

Hovercraft B/C Answer Key

Science Olympiad North Regional Tournament at the University of Florida



ANSWER KEY

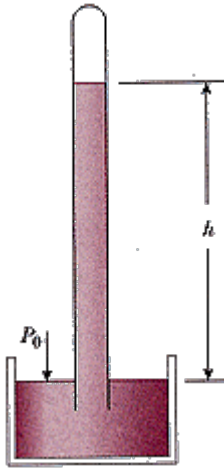
1. A 3.00-kg object undergoes an acceleration given by vector $\mathbf{a} = (2.00\mathbf{i} + 5.00\mathbf{j}) \text{ m/s}^2$. Find the resultant force \mathbf{F} and its magnitude.
 - a. $6.00\mathbf{i} + 15\mathbf{j} \text{ N}$
 - b. 16.2 N
2. A projectile is fired in such a way that its horizontal range is equal to three times its maximum height. What is the angle of projection?
 - a. 53.1 degrees
3. *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?
 - a. **Cannot cross the road**
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)
 - a. **They both fall at the same rate**
5. A 500g object is pushed at 10 m/s^2 . What is the force given to the object?
 - a. 500 N
6. An electron of mass $9.11 \times 10^{-31} \text{ kg}$ has an initial speed of $3.00 \times 10^5 \text{ m/s}$. It travels in a straight line and its speed increases to $7.00 \times 10^5 \text{ m/s}$ 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.
 - a. $3.64 \times 10^{-18} \text{ N}$
 - b. $F/F_g = 4.08 \times 10^{11}$
7. A rubber ball is dropped on the floor, what causes the ball to bounce back up?
8. 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?
 - a. 3.73 m
9. Two blocks are connected by a rope of negligible mass and are being dragged by a horizontal force F . Suppose that $F = 68.0 \text{ N}$, $m_1 = 12.0 \text{ kg}$, $m_2 = 18.0 \text{ kg}$, 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 --
 - a. $M_1 11.8\text{N}, M_2 17.6\text{N}, \text{Tension} = 27.2 \text{ N}, a = 1.29 \text{ m/s}^2$
10. What are Newton's three laws?
 - a. 1.
 - b. 2.
 - c. 3.
11. Can Kinetic energy be negative?
 - a. **No**
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?
 - a. **KE depends on the square of velocity**
 - b. **If net work is zero, the speed of a particle does not change**
13. In a pendulum, where is the greatest moment of Kinetic energy?

- a. **Bottom**
14. What is the unit associated with momentum?
a. **kg*m/s**
15. Give an example of an elastic collision.
a. **Pool balls on a table**
16. If two particles have equal kinetic energies, are their momenta necessarily equal?
a. **No**
17. Does the center of mass of a rocket in free space accelerate? Explain
a. **No, Conservation of momentum**
18. "An object in motion remains at motion until acted on by an outside force". What concept is this referring to?
a. **Inertia**

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19. What has a greater density, a kilogram of lead or a kilogram of feathers?
a. **Lead**
20. A closed large box and a hummingbird are on a scale. Does the weight recorded by the scale increase or decrease while the bird is flying? Explain.
a. **Fluctuates minimally, but stays centered around the original weight**
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/cm³. What force is required to hold it completely submerged under water?
a. **.258 N**
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.
a. **Glycerin 1250 kg/m³**
b. **Sphere 500 kg/m³**

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?

a. 10.5 m