Name: _____ Date: _____

1. Driving down the road, you hit an insect. How does the force your car exerts on the insect compare to the force the insect exerts on the car?
A) The insect exerts no force on the car
B) The two forces are equal in magnitude.
C) The force the car exerts on the insect is less.
D) The force the insect exerts on the car is less.

2. Why do elastic balls bounce so well?
A) They are always thrown well.
B) They store energy through compression, like a spring.
C) They permanently deform, storing energy.
D) They are all filled with a special energy-absorbent liquid.

3. A baseball player throws a bat up in the air, so that it spins as it translates. The bat will rotate about its
A) center of mass
B) pivot point near the handle
C) long axis
D) pivot point farthest from the handle

4. When building soap box cars which race by coasting downhill it is better to have solid wheels rather than ones of equal mass with spokes because
A) The wheels with spokes lose too much energy by heating up the air.
B) The solid wheels have a lower moment of inertia and therefore accelerate faster.
C) The solid wheels are easier to paint.
D) The solid wheels have a higher moment of inertia and therefore retain more rotational energy.

5. You are riding an amusement park ride where you are strapped to the inside of a giant metal wheel that is rotating quite rapidly. Your acceleration is
A) Toward the center
B) Zero
C) Straight up
D) Straight down

6. Suppose you are standing on a bathroom scale when you are flying in a jet airplane. For a moment the scale reads more than your actual weight. During that moment, it's exerting an upward force on you that is greater than your weight and you are
A) not accelerating.
B) accelerating upward.
C) accelerating sideways.
D) accelerating downward.

7. A child is riding a bike and skids to a stop. What happens to their kinetic energy?

A) It is conserved.
B) It is dissipated by static friction.
C) It is turned into heat by sliding friction.
D) It is turned into potential energy.

8. A projectile is thrown directly upward and caught again. At the top of its path
   A) its vertical velocity is zero
   B) its acceleration changes
   C) it stops accelerating
   D) its horizontal velocity changes

9. The spin cycle in your washing machine partially dries clothes by spinning them in a perforated metal basket. Such a process works because
   A) the water is drained by gravity out the bottom of the basket.
   B) the water is drawn to the center of the basket
   C) the water leaves the basket moving tangent to the circular path
   D) the water is forced directly outward from the basket

10. A spinning Frisbee is thrown between two persons in a park. The motion of the Frisbee is
    A) rotational and translational.
    B) neither rotational nor translational.
    C) purely translational.
    D) purely rotational.

11. Your weight and mass are different in that
    A) your mass depends upon local gravity but your weight does not.
    B) your weight depends upon local gravity but your mass does not.
    C) being weightless means that you have to lose mass.
    D) your weight is measured in kg but not your mass

12. Suppose you take off in a car with your physics book on top. If you are accelerating forward and the book rides with you, in what direction does friction act on the book?
    A) The force of friction is infinite.
    B) backwards
    C) forwards
    D) There is no friction since there is no sliding.

13. Suppose you weigh 986 N. How much force does the Earth exert on you, if any?
    A) none
    B) it cannot be determined
    C) 986 N
    D) 98.6N

14. When you throw a tennis ball against the floor at an angle,
    A) the speed of the ball reverses.
    B) the vertical component of its velocity doubles.
    C) the horizontal component of its velocity reverses.
    D) the direction of the vertical component of its velocity reverses.

Answer Key

1. B
2. B
3. A
4. B
5. A
6. B
7. C
8. A
9. C
10. A
11. B
12. C
13. C
14. D

15. You are riding on the edge of a spinning playground merry-go-round. If you pull yourself to the center of the merry-go-round, what will happen to its rotation?

   The moment of inertia (rotational mass) of the system (marry-go-round + you) will decrease and the angular speed will increase by conservation of angular momentum.

16. If you lift the front wheel of your bicycle off the ground, it will probably begin turning until the wheel's air inlet nipple is at the bottom of the wheel. Use the concept of balance to explain why the nipple's weight causes the wheel to turn.

When the nipple is on one side, the wheel is unbalanced. There is a net torque on the wheel and it undergoes angular acceleration.

17. Why do skiers begin to skid across the snow when they try to turn too sharply?

In order to generate the frictional force in the direction perpendicular to the skis (central force of the rotational motion).

18. Your car's brakes could stop your forward motion simply by preventing the wheels from turning. The wheels would then experience sliding friction with the ground and would convert the car's kinetic energy into thermal energy. Why isn't that a good technique for stopping?

As is the case with starting the car, you can stop faster if you use the static friction (no sliding) to stop the car. This requires the tires to perform a decelerated rotation that is slow enough so that the car does not slide. Note that there is still some loss of heat to kinetic friction between the breaks and the tires.

19. Explain why a thrown ball travels in an arc.

The trajectory is an arc because the velocity of the ball is not constant. Vertical motion is accelerated due to gravity, whereas horizontal velocity is constant due to lack of horizontal forces (ignoring air resistance).

20. The earth spins slightly faster in July and August than it does in April, shortening the day by about 0.0012 seconds. This seasonal effect is caused by the melting of snow from the vast mountains of the Northern Hemisphere. Why?

Melting water looses altitude, bringing the earth's mass closer to its axis of rotation, hence reducing the rotational inertia. By conservation of angular momentum, the speed of rotation increases in response.

21. Why do trains have brakes on each car, rather than just on the locomotive?

Two reasons: 1. because this increases the total frictional force on the train, allowing it to stop faster. 2. Otherwise the joints between the cars would experience a large force due to the cars' inertia.

22. Explain why a car will accelerate faster from rest if you avoid skidding your wheels.

   While avoiding skidding, we use the static frictional force to accelerate, The static frictional force can get larger than the kinetic frictional force while skidding due to the larger frictional coefficient.

23. You are an astronaut and during a space walk, the rockets at the back of your space suit fail. You are 5 meters away from your spaceship and motionless with respect to it. Discuss what you would do to get back to your ship.

In order to gain momentum in the direction of the spaceship, you need to throw something in the opposite direction. This could be your useless rockets.

24. You lift a box from the ground 2 meters up by (a) lifting it straight up, (b) by pushing it up a 10m long ramp. Compare for the two cases the force you exert on the box, the work you do, the gravitational potential energy of the box at the top.

Force needed is greater in (a), whereas the work and the final gravitational potential energy of the box (which increases by the amount of work done) are the same in the two cases, since they depend only on the height of the box.

25. While a coin tips over easily when you stand it on edge, a coin that's spinning on its edge stays up for a remarkably long time. Why?

The gravitational and normal forces on the coin do not generate a torque opposing the existing angular momentum, hence the coin continues to rotate due to its inertia.