TALLENTEX Physics

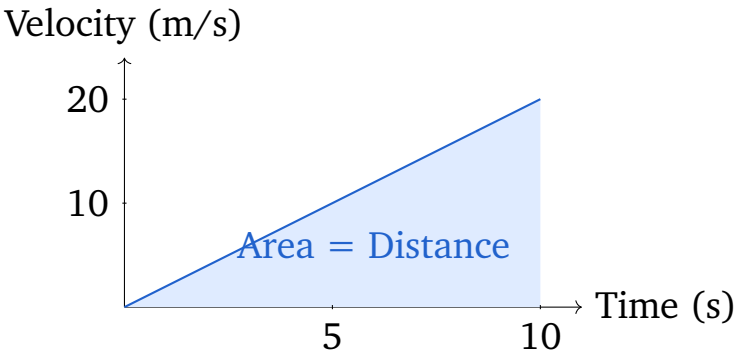
Sample Paper – 1

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.

Q1. The velocity-time graph of a body starting from rest is shown in the figure. The total distance covered by the body in 10 seconds is:



(A) 100 m

(B) 200 m

(C) 50 m

(D) 150 m

Q2. Train A moves at 60 km/h and train B moves at 40 km/h in the same direction on parallel tracks. The speed of train B as observed by a passenger sitting in train A is:

(A) 100 km/h

(B) 20 km/h

(C) 40 km/h

(D) 60 km/h

Q3. A car has a velocity of 10 m/s at $t = 0$ and 30 m/s at $t = 4\,\text{s}$. Its acceleration is:

(A) $10\,\text{m/s}^2$

(B) $7.5\,\text{m/s}^2$

(C) $5\,\text{m/s}^2$

(D) $2.5\,\text{m/s}^2$

Q4. A passenger in a moving bus tends to fall forward when the driver applies sudden brakes. This happens because of:

(A) Friction between the passenger and the seat

(B) Gravitational pull of the Earth

(C) The bus exerts a backward force on the passenger

(D) Inertia of motion of the passenger's body

Q5. A body of mass 4 kg moving with velocity 6 m/s collides with and sticks to a stationary body of mass 2 kg. Their common velocity after collision is:

(A) 4 m/s

(B) 6 m/s

(C) 2 m/s

(D) 3 m/s

Q6. The acceleration due to gravity g on the surface of a planet of mass M and radius R is given by: (where G is the universal gravitational constant)

(A) $g = \dfrac{GM}{R}$

(B) $g = \dfrac{GM}{R^2}$

(C) $g = \dfrac{G}{MR^2}$

(D) $g = GMR$

Q7. A stone is dropped from a height of 45 m. Taking $g = 10\,\text{m/s}^2$, the time taken by the stone to reach the ground is:

(A) 2 s

(B) 4 s

(C) 3 s

(D) $\sqrt{5}$ s

Q8. A person carries a heavy box horizontally on his head and walks 10 m on a level ground at constant velocity. The work done by gravity on the box is:

(A) 50 J

(B) 100 J

(C) Negative

(D) Zero

Q9. A 5 kg object is lifted to a height of 3 m above the ground. Taking $g = 10\,\text{m/s}^2$, the gravitational potential energy gained by the object is:

(A) 150 J

(B) 300 J

(C) 50 J

(D) 75 J

Q10. A sound wave travels through air at a speed of 340 m/s and has a wavelength of 0.85 m. Its frequency is:

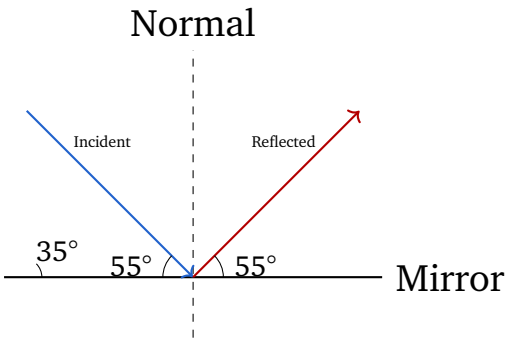
(A) 289 Hz

(B) 400 Hz

(C) 500 Hz

(D) 340 Hz

Q11. The figure shows a ray of light striking a plane mirror. The angle between the incident ray and the mirror surface is 35. According to the laws of reflection, the angle of reflection is:



(A) 35

(B) 70

(C) 55

(D) 90

Q12. A concave mirror has a focal length of 10 cm. An object is placed 30 cm in front of the mirror. Using the mirror formula $\left(\frac{1}{v}+\frac{1}{u}=\frac{1}{f}\right)$, the image is formed at:

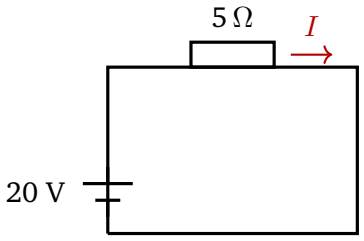
(A) 20 cm behind the mirror

(B) 30 cm in front of the mirror

(C) 10 cm behind the mirror

(D) 15 cm in front of the mirror

Q13. The figure shows a simple electric circuit. The current through the resistor is:



(A) 4 A

(B) 2 A

(C) 0.25 A

(D) 100 A

Q14. A charge of 120 C flows through a conductor in 60 seconds. The electric current through the conductor is:

(A) 7200 A

(B) 2 A

(C) 0.5 A

(D) 60 A

Q15. A long straight wire carries electric current directed from left to right ($\rightarrow$) in the plane of the paper. The direction of the magnetic field at a point P directly above the wire is:

(A) Into the page

(B) Downward

(C) Out of the page

(D) Upward

Detailed Solutions

Q1.

Solution

Concept — Motion (v-t graph): The area enclosed between the velocity-time graph and the time axis gives the total distance covered by the body.

Step 1 — Identify the shape: The graph is a straight line from the origin $(0, 0)$ to $(10\,\text{s},\ 20\,\text{m/s})$, forming a right-angled triangle with the time axis.

Step 2 — Calculate the area:

$$\text{Distance} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 10\,\text{s} \times 20\,\text{m/s} = \boxed{100\,\text{m}}$$

Why other options are wrong:

- Option B (200 m): Uses the full rectangle area $10 \times 20 = 200$ instead of the triangle.
- Option C (50 m): Halves the result again without justification, giving $\frac{1}{2} \times 50 = 25$ or uses wrong dimensions.
- Option D (150 m): Arithmetic error, no correct geometric interpretation gives this value.

Final Answer: Distance = 100 m $\Rightarrow$ A

Answer: (A) Go Back to Q 1

Q2.

Solution

Concept — Relative Velocity: When two objects move in the same direction, the velocity of one object relative to the other is the difference of their velocities.

Step 1 — Apply the formula:

$$v_{B\,\text{relative to}\,A} = v_B - v_A = 40\,\text{km/h} - 60\,\text{km/h} = -20\,\text{km/h}$$

The magnitude is $20\,\text{km/h}$. The negative sign means train B appears to move backward relative to train A.

Why other options are wrong:

- Option A (100 km/h): Sum of speeds, applicable only when trains move in

opposite directions.

- Option C (40 km/h): Speed of train B in the ground frame, not relative to train A.
- Option D (60 km/h): Speed of train A in the ground frame.

Final Answer: Relative speed = 20 km/h $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept — Acceleration: Acceleration is defined as the rate of change of velocity with time.

Step 1 — Apply the formula:

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t} = \frac{30\,\text{m/s} - 10\,\text{m/s}}{4\,\text{s}} = \frac{20}{4} = \boxed{5\,\text{m/s}^2}$$

Why other options are wrong:

- Option A ($10\,\text{m/s}^2$): Divides 30 by 3 instead of using the change in velocity.
- Option B ($7.5\,\text{m/s}^2$): Takes average of speeds $(10+30)/2 \div$ something incorrectly.
- Option D ($2.5\,\text{m/s}^2$): Divides the final velocity by $t \times 2$, an incorrect approach.

Final Answer: Acceleration = 5 m/s^2 $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept — Newton's First Law (Inertia of Motion): A body in motion tends to remain in motion unless acted upon by an external force. This property is called inertia of motion.

Step 1 — Analyse the situation: When the bus suddenly brakes, the bus decelerates. However, the passenger's body was in motion with the bus and, due to inertia, tends to continue moving forward at the same speed.

Step 2 — Identify the correct cause: The passenger lurches forward because of

the **inertia of motion** of the passenger's body, not because of any forward force applied by the bus.

Why other options are wrong:

- Option A (Friction): Friction between seat and passenger actually opposes forward sliding; it is not the cause.
- Option B (Gravity): Gravity acts downward and has no role in the forward lurch.
- Option C (Bus exerts backward force): The bus decelerates, but this acts on the seat, not directly pushing the passenger forward.

Final Answer: Inertia of motion $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q 4

Q5.

Solution

Concept — Conservation of Linear Momentum: In a closed system with no external forces, the total momentum before collision equals the total momentum after collision.

Step 1 — Calculate initial momentum:

$$p_i = m_1 v_1 + m_2 v_2 = 4\,\text{kg} \times 6\,\text{m/s} + 2\,\text{kg} \times 0 = 24\,\text{kg m/s}$$

Step 2 — Apply conservation after perfectly inelastic collision:

$$p_f = (m_1 + m_2)\, v = (4 + 2)\, v = 6v$$

$$6v = 24 \implies v = \frac{24}{6} = \boxed{4\,\text{m/s}}$$

Why other options are wrong:

- Option B (6 m/s): Ignores the second body's mass, treating the system as if only the first body moves.
- Option C (2 m/s): Uses wrong total mass or wrong momentum value.
- Option D (3 m/s): Divides total momentum by 8 instead of 6.

Final Answer: Common velocity = 4 m/s $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept — Acceleration due to Gravity: Derived from Newton's Law of Universal Gravitation combined with Newton's Second Law.

Step 1 — Set up the equations:

$$F_{\text{gravity}} = \frac{GMm}{R^2}, \qquad F = mg$$

Step 2 — Equate and solve for g:

$$mg = \frac{GMm}{R^2} \implies g = \frac{GM}{R^2}$$

Why other options are wrong:

- Option A (GM/R): Missing the square on R; this would be proportional to escape speed squared.
- Option C (G/MR^2): Mass M is in the denominator instead of numerator.
- Option D (GMR): Multiplies instead of divides by R^2; dimensionally inconsistent.

Final Answer: $g = \dfrac{GM}{R^2} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 6

Q7.

Solution

Concept — Free Fall Kinematics: For a body dropped from rest, the equation of motion under gravity is $h = \frac{1}{2}gt^2$.

Step 1 — Solve for time:

$$h = \frac{1}{2}gt^2 \implies t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 45}{10}} = \sqrt{\frac{90}{10}} = \sqrt{9} = \boxed{3\,\text{s}}$$

Why other options are wrong:

- Option A (2 s): Corresponds to $h = \frac{1}{2} \times 10 \times 4 = 20\,\text{m}$, not 45 m.
- Option B (4 s): Corresponds to $h = \frac{1}{2} \times 10 \times 16 = 80\,\text{m}$, not 45 m.
- Option D ($\sqrt{5}$ s): Approximately 2.24 s, which does not satisfy the equation

for $h = 45\,\text{m}$.

Final Answer: Time = 3 s $\Rightarrow$ C

Answer: (C) Go Back to Q 7

Q8.

Solution

Concept — Work Done by a Force: $W = F \cdot s \cdot \cos\theta$, where θ is the angle between the force and the direction of displacement.

Step 1 — Identify the angle: Gravity acts *vertically downward*. The displacement of the box is *horizontal*. The angle between them is $\theta = 90$.

Step 2 — Calculate work:

$$W = mg \times s \times \cos 90 = mg \times s \times 0 = \boxed{0\,\text{J}}$$

Why other options are wrong:

- Option A (50 J) and B (100 J): Assume gravity does positive work, ignoring the perpendicular geometry.
- Option C (Negative): Work would be negative only if the displacement had a downward component, which it does not here.

Final Answer: Work done by gravity = Zero $\Rightarrow$ D

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept — Gravitational Potential Energy: The energy stored in an object due to its height above the ground is given by $PE = mgh$.

Step 1 — Substitute values:

$$PE = mgh = 5\,\text{kg} \times 10\,\text{m/s}^2 \times 3\,\text{m} = \boxed{150\,\text{J}}$$

Why other options are wrong:

- Option B (300 J): Uses $h = 6\,\text{m}$ or doubles the result incorrectly.

- Option C (50 J): Divides by mass ($g \times h = 30$, then divides by an extra factor).
- Option D (75 J): Halves the correct answer without justification.

Final Answer: PE = 150 J $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept — Wave Speed Relation: The relationship between speed, frequency, and wavelength is $v = f\lambda$.

Step 1 — Solve for frequency:

$$f = \frac{v}{\lambda} = \frac{340\,\text{m/s}}{0.85\,\text{m}} = \boxed{400\,\text{Hz}}$$

Why other options are wrong:

- Option A (289 Hz): Multiplies $340 \times 0.85 = 289$ instead of dividing.
- Option C (500 Hz): Uses an incorrect wavelength of 0.68 m.
- Option D (340 Hz): Confuses frequency with wave speed.

Final Answer: Frequency = 400 Hz $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 10

Q11.

Solution

Concept — Laws of Reflection: The angle of incidence equals the angle of reflection, where both angles are measured with respect to the *normal* to the mirror surface, not the mirror itself.

Step 1 — Find the angle of incidence:

$$\text{Angle between ray and mirror} = 35 \implies \text{Angle of incidence} = 90 - 35 = 55$$

Step 2 — Apply the law of reflection:

$$\text{Angle of reflection} = \text{Angle of incidence} = \boxed{55}$$

Why other options are wrong:

- Option A (35): Confuses angle with mirror surface for the angle with the normal.
- Option B (70): Doubles the mirror angle (2×35) without physical justification.
- Option D (90): The angle of incidence is 90 only for normal incidence, not here.

Final Answer: Angle of reflection = 55° $\Rightarrow$ C

Answer: (C) Go Back to Q 11

Q12.

Solution

Concept — Mirror Formula with Sign Convention: Using the New Cartesian sign convention, distances measured in the direction of incident light are positive; those opposite are negative. For a concave mirror: $u < 0$, $f < 0$.

Step 1 — Assign values:

$$u = -30\,\text{cm}, \quad f = -10\,\text{cm}$$

Step 2 — Apply mirror formula:

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{-30} = -\frac{1}{10} + \frac{1}{30} = \frac{-3+1}{30} = \frac{-2}{30}$$

$$v = -15\,\text{cm}$$

The negative sign means the image is **in front of the mirror** (real image), at 15 cm.

Why other options are wrong:

- Option A (20 cm behind): Incorrect sign convention or arithmetic.
- Option B (30 cm in front): Happens when object is at $2f$, but here $u = -30 = 3f$, so image is at -15 cm.
- Option C (10 cm behind): Confuses image position with focal length.

Final Answer: Image at 15 cm in front of mirror $\Rightarrow$ D

Answer: (D) Go Back to Q 12

Q13.

Solution

Concept — Ohm's Law: The current through a conductor is directly proportional to the voltage across it and inversely proportional to its resistance: $I = V/R$.

Step 1 — Substitute values:

$$I = \frac{V}{R} = \frac{20\,\text{V}}{5\,\Omega} = \boxed{4\,\text{A}}$$

Why other options are wrong:

- Option B (2 A): Uses $R = 10\,\Omega$ or halves incorrectly.
- Option C (0.25 A): Inverts the formula, calculating $R/V = 5/20$.
- Option D (100 A): Multiplies $V \times R = 20 \times 5$, incorrectly applying the formula.

Final Answer: Current = 4 A $\Rightarrow$ A

Answer: (A) Go Back to Q 13

Q14.

Solution

Concept — Electric Current: Current is defined as the rate of flow of electric charge: $I = Q/t$.

Step 1 — Substitute values:

$$I = \frac{Q}{t} = \frac{120\,\text{C}}{60\,\text{s}} = \boxed{2\,\text{A}}$$

Why other options are wrong:

- Option A (7200 A): Multiplies $Q \times t = 120 \times 60$ instead of dividing.
- Option C (0.5 A): Inverts the fraction, calculating $t/Q = 60/120$.
- Option D (60 A): Drops the denominator and uses $Q/2$ or just the time value.

Final Answer: Current = 2 A $\Rightarrow$ B

Answer: (B) Go Back to Q 14

Q15.

Solution

Concept — Right-Hand Thumb Rule: For a straight current-carrying conductor, if the right-hand thumb points in the direction of conventional current, the curled fingers indicate the direction of the magnetic field lines around the wire.

Step 1 — Apply the rule: Current flows to the right ($\rightarrow$). Point the right-hand thumb to the right. The fingers curl:

- Above the wire: fingers point **out of the page** ($\odot$)
- Below the wire: fingers point **into the page** ($\otimes$)

Step 2 — Answer: At point P directly above the wire, the magnetic field is directed **out of the page**.

Why other options are wrong:

- Option A (Into the page): Correct for a point *below* the wire, not above.
- Option B (Downward): The magnetic field of a straight wire forms circular loops; it cannot be simply up or down at a point beside/above the wire.
- Option D (Upward): Same reasoning as B; not a valid direction for the field here.

Final Answer: Out of the page $\Rightarrow$ $\boxed{\text{C}}$

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