TALLENTEX Physics Sample Paper – 9

Duration: 23 Minutes | Maximum Marks: 60

Instructions

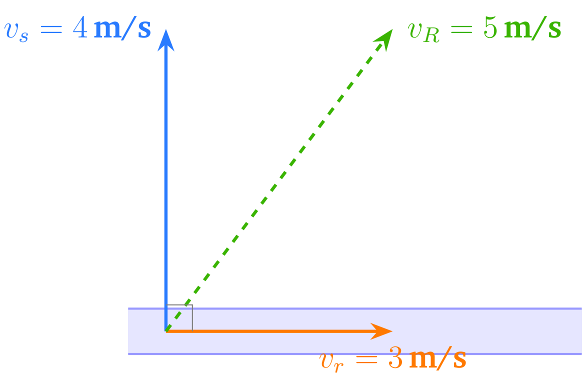
- This paper contains **15 MCQ** questions, each with a **single correct answer**.
- Marking scheme: **+4** marks for correct answer, $-$**1** mark for wrong answer, **0** for unattempted.
- Syllabus: **NCERT Class 8 and Class 9 Physics**.
- **No** mobile phones, calculators, or electronic gadgets are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

Section – Physics (Q1 to Q15)

Q1. A car moving at $72\,\text{km/h}$ decelerates uniformly and comes to rest in $10\,\text{s}$. The magnitude of retardation is:

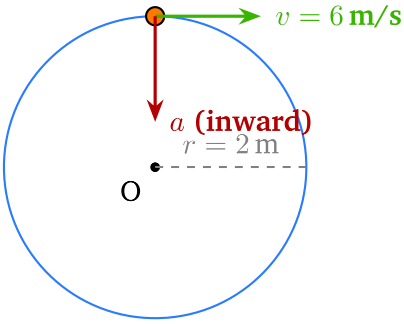
A. $2\,\text{m/s}^2$
B. $7.2\,\text{m/s}^2$
C. $0.2\,\text{m/s}^2$
D. $20\,\text{m/s}^2$

Q2. A swimmer can swim at $4\,\text{m/s}$ in still water. A river flows at $3\,\text{m/s}$. If the swimmer heads straight across the river (perpendicular to the flow), her resultant speed with respect to the ground is:



A. $7\,\text{m/s}$
B. $5\,\text{m/s}$
C. $1\,\text{m/s}$
D. $3.5\,\text{m/s}$

Q3. A particle moves in a circle of radius $r = 2\,\text{m}$ with a constant speed $v = 6\,\text{m/s}$. The centripetal acceleration of the particle is:



A. $12\,\text{m/s}^2$
B. $3\,\text{m/s}^2$
C. $18\,\text{m/s}^2$
D. $36\,\text{m/s}^2$

Q4. A rocket ejects $2\,\text{kg}$ of gas per second at a speed of $500\,\text{m/s}$ relative to the rocket. The thrust force on the rocket is:

A. $250\,\text{N}$
B. $502\,\text{N}$
C. $100\,\text{N}$
D. $1000\,\text{N}$

Q5. Three equal forces, each of magnitude F, act on a body at angles of $120°$ to each other. The magnitude of the net (resultant) force on the body is:

A. Zero
B. F
C. $2F$
D. $3F$

Q6. The orbital speed of a satellite revolving close to the Earth's surface (height $h \approx 0$) is given by $v = \sqrt{gR}$, where $g = 10\,\text{m/s}^2$ and $R = 6400\,\text{km}$. The orbital speed is approximately:

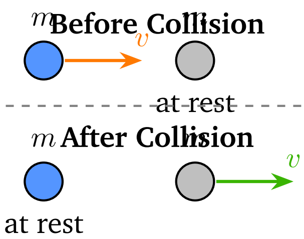
A. $11.2\,\text{km/s}$

B. $8\,\text{km/s}$
C. $6\,\text{km/s}$
D. $3.2\,\text{km/s}$

Q7. According to Stokes' law, the terminal velocity of a small sphere falling through a viscous fluid is proportional to:

A. r (radius)
B. $r^{1/2}$
C. r^2
D. r^3

Q8. A ball of mass m moving with velocity v undergoes a perfectly elastic head-on collision with an identical ball of mass m at rest. After the collision:



A. Both balls move with speed $v/2$
B. Both balls come to rest
C. The first ball continues with speed v; the second remains at rest
D. The first ball comes to rest; the second moves with speed v

Q9. A single movable pulley is used to lift a load W. Neglecting friction, the effort required is:

A. $W/2$
B. W
C. $2W$
D. $W/4$

Q10. The speed of sound in air at $0°\text{C}$ is $332\,\text{m/s}$. The speed increases by approximately $0.6\,\text{m/s}$ for every $1°\text{C}$ rise in temperature. The speed of sound at $30°\text{C}$ is approximately:

A. $332\,\text{m/s}$
B. $350\,\text{m/s}$
C. $362\,\text{m/s}$
D. $302\,\text{m/s}$

Q11. A convex lens has a focal length of $25\,\text{cm}$. Its power is:

A. $-4\,\text{D}$
B. $25\,\text{D}$
C. $+4\,\text{D}$
D. $0.25\,\text{D}$

Q12. Optical fibres transmit light signals over long distances with very little loss. The principle used in optical fibres is:

A. Interference of light
B. Diffraction of light
C. Scattering of light
D. Total internal reflection

Q13. A resistor has colour bands: Brown – Black – Red. Using the resistor colour code (Brown $= 1$, Black $= 0$, Red $= 2$), its resistance is:

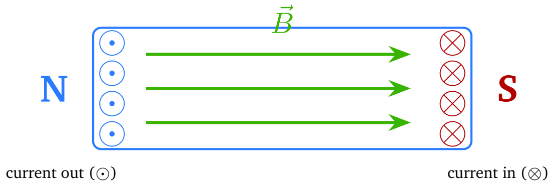
A. $1000\,\Omega$
B. $102\,\Omega$
C. $120\,\Omega$
D. $10\,\Omega$

Q14. A step-up transformer has a primary coil of 100 turns connected to $220\,\text{V}$ AC supply. If the secondary coil has 400 turns, the secondary voltage is:

A. $55\,\text{V}$
B. $880\,\text{V}$

C. $440\,\mathrm{V}$
D. $220\,\mathrm{V}$

Q15. A solenoid has 500 turns per metre and carries a current of $2\,\mathrm{A}$. The magnetic field inside the solenoid ($\mu_0 = 4\pi \times 10^{-7}\,\mathrm{T\,m/A}$) is approximately:



A. $4\pi \times 10^{-3}\,\mathrm{T}$
B. $4\pi \times 10^{-7}\,\mathrm{T}$
C. $4\pi \times 10^{-4}\,\mathrm{T}$
D. $4\pi \times 10^{-2}\,\mathrm{T}$

Detailed Solutions

Q1.

Solution

Concept — Uniform Retardation (Kinematics): Retardation is the magnitude of deceleration. Using the first equation of motion $v = u + at$ (with a negative for deceleration), we can find the retardation directly.

Step 1 — Convert initial speed to m/s:

$$u = 72\,\text{km/h} \times \frac{5}{18} = 20\,\text{m/s}$$

Step 2 — Apply first equation of motion:

$$v = u + at \implies 0 = 20 + a \times 10 \implies a = -2\,\text{m/s}^2$$

The magnitude of retardation $= 2\,\text{m/s}^2$.

Why other options are wrong:

- Option B ($7.2\,\text{m/s}^2$): Divides the unconverted speed 72 by 10 without unit conversion.
- Option C ($0.2\,\text{m/s}^2$): Divides $20\,\text{m/s}$ by 100 (incorrect).
- Option D ($20\,\text{m/s}^2$): Reads off initial speed in m/s as the retardation.

Final Answer: $2\,\textbf{m/s}^2 \Rightarrow \boxed{\text{A}}$

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

Q2.

Solution

Concept — River Crossing (Vector Addition): When a swimmer heads perpendicular to the river flow, the swimmer's velocity v_s and the river's velocity v_r are at right angles to each other. The resultant speed is found using the Pythagorean theorem.

Step 1 — Identify the two perpendicular velocity components:

$$v_s = 4\,\text{m/s (across river)}, \quad v_r = 3\,\text{m/s (along river)}$$

Step 2 — Calculate resultant speed:

$$v_R = \sqrt{v_s^2 + v_r^2} = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5\,\text{m/s}$$

This is a 3–4–5 Pythagorean triple.

Why other options are wrong:

- Option A ($7\,\text{m/s}$): Simple sum of speeds $4 + 3 = 7$; valid only if velocities are in the same direction.
- Option C ($1\,\text{m/s}$): Difference of speeds $4 - 3 = 1$; valid only if velocities are in opposite directions.
- Option D ($3.5\,\text{m/s}$): Average of the two speeds; has no physical basis here.

Final Answer: $5\,\textbf{m/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept — Centripetal Acceleration (Circular Motion): A particle moving in a circle at constant speed v experiences a centripetal acceleration directed towards the centre, given by $a = \dfrac{v^2}{r}$.

Step 1 — Identify given values:

$$v = 6\,\text{m/s}, \quad r = 2\,\text{m}$$

Step 2 — Substitute into formula:

$$a = \frac{v^2}{r} = \frac{(6)^2}{2} = \frac{36}{2} = 18\,\text{m/s}^2$$

Why other options are wrong:

- Option A ($12\,\text{m/s}^2$): Uses $a = v \times r/$something; incorrect formula.
- Option B ($3\,\text{m/s}^2$): Uses $a = v^2/r^2 = 36/4 = 9$ or $a = r^2/v = 4/6$; both wrong.
- Option D ($36\,\text{m/s}^2$): Uses $a = v^2 = 36$, forgetting to divide by r.

Final Answer: $18\,\textbf{m/s}^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept — Rocket Propulsion (Newton's Third Law): The thrust force on a rocket equals the rate of change of momentum of the ejected gas. If mass Δm is ejected per second at speed v_e, then:

$$F_{\text{thrust}} = \frac{\Delta m}{\Delta t} \times v_e$$

Step 1 — Identify given values:

$$\frac{\Delta m}{\Delta t} = 2\,\text{kg/s}, \quad v_e = 500\,\text{m/s}$$

Step 2 — Calculate thrust:

$$F = 2\,\text{kg/s} \times 500\,\text{m/s} = 1000\,\text{N}$$

Why other options are wrong:

- Option A ($250\,\text{N}$): Divides the correct answer by 4; no physical basis.
- Option B ($502\,\text{N}$): Adds $2+500 = 502$; confused addition with multiplication.
- Option C ($100\,\text{N}$): Divides $500/2 \times (1/2.5)$; incorrect formula.

Final Answer: $1000\,\mathbf{N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept — Equilibrium of Concurrent Forces: When three equal forces each of magnitude F act at equal angles of $120°$ to each other, they form a symmetric pattern. Their vector sum can be evaluated using the law of vector addition.

Step 1 — Resolve forces into components: Let the three forces be at $0°$, $120°$, and $240°$:

$$\sum F_x = F\cos 0° + F\cos 120° + F\cos 240° = F\left(1 - \tfrac{1}{2} - \tfrac{1}{2}\right) = 0$$

$$\sum F_y = F\sin 0^\circ + F\sin 120^\circ + F\sin 240^\circ = F\left(0 + \frac{\sqrt{3}}{2} - \frac{\sqrt{3}}{2}\right) = 0$$

Step 2 — Net force:

$$F_{\text{net}} = \sqrt{(\sum F_x)^2 + (\sum F_y)^2} = \sqrt{0+0} = 0$$

The three equal forces at 120° to each other are in equilibrium.

Why other options are wrong:

- Option B (F): Would be the resultant of only two equal forces at 120°, not three.
- Option C ($2F$): Incorrect; not a valid result for symmetric three-force system.
- Option D ($3F$): Correct only if all forces act in the same direction.

Final Answer: Zero $\Rightarrow \boxed{\text{A}}$

$\boxed{\textbf{Answer: (A)}}$ **Go Back to Q 5**

Q6.

Solution

Concept — Orbital Speed of a Near-Earth Satellite: For a satellite orbiting close to Earth's surface ($h \approx 0$), the gravitational force provides the centripetal force. Setting $mg = mv^2/R$ and solving for v:

$$v = \sqrt{gR}$$

Step 1 — Substitute values:

$$g = 10\,\text{m/s}^2, \quad R = 6400\,\text{km} = 6.4 \times 10^6\,\text{m}$$

$$v = \sqrt{10 \times 6.4 \times 10^6} = \sqrt{6.4 \times 10^7} \approx 8000\,\text{m/s} = 8\,\text{km/s}$$

Why other options are wrong:

- Option A ($11.2\,\text{km/s}$): This is the escape velocity $v_e = \sqrt{2gR}$, not orbital speed.
- Option C ($6\,\text{km/s}$): Underestimate; uses an incorrect value of g or R.
- Option D ($3.2\,\text{km/s}$): Half of the correct answer; arises from using R in km without conversion.

Final Answer: 8 **km/s** $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 6

Q7.

Solution

Concept — Terminal Velocity and Stokes' Law: When a small sphere of radius r falls through a viscous fluid of viscosity η, it reaches terminal velocity when the net downward force (gravity minus buoyancy) equals the viscous drag (Stokes' drag $F = 6\pi\eta r v$).

Step 1 — Balance of forces at terminal velocity:

$$\frac{4}{3}\pi r^3(\rho - \sigma)g = 6\pi\eta r v_T$$

where ρ is the density of the sphere and σ is the density of the fluid.

Step 2 — Solve for v_T:

$$v_T = \frac{2r^2(\rho - \sigma)g}{9\eta}$$

Therefore, $v_T \propto r^2$.

Why other options are wrong:

- Option A (r): Incorrect power; would apply only if drag were proportional to r^2.
- Option B ($r^{1/2}$): Not supported by Stokes' law derivation.
- Option D (r^3): The r^3 factor appears in the gravitational force, but after cancelling with r in drag, the result is r^2.

Final Answer: $r^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept — Elastic Collision Between Equal Masses: In a perfectly elastic head-on collision between two equal masses, where one mass is initially at rest, the velocities are exchanged. The moving object stops and the stationary object moves with the original velocity.

Step 1 — Apply conservation of momentum:

$$mv + m \cdot 0 = mv_1' + mv_2' \implies v = v_1' + v_2'$$

Step 2 — Apply conservation of kinetic energy:

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_1'^2 + \frac{1}{2}mv_2'^2 \implies v^2 = v_1'^2 + v_2'^2$$

Solving simultaneously: $v_1' = 0$ and $v_2' = v$. The first ball comes to rest; the second moves with speed v.

Why other options are wrong:

- Option A (both at $v/2$): This conserves momentum but violates conservation of kinetic energy.
- Option B (both at rest): Violates conservation of momentum.
- Option C (first continues at v, second at rest): Violates conservation of kinetic energy (second ball must gain energy).

Final Answer: First ball stops; second ball moves at $v \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept — Single Movable Pulley (Simple Machines): A single movable pulley has a mechanical advantage (MA) of 2. This means the effort needed to lift a load W is halved.

Step 1 — Mechanical advantage of a movable pulley: In a single movable pulley, two segments of the rope support the load. By the law of the machine (neglecting friction):

$$\text{MA} = \frac{\text{Load}}{\text{Effort}} = 2$$

Step 2 — Find effort:

$$\text{Effort} = \frac{W}{\text{MA}} = \frac{W}{2}$$

Why other options are wrong:

- Option B (W): This applies to a fixed pulley, which only changes the direction of force, not its magnitude.

- Option C ($2W$): Greater than the load; that would be a mechanical disadvantage, not an advantage.
- Option D ($W/4$): Would require MA = 4, which needs a system of two movable pulleys.

Final Answer: $W/2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept — Speed of Sound and Temperature: The speed of sound in air increases with temperature. The empirical relationship gives an increase of approximately $0.6\,\text{m/s}$ per degree Celsius rise in temperature, starting from $332\,\text{m/s}$ at $0°\text{C}$.

Step 1 — Apply the temperature correction:

$$v_T = v_0 + 0.6 \times T$$

where T is the temperature in °C.

Step 2 — Calculate speed at $30°$C:

$$v_{30} = 332 + 0.6 \times 30 = 332 + 18 = 350\,\text{m/s}$$

Why other options are wrong:

- Option A ($332\,\text{m/s}$): This is the speed only at $0°$C; no correction applied.
- Option C ($362\,\text{m/s}$): Adds 30 directly (not 0.6×30); overestimates.
- Option D ($302\,\text{m/s}$): Subtracts instead of adding; speed increases with temperature.

Final Answer: $350\,\textbf{m/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 10

Q11.

Solution

Concept — Power of a Lens: The power of a lens is defined as the reciprocal of its focal length when the focal length is expressed in metres. For a convex lens, the focal length is positive, so the power is positive.

$$P = \frac{1}{f\,(\text{in metres})}$$

Step 1 — Convert focal length to metres:

$$f = 25\,\text{cm} = 0.25\,\text{m}$$

Step 2 — Calculate power:

$$P = \frac{1}{0.25} = +4\,\text{D (dioptres)}$$

The positive sign confirms it is a converging (convex) lens.

Why other options are wrong:

- Option A (-4 D): Negative power corresponds to a concave (diverging) lens.
- Option B (25 D): Uses $P = f$ directly (in cm) instead of $P = 1/f$ (in m).
- Option D (0.25 D): Uses $P = f$ in metres instead of $P = 1/f$.

Final Answer: $+4$ **D** $\Rightarrow \boxed{\text{C}}$

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q 11

Q12.

Solution

Concept — Optical Fibre and Total Internal Reflection: An optical fibre consists of a glass core surrounded by a cladding of lower refractive index. When light travels from a denser medium (core) to a less dense medium (cladding) at an angle greater than or equal to the critical angle, it undergoes **total internal reflection** and stays confined within the fibre.

Step 1 — Condition for total internal reflection:

$$\theta_i \geq \theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right)$$

where $n_1 > n_2$ (core denser than cladding).

Step 2 — Application: Every time light hits the core–cladding boundary at a steep angle (greater than θ_c), it is totally reflected back into the core. This allows signals to travel long distances with minimal energy loss.

Why other options are wrong:

- Option A (Interference): Interference is a wave phenomenon used in anti-reflection coatings, not in fibre transmission.
- Option B (Diffraction): Diffraction causes light to spread around obstacles; not the operating principle here.
- Option C (Scattering): Scattering causes signal loss in fibres; it is an imperfection, not the operating mechanism.

Final Answer: Total internal reflection $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 12

Q13.

Solution

Concept — Resistor Colour Code: In the standard resistor colour code, the first two bands give the first two significant digits and the third band (multiplier) gives the power of 10 to multiply by.

$$\text{Resistance} = (\text{1st digit})(\text{2nd digit}) \times 10^{\text{multiplier}}$$

Step 1 — Read the colour code:

- Brown $= 1$ (1st digit)
- Black $= 0$ (2nd digit)
- Red $= 2$ (multiplier, i.e., $\times 10^2$)

Step 2 — Calculate resistance:

$$R = 10 \times 10^2 = 10 \times 100 = 1000\,\Omega = 1\,\text{k}\Omega$$

Why other options are wrong:

- Option B ($102\,\Omega$): Reads the multiplier as a digit (1, 0, 2 concatenated).
- Option C ($120\,\Omega$): Swaps the order of digits or misreads the colour sequence.

- Option D ($10\,\Omega$): Ignores the multiplier band (Red = $\times 100$).

Final Answer: $1000\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept — Step-Up Transformer: A transformer works on the principle of mutual electromagnetic induction. The turns ratio determines how the voltage is stepped up or down:

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}$$

A step-up transformer has $N_2 > N_1$, so $V_2 > V_1$.

Step 1 — Identify given values:

$$V_1 = 220\,\text{V}, \quad N_1 = 100\,\text{turns}, \quad N_2 = 400\,\text{turns}$$

Step 2 — Calculate secondary voltage:

$$V_2 = V_1 \times \frac{N_2}{N_1} = 220 \times \frac{400}{100} = 220 \times 4 = 880\,\text{V}$$

Why other options are wrong:

- Option A ($55\,\text{V}$): Uses $V_2 = V_1 \times (N_1/N_2) = 220/4 = 55$; this applies to a step-down transformer.
- Option C ($440\,\text{V}$): Uses turns ratio of $200/100 = 2$ instead of $400/100 = 4$.
- Option D ($220\,\text{V}$): Assumes output equals input, ignoring the turns ratio.

Final Answer: $880\,\textbf{V} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 14

Q15.

Solution

Concept — Magnetic Field Inside a Solenoid: A solenoid carrying current produces a uniform magnetic field inside it. The formula is:

$$B = \mu_0 n I$$

where n is the number of turns per unit length and I is the current.

Step 1 — Identify given values:

$$n = 500\,\text{turns/m}, \quad I = 2\,\text{A}, \quad \mu_0 = 4\pi \times 10^{-7}\,\text{T m/A}$$

Step 2 — Substitute into formula:

$$B = \mu_0 n I = (4\pi \times 10^{-7}) \times 500 \times 2 = 4\pi \times 10^{-7} \times 10^3 = 4\pi \times 10^{-4}\,\text{T}$$

$$B \approx 4 \times 3.14159 \times 10^{-4} \approx 1.26 \times 10^{-3}\,\text{T}$$

Why other options are wrong:

- Option A ($4\pi \times 10^{-3}$ T): Overestimates by factor of 10; perhaps uses $n = 5000$.
- Option B ($4\pi \times 10^{-7}$ T): Forgets to multiply by n and I (uses only μ_0).
- Option D ($4\pi \times 10^{-2}$ T): Overestimates by factor of 100; incorrect power of 10.

Final Answer: $4\pi \times 10^{-4}\,\mathbf{T} \approx 1.26 \times 10^{-3}\,\mathbf{T} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 15

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