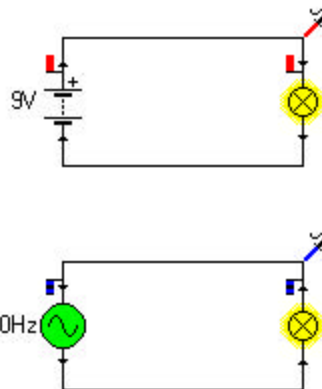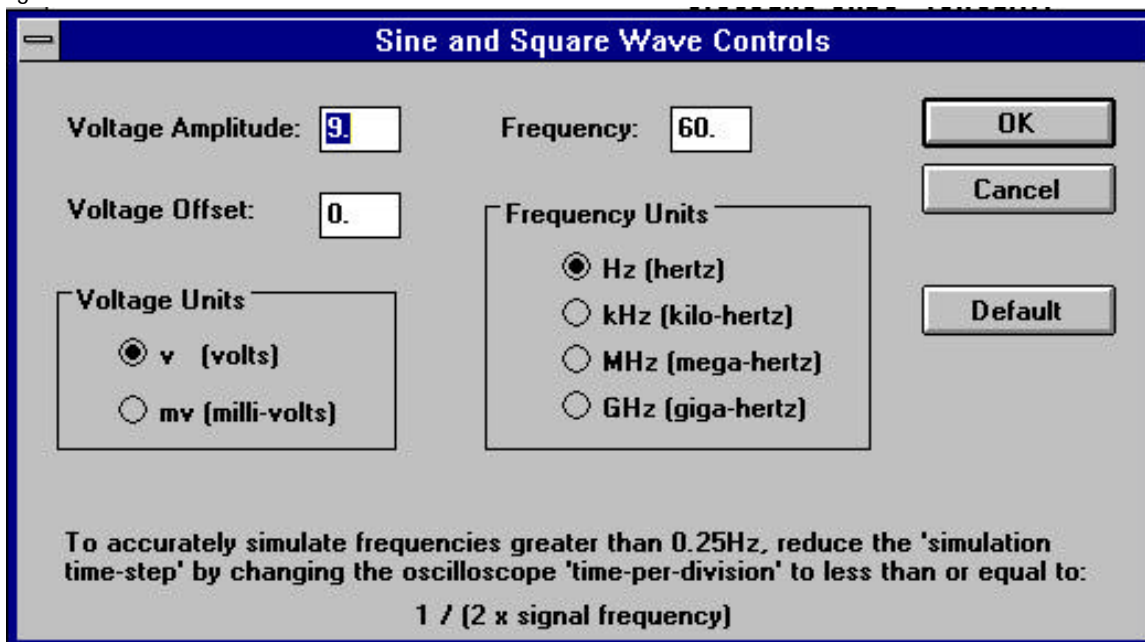## Crocodile Clips:

AC and DC circuits

1. Open Crocodile Clips and build two simple circuits; one powered by 9 volt direct current power source, and the second powered by an AC power source. The power sources can be selected from the power supplies toolbar (above).
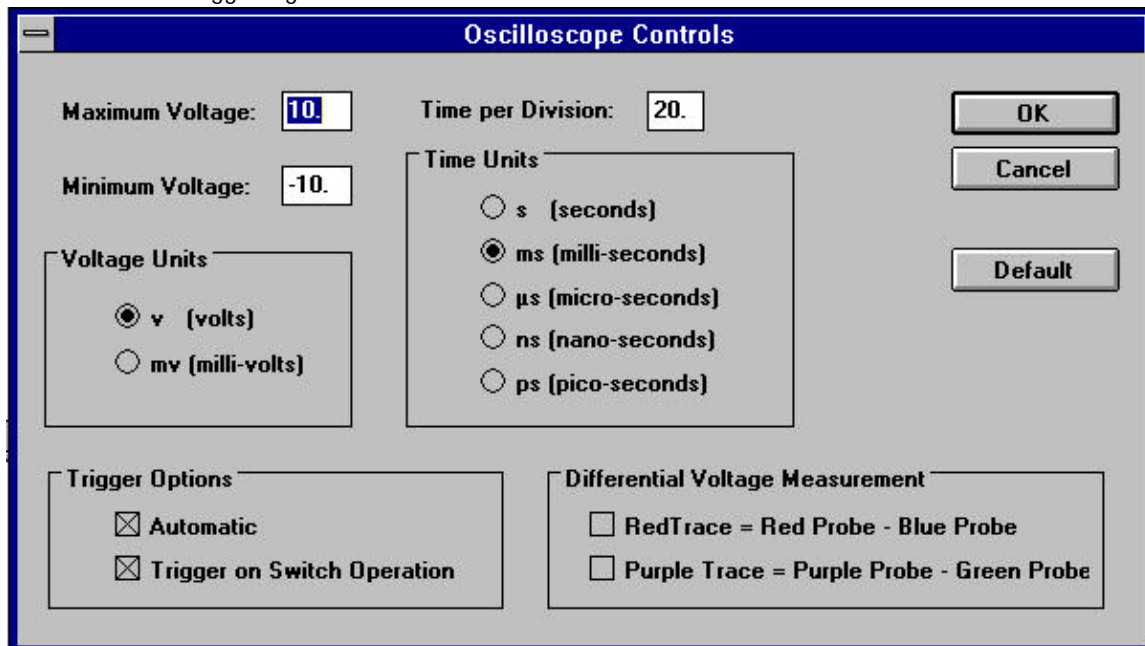

2. Click on the number beside the Alternating Current (sine wave) symbol to access the controls dialog box (below). Change the frequency (cycles per second) to 60; set the voltage amplitude to 9 volts and leave the voltage offset at 0.
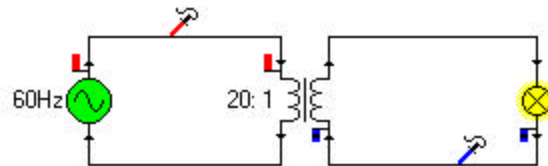
3. In order see the difference between alternating current and direct current, it is useful to use an oscilloscope, a measuring instrument designed to give a graphical representation of voltage changes. Click on the oscilloscope probe on the toolbar, and drag it to the DC circuit as shown on the circuit diagram. Repeat to connect a probe to the AC circuit.

4. Now click on the oscilloscope button on the toolbar to access the Oscilloscope Controls. In order to see the 60 Hertz waveform clearly, some adjustments must be made. Change the time to division to 20 milliseconds; set maximum voltage to 10 volts and minimum voltage to -10v. Under Trigger Options, click on the selection box for automatic triggering.
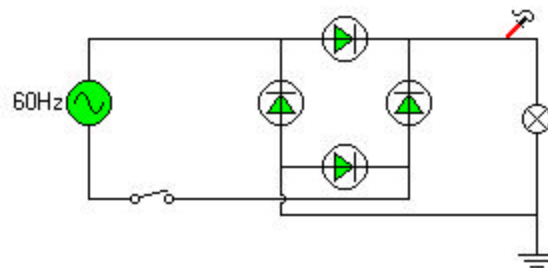
Oscilloscope Controls

Maximum Voltage: `10.`	Time per Division: `20.`
Minimum Voltage: `-10.`	

Time Units
- ○ s (seconds)
- ● ms (milli-seconds)
- ○ μs (micro-seconds)
- ○ ns (nano-seconds)
- ○ ps (pico-seconds)

Voltage Units
- ● v (volts)
- ○ mv (milli-volts)

OK
Cancel
Default

Trigger Options
- ☒ Automatic
- ☒ Trigger on Switch Operation

Differential Voltage Measurement
- ☐ RedTrace = Red Probe - Blue Probe
- ☐ Purple Trace = Purple Probe - Green Probe

5. When you exit from the Oscilloscope Controls (by clicking on OK), the oscilloscope will be displayed on the lower half of the screen. You can adjust the size of the display by dragging the border of the window up or down. The colour of the line on the screen corresponds to the colour of the probe on the circuit. In a sheet of graph paper, record the shape of the AC and DC voltages in separate drawings. On the AC diagram, indicate the peak voltage, and mark the beginning and end of two complete cycles. Carefully record the elapsed between the initial 0 crossing, positive peak, 0 crossing, negative peak and final 0 crossing. Also on the paper show the time for one complete cycle.

Crocodile Clips:

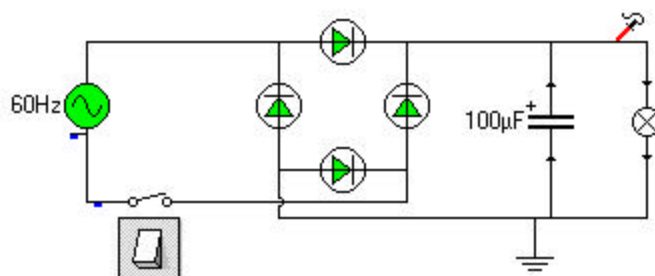# Transformers, Diodes and Power Supplies

1. Construct the circuit below using Crocodile Clips. Change the settings for the AC power source to 120 Volts, 60 Hz.

2. Open the Oscilloscope dialog box and change the maximum voltage to 120 volts, the minimum voltage to -120 volts, the time per division to 100 milliseconds, and select automatic triggering. Record the graphs for the input and output from the transformer on the answer sheet.

3. Build the following circuit using Crocodile Clips. The direction of the diodes and the location of the connections is critical, so follow the diagram closely. Set the AC source to 6 volts, 60 Hz.
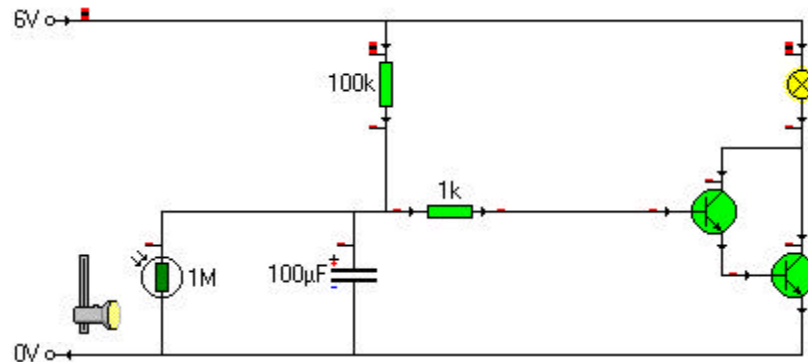

4. Open the Oscilloscope dialog box and set the time per division to 20 milliseconds the maximum voltage to 10 volts, and the minimum voltage to -10 volts. Record both the input voltage and the output voltage on the answer sheet.

5. Modify the circuit above by adding a capacitor to the circuit in parallel with the load. Record the new output wave form on the answer sheet.

6. Change the value of the capacitor to 1000 µF and record the new wave form on the answer sheet. Be sure to mark clearly which graph is which!
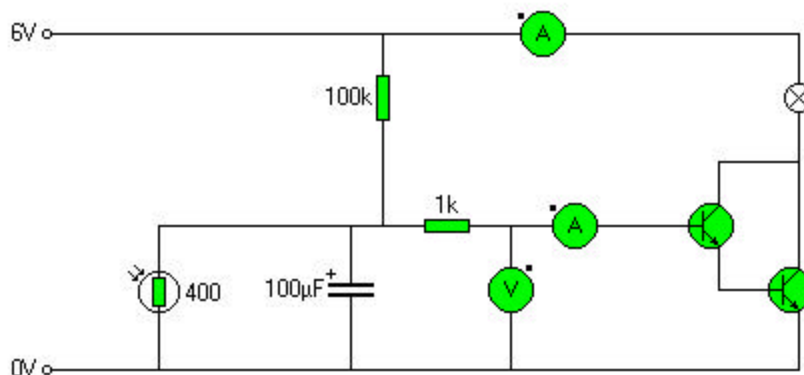
Crocodile Clips:

Transistor Circuits

1. Construct the circuit below using Crocodile Clips. The device at the lower left is a light dependent or photo-sensitive resistor. It can be located on the input components toolbar (third button from the left on the main

   toolbar).

When no light strikes it, the resistance is 1 Megohm (1,000,000 ohms), but when exposed to light (by raising the slider with the mouse pointer) the resistance falls to 400 ohms. When the resistance on the photo-resistor is low, it drops the voltage at the base of the first transistor so that it turns off. The second transistor is connected in what is called a Darlington circuit, so that when the first transistor is off, the second transistor and the light are also cut off. Raise and lower the slider and observe the changes in the circuit. (There is a time delay while the resistance changes.)
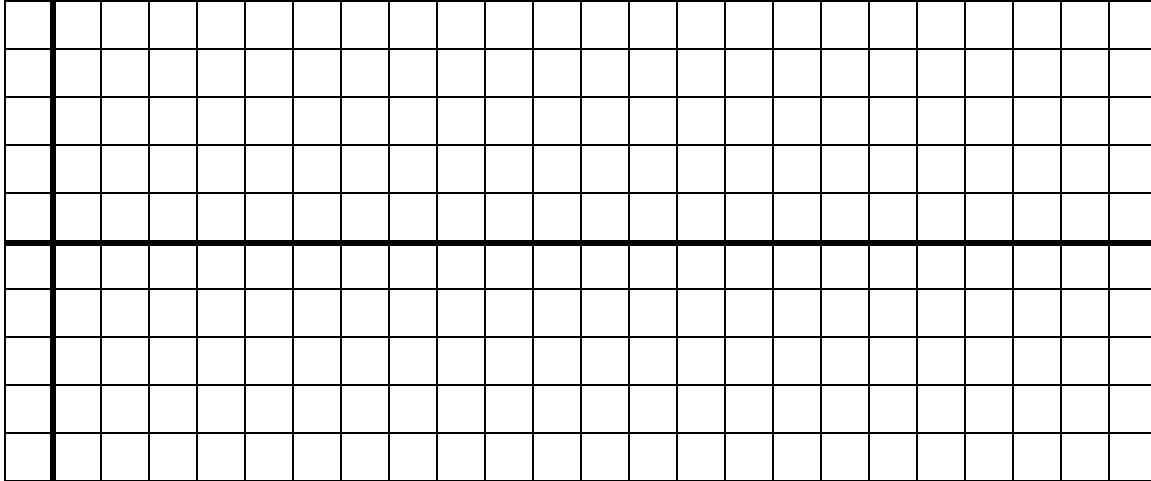
2. Now open the meters toolbar and add a voltmeter and two ammeters to the circuit as shown below. From the **Measure** menu, choose **Meter Autorange** (this is not necessary in Crocodile Physics)**.**

Notice that the ammeters are connected in *series* in order to measure the current that flows *through* them. The voltmeter, however, is connected in *parallel* to measure the voltage *between* two points in the circuit. In the real world, improper connection will destroy the meters, in Crocodile Clips it will only provide erroneous or meaningless measurements.
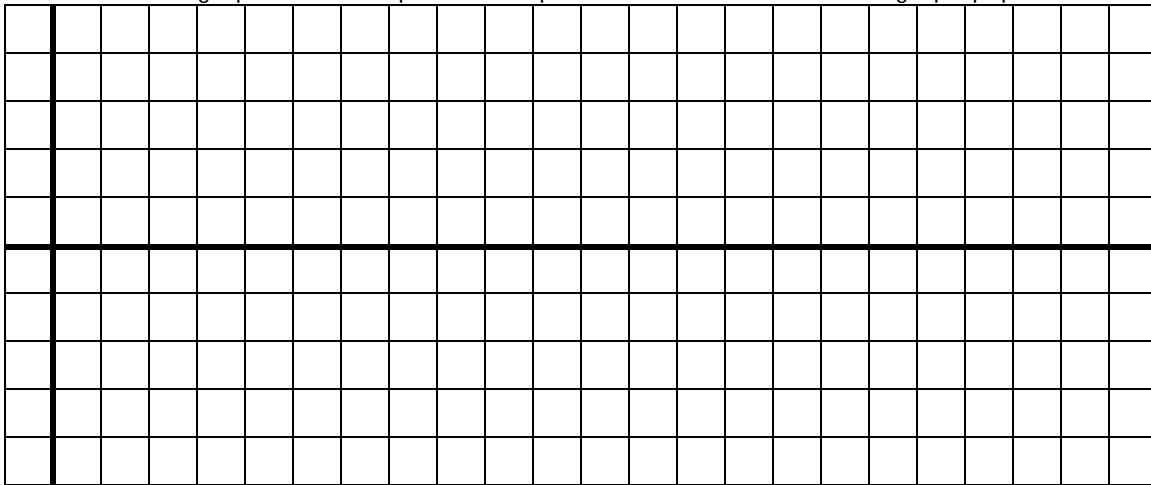
Crocodile Clips Answer Sheet

1. On the graph below, record the shape of the AC and DC voltages on the same drawing. On the AC diagram, indicate the peak voltage, and mark the beginning and end of two complete cycles. Carefully record the elapsed between the initial 0 crossing, positive peak, 0 crossing, negative peak and final 0 crossing. Also on the paper show the time for one complete cycle.
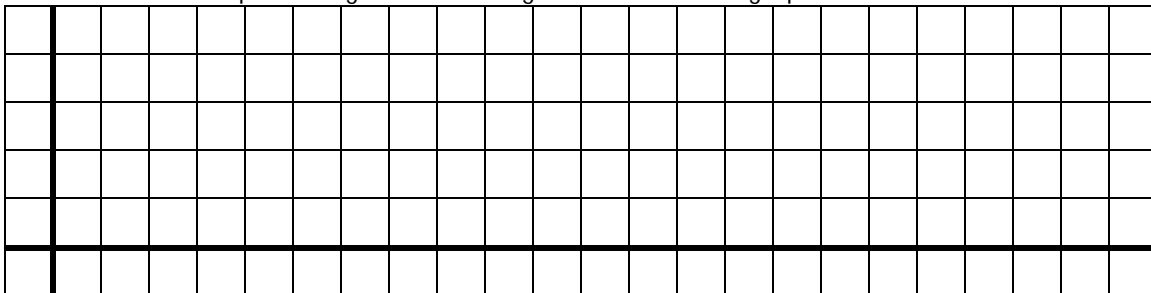
TITLE

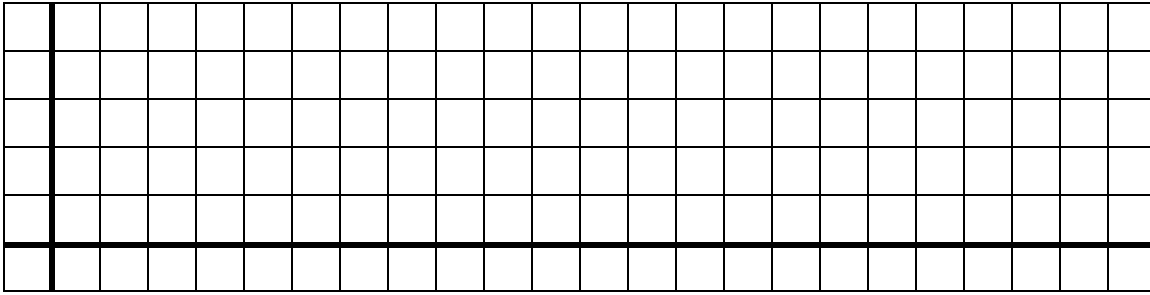2. Record the graphs for the input and output from the transformer on graph paper.

TITLE:

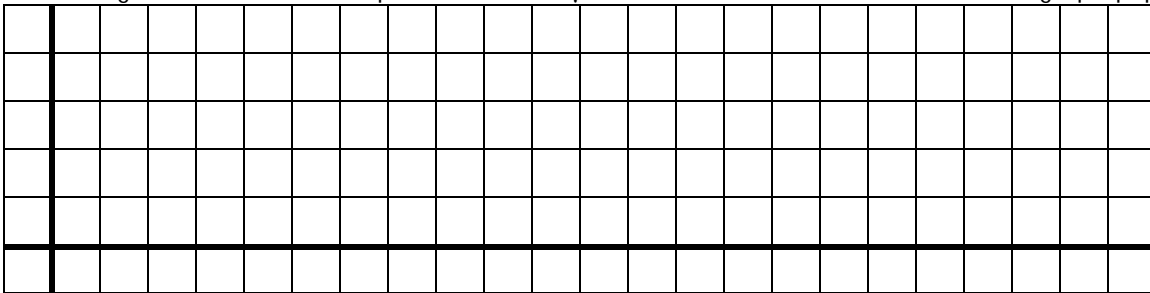3. Record the output voltage for the bridge rectifier on the graph below.

TITLE

4. Modify the circuit by adding a capacitor to the circuit in parallel with the load. Record the new output waveform on graph paper.
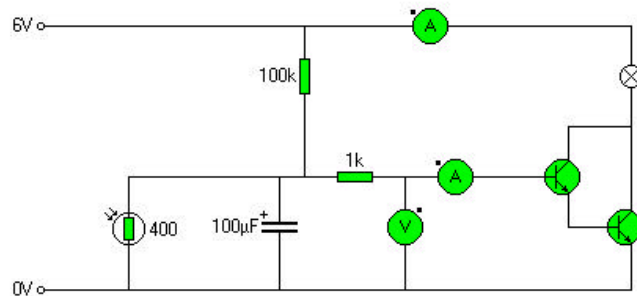
TITLE

5. Change the value of the capacitor to 1000 µF and record the new wave form on graph paper.

TITLE

6. Complete the table below by recording the readings on the three meters in the transistor circuit when the light is on and when it is off.

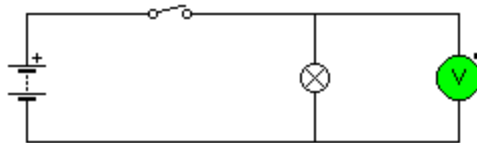| SLIDER POSITION	PHOT0-RESISTOR RESISTANCE	BASE VOLTAGE	BASE CURRENT (LOWER AMMETER)	COLLECTOR CURRENT (UPPER AMMETER)	LIGHT (ON OR OFF)
UP (BRIGHT)					
DOWN (DARK)					

7. Answer these questions:
a)   What is the relationship between the Collector current and the Base current?

b)   Why would such a circuit be useful in digital electronics?

Crocodile Clips:
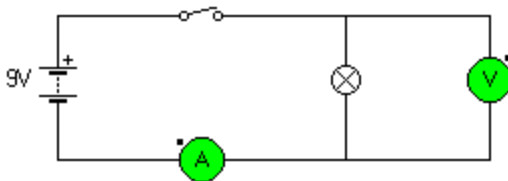
Series and Parallel Circuits

Name: _____

1. Build a simple circuit, then add a voltmeter to the circuit.

a) Record the voltage reading: _____

b) Why is the voltage reading different than the reading on the power source?

2. Add an ammeter to the circuit. From the Measure menu select "meter autorange". The ammeter must be connected in series. The voltmeter is connected in parallel. Save the circuit in your workspace.

a) Record the amperage: _____

b) In the SI or metric system, the prefix m means:_____

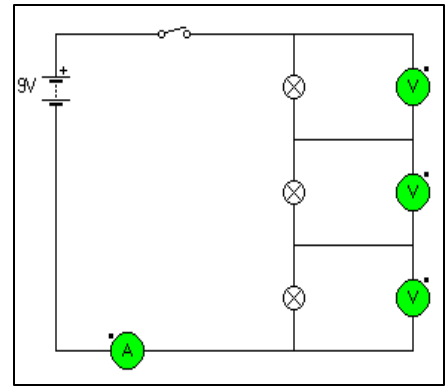2.   Calculate the resistance of the light using the formula

$$R = \frac{V}{A} = \text{———————} =$$

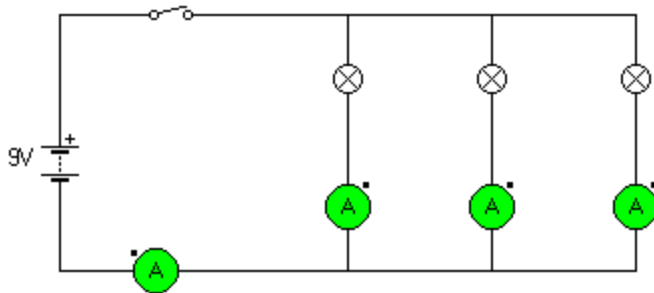| Electrical Quantity	Abbreviation	Unit of Measurement
Potential	V or E	Volts
Current	A or I	Amperes
Resistance	Ω	Ohms

4. Build a circuit with 3 lamps in series. Make sure the voltage is 9 volts.

      a) Measure the amperage: _____

      b) Measure the voltage across each lamp:

      _____

      c) What voltage is needed at the power supply to make all the lamps glow brightly?

5. Arrange 3 lamps in a parallel circuit . Measure the amperage in each branch and total the total amperage.

      a) record all measurements in the table below (round off)

	Lamp 1	Lamp 2	Lamp 3	Total current
Amperage				

      b) What is the mathematical relationship between the total current and branch currents?

_____

_____

7. Using crocodile clips, construct a parallel circuit using a lamp, a buzzer and a motor . Add 3 switches so that you can turn each device on and off independently. Draw the circuit in the space below.