Class 11 Physics Laws of Motion Test

Class 11 Physics Test: Laws of Motion
Time Allowed: 1 Hour | **Total Marks:** 30
Topics Covered: Chapter–4: Laws of Motion (Newton's Laws, momentum, impulse, conservation of linear momentum, concurrent forces, static and kinetic friction, dynamics of circular motion, level and banked roads)

SECTION A: 1-Mark Questions (Conceptual and Numerical)
(Answer all questions. Each question carries 1 mark. Select the correct option.)

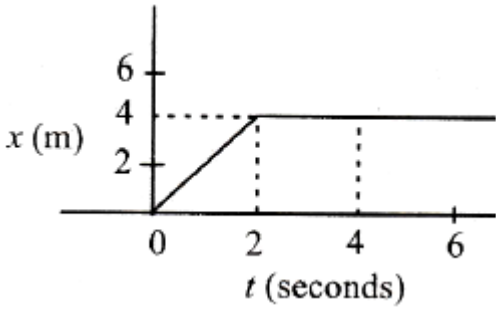
Q1. Which of the following is known as the law of inertia?
(A) Newton’s first law of motion
(B) Newton’s second law of motion
(C) Newton’s third law of motion
(D) Law of conservation of mass

Q2. A car moves at a speed of 20 m/s on a banked road and describes an arc of a circle of radius $40\sqrt{3}$ m. The angle of banking in degrees is ($g = 10$ m/s^2):
(A) 25
(B) 60
(C) 30
(D) 45

Q3. Sand is being dropped on a conveyor belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity v m/s will be:
(A) Mv
(B) 2 Mv
(C) Mv/2
(D) zero

Q4. The proper use of lubricants cannot reduce:
(A) Static friction
(B) Inertia
(C) Sliding friction
(D) Rolling friction

Q5. In the figure given, the position-time graph of a particle of mass 0.1 kg is shown. The impulse at t = 2s is:



(A) 0.2 kg–m/s
(B) -0.2 kg–m/s
(C) 0.1 kg–m/s
(D) -0.4 kg–m/s

SECTION B: 2-Mark Questions (Conceptual)
(Answer all questions. Each question carries 2 marks.)

Q6. What do you understand by impulse? Use it to explain why a cricket player lowers his hands while catching a ball.

Q7. Explain why static friction is called a self-adjusting force.

SECTION C: 3-Mark Questions (Conceptual, Derivation, and Numerical)
(Answer all questions. Each question carries 3 marks.)

Q8. Why does a cyclist lean inward when moving along a curved path? Determine the angle through which the cyclist bends from the vertical to negotiate a curve.

Q9. A bullet of mass 100g moving with 20 m/s strikes a wooden plank and penetrates up to 20 cm. Calculate the resistance (reaction force) offered by the wooden plank.

Q10. Find the maximum speed at which a car can take turns around a curve of a 30m radius on a level road, if the coefficient of friction between tires and road is 0.4.

Q11. A vehicle is moving on a horizontal road with speed v. If the coefficient of friction between the tyres and the road is μ, show that the shortest distance in which the vehicle can be stopped is $s = \frac{v^2}{2\mu g}$.

SECTION D: 4-Mark Case-Study Based Question
(Read the text carefully and answer the questions that follow. Each sub-question carries 1

mark.)

Q12. When a car negotiates a curved road, the force of friction between the road and the tyres provides the centripetal force required to keep the car in motion around the curve. A large amount of friction between the tyres and the road produces considerable wear and tear on the tyres. To avoid dependence on friction, the curved road is given an inclination sloping upwards towards the outer circumference. This reduces the wearing of the tyres because the horizontal component of the normal reaction provides the necessary centripetal force. The system of raising the outer edge of a curved road above the inner edge is called the banking of the curved road. The maximum safe velocity of a vehicle on a banked road depends on the radius of the turn, acceleration due to gravity, the angle of banking, and the coefficient of friction between the tyres and the road.

(i) If the radii of circular paths of two particles of the same mass are in the ratio of 16:25, then to have a constant centripetal force, their velocities should be in a ratio of:
(A) 3:2
(B) 4:1
(C) 4:5
(D) 2:3

(ii) The maximum speed with which a car can be driven round a curve of radius 16m without skidding (when g = 10 m/s² and the coefficient of friction between rubber tyres and the roadway is 0.4) is:
(A) 8 m/s
(B) 10 m/s
(C) 6 m/s
(D) 4 m/s

(iii) A body moves along a circular path of radius 1m and the coefficient of friction is 0.225. What should be its angular speed in rad/s if it is not to slip from the surface (take g = 10 m/s²)?
(A) 1.5 rad/s
(B) 0.5 rad/s
(C) 3.5 rad/s
(D) 2.0 rad/s

(iv) The force which is acting as a centripetal force when a vehicle takes a circular turn on a level road is:
(A) Normal reaction
(B) Frictional force
(C) Components of normal force
(D) None of the above

SECTION E: 5-Mark Question (Derivation)
(This question carries 5 marks.)

Q13. What is meant by the banking of roads? Explain the need for it. Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at angle θ. The coefficient of friction between the road and wheels is μ.
