Sample Question Paper. PHY401. 24th August 2024. Time : 20 Minutes. Marks : 5

Name : ..... Roll number : .....

• This paper has 1 page and 5 questions in total. Each question carries 1 mark.
• Steps leading to your answer must be shown systematically **in the copy provided separately**. Any answer that has been entered but working has not been shown in the copy will attract penalty.
• For each question, please give **only** a **numerical answer rounded off to the number of decimal places asked**, and **only in the corresponding answer box provided with each question**. Answer to a given question written anywhere else or in a wrong box will not be considered.

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1) A ball with moment of inertia $mr^2/2$ rests on top of a fixed sphere of large radius. There is friction between the ball and the sphere. The ball is given an infinitesimal kick, and it rolls down without slipping.The ball loses contact with the sphere when the line joining its center of mass to the center of mass of the sphere makes an angle θ with the vertical. If $\cos\theta = 4/n$, what is the value of n ?

Ans 1: [ ]

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2) A cone rolls without slipping on horizontal floor. The half-angle at its vertex is $\alpha = 45^0$ and the height of its axis is h. The speed of the center of the base of the cone with respect to the ground is v. The angular speed of the cone with respect to the ground is nv/h. What is the value of n, up to 2 decimal places ?

Ans 2: [ ]

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3) The point of suspension of a simple pendulum of mass 0.5 Kg and length 2 m oscillates horizontally with position given by $x = 2\cos(5t)$. The angular position of the pendulum (measured with respect to a vertical axis passing through $x = 0$) at time $t = \pi/5$ is n. What is the value of n up to 2 decimal places ?

Ans 3: [ ]

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4) A particle of mass 0.1 Kg slides down a frictionless inclined plane of mass 2 Kg. The plane makes an angle of 60^0 with the horizontal and is itself on frictionless horizontal surface. If the particle starts to roll down the plane at $t = 0$, the speed of the plane at $t = 1$ sec is n m/sec. What is the value of n ?

Ans 4: [ ]

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5) Consider the fixed points of the system $\dot{x} = -x + x^3$, $\dot{y} = -3y$. Upon linearisation, it is found that at the stable node, the ratio of the larger eigenvalue to the smaller eigenvalue of the Jacobian matrix is n. What is the value of the magnitude of n ?

Ans 5: [ ]
