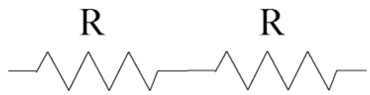
ECE 2040 Midterm Exam 1
Fall 2020

General Instructions instructions:

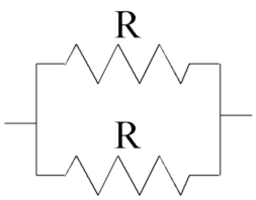
- Exam is closed book / closed notes other than the one-page of handwritten notes.
- Most questions are worth 3 points; first two questions are worth 2 points.
- Only the final answers, as indicated by the question, will be considered correct for each question.
- Choose the best possible answer available in all cases.

Honorlock instructions:

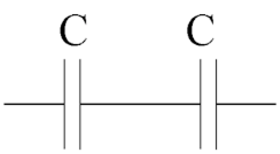
- The only notes allowed is a one-page of handwritten notes. Front and back of the sheet are allowed. Sheet should be shown to the camera.
- Restroom breaks are not encouraged, although if necessary, it is allowed when asking the proctoring system. Timing will be recorded.
- Blank scratch paper is allowed, and needs to be shown to the proctor.
- Music is allowed assuming it is at a low volume and not conveying any exam answers.



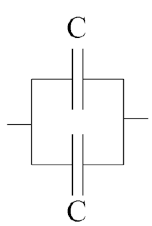
1. (2pt) For the elements above and R = 10kΩ, the equivalent resistance is
a. 2.5kΩ
b. 5kΩ
c. 10kΩ
d. 20kΩ
e. 40kΩ



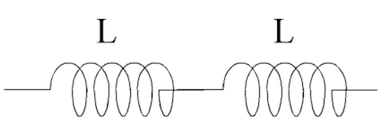
2. For these elements and R = 10kΩ, the equivalent resistance is
a. 2.5kΩ
b. 5kΩ
c. 10kΩ
d. 20kΩ
e. 40kΩ



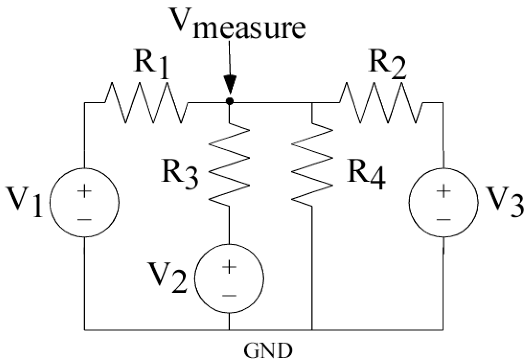
3. For the elements above and C = 1nF, the equivalent capacitance is
a. 0.25nF
b. 0.5nF
c. 1nF
d. 2nF
e. 4nF



4. For these elements and C = 1nF, the equivalent capacitance is
a. 0.25nF
b. 0.5nF
c. 1nF
d. 2nF
e. 4nF



5. For the elements above and L = 1mH, the equivalent inductance is
a. 0.25mH
b. 0.5mH
c. 1mH
d. 2mH
e. 4mH



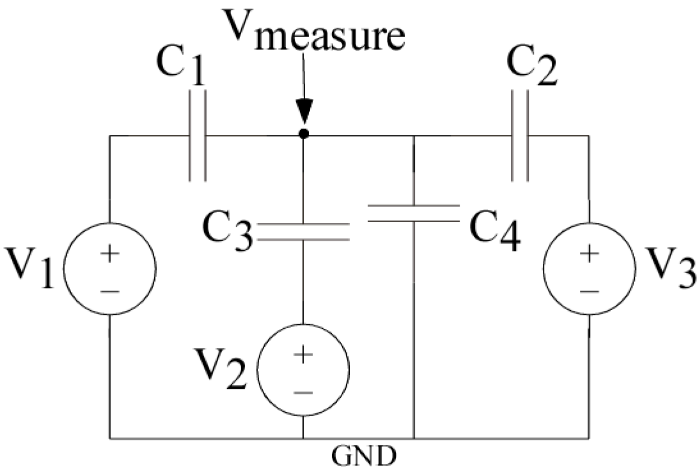
6. For R_1 = 1kΩ, R_3 = 2kΩ, R_2 = 4kΩ, and R_4 = 4kΩ, if V_2 = V_3 = 0V, what is $V_{measure}$ for V_1 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

7. For R_1 = 1kΩ, R_3 = 2kΩ, R_2 = 4kΩ, and R_4 = 4kΩ, if V_1 = V_3 = 0V, what is $V_{measure}$ for V_2 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

8. For R_1 = 1kΩ, R_3 = 2kΩ, R_2 = 4kΩ, and R_4 = 4kΩ, if V_1 = V_2 = 0V, what is $V_{measure}$ for V_3 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

9. For R_1 = 1kΩ, R_3 = 2kΩ, R_2 = 4kΩ, and R_4 = 4kΩ, if V_1 = V_2 = V_3 = 2V, what is $V_{measure}$?
a. 1.0V
b. 1.25V
c. 1.5V
d. 1.75V
e. 2V

10. T/F: For R_1 = 1kΩ, R_3 = 2kΩ, R_2 = 4kΩ, and R_4 = 4kΩ, if V_1 = V_2 = V_3 = 0V, $V_{measure}$ could be a voltage other than 0V.



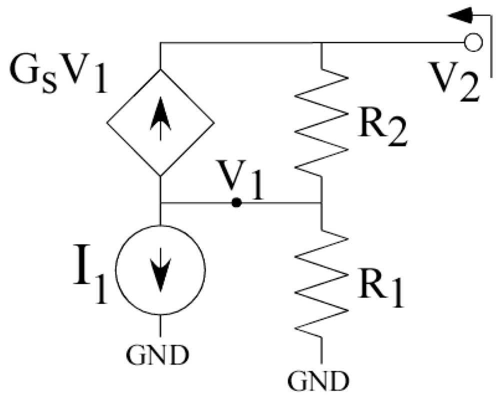
11. For C_1 = 4pF, C_3 = 2pF, C_2 = 1pF, and C_4 = 1pF, assuming $V_{measure}$ = 0V when $V_1 = V_2 = V_3$ = 0V, if $V_2 = V_3$ = 0V, what is $V_{measure}$ for V_1 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

12. For C_1 = 4pF, C_3 = 2pF, C_2 = 1pF, and C_4 = 1pF, assuming $V_{measure}$ = 0V when $V_1 = V_2 = V_3$ = 0V, if $V_1 = V_3$ = 0V, what is $V_{measure}$ for V_2 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

13. For C_1 = 4pF, C_3 = 2pF, C_2 = 1pF, and C_4 = 1pF, assuming $V_{measure}$ = 0V when $V_1 = V_2 = V_3$ = 0V, if $V_1 = V_2$ = 0V, what is $V_{measure}$ for V_3 = 4V?
a. 0.125V
b. 0.25V
c. 0.5V
d. 1V
e. 2V

14. For C_1 = 4pF, C_3 = 2pF, C_2 = 1pF, and C_4 = 1pF, assuming $V_{measure}$ = 0.5V when $V_1 = V_2$, V_3 = 0V, if $V_1 = V_2 = V_3$ = 2V, what is $V_{measure}$?
a. 1.5V
b. 1.75V
c. 2.0V
d. 2.25V
e. 2.5V

15. T/F: For C_1 = 4pF, C_3 = 2pF, C_2 = 1pF, and C_4 = 1pF, if $V_1 = V_2 = V_3$ = 0V, $V_{measure}$ could be a voltage other than 0V.

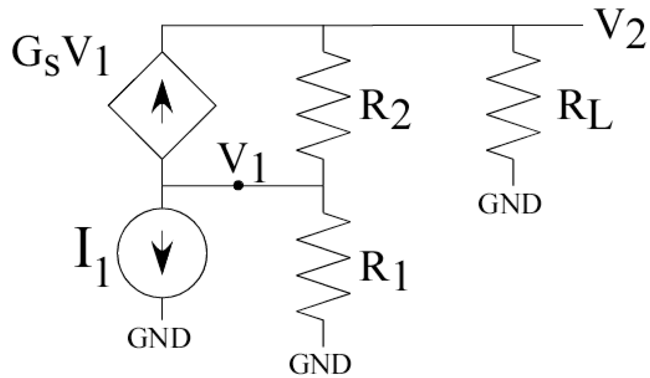


16. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 0$, what is the equivalent Thevenin voltage source value for this one-port network?
a. -2V
b. -1V
c. 0.5V
d. 1V
e. 2V

17. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 0$, what is the equivalent one-port resistance for this one-port network?
a. 0.5MΩ
b. 1MΩ
c. 2MΩ
d. 4MΩ
e. 8MΩ

18. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 0$, what is the equivalent Norton current source value for this one-port network?
a. -1μA
b. -0.5μA
c. 0μA
d. 0.5μA
e. 1μA

19. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 0$ with $R_L = 40k\Omega$, what is the measured output voltage at V_2?
a. -10mV
b. -20mV
c. -40mV
d. -100mV
e. -200mV

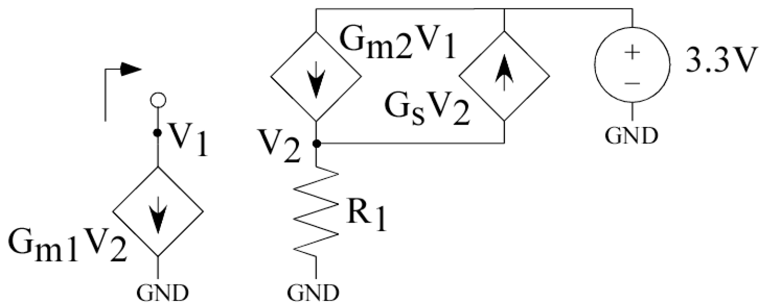


20. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 1/1k\Omega$, what is the equivalent Norton current source value for this one-port network?
a. -1μA
b. -0.5μA
c. 0μA
d. 0.5μA
e. 1μA

21. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 1/1k\Omega$, what is the equivalent one-port resistance for this one-port network?
a. 1MΩ
b. 2MΩ
c. 10MΩ
d. 100MΩ
e. 1GΩ

22. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 1/1k\Omega$, what is the equivalent Thevenin voltage source value for this one-port network?
a. -1000V
b. -100V
c. -10V
d. -1V
e. 0V

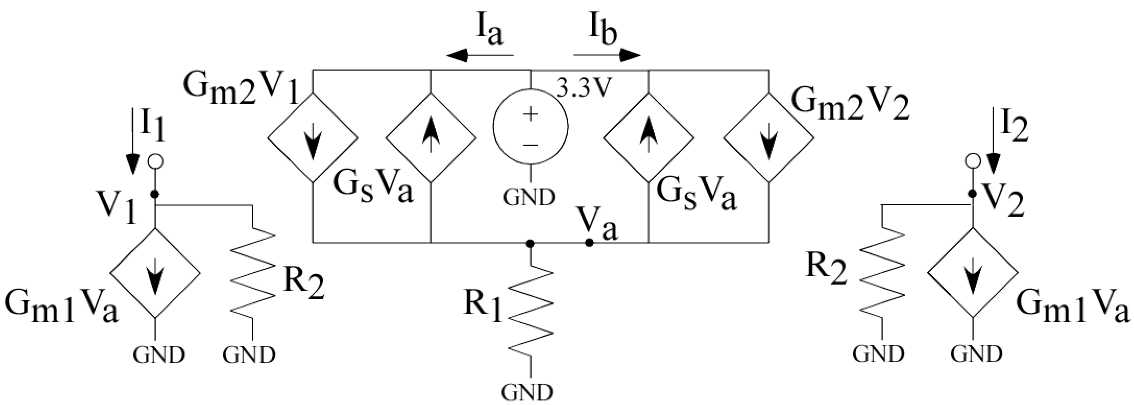
23. When $I_1 = 1\mu A$, $R_1 = 1M\Omega$, and $R_2 = 1M\Omega$, and for $G_s = 1/1k\Omega$ with $R_L = 40k\Omega$, what is the measured output voltage at V_2?
a. -10mV
b. -20mV
c. -40mV
d. -100mV
e. -200mV



24. For $G_s = 1/1k\Omega$, $G_{m1} = 1/200k\Omega$, $G_{m2} = 1/2k\Omega$, and $R_1 = 1M\Omega$, what is the equivalent resistance for the one-port network at V_1?
a. 400kΩ
b. 100kΩ
c. 4MΩ
d. 10kΩ
e. 40kΩ

25. For $G_s = 1/1k\Omega$, $G_{m1} = 1/200k\Omega$, $G_{m2} = 1/2k\Omega$, and $R_1 = 1M\Omega$, what is the equivalent Thevenin voltage for the one-port network at V_1?
a. -2V
b. -1V
c. 0V
d. 1V
e. 2V

26. For $G_s = 1/10k\Omega$, $G_{m1} = 1/10M\Omega$, $G_{m2} = 1/20k\Omega$, and $R_1 = 10M\Omega$, what is the equivalent resistance for the one-port network at V1?
a. 1MΩ
b. 4MΩ
c. 10MΩ
d. 20MΩ
e. 40MΩ



27. For the Differential Mode Circuit, the G_s element can be ignored. (T/F)

28. For the Differential Mode Circuit, the G_{m2} element can be ignored. (T/F)

29. For the Common Mode Circuit, the G_{m1} element can be ignored. (T/F)

30. Assume we have two inputs, I_1 and I_2. $G_s = 1/1k\Omega$, $G_{m1} = 1/10k\Omega$, $G_{m2} = 1/10k\Omega$, $R_2 = 1M\Omega$, and $R_1 = 5M\Omega$. For a Differential current input, $I_1 = -I_2$, the gain from input to differential output, $I_1 = -I_2$, is

a. 10
b. 20
c. 40
d. 100
e. 200

31. Assume we have two inputs, I_1 and I_2. $G_s = 1/1k\Omega$, $G_{m1} = 1/10k\Omega$, $G_{m2} = 1/10k\Omega$, $R_2 = 1M\Omega$, and $R_1 = 5M\Omega$. For a Common current input, $I_1 = I_2$, the gain from input to common output, $I_1 = I_2$, is

a. 0.0001
b. 0.001
c. 0.01
d. 0.1
e. 1

32. Assume we have two inputs, $I_1 = 20.1\mu A$ and $I_2 = 19.9\mu A$ $G_s = 1/1k\Omega$, $G_{m1} = 1/10k\Omega$, $G_{m2} = 1/10k\Omega$, $R_2 = 1M\Omega$, and $R_1 = 5M\Omega$. What is the common input current?

a. 2μA
b. 4μA
c. 10μA
d. 20μA
e. 40μA

33. Assume we have two inputs, $I_1 = 20.1\mu A$ and $I_2 = 19.9\mu A$ $G_s = 1/1k\Omega$, $G_{m1} = 1/10k\Omega$, $G_{m2} = 1/10k\Omega$, $R_2 = 1M\Omega$, and $R_1 = 5M\Omega$. What is the differental input current?

a. 1nA
b. 10nA
c. 100nA
d. 1μA
e. 10μA

34. Assume we have two inputs, $I_1 = 20.1\mu A$ and $I_2 = 19.9\mu A$ $G_s = 1/1k\Omega$, $G_{m1} = 1/10k\Omega$, $G_{m2} = 1/10k\Omega$, $R_2 = 1M\Omega$, and $R_1 = 5M\Omega$. What is the output at I_a?

a. 1nA
b. 10nA
c. 100nA
d. 1μA
e. 10μA