

Hovercraft

Holt High School Division B Science Olympiad Invitational

February 24, 2018

School Name : _____

Team Number: _____ Team Name: _____

Student 1 Name: _____ Student 2 Name: _____

Instructions

1. You will have at least 20 minutes to take this test
2. This test has two parts. Total points for this test = 18×2 (Part A) + 5×3 (Part B) = 51 points
3. You may take apart the test, but please put the pages in order before turning in
4. Please write legibly and make sure your answers are clearly indicated. Answers must have **correct units**. No partial credit is given.
5. Please write your answers **rounded to 2 decimal places**
6. Please use the approximation of **9.81 m/s^2** for acceleration due to gravity

Part A: Each answers carry 2 points

1. Tendency of an object to do nothing or remain unchanged is called
 - a. Gravity
 - b. Inertia
 - c. Force
 - d. Momentum
2. A 2000 kg car is travelling at a constant velocity of 70 km/h. what is the acceleration experienced by the car? (Unit conversion: 1 Km/h = 0.28 m/s)
 - a. 0 m/s^2
 - b. 19.44 m/s^2
 - c. 19620 m/s^2
 - d. 140000 m/s^2
3. What is the mass of the car, if the car engine has to provide 500 N to accelerate the car at 0.4 m/s^2 ?
 - a. 0 Kg
 - b. 200 Kg
 - c. 1250 Kg
 - d. 1962 Kg
4. Tiger Woods hits a 0.05 kg golf ball with a force of 2.5 N. If the duration of contact of the golf club head and the golf ball is 0.8 seconds, what is the velocity of the golf ball?
 - a. 0 m/s
 - b. 0.1 m/s
 - c. 31.25 m/s
 - d. 40 m/s
5. Compared to the amount of energy required to move a car from rest to 10 m/s, the amount of energy required to move the same car from 10 m/s to 20 m/s is
 - a. $\frac{1}{2}$ times as much
 - b. the same
 - c. twice as much
 - d. three times as much
6. After you sat on a chair, the resultant force on you is
 - a. Zero
 - b. Same as your weight and acts downwards
 - c. Same as your weight and acts upwards
 - d. Same as your weight and acts forward to you
7. In the absence of an external force, a moving object will
 - a. Stop immediately
 - b. Moves at constant velocity
 - c. Goes faster and faster
 - d. Slows down and stops eventually

8. An astronaut is dragging a box on the surface of the moon. If the gravity of moon is $\frac{1}{6}$ th of earth's gravity, what will be the frictional force between box and moon's surface when compared to earth? Assume coefficient of friction at moon and earth are same.
- Same as earth
 - $\frac{1}{6}$ th of earth
 - 6 times as of earth
 - 36 times as of earth
9. A bus travelled 2000 m in 5 minutes from point A to point B and then it took 6 minutes to go back to point A. What is the velocity of the bus for the round trip? (Unit conversion: 1 minute = 60 seconds)
- 0 m/s
 - 6.06 m/s
 - 66.67 m/s
 - 363.64 m/s
10. An object can have northward velocity and southward acceleration.
- True
 - False
11. Momentum is conserved in both elastic collisions and inelastic collisions.
- True
 - False
12. When a ball thrown upward in the air reaches the maximum height, which of the following is true?
- Vertical displacement is zero
 - Vertical component of velocity is zero
 - Vertical component of acceleration is zero
 - Vertical component of force is zero
13. Lionel Messi kicked a soccer ball from the ground with an initial velocity of 25 m/s at an angle of 60° from the ground. How long it will take for the ball to reach the ground again?
- 4.41 s
 - 23.54 s
 - 25.60 s
 - 1500 s
14. At what angle should you throw a ball to reach farthest distance (range)?

15. Thomas the tank engine shunted a 200 kg troublesome truck and made it to move at a velocity of 3 m/s after shunting. If there is no friction between the troublesome truck and the rails, how much energy did Thomas spend on the troublesome truck?
- 0 J
 - 600 J
 - 900 J
 - 1800 J
16. Jane's car stuck in snow and her two friends are helping her to push the car out of the snow. If her friend Bill is pushing the car in forward direction with a force of 300 N and another friend Bob is pushing the car towards leftward direction with a force of 400 N, what is the magnitude of the net force acting on Jane's car?
- 100 N
 - 500 N
 - 700 N
 - 120,000 N
17. Norman kept a 2 kg book at the middle of a wood plank 3 m long and started to raise one end of the wood plank. If the kinetic friction coefficient between wood plank and book is 0.58, at what angle the book will start to slide?
- 0°
 - 30.11°
 - 33.69°
 - 58°
18. A football player lifts a 1.5 kg football to a height of 3 meters. How much work did he do?
- 0 J
 - 4.5 J
 - 11.25 J
 - 44.15 J

Part B: Each answers carry 3 points

19. A propeller fan in a hovercraft produces a thrust force of 20 N. If the total mass of hovercraft is 8 kg, and there is no friction between the hovercraft skirt and the track, calculate the following values.

- a. How long it will take for the hovercraft to travel 5 meters from the starting point?

- b. What will be the velocity of the hovercraft when it reaches 5 meters from the starting point?

c. What will be the acceleration of the hovercraft?

20. A hovercraft of self-mass 2 kg has a lift fan that can produce a static pressure up to 327 Pascal. The bottom air cushion area of the hovercraft is 0.15 m² and from which the area of skirt that contacts the track when fully inflated is 0.01 m². (Hint: $Pressure = \frac{Force}{Area}$)

a. How much the additional mass can the hovercraft lift?

b. If the dynamic friction coefficient between the skirt and track is 0.4, how much force the propeller fan has to spend on overcoming the friction?