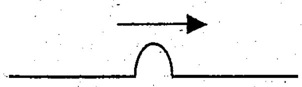
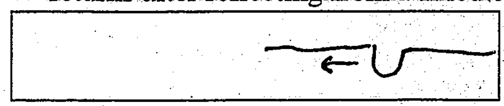
Mechanical Waves Problems

KEY ?

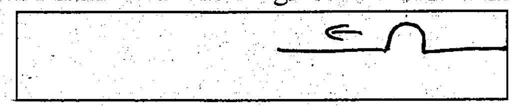
1.



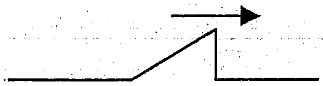
a. In the box below, draw the pulse as it returns after reflecting from a fixed end.



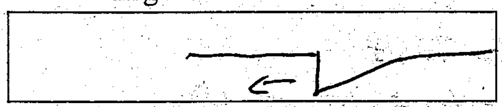
b. Draw the pulse as it returns after reflecting from a free end.



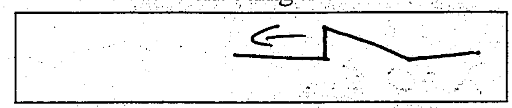
2.



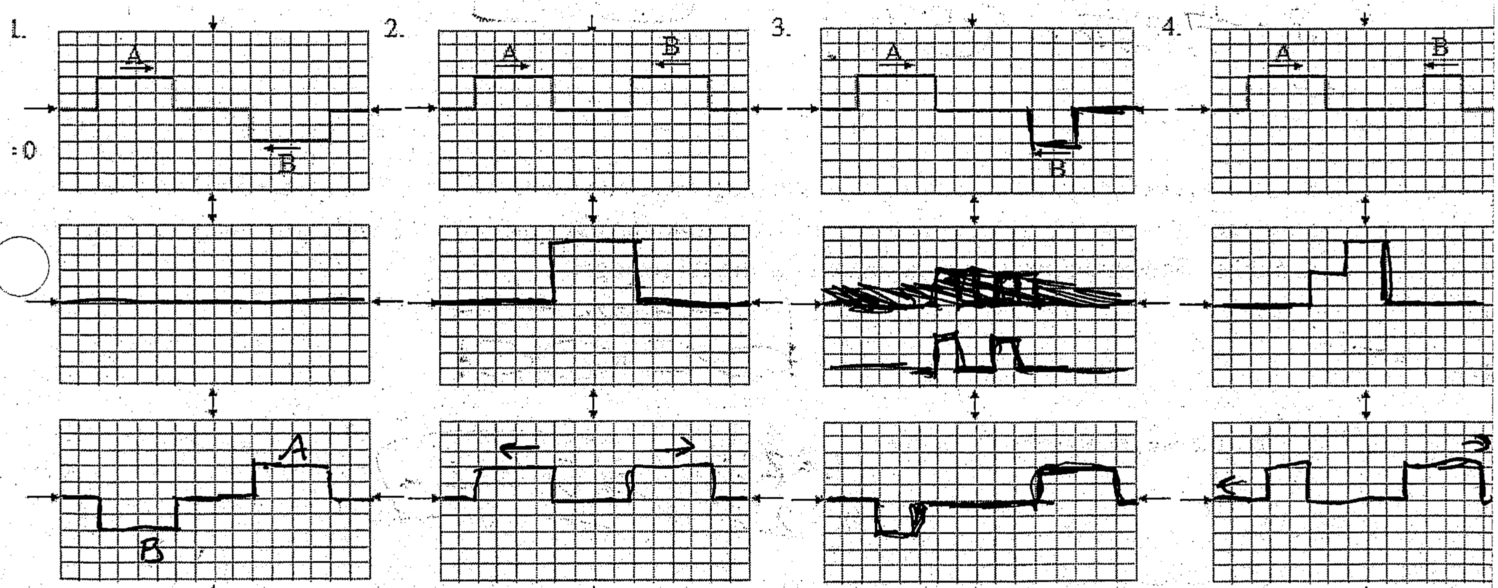
a. Draw the pulse as it returns after reflecting from a fixed end.



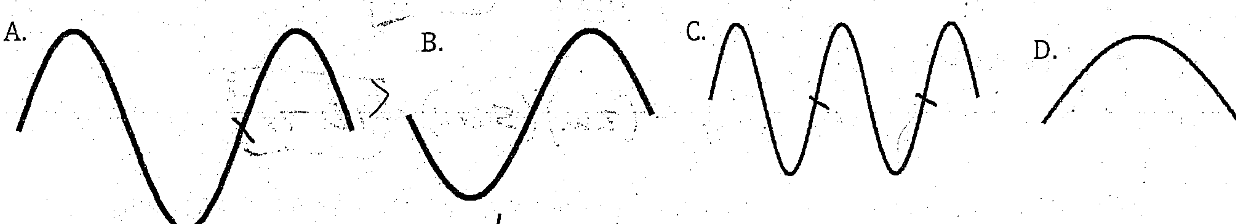
b. Draw the pulse as it returns after reflecting from a free end.



3. Draw the following waves when the completely overlap. Then sometime soon after they arrived at the center.



5. Below are a number of series of waves. Underneath each diagram write the numbers of waves in the series.



A. 1.5

B. 1

C. 2.5

D. 0.5

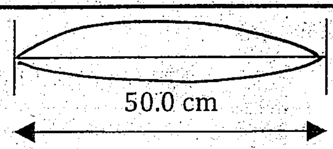
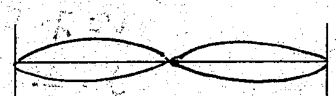
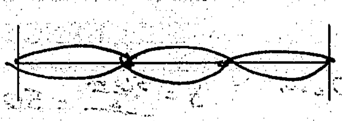
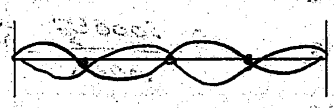
a. Which of the above has the biggest amplitude? A + D

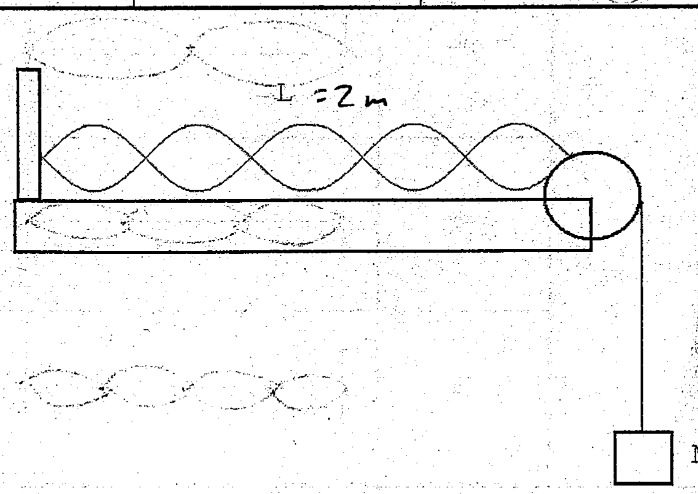
b. Which of the above has the shortest wavelength? C

c. Which of the above has the longest wavelength? D

10. The same string is attached to a hanging mass of 400 g. The linear density and the length of the string have not changed. The wave speed increased to 70.7m/s. Explain why.

11. Complete the chart for the first four modes of vibration.

MODE	DIAGRAM	WAVELENGTH	FREQUENCY	WAVE SPEED
1st	 50.0 cm	$\frac{1}{2}\lambda = 50cm$ $\lambda = 100cm = 1m$	$f = \frac{v}{\lambda}$ $f = \frac{70.7 m/s}{1m} = 70.7Hz$	70.7 m/s
2nd		$1\lambda = 50cm = 0.5m$	$f = \frac{70.7 m/s}{0.5m} = 141.4 Hz$	"
3rd		$\frac{3}{2}\lambda = 50cm$ $\lambda = 33.3cm$ $\lambda = 0.33m$	$f = \frac{70.7 m/s}{0.33} = 212 Hz$	"
4th		$2\lambda = 50cm$ $\lambda = 25cm$ $\lambda = 0.25m$	$f = \frac{70.7 m/s}{0.25m} = 282.8Hz$	"



12. A string that is a length of 2.0 m resonates in five loops as shown above at a frequency of 15Hz.

a. What is the wavelength?

$L = 2m = \frac{5}{2}\lambda$

$\lambda = 0.8 m$

b. What is the wave speed?

$V = \lambda \cdot f$

$V = (0.8 m)(15 Hz)$

$V = 12 m/s$

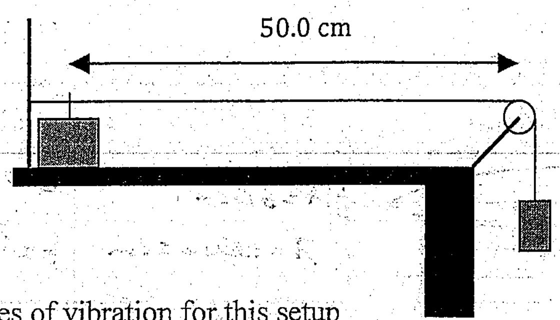
c. What will happen to the number of loops if the suspended mass is increased? Explain

*Keeping f constant

increased tension => increased velocity: ↑V = f λ↑

if f is constant then λ will have to increase so the number of loops will decrease.

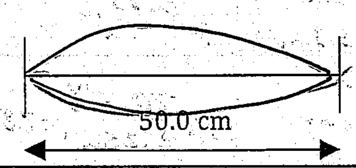
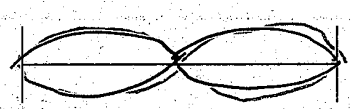
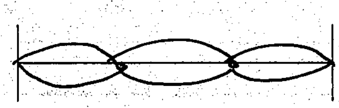
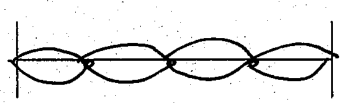
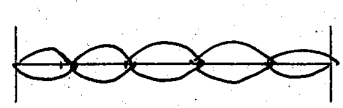
9. A string is fixed between the wave driver and pulley located 50.0 cm apart. A 200. g mass is atteched to the end of the string providing the tension. When a wave generator vibrates at 150. Hz the string resonates in the third mode.

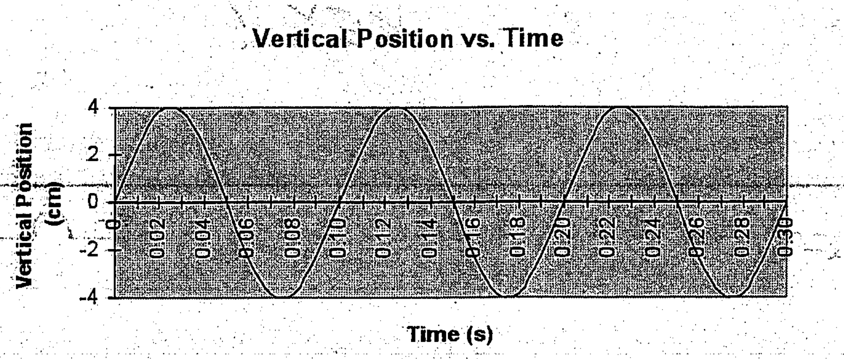


a. Sketch the first 5 modes of vibration for this setup
b. Find the wavelength for each of these modes
c. Determine the speed of the wave for each of these modes
d. Determine the resonant frequency for each of these modes

$V = \lambda \cdot f$

$f = \frac{v}{\lambda}$

MODE	DIAGRAM	WAVELENGTH	FREQUENCY	WAVE SPEED
1st		$\frac{1}{2}\lambda = 50cm$ $\lambda = 100cm$ $\lambda = 1m$	$f = \frac{50 m/s}{1m} = 50Hz$ $f = \frac{5000 cm/s}{100cm} = 50Hz$	50 m/s 5000 cm/s
2nd		$1\lambda = 50cm$ $\lambda = 50cm$ $\lambda = 0.5m$	$f = \frac{50 m/s}{0.5m} = 100Hz$	"
3rd		$\frac{3}{2}\lambda = 50cm$ $\lambda = 33.3cm$ $\lambda = 0.3\bar{3}m$	150. Hz	" 50 m/s 5000 cm/s
4th		$2\lambda = 50cm$ $\lambda = 25cm$ $\lambda = 0.25m$	$f = \frac{50 m/s}{0.25m} = 200Hz$	"
5th		$\frac{5}{2}\lambda = 50cm$ $\lambda = 20cm$ $\lambda = 0.2m$	$f = \frac{50 m/s}{0.2m} = 250Hz$	"



6. Use the position time graph above to determine the following if the wavelength was 0.5m: amplitude, period, speed, and frequency.

$\lambda = 0.5m$

$T = 0.10s$

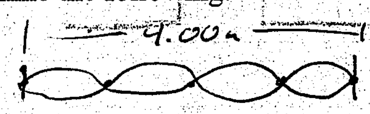
$f = \frac{1}{T} = \frac{1}{0.10s} = 10 Hz$

$V = \lambda \cdot f$

$V = (0.5m)(10 Hz)$

$V = 5 m/s$

7. Two physics students are setting up a standing wave 4.00 meters apart. There were 5 nodes produced in the standing wave. One student moves her hand from the rest position back and forth along the floor 20 times in 4.00 s. Sketch the situation and determine the following:



a. the wavelength of the wave

$L = 2\lambda$

$4m = 2\lambda$

$\lambda = 2m$

b. the frequency of the wave produced

$f = \frac{wave}{Time} = \frac{20 waves}{4.00s} = 5 Hz$

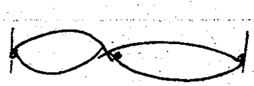
c. the speed of the wave

$V = \lambda \cdot f = (2m)(5Hz) = 10 m/s$

8. What frequency and period would be required for the students to produce a standing wave with three nodes?

$V = 10 m/s$

$L = 4.00m = 1\lambda$



$f = \frac{V}{\lambda}$

$f = \frac{(10 m/s)}{4.00m}$

$f = 2.5 Hz$

$T = \frac{1}{f}$

$T = \frac{1}{2.5Hz}$

$T = 0.4s$