Rotation
Assignment 1

Question
Three bodies A(ring) ,B(Solid cylinder) ,C (solid sphere) rolls down the same inclined plane of angle α and height H with out slipping.
The radii of the bodies are identical and equal to R.The mass of the bodies are M_1, M_2, M_3 respectively. The relation in the masses is given as below
$M_1 > M_2 > M_3$

1 Statement I: The velocity of the center of mass of the bodies at the bottom of the incline plane is dependent on the mass of the bodies
Statement II: The total kinetic energy(Translation + Rotational) will be largest for the body A at the bottom of the inclined plane
a) Statement I is true only
b) Statement II is true only
c) Both the statements are true
d) Both of them are false

2. Which one will have largest center of mass velocity at the bottom of the incline plane
a) A
b) B
c) C
d) Data insufficient

3 Which one will have least center of mass velocity at the bottom of the incline plane
a) A
b) B
c) C
d) Data insufficient

4 At any time during the motion, the velocity of the point in contact of the body with the incline plane
a) 0
b) $2v_{cm}$
c) v_{cm}
d) None of the above

5 At any time during the motion, the velocity of the uppermost point of the body
a) 0
b) $2v_{cm}$
c) v_{cm}
d) None of the above

6 The angular velocity will be maximum at the bottom of the incline place for the body

a) A
b) B
c) C
d) Data insufficient

Question
A nearly mass less rod (AB) of Length L is pivoted at one end A so that it can swing free as a pendulum. Three masses A(m) ,B(2m) and C(3m) are attached to it at the distance L/4,L/3 and L/2 respectively from end A. The rod is held horizontal and then it is released

7 Find the Moment of the Inertia of system about the pivoted end

a) $I = \frac{mL^2}{144}$

b) $I = \frac{14mL^2}{144}$

c) $I = \frac{151mL^2}{144}$

d) $I = \frac{149mL^2}{144}$

8 Find the angular acceleration of the rod at the instant it is release

a) $\alpha = \frac{348g}{14L}$

b) $\alpha = \frac{348g}{19L}$

c) $\alpha = \frac{34g}{149L}$

d) $\alpha = \frac{348g}{149L}$

Question
A projectile of mass m is fired from point O(origin) with an initial velocity u at angle θ above the horizontal

9 Find the X,Y,Z component of the angular momentum of the projectile as a function of time about the origin

a) $0,0,\frac{-mgut^2\cos\theta}{2}$

b) $0,0,\frac{mgut^2\cos\theta}{2}$

c) $0,u^2\cos\theta t,-mgut^2$

d) $0, u^2 \sin\theta t, -mgut^2$

10 Calculate the torque of the weight acting on the projectile about the origin
a) mgucos θ t **k**
b) - mgucos θ t **k**
c) - mgucos θ t **j**
d) none of these

11 Position vector of a body of mass 6 kg is given by as
r = **i**($3t^2$-6t) + **j**($-4t^3$) m
Find the torque acting on it about the origin
a) **k**($-288t^3$+864 t^2)
b) **k**($-288t^3$-864 t^2)
c) 288 **i** + $864t^2$ **j**
d) None of these

Question
A rod of length L and mass M can freely rotate around a pivot at A. A bullet of mass m and velocity v hit the rod at a height h from A and becomes imbedded in it

12. Find the angular velocity of the Rod just after the collision
a) $\frac{mvh}{mh^2 + ML^2}$
b) $\frac{mvh}{mh^2 + \frac{1}{3}ML^2}$
c) $\frac{mvh}{mh^2 + \frac{1}{2}ML^2}$
d) None of these

13 Find the linear momentum of the system just after the collision if ω is the angular velocity just after the collision
a)(mh+ML/2) ω
b) (mh+ML) ω
c) (mh+ML/3) ω
d) None of these

Question

An upright hoop is projected on a pavement with a initial horizontal speed v_0 but with out spin so that its slide. The resulting frictional force causes the hoop to spin to loose translational speed and to acquire an angular speed. Eventually the hoop rolls without slipping and let μ be the coefficient of friction

14 Find the time taken by the hoop to start rolling with out slipping
a) $v_0/2\ \mu g$
b) $v_0/2\ g$
c) $v_0/\ \mu g$
d) None of these

15 Find the velocity of the hoop at no slipping
a) $v_0/2$
b) $3\ v_0/2$
c) $v_0/4$
d) None of these

Answers
1) d
2) c
3) a
4) a
5) b
6) c
7) d
8) d
9) a
10) b
11) a
12) b
13) a
14) a
15) a