Written Exercises

This section contains written exercises that cover information in this book.
The exercises are divided into two parts, Part I and Part II.

- Part I covers information presented in these sections:

  The Oscilloscope

  Performance Terms and Considerations

- Part II covers information presented in sections:

  The Systems and Controls of an Oscilloscope

  Operating the Oscilloscope

  Measurement Techniques

The following exercises cover vocabulary and application information.

Check how well you have absorbed the information in these sections by doing this short self–test. Answers begin on page 55.

Part I

- The Oscilloscope
- Performance Terms and Considerations

Vocabulary Exercise – Write the letter of the definitions in the right column next to the correct words in the left column.

Term		Definition
1. __Acquisition	A	The unit of electric potential difference.
2. __Analog	B	A performance measurement indicating the precision of an ADC, measured in bits.
3. __Bandwidth	C	Term used when referring to degree points of a signal's period.
4. __Digital Phosphor	D	The number of times a signal repeats in one second.
5. __Frequency	E	The amount of time it takes a wave to complete one cycle.
6. __Glitch	F	A stored digital value that represents the voltage of a signal at a specific point in time on the display.
7. __Period	G	A common waveform shape that has a rising edge, a width, and a falling edge.
8. __Phase	H	A performance measurement indicating the rising edge speed of a pulse.
9. __Pulse	I	Oscilloscope circuitry that controls the timing of the sweep.
10. __Waveform Point	J	An intermittent spike in a circuit.
11. __Rise Time	K	A signal measured by an oscilloscope that only occurs once.
12. __Sample Point	L	The oscilloscope's process of collecting sample points from the ADC, processing them, and storing them in memory.
13. __Digital Storage	M	Something that operates with continuously changing values.
14. __Time Base	N	Digital oscilloscope that captures 3 dimensions of signal information in real-time.
15. __Transient	O	Digital oscilloscope with serial processing.
16. __ADC Resolution	P	A sine wave frequency range, defined by the – 3dB point.
17. __Volt	Q	The raw data from an ADC used to calculate and display waveform points.

Part I

▶ The Oscilloscope

▶ Performance Terms and Considerations

Application Exercise

Circle the best answers for each statement. Some statements have more than one right answer.

1. With an oscilloscope you can:
   a. Calculate the frequency of a signal.
   b. Find malfunctioning electrical components.
   c. Analyze signal details.
   d. All the above.
2. The difference between analog and digitizing oscilloscopes is:
   a. Analog oscilloscopes do not have on–screen menus.
   b. Analog oscilloscopes apply a measurement voltage directly to the display system, while digital oscilloscopes first convert the voltage into digital values.
   c. Analog oscilloscopes measure analogs, whereas digitizing oscilloscopes measure digits.
   d. Analog oscilloscopes do not have an acquisition system.
3. An oscilloscope's vertical section does the following:
   a. Acquires sample points with an ADC.
   b. Starts a horizontal sweep.
   c. Lets you adjust the brightness of the display.
   d. Attenuates or amplifies the input signal.
4. The time base control of the oscilloscope does the following:
   a. Adjusts the vertical scale.
   b. Shows you the current time of day.
   c. Sets the amount of time represented by the horizontal width of the screen.
   d. Sends a clock pulse to the probe.
5. On an oscilloscope display:
   a. Voltage is on the vertical axis and time is on the horizontal axis.
   b. A straight diagonal trace means voltage is changing at a steady rate.
   c. A flat horizontal trace means voltage is constant.
   d. All the above.
6. All repeating waves have the following properties:
   a. A frequency measured in hertz.
   b. A period measured in seconds.
   c. A bandwidth measured in hertz.
   d. All the above.
7. If you probe inside a computer with an oscilloscope, you are likely to find the following types of signals:
   a. Pulse trains.
   b. Ramp waves.
   c. Sine waves.
   d. All the above.
8. When evaluating the performance of an analog oscilloscope, some things you might consider are:
   a. The bandwidth.
   b. The vertical sensitivity.
   c. The ADC resolution.
   d. The sweep speed.
9. The difference between digital storage oscilloscopes (DSO) and digital phosphor oscilloscopes (DPO) is:
   a. The DSO has a higher bandwidth.
   b. The DPO captures three dimensions of waveform information in real-time.
   c. The DSO has a color display.
   d. The DSO captures more signal details.

Part II

- ▶ The Systems and Controls of an Oscilloscope
- ▶ Operating the Oscilloscope
- ▶ Measurement Techniques

Vocabulary Exercise – Write the letter of the definitions in the right column next to the correct words in the left column.

Term		Definition
1. __Averaging Mode	A	The unintentional interaction of the probe and oscilloscope with the circuit being tested which distorts a signal.
2. __Circuit Loading	B	A conductor that connects electrical currents to the Earth.
3. __Compensation	C	A sampling mode in which the digital oscilloscope collects as many samples as it can as the signal occurs, then constructs a display, using interpolation if necessary.
4. __Coupling	D	A sampling mode in which the digital oscilloscope constructs a picture of a repetitive signal by capturing a little bit of information from each repetition.
5. __Earth Ground	E	A device that converts a specific physical quantity such as sound, pressure, strain, or light intensity into an electrical signal.
6. __Equivalent–Time	F	A test device for injecting a signal into a circuit input.
7. __Graticule	G	A processing technique used by digital oscilloscopes to eliminate noise in a displayed signal.
8. __Interpolation	H	The method of connecting two circuits together.
9. __Real Time	I	A “connect–the–dots” processing technique to estimate what a fast waveform looks like based on only a few sampled points.
10. __Signal Generator	J	The grid lines on a screen for measuring oscilloscope traces.
11. __Single Sweep	K	A trigger mode that triggers the sweep once, must be reset to accept another trigger event.
12. __Transducer	L	A probe adjustment for 10X attenuator probes that balances the electrical properties of the probe with the electrical properties of the oscilloscope.

Part II

- ▶ The Systems and Controls of an Oscilloscope
- ▶ Operating the Oscilloscope
- ▶ Measurement Techniques
- ▶ The Systems and Controls of an Oscilloscope
- ▶ Operating the Oscilloscope
- ▶ Measurement Techniques

Application Exercise

Circle the best answers for each statement. Some statements have more than one right answer.

1. To operate an oscilloscope safely, you should:
   a. Ground the oscilloscope with the proper three–pronged power cord.
   b. Learn to recognize potentially dangerous electrical components.
   c. Avoid touching exposed connections in a circuit being tested even if the power is off.
   d. All the above.
2. Grounding an oscilloscope is necessary:
   a. For safety reasons.
   b. To provide a reference point for making measurements.
   c. To align the trace with the screen's horizontal axis.
   d. All the above.
3. Circuit loading is caused by:
   a. An input signal having too large a voltage.
   b. The probe and oscilloscope interacting with the circuit being tested.
   c. A 10X attenuator probe being uncompensated.
   d. Putting too much weight on a circuit.
4. Compensating a probe is necessary to:
   a. Balance the electrical properties of the 10X attenuator probe with the oscilloscope.
   b. Prevent damaging the circuit being tested.
   c. Improve the accuracy of your measurements.
   d. All the above.
5. The trace rotation control is useful for:
   a. Scaling waveforms on the screen.
   b. Detecting sine wave signals.
   c. Aligning the waveform trace with the screen's horizontal axis on an analog oscilloscope.
   d. Measuring pulse width.
6. The volts per division control is used to:
   a. Scale a waveform vertically.
   b. Position a waveform vertically.
   c. Attenuate or amplify an input signal.
   d. Set the numbers of volts each division represents.
7. Setting the vertical input coupling to ground does the following:
   a. Disconnects the input signal from the oscilloscope.
   b. Causes a horizontal line to appear with auto trigger.
   c. Lets you see where zero volts is on the screen.
   d. All the above.
8. The trigger is necessary to:
   a. Stabilize repeating waveforms on the screen.
   b. Capture single–shot waveforms.
   c. Mark a particular point of an acquisition.
   d. All the above.
9. The difference between auto and normal trigger mode is:
   a. In normal mode the oscilloscope only sweeps once and then stops.
   b. In normal mode the oscilloscope only sweeps if the input signal reaches the trigger point; otherwise the screen is blank.
   c. Auto mode makes the oscilloscope sweep continuously even without being triggered.
   d. All the above.
10. The acquisition mode that best reduces noise in a repeating signal is:
    a. Sample mode.
    b. Peak detect mode.
    c. Envelope mode.
    d. Averaging mode.

11. The two most basic measurements you can make with an oscilloscope are:
    a. Time and frequency measurements.
    b. Time and voltage measurements.
    c. Voltage and pulse width measurements.
    d. Pulse width and phase shift measurements.

12. If the volts/division is set at 0.5, the largest signal that can fit on the screen (assuming an 8 x 10 division screen) is:
    a. 62.5 millivolts peak–to–peak.
    b. 8 volts peak–to–peak.
    c. 4 volts peak–to–peak.
    d. 0.5 volts peak–to–peak.

13. If the seconds/division is set at 0.1 ms, the amount of time represented by the width of the screen is:
    a. 0.1 ms.
    b. 1 ms.
    c. 1 second.
    d. 0.1 kHz.

14. By convention, pulse width is measured:
    a. At 10% of the pulse's peak-to-peak (pk-pk) voltage.
    b. At 50% of the pulse's peak-to-peak (pk-pk) voltage.
    c. At 90% of the pulse's peak-to-peak (pk-pk) voltage.
    d. At 10% and 90% of the pulse's peak-to-peak (pk-pk) voltage.

15. You attach a probe to your test circuit but the screen is blank. You should:
    a. Check that the screen intensity is turned up.
    b. Check that the oscilloscope is set to display the channel that the probe is connected to.
    c. Set the trigger mode to auto since norm mode blanks the screen.
    d. Set the vertical input coupling to AC and set the volts/division to its largest value since a large DC signal may go off the top or bottom of the screen.
    e. Check that the probe isn't shorted and make sure it is properly grounded.
    f. Check that the oscilloscope is set to trigger on the input channel you are using.
    g. All of the above.

Answer Key

This section provides the answers to all written exercises in the previous sections.

Part I: Vocabulary Exercise Answers

1. L	5. D	9. G	13. O
2. M	6. J	10. F	14. I
3. P	7. E	11. H	15. K
4. N	8. C	12. Q	16. B
			17. A

Part I: Oscilloscope Application Exercise Answers

1. D	3. D	5. D	7. A
2. B,D	4. C	6., A,B	8. A,B,D
			9. B

Part II: Vocabulary Exercise Answers

1. G	4. H	7. J	10. F
2. A	5. B	8. I	11. K
3. L	6. D	9. C	12. E

Part II: Oscilloscope Application Exercise Answers

1. D	5. C	9. B,C	13. B
2. A,B	6. A,C,D	10. D	14. B
3. B	7. D	11. B	15. G
4. A,C	8. D	12. C	