Physics@Mac Online Physics Competition
November 27, 2014

1. How many atoms make up your body?

    a) 10^{28}
    b) 10^{25}
    c) 10^{22}
    d) 10^{19}

2. A short length of circular tubing has both its open ends covered with plastic wrap that forms a waterproof seal. When this is placed underwater, the water pressure causes the plastic wrap to flex and form a concave lens filled with air. A fish swims by in the distance. The lens forms an image of the fish that is:

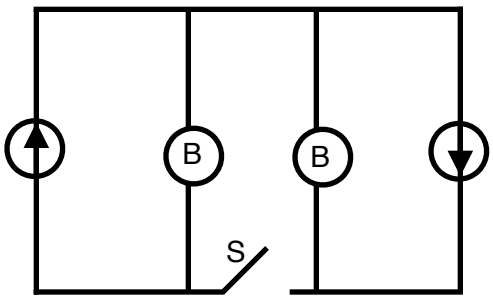
    a) real and inverted
    b) real and upright
    c) virtual and upright
    d) virtual and inverted

3. A mass of 500 g is attached to the bottom of a spring attached to the ceiling, and has a spring constant of 10 N/m. The mass is then released from rest with the spring in its unstretched state. What is the magnitude of the net work done on the mass between the point where it was released and the lowest point that it reaches?

    a) 4.9 J
    b) 2.4 J
    c) 1.2 J
    d) 0 J

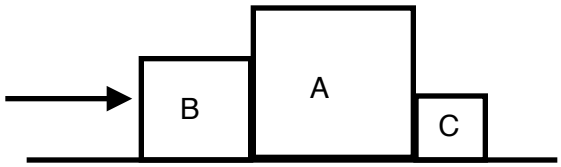
4. The circuit symbol  represents an ideal current source. When connected in a circuit, it delivers a fixed electrical current flowing in the direction of the arrow. The circuit below has two identical current sources, two identical light bulbs B, a switch S, and wires. Initially the switch is closed, and then it is opened. Comparing the closed to open conditions, the light bulbs.

    a) are initially bright and stay bright
    b) are initially bright but turn dark
    c) are initially dark but turn bright
    d) are initially dark and stay dark

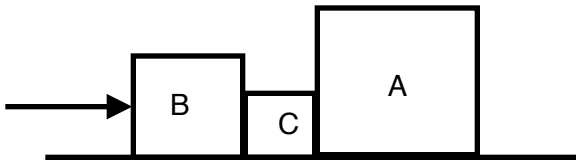


5. You are going to push three blocks of different masses, $m_A > m_B > m_C$, across a frictionless surface with a constant force, as shown in the figure below. How would you arrange the blocks so that the net force on the middle block is smallest?

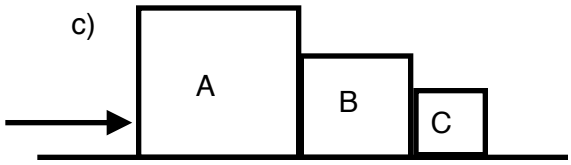
a)



b)



c)



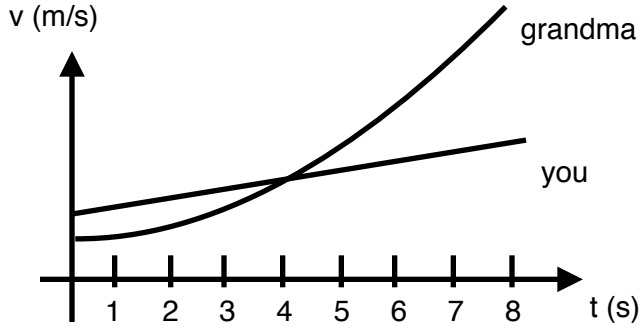
d) The arrangement does not have any effect on the force on the middle block. They are all the same.

6. A car crosses a bridge 2 kilometres in length. In the first kilometre the car travels at a speed of 30 km/h. At what speed must it travel down the second kilometre such that it's average speed is 60 km/h?

a) 60 km/h
b) 90 km/h
c) 120 km/h
d) It is not possible

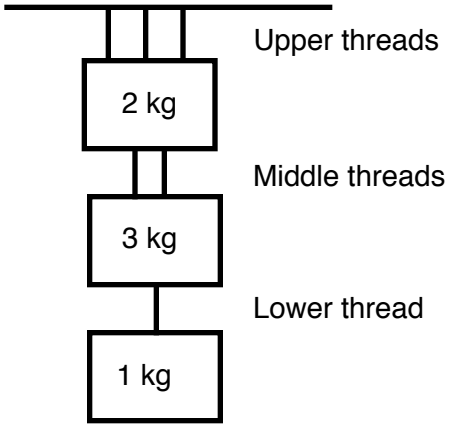
7. You have a running race against your grandma. You take the lead early in the race; however, grandma eventually overtakes you to win. Based on the velocity-time graph provided, which time best describes the instant when grandma catches up to you?

a) at about t = 2 seconds
b) at about t = 4 seconds
c) at about t = 7 seconds
d) at about t= 14 seconds

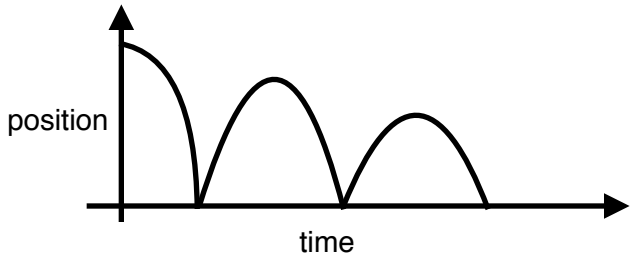


8. Three masses are hanging by threads from the ceiling of an elevator as shown in the diagram. The elevator begins to accelerate upwards. Assuming that all of the six threads are perfectly identical, which thread(s) is (are) most likely to break?

a) the upper threads
b) the middle threads
c) the lower thread
d) the upper and middle threads are equally likely to break

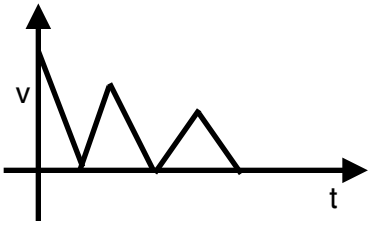


9. A tennis ball is released from about a meter off the floor and bounces several times straight up and down. Its vertical position as a function of time is shown.

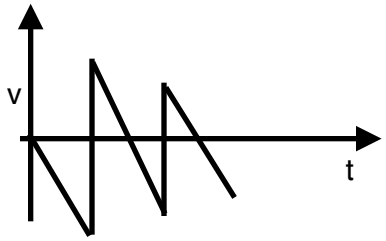


Over the same time interval, which of the sketches below best represent the tennis ball's velocity as a function of time?

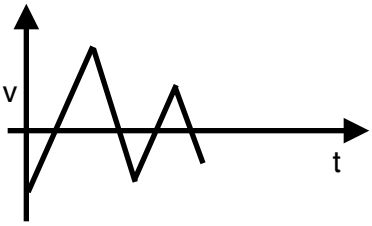
a)



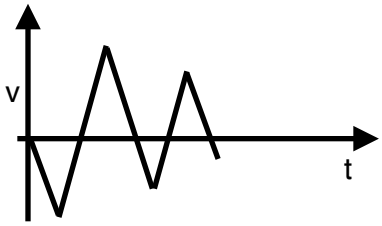
b)



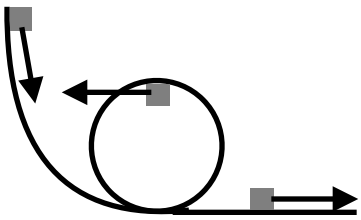
c)



d)



10. A small block slides down a frictionless track, around the inside of a loop-the-loop, and then onto a flat segment, never losing contact with the track. Which of the free-body diagrams best describes the block at the top of the loop?



a)

b)

c)

d)