: Light → Electrical - Batteries: Chemical ↔ Electrical - Door bell: Electrical → Sound

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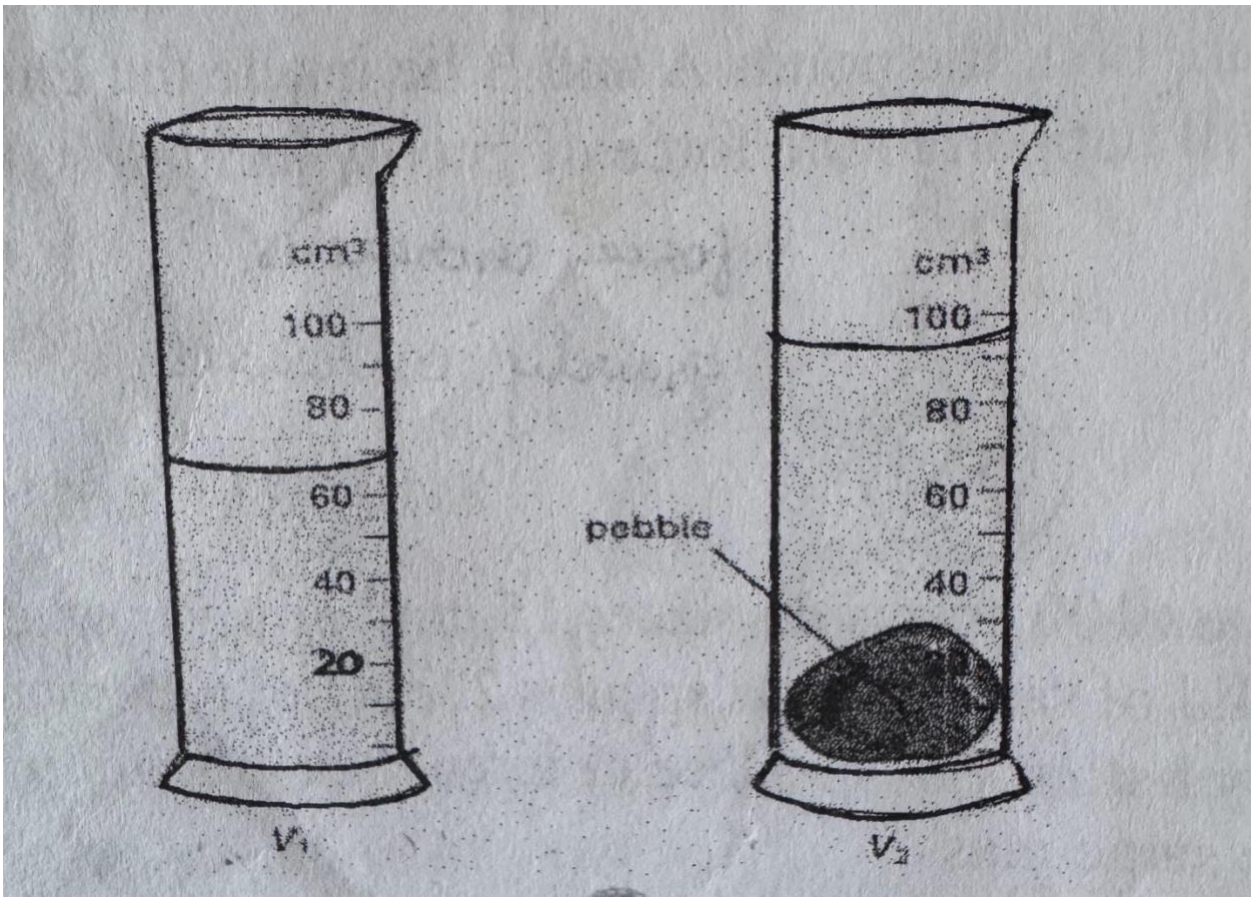
Q(b). Observe the diagram and find out the volume of the stone immersed [3]

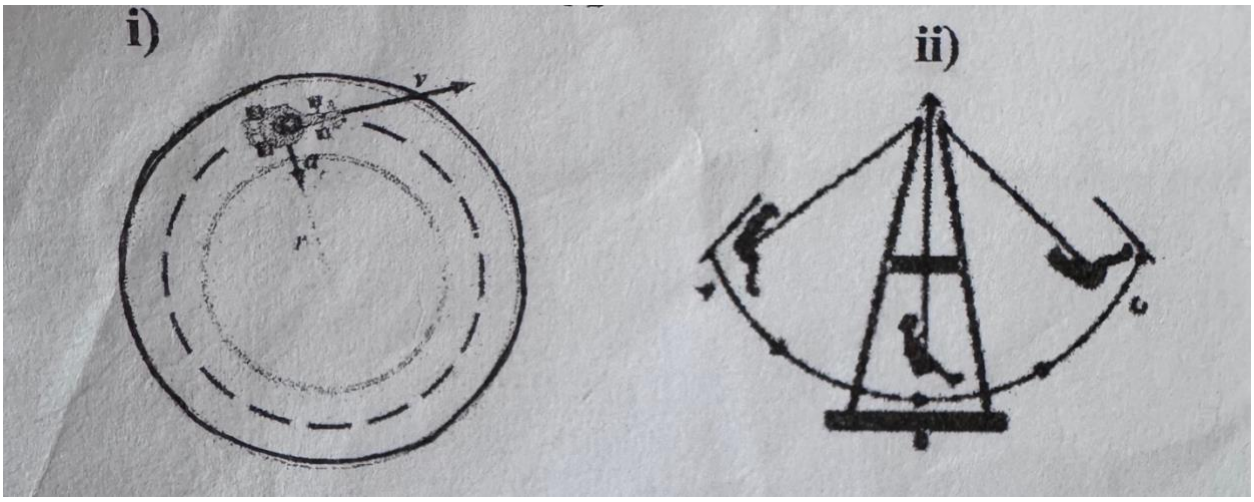


(Measuring cylinder shows initial water level at 70 cm^3, final level at 95 cm^3)

Answer: - Initial water level (V_1) = 70 cm^3 - Final water level (V_2) = 95 cm^3 - **Volume of stone = V_2 - V_1 = 95 - 70 = 25 cm^3**

Method: This is the water displacement method for finding the volume of irregular solids. When the stone is submerged, it displaces water equal to its own volume.

Q(c). Observe the picture and name the type of motion. Write another example for each type. [4]



(Pictures showing: i) Satellite/Earth orbit, ii) Giant wheel, iii) Simple pendulum)

Picture	Type of Motion	Another Example
i) Satellite orbiting	**Circular motion**	Moon around Earth, electron around nucleus
ii) Giant wheel	**Rotatory/Circular motion**	Spinning top, ceiling fan
iii) Pendulum	**Oscillatory/Periodic motion**	Swing, vibrating guitar string

---

QUESTION NO 5

F. Numerical [4×3=12]

Q(a). The truck covers 90 kilometer in 2 hours, then 45 kilometers in the next 1.5 hours and then 60 kilometer in the next 1.5 hours. Find the average speed of the truck.

Answer:

Total distance: - First leg: 90 km - Second leg: 45 km - Third leg: 60 km - **Total = 90 + 45 + 60 = 195 km**

Total time: - First leg: 2 hours - Second leg: 1.5 hours - Third leg: 1.5 hours - **Total = 2 + 1.5 + 1.5 = 5 hours**

Average Speed = Total Distance / Total Time Average Speed = 195 km / 5 h = 39 km/h

---

Q(b). The length, breadth and height of a cuboidal box are 30 cm, 15 cm and 8 cm respectively. Calculate the volume of the box in SI unit.

Answer:

Converting to SI units (metres): - Length = 30 cm = 0.30 m - Breadth = 15 cm = 0.15 m - Height = 8 cm = 0.08 m

Volume = Length × Breadth × Height Volume = 0.30 × 0.15 × 0.08 Volume = 0.0036 m^3 (or 3.6×10^{-3} m^3)

Alternative: $30 \times 15 \times 8 = 3600$ $cm^3 = 3600 \times 10^{-6}$ $m^3 = 0.0036$ m^3

Q(c). A car travels a distance of 15 km in 30 minutes. Find the speed of the car in (i) km/h (ii) m/s

Answer:

Given: - Distance = 15 km = 15,000 m - Time = 30 minutes = 0.5 hour = 1800 seconds

(i) Speed in km/h: - Speed = Distance / Time - Speed = 15 km / 0.5 h - **Speed = 30 km/h**

(ii) Speed in m/s: - Speed = 15,000 m / 1800 s - **Speed = 8.33 m/s**

OR: 30 km/h × (5/18) = 8.33 m/s

Q(d). A cork has a volume 25 cm^3. The density of cork is 0.25 g/cm^3. Find the mass of cork.

Answer:

Given: - Volume (V) = 25 cm^3 - Density (ρ) = 0.25 g/cm^3

Formula: Density = Mass / Volume **Therefore:** Mass = Density × Volume

Calculation: - Mass = 0.25 g/cm^3 × 25 cm^3 - **Mass = 6.25 grams**

Note: Cork has a low density (< 1 g/cm^3), which is why it floats on water.

Summary of Key Formulas Used:

Formula	Description
Density = Mass/Volume	ρ = m/V
Speed = Distance/Time	v = d/t

Formula	Description
$KE = \frac{1}{2}mv^2$	Kinetic energy
$PE = mgh$	Gravitational potential energy
Average speed = Total distance/Total time	For varying speeds
1 kgf = 9.8 N	Force conversion
1 L = 1000 cm^3 = 1000 mL	Volume conversion
1 mL = 1 cm^3	Volume equivalence
1 calorie = 4.186 J	Energy conversion

SAMPLE PAPER 8

Paper Date: 20.02.2020 | **Total Marks:** 80 | **Duration:** 2 hours

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QUESTION NO 1

A. Fill in the Blanks [7x1=7]

Q1. A freely falling stone describes _____ motion.

Answer: Rectilinear (or Linear)

Justification: A freely falling stone moves in a straight line path (vertically downward) under the influence of gravity. Motion along a straight line is called rectilinear motion or linear motion.

Q2. Larger the amplitude more is the _____.

Answer: Loudness

Justification: Loudness of sound is directly related to the amplitude of vibration. Greater amplitude means particles vibrate with larger displacement, producing louder sound. Mathematically, Loudness $\propto A^2$ (loudness is proportional to the square of amplitude).

Q3. The range of sonic sound is in between _____ and _____.

Answer: 20 Hz and **20,000 Hz**

Justification: Sonic sound (audible sound) is the range of frequencies that can be heard by the human ear. This range is from 20 Hz to 20,000 Hz (20 kHz). Sound below 20 Hz is infrasonic, and above 20,000 Hz is ultrasonic.

Q4. _____ is the surer test of magnetism.

Answer: Repulsion

Justification: Repulsion is the surer test of magnetism because: - Attraction can occur between a magnet and a magnetic material (iron, nickel) even if the material is not a magnet - Repulsion only occurs between two magnets when like poles face each other - If two objects repel each other, both must definitely be magnets

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Q5. If an arrow travels 300m in 4s its speed is _____ m/s.

Answer: 75 m/s

Justification: - Distance = 300 m - Time = 4 s - Speed = Distance / Time - **Speed = 300 / 4 = 75 m/s**

Q6. When the magnet is kept stationary near the solenoid the galvanometer reading is _____.

Answer: Zero

Justification: According to Faraday's law of electromagnetic induction, an EMF (and hence current) is induced only when there is a **change** in magnetic flux through the coil. When the magnet is stationary, there is no change in magnetic flux, so no current is induced and the galvanometer shows zero deflection.

Q7. The number of vibrations of a vibrating body in one second is called _____.

Answer: Frequency

Justification: Frequency is defined as the number of oscillations (or vibrations) completed by a vibrating body in one second. Its SI unit is Hertz (Hz). 1 Hz = 1 vibration per second.

B. State True or False [7x1=7]

Q1. In Faraday's experiment, if the movement of the magnet is continuous, the needle does not show any deflection.

Answer: False

Justification: If the movement of the magnet is continuous, the magnetic flux through the coil keeps changing, which continuously induces an EMF and current. The galvanometer needle **will show deflection** as long as the magnet is moving. The needle shows no deflection only when the magnet is stationary.

Q2. A current is induced in the coil when the number of magnetic lines of force associated with a coil change.

Answer: True

Justification: This is the principle of electromagnetic induction (Faraday's law). When the magnetic flux (number of magnetic field lines) through a coil changes, an EMF is induced which causes current to flow if the circuit is closed.

Q3. The characteristic of sound that depends on its frequency is loudness.

Answer: False

Justification: The characteristic of sound that depends on frequency is **pitch**, not loudness. - **Pitch** depends on **frequency** (higher frequency = higher pitch) - **Loudness** depends on **amplitude** (greater amplitude = louder sound)

Q4. Sound cannot travel through vacuum.

Answer: True

Justification: Sound is a mechanical wave that requires a material medium (solid, liquid, or gas) to propagate. In vacuum, there are no particles to vibrate and transmit sound energy. This is why astronauts in space cannot hear each other without radio communication.

Q5. Curtain is a good reflector of sound.

Answer: False

Justification: Curtains are good **absorbers** of sound, not reflectors. Soft, porous materials like curtains, carpets, and foam absorb sound energy and reduce echoes. Hard, smooth surfaces like concrete walls, glass, and metal are good reflectors of sound.

Q6. Km/hr is the SI unit of speed.

Answer: False

Justification: The SI unit of speed is **metre per second (m/s)**. Km/hr (kilometer per hour) is a common unit used in everyday life but is not the SI unit. To convert: 1 km/hr = 1000m/3600s = 5/18 m/s.

Q7. Displacement is the actual length of the path covered by a moving object.

Answer: False

Justification: The actual length of the path covered is called **distance**, not displacement. - **Distance** = Total length of the path traveled (scalar quantity) - **Displacement** = Shortest distance between initial and final positions with direction (vector quantity)

C. Pick the Odd One and Give Reason [3x1=3]

Q1. Amplitude, frequency, time period, timbre.

Answer: Timbre is the odd one.

Justification: Amplitude, frequency, and time period are measurable quantities with numerical values. Timbre (quality) is a characteristic of sound that distinguishes sounds of the same pitch and loudness produced by different sources. It depends on the waveform shape, not a single numerical value.

Q2. Electric bell, electric motor, MRI, electric heater.

Answer: Electric heater is the odd one.

Justification: Electric bell, electric motor, and MRI (Magnetic Resonance Imaging) all work on the principle of electromagnetism - they use electromagnets or electromagnetic fields.

Electric heater works on the **heating effect of electric current** (Joule heating), not electromagnetism.

Q3. Translatory motion, rectilinear motion, curvilinear motion, rotatory motion.

Answer: Rotatory motion is the odd one.

Justification: Translatory motion is the general term for motion where an object moves from one position to another. Rectilinear motion (straight line) and curvilinear motion (curved path) are both **types of translatory motion**. Rotatory motion (spinning about an axis) is a different category of motion altogether.

QUESTION NO 2

D. Think and Answer Based on Application Skills [4x2=8]

Q1. A thunder is heard after the flash of lightning.

Answer: Thunder is heard after the flash of lightning because **light travels much faster than sound**.

Justification: - Speed of light $\approx 3 \times 10^8$ m/s - Speed of sound in air ≈ 340 m/s - Light is about 880,000 times faster than sound

When lightning strikes, both light and sound are produced simultaneously. Light reaches our eyes almost instantaneously, but sound takes time to travel the distance. For every 3 seconds delay between seeing lightning and hearing thunder, the lightning is approximately 1 km away.

Q2. A body can be at rest as well as in the state of motion.

Answer: This statement is **true** because rest and motion are **relative terms**.

Justification: Whether a body is at rest or in motion depends on the observer's frame of reference. - A passenger sitting in a moving train is **at rest** relative to other passengers in the train - The same passenger is **in motion** relative to a person standing on the platform - The Earth appears stationary to us, but it is actually moving around the Sun

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Q3. Big indoor auditoriums are carpeted and their walls are coated with rough materials.

Answer: This is done to **reduce echo and reverberation** for better sound quality.

Justification: - Hard, smooth surfaces reflect sound waves, causing multiple reflections (reverberation) and echo - Soft materials like carpets, curtains, and rough coatings **absorb sound** instead of reflecting it - This prevents sound from bouncing around, making speech and music clearer - Without these measures, the sound would become blurred and unclear

---

Q4. Two coils having 10 turns each, one of them 1 cm long and the other is 2 cm long. Which will make a stronger magnet?

Answer: The **1 cm long coil** will make a stronger magnet.

Justification: - Magnetic field strength depends on the number of turns per unit length (n/L) - Both coils have 10 turns - For 1 cm coil: turns per unit length = 10/1 = 10 turns/cm - For 2 cm coil: turns per unit length = 10/2 = 5 turns/cm - Higher concentration of turns produces a stronger magnetic field - Therefore, the shorter coil (1 cm) creates a stronger electromagnet

---

E. Define the Following Terms [5x1=5]

Q1. Electromagnetism

Answer: Electromagnetism is the branch of physics that deals with the relationship between electricity and magnetism. It studies how electric current produces magnetic fields and how changing magnetic fields produce electric current.

Key points: - A current-carrying conductor produces a magnetic field around it - Moving charges experience force in a magnetic field - Applications: Electric motors, generators, transformers, electromagnets

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Q2. Wavelength

Answer: Wavelength is the distance between two consecutive compressions or two consecutive rarefactions in a longitudinal wave, OR the distance between two consecutive crests or two consecutive troughs in a transverse wave.

Key points: - Symbol: λ (lambda) - SI unit: metre (m) - Relationship: $v = f \times \lambda$ (wave speed = frequency × wavelength)

Q3. Acceleration [NOTFOREXAM - Acceleration not in syllabus]

Answer: Acceleration is the rate of change of velocity of an object with respect to time.

Key points: - Formula: Acceleration = Change in velocity / Time = (v - u) / t - SI unit: metre per second squared (m/s^2) - Acceleration is a vector quantity (has both magnitude and direction) - Positive acceleration = speeding up; Negative acceleration (deceleration) = slowing down

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Q4. Echo

Answer: Echo is the repetition of sound caused by the reflection of sound waves from a hard surface back to the listener.

Key points: - Minimum distance required for echo = 17 metres (based on persistence of hearing = 0.1 s) - Echo is used in SONAR, medical ultrasonography, and measuring distances - Hard, smooth surfaces produce clear echoes; soft surfaces absorb sound

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Q5. Solenoid

Answer: A **solenoid** is a coil of insulated wire wound in the form of a cylinder, which acts like a magnet when electric current passes through it.

Key points: - It produces a uniform magnetic field inside the coil - One end acts as North pole, the other as South pole - Magnetic field strength depends on: number of turns, current, and presence of iron core - Used in electromagnets, doorbells, relays, and MRI machines

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F. Differentiate Between [4x2=8]

Q1. Periodic and Non-periodic Motion

Periodic Motion	Non-periodic Motion
Motion that repeats itself at regular intervals of time	Motion that does not repeat itself at regular intervals
Has a definite time period	Has no fixed time period
Examples: Pendulum, heartbeat, Earth's rotation, hands of clock	Examples: Movement of car on road, flight of a bird, kicking a football

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Q2. Speed and Velocity

Speed	Velocity
The distance traveled by an object per unit time	The displacement of an object per unit time
Scalar quantity (magnitude only)	Vector quantity (magnitude and direction)
Formula: Speed = Distance/Time	Formula: Velocity = Displacement/Time
SI unit: m/s	SI unit: m/s
Always positive	Can be positive, negative, or zero

Q3. Longitudinal and Transverse Wave

Longitudinal Wave	Transverse Wave
Particles vibrate parallel to (same direction as) the direction of wave propagation	Particles vibrate perpendicular to the direction of wave propagation
Consists of compressions and rarefactions	Consists of crests and troughs
Example: Sound waves in air	Example: Light waves, water ripples
Can travel through solids, liquids, and gases	Cannot travel through gases (for mechanical waves)

QUESTION NO 3

G. Answer the Following Questions

Q1. State the conditions for an echo to be heard. [3]

Answer:

5. **Minimum distance:** The reflecting surface should be at least **17 metres** away from the source of sound
    - This is because persistence of hearing is 0.1 seconds
    - Sound must travel to the surface and back (2d) in more than 0.1 s
    - Minimum distance = (Speed × Time)/2 = (340 × 0.1)/2 = 17 m
6. **Hard reflecting surface:** The surface should be hard and smooth (like cliff, wall, or building) to reflect sound effectively
7. **Sufficient loudness:** The original sound should be loud enough so that after reflection and some energy loss, the echo is still audible

---

Q2. What are the characteristics of sound? [3]

Answer: The three characteristics of sound are:

8. **Loudness:**
    - Depends on the **amplitude** of vibration
    - Greater amplitude = Louder sound
    - Measured in decibels (dB)
9. **Pitch:**
    - Depends on the **frequency** of vibration
    - Higher frequency = Higher pitch (shriller sound)
    - Lower frequency = Lower pitch (bass sound)
10. **Quality (Timbre):**
    - Depends on the **waveform** of the sound
    - Helps distinguish between two sounds of same pitch and loudness
    - Example: We can distinguish a guitar from a piano playing the same note

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Q4. Give two examples where a body performs rotatory and translatory motion simultaneously. [2]

Answer:

11. **A rolling ball:** The ball rotates about its own axis (rotatory) while also moving forward (translatory)

12. **Wheels of a moving vehicle:** Each wheel rotates about its axle (rotatory) while the vehicle moves forward (translatory)

Other examples: - A spinning top moving across the floor - Earth's motion (rotates on axis + revolves around Sun) - A drill bit while drilling

---

Q5. Name the unit of measurement of loudness of a sound? What is the range of loudness of normal conversation? [1]

Answer: - **Unit of loudness: Decibel (dB)** - **Range of normal conversation: 40-60 dB** (approximately 60 dB)

Justification: The decibel scale is logarithmic. Whisper is about 30 dB, normal conversation 60 dB, and sounds above 80 dB can cause hearing damage with prolonged exposure.

H. Numerical [10]

Q1. A sound has a frequency of 100 Hz. What is its time period? [1]

Answer: - Frequency (f) = 100 Hz - Time period (T) = 1/f - **T = 1/100 = 0.01 seconds**

Justification: Time period and frequency are inversely related. The time period is the time taken to complete one oscillation. If 100 oscillations occur per second, each oscillation takes 1/100th of a second.

Q2. A boy claps his hand in front of a cliff and hears the echo 2s later. If the speed of sound is 340 m/s, calculate the distance of the cliff from the boy. [3]

Answer: - Time for echo = 2 seconds - Speed of sound = 340 m/s - The sound travels to the cliff AND back

Calculation: - Total distance traveled by sound = Speed × Time = 340 × 2 = 680 m - Distance of cliff = Total distance / 2 - **Distance of cliff = 680 / 2 = 340 metres**

Justification: The sound has to travel from the boy to the cliff and then back from the cliff to the boy. So the actual distance to the cliff is half the total distance traveled by the sound.

Q3. A car covers 54 km in 1 hour. Find its speed in m/s. [2]

Answer: - Distance = 54 km - Time = 1 hour

Method 1 (Direct conversion): - Speed = 54 km/hr - To convert km/hr to m/s, multiply by 5/18 - Speed = 54 × 5/18 = **15 m/s**

Method 2 (Unit conversion): - Distance = 54 km = 54 × 1000 = 54,000 m - Time = 1 hour = 3600 seconds - Speed = 54,000 / 3600 = **15 m/s**

Q4. Which is faster – a bus covering 720m in 1 minute or a car covering 1 km in 20s. Calculate and compare the speed. [3]

Answer:

Speed of Bus: - Distance = 720 m - Time = 1 minute = 60 seconds - Speed = 720/60 = **12 m/s**

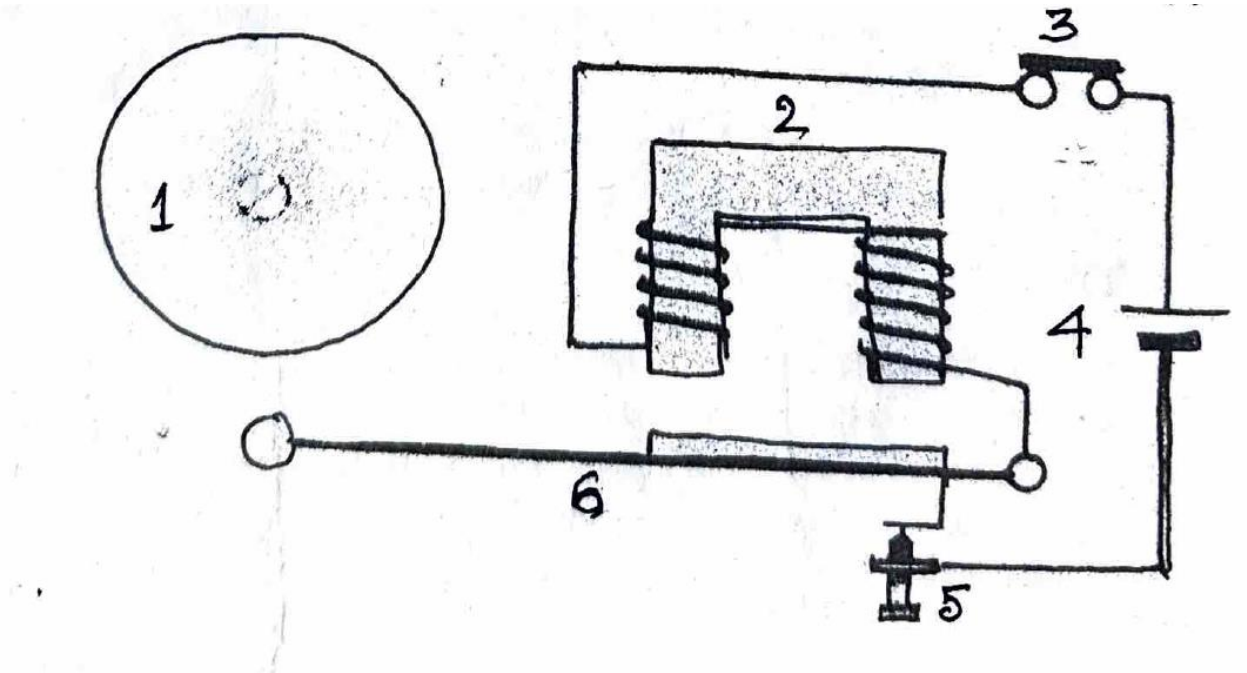
Speed of Car: - Distance = 1 km = 1000 m - Time = 20 seconds - Speed = 1000/20 = **50 m/s**

Comparison: The **car is faster** (50 m/s > 12 m/s)

The car is approximately 4 times faster than the bus.

QUESTION NO 4

I. Name and Label the Diagram. State the Principle it Works. [7]



Answer:

Name: Electric bell

1 – Gong

2 – Soft iron electromagnet

3 – Switch

4 – Battery

5 – Contact Screw

6 – Armature

Principle: The electric bell works on the principle of **electromagnetism** - when electric current flows through a coil wound around a soft iron core, it becomes an electromagnet and attracts magnetic materials.

Working: 1. When the switch is pressed, current flows through the circuit 2. The electromagnet gets magnetized and attracts the soft iron armature 3. The hammer attached to the armature strikes the gong, producing sound 4. As the armature moves towards the electromagnet, it breaks contact with the contact screw 5. The circuit breaks, the electromagnet loses its magnetism 6. The springy metal strip pulls the armature back to its original position 7. Contact is restored, current flows again, and the cycle repeats 8. This rapid make-and-break action causes the hammer to strike the gong repeatedly, producing a continuous ringing sound

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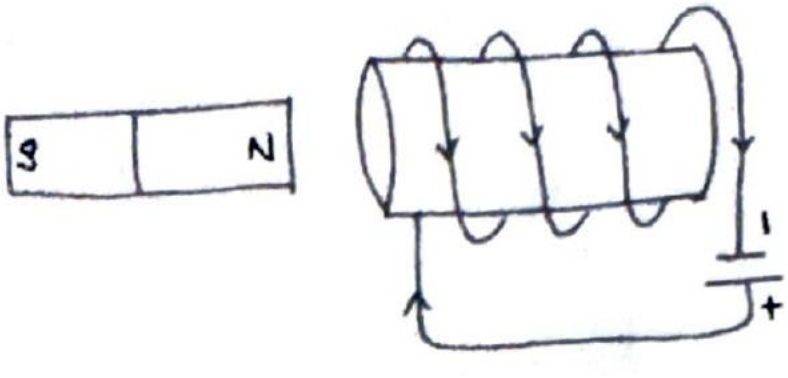
QUESTION NO 5

J. Observe the Pictures and Answer the Following Questions

Q1. Will the coil attract or repel the magnet? Explain. [3]

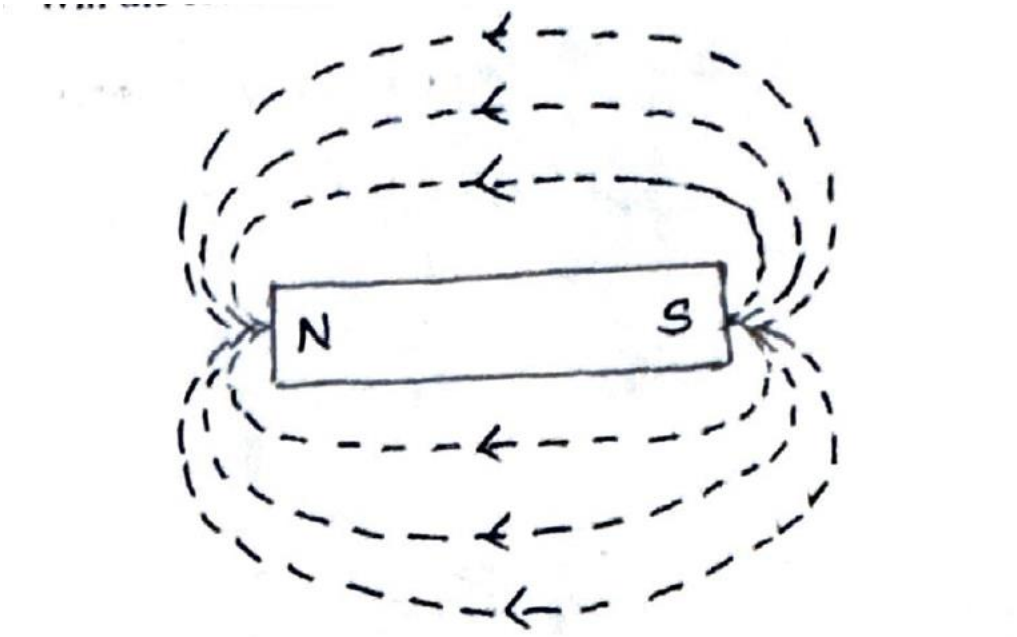


(Picture shows a bar magnet near a solenoid connected to a circuit)

Answer: The coil will **attract** the magnet.

When current flows through the solenoid, it becomes an electromagnet with a South pole at the left end and North pole at the right end. Since the magnet's North pole faces the solenoid's South pole, they will attract each other.

Q2. Is the picture of field lines of a bar magnet correct? If not identify the mistake. [2]



(Picture shows magnetic field lines of a bar magnet)

Answer: If the field lines are shown going **INTO the North pole** or **OUT OF the South pole**, the picture is **INCORRECT**.

Correct representation: - Magnetic field lines **emerge from the North pole** outside the magnet - Magnetic field lines **enter the South pole** outside the magnet - Inside the magnet, field lines go from South to North - Field lines never intersect each other - Field lines form closed loops

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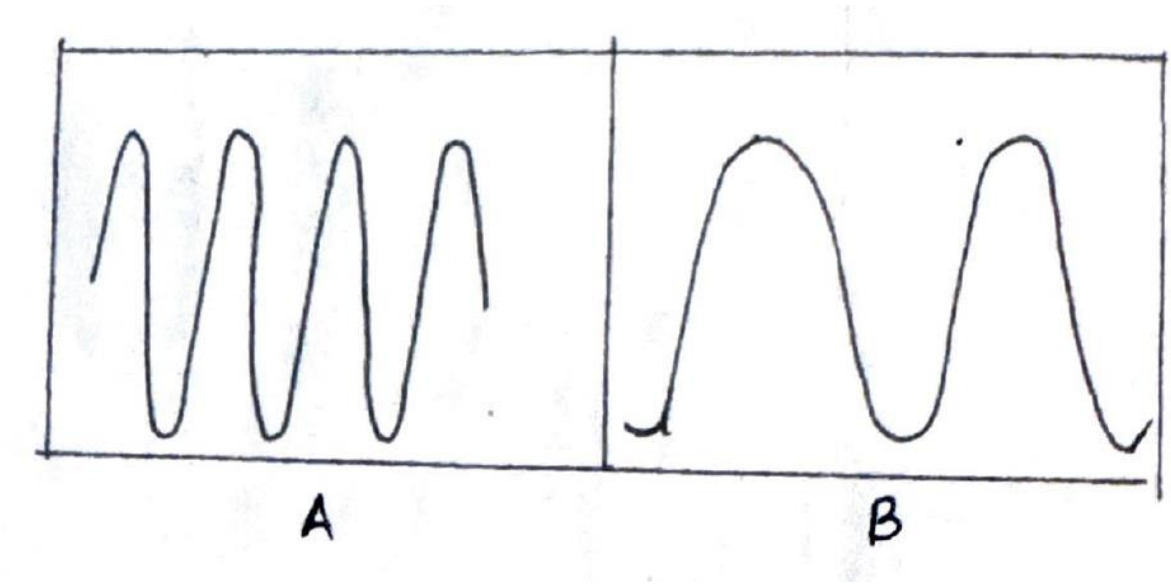
Q3. Waveforms A and B Analysis [5]



(Two waveforms shown - A has higher frequency, B has lower frequency)

a. The waveforms A and B represent the sound produced by a string before and after it is tightened. Identify which one is before and which one is after. [2]

Answer: - **Waveform B** (lower frequency) = Before tightening - **Waveform A** (higher frequency) = After tightening

Justification: When a string is tightened, its tension increases, which causes it to vibrate faster (higher frequency). The waveform with more waves (higher frequency) represents the tightened string.

b. Which of these will produce higher pitched sound? [1]

Answer: Waveform A will produce higher pitched sound.

Justification: Pitch depends on frequency. Waveform A has more oscillations in the same time period, meaning higher frequency, hence higher pitch.

c. Will there be a difference in their loudness? Explain. [2]

Answer: No because their amplitudes are the same.

Justification: - Loudness depends on **amplitude** (height of the wave from mean position) - If both waveforms have the **same amplitude**, they will have the **same loudness**. Tightening a string changes pitch (frequency) but may not significantly change amplitude/loudness unless the string is plucked with different force

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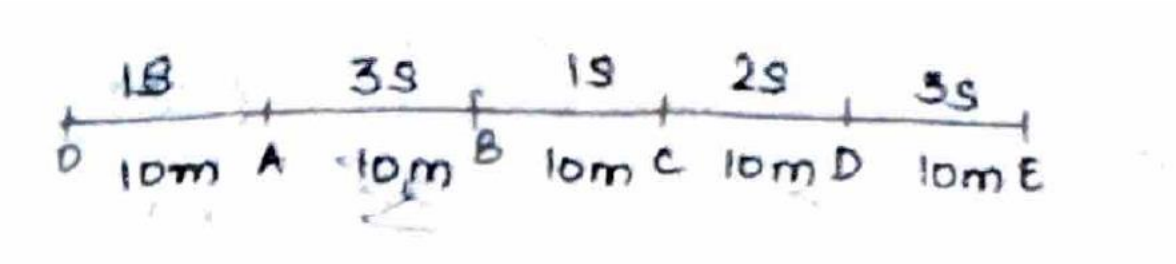
Q4. Journey of an Object - Uniform or Non-uniform Motion [5]

(Diagram shows: O→A (10m, 1s), A→B (10m, 3s), B→C (10m, 1s), C→D (10m, 2s), D→E (10m, 5s))



a. Is it uniform or non-uniform motion? Give reason for your answer. [3]

Answer: It is **non-uniform motion**.

Justification: In uniform motion, equal distances are covered in equal intervals of time. Here: - Distance O to A (10m) takes 1 second - Distance A to B (10m) takes 3 seconds - Distance B to C (10m) takes 1 second - Distance C to D (10m) takes 2 seconds - Distance D to E (10m) takes 5 seconds

Since the same distance (10m) is covered in different time intervals (1s, 3s, 1s, 2s, 5s), the speed is not constant. Therefore, it is **non-uniform motion**.

b. Calculate the average speed of the object. [2]

Answer: - Total distance = 10 + 10 + 10 + 10 + 10 = **50 m** - Total time = 1 + 3 + 1 + 2 + 5 = **12 s** (Note: Check the actual values from paper - appears to be 1+3+1+2+5=12s or similar) - Average speed = Total distance / Total time - **Average speed = 50/12 ≈ 4.17 m/s** (or 50/10 = 5 m/s if total time is 10s)

Summary of Key Formulas Used:

Formula	Description
Speed = Distance/Time	Basic speed calculation
f = 1/T	Frequency and Time period relationship
Echo distance = (Speed × Time)/2	For echo calculations
v = f × λ	Wave equation
Acceleration = (v-u)/t	Rate of change of velocity
Average speed = Total distance/Total time	For varying speeds

SAMPLE PAPER 9

QUESTION NO 1

I. Fill in the Blanks [7]

Q1. _____ cells cannot be recharged.

Answer: Primary (or Dry)

Justification: Primary cells (like dry cells) are non-rechargeable because the chemical reactions inside them are irreversible. Once the chemicals are used up, the cell is exhausted. Secondary cells (like lead-acid batteries) can be recharged because their chemical reactions are reversible.

Q2. Kinetic energy and potential energy are the types of _____ energy.

Answer: Mechanical

Justification: Mechanical energy is the sum of kinetic energy (energy due to motion) and potential energy (energy due to position or configuration). Total Mechanical Energy = Kinetic Energy + Potential Energy.

Q3. In an electric bulb the electrical energy gets converted into _____.

Answer: Light energy (and heat energy)

Justification: When current flows through the filament of an electric bulb, the electrical energy is converted primarily into light energy (which illuminates) and heat energy (which makes the bulb hot). In incandescent bulbs, only about 5% becomes light, while 95% becomes heat.

Q4. The motion of a spinning top and a giant wheel is an example of _____ motion.

Answer: Rotatory (or Circular)

Justification: Rotatory motion is the motion in which an object spins or rotates about a fixed axis. Both a spinning top and a giant wheel rotate around their central axis, making them examples of rotatory motion.

Q5. If we use the units of gram for mass and cubic centimetres for volume then the unit for density will be _____.

Answer: g/cm^3 (gram per cubic centimetre)

Justification: Density = Mass/Volume. If mass is in grams (g) and volume is in cubic centimetres (cm^3), then density will be in g/cm^3. This is the CGS unit of density. The SI unit is kg/m^3.

Q6. A battery is a combination of _____.

Answer: Cells (or two or more cells)

Justification: A battery is made by connecting two or more cells together. Cells can be connected in series (to increase voltage) or parallel (to increase capacity). For example, a 9V battery contains six 1.5V cells connected in series.

Q7. 1 litre = _____ cm^3.

Answer: 1000

Justification: - 1 litre = 1000 mL - 1 mL = 1 cm^3 - Therefore, 1 litre = 1000 cm^3

This is a standard volume conversion used in measurements.

II. Write True or False [7]

Q1. The SI unit of area is hectare.

Answer: False

Justification: The SI unit of area is **square metre (m^2)**. Hectare (ha) is a commonly used unit for measuring large land areas, where 1 hectare = 10,000 m^2, but it is not the SI unit.

Q2. The unit of frequency is hertz.

Answer: True

Justification: Hertz (Hz) is the SI unit of frequency, named after Heinrich Hertz. 1 Hz = 1 oscillation per second. It is used to measure the frequency of sound waves, electromagnetic waves, and other periodic phenomena.

Q3. 1 Kgf = 12N.

Answer: False

Justification: 1 kilogram-force (kgf) = **9.8 N** (approximately 10 N), not 12 N. - 1 kgf is the force exerted by gravity on a mass of 1 kg - Weight = mass × g = 1 kg × 9.8 m/s^2 = 9.8 N

Q4. A book lying on the table is an example of body neither at rest nor in motion.

Answer: False

Justification: A book lying on a table is at **rest** relative to the table and the room. However, rest and motion are relative terms - the book is in motion relative to the Sun (as Earth rotates and revolves). But the statement “neither at rest nor in motion” is incorrect - an object is always either at rest OR in motion relative to a given reference point.

Q5. The electricity can be obtained from the energy possessed by the flowing water.

Answer: True

Justification: This is the principle of **hydroelectric power**. Flowing water has kinetic energy. In hydroelectric power plants, this kinetic energy is used to rotate turbines, which are connected to generators that convert mechanical energy into electrical energy.

Q6. When a ball falls down vertically its motion is linear.

Answer: True

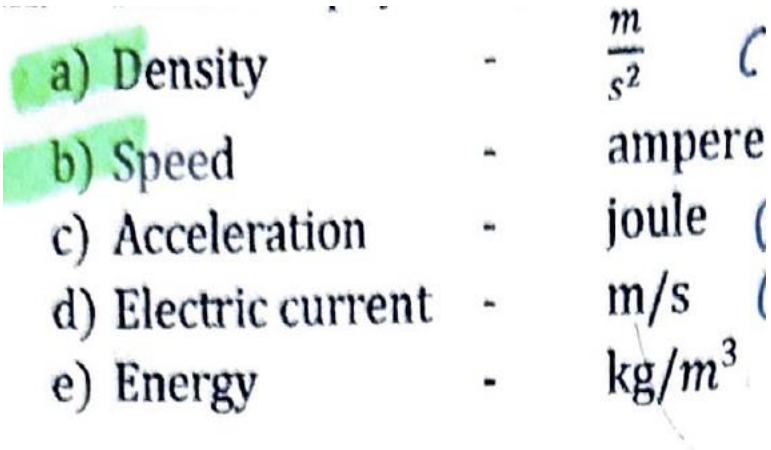
Justification: Linear motion (rectilinear motion) is motion along a straight line. When a ball falls vertically downward under gravity (without any horizontal velocity), it moves in a straight vertical line, which is linear motion.

Q7. Density = mass × volume.

Answer: False

Justification: The correct formula is **Density = Mass / Volume** (ρ = m/V), not mass × volume. - Density is mass per unit volume - SI unit: kg/m^3 - CGS unit: g/cm^3

III. Match the Physical Quantity with its SI Unit [5]



Physical Quantity	SI Unit
a) Density	kg/m^3
b) Speed	m/s
c) Acceleration **[NOTFOREXAM]**	m/s^2
d) Electric current	ampere (A)
e) Energy	joule (J)

Answers: a-e, b-d, c-a, d-c, e-b (based on column arrangement in paper)

Justification: - Density = mass/volume, so kg/m^3 - Speed = distance/time, so m/s - Acceleration = change in velocity/time, so m/s^2 **[NOTFOREXAM - not in syllabus]** - Electric current measured in ampere (base SI unit) - Energy measured in joule (J) = $kg \cdot m^2/s^2$

QUESTION NO 2

IV. Define [10]

a) Acceleration

Answer: Acceleration is the rate of change of velocity of an object with respect to time.

- **Formula:** a = (v - u) / t, where v = final velocity, u = initial velocity, t = time
- **SI unit:** metre per second squared (m/s^2)
- **Nature:** Vector quantity (has magnitude and direction)
- **Example:** A car speeding up from 0 to 60 km/h experiences positive acceleration

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b) 1 Kgf

Answer: 1 kilogram-force (kgf) is the gravitational force acting on a mass of 1 kilogram at the Earth's surface.

- **Value:** 1 kgf = 9.8 N (approximately 10 N)
- **Calculation:** Weight = mass × g = 1 kg × 9.8 m/s^2 = 9.8 N
- **Usage:** Often used in everyday life to express weight/force
- **Note:** kgf is a gravitational unit, while Newton is the SI unit of force

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c) Electric Current

Answer: Electric current is the rate of flow of electric charge through a conductor.

- **Formula:** I = Q/t, where Q = charge, t = time
- **SI unit:** Ampere (A)
- **Definition of 1 Ampere:** When 1 coulomb of charge flows through a conductor in 1 second
- **Nature:** Current flows from positive to negative terminal (conventional current)

---

d) Energy

Answer: Energy is the capacity of a body to do work.

- **SI unit:** Joule (J)
- **Types:** Kinetic energy, potential energy, heat energy, light energy, sound energy, electrical energy, chemical energy, nuclear energy
- **Property:** Energy can neither be created nor destroyed, only transformed from one form to another (Law of Conservation of Energy)

e) Frequency

Answer: Frequency is the number of oscillations (or vibrations) completed by a vibrating body in one second.

- **Formula:** f = 1/T, where T = time period
- **SI unit:** Hertz (Hz)
- **Relationship with pitch:** Higher frequency = higher pitch of sound
- **Example:** If a tuning fork vibrates 256 times per second, its frequency is 256 Hz

---

V. Differentiate Between [8]

a) Kinetic Energy and Potential Energy

Kinetic Energy	Potential Energy
Energy possessed by a body by virtue of its **motion**	Energy possessed by a body by virtue of its **position** or **configuration**
Formula: KE = ½mv^2	Formula: PE = mgh (gravitational)
Depends on mass and velocity	Depends on mass, height, and gravitational acceleration
Example: Moving car, flowing water, flying bird	Example: Water in a dam, stretched spring, raised hammer

---

b) Distance and Displacement

Distance	Displacement
Total length of the path traveled by an object	Shortest distance between initial and final positions
Scalar quantity (magnitude only)	Vector quantity (magnitude and direction)
Always positive or zero	Can be positive, negative, or zero
Path dependent	Path independent
Example: If you walk 3m north then 4m south, distance = 7m	Example: Same walk gives displacement = 1m south

---

c) Speed and Velocity

Speed	Velocity
Rate of change of distance	Rate of change of displacement

Speed	Velocity
Scalar quantity	Vector quantity
Speed = Distance/Time	Velocity = Displacement/Time
Always positive	Can be positive, negative, or zero
Average speed = Total distance/Total time	Average velocity = Total displacement/Total time

---

d) Mass and Volume

Mass	Volume
Amount of matter contained in a body	Amount of space occupied by a body
SI unit: kilogram (kg)	SI unit: cubic metre (m^3)
Measured using beam balance or physical balance	Measured using measuring cylinder, overflow jar
Scalar quantity	Scalar quantity
Does not change with location	Does not change with location (at constant temperature)

VI. Classify as Scalar and Vector [3]

Given quantities: length, velocity, speed, time, acceleration, displacement

Scalar Quantities	Vector Quantities
Length	Velocity
Speed	Acceleration
Time	Displacement

Justification: - **Scalars** have only magnitude (size/value) - **Vectors** have both magnitude and direction - Length, speed, and time are described by just a number and unit - Velocity, acceleration, and displacement require direction to be fully described

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QUESTION NO 3

VII. Answer Based on Thinking Skills [6]

a) Why water stored in a dam has potential energy?

Answer: Water stored in a dam has **gravitational potential energy** because:

- **Position above ground:** The water is stored at a height above the turbines/ground level
- **Formula:** PE = mgh (mass × gravity × height)
- **Work done:** Work was done against gravity to lift/collect the water at that height
- **Conversion:** When released, this potential energy converts to kinetic energy as water falls, which then rotates turbines to generate electricity

The higher the dam and more water stored, the greater the potential energy available.

---

b) Why is a car driven on any city road an example of non-uniform motion?

Answer: A car on a city road exhibits **non-uniform motion** because:

13. **Traffic signals:** The car must stop at red lights and start again
14. **Speed variations:** The car speeds up, slows down due to traffic
15. **Turns:** Direction changes when taking turns
16. **Obstacles:** Pedestrians, other vehicles cause speed changes
17. **Speed bumps:** Force the car to slow down

In non-uniform motion, the speed and/or direction keeps changing. A car maintains constant speed only in ideal conditions (empty highway), which doesn't occur in city driving.

---

c) An atom gains electron from another atom. What will be the nature of charge on the gainer atom?

Answer: The atom that gains an electron will have a **negative charge** (it becomes a negative ion or anion).

Justification: - Atoms are normally electrically neutral (protons = electrons) - Electrons have negative charge (-1) - When an atom gains an electron, it has more electrons than protons - Excess negative charge makes the atom a negative ion - Example: Chlorine atom (17 protons, 17 electrons) gains 1 electron to become Cl^- ion (17 protons, 18 electrons)

VIII. Answer the Following

a) State the law of conservation of energy. [2]

Answer: The **Law of Conservation of Energy** states that energy can neither be created nor destroyed; it can only be transformed from one form to another. The total energy of an isolated system remains constant.

Key points: - Total energy before = Total energy after any transformation - Energy is conserved in all physical and chemical processes - Example: In a falling ball, potential energy converts to kinetic energy, but total mechanical energy remains constant (ignoring air resistance)

---

b) What is the principle behind the working of a spring balance? [1]

Answer: A spring balance works on **Hooke's Law**, which states that the extension of a spring is directly proportional to the applied force (within the elastic limit).

Principle: - F = kx (Force = spring constant × extension) - When an object is hung, its weight stretches the spring - Greater the weight, greater the extension - The scale is calibrated to show weight directly - Spring balance measures **weight**, not mass

---

c) Rest and motion are relative term. Explain. [2]

Answer: Rest and motion are **relative terms** because an object can be at rest with respect to one reference point but in motion with respect to another.

Example: - A passenger sitting in a moving bus is at **rest** relative to the bus and other passengers - The same passenger is in **motion** relative to a person standing on the road - The Earth appears at rest to us, but it is actually rotating and revolving around the Sun

Conclusion: Whether an object is at rest or in motion depends on the reference point (frame of reference) chosen by the observer.

IX. Numerical [8]

a) A block of mass 1500 kg has volume $3m^3$. Calculate its density.

Answer:

Given: - Mass (m) = 1500 kg - Volume (V) = 3 m^3

Formula: Density = Mass / Volume

Calculation: - Density = 1500 kg / 3 m^3 - **Density = 500 kg/m^3**

---

b) A boy starts from home, goes to a shop which is 12 km away buys things and come back. What is the distance travelled by him and What is his displacement from his starting point?

Answer:

Distance travelled: - Distance to shop = 12 km - Distance from shop to home = 12 km - **Total distance = 12 + 12 = 24 km**

Displacement: - Displacement is the shortest distance from initial to final position - The boy starts from home and returns to home - Initial position = Final position - **Displacement = 0 km**

Justification: Distance is the total path covered (24 km), while displacement is zero because the boy returned to his starting point.

---

c) A car travels 40 km in the first hour, 45 km in the second hour and 35 km in the third hour. Calculate the average speed.

Answer:

Total distance: - First hour: 40 km - Second hour: 45 km - Third hour: 35 km - **Total distance = 40 + 45 + 35 = 120 km**

Total time: - **Total time = 1 + 1 + 1 = 3 hours**

Average speed = Total distance / Total time Average speed = 120 km / 3 h = 40 km/h

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d) A man jogs at a uniform speed of 16 km/h. How much distance will he cover in 45 min?

Answer:

Given: - Speed = 16 km/h - Time = 45 min = 45/60 h = 0.75 h (or 3/4 h)

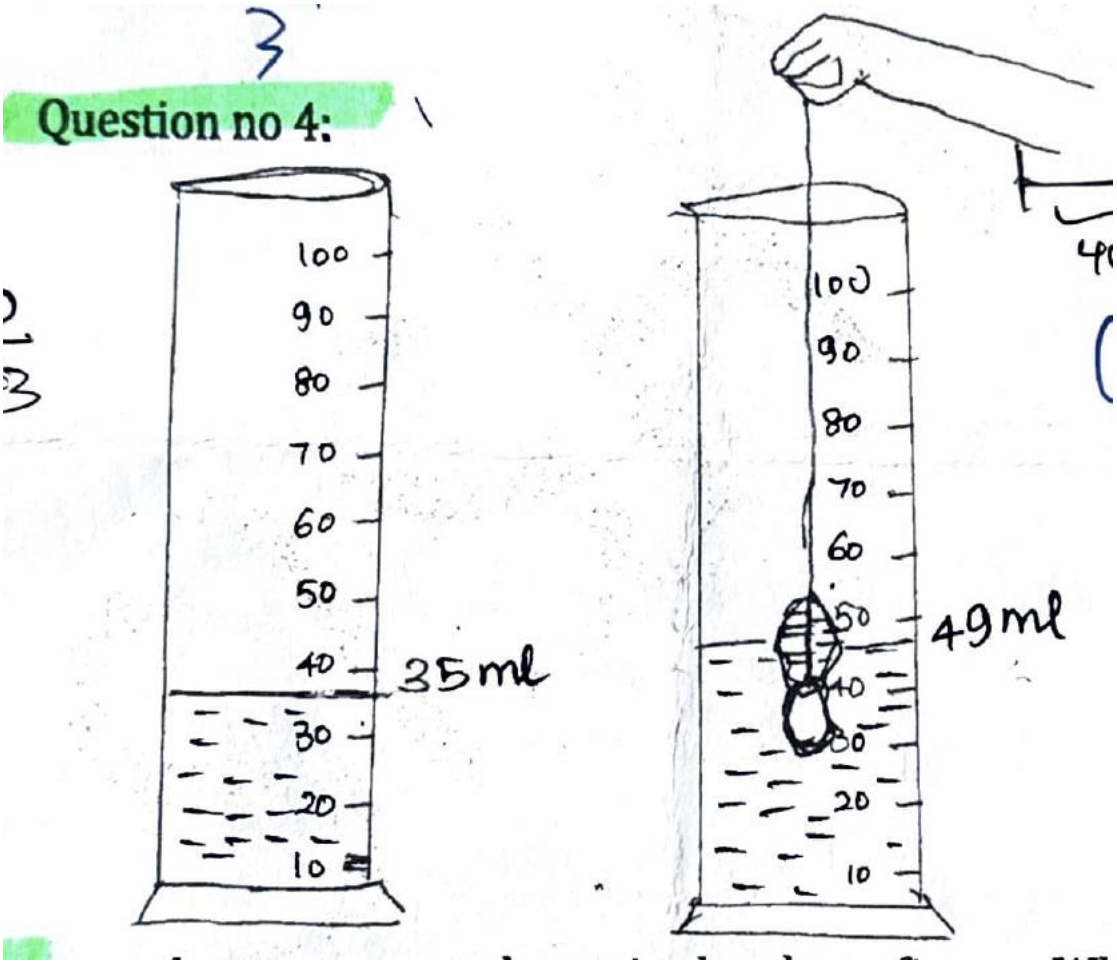
Formula: Distance = Speed × Time

Calculation: - Distance = 16 × 0.75 - **Distance = 12 km**

OR: Distance = 16 × (45/60) = 16 × 3/4 = 12 km

QUESTION NO 4

X. Measuring Cylinder Questions



(Diagram shows measuring cylinder with water level at 35 ml initially, rising to 49 ml after stone is added)

1. Name the instrument shown in the above figure. What is it used to measure?

Answer: The instrument is a **Measuring Cylinder** (or Graduated Cylinder).

It is used to measure the **volume of liquids**. It can also be used to find the volume of irregular solids using the water displacement method.

---

2. When the stone is put into the measuring cylinder the water level rises from (a) to that shown in (b). What is the method called as?

Answer: This method is called the **Water Displacement Method** (or Displacement Method).

Principle: When an irregular solid is immersed in water, it displaces water equal to its own volume. The rise in water level indicates the volume of the solid.

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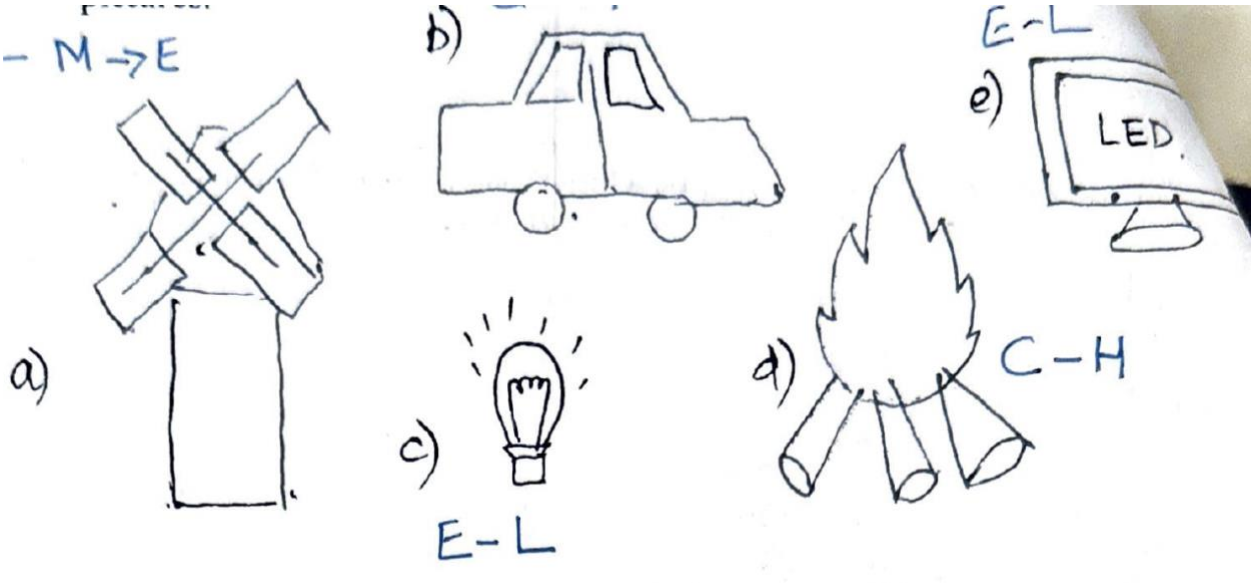
3. Find the volume of the stone and its density if the mass of stone is 7 grams.

Answer:

Finding Volume: - Initial water level (a) = 35 ml - Final water level (b) = 49 ml - **Volume of stone = 49 - 35 = 14 ml = 14 cm^3**

Finding Density: - Mass of stone = 7 g - Volume of stone = 14 cm^3 - Density = Mass / Volume - **Density = 7 / 14 = 0.5 g/cm^3**

XI. Name the Energy Transformation Taking Place in the Pictures

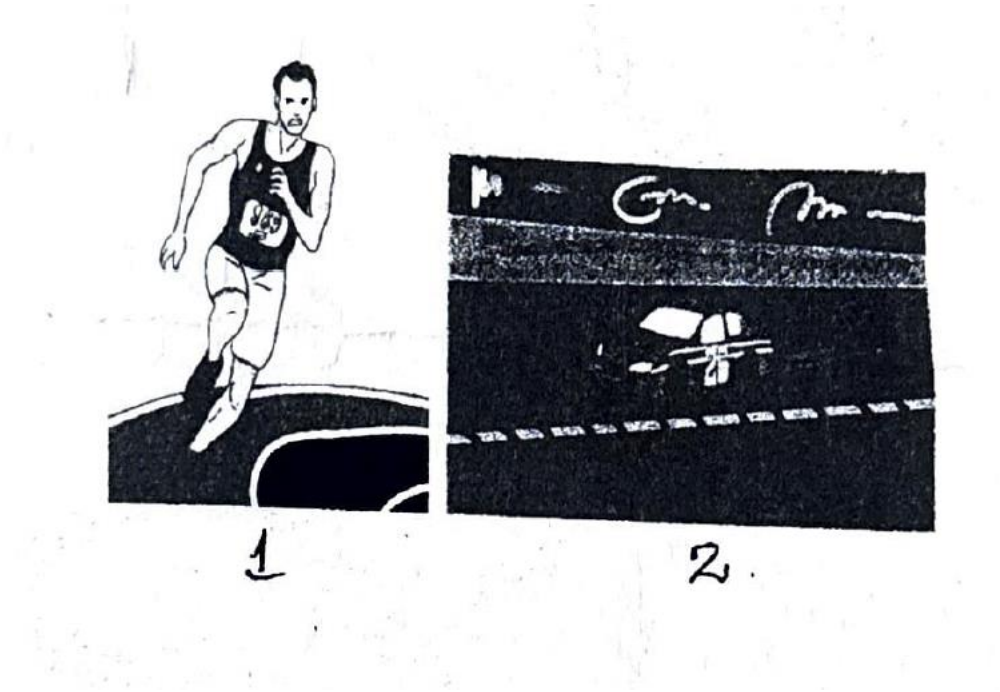


(Pictures showing: a) Windmill, b) Car/vehicle, c) Electric bulb, d) Fire/burning wood, e) LED)

Answer:

Picture	Energy Transformation
a) Windmill	**Mechanical energy → Electrical energy** (Wind's kinetic energy rotates blades, generator converts to electricity)
b) Car/vehicle	**Chemical energy → Mechanical energy** (Fuel burns, engine produces motion)
c) Electric bulb	**Electrical energy → Light energy + Heat energy**
d) Fire/burning wood	**Chemical energy → Heat energy + Light energy**
e) LED	**Electrical energy → Light energy** (LEDs are more efficient, less heat)

XII. Speed Calculations - Athlete and Racing Car



(Fig 1 shows athlete covering 100m in 10 seconds; Fig 2 shows racing car completing 100m straight in 2 seconds)

a) What is the speed of the athlete and the racing car shown in figure 1 and 2 respectively?

Answer:

Athlete's speed: - Distance = 100 m - Time = 10 s - Speed = Distance / Time = 100 / 10 = **10 m/s**

Racing car's speed: - Distance = 100 m - Time = 2 s - Speed = Distance / Time = 100 / 2 = **50 m/s**

---

b) If the athlete keeps going at a speed of 8 m/s, how far could he run in a minute?

Answer:

Given: - Speed = 8 m/s - Time = 1 minute = 60 seconds

Formula: Distance = Speed × Time

Calculation: - Distance = 8 × 60 - **Distance = 480 m**

---

c) How long will the athlete take to run 400m at speed of 8 m/s?

Answer:

Given: - Distance = 400 m - Speed = 8 m/s

Formula: Time = Distance / Speed

Calculation: - Time = 400 / 8 - **Time = 50 seconds**

INTERNAL TEST (15 Marks) - Pages 5-7

Define [5]

1. Area

Answer: Area is the measure of the surface covered by an object or a plane figure. - SI unit: square metre (m^2) - Formula for rectangle: Area = Length × Breadth

2. Volume

Answer: Volume is the three-dimensional space occupied by an object. - SI unit: cubic metre (m^3) - Formula for cuboid: Volume = Length × Breadth × Height

3. Density

Answer: Density is the mass per unit volume of a substance. - Formula: $\rho = m/V$ - SI unit: kg/m^3

4. Capacity

Answer: Capacity is the internal volume of a container, or the maximum amount of substance it can hold. - Usually measured in litres (L) for liquids

5. Meniscus

Answer: Meniscus is the curve that forms at the surface of a liquid in a measuring cylinder when a liquid is poured into it. - **Concave meniscus:** Water and liquids that wet glass (read at bottom of curve) - **Convex meniscus:** Mercury (read at top of curve)

Fill in the Blanks [5]

1. Volume of irregular solids can be found using _____ method.

Answer: Displacement (or Water displacement)

2. Volume of a sphere can be calculated using a formula _____.

Answer: $V = (4/3)\pi r^3$

3. Area of irregular shape can be found using a _____.

Answer: Graph paper

4. 1 kg/m^3 = _____ g/cm^3

Answer: 0.001 (or 1/1000)

Conversion: 1 kg/m^3 = 1000g/1000000cm^3 = 0.001 g/cm^3

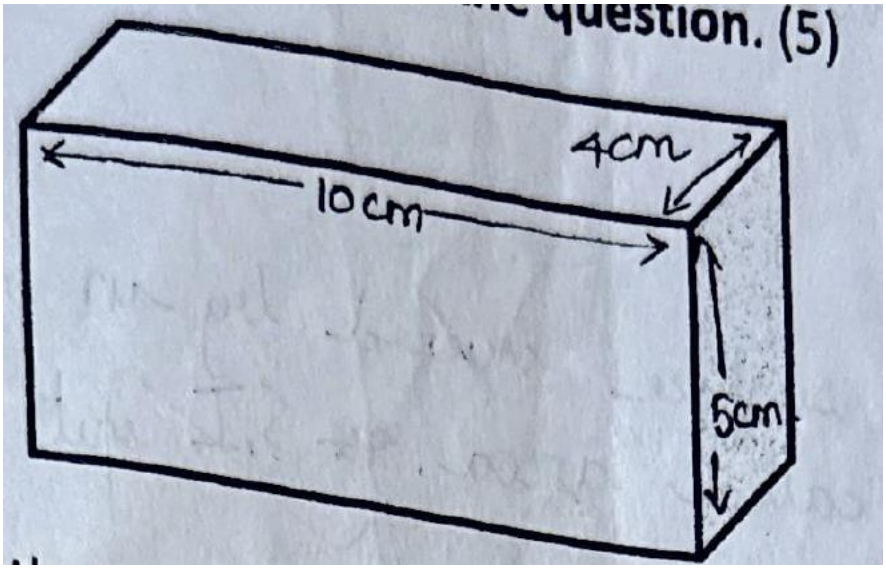
5. A metal or glass jar with an overflow outlet.

Answer: Overflow jar (or Eureka can)

6. 1 ml = _____ cm^3

Answer: 1

Observe the Figure and Answer [5]



(Rectangular block with dimensions 10 cm × 4 cm × 5 cm)

1. Calculate the volume of the rectangular block

Answer: - Volume = Length × Breadth × Height - Volume = 10 × 4 × 5 = **200 cm^3**

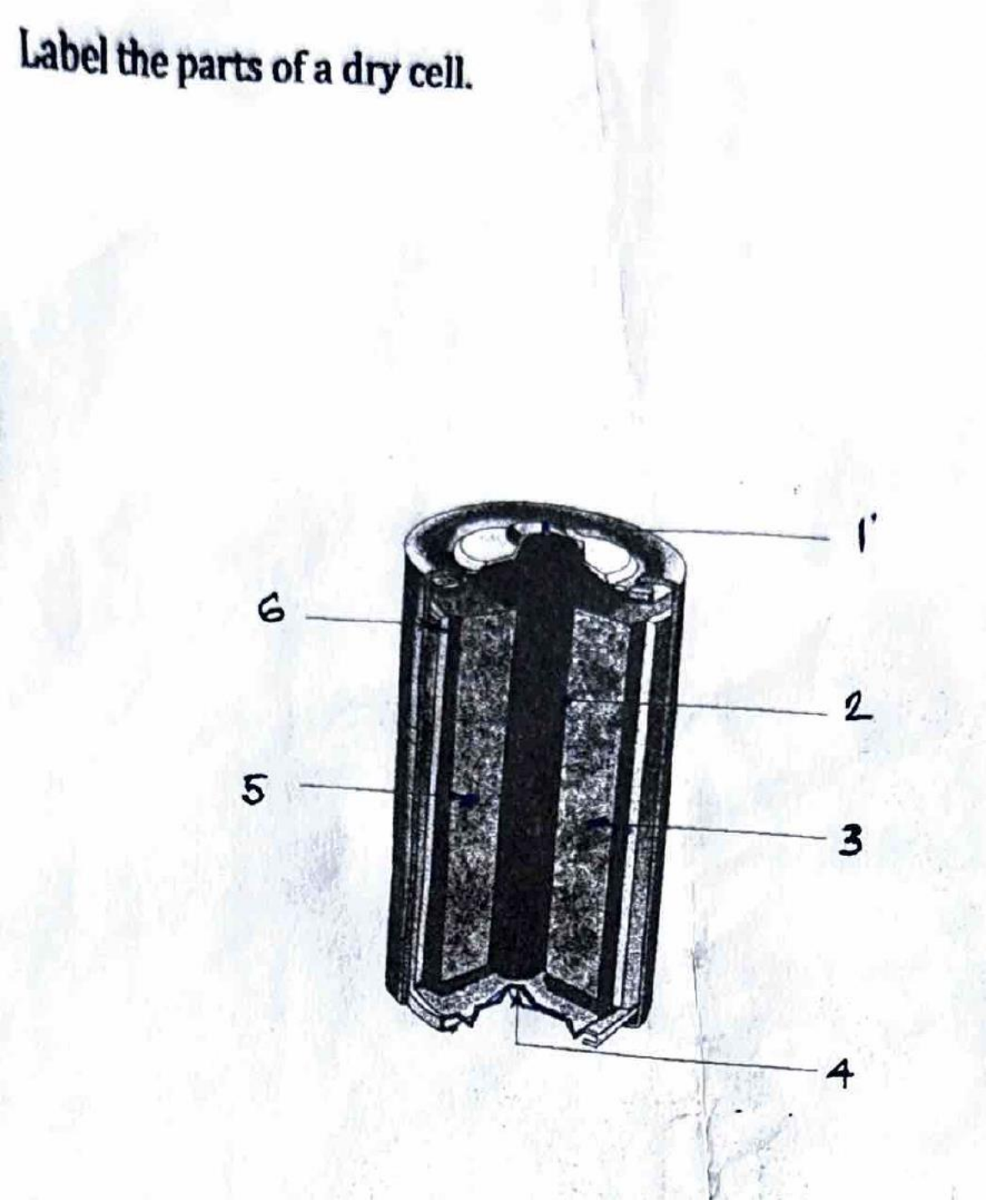
2. If the block has a mass of 500 g, what is its density?

Answer: - Density = Mass / Volume - Density = 500 g / 200 cm^3 = **2.5 g/cm^3**

3. If the block is made of lead with density of 11.3 g/cm^3, what will be its mass?

Answer: - Mass = Density × Volume - Mass = 11.3 × 200 = **2260 g** (or 2.26 kg)

Label the Parts of a Dry Cell [6]



(Diagram shows dry cell with parts numbered 1-6)

Parts of a Dry Cell: 1. **Brass cap** (Positive terminal) 2. **Carbon rod** (Positive electrode) 3. **Manganese dioxide and carbon mixture** (Depolarizer) 4. **Zinc container** (Negative electrode) 5. **Ammonium chloride paste** (Electrolyte) 6. **Muslin bag**

Summary of Key Formulas Used:

Formula	Description
Density = Mass/Volume	$\rho = m/V$
Speed = Distance/Time	$v = d/t$
KE = ½mv^2	Kinetic energy
PE = mgh	Gravitational potential energy
1 kgf = 9.8 N	Force conversion
1 L = 1000 cm^3	Volume conversion
Average speed = Total distance/Total time	For non-uniform motion

This paper focuses on Measurements and Energy - syllabus topics for I Term Examination.