Name _____ Grade = /100
(1 point)

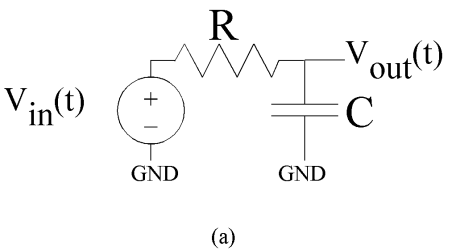
ECE 2040 Midterm Exam 2
Spring 2019

Each question is worth 3 points.
All of your answers need to be on this sheet.
Only the final answers, as indicated by the question, will be considered correct for each question.
You will only turn in this single sheet. You can take the rest of the exam with you. We will not keep the rest of the exam materials if you leave them.

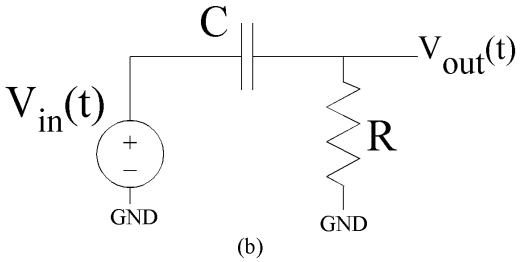
Choose the *best possible answer* available in all cases.

1. _____	12. _____	23. _____
2. _____	13. _____	24. _____
3. _____	14. _____	25. _____
4. _____	15. _____	26. _____
5. _____	16. _____	27. _____
6. _____	17. _____	28. _____
7. _____	18. _____	29. _____
8. _____	19. _____	30. _____
9. _____	20. _____	31. _____
10. _____	21. _____	32. _____
11. _____	22. _____	33. _____

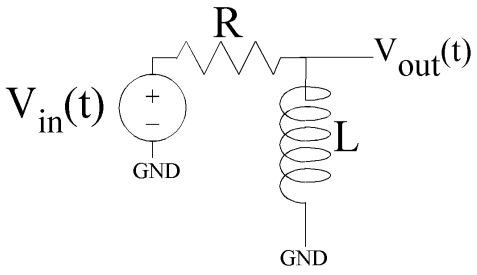
Use the following circuit diagrams for the following questions: (R = 10kΩ, C = 100nF, L = 100mH). Choose the most correct answers.



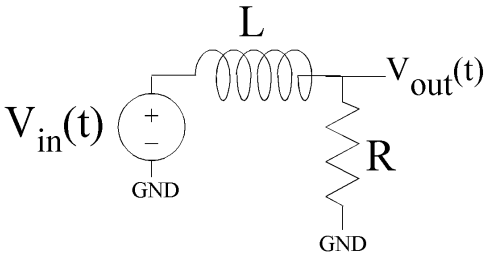
(a)



(b)



(c)



(d)

1. What is the timeconstant for circuit (a)?
a. 0.01ms
b. 0.1ms
c. 1ms
d. 10ms
e. 100ms

2. What is the timeconstant for circuit (d)?
a. 0.001ms
b. 0.01ms
c. 0.1ms
d. 1ms
e. 10ms

3. For a 1V step input (V_{in} = 1V u(t)) for circuit (a), what is the steady state (t→infinity) output voltage (V_{out})?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

4. For a 1V step input (V_{in} = 1V u(t)) for circuit (b), what is the steady state (t→infinity) output voltage (V_{out})?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

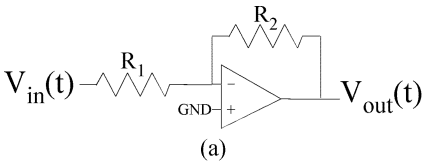
5. For a 1V step input (V_{in} = 1V u(t)) for circuit (d), what is the steady state (t→infinity) output voltage (V_{out})?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

6. For a 1V step input (V_{in} = 1V u(t)) for circuit (b), what is the initial output voltage (V_{out}) after the step ($t=0^+$) ?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

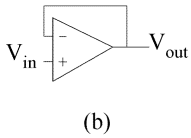
7. For a 1V step input (V_{in} = 1V u(t)) for circuit (c), what is the initial output voltage (V_{out}) after the step ($t=0^+$) ?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

8. For a 1V step input (V_{in} = 1V u(t)) for circuit (d), what is the initial output voltage (V_{out}) after the step ($t=0^+$) ?
a. -1V
b. -100mV
c. 0V
d. 100mV
e. 1V

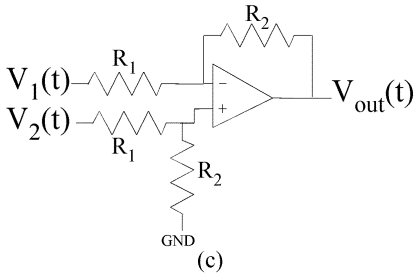
Use the following circuit diagrams for the following questions (R_1 = 10kΩ, R_2 = 100kΩ, Op-Amp gain is infinite):



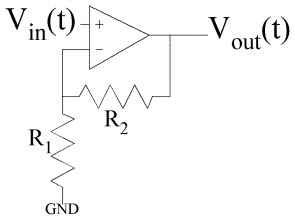
(a)



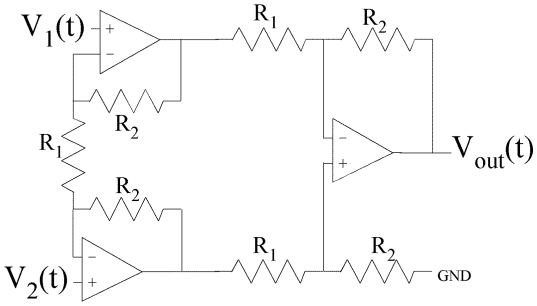
(b)



(c)



(d)



(e)

9. What is the gain (V_{out}/V_{in}) for circuit (b)?
a. 1
b. 2
c. 4
d. 8
e. 16

10. What is the gain (V_{out}/V_{in}) for circuit (a)?
a. -11
b. -10
c. 1
d. 10
e. 11

11. What is the resistance looking into V_{in} for circuit (a)?
a. 1kΩ
b. 10kΩ
c. 100kΩ
d. 1000kΩ
e. Infinite

12. What is the gain ($V_{out}/ (V_2-V_1)$) for circuit (c)?
a. -11
b. -10
c. 1
d. 10
e. 11

13. What is the gain (V_{out}/V_{in}) for circuit (d)?
a. -11
b. -10
c. 1
d. 10
e. 11

14. What is the resistance looking into V_{in} for circuit (b)?
a. 1kΩ
b. 10kΩ
c. 100kΩ
d. 1000kΩ
e. Infinite

15. What is the magnitude of the gain ($V_{out}/ (V_2-V_1)$) for circuit (e)?
a. 1
b. 3
c. 10
d. 30
e. 100

Select the Laplace Transform Pairs for the following questions using the potential answers given. Assume initial states, if required, are 0.

16. $u(t)$

17. $\frac{df(t)}{dt}$

18. $\int f(t)dt$

19. $e^{-at}u(t)$

20. $f(t \to \infty)$

21. $\sin(\omega_1 t)$

a. 1

b. $\frac{1}{s(s+a)}$

c. $\lim_{t\to\infty} sF(s)$

d. $\frac{1}{s+a}$

e. $\frac{1}{s}F(s)$

f. $\frac{1}{s}$

g. $\lim_{t\to 0} sF(s)$

h. $\frac{s}{s^2+\omega_1^2}$

i. $\frac{\omega_1}{s^2+\omega_1^2}$

j. $sF(s)$

22. $H(s) = \frac{V_{out}(s)}{V_{in}(s)} = \frac{s\tau}{1+s\tau}$, and $V_{in} = u(t)$, what is $V_{out}(t)$?

a. $V_{out}(t) = 1$

b. $V_{out}(t) = u(t)$

c. $V_{out}(t) = (1 - e^{-t/\tau})u(t)$

d. $V_{out}(t) = e^{-t/\tau}u(t)$

e. $V_{out}(t) = \tau e^{-t/\tau}u(t)$

23. $H(s) = \frac{V_{out}(s)}{V_{in}(s)} = \frac{1}{1+s\tau}$, and $V_{in} = u(t)$, what is $V_{out}(t)$?

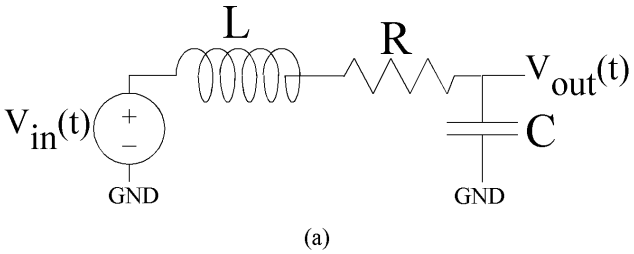
a. $V_{out}(t) = 1$

b. $V_{out}(t) = u(t)$

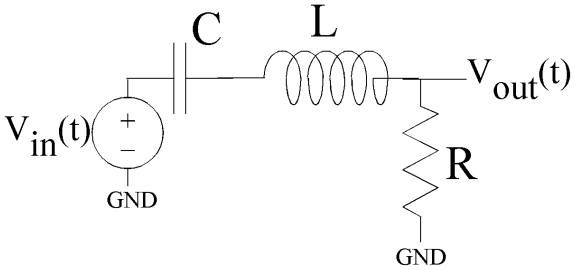
c. $V_{out}(t) = (1 - e^{-t/\tau})u(t)$

d. $V_{out}(t) = e^{-t/\tau}u(t)$

e. $V_{out}(t) = \tau e^{-t/\tau}u(t)$



(a)



(b)

24. For circuit (a), what is the gain (V_{out}/V_{in}) in Laplace domain?

a. 1

b. $\frac{1}{sRC+1}$

c. $\frac{1}{s^2LC+sRC+1}$

d. $\frac{sRC}{s^2LC+sRC+1}$

e. $\frac{s^2LC}{s^2LC+sRC+1}$

25. For circuit (b), what is the gain (V_{out}/V_{in}) in Laplace domain?

a. 1

b. $\frac{1}{sRC+1}$

c. $\frac{1}{s^2LC+sRC+1}$

d. $\frac{sRC}{s^2LC+sRC+1}$

e. $\frac{s^2LC}{s^2LC+sRC+1}$

26. For circuit (a), what is the gain (V_{out}/V_{in}) at steady state after a 1V step (1V u(t))?

a. -1V

b. -300mV

c. 0

d. 300mV

e. 1V

27. For circuit (b), what is the gain (V_{out}/V_{in}) at steady state after a 1V step (1V u(t))?

a. -1V

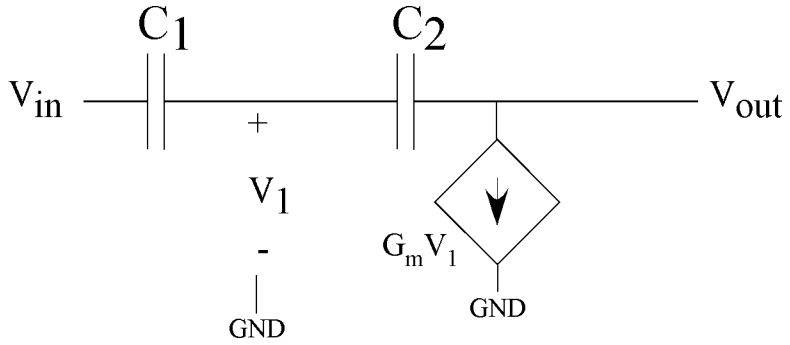
b. -300mV

c. 0

d. 300mV

e. 1V

The following questions relate to the circuit below. $C_1 = 1pF$, $C_2 = 100fF$, $1/G_m = 1M\Omega$, $R_L = 1G\Omega$.



28. How many state variables in this circuit?
a. 0
b. 1
c. 2
d. 3
e. 4

29. What is the time constant for this circuit?
a. 1ns
b. 10ns
c. 100ns
d. 1000ns
e. 10000ns

30. For an input voltage of 0V, one could get an output voltage of 1V. (T=A/F=B).

31. For a 10mV step in the input (10mV u(t)), the change in V_{out} at steady state (t→ infinity) would be positive (T=A, F=B). Assume $V_{out} = 0$ for $V_{in} = 0$, at $t=0^-$.

32. Assume $V_{out} = 0$ for $V_{in} = 0$, at $t=0^-$. For a 10mV step in the input (10mV u(t)), the magnitude change in V_{out} at steady state (t→ infinity) would be
a. 0mV
b. 3mV
c. 10mV
d. 30mV
e. 100mV

33. Assume $V_{out} = 0$ for $V_{in} = 0$, at $t=0^-$. For a 10mV step in the input (10mV u(t)), the magnitude change in V_{out} after the step (t→ 0^+) would be
a. 0mV
b. 3mV
c. 10mV
d. 30mV
e. 100mV

Name ___Solutions___ Grade = /100
(1 point)

ECE 2040 Midterm Exam 2
Spring 2019

Each question is worth 3 points.
All of your answers need to be on this sheet.
Only the final answers, as indicated by the question, will be considered correct for each question.
You will only turn in this single sheet. You can take the rest of the exam with you. We will not keep the rest of the exam materials if you leave them.

Choose the *best possible answer* available in all cases.

1. c	12. d	23. c
2. b	13. e	24. c
3. e	14. e	25. d
4. c	15. e	26. e
5. e	16. f	27. c
6. e	17. j	28. b
7. e	18. e	29. c
8. c	19. d	30. A
9. a	20. g	31. B
10. b	21. i	32. e
11. b	22. d	33. a