TALLENTEX Physics

Sample Paper – 5

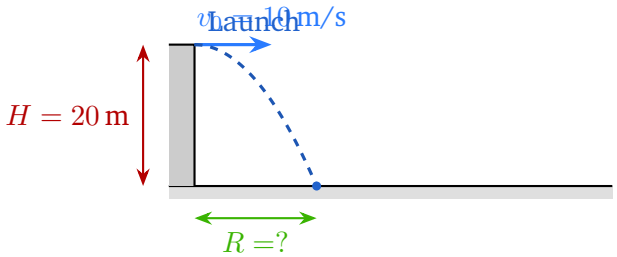
Duration: 23 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Correct Answer), modelled on the Physics portion of **TALLENTEX** entrance.
- Each correct answer carries **+4 marks**. There is **a penalty of** -1 **mark** for incorrect answers. Unattempted questions carry no penalty.
- Only **one** option is correct. Choose carefully.
- Syllabus: **NCERT Class 8 and Class 9 Physics**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Section A — Multiple Choice Questions (MCQ)

Q1. A ball is projected horizontally from the edge of a cliff of height 20 m with a speed of $10\,\text{m/s}$ (take $g = 10\,\text{m/s}^2$). The horizontal range R before the ball hits the ground is:



(A) 20 m

(B) 10 m

(C) 40 m

(D) 200 m

Q2. A car starts from rest and travels with a uniform acceleration of $4\,\text{m/s}^2$. Using $s = ut + \frac{1}{2}at^2$, the distance covered in the **4th second** (between $t = 3\,\text{s}$ and $t = 4\,\text{s}$) is:

(A) 16 m

(B) 14 m

(C) 32 m

(D) 28 m

Q3. Which instrument in a vehicle measures the **total distance** travelled by it since it was manufactured?

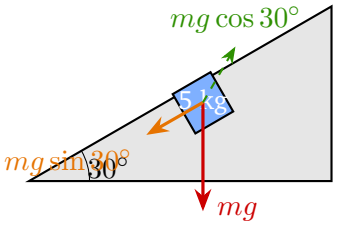
(A) Speedometer

(B) Accelerometer

(C) Odometer

(D) Tachometer

Q4. A block of mass 5 kg rests on a frictionless inclined plane making 30° with the horizontal. The component of gravitational force acting **along the incline** (pointing down the slope) is: ($g = 10\,\text{m/s}^2$)



(A) 50 N

(B) $25\sqrt{3}$ N

(C) 43.3 N

(D) 25 N

Q5. A wooden block is dragged on a rough horizontal floor. The normal reaction on the block is 40 N and the coefficient of kinetic friction is 0.25. The frictional force acting on the block is:

(A) 10 N

(B) 40 N

(C) 0.25 N

(D) 160 N

Q6. The weight of an astronaut of mass 80 kg on Mars, where the acceleration due to gravity is approximately $3.7\,\text{m/s}^2$, is:

(A) 80 N

(B) 296 N

(C) 800 N

(D) 370 N

Q7. A solid sphere floats in water with **one-third** of its volume submerged. The density of the sphere is: (density of water $= 1000\,\text{kg/m}^3$)

(A) $1000\,\text{kg/m}^3$

(B) $500\,\text{kg/m}^3$

(C) $333\,\text{kg/m}^3$

(D) $3000\,\text{kg/m}^3$

Q8. A body of mass 2 kg moving at $6\,\text{m/s}$ is brought to rest by a constant retarding force over a distance of 4 m. Using the work-energy theorem, the magnitude of the retarding force is:

(A) 3 N

(B) 36 N

(C) 12 N

(D) 9 N

Q9. A machine lifts a load of 1000 N through 2 m in 10 s by applying an effort of 500 N through 5 m. The efficiency of the machine is:

(A) 80%

(B) 50%

(C) 40%

(D) 100%

Q10. A guitar string is tightened so that it produces a **higher note**. This happens because tightening the string:

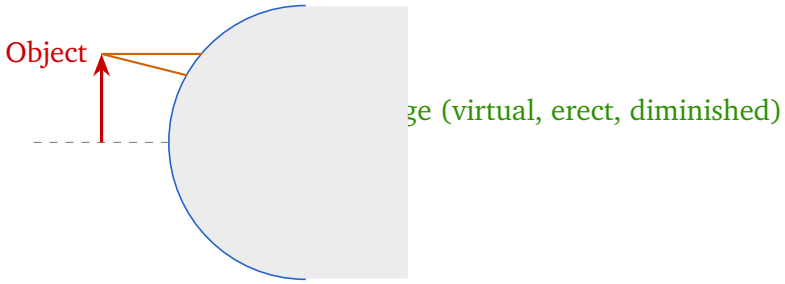
(A) Increases the amplitude of vibration

(B) Increases the frequency of vibration

(C) Decreases the speed of sound in the string

(D) Increases the wavelength of sound

Q11. An object is placed in front of a convex mirror. The image formed is:



(A) Real, inverted, and magnified

(B) Real, inverted, and diminished

(C) Virtual, erect, and diminished

(D) Virtual, erect, and of the same size

Q12. The speed of light in a certain medium is 2×10^8 m/s. The refractive index of the medium with respect to vacuum (speed of light in vacuum $= 3 \times 10^8$ m/s) is:

(A) 0.67

(B) 2.0

(C) 1.0

(D) 1.5

Q13. An electric bulb of resistance $100\,\Omega$ is connected to a 200 V supply. The power consumed by the bulb, using $P = V^2/R$, is:

(A) 400 W

(B) 200 W

(C) 2 W

(D) 20 000 W

Q14. Three resistors of $6\,\Omega$, $6\,\Omega$, and $6\,\Omega$ are connected in **parallel**. The equivalent resistance of the combination is:

(A) $6\,\Omega$

(B) $2\,\Omega$

(C) $18\,\Omega$

(D) $3\,\Omega$

Q15. A galvanometer can be converted into an ammeter by connecting a:

(A) High resistance in series with it

(B) High resistance in parallel with it

(C) Low resistance (shunt) in parallel with it

(D) Low resistance (shunt) in series with it

Detailed Solutions

Q1.

Solution

Concept: In horizontal projectile motion, horizontal and vertical motions are independent.

Step 1 — Time of flight. The ball falls height $H = 20\,\text{m}$ under gravity:

$$H = \tfrac{1}{2}gt^2 \implies 20 = \tfrac{1}{2} \times 10 \times t^2 \implies t^2 = 4 \implies t = 2\,\text{s}.$$

Step 2 — Horizontal range. No horizontal acceleration, so:

$$R = v_0 \times t = 10 \times 2 = \mathbf{20}\,\text{m}.$$

Why other options are wrong:

- (B) 10 m: Uses $t = 1\,\text{s}$ (only half the correct fall time).
- (C) 40 m: Doubles the correct answer, possibly forgetting the $\frac{1}{2}$ in the free-fall formula.
- (D) 200 m: Uses $t = 20\,\text{s}$ (confuses height value with time).

Final Answer: $R = 20\,\text{m}$.

Answer: (A) Go Back to Q 1

Q2.

Solution

Concept: The distance covered in the nth second is given by $s_n = u + a\left(n - \frac{1}{2}\right)$.

Here $u = 0$, $a = 4\,\text{m/s}^2$, $n = 4$:

$$s_4 = 0 + 4(4 - 0.5) = 4 \times 3.5 = \mathbf{14}\,\text{m}.$$

Verification using totals:

$$s(4\,\text{s}) = \tfrac{1}{2} \times 4 \times 16 = 32\,\text{m}; \quad s(3\,\text{s}) = \tfrac{1}{2} \times 4 \times 9 = 18\,\text{m}; \quad \Delta s = 14\,\text{m}.\checkmark$$

Why other options are wrong:

- (A) 16 m: Computes $\frac{1}{2}at^2$ with $t = 4$, which is the total distance, not the 4th-second distance.

- (C) 32 m: The total distance covered in 4 s, not just in the 4th second.
- (D) 28 m: Uses $n = 4$ in $s_n = 2an$ (an incorrect formula).

Final Answer: Distance in 4th second $= 14$ m.

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept: Instruments in a vehicle serve different purposes.

The **odometer** records the cumulative total distance a vehicle has travelled over its entire lifetime. It is usually embedded inside the speedometer cluster and shows a running total in kilometres (or miles).

Why other options are wrong:

- (A) Speedometer: Measures *current speed*, not total distance.
- (B) Accelerometer: Measures acceleration (rate of change of velocity).
- (D) Tachometer: Measures engine speed (revolutions per minute, RPM).

Final Answer: Odometer.

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept: On an inclined plane, the weight mg has two components — one perpendicular to the surface ($mg\cos\theta$) and one along (down) the surface ($mg\sin\theta$).

$$F_{\parallel} = mg\sin 30^\circ = 5 \times 10 \times 0.5 = \mathbf{25}\,\text{N}.$$

Why other options are wrong:

- (A) 50 N: This is mg itself (no angle applied).
- (B) $25\sqrt{3}$ N: This is $mg\cos 30^\circ$, the component *perpendicular* to the incline.
- (C) 43.3 N: Same as $mg\cos 30^\circ \approx 43.3$ N; wrong component.

Final Answer: $F_{\parallel} = 25$ N.

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept: Kinetic (sliding) friction $f_k = \mu_k N$, where N is the normal reaction and μ_k is the coefficient of kinetic friction.

$$f_k = \mu_k \times N = 0.25 \times 40 = \mathbf{10}\,\text{N}.$$

Why other options are wrong:

- (B) 40 N: The normal reaction itself, not friction.
- (C) 0.25 N: Only the coefficient, not multiplied by N.
- (D) 160 N: Uses $N/\mu_k = 40/0.25 = 160$ (inverted formula).

Final Answer: Frictional force $= 10\,\text{N}$.

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept: Weight $W = mg$, where g is the local gravitational acceleration.

$$W = 80 \times 3.7 = \mathbf{296}\,\text{N}.$$

Why other options are wrong:

- (A) 80 N: This is the mass in kg, not the weight.
- (C) 800 N: Uses Earth's $g = 10\,\text{m/s}^2$ instead of Mars's.
- (D) 370 N: Uses mass $= 100\,\text{kg}$ (incorrect).

Final Answer: Weight on Mars $= 296\,\text{N}$.

Answer: (B) Go Back to Q 6

Q7.

Solution

Concept: Archimedes' principle — for a floating body, weight of body = weight of fluid displaced.

Let the volume of the sphere be V and its density be ρ_s.

$$\rho_s V g = \rho_w \cdot \tfrac{V}{3} \cdot g \implies \rho_s = \frac{\rho_w}{3} = \frac{1000}{3} \approx \mathbf{333}\,\text{kg/m}^{\mathbf{3}}.$$

Why other options are wrong:

- (A) 1000 kg/m^3: Would mean the sphere is as dense as water (fully submerged, not floating).
- (B) 500 kg/m^3: Would correspond to half the volume submerged.
- (D) 3000 kg/m^3: Denser than water; the sphere would sink.

Final Answer: $\rho_{\text{sphere}} \approx 333\,\text{kg/m}^3$.

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept: Work-energy theorem: $W_{\text{net}} = \Delta KE$.

Step 1 — Change in KE:

$$\Delta KE = \tfrac{1}{2}mv^2 - \tfrac{1}{2}mu^2 = 0 - \tfrac{1}{2} \times 2 \times 36 = -36\,\text{J}.$$

Step 2 — Work done by retarding force:

$$W = -F \times d \implies -36 = -F \times 4 \implies F = \frac{36}{4} = \mathbf{9}\,\text{N}.$$

Why other options are wrong:

- (A) 3 N: Divides $\frac{1}{2}mu^2$ by d^2 (incorrect).
- (B) 36 N: Gives the change in KE directly as force, omitting division by distance.
- (C) 12 N: Uses $F = mu^2/(2d) = 2 \times 36/12 = 6$... or another arithmetic slip.

Final Answer: Retarding force $= 9\,\text{N}$.

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept: Efficiency $\eta = \dfrac{\text{Work output}}{\text{Work input}} \times 100\%$.

$$\text{Work output} = \text{Load} \times \text{load distance} = 1000 \times 2 = 2000\,\text{J}.$$

$$\text{Work input} = \text{Effort} \times \text{effort distance} = 500 \times 5 = 2500\,\text{J}.$$

$$\eta = \frac{2000}{2500} \times 100 = \mathbf{80\%}.$$

Why other options are wrong:

- (B) 50%: Incorrectly takes Effort/Load $= 500/1000$.
- (C) 40%: Inverts output and input.
- (D) 100%: A real machine always has losses; input $>$ output here.

Final Answer: Efficiency $= 80\%$.

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept: The pitch (note) of a string depends on its frequency of vibration. Frequency $\propto \sqrt{T}$, where T is the tension in the string.

Tightening the string **increases tension** $\Rightarrow$ **increases frequency** $\Rightarrow$ higher pitch (higher note).

Why other options are wrong:

- (A) Increases amplitude: Amplitude affects loudness, not pitch.
- (C) Decreases speed of sound: Speed of the wave in the string actually *increases* with tension.
- (D) Increases wavelength: Since $v = f\lambda$ and speed increases more than frequency, the net effect on λ is not a simple increase; but in any case, pitch is determined by frequency, not wavelength alone.

Final Answer: Tightening increases the frequency of vibration.

Answer: (B) Go Back to Q 10

Q11.

Solution

Concept: A convex mirror always produces a virtual, erect, and diminished image regardless of the position of the object.

The image is formed *behind* the mirror (between the pole P and the focus F), hence it is virtual and erect. Because the reflected rays diverge, the image is always smaller than the object (diminished).

Why other options are wrong:

- (A) Real, inverted, magnified: A convex mirror never forms real images.
- (B) Real, inverted, diminished: Real images require converging reflected rays; convex mirrors diverge rays.
- (D) Virtual, erect, same size: The image is smaller (diminished), not the same size.

Final Answer: Virtual, erect, and diminished.

Answer: (C) Go Back to Q 11

Q12.

Solution

Concept: Refractive index $n = \frac{c}{v}$, where c is the speed of light in vacuum and v is the speed of light in the medium.

$$n = \frac{3 \times 10^8}{2 \times 10^8} = \mathbf{1.5}.$$

Why other options are wrong:

- (A) 0.67: This is v/c (the reciprocal ratio), not the refractive index.
- (B) 2.0: Forgets the factor of 3 in the numerator; uses v as numerator.
- (C) 1.0: Would mean the speed is unchanged — only true for vacuum itself.

Final Answer: Refractive index $= 1.5$.

Answer: (D) Go Back to Q 12

Q13.

Solution

Concept: Electrical power $P = \dfrac{V^2}{R}$.

$$P = \frac{(200)^2}{100} = \frac{40\,000}{100} = \mathbf{400}\,\text{W}.$$

Why other options are wrong:

- (B) 200 W: Uses $P = V/R$ (missing the square on V).
- (C) 2 W: Uses $P = R/V^2$ (completely inverted).
- (D) 20 000 W: Uses $P = V^2 \times R = 40\,000 \times 100$ (multiplies instead of divides).

Final Answer: Power consumed $= 400\,\text{W}$.

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept: For resistors in parallel, $\dfrac{1}{R_{\text{eq}}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$.

$$\frac{1}{R_{\text{eq}}} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2} \implies R_{\text{eq}} = \mathbf{2\,\Omega}.$$

Why other options are wrong:

- (A) 6 Ω: This is the resistance of a single resistor, not the parallel combination.
- (C) 18 Ω: This is the series combination $(6 + 6 + 6)$, not parallel.
- (D) 3 Ω: Off by a factor of $\frac{3}{2}$; possibly uses R/n with wrong n.

Final Answer: $R_{\text{eq}} = 2\,\Omega$.

Answer: (B) Go Back to Q 14

Q15.

Solution

Concept: A galvanometer has a very small full-scale deflection current. To measure large currents (ammeter), most of the current must bypass the coil through a parallel path.

A **low resistance (shunt) is connected in parallel** with the galvanometer. Most of the current flows through the shunt, while only a small fraction passes through the sensitive coil, protecting it and extending the range.

Why other options are wrong:

- (A) High resistance in series: This converts a galvanometer into a *voltmeter*, not an ammeter.
- (B) High resistance in parallel: A high parallel resistance would not divert enough current away from the coil.
- (D) Low resistance in series: Adding resistance in series reduces the current through the meter and decreases sensitivity; this does not make an ammeter.

Final Answer: Low resistance (shunt) in parallel.

Answer: (C) Go Back to Q 15

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
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