

Hovercraft Test

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For Grader Use Only:

Test Score: ____/146

Rank: ____



Directions:

- Do **NOT** open this test without instruction by the proctor
- Round answers to the **hundredths** place if necessary, answers ± 0.2 of the **original** answer on the key will be accepted
- Think through each question carefully
- Remember to put units on your answers, otherwise you **will not** get **full** credit for a correct answer
- Answer in metric units unless otherwise specified (seconds, meters, etc.)
- There is a total of 146 points for this test. Each questions point value is in parentheses.

Good Luck!

Team Name: _____

Competitor Name(s):

Team Number: _____

Name(s): _____ Team Number: _____

1. An African elephant can reach heights of 13 feet and possess a mass of as much as 6000 kg. Determine the weight of an African elephant in Newtons and in pounds. (Given: 1.00 N = .225 pounds) **(5)**

2. A 2-kg object is moving horizontally with a speed of 4 m/s. How much net force is required to keep the object moving at this speed and in this direction? **(5)**

3. A hockey player applies an average force of 80.0 N to a 0.25 kg hockey puck for a time of 0.10 seconds. Determine the impulse experienced by the hockey puck. **(5)**

4. While driving down the road, a firefly strikes the windshield of a bus and makes a mess in front of the driver. This is a clear case of Newton's third law of motion. The firefly hit the bus and the bus hits the firefly. Which of the two forces is greater: the force on the firefly or the force on the bus? **(5)**

5. For years, space travel was believed to be impossible because there was nothing that rockets could push off of in space in order to provide the propulsion necessary to accelerate. This inability of a rocket to provide propulsion is because **(5)**
 - A. Space is void of matter so the rockets have nothing to push off of.
 - B. Gravity is absent in space.
 - C. Space is void of air and so there is no air resistance in space.
 - D. Nonsense! Rockets do accelerate in space and have been able to do so for a long time.

6. An airplane accelerates down a runway at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff. **(5)**

7. Rocket-powered sleds are used to test the human response to acceleration. If a rocket-powered sled is accelerated to a speed of 444 m/s in 1.83 seconds, then what is the acceleration and what is the distance that the sled travels? **(5)**

8. An engineer is designing the runway for an airport. Of the planes that will use the airport, the lowest acceleration rate is likely to be 3 m/s^2 . The takeoff speed for this plane will be 65 m/s. Assuming this minimum acceleration, what is the minimum allowed length for the runway? **(5)**

9. A long jumper leaves the ground with an initial velocity of 12 m/s at an angle of 28 degrees above horizontal.

a) Determine the time of flight of the long jumper. **(6)**

b) Determine the horizontal distance of the long jumper. **(6)**

c) Determine the peak height of the long-jumper. **(6)**

10. A 20 kg Red car and a 13 kg Blue car have a head on collision (The Red car is travelling right). Before the collision, the Red car was traveling at 12 m/s and the blue car was traveling at 4 m/s.

a) What is the total kinetic energy of the system? **(3)**

b) Assuming that this collision is perfectly elastic, what is the final velocity of the Blue Car? **(7)**

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c) Assuming that the collision between each car is now perfectly inelastic, determine the final velocity of the Red Car? **(5)**

d) Refer back to the last question (Part c), how much Kinetic energy is lost? **(4)**

11. Bob Lee has a mass of 93 kg's and is in an elevator that he built himself in the Burj Khalifa.

a) Assuming that the elevator's velocity is 2 m/s, what is the force exerted by Bob on the elevator? **(5)**

b) Assuming now that the elevator is accelerating 3 times that of gravity, what is the normal force of the elevator? **(5)**

12. James found a peach and decided to throw it 13 degrees above the horizontal at velocity of 7 m/s.

a) How far from James does the ball land? **(6)**

b) What is the highest point in meters that the peach reaches? **(6)**

c) How long does it take to get to that point? **(4)**

Name(s): _____

Team Number: _____

13. State Newton's first law: **(2)**

14. State Newton's second law: **(2)**

15. State Newton's third law: **(2)**

16. Carl and YEEthan are playing football at their local park. There is a distance of 68 m between them, and the ball leaves Carl's hand at a velocity of 35 m/s. (Assume they are the same height)

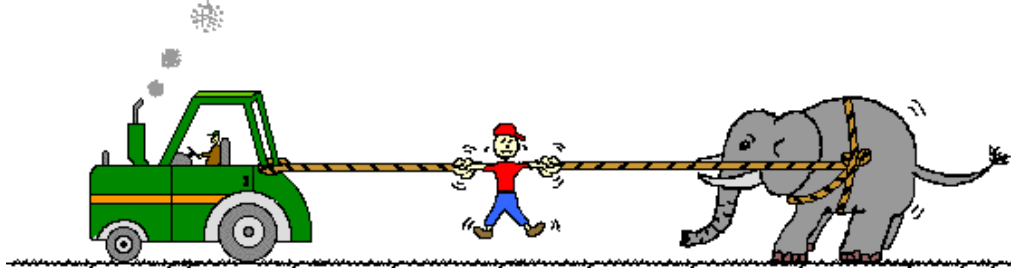
a) What are the angle(s) that Carl can throw the ball to YEEthan, so he doesn't have to jump? Answer as a range. (Carl is a really good thrower) **(4)**

b) Using the largest angle possible that you found in the previous question, how long will it take to reach YEEthan? **(4)**

c) Carl decides to throw the football at an angle of 35 degrees. Assuming that YEEthan doesn't move, and Carl throws the ball at the same velocity (35 m/s), will the ball land in front or behind him, and by how much? **(5)**

d) Using the information found from the last question, and that YEEthan is 3 m tall, and can reach 2 m above his head, how high will he have to jump in order to reach the ball without moving back (assume ball is thrown from a height of 0 m)? **(9)**

17. Identify five pairs of action-reaction force pairs in the following diagram. (1 pt. each)



a)

b)

c)

d)

e)

18. Which of the following has the most amount of potential energy? (4)

- A. A car on top of Mt. Everest
- B. A book being read
- C. A car speeding down Mt. Everest
- D. A Fish at the bottom of the Mariana Trench

19. A 1 kg brick falls o a 4 m high roof. It reaches the ground with a velocity of $8.85 \text{ m} \cdot \text{s}^{-1}$. What is the kinetic energy of the brick when it reaches the ground? (3)

20. Determine the kinetic energy of a 625-kg roller coaster car that is moving with a speed of 18.3 m/s. (2)

Answer Key

1. 58800 N or 13230 lb
2. 0 N
3. Impulse = 8 N*s
4. They are equal
5. D
6. 1721.34 M
7. $a=243 \text{ m/s/s}$; $d=406 \text{ m}$
8. $d=704 \text{ m}$
9. Time=1.1 secs; vertical= 1.6 meters
10. a) 1544 J
b) -10.545 m/s
c) 5.687 m/s
d) 1,008.476 J
11. a) -911.4 N
b) 3465.6 N
12. a) 2.192 m
b) 0.1265 m
c) 0.16067 s
13. An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
14. Net Force = Mass * Acceleration
15. For every action, there is an equal or opposite reaction
16. a) 73.52 degrees and 16.48 degrees -
b) 6.85 seconds
c) Behind him by 49.46 m
d) He will have to jump 15.16/18.16 m
17. Sample Answers:
 - a) The elephant's feet push backward on the ground; the ground pushes forward on its feet.
 - b) The right end of the right rope pulls leftward on the elephant's body; its body pulls rightward on the right end of the right rope.
 - c) The left end of the right rope pulls rightward on the man; the man pulls leftward on the left end of the right rope.
 - d) The right end of the left rope pulls leftward on the man; the man pulls rightward on the right end of the left rope.
 - e) The tractor pulls leftward on the left end of the left rope; the left end of the left rope pulls rightward on the tractor.
18. A
19. a) 39.2 J
20. 104, 653.125 J

More questions & answers coming soon!