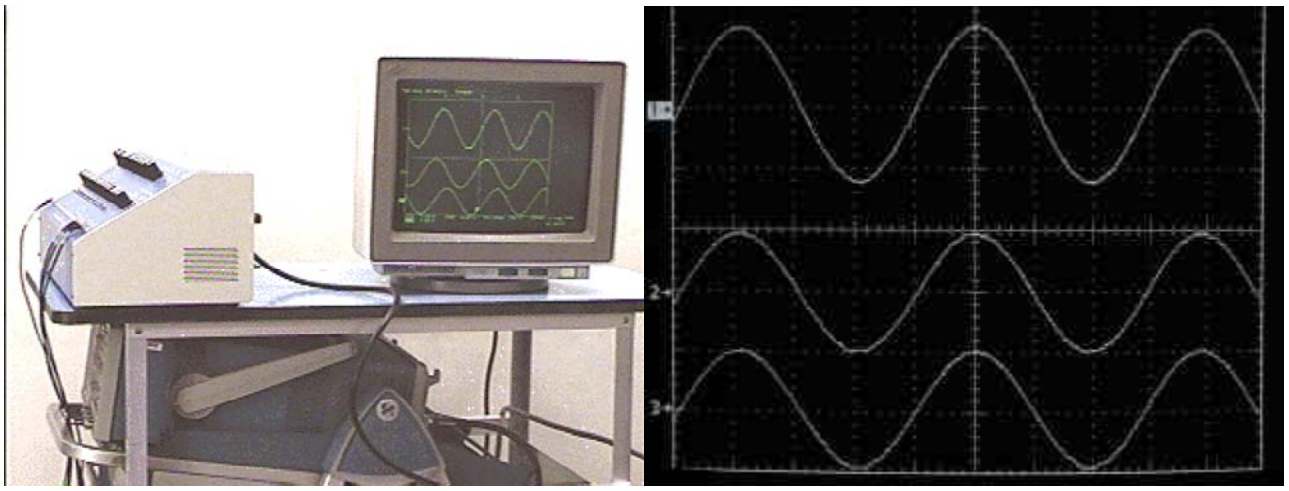
Question #213

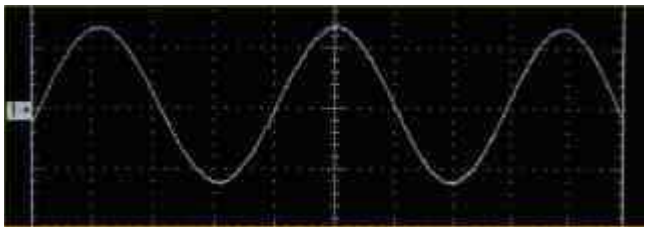
Using a *Fourier Synthesizer*, designed and constructed at the University of Maryland, we can study standing waves by displaying the waves using an oscilloscope. Two identical component waves moving in opposite directions can be added at a series of times to obtain the sum waves at those particular times. One such addition is shown in the photograph at the right below, the equipment used for the experiment is shown at the left.



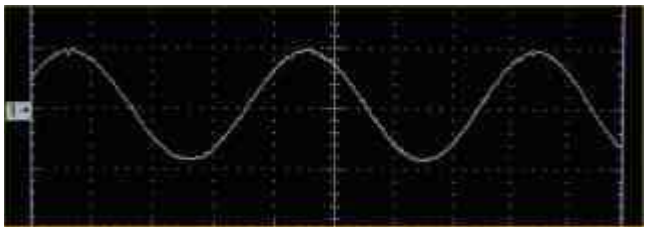
Suppose that we take two infinite waves, a segment of each being shown in the photograph at the right above in the region where they overlap. Now further suppose that the wave in the center moves to the left and the wave on the bottom moves to the right, both at the same wave speed, and the sum wave is seen on the trace at the top at a series of time intervals. The time interval will be exactly one-sixteenth of a period of the waves shown, so after sixteen such steps both the individual waves and their sum should be exactly the same, as seen in the picture on the right above.

Shown below are a number of possible sum waves that might be produced at some time during one period of the motion described above. On the other hand, some of these waves will not be produced as standing waves by these two components due to a number of possible issues.

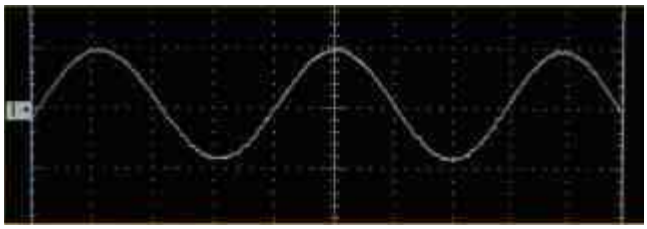
(a)

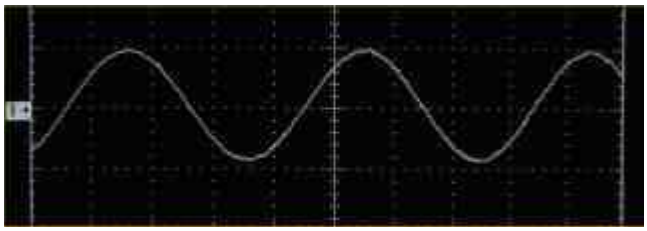


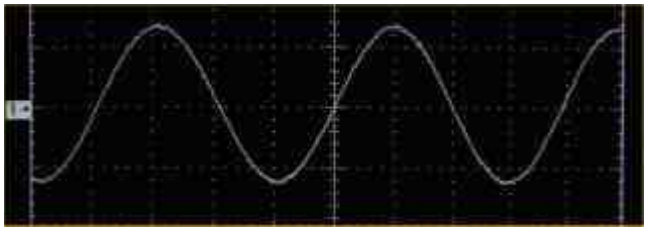
(b)

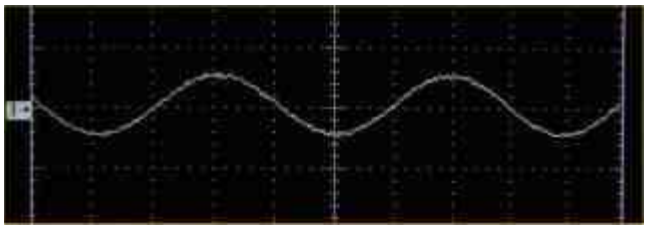


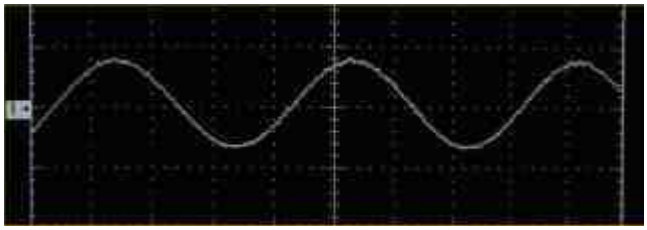
(c)

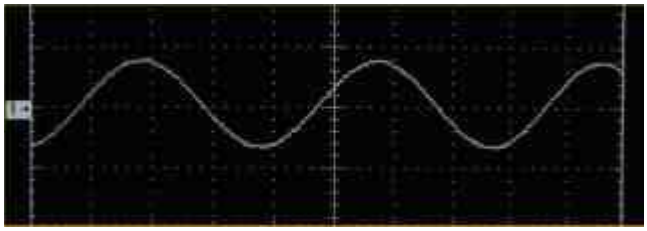


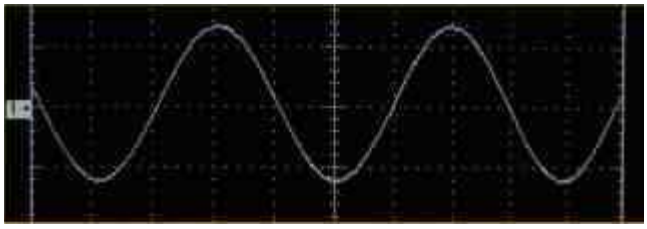
(d) 

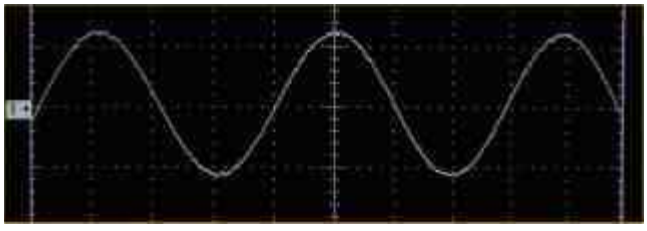
(e) 

(f) 

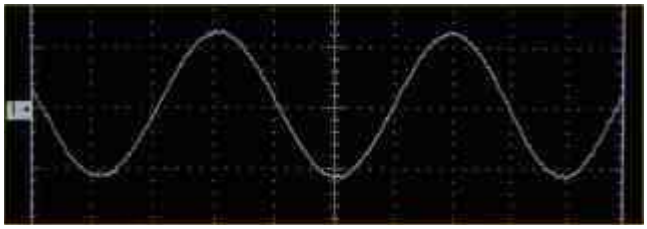
(g) 

(h) 

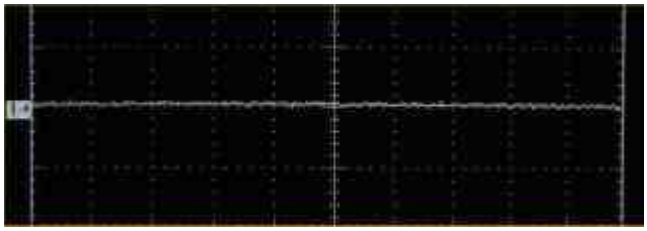
(i) 

(j) 

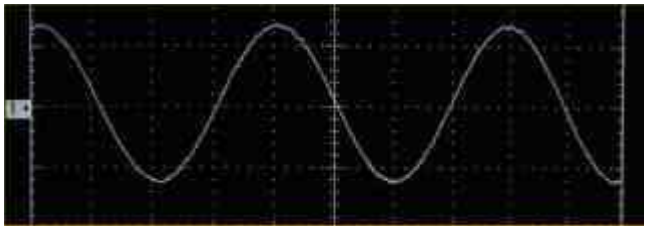
(k)



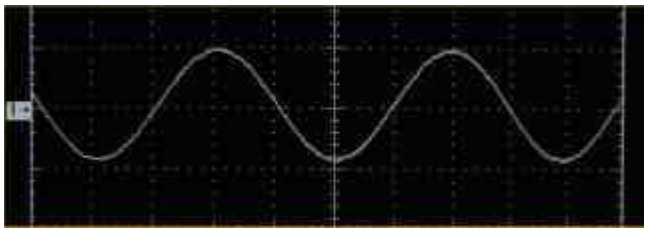
(l)



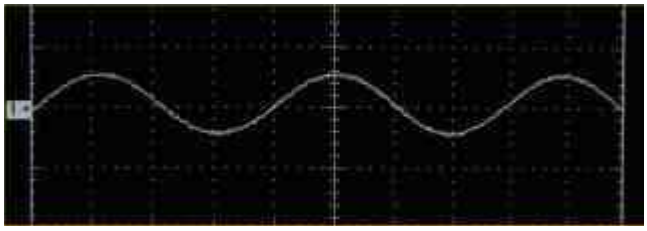
(m)



(n)



(o)



You are to identify, from the waves shown above, which of the waves will be created by adding the two identical component waves as they move with the same speed in opposite directions.

The answer to be given next week will include not only which waves are and are not possible, but also how all of these waves are produced. The second part of this question then is to determine by any means available just how the "phony" standing waves were produced.

As a guide in organizing your thoughts: check which of the following waves are actual standing waves produced at some time in the cycle of the two components described.

- (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)

- (h)
- (i)
- (j)
- (k)
- (l)
- (m)
- (n)
- (o)

Click here for Answer #213 after March 21, 2005.

Question of the Week

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For questions and comments regarding the *Question of the Week* contact Dr. Richard E. Berg by e-mail or using phone number or regular mail address given on the Lecture-Demonstration Home Page.