2018 Rustin Invitational Hovercraft Test

A.k.a Going from Hover*craft* to Hoover*ball*

Mr S’Voske is a great tinkerer with hovercrafts, but there is not a huge demand for hovercraft tinkerer in the West Chester area, so he aspires to greater things, and more money. One of his get-rich schemes is to become one of the few ninjas in Southeastern Pennsylvania. For some reason, he thinks that this will generate millions in personal income and spends much of his time in training.

Just yesterday, he had an eventful training session. As a warmup, he tried to break a cinderblock in his basement; he punched as hard as he could. The cinderblock was no worse for the wear, but the intense pain in his hand made him wince. This should have been no surprise to him as the cinderblock…

**1.**

1. creates friction with his hand.
2. exerts an equal force back on his hand.
3. exerts double the kinetic energy in the opposite direction.
4. converts momentum into elasticity

“Owy!” he yelled to no one around. “The product of the speed of my fist and the mass of my hand, in other words, the **#2**. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of my punch should have made smithereens of this block. This must be some block! I will have my revenge.” He dropped a 10kg barbell plate on the block from a height of 2 m. Nothing happened. He then dropped a 20kg plate from the same height. The block shattered! “Sweet revenge! I knew this would work, as the kinetic energy of the plate hitting the block was **#3** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that of the first plate.” The pieces skittered across the basement floor, the **#4** \_\_\_\_\_\_\_\_\_\_\_\_\_\_, or the resistance of the pieces to change their motion, made them move quite a distance until the force of **#5**\_\_\_\_\_\_\_\_\_\_\_\_ made them finally come to a resting place many meters away, all of the energy of the pieces….

**6.**

a. became internal energy on the floor.

b. became internal energy on the pieces.

c. was transformed to internal energy and some of it was transferred away by heat and sound waves.

d. was transferred away from the pieces.

After sweeping up, Mr S’Voske stated, “My hurt hand will not affect my workout,” as he slid metal plates onto a barbell bar. He pushed a 20kg plate at a speed of 4m/s into another 20 kg plate. After hitting, they both slid together at speed of **#7**\_\_\_\_\_\_\_\_\_\_\_\_. In all, the mass of the barbell was 200 kg. The weight of this barbell was **#8** \_\_\_\_\_\_\_\_\_\_\_\_\_ N, the most he ever attempted to bench press. The potential energy of the barbell 2m from the floor was **#9** \_\_\_\_\_\_\_\_\_\_. He lay on the bench, lowered the barbell, and pushed it upward at a speed of .5 m/s. The kinetic energy of the barbell was an amazing **#10**\_\_\_\_\_\_\_\_\_! He tried again, and did it! Good job Mr. S’Voske! On the third attempt, he got it part way until his arms give out and 1,000 J of kinetic energy fell at a speed of **#11**\_\_\_\_\_\_\_\_\_\_ right on his sternum. At least he forgot the pain in his hand! “Oh well, I think that’s enough weight training for one day,” he hoarsely declared.

He persistently moved onto the heavy punching bag, 40kg of rags in a bag suspended 4m from the floor, a potential energy of **#12**\_\_\_\_\_\_\_\_\_\_. He punched with a force of 40N for a half-second, the impulse experienced by the bag was **#13**\_\_\_\_\_\_\_\_\_\_. The force on his hand reminded him of the cinderblock damage again! Ignoring this, as ninjas ignore pain, he continued to punch, which set the bag to swinging. When the bag swung away from him, the time of contact became twice as long, which reduced the force of the punch by **#14** \_\_\_\_\_\_\_\_ times the original blow, which lessened the pain in his tender hand, but when the bag swung toward him, the distance was cut in half, increasing the force by **#15** \_\_\_\_\_\_\_\_ times the original punch. After a few of these, he decided to cut this portion of the workout short. He forgot the pain caused by Newton’s **#16** \_\_\_\_\_\_\_\_\_ Law of Motion!

Medicine ball time! He pushes the 10kg ball across the floor at 4m/s2 for one second; the force required to do this was #**17** \_\_\_\_\_\_ N. The kinetic energy of the ball was **#18** \_\_\_\_\_\_\_\_\_\_. After it stopped, he then heaved it into the air at a speed of 1m/s. The kinetic energy as it left his hand was **#19** \_\_\_\_\_\_\_\_\_. When it reached its apex, the kinetic energy was **#20** \_\_\_\_\_\_\_\_\_ and when it finally landed it was **#21** \_\_\_\_\_\_\_\_\_\_. He liked the way this felt and threw it again at an angle of 45 degrees from the floor at the same speed. The ball flew to a height of **#22**\_\_\_\_\_\_\_\_ at its peak and travel across the room a horizontal distance of **#23** \_\_\_\_\_\_\_\_\_\_ in **#24**\_\_\_\_\_\_\_\_\_\_\_. seconds. He kept heaving the ball until he couldn’t bear another toss.

“Wow,” he exclaimed in his exhaustion. “This medicine ball-throwing is a fabulous exercise. I shall immediately give up this ninja thing and try to publish this new workout technique and make millions.” Little did he know that people already knew this way to fitness. This sport, called “Hooverball,” was very popular during the 1930’s, and was played by everyone from Clark Gable, to the inventor of the hovercraft, **#25** \_\_\_\_\_\_\_\_\_\_\_. Well, don’t tell him, as least he isn’t thinking about the pain in his hand and chest!

Hovercraft Answer Sheet School \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Names \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Hovercraft Answer Key School \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team # \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Names \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. \_\_\_\_\_momentum\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_double\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_inertia\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. \_\_\_\_\_friction\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. \_\_\_\_\_\_c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. \_\_\_\_\_\_2 m/s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. \_\_\_\_\_\_1960\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. \_\_\_\_\_\_3920J\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. \_\_\_\_\_\_25J\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. \_\_\_\_\_\_3.16 m/s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. \_\_\_\_\_\_\_\_1568J\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
13. \_\_\_\_\_\_\_\_20n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
14. \_\_\_\_\_\_\_\_1/2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
15. \_\_\_\_\_\_\_\_2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
16. \_\_\_\_\_\_\_\_3rd\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
17. \_\_\_\_\_\_\_\_\_40\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
18. \_\_\_\_\_\_\_\_\_\_80J\_\_\_\_\_\_\_\_\_\_\_\_\_\_
19. \_\_\_\_\_\_\_\_\_\_5J\_\_\_\_\_\_\_\_\_\_\_\_\_\_
20. \_\_\_\_\_\_\_\_\_\_0J\_\_\_\_\_\_\_\_\_\_\_\_\_\_
21. \_\_\_\_\_\_\_\_\_\_5J\_\_\_\_\_\_\_\_\_\_\_\_\_\_
22. \_\_\_\_\_\_\_\_\_2.5cm\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
23. \_\_\_\_\_\_\_\_\_5cm\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
24. \_\_\_\_\_\_\_\_.1 sec\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
25. \_\_\_Christopher Cockerell\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_