TALLENTEX Physics Sample Paper – 10

Duration: 23 Minutes | Maximum Marks: 60

Instructions

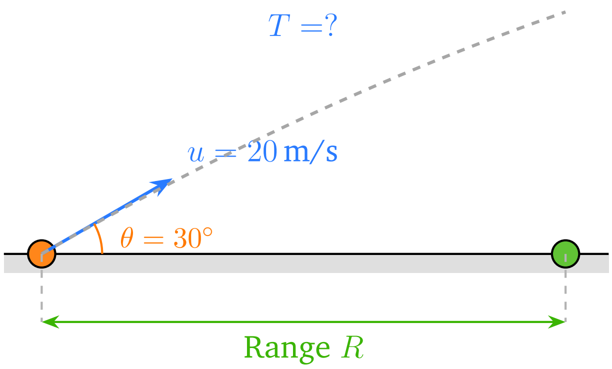
- This paper contains **15 MCQ** questions, each with a **single correct answer**.
- Marking scheme: **+4** marks for correct answer, **−1** mark for wrong answer, **0** for unattempted.
- Syllabus: **NCERT Class 8 and Class 9 Physics**.
- **No** mobile phones, calculators, or electronic gadgets are allowed.

Section – Physics (Q1 to Q15)

Q1. In a distance-time (s-t) graph for a moving object, what does the slope of the graph represent?

A. Acceleration of the object
B. Displacement of the object
C. Force acting on the object
D. Speed (instantaneous velocity) of the object

Q2. A ball is projected at an angle $\theta = 30^\circ$ with the horizontal with an initial speed $u = 20\,\text{m/s}$. Taking $g = 10\,\text{m/s}^2$, the total time of flight of the ball is:

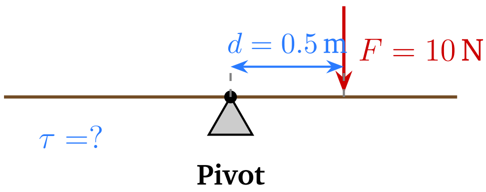


A. 2 s
B. 4 s
C. 1 s
D. 3 s

Q3. An object moves in a circle of radius $r = 7\,\text{m}$ with a constant speed $v = 22\,\text{m/s}$. The time taken to complete one full revolution is: (Take $\pi = 22/7$)

A. 1 s
B. 2 s
C. 4 s
D. 7 s

Q4. A horizontal rod is pivoted at its centre. A force of 10 N is applied vertically downward at a point 0.5 m from the pivot. The torque produced about the pivot is:



A. 10 N·m
B. 0.5 N·m
C. 5 N·m
D. 20 N·m

Q5. A spring has a spring constant $k = 200\,\text{N/m}$. If the spring is stretched by 5 cm from its natural length, the restoring force developed in the spring is:

A. 1000 N
B. 40 N
C. 4 N
D. 10 N

Q6. A geostationary satellite appears stationary to an observer on Earth because it:

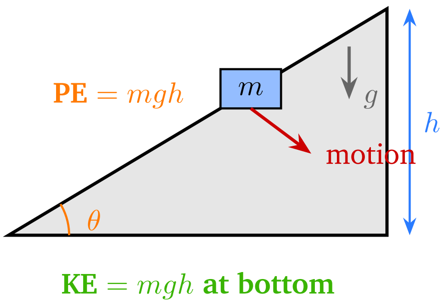
A. Revolves around Earth in 24 hours in an equatorial orbit at approximately 36,000 km altitude

B. Does not move at all; it is fixed in space
C. Moves very slowly in a polar orbit at 1,000 km altitude
D. Revolves in 12 hours matching the Earth's rotation twice per day

Q7. Water rises inside a narrow glass tube dipped in a water container. This phenomenon is called **capillary action**. Which of the following is true about capillary rise?

A. Wider the tube, higher the rise
B. Narrower the tube, higher the rise
C. Rise is independent of tube diameter
D. Water always rises to the same height regardless of the liquid

Q8. A block of mass m slides down a smooth (frictionless) inclined plane of height h. What is the speed of the block at the bottom of the incline?



A. $\sqrt{gh}$
B. $2gh$
C. $\sqrt{2gh}$
D. $\sqrt{2mgh}$

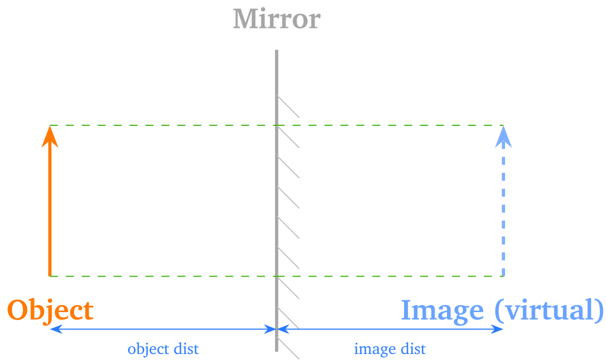
Q9. The SI unit of power is the **watt** (W). One watt is defined as:

A. 1 joule per metre
B. 1 newton per second
C. 1 joule per metre^2
D. 1 joule per second

Q10. Bats navigate and detect objects in the dark by emitting high-frequency sound waves and detecting their echoes. These sound waves belong to which category?

A. Ultrasound (frequency $> 20{,}000\,\text{Hz}$)
B. Infrasound (frequency $< 20\,\text{Hz}$)
C. Audible sound (frequency 20–20,000 Hz)
D. Electromagnetic waves

Q11. Which of the following correctly describes the image formed by a **plane mirror**?



A. Real, inverted, same size
B. Virtual, erect, laterally inverted, same size, behind the mirror
C. Virtual, inverted, magnified
D. Real, erect, diminished

Q12. Which part of the human eye controls the amount of light entering the eye by changing the size of the pupil?

A. Cornea
B. Retina
C. Iris
D. Lens

Q13. An LED (Light Emitting Diode) emits light only when it is:

A. Connected to an AC supply of high frequency
B. Reverse biased

C. Made of a metallic conductor
D. Forward biased (and is made of a semiconductor material)

Q14. In Oersted's experiment, when current flows through a straight wire placed near a magnetic compass, the compass needle is deflected. This demonstrates that:

A. A moving electric charge (current) produces a magnetic field
B. A magnetic field produces an electric current
C. Electric and magnetic fields are unrelated
D. The compass needle is made of a conductor

Q15. According to Faraday's law of electromagnetic induction, an EMF is induced in a coil when:

A. The coil is placed in a uniform magnetic field
B. The magnetic flux through the coil changes with time
C. A constant current flows through the coil
D. The coil is made of copper wire

Detailed Solutions

Q1.

Solution

Concept — Distance-Time Graph: In a distance-time (s-t) graph, the slope at any point represents the rate of change of distance with time, which is the **speed** (or instantaneous velocity) of the object at that point.

Step 1 — Definition of slope:

$$\text{Slope} = \frac{\Delta s}{\Delta t} = \frac{\text{change in distance}}{\text{change in time}} = \text{Speed}$$

Step 2 — Physical interpretation: A **steeper slope** means higher speed. A **flat (horizontal) line** means the body is at rest (zero speed). A straight line with constant slope means uniform speed.

Why other options are wrong:

- Option A (Acceleration): Acceleration is the slope of a velocity-time (v-t) graph, not an s-t graph.
- Option B (Displacement): Displacement is the *value* on the y-axis, not the slope.
- Option C (Force): Force is not directly read from an s-t graph.

Final Answer: Speed (instantaneous velocity) of the object $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q 1**

Q2.

Solution

Concept — Projectile Motion (Time of Flight): For a projectile launched at angle θ with initial speed u, the time of flight is the total time the projectile remains in the air. It is derived by analysing the vertical component of motion.

Step 1 — Vertical component and formula: The vertical component of initial velocity is $u \sin\theta$. The projectile goes up, decelerates, returns to the same level. Using $v = u - gt$ at the top (vertical velocity $= 0$), and symmetry:

$$T = \frac{2\,u\sin\theta}{g}$$

Step 2 — Substitute values:

$$u = 20\,\text{m/s}, \quad \theta = 30^\circ, \quad g = 10\,\text{m/s}^2$$

$$T = \frac{2 \times 20 \times \sin 30^\circ}{10} = \frac{2 \times 20 \times 0.5}{10} = \frac{20}{10} = 2\,\text{s}$$

Why other options are wrong:

- Option B (4 s): Results from using $\sin 60^\circ$ or $\theta = 60^\circ$ by mistake.
- Option C (1 s): Half of the correct answer; perhaps only computing the time to reach the peak.
- Option D (3 s): No valid computation leads to this value with given data.

Final Answer: $T = 2\,\text{s} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q 2**

Q3.

Solution

Concept — Uniform Circular Motion (Period): An object moving in a circle of radius r at constant speed v completes one revolution when it covers a distance equal to the circumference $2\pi r$. The time taken for one full revolution is the period T.

Step 1 — Formula for period:

$$T = \frac{\text{Circumference}}{\text{Speed}} = \frac{2\pi r}{v}$$

Step 2 — Substitute values ($\pi = 22/7$):

$$T = \frac{2 \times \frac{22}{7} \times 7}{22} = \frac{2 \times 22}{22} = 2\,\text{s}$$

Why other options are wrong:

- Option A (1 s): Divides circumference by $2v$ instead of v.
- Option C (4 s): Doubles the correct answer; perhaps uses $r = 14$ m by mistake.
- Option D (7 s): Confuses radius with the period.

Final Answer: $T = 2\,\text{s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 3

Q4.

Solution

Concept — Torque (Moment of Force): Torque (τ) is the turning effect of a force about a pivot. It is defined as the product of the applied force and the perpendicular distance from the pivot (moment arm).

Step 1 — Formula:

$$\tau = F \times d_{\perp}$$

Step 2 — Substitute values:

$$F = 10\,\text{N}, \quad d_{\perp} = 0.5\,\text{m}$$

$$\tau = 10 \times 0.5 = 5\,\text{N·m}$$

Why other options are wrong:

- Option A (10 N·m): Ignores the distance factor; uses F alone.
- Option B (0.5 N·m): Uses only the distance, ignoring the force.
- Option D (20 N·m): Adds $F + d$ or doubles the force; not a valid calculation.

Final Answer: $\tau = 5\,\textbf{N·m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 4

Q5.

Solution

Concept — Hooke's Law (Spring Force): Hooke's law states that the restoring force in a spring is directly proportional to the extension (or compression) from its natural length, provided the elastic limit is not exceeded: $F = kx$.

Step 1 — Convert extension to SI units:

$$x = 5\,\text{cm} = 0.05\,\text{m}$$

Step 2 — Apply Hooke's law:

$$F = kx = 200\,\text{N/m} \times 0.05\,\text{m} = 10\,\text{N}$$

Why other options are wrong:

- Option A (1000 N): Uses $x = 5\,\text{m}$ (forgets to convert cm to m).
- Option B (40 N): Multiplies $k \times x$ using $x = 0.2$ m (incorrect conversion).
- Option C (4 N): Uses $x = 0.02$ m or divides by an extra factor.

Final Answer: $F = 10\,\mathbf{N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 5

Q6.

Solution

Concept — Geostationary Satellite: A geostationary satellite is a special artificial satellite that orbits Earth in the equatorial plane at an altitude of approximately 36,000 km. Its orbital period equals Earth's rotational period of 24 hours, so it appears stationary to an observer on the ground.

Step 1 — Key conditions for geostationary orbit:

- Orbital period $= 24$ hours (matches Earth's rotation).
- Orbit is in the equatorial plane.
- Altitude $\approx 36{,}000\,\text{km}$ above Earth's surface.
- Rotates from west to east (same as Earth).

Step 2 — Conclusion: Because the satellite's angular velocity matches Earth's, it always remains above the same point on the equator, appearing stationary.

Why other options are wrong:

- Option B (Does not move): The satellite is always in motion; it just matches Earth's rotation.
- Option C (Polar orbit at 1,000 km): Polar orbit satellites are not geostationary; they cross the poles.
- Option D (12-hour period): A 12-hour orbit is a GPS-like (MEO) orbit, not geostationary.

Final Answer: 24-hour equatorial orbit at $\approx 36{,}000\,\mathbf{km} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 6

Q7.

Solution

Concept — Capillary Action (Surface Tension): Capillary action is the ability of a liquid to flow in narrow spaces without the help of gravity. It occurs due to the interplay of **adhesive forces** (between liquid and tube walls) and **cohesive forces** (within the liquid), collectively described as **surface tension**.

Step 1 — Formula for capillary rise:

$$h = \frac{2T\cos\theta}{\rho g r}$$

where T is surface tension, θ is the contact angle, ρ is the liquid density, g is gravitational acceleration, and r is the tube radius.

Step 2 — Effect of tube radius: Since $h \propto \frac{1}{r}$, **narrower tubes** (smaller r) produce **higher** capillary rise.

Why other options are wrong:

- Option A (Wider tube, higher rise): This is the opposite of what the formula shows.
- Option C (Independent of diameter): Rise is inversely proportional to radius, so it depends on diameter.
- Option D (Same height for all liquids): Rise depends on T, ρ, and θ, all of which vary with the liquid.

Final Answer: Narrower the tube, higher the rise $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 7

Q8.

Solution

Concept — Conservation of Energy (Inclined Plane): When a block slides down a smooth (frictionless) inclined plane, there is no energy loss due to friction. By the principle of conservation of mechanical energy, the potential energy at the top is completely converted to kinetic energy at the bottom.

Step 1 — Energy conservation:

$$\text{PE at top} = \text{KE at bottom}$$

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

Step 2 — Solve for speed v:

$$v^2 = 2gh \implies v = \sqrt{2gh}$$

Note: the mass m cancels, so the speed is independent of the mass of the block.

Why other options are wrong:

- Option A ($\sqrt{gh}$): Missing the factor of 2 from $\frac{1}{2}mv^2$.
- Option B ($2gh$): This is v^2, not v (forgot to take the square root).
- Option D ($\sqrt{2mgh}$): Incorrectly retains mass m inside the square root; m cancels in the derivation.

Final Answer: $v = \sqrt{2gh} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 8

Q9.

Solution

Concept — Power and Its SI Unit: Power is defined as the rate of doing work (or the rate of energy transfer). Mathematically:

$$P = \frac{W}{t} = \frac{\text{Work done (joules)}}{\text{Time taken (seconds)}}$$

Step 1 — Definition of 1 watt:

$$1\,\text{W} = \frac{1\,\text{J}}{1\,\text{s}} = 1\,\text{J}\,\text{s}^{-1}$$

One watt is the power when one joule of work is done in one second.

Step 2 — Cross-check with other units: $1\,\text{W} = 1\,\text{kg}\,\text{m}^2\,\text{s}^{-3}$ (in base SI units), consistent with joule per second.

Why other options are wrong:

- Option A (1 J per metre): That is the unit of force (newton), not power.
- Option B (1 N per second): This has no standard physical meaning for power.
- Option C (1 J per m^2): This is the unit of pressure (pascal), not power.

Final Answer: 1 joule per second $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 9

Q10.

Solution

Concept — Range of Sound Frequencies: Sound waves are classified based on their frequency:

- **Infrasound**: frequency $< 20\,\text{Hz}$ (below human hearing range).
- **Audible sound**: frequency $20\,\text{Hz} – 20{,}000\,\text{Hz}$ (heard by humans).
- **Ultrasound**: frequency $> 20{,}000\,\text{Hz}$ (above human hearing range).

Step 1 — Bat navigation (echolocation): Bats emit ultrasonic pulses (typically 20 kHz – 100 kHz) and detect the echoes reflected from objects. This process, called **echolocation**, allows them to determine the size, shape, and location of obstacles or prey even in complete darkness.

Why other options are wrong:

- Option B (Infrasound): Infrasound ($< 20\,\text{Hz}$) is used by elephants and whales, not bats.
- Option C (Audible sound): Human ears can hear audible sound; bats use frequencies far above this range.
- Option D (Electromagnetic waves): Bats use *sound* (mechanical) waves, not electromagnetic waves.

Final Answer: Ultrasound (frequency $> 20{,}000\,\text{Hz}$) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 10

Q11.

Solution

Concept — Image in a Plane Mirror: A plane mirror forms an image by the law of reflection. The image formed has the following properties (all from NCERT Class 8):

- The image is **virtual** (cannot be obtained on a screen).
- It is **erect** (upright, same orientation as the object).
- It is **laterally inverted** (left and right are swapped).
- The image size equals the object size (**same magnification = 1**).

- The image is located **behind the mirror**, at the same distance as the object is in front.

Step 1 — Compare with options: Option B matches all five properties exactly.

Why other options are wrong:

- Option A (Real, inverted): Plane mirror never forms a real or inverted image.
- Option C (Virtual, inverted, magnified): Image is erect (not inverted) and same size (not magnified).
- Option D (Real, erect, diminished): Plane mirror image is virtual, not real or diminished.

Final Answer: Virtual, erect, laterally inverted, same size, behind the mirror $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q 11**

Q12.

Solution

Concept — Structure of the Human Eye: The eye has several parts, each with a specific role in vision. The **iris** is the coloured, muscular diaphragm surrounding the pupil.

Step 1 — Role of the iris: The iris controls the size of the **pupil** (the opening through which light enters). In bright light, the iris contracts to make the pupil smaller (less light enters). In dim light, the iris expands to make the pupil larger (more light enters). This is an automatic reflex that protects the retina from damage.

Step 2 — Summary:

$$\text{Iris} \to \text{controls pupil size} \to \text{regulates amount of light entering the eye}$$

Why other options are wrong:

- Option A (Cornea): The cornea is the transparent outer covering; it refracts light but does not control pupil size.
- Option B (Retina): The retina contains photoreceptors (rods and cones) and detects light; it does not control pupil size.
- Option D (Lens): The lens focuses light on the retina by changing its shape

(accommodation); it does not control the amount of light.

Final Answer: Iris $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 12

Q13.

Solution

Concept — LED (Light Emitting Diode): An LED is a semiconductor device (p-n junction diode) that emits light when charge carriers recombine at the junction. It is made of semiconductor materials such as GaAs, GaP, or GaN (not metals).

Step 1 — Forward bias condition: When an LED is **forward biased** (positive terminal connected to p-type, negative to n-type), the depletion region narrows and charge carriers cross the junction. As electrons recombine with holes, they release energy in the form of **photons** (light).

Step 2 — Reverse bias: When reverse biased, the depletion region widens and no significant current flows, so no light is emitted.

Why other options are wrong:

- Option A (AC supply of high frequency): LEDs require DC forward bias, not high-frequency AC for emission.
- Option B (Reverse biased): No current flows and no light is emitted under reverse bias.
- Option C (Made of metallic conductor): LEDs are made of *semiconductors*, not metallic conductors.

Final Answer: Forward biased (semiconductor material) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 13

Q14.

Solution

Concept — Oersted's Experiment (Magnetic Effect of Current): In 1820, Hans Christian Oersted discovered that a compass needle placed near a current-carrying wire is deflected when the current flows. When the current is switched off, the needle returns to its original position. This was the first experimental proof that **electric current produces a magnetic field.**

Step 1 — Observation: Current flows through wire $\Rightarrow$ Compass needle deflects. No current $\Rightarrow$ No deflection.

Step 2 — Conclusion: A moving electric charge (electric current) creates a magnetic field around it. The direction of the magnetic field is given by the **Right-Hand Thumb Rule**: point the thumb in the direction of current; curling fingers show the direction of the circular magnetic field.

Why other options are wrong:

- Option B (Magnetic field produces current): This is *Faraday's law* (electromagnetic induction), not Oersted's experiment.
- Option C (Electric and magnetic fields are unrelated): Oersted's experiment directly links them.
- Option D (Compass needle is a conductor): A compass needle is a permanent magnet (ferromagnetic material), not a conductor.

Final Answer: A moving electric charge (current) produces a magnetic field $\Rightarrow \boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q 14

Q15.

Solution

Concept — Faraday's Law of Electromagnetic Induction: Michael Faraday discovered that an **electromotive force (EMF)** is induced in a conducting coil whenever the **magnetic flux** through the coil changes with time. This is the fundamental principle behind electric generators, transformers, and inductors.

Step 1 — Faraday's law:

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

where $\Phi_B = B \cdot A \cdot \cos\theta$ is the magnetic flux through the coil. An EMF is induced only when Φ_B changes (by changing B, A, or θ).

Step 2 — Practical examples: Moving a magnet towards/away from a coil, rotating a coil in a magnetic field, or switching on/off a nearby current all change the flux and induce an EMF.

Why other options are wrong:

- Option A (Placed in a uniform, constant field): A constant flux produces zero induced EMF ($d\Phi_B/dt = 0$).

- Option C (Constant current flows through the coil): A steady current in the coil itself does not induce an EMF; it must be a *changing* external flux.
- Option D (Made of copper wire): The material of the coil does not determine whether induction occurs; changing flux does.

Final Answer: The magnetic flux through the coil changes with time $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q 15**

Questions 1–15									
1	D	2	A	3	B	4	C	5	D
6	A	7	B	8	C	9	D	10	A
11	B	12	C	13	D	14	A	15	B