

1. Which of the following rotational-translational pairs is incorrect?
  - A)  $\ddagger$  and  $x$
  - B)  $\omega$  and  $v$
  - C)  $\alpha$  and  $a$
  - D)  $I$  and  $M$
  - E)  $\tau$  and  $W$
  
2. Which of the following objects has the least kinetic energy at the bottom of the incline if they all have the same mass and radius?
  - A) cylinder
  - B) sphere
  - C) hoop
  - D) all have the same
  - E) not enough information
  
3. Which of the following objects has the greatest rotational kinetic energy at the bottom of the incline if they all have the same mass and radius?
  - A) cylinder
  - B) sphere
  - C) hoop
  - D) all have the same
  - E) not enough information
  
4. Which of the following objects has the least rotational kinetic energy at the bottom of the incline if they all have the same mass and radius?
  - A) cylinder
  - B) sphere
  - C) hoop
  - D) all have the same
  - E) not enough information
  
5. Which of the following objects has the greatest translational energy at the bottom of the incline if they all have the same mass and radius?
  - A) cylinder
  - B) sphere
  - C) hoop
  - D) all have the same
  - E) not enough information
  
6. Which of the following objects has the least translational kinetic energy at the bottom of the incline if they all have the same mass and radius?
  - A) cylinder
  - B) sphere
  - C) hoop
  - D) all have the same
  - E) not enough information
  
7. The parallel axis theorem is used to calculate
  - A) Angular velocity
  - B) Translational velocity
  - C) Moment of inertia
  - D) Torque
  - E) Angular momentum

8. What is the moment of inertia for a solid disk with a diameter of .8 meters and a mass of 5 kg?
- A) .4 kgm<sup>2</sup>  
B) .5 kgm<sup>2</sup>  
C) .6 kgm<sup>2</sup>  
D) .7 kgm<sup>2</sup>  
E) .8 kgm<sup>2</sup>
9. What is the moment of inertia for a solid sphere with a radius of .5 meters and a mass of 5 kg?
- A) .125 kgm<sup>2</sup>  
B) .25 kgm<sup>2</sup>  
C) .5 kgm<sup>2</sup>  
D) 2.5 kgm<sup>2</sup>  
E) 5 kgm<sup>2</sup>
10. What is the ratio of the moment of inertias for a solid disk and solid sphere with the same mass and same radius?
- A) 2:5  
B) 1:2  
C) 4:5  
D) 5:4  
E) 5:2
11. A block mass 3 kg is hung from a pulley of radius R and mass 4 kg and is allowed to fall. What is the acceleration of the block?
- A) .2g  
B) .4g  
C) .6g  
D) .8g  
E) g
12. A solid sphere of mass  $M$  and radius  $R$  rolls without slipping down an inclined plane whose incline angle with the horizontal is  $30^\circ$ . What is the acceleration of the sphere's center of mass?
- A)  $g/3$   
B)  $5g/14$   
C)  $5g/7$   
D)  $2g/3$   
E)  $g$
13. Mass is the translational analog of the
- A) angle  
B) angular velocity  
C) angular acceleration  
D) torque  
E) moment of inertia
14. A solid cylinder of radius .2 m and mass 2 kg is at rest at a height 1.2 m at the top of an inclined plane making an angle  $60^\circ$  with the horizontal. Assuming no slipping, what is the speed of the cylinder at the bottom of the incline?
- A) Zero  
B) 2 m/s  
C) 4 m/s  
D) 6 m/s  
E) 10 m/s
15. Which of the following quantities is non-zero for a car parked on a hill?
- A) the net force on the car  
B) the moment of inertia of the car around a given axis  
C) the work done by friction on the car  
D) the work done by gravity on the car  
E) the impulse imparted to the car by the normal force

16. What is the ratio of the moment of inertia of a solid sphere of mass  $m$  and radius  $r$  to the moment of inertia of a hoop of the same mass and same radius?

- A) 1:1
- B) 3:4
- C) 2:5
- D) 5:2
- E) 4:3

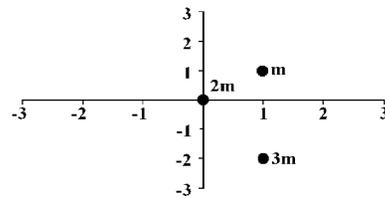
17. What is the ratio of the moment of inertia of a cylinder of mass  $m$  and radius  $r$  to the moment of inertia of a hoop of the same mass and same radius?

- A) 1:1
- B) 1:2
- C) 2:1
- D) 1:4
- E) 4:1

18. What is the ratio of the moment of inertia of a cylinder of mass  $m$  and radius  $r$  to the moment of inertia of a sphere of the same mass and same radius?

- A) 1:1
- B) 2:5
- C) 5:2
- D) 4:5
- E) 5:4

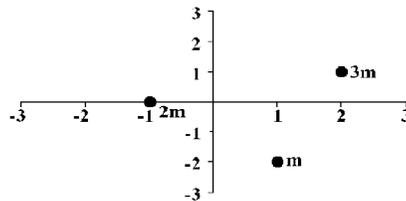
19. Base your answer to the following question on the diagram below.



What is the moment of inertia of the system of particles if it is rotated about the origin?

- A)  $4m$
- B)  $6m$
- C)  $11m$
- D)  $13m$
- E)  $17m$

20. Base your answer to the following question on the diagram below.



What is the total rotational inertia of the system when it is rotated about the origin?

- A)  $6m$
- B)  $11m$
- C)  $16m$
- D)  $22m$
- E)  $26m$

21. A force  $F$  is exerted on a rod at a distance  $r$  from its axis of rotation. If the rod experiences an angular acceleration of  $\alpha$ , what is the moment of inertia of the rod about this axis?

- A)  $Fr\alpha$
- B)  $Fr/\alpha$
- C)  $\alpha/Fr$
- D)  $r\alpha/F$
- E)  $F\alpha/r$

22. An object of mass  $m$  has a moment of inertia  $I$  when it is rotated about its center of mass. What is its rotational inertia if it is rotated about an axis that is a distance  $d$  from its center of mass?

- A)  $I$
- B)  $I/md$
- C)  $I - md$
- D)  $I - md^2$
- E)  $I + md^2$

23. A rod of length 2 m and mass of 5 kg is initially rotated around its center by a torque  $\tau$ . What is its angular acceleration if it is rotated around one of its ends by the same torque  $\tau$ ?

$$\frac{\tau}{20} \quad \frac{3\tau}{5}$$

A) D)

$$\frac{3\tau}{20} \quad \frac{5\tau}{3}$$

B) E)

$$\frac{\tau}{5}$$

C)

24. A rod has non uniform mass distribution, a length  $l$ , and a mass  $m$ . If it is rotated around an axis that is perpendicular to its length, at what location of this axis will the rod have the smallest moment of inertia?

- A) one of the ends
- B) at its center,  $l/2$
- C) at its center of mass
- D) at the point with the highest density
- E) the moment of inertia is the same for any location

**Answer Key**  
**Rotational Kinematics MC Questions [Mar 28, 2011]**

1.   E  

2.   D  

3.   C  

4.   B  

5.   B  

6.   C  

7.   C  

8.   A  

9.   C  

10.  D  

11.   C  

12.   B  

13.   E  

14.   C  

15.   B  

16.   C  

17.   B  

18.   E  

19.   E  

20.   D  

21.   B  

22.   E  

23.   B  

24.   C  

---

Name \_\_\_\_\_

Class \_\_\_\_\_

Date \_\_\_\_\_

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

8. \_\_\_\_\_

9. \_\_\_\_\_

10. \_\_\_\_\_

11. \_\_\_\_\_

12. \_\_\_\_\_

13. \_\_\_\_\_

14. \_\_\_\_\_

15. \_\_\_\_\_

16. \_\_\_\_\_

17. \_\_\_\_\_

18. \_\_\_\_\_

19. \_\_\_\_\_

20. \_\_\_\_\_

21. \_\_\_\_\_

22. \_\_\_\_\_

23. \_\_\_\_\_

24. \_\_\_\_\_

---