Exam 3

Physics 181, Wed of finals week 1pm-3pm

You may use a 3"x5" card of notes, both sides. NO PHONES.

Present *clear* and *complete* answers.

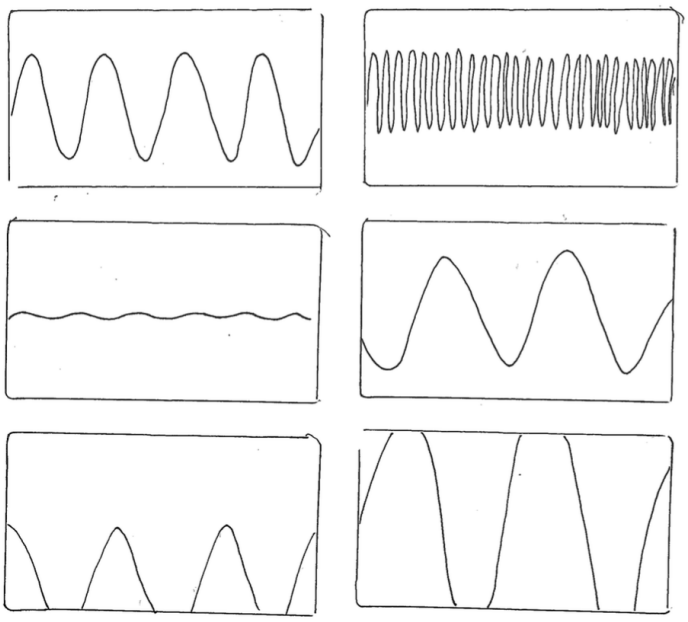
Unjustified answers will earn no points. Any person who has taken this class should be able to understand what you did just by reading your solution. A diagram and a few words usually help. Start calculations with definitions (*e.g.* $\vec{v} \equiv \frac{d\vec{r}}{dt}$), facts (*e.g.* Newton's laws), or commonly used equations (*e.g.* constant acceleration equations).

1. You're trying to measure a voltage signal on an oscilloscope. You see a reasonable trace,

   (a) but it's constantly moving. What's likely wrong and how do you fix it? Give specific instructions. "Autoset" or "Run/Stop" are not acceptable answers.

   (b) but the measure function says you have a 84Vpp signal. You're pretty sure it's less than 10Vpp. What might be wrong and how do you fix it? Give specific instructions.

   (c) but you can use the scale knobs to change the display. Which of the the following traces (of the same signal!) are most appropriate for measuring the peak to peak voltage? the period? Why are the others not appropriate?



2. What is a diode's turn-on voltage? How can it be measured?

   There's more than one way to do this. List them. Include a diagram when appropriate.

3. What does it mean for a diode to be

   (a) forward biased
   (b) reverse biased

   Draw a circuit diagram. Describe and explain the behavior that is observed.

4. Analyze a diode circuit. Specifically,

   (a) determine if the diode is forward or reverse biased
   (b) trace the path of the current. When input is an oscillating signal, do this for both halves of the signal.

   Use Kirchoff's rules to determine
   (c) the current through a part of the circuit
   (d) a relationship (equation) between the input voltage, output voltage, and the diode?s turn on voltage.

5. For a given $v(t)$, calculate the average voltage $\bar{v}$ and the root-mean-square voltage v_{rms}. For example, a square wave.

6. Consider the following circuits

   half-wave rectifier
   full-wave rectifier
   full-wave rectifier with buffering capacitor

   (a) What is a rectifier? Your answer should address function or behavior, not the circuit components.
   (b) Compare and contrast the behavior of the 3 rectifiers listed. Graphs of $v_{in}(t)$ and $v_{out}(t)$ are helpful.
   (c) Explain the purpose of the capacitor. How does it affect the output?

7. Given an oscilloscope trace of $v(t)$, determine its mean voltage and ripple voltage. Which is referred to as the d.c. component? the a.c. component?

8. State the op-amp current and voltage rules.

9. (a) Identify whether an op-amp circuit is an open loop circuit, or has feedback.

   (b) What is the behavior of an open-loop op-amp circuit?

   (c) What are V_{CC} and V_{EE} in an op amp circuit? What are they used for and how do they affect the circuit output?

10. Some circuits deliver an output at a power greater than the power of the input, $P_{\text{out}} > P_{\text{in}}$. How is this possible without violating energy conservation?

11. For an op-amp circuit, determine the

    (a) gain, $G(\omega)$
    (b) input and output impedances

12. Determine the resolution of an n-bit analog-to-dc converter. That is, how is a 16-bit A/D converter different from a 64-bit? What do we mean by resolution?

13. Explain pulse width modulation (PWM). Provide a diagram and an example of how it's used.