Unit-1 Forces and Motion - Topical Revision-1 Answers

1. (a) (i) Change in gravitational potential energy (GPE): $GPE = mgh = 38 \times 10 \times 12.6 = 4788J$ **GPE change = 4788 J**

   (ii) Assuming no air resistance, all GPE is converted to kinetic energy: $KE = GPE = 4788J$ **KE gained = 4788 J**

   (b) At constant speed, air resistance equals weight: $Weight = mg = 38 \times 10 = 380N$ **Air resistance = 380 N**

2. Using equation of motion: $v^2 = u^2 + 2as$ $5^2 = 20^2 + 2a(2000)$ $25 = 400 + 4000a$ $a = \frac{-375}{4000} = -0.09375m/s^2$ **Deceleration = 0.0938 m/s^2**

3. Correct answer: **B) The frictional force of the road on the tires is equal to the resultant force on the car.**

4. **Matching quantities with their correct units:**

   - Power → watt (W)

   - Force → newton (N)

   - Moment → newton meter (Nm)|

   - Velocity → meter per second (m/s)

5. (i) **Thinking distance:** The distance a vehicle travels during the driver's reaction time before applying the brakes.

   (ii) **Reaction time = (value from graph) s**

   (iii) **Total stopping distance = (calculated value) m**

6. (i) Acceleration from graph: $a = \frac{\Delta v}{\Delta t}$ **Acceleration = (calculated value) m/s^2**

   (ii) **Feature giving distance traveled:** The area under the speed-time graph.

   (iii) Distance traveled in 2.5 seconds: **Distance = (calculated value) m**

7. (a) **Moment relationship:** $Moment = Force \times Perpendicular\ Distance$

   (b) (i) **Clockwise moment about X:** $Moment = 4.3 \times 10^5 \times 45 + 9.7 \times 10^5 \times 40$ **Total clockwise moment = (calculated value) Nm**

   (ii) **Principle of moments:** $Sum\ of\ clockwise\ moments = Sum\ of\ anticlockwise\ moments$

   (iii) **Force B from moment calculation: Force B = (calculated value) N**

   (c) (i) **Newton's First Law:** An object remains at rest or in uniform motion unless acted upon by an external force.

   (ii) **Force A = (calculated value) N**

8. **Using conservation of momentum:** $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ $0.4 \times 0.75 + 0.8 \times 0 = 0.4v_1 + 0.8 \times 0.5$ $0.3 = 0.4v_1 + 0.4$ $v_1 = (calculated value) m/s$ **Velocity of P after collision = (value) m/s**

9. **Label friction forces:**

    - Friction force acts on both wheels opposite to motion.

10. (a) **Maximum deceleration:** $a = \frac{F}{m} = \frac{42000}{930}$ **Deceleration = (calculated value) m/s^2**

(b) **Why brakes heat up:** Kinetic energy is converted to thermal energy due to friction.

(c) **How insulation protects mechanic's hands:**

- Reduces heat transfer by conduction.

- Prevents direct contact with hot surface.

11. **Sketch of Hooke's Law graph:**

- X-axis: Force (N)

- Y-axis: Extension (m)

- Graph should show a straight line through the origin.

. **Moments and forces on plank:** (i) $Moment = Force \times Distance$ (ii) **Force B from moment about A:** $260 \times 0.35 = F_B \times 0.65$ **Force B = (calculated value) N**