DEPARTMENT OF PHYSICS
Indian Institute of Technology Kharagpur
Classical Mechanics-I
Course: PH20007
Assignment-9: Assignment-9 (Rigid body dynamics-4 and Lagrangian-1)

1. For heavy symmetric top to sleep, for the function $f(u)$
(a) Two of the physical roots must lie between 1 and infinity
(b) All three roots must lie between 0 and 1
(c) Two roots must be at zero and third root at 1
(d) Two roots must be at 1 and third root between 1 and infinity

2. The condition for "sleeping top" is
(a) $\omega_z^2 \geq \frac{4mglI_1}{I_3^3}$
(b) $\omega_z^2 \leq \frac{4mglI_1}{I_3^3}$
(c) $\omega_z^3 \geq \frac{4mglI_1}{I_3^3}$
(d) $\omega_z^3 \leq \frac{4mglI_1}{I_3^3}$

3. If in some mechanical system equations do not explicitly depend on time, then the constraint can said to be
(a) Holonomic
(b) Rheonomic
(c) Scleronomic
(d) Dissipative

4. Principal of virtual work states
(a) In any virtual displacement, the total work done by the forces of constraint is zero
(b) In any virtual displacement, the total work done by the forces of constraint is non-zero
(c) For any external forces, the total work done by the forces of constraint is zero
(d) None of the above are true

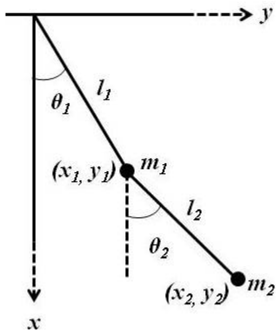
5. After removal of constrains, application of D$'$ Alemberts principle provides
(a) Full solution of the dynamical problem
(b) A single, coupled equation of motion
(c) Set of equations of motion
(d) A set of boundary conditions of motion

6. For a set of generalised co-ordinates, which one of the following is not true
(a) Their values determine the configuration of the system
(b) They may be varied arbitrarily and independently of each other, without violating the constraints of the system
(c) There is no uniqueness in the choice of generalised co-ordinates i.e. choice should be a set

of co-ordinates that will give a reasonable mathematical simplification of the problem
(d) A set of generalised co-ordinates is a unique set of co-ordinates to describe the configuration of the system

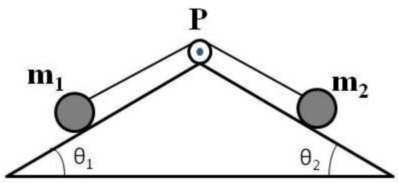
7. The motion of a particle of mass m is constrained to move on an ellipse. Which set of generalised co-ordinates is required to specify the motion of the particle
(a) x and y
(b) r and θ
(c) θ
(d) x, y and θ

8. The transformation equation for the system (see figure) is



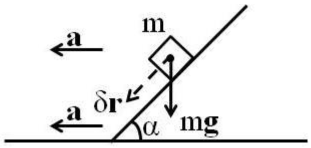
(a) $(x_1, y_1) = (l_1\ cos\ \theta_1, l_1\ sin\ \theta_1)$ and $(x_2, y_2) = (l_1\ cos\ \theta_1 + l_2\ cos\ \theta_2, l_1\ sin\ \theta_1 + l_2\ sin\ \theta_2)$
(b) $(x_1, y_1) = (l_1\ sin\ \theta_1, l_1\ sin\ \theta_1)$ and $(x_2, y_2) = (l_1\ sin\ \theta_1 + l_2\ sin\ \theta_2, l_1\ sin\ \theta_1 + l_2\ sin\ \theta_2)$
(c) $(x_1, y_1) = (l_1\ cos\ \theta_1, l_1\ sin\ \theta_1)$ and $(x_2, y_2) = (l_1\ cos\ \theta_1 - l_2\ cos\ \theta_2, l_1\ sin\ \theta_1 - l_2\ sin\ \theta_2)$
(d) $(x_1, y_1) = (l_1\ cos\ \theta_1, l_1\ cos\ \theta_1)$ and $(x_2, y_2) = (l_1\ sin\ \theta_1 + l_2\ cos\ \theta_2, l_1\ cos\ \theta_1 + l_2\ sin\ \theta_2)$

9. Two unequal masses m_1 and m_2 are constrained to move on two smooth inclined planes and they are connected by an inextensible string which passes over a fixed smooth pully P as shown in figure. The condition of equilibrium is



(a) $m_1\ sin\ \theta_2 = m_2\ sin\ \theta_1$
(b) $m_1\ cos\ \theta_1 = m_2\ cos\ \theta_2$
(c) $m_1\ cos\ \theta_2 = m_2\ cos\ \theta_1$
(d) $m_1\ sin\ \theta_1 = m_2\ sin\ \theta_2$

10. An incline that makes an angle α with the horizontal is given a horizontal acceleration of magnitude a in the vertical plane of the incline, as shown in figure, in order to prevent the sliding of any frictionless block placed on the incline. The value of a is



(a) $tan\ \alpha$
(b) $g\ tan\ \alpha$
(a) $\frac{1}{3}g\ tan\alpha$
(a) $cos\ \alpha$

End