TECHNOLOGY EDUCATION LEARNING ACTIVITY

SYSTEM TITLE: Electricity/Electronics

COURSE TITLE: AC Electricity

COURSE LENGTH: Full year

ACTIVITY: Learning Package - Oscilloscope & Signal Generator Usuage

TIME: 4 Class periods

OBJECTIVES: The student will be able to:

- identify the controls of a triggered single trace oscilloscope.
- identify the controls of a sign and square wave signal generator.
- measure ac waveforms with the oscilloscope.
- measure DC waveforms with the oscilloscope.
- measure and calculate the frequency of ac signals with the oscilloscope.

AC ELECTRICITY
Learning Package
Oscilloscope & Signel Generator

NAME________________________________

DUE DATE____________

PERFORMANCE OBJUCTIVES:

A. Identify the controls of a triggered single trace oscilloscope.
B. Measure ac waveforms with the oscilloscope and an Electronic VOM using a sine-square wave signal souce.
C. Measure DC voltages with the oscilloscope and an Electronic VOM.
D. Measure the frequency of ac signals using the calibrated time base of the oscilloscope.

BASIC CONCEPTS:

1. An oscilloscope visually displays instantaneous (real-time) and peak values of voltage and current.
2. An oscilloscope graticule (grid, mask, grating) is a transparent scale with vertical and horizontal markings that allow time and amplitude to be measured directly.
3. An oscilloscope can be used in place of a voltmeter to measure DC or ac voltages.

INTRODUCTORY INFORMATION:

A wide variety of instruments are used in electronics to measure the amplitude and frequency of ac signals. The oscilloscope here after refered to as scope is one of these instruments. It not only measures amplitude and frequency but in addition, displays the shape (waveform) of the signal. With an scope you can check waveforms that are vital to radio, television, high quality sound equipment, computers, radar and a host of other devices.

The principal components of the scope are a cathode-ray tube (CRT), horizontal deflection circuit, vertical deflection circuit, and high and low voltage power supplies.

Basically, the CRT contains an electron gun and sets of horizontal and vertical deflection plates. The electron gun produces and focuses an electron beam on a phosphorescent coating on the inside face of the tube. This causes a visible spot to appear on the face of the tube when viewed from the front. When voltages are appled to the deflection plates from the horizontal and vertical deflection circuits, the electron beam, and thus the spot, is made to move by the combined effect of the two deflection voltages. The trace appears as a visible pattern on the screen.

The CRT screen usually covered by a transparent overlay, called a gratucule, which has a grid pattern graduated in centimeters. Each centimeter represents one division. The two axes (X and Y) of the graticule are used with the horizontal and vertical deflection circuits to measure time and amplitude directly from the displayed waveform.

The horizontal deflection circuit supplies voltages to the horizontal deflection plates which causes the electron beam to move or sweep across the face of the CRT. The circuit includes a calibrated sweep control for adjusting the number of sweeps per second so that time and frequency measurements can be made.

The vertical deflection circuit is the circuit to which the signal to be measured is generally applied. It supplies a voltage to the vertical deflection plates of the CRT which causes the tract to move up and down. A calibrated vertical gain control allows the vertical deflection to be measueed. High and low voltage power supplies provide operating voltages for the CRT and the oscilloscope circuits.

Scopes can be classified as free-running or triggered, with single, dual or multiple-trace capabilities. In the free-running scope, display stability is achieved by synchronization, whereby a seperate signal, usually taken from the vertical deflection circuit, is applied to the horizontal sweep circuit to cause it to sweep in time with the vertical signal. In the triggered scope, the horizontal sweep circuits produce a sweep only when triggered. This is usually accomplished by a signal from the vertical diflection ciruit, or from an external source related to the signal to be observed which, when applied to the sweep circuit, produces a sweep that coincides with the vertical input signal. Both types of scopes can be used to display waveforms, but the triggered scope is easier to use since it has a stable display and allows time and frequency measurements to be made.

In this laboratory exercise you will become familiar with a triggered, single-trace scope. However,in the future you may be exposed to different instruments with features and controls for extended capabilities. The procedures described in this laboratory exercise apply to the Xetex single trace triggered scope.

REFERENCES:

"The XYZ's of Using A Scope" by Tektronics
Instruciton manuals - Xetex oscilloscope
- LIS

INSTRUMENTS AND COMPONENTS:

Xetex Oscilloscope
LIS
#49 Power Supply
Graph Paper
Scope Leads
ac Power cord

EXPERIMENTAL PROCEDURE:

1. To check out the operation of the scope, set the scope controls to the initial operating positions as follows.
   A. Get the scope out of the station. Place on top of the station and plug into an ac receptical
   B. Turn BRILLIANCE ON/OFF control to ON and allow a few monents for the trace to appear. (Acceptable trace color - Light Blue)
   C. Center the trace. Adjust the Y-SHIFT control so the trace is on the center line of the graticule. Adjust the X-SHIFT control so the left end of the trace is lined up with the left edge of the graticule.
   D. Adjust the FOCUS control until the trace looks sharp and bright.
   E. Adjust the INT-EXT slide switch to INT.
   F. Adjust the TRIGGER MODE switch to the **Norm** mode position.
   G. Adjust the +/- slide switch to +.

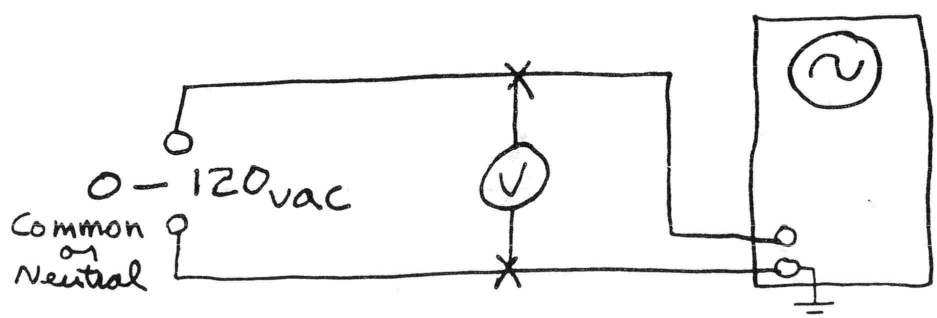
H. Stablize the trace (adjust it so it stops flipping or moving from side to side) by doing the following steps.

1. Adjust the TRIGGER LEVEL control so it is just off the "auto" position.
2. Adjust the STABILITY control so the trace just blanks out.
3. Turn the TRIGGER LEVEL control to the "auto" position. The trace should return and should be stationary. If not adjust slightly the STABILITY control.
4. Redue as needed steps 1, 2, & 3 each time you adjust the TIME/CM control.

I. Get scope leads (called X1 probe or direct probe) from the leads rack and blug into YIN jacks. Make sure ground on leads matches ground jack of scope.

2. Connect the ckt as shown in Figure 1. Connect the scope and voltmeter across the 120v ac power cord. Make sure the YIN lead is conneected to the hot side of the power cord and ground lead to the neutral side. Plug the power cord into the 0-120vac receptical on the #49 Power Supply. Set the voltmeter for a 200v range. Adjust the scopes TIME/CM control to the **1msec** position and the AC-DC slide switch to **AC.**

Figure 1.



3. Turn on and vary the power source. Observe the trace as you vary the power source. Describe your observations of the change in shape and height of the trace.

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4. Set the VOLTS/CM control to the .5v position. Adjust the power source for an observed 3vp-p, 3 cycle trace. Adjust the VARIABLE TIME control to get the three cycles. Draw the wave form, in graticule number 4 on the supplied graph paper. Lable the drawing with your VOLTS/CM control settings.

5. Fill in Table 1.

A. Calculate the peak to peak values and record in Table 1.

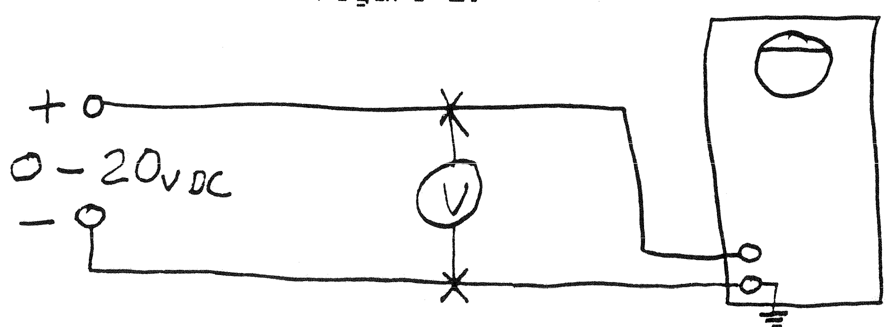
B. Adjust the power source for each of the 6 voltage values. Measure and record the peak to peak values in the table. Make sure the FINE GAIN control is set at CAL(calibrate).

Table 1.

Voltmeter ac rms readings	Calculated v p-p values	Scope measurements p-p values
2v		
8v		
15v		
25v		
75v		
110v		

6. Connect the ckt shown in Figure 2. Connect the scope and voltmeter to the DC power supply. Adjust the scopes VOLTS/CM and TIME/CM controls as in Step 2. Set the AC/DC slide switch to "DC".

Figure 2.



7. Turn on and vary the power source. Observe the trace as you vary the power source. Describe your observations of the change in shape and height of the trace.

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8. Set the VOLT/CM control for the "1v" position and leave the TIME/CM control as is. Adjust the power source for a 3vDC trace. Draw the wave form, in graticule number 8 on the supplied graph paper. Lable the drawing with your VOLTS/CM and TIME/CM control settings.

9. Fill in Table 2.
   A. Adjust the power source for each of the 4 voltage values. Measure and record the values in the table. Make sure the FINE GAIN control is set at CAL(calibrate).

Table 2.

DC Voltage Readings	Scope measurement vDC Readings
2.3v	
7.5v	
11.7v	
18.9v	

10. Adjust the AC-DC slide switch to "AC". Turn on and vary the power source. Observe the trace as you vary the power source. Describe your observations of the change in shape and height of the trace.

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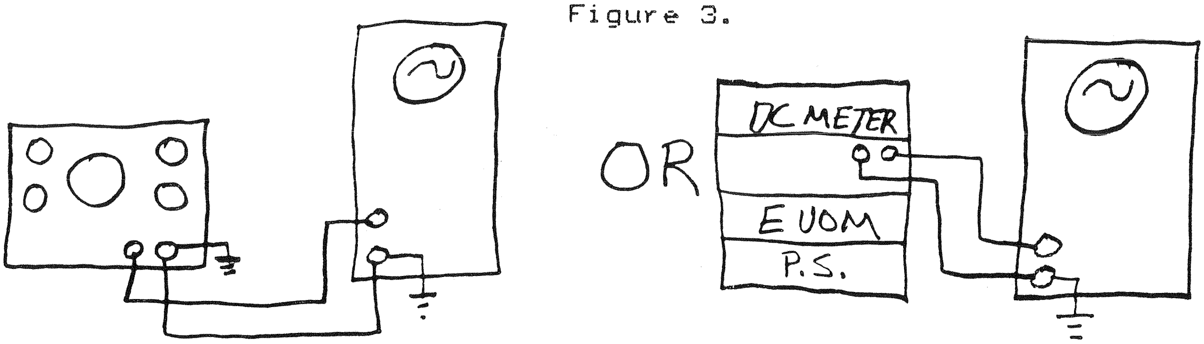
11. Connect the ckt shown in Figure 3. Attach your scope leads to the AF Signal Generator, making sure the ground lead of the scope is connected to the negative jack of the generator and the Y-in lead is connected to the positive jack.

Figure 3.



12. Adjust the generator for a 1kHz signal. Adjust the gererators lever adjust control so a 2vp-p trace is displayed on the scope face. Adjust the scope controls so 4 cycles are displayed. Draw the wave form, in graticule number 12 on the supplied graph paper. Lable the drawing with your VOLTS/CM and TIME/CM control settings.

13. Adjust the generator for a frequency and peak to peak voltage (of your own choosing) as displayed on the scope. Record your chosen frequency and voltage values.

f = ____________________________ Ep-p = ________________________

14. Make sure your FINE GAIN and VARIABLE TIME control is set on CAL. Draw the wave form, in graticule number 14 on the supplied graph paper. Lable the drawing with your VOLTS/CM and TIME/CM control settings.

15. Using the supplied formula for finding an unknown frequency(can be used with most any scope), calculate the frequency from Steps 13 & 14. Show all work in the space provided.

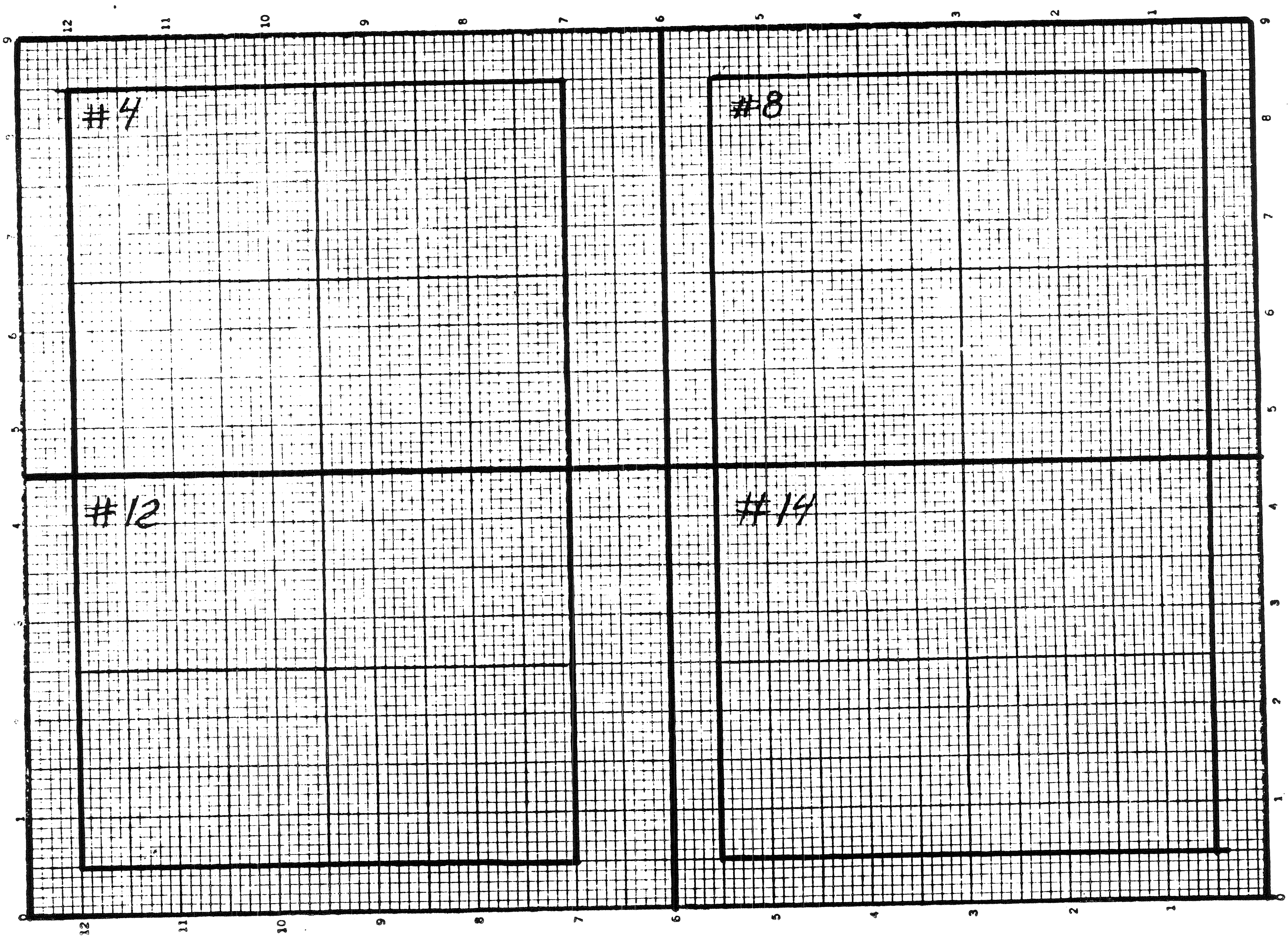
Frequency(f) = 1 / Time Perios(T)

Time Period(T) = TIME/CM control setting in seconds times the width of the gratucle in cm divided by the number of displayed cycles.

OR R R R R R R R R

$$f = \frac{1}{\dfrac{\text{TIME/CM setting in sec X width of gratucule in cm}}{\text{\# of displayed cycles}}}$$

16. An oscilloscope is a very useful and fascinating test instrument, but it takes time and practice to learn how to use it efficiently.


#4
#8
#12
#14

REVIEW QUESTIONS:

1. What is the name of an oscilloscope that can display two seperate waveforms at the same time?

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2. Define the term calibration as used with an oscilloscope.

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3. Name the three major applications of an oscilloscope.

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4. Name all the controls which when adjusted accomplish the following.

Brigtness of trace____

Position the trace____

Stabilize the trace____

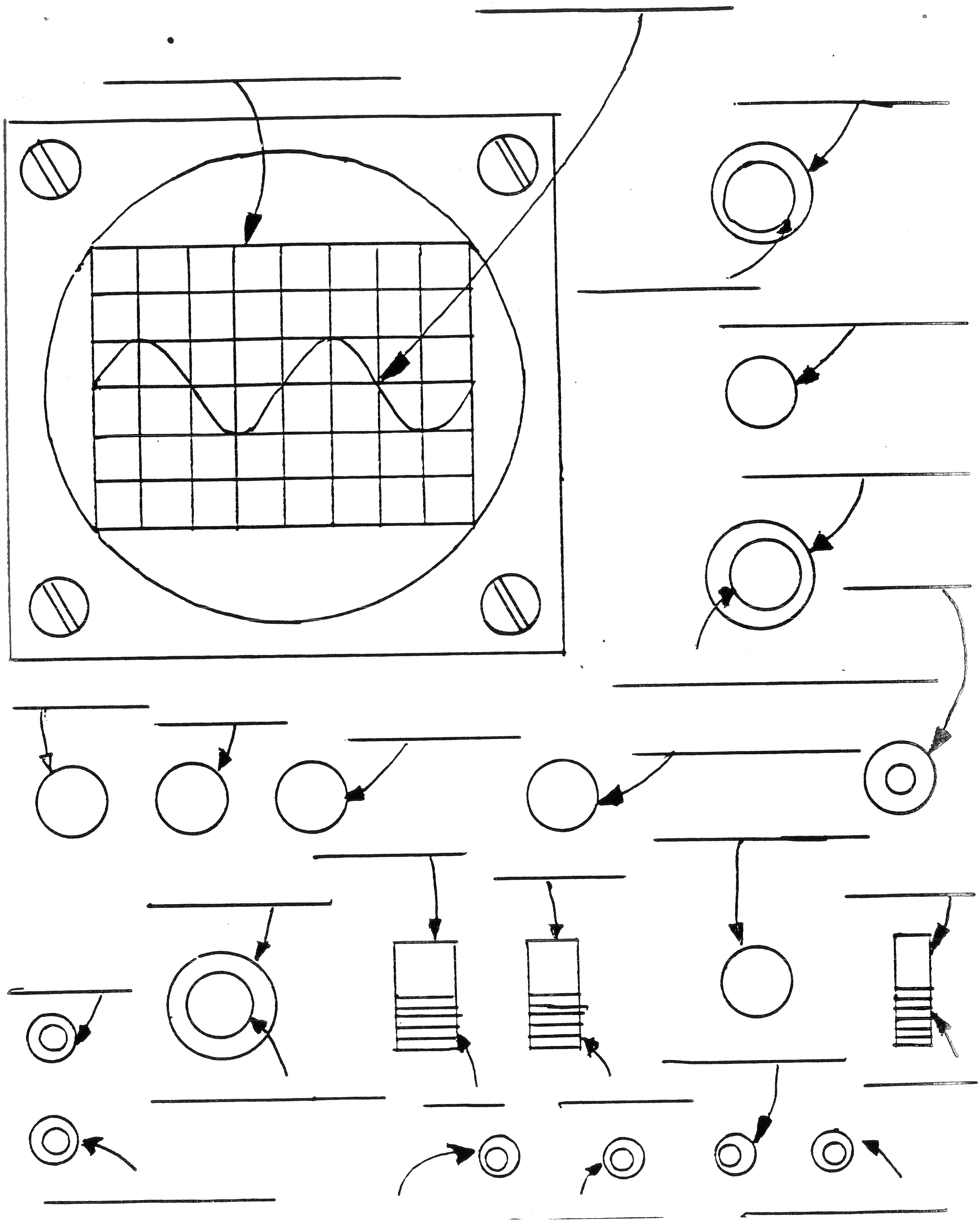
Sharpness of trace____

Vertical graticule division value________________________________

Horizontal graticule division value______________________________

Sweep time adjustment____

5. Complete the attached oscilloscope pictorial diagram by filling in the blanks with the name of each control, jack, or part of the scope.



Name ______
Function ______

Name ______
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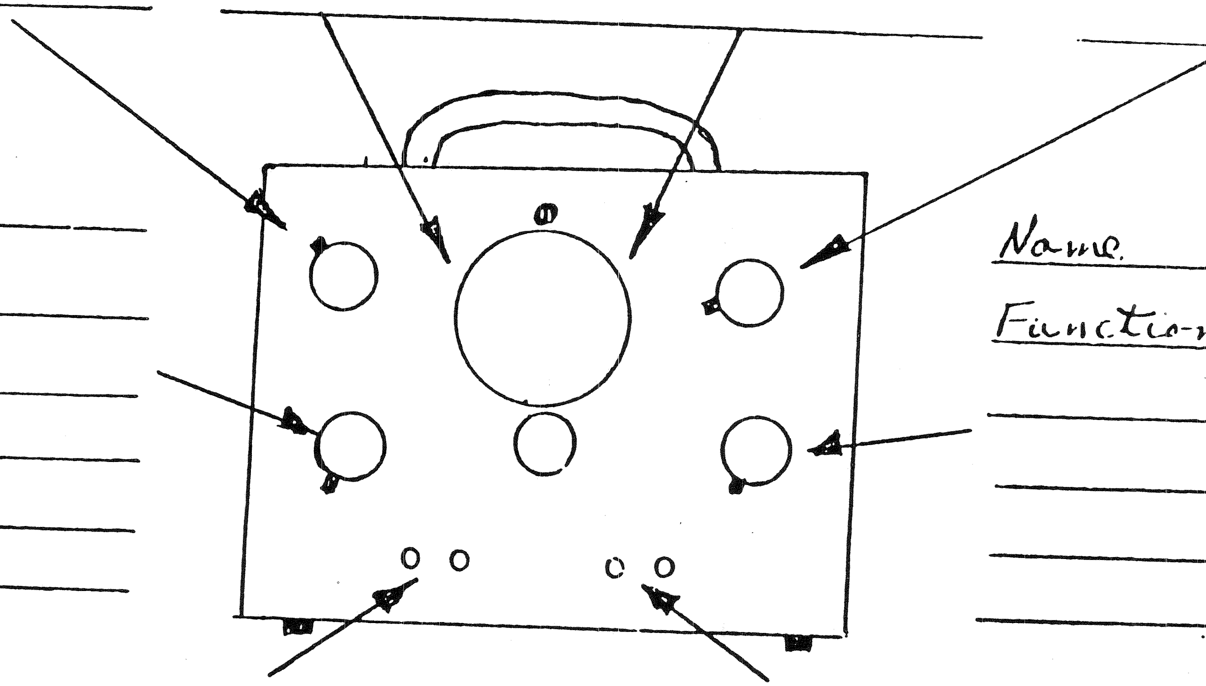

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