Hovercraft Test Division B Solutions Manual

Scoring:

- Multiple Choice - 1 point for correct answer
- Calculation: 3 points for correct answer, 1 point for correct units, and 1 point for correct significant figures
- Short Answer: 5 points for correct answer (partial credit may be given on graders' discretion)

Answers are correct to within 5%

1. 2 kg ball: 13.7 m/s left 5 kg ball: 4.28 m/s (or 4.29 m/s) right (3-1-1 for **each ball**: 3pts for answer, 1pt for units, 1pt for sig figs) (so this question is 10 points total)
2. 4.50 kg (3-1-1: 3pts for answer, 1pt for units, 1pt for sig figs)
3. 14.0 m/s (3-1-1)
4. 0.5 m (3-1-1)
5. 84 m (3-1-1)
6. 59° (3-1-1)
7. B (1pt)
8. C (1pt)
9. B (1pt)
10. C (1pt)
11. B (1pt)
12. Reaction Force: Your gravitation pull on the earth Strength: Same
    (2 points for each part, 1 extra if both correct)
13. Property: Inertia Law: First
    (2 points for each part, 1 extra if both correct)
14. Object: Earth Law: Third
    (2 points for each part, 1 extra if both correct)
15. C (1pt)

Hovercraft Test Division B

All answers need to have the correct number of significant figures in SI units.

All answers must be on the answer sheet. No credit will be given for answers written on the test.

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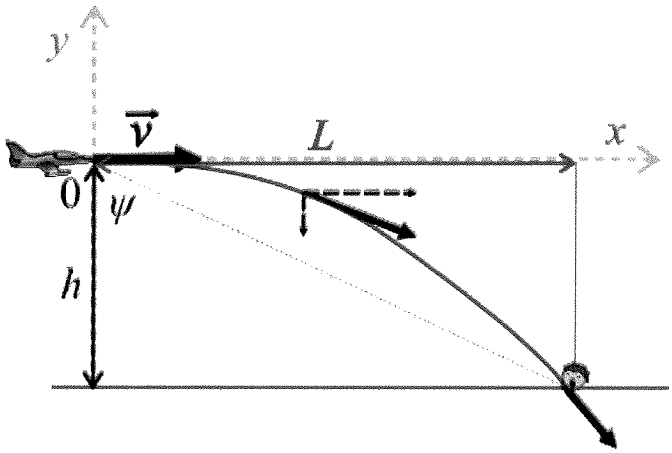
Use $g = 9.8\,\mathrm{m/s^2}$ for all questions unless otherwise stated.

1. A 2.00 kg ball traveling at 12.0 m/s to the right collides with a 5.00 kg ball traveling at 6.00 m/s to the left. If the collision is perfectly elastic, find the final velocities of the two balls.
2. A 3.00 kg mass is traveling at 15.0 m/s to the right and has an inelastic collision with an unknown mass traveling at 10.0 m/s to the left and the masses are at rest after the collision. What is the unknown mass in kg?
3. What is the final velocity of a ball that is dropped from a height of 10.0 m just before it hits the ground in m/s?
4. A mass $m = 10\,\mathrm{g}$ goes down an incline and onto a circular loop-the-loop of radius $r = 20\,\mathrm{cm}$. What is the minimum height of the incline so that the mass can make it around the loop without falling off (assume all surfaces are frictionless)?
5. An astronaut is working on the outside of the international space station, while holding his box of tools, when the cable keeping him attached breaks! The astronaut is left suspended, and notices that his oxygen tank is running low with only 420.0 s of air left. Since the international space station is on his left, the astronaut, with some quick thinking, realizes that he can throw his box of tools, which by itself has mass 10.0 kg, to the right. Together, the astronaut and box of tools have 110.0 kg of mass, and the astronaut can throw the box at 2.0 m/s. When the astronaut throws the box, what distance towards the station can he cover before running out of oxygen?

6. A rescue plane flies to help a drowning man. The pilot keeps the plane at a constant height of 1000.0 m above the water surface and heads directly above the mans head (see the figure below). The speed of the plane is 420.0 km/h. At what angle of view (in degrees) must the pilot release the rescue bag in order to let it fall as close to the man as possible (assume air resistance is negligible)?



7. Suppose a projectile is launched at an angle θ between $0° < \theta < 90°$ from the horizontal. Which of the following is true about the velocity $\vec{v}$ and acceleration $\vec{a}$ of the projectile?

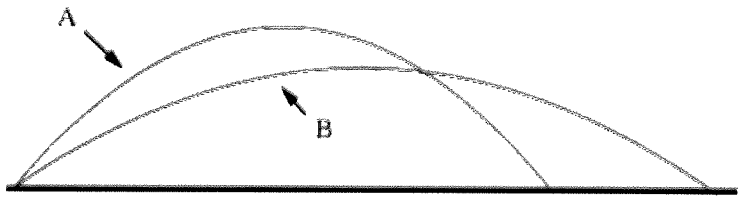
   (a) $|\vec{v}| = 0 = |\vec{a}|$
   (b) $\vec{v}_x > 0, \vec{v}_y = 0, |\vec{a}| = g$
   (c) $\vec{v}_x = 0, \vec{v}_y > 0, |\vec{a}| = g$
   (d) $\vec{v}_x > 0, \vec{v}_y = 0, |\vec{a}| = 0$
   (e) $\vec{v}_x > 0, \vec{v}_y > 0, |\vec{a}| > 0$

8. Suppose a projectile is launched at an angle θ between $0° < \theta < 90°$ from the horizontal. Let H represent the horizontal distance that the object covers. For which of the following launch angles will H be the largest (neglect air resistance)?

   (a) 15°
   (b) 30°
   (c) 45°
   (d) 60°
   (e) 75°

9. Shown below are the trajectories of two projectiles A and B. If both were launched at the same time with the same magnitude of initial velocity, which one hit the ground first (neglect air resistance)?

   (a) A
   (b) B
   (c) they hit at the same time



10. We can walk because the force of friction between the floor and our feet accelerates us. If a person with a mass of 70 kg walks without slipping 8 m on a wooden floor with coefficient of friction $\mu = 0.3$, what is the work done by friction?

    (a) 170N
    (b) 1600N
    (c) 0N
    (d) -1600N

11. Choose the relationship between impulse, J and an average force F_{avg} over a time interval Δt.

    (a) $J = \frac{F_{avg}^2}{\Delta t}$
    (b) $J = F_{avg}\Delta t$
    (c) $J = \frac{F_{avg}}{\Delta t}$
    (d) $J = \frac{\Delta t}{F_{avg}}$

12. What is the reaction force to the earth's gravitational pull on you, and how strong is it compared to the earth's gravitational pull on you?

13. Imagine riding in a car, when the driver comes to a sudden stop. You may have experienced the sensation of being thrown forward very quickly in your seat, even though the entire car is slowing down. Give a one word answer to describe the property of mass that is being shown in this example. Also, give the number for which of Newton's Laws discusses this property.

14. You and a friend are playing tug-of-war, a game where two players grab opposite ends of a rope and pull towards themselves. The first player to fall over loses. Now, in a tug-of-war, the winning player must be exerting a greater force in some way. However, by one of Newton's Laws of Motion, any force that one player exerts has a reaction force in the opposite direction. So, how does a player win in tug-of-war? More specifically, give a one word answer for what *other object* the winning player is exerting more force on. Also, give the number for which of Newton's Laws discusses this property.

15. You are taking a walk on the beach and notice that with every step you take, you sink slightly into the sand but not completely. Why do you not sink? Choose the answer that explains this situation. (Hint: Think in terms of Newton's Laws.)

    (a) Sand has mass.

    (b) Sand is loosely packed.

    (c) There is a reaction force from sand to the force of gravity pulling you down.

    (d) Sand accelerates downward from your weight.