Conceptual Physics Self Test Chapter 11 Name _____

Acceleration of gravity: $g = 10\ m/s^2$

$v = \Delta d/\Delta t$ $a = \Delta v/\Delta t$ $v_f = v_o + at$ $d = v_o t + 1/2at^2$ $F = ma$ $W = mg$

$Ft = \Delta(mv)$ **Momentum = mv net momentum** $_{\text{before collision}}$ **= net momentum** $_{\text{after collision}}$

$W_{ork} = Fd$ $P = W_{ork}/t$ $KE = \frac{1}{2} mv^2$ $PE = mgh$

Angular momentum = I ω Torque = $F_\perp$ **x d**

Comparisons between linear and angular quantities

Definition		**FORCE** a push or a pull which changes the linear motion of an object	**TORQUE** a force applied at right angles to a a lever arm producing a change in rotation of the object
Symbol	**F**		**T**
Symbol and units		**LINEAR SPEED** v (meters/second)	**ROTATIONAL SPEED** ω (rotations/second)
Definition		**LINEAR INERTIA** reluctance of any object to change its state of motion	**ROTATIONAL INERTIA** reluctance of any object to change its state of rotation
Symbol	**M**		**"I"**
Depends on		**mass**	**mass and its distribution from the spin axis. "I" increases as mass moves out from the spin axis**
Formula		**LINEAR MOMENTUM** mv	**ANGULAR MOMENTUM** I ω
To Change Momentum	**Apply a force (F)**		**Apply a torque (**$F_\perp$ **x d)**
Conservation		$mv_{before} = mv_{after}$ (no external force)	$I\omega_{before} = I\omega_{after}$ (no external torque)

Multiple Choice

___ 1. Torque is defined as:
- a. mass x velocity
- b. force x time
- c. force x lever arm
- d. mass x acceleration

___ 2. Suppose you try loosening a nut with a wrench, and the nut does not give at all. To loosen the nut you could:
- a. extend the lever arm by putting a pipe over the free end of the wrench
- b. exert a larger force
- c. have a friend help
- d. make sure that the force is perpendicular to the lever arm
- e. all of these

___ 3. Which objects roll down an incline in less time?
- a. objects with small rotational inertia
- b. objects with large rotational inertia
- c. time to roll down is independent of rotational inertia

___ 4. A meter stick is balanced at the 50 cm mark. You tie a 30 N weight at the 30 cm mark. Where should a 20 N weight be placed to balance the stick? Draw a diagram in the space provided.
- a. 20 cm mark
- b. 50 cm mark
- c. 70 cm mark
- d. 80 cm mark

___ 5. Angular momentum is defined as
- a. mass times velocity
- b. rotational inertia x rotational velocity
- c. momentum x rotational velocity
- d. rotational inertia x mass

(16c)

___ 6. When an aerial gymnast goes from an extended position to a tucked position, she
   a. increases her rotational inertia
   b. decreases her rotational inertia
   c. has no effect on her rotational inertia

___ 7. When an aerial gymnast goes from an extended position to a tucked position, she
   a. increases her rotational velocity
   b. decreases her rotational velocity
   c. has no effect on her rotational velocity

___ 8. When an aerial gymnast goes from an extended position to a tucked position, she
   a. increases her angular momentum
   b. decreases her angular momentum
   c. has no effect on her angular momentum

___ 9. A The reason a spinning skater turns faster when she pulls her arms in is because her:
   a. angular momentum is decreased
   b. angular momentum is increased
   c. rotational inertia is decreased and angular momentum is conserved
   d. rotational inertia is increased and angular momentum is conserved

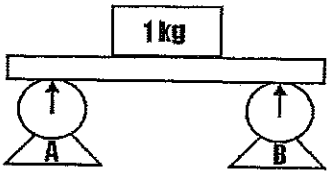
___ 10. Which is slower rolling down a hill?
   a. a solid ball
   b. a hollow ball

___ 11. Which has more rotational inertia?
   a. a solid ball of mass "M"
   b. a hollow ball of mass "M"

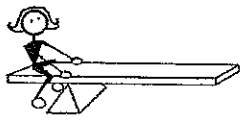
___ 12. A tightrope walker uses a long pole to help maintain balance by:
   a. increasing his rotational inertia
   b. decreasing his rotational inertia
   c. raising his center of gravity
   d. increasing his angular momentum

___ 13. A uniform half-meter stick with the fulcrum placed at the 11 cm mark can be balanced by placing a 1.0 N weight on the 4 cm mark. Draw a diagram of the situation. What is the weight of the meter stick?
   a. .36 N
   b. .44 N
   c. .50 N
   d. 2.0 N

___ 14. Compared to the reading of scale A, the reading of scale B is
   a. more
   b. less
   c. the same



___ 15. This child can see-saw by herself because her invisible partner is actually:
   a. the fulcrum
   b. the rotational inertia of the see-saw
   c. the weight of the board at the center of gravity
   d. this can't be done

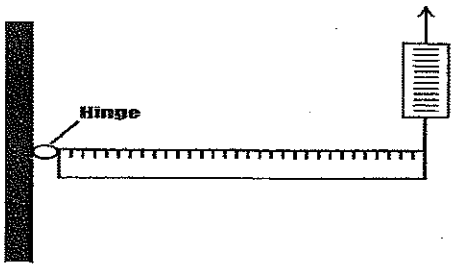


___ 16. The steering wheel of a bus is much larger than the steering wheel of a car because:
   a. a given force can produce more torque
   b. a given force can produce less torque
   c. a larger wheel has more rotational inertia
   d. a larger wheel has less rotational inertia

___ 17. Two solid steel spheres of different diameters are allowed to roll down an incline. The one that reaches the bottom first is:
   a. the larger sphere b. the smaller sphere c. both the same

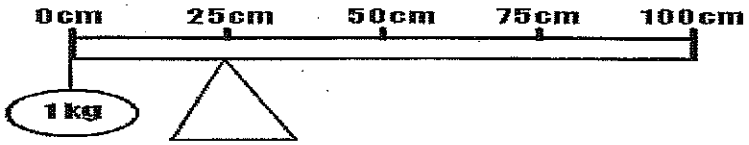
___ 18. Your answer to number 17 is because
- a. the smaller sphere has less mass to accelerate
- b. the force of gravity is greater on the larger sphere
- c. objects of the same shape accelerate equally down an incline
- b. condition of stability

___ 18. A meter stick is hinged at one end and the free end is held up by a spring balance. If the stick has a mass of 80 g, the reading of the spring balance will be:
a. 40 g b. 80 g c. 120 g d. 160 g



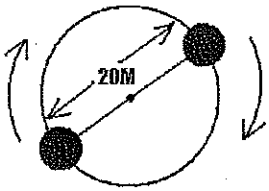
___ 19. Any solid cylinder will roll down an incline with greater acceleration than any hollow cylinder if
- a. mass of the solid cylinder is larger
- b. diameter of the solid cylinder is larger
- c. mass of the solid cylinder is smaller
- d. none of these is necessary

___ 20. What is the mass of the meter stick shown in the figure?
- a. 0 kg
- b. 0.5 kg
- c. 1.0 kg
- d. 1.5 kg



____ 21. If a trapeze artist rotates twice each second while sailing through the air, and contracts to reduce her rotational inertia to ¼ its original value, how many rotations will result?
- a. 2 rot/s
- b. 4 rot/s
- c. 6 rot/s
- d. 8 rot/s

____ 22. A pair of identical 50 kg space pods in outer space are connected to each other by an 20-m long cable. They rotate about a common point like a spinning dumbbell as shown in the figure. What is the rotational inertia of the two-pod system about its mid-point?
- a. 5000 kg · m^2
- b. 10000 kg · m^2
- c. 15000 kg · m^2
- d. 20000 kg · m^2



True/False: If the statement is false, change the underlined word so that statement becomes true:

___ 23. The rotational speed of a wheel is the number of rotations it makes in a one second interval.

___ 24. A spinning wheel will maintain its state of angular momentum unless acted on by an external force.

___ 25. When an ice skater pulls her arms in to increase her rotational speed, her angular momentum is unchanged.

QUESTIONS/PROBLEMS

26. On some doors, the doorknob is in the center of the door.
- a. What would a physicist say about the practicality of this arrangement?
- b. Why would physicists design doors with knobs farther out from the hinges?

27. Figure skaters commonly change the shape of their body in order to achieve spins on the ice. The skater pulls in her arms as she is spinning. How does this affect her:
- a. rotational inertia?
- b. angular speed?
- d. angular momentum?