Hovercraft B/C Test

Rank: _____
Points: ____

Science Olympiad North Regional
Tournament at the University of Florida

Name(s): _____

Team Name: _____

School Name: _____

Team Number: _____

The written test will consist of at least five questions from each of the following areas:
i. Newton's Laws of Motion: inertia, force, impulse, action-reaction
ii. Kinematics: projectile velocity, speed, acceleration, position
iii. Kinetic energy: calculation, momentum, non-relativistic
iv. Division C only - Fluid mechanics: density, buoyancy, viscosity, Bernoulli's principle, Pascal's law

> Failure to follow all directions will result in failure
> Write team number at top right of every page
> All tie breaker questions will only be graded in the event of a tie.
> An asterisk * indicates a potentially trick question.

> Looseleaf paper will be provided for answering. Please number all pages clearly and title each page with team number.

Division B

1. A 3.00-kg object undergoes an acceleration given by vector **a** = (2.00i + 5.00j) m/s^2. Find the resultant force **F** and its magnitude.

2. A projectile is fired in such a way that is horizontal range is equal to three times its maximum height. What is the angle of projection?

3. **Tiebreaker 1***A car has one minute to cross a 60 mile road. It covers the first half driving a rate of 30 mph. How fast does the car need to go to cross the road in the time given?

4. *Does a bullet fall faster when dropped or shot out of a gun? (Assuming both are starting at the same height and the gun is angled at 0 degrees)

5. A 500g object is pushed at 10 m/s^2. What is the force given to the object?

6. An electron of mass 9.11 * 10^-31 kg has an initial speed of 3.00 * 10^5 m/s. It travels in a straight line and its speed increases to 7.00 * 10^5 m/s in a distance of 5.00cm. Assuming constant acceleration, (a) determine the force on the electron and (b) compare this force with the weight due to gravity of the electron, which we neglected.

7. A rubber ball is dropped on the floor, what causes the ball to bounce back up?

8. **Tiebreaker 2.** A block is given an initial velocity of 5.00 m/s up a frictionless 20.0 degree incline. How far up the incline does the block slide before coming to rest?

9. Two blocks are connected by a rope of negligible mass are being dragged by a horizontal force F. Suppose that F=68.0 N, m1 = 12.0 kg, m2 = 18.0 kg, and the coefficient of kinetic friction between each block and the surface is 0.100. (a) Draw a free body diagram for each block. (b) Determine the tension, T, and the magnitude of the acceleration of the system.

   VISUAL [M1]----[M2]---------->-->-->--Force of pulling

10. What are Newton's three laws?

11. Can Kinetic energy be negative?

12. (a) If the speed of a particle is doubled, what happens to its kinetic energy? (b) What can be said about the speed of a particle if the net work done on it is zero?

13. In a pendulum, where is the greatest moment of Kinetic energy?

14. What is the unit associated with momentum?

15. Give an example of an elastic collision.

16. If two particles have equal kinetic energies, are their momenta necessarily equal?

17. Does the center of mass of a rocket in free space accelerate? Explain

18. **Tiebreaker 3**"An object in motion remains at motion until acted on by an outside force". What concept is this referring to?

19-24 Division C Only

19. What has a greater density, a kilogram of lead or a kilogram of feathers?

20. A closed large box and a hummingbird are on a scale. Does the weight recorded by the scale increases or decrease while the bird is flying? Explain.

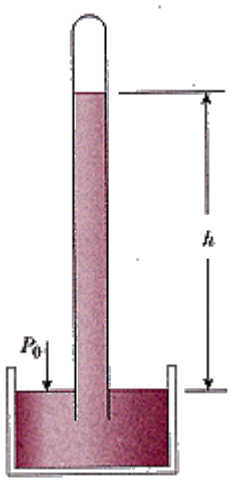
21. A glass of water has an ice cube in it, which slowly warms up to room temperature. Does the height of the water:
    a. Decrease
    b. Stay the same
    c. Increase

22. A ping pong ball has a diameter of 3.80 cm and average density of 0.0840 g/cm^3. What force is required to hold it completely submerged under water?

23. A plastic sphere floats in water with 50.0 percent of its volume submerged. The same sphere floats in glycerin with 40.0 percent of its volume submerged. Determine the densities of the glycerin and the sphere.

TEAM NUMBER:_____

24. Grape drink,of density of 984 Kg/m^3, is used as a working liquid for Torricellis



barometer. What was the height of the grape drink column for normal atmospheric pressure?