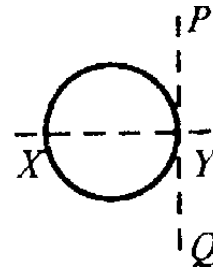


S6 Physics Rotational dynamics

1. (86-MC7) The moment of inertia of a circular loop, when rotated in turn about 3 different axes, are shown in the following table:

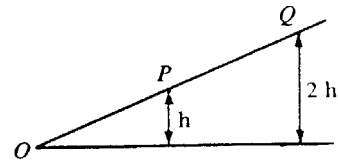
<u>axis</u>	<u>moment of inertia</u>
XY	I_1
PQ	I_2
an axis through Y and perpendicular to the plane of the loop	I_3



Which of the following is correct?

- A. $I_1 > I_2 > I_3$ B. $I_2 > I_1 > I_3$ C. $I_2 > I_3 > I_1$ D. $I_3 > I_1 > I_2$
 E. $I_3 > I_2 > I_1$
2. (87-MC7) A toy car has a lead flywheel of moment of inertia 0.001 kgm^2 attached to the axis of its rear wheels. The flywheel is now accelerating to rotate at 15 revolutions per minute and the toy car is allowed to move on a table. If the effective deceleration force experienced by the car is 0.025 N , the car will stop after travelling a distance
- A. 1.23 m B. 2.47 m C. 3.00 m D. 4.93 m E. 6.00 m
3. (87-MC8) A sphere and a cylinder, each having the same mass and radius, are released together, side by side, at the top of an inclined plane and roll down along lines of greatest slope, without slipping. It is observed that the sphere reaches the bottom first. Which of the following statements is/are correct?
- (1) The angular acceleration of each is the same.
 (2) The cylinder has a greater moment of inertia.
 (3) The kinetic energy of each is the same at the bottom.
- A. (1), (2)&(3) B. (1)&(2) only C. (2)&(3) only D. (1) only E. (3) only

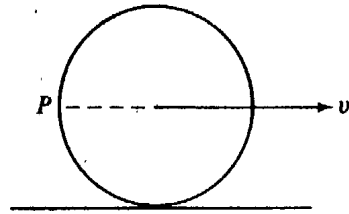
4. (89-MC13) A ball rolls down an inclined plane. The ball is first released from rest from P and then later from Q. Which of the following statements is/are correct?



- (1) The ball takes twice as much time to roll from Q to O as it does to roll from P to O
 (2) The acceleration of the ball at Q is twice as large as the acceleration at P.
 (3) The ball has twice as much K.E. at O when rolling from Q as it does when rolling from P.

A. (1), (2)&(3) B. (1)&(2) only C. (2)&(3) only D. (1) only E. (3) only

5. (90-MC5) A wheel rolls horizontally along the ground without slipping. The speed of the centre of mass of the wheel is v . The instantaneous speed of point P relative to the ground is



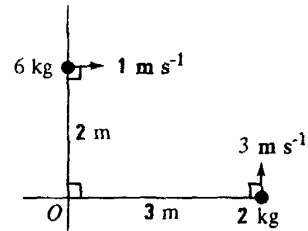
A. zero B. v C. $1.41 v$ D. $2 v$ E. $4 v$

6. (91-MC9) The turntable of a gramophone rotates at a steady angular speed ω . A record is dropped from rest on the turntable. Initially, the record slips but it undergoes uniform angular acceleration and eventually moves with the same angular speed as the turntable. The turntable turns through an angle θ while the record is slipping on its surface. Find the angular acceleration of the record and the angle which it turns through before it attains the steady speed of the turntable.

	<u>Angular acceleration</u>	<u>Angle</u>
A.	$\omega^2 / (2\theta)$	$\theta/2$
B.	$\omega^2 / (2\theta)$	θ
C.	$\omega^2 / (2\theta)$	2θ
D.	ω^2 / θ	$\theta/2$
E.	ω^2 / θ	θ

7. (92-MC6) Two objects are moving with instantaneous velocities as shown in the diagram. The total angular momentum about the point O at this instant is

- A. $4 \text{ kg m}^2 \text{ s}^{-1}$
 B. $6 \text{ kg m}^2 \text{ s}^{-1}$
 C. $10 \text{ kg m}^2 \text{ s}^{-1}$
 D. $20 \text{ kg m}^2 \text{ s}^{-1}$
 E. $30 \text{ kg m}^2 \text{ s}^{-1}$

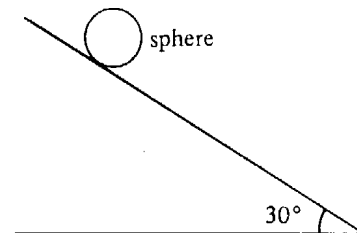


8. (92-MC7) A gymnast on a trampoline is performing a somersault and draws his knees to his chest. Which of the following quantities (about a horizontal axis through his centre of mass) will be increased?

(1) His angular momentum (2) His moment of inertia (3) His rotation speed

- A. (1), (2)&(3) B. (1)&(2) only C. (2)&(3) only D. (1) only E. (3) only

9. (93-MC2) A sphere of mass 1 kg is released from rest on an inclined plane of inclination 30° to the horizontal. If the sphere rolls without slipping, find the gain in kinetic energy and the work done against friction by the sphere after travelling a distance of 5 m along the plane.

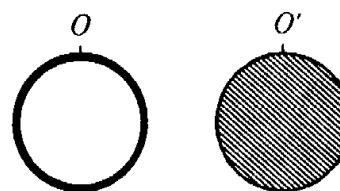


	<u>gain in kinetic energy/J</u>	<u>work done against friction</u>
A.	25	0
B.	25	25
C.	50	cannot be determined
D.	50	0
E.	50	25

10. (93-MC9) A ring of radius a is made from thin wire. The moment of inertia of the ring about an axis through its centre and perpendicular to its plane is I . What would be the moment of inertia of a ring, made from the same type of wire but with radius $2a$, about a similar axis?

- A. I B. $2I$ C. $4I$ D. $8I$ E. $16I$

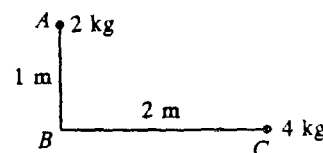
11. (94-MC10) The figure shows a uniform ring and a uniform disc, with equal mass and radius, smoothly hinged at point O and O' on their respective circumferences. They are set into small oscillation of equal amplitude about axes through O and O' perpendicular to the plane of the paper. Which of the following statements is/are correct?



- (1) The moment of inertia of the ring about the axis through O is greater than that of the disc about the axis through O'.
- (2) The period of oscillation of the ring is longer.
- (3) Both the ring and the disc have the same total kinetic energy when their centres are vertically below their respective axes.

A. (1) only B. (3) only C. (1)&(2) only D. (2)&(3) only E. (1), (2)&(3)

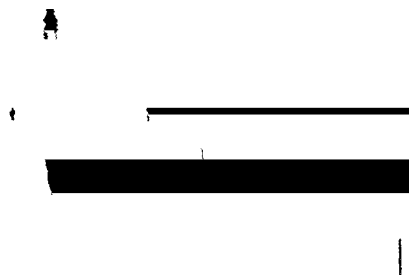
12. (95-MC9) Point masses of 2 kg and 4 kg are attached to the ends of an L-shaped light frame ABC, with AB vertical and BC horizontal. The frame is pivoted at end free to rotate about point B in a vertical plane. What is the initial angular acceleration of the system when released from rest?



A. 4.4 rad s^{-1} B. 5.0 rad s^{-1} C. 5.6 rad s^{-1} D. 8.0 rad s^{-1} E. 10.0 rad s^{-1}

13. (96-MC8) Three uniform wires, of same length and mass but with different shapes, are hinged to an axis passing through O and perpendicular to the plane of the paper as shown. Arrange their moment of inertia about O in ascending order of magnitude.

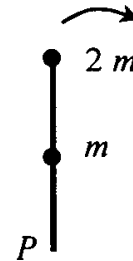
- A. (1), (2), (3)
- B. (2), (1), (3)
- C. (1), (3), (2)
- D. (2), (3), (1)
- E. (3), (2), (1)



14. (97-7) A constant external torque X is applied to a flywheel which is initially at rest. The angular speed of the flywheel increases to a certain value after 21 s. If the external torque is now doubled, the flywheel will acquire the same angular speed after 9 s. Find the average frictional torque exerted at the bearings of the flywheel.

A. $X/2$ B. $3X/7$ C. $7X/10$ D. $4X/7$ E. $X/4$

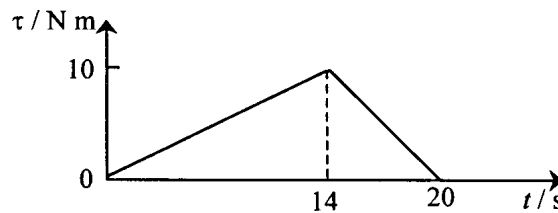
15. (99-6) A light, rigid rod of length 1 m is hinged smoothly at P at one end. Two small masses m and $2m$ are fixed to the mid-point and the other end of the rod respectively. The rod is held vertically above P and is released from rest. What is the total rotational energy of the system when the rod rotates to the position vertically below P? (Neglect air resistance)



A. 2.5 mg B. 4.5 mg C. 5 mg D. 7.5 mg E. 9 mg

16. (99-7) A turntable of moment of inertia $1.0 \times 10^{-3} \text{ kgm}^2$ is under the action of a torque. The variation of the torque τ acting about the axis of rotation with time t is as shown. If the turntable is at rest initially, what is its angular momentum at $t = 20\text{s}$?

A. $40 \text{ kgm}^2\text{s}^{-1}$
 B. $100 \text{ kgm}^2\text{s}^{-1}$
 C. $200 \text{ kgm}^2\text{s}^{-1}$
 D. $1 \times 10^5 \text{ kgm}^2\text{s}^{-1}$
 E. $2 \times 10^5 \text{ kgm}^2\text{s}^{-1}$



17. (00-14) With his arms and legs outstretched, a diver leaves a high-diving board with some initial angular velocity. Before he enters the water, which of the following statements is INCORRECT? (Neglect air resistance)
- A. His angular momentum about the centre of gravity remains constant.
 B. No external force acts on him.
 C. His loss in potential energy becomes his kinetic energy
 D. He can decrease his moment of inertia by pulling his arms and legs to his chest.
 E. He can make more turns before reaching the water surface by coiling up his body.