ECE 214 — Exam # 2

Estimated time for completion: <1.25 hour
16 April 2013

Rules of the Exam

Rule 1: The examination period begins at 8:00am on Tuesday 16 April 2013 and ends at 9:15am on Tuesday 16 April 2013.

Rule 2: There are three problems. All problems have equal weight.

Rule 3: The exam is closed book and closed notes but you may use your ECE 214 Laboratory Notebook, a ruler, and a calculator.

Rule 4: Show all work and intermediate steps in your solutions. Clearly state all assumptions. Be neat!!!

_____

Name

Problem 1 The op–amp below is ideal. The input signal is V_{in}.

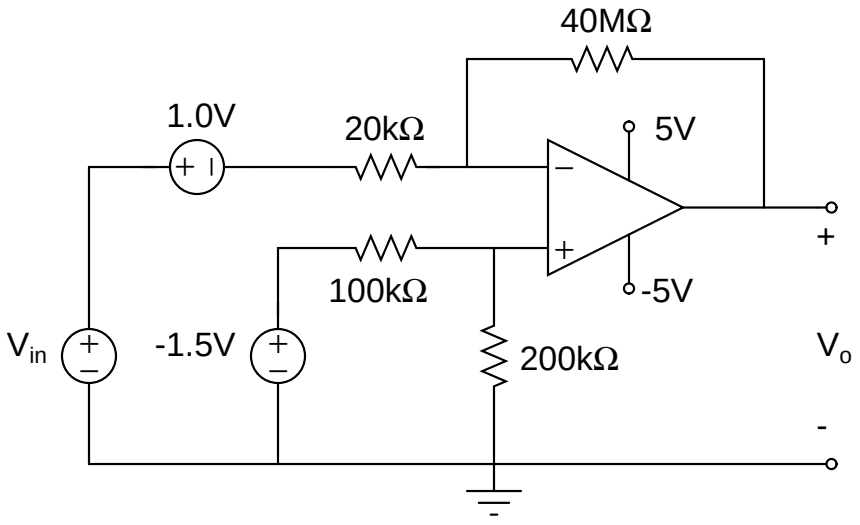


Figure 1: Circuit #1

Which of the following best describes Circuit #1?

1. Inverting OpAmp with DC offset
2. Non–Inverting OpAmp with DC offset
3. Inverting Integrator
4. Non–Inverting Integrator
5. Schmitt Trigger

Write the equation for the output voltage V_o as a function of the input voltage V_{in}? Sketch the output voltage V_o for the given input voltage V_{in} shown on the next page. Make sure to label the "Y–axis" of the graph.

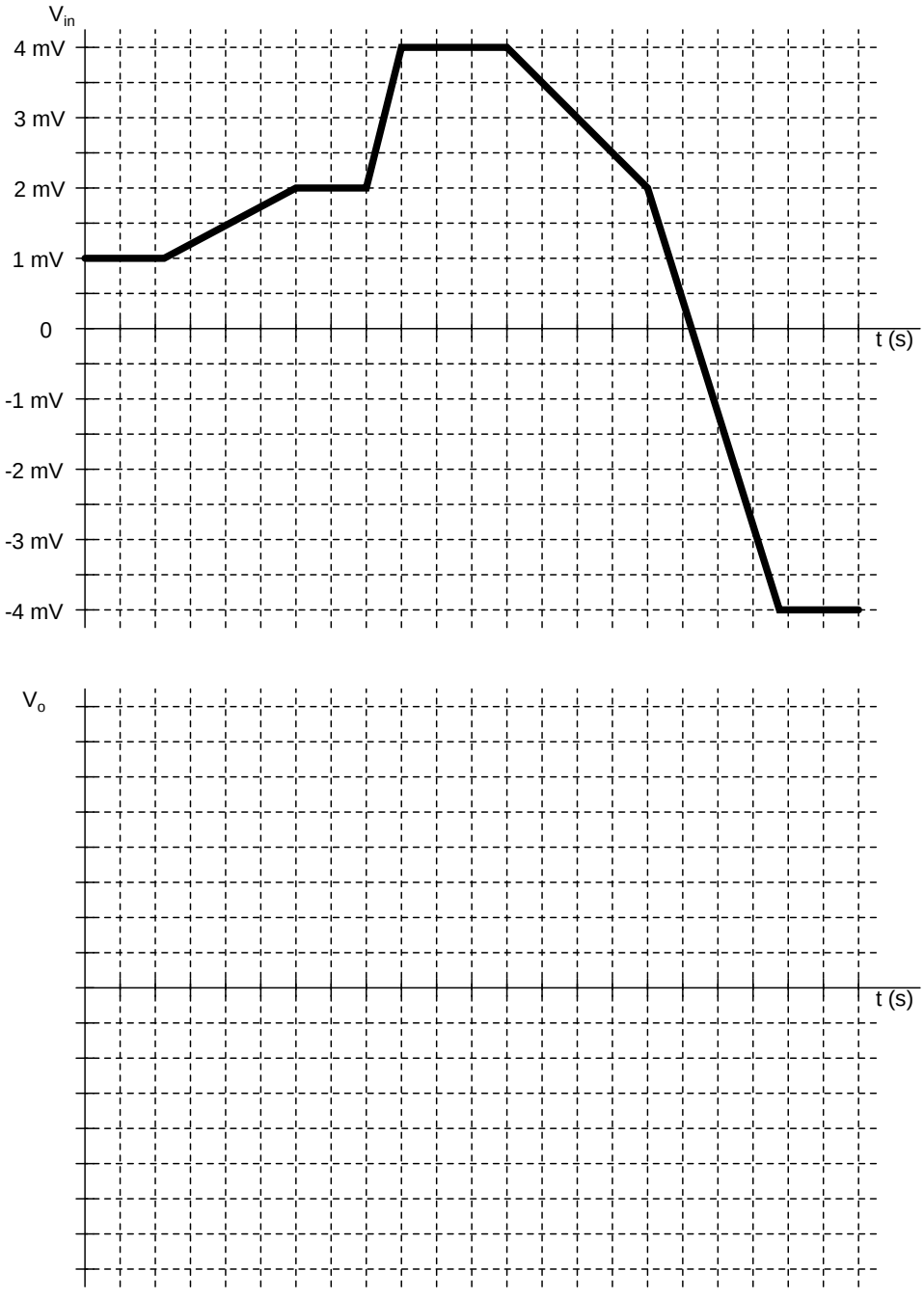


Figure 2: Input and output voltages for Circuit #1

Problem 2 The op–amp below is ideal. The input signal is V_{in}.

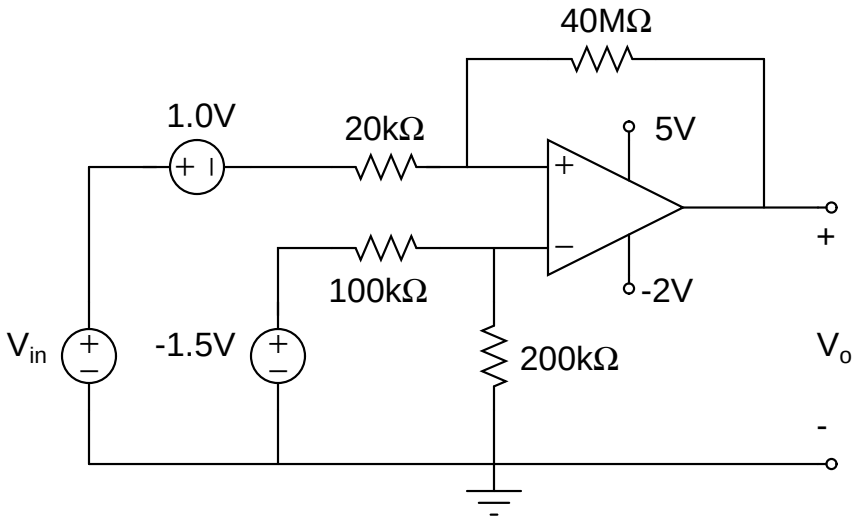


Figure 3: Circuit #2

Which of the following best describes Circuit #2?

1. Inverting OpAmp with DC offset
2. Non–Inverting OpAmp with DC offset
3. Inverting Integrator
4. Non–Inverting Integrator
5. Schmitt Trigger

Write the equation for the output voltage V_o as a function of the input voltage V_{in}? Sketch the output voltage V_o for the given input voltage V_{in} shown on the next page. Make sure to label the "Y–axis" of the graph.

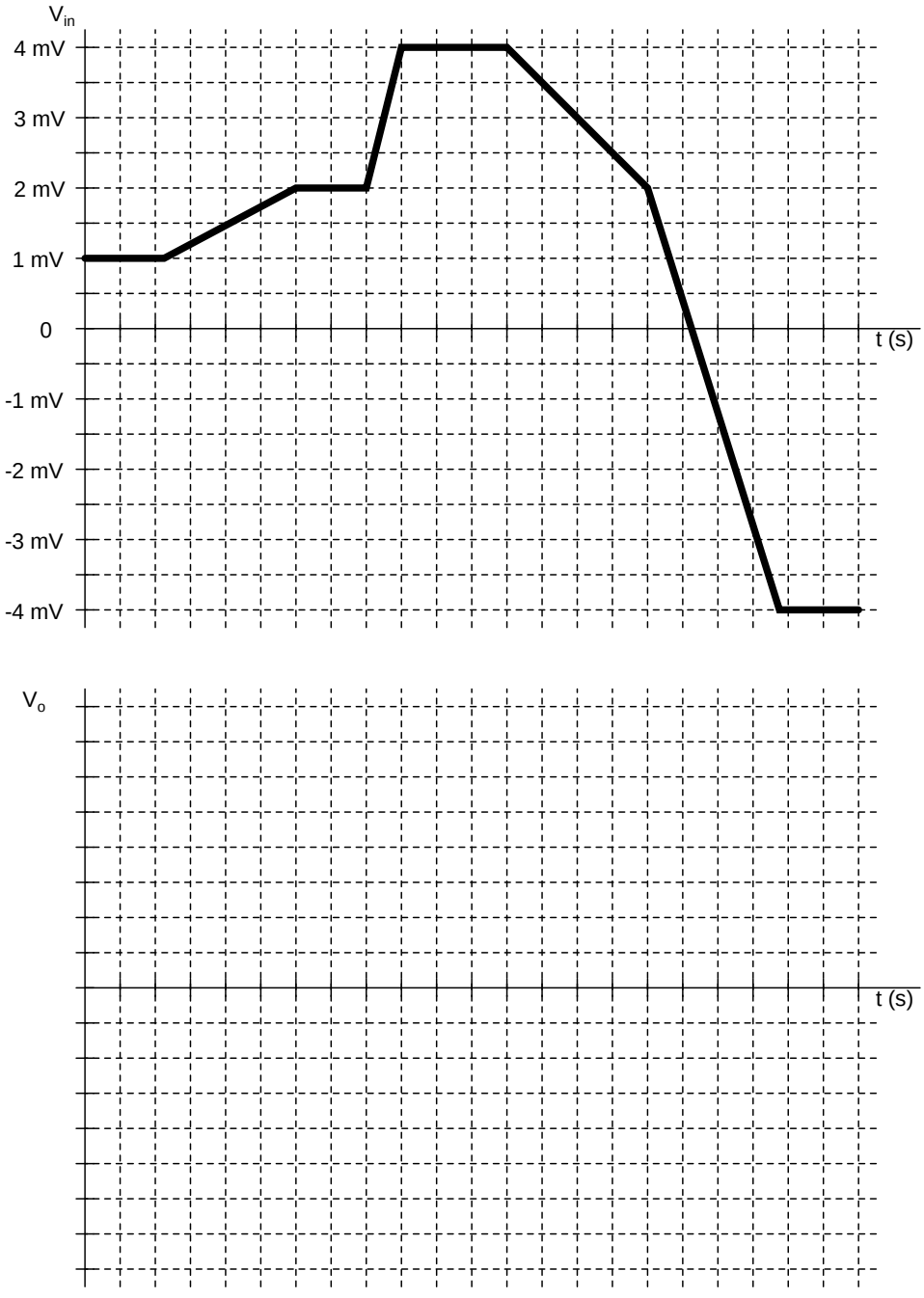
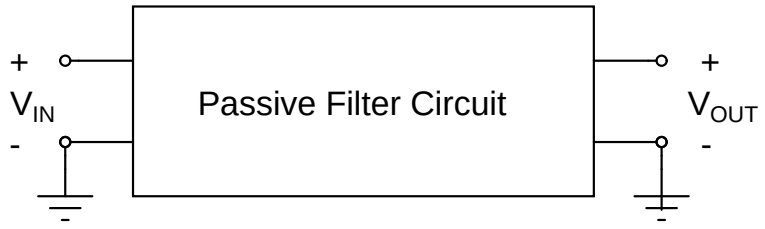


Figure 4: Input and output voltages for Circuit #2

Problem 3: Filter Circuit

Consider the ideal passive filter circuit shown below:



For the questions below circle the most correct answer:

1. V_{IN} is a square wave with a 50% duty cycle, a frequency of 25 kHz and a peak–to–peak voltage of 5 V. V_{OUT} is a sinusoidal waveform with a single frequency of 50 kHz. What type of filter could be used to generate V_{OUT}?

   (a) low pass filter
   (b) band pass filter
   (c) band reject filter
   (d) high pass filter
   (e) none of the above

2. V_{IN} is a square wave with a 50% duty cycle, a frequency of 25 kHz and a peak–to–peak voltage of 5 V. V_{OUT} that is a sinusoidal waveform with a single frequency of 75 kHz? What type of filter could be used to generate V_{OUT}?

   (a) low pass filter
   (b) band pass filter
   (c) band reject filter
   (d) high pass filter
   (e) none of the above

3. V_{IN} is a triangular wave with a frequency of 20 kHz and the filter is a low pass filter with a cutoff frequency of 60 kHz. What is the relative amplitude of the 3rd harmonic to the fundamental at the output of the filter?

   (a) -22.08 dB
   (b) -19.08 dB
   (c) -16.08 dB
   (d) -12.54 dB
   (e) -3 dB
   (f) +3 dB
   (g) none of the above

4. V_{IN} is a triangular wave with a frequency of 20 kHz and the filter is a high pass filter with a cutoff frequency of 20 kHz. What is the relative amplitude of the 3rd harmonic to the fundamental at the output of the filter?

   (a) -22.08 dB
   (b) -19.08 dB
   (c) -16.08 dB
   (d) -12.54 dB
   (e) -3 dB
   (f) +3 dB
   (g) none of the above

5. V_{IN} is a triangular wave with a frequency of 20 kHz and the filter is a high pass filter with a cutoff frequency of 60 kHz. What is the relative amplitude of the 3rd harmonic to the fundamental at the output of the filter?

   (a) -22.08 dB
   (b) -19.08 dB
   (c) -16.08 dB
   (d) -12.54 dB
   (e) -3 dB
   (f) +3 dB
   (g) none of the above