

#	Question	Answer(s)
1	When do we know to use a Unity Gain buffer	If there is loading effect (when you connect a second stage circuit to the first stage, sometimes the second stage will affect the behavior of the first stage), we will need to buffer the voltage from the first stage using a unity gain buffer
2	Will we have circuit reference on the exam?	Nope, so make sure you have the circuits you find useful on your cheat sheet
3	will there be a course staff review session for mt2?	Yes, should be Thursday 7-9 pm. We will post details on Piazza soon.
4	A comparator is in open loop gain right	Yes!
5	how do Vdd and Vss affect our circuit if Vdd is not = -Vss	For a comparator, Vdd and Vss will determine the output levels. For a negative feedback op-amp, there's no effect on the circuit behavior in this course.
6	so the only case which we've studied so far in which we might have to draw the rail voltages would be the comparator?	Yes, typically we can omit the power rails for a negative feedback op-amps, but there's nothing wrong to draw them for all the op-amps. Definitely remember to draw those power rails for a comparator.
7	I am still a bit confused on the value of A. Shouldn't it be a step function change with the value of v-plus - v-minus	A is a very large number (assume it's inf). Vout is a step function vs (V+ - V-) when we are in open loop (a comparator).
8	Does the golden rule apply to current leaving V_out, or only current entering V+ and V-?	only current entering V+ and V-. cannot be applied on V_out.
9	when can you assume Vdd = -Vss?	If we don't specify the Vdd and Vss in the diagram or in the text, we can assume Vdd = -Vss as the default setting.
10	If we show negative feedback, we can assert that the two nodes are equal?	If it's negative feedback, by the golden rule V+ = V-. Hopefully these are the nodes you were referring to.
11	wouldn't the second golden rule imply that V_out is always zero since V_out = A(V+ - V-)?	remember we assume A is inf, and inf*0 can be anything including a finite number
12	What's the difference between opamps and comparators?	in real cases comparators are specially designed circuit module. In our course, open-loop op-amp and comparator are the same thing.
13	If A is a constant (inf), how would V_out be able to alter	inf*0 is a very special case in math. It can do a lot of weird things. We cannot really treat inf as a constant.
14	If V+=V- in negative feedback, doesn't that mean Vout = A(0-0) = 0?	live answered
15	is A constant in an op amp?	You can consider it as a constant (very large, or inf) unless otherwise stated.
16	With a large enough gain, shouldn't Vout hit the power rails even without positive feedback?	live answered
17	Just to double check, if Vout is connected to V-, it is negative feedback; if it is connected to V+, it is positive feedback. Is that true?	Well, it's not always true, depending on what you connect between Vout and V-. However if you connect a wire or a resistor, your statement is true.
18	are we assuming A is 1	Nope, we assume A is infinite.
19	Why is positive feedback unstable? Wouldn't it just rail to Vdd?	Yes it will rail to Vdd, but in this case a very small disturbance can flip the output from Vdd to Vss.
20	Do we need to do the "wiggle check" to check for negative feedback or do we just have to see if the feedback is connected to the positive or negative terminal?	You don't need to show how you check it in exams or homework, but make sure you know how to check whether it's in negative feedback by the "wiggle check".
21	What is the starting point for v_out in a positive feedback loop? V_SS?	Will depend on the initial values of V+ and V-, like in a comparator.
22	If V+ = V- does that mean Vout would be 0 in the ideal state?	live answered
23	Does V+ actually equal V-, or does it only ever get really really close to it? If it's truly 0, A(v+ - v-) wouldn't equal Vin right?	In our ideal op-amp with inf A, V+ = V- if we have negative feedback. In real op-amp it's really really close.
24	Would the Positive Feedback circuit maintain positive feedback if we passed both nodes into the positive terminal? So we end up summing both values for even more rapid growth?	There are different ways to make a positive feedback. It's not in scope of our course, so it was just one example.
25	why is non-inverting?	Since we want a positive coefficient (3)
26	Shouldn't we connect Vin to the ground?	We can label the node voltage Vin to the node instead of drawing the entire voltage source, just for simplicity.
27	Do we need to show negative feedback in design problems on the exam	You don't have to show how you check whether it's negative feedback, as long as you draw the correct negative feedback circuit.
28	Thank you for fielding the questions. I'm still a little confused on if Vout would be 0 in the ideal state given V+ = V-	Since A is inf and (V+ - V-) is 0, we have inf times 0. The result can be a finite number. For example, when x goes to inf, 1/x goes to 0, but x * (1/x) is always 1.
29	on an exam, do we need to resolve all of this or can we remember the eq/have it on an eq?	on a cheatsheet**
30	When would you want an amplifier with reference versus without reference?	Reference can give you a voltage offset. Say if we want Vout = 3Vin + 2V, the reference voltage can give you that 2V offset
31	capacitors are the only pieces we have so far that depend on time right	Yes, you got the key point!
32	Are these steps written out anywhere? Ex: in the notes or something	They will be on tomorrow's discussion.
33	So in the case where Vout = -3vin + 2 vin, how do you go about connecting the inverting op-amp to the non-inverting op-amp?	If you mean there are two Vin voltages, we can use an inverting amp to flip the first Vin and then connect both to a summing non-inverting amp.
34	would you mind explaining why the comparator has 2 inputs again?	The comparator is comparing two things, so we need 2 inputs. In the block diagram the first one is the time after we push the button, the second one is our given threshold 2 second.
35	Is LED lights up with 2V given?	live answered
36	When connecting an inverting amp to non-inverting amp, how do you connect the two? Like what part of the non inverting amp do you connect to the inverting one?	We can connect the Vout node of a non-inverting amp to the Vin node of an inverting amp, or vice versa.

37	is t usually measured in seconds or milliseconds?	Second is the default unit.
38	Why is our $V_{ref} = V_c(2\text{ s})$ and not our $V_+$ ?	The comparator is not a negative feedback op-amp, so the $V_+ = V_-$ rule does not apply. $V_{ref}$ is our set point for the 2 second timing.
39	Why does Prof say KCL doesn't work with current source?	KCL should always be satisfied, however if we have an open circuit for a current source, KCL cannot be satisfied, so we should not have an open circuit for the current source.
40	Can we open the switch back up when the LED lights up	Yes we can control the switch after the LED lights up
41	whats step 4	live answered
42	Isn't that a short circuit with pos flowing into neg	live answered
43	why is it bad to open cct an $I_s$ and bad to short cct a $V_s$	open cct an $I_s$ cannot satisfy KCL, short cct a $V_s$ cannot satisfy KVL
44	Aren't we going to drain the current source with this	Nope, it's a current source so it always has that current flowing no matter what we connect to it.
45	How do we discharge capacitors?	by short circuit its two plates
46	would we want another switch between the cap and amp, I thought the point was to use cap to provide a voltage to amp, but right now the current source also applies a volt before the cap can charge	Nope, the current source does not apply a voltage to the cap before we push the button, since there's just a wire connecting the two plates of the cap. It's not necessary for a current source to have a voltage across it.
47	Would you have to hold down the button for two seconds in this design or does the button toggle the switch?	live answered
48	does $V_c(t)$ grow infintely if we leave it connected to $I_s$	live answered
49	How do we set the time we want the Countdown Timer to run in this circuit?	We set it by the comparator $V_{ref}$
50	When a current source is connected in a short circuit, does current j flow back into the current source? Does the charge from the capacitor also j flow back into the current source?	Current from the current source flows back to the current source, charge in the capacitor flows from one plate to the other one
51	Why doesn't the current source push current into the op-amp	The input terminals of the op-amp do not take in current. It's our golden rule #1.
52	why we can't directly connect $u_2$ to ground again?	If we directly connect it to the ground, all the current will go to ground at that point without going to the 'element'
53	why inverted	
54	We don't need to ground $V_{out}$ because it's already grounded from the op amp right	$V_{out}$ is not grounded. The reference point to the node voltage $V_{out}$ is the ground.
55	why does the element have to bein the negative feedback loop	Because we want the current through the element to be a constant, and the negative feedback loop gives us this nice property.
56	I'm confused. Wouldnt $I_r$ increase if $V_s$ increases? I thought we wanted a constant $I_s$ with a variable $V_s$	Nope, we want the $I_s$ independent of the element. We can tune $I_s$ by tuning $V_s$ in this circuit.
57	why do we need $u_2$ to be 0V again?	That way we will know the current is $V_s/R$ which is independent on the element.
58	If $V_{out} = V_{in}$ , and $V_{in}$ is $u_2 = 0$ , and $V_{out}$ is on the other side of the element, why is there current flowing across the element?	$V_{out} = V_{in}$ is not true. It's not a rule for the op-amp.
59	Don't we have an open circuit here ?	Nope, we only connect the $v_{out}$ back to the $V_-$ through the element, but it's still a closed circuit
60	how is $u_2$ zero?	Buy the op-amp golden rule #2
61	does current ever come out of an op-amp	The output terminal of an op-amp can output/take in current.
62	Why don't we need an op-amp on the side of the circuit with the voltage source? Isn't it possible to connect both ends of the current source in the circuit?	
63	What is $I_2$ ?	I think it's the current through R.
64	why is $U_2 = 0$	"That way we will know the current is $V_s/R$ which is independent on the element." - from a similar question earlier
65	sorry i got lost a little but how did we get $V_{RL} = V_{S/R} * R_L$ ?	The current through $R_L$ is $V_s/R$ , so the voltage is $V_s/R * R_L$ .
66	ok thanks	
67	how is this different from the first design we had? $R_L$ is still in series with R and share the same current. what was the problem w the first version?	We build a current source here.
68	why cant the circuit with just $V_s$ and R be the current source we built?	because of loading effect. Once we plug in an element, the current will change