Name _____ Date _____
Regents Physics Lab #26R
Period _____ Mrs. Nadworny

Partners: Due Date _____

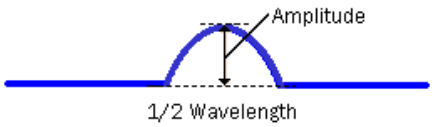
# Waves on a Spring

NO Lab Write-Up Required

**Materials:**
- Slinky
- stopwatch
- meter stick

**Procedure:**

**Part One – Wave Properties**




1. Go where there is plenty of room to stretch your spring, like the hallway or back of the classroom.
2. *Place your spring on the floor.* Have one partner hold each end and stretch it for a few meters so that it is not too loose or too tight.
3. Have one partner hold their end firm. The other partner should shake their end to one side and back with their hand quickly, once. Watch the pulse produced in the spring as it travels down the spring.
    a. Sketch what it looks like in the space below for this single pulse. (3 pts)

4. Now you are going to create more pulses, but with different amplitudes. Change how far to the side you move your hand to see what change in hand motion affect amplitude. Keep the speed of your hand the same.
    a. How do you create tall (large amplitude) pulses? (2 pts)

    _____

    b. How do you create short (small amplitude) pulses? (2 pts)

    _____

5. Now you are going to create more pulses, but with different wavelengths. Change how quickly you move your hand to the side to see what change in hand motion affect amplitude. Keep the distance you move your hand the same.
    a. How do you create wide (large wavelength) pulses? (2 pts)

    _____

    b. How do you create narrow (small wavelength) pulses? (2 pts)

    _____

6. Finally, you are going to experiment with changing the tension in the spring. Change the distance between the two lab partners. Observe the spring, its behavior and pulse motion.

    a. How do you create a tense/tight spring? (1pt) _____

    b. How do you create a loose spring? (1pt) _____

## Part Two – Wave Speed

**Research Question:** How does the tension of a spring, the amplitude of a pulse and the wavelength of a pulse affect the speed of the pulse?

**Experiment #1-** How does the tension of the spring affect the speed of a pulse?

Hypothesis: (2 pts)

Variables: (6 pts)

Independent –

Dependent –

Constants/Controls –

Procedure:

1. Stretch the spring so that it is a tense/tight spring. Record the distance between lab partners to the nearest whole centimeter. Convert to meters.
2. One partner should send a single pulse to the other partner.
3. Measure and record the time it takes for the pulse to travel from one partner to the other.
4. Repeat steps 1 -3 while decreasing the tension in the spring.
5. Calculate the speed of the pulses.
6. Calculate the range of the speeds.

Data Collection: (5 pts)

| Tightness | Distance (cm) | Distance (m) | Time (s) | Speed (m/s) |
|---|---|---|---|---|
| **Tight Spring** | | | | |
| **Normal Spring** | | | | |
| **Loose Spring** | | | | |
| | | | **Range = high - low:** | |

Data Processing: Show a sample calculation for the speed using the GUESS method. (5 pts)

**Experiment #2-** How does the amplitude of the pulse affect its speed?

Hypothesis: (2 pts)

Variables: (6 pts)

Independent –

Dependent –

Constants/Controls –

Procedure:

1. Stretch the spring so that it is a normal spring. Record the distance between lab partners to the nearest whole centimeter. Convert to meters. This value should not change.
2. One partner should send a single tall pulse to the other partner.
3. Measure and record the time it takes for the pulse to travel from one partner to the other.
4. Repeat steps 2 -3 while decreasing the amplitude of the pulse.
5. Calculate the speed of the pulses.
6. Calculate the range of the speeds.

Data Collection: (5 pts)

| Height | Sketch (a single pulse) | Distance (cm) | Distance (m) | Time (s) | Speed (m/s) |
|---|---|---|---|---|---|
| **Tall pulse** | | | | | |
| **Normal pulse** | | | | | |
| **Short pulse** | | | | | |
| | | | **Range = high - low:** | | |

Data Processing: Show a sample calculation for the speed using the GUESS method. (5 pts)

**Experiment #3-** How does the wavelength of the pulse affect its speed?

Hypothesis: (2 pts)

Variables: (6 pts)

Independent –

Dependent –

Constants/Controls –

Procedure:

1. Stretch the spring so that it is a normal spring. Record the distance between lab partners to the nearest whole centimeter. Convert to meters. This value should not change.
2. One partner should send a single wide pulse to the other partner.
3. Measure and record the time it takes for the pulse to travel from one partner to the other.
4. Repeat steps 2 -3 while decreasing the wavelength of the pulse.
5. Calculate the speed of the pulses.
6. Calculate the range of the speeds.

Data Collection: (5 pts)

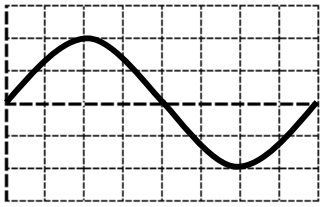
| Width | Sketch (a single pulse) | Distance (cm) | Distance (m) | Time (s) | Speed (m/s) |
|---|---|---|---|---|---|
| **Wide pulse** | | | | | |
| **Normal pulse** | | | | | |
| **Narrow pulse** | | | | | |
| | **Range = high - low:** | | | | |

Data Processing: Show a sample calculation for the speed using the GUESS method. (5 pts)

**Part Three – Making Waves** (3 pts each)

1. Place your spring on the floor. Stretch the spring back to its normal length.
2. Have one partner hold their end firm. The other partner should shake their end to one side and back again repeatedly, at a moderate rate, to make a series of pulses.
3. Sketch what you see in the space below.

**Normal size:**

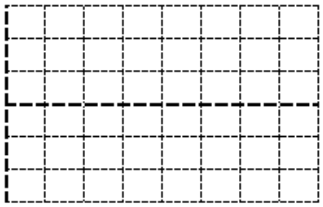


A = _____

λ = _____

4. Now, keep the width of the pulse the same as the normal wave, but change the height. Shake some taller pulses and some shorter pulses. Sketch what you see on the spring in the space below for tall pulses and for short pulses.

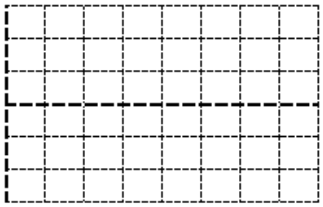
**Tall size:**



A = _____

λ = _____

**Short size:**

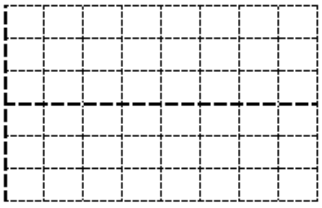


A = _____

λ = _____

5. Now, keep the height of the pulses the same as the normal wave, but change the width. Shake some pulses that are wider and some pulses that are narrower. Sketch what you see on the spring in the space below for wide pulse and for narrow pulses.

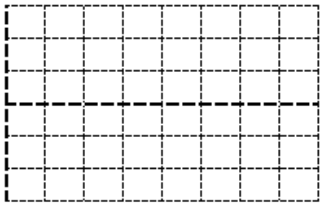
**Wide size:**



A = _____

λ = _____

**Narrow size:**



A = _____

λ = _____

**Post-Lab Questions:** (3 pts each)

1. Describe what happens to a pulse as it travels down the spring (ex – speed, size, shape)

   _____

   _____

2. Does the speed of a wave measure how fast the wave moves from end to end or how fast the particles move side to side?

   _____

   _____

3. Only one factor should have affected the speed of the wave. Which one was it? Support using your results and class notes.

   _____

   _____

   _____

4. Two of the factors should not have affected the speed of the wave. Which two were they? Support using your results and class notes.

   _____

   _____

   _____

5. What is the relationship between the amplitude of a pulse and the energy required to make the pulse? Explain.

   _____

   _____

6. What is the relationship between the wavelength of a pulse and the energy required to make the pulse? Explain.

   _____

   _____

7. What is the relationship between wavelength and frequency? Explain.

   _____

   _____