PRINT NAME (Last, First): _____

SIGN YOUR NAME: _____

STUDENT ID #: _____

# 1	# 2	# 3	# 4	5	6	7	TOTAL
12	10	8	10	10	10	10	70

Intructions:

1 You have 90 minutes to complete this exam.

2 Print and sign your name, enter your student ID number.

3 Read the questions carefully.

4 Write your solution clearly.

5 You must supply units for all your answers (i.e. $\text{k}\Omega, \mu\text{A}$)

6 This exam has 7 questions worth 70 points, so you should proceed at around 1 point per minute.

Problem # 1 ($2 \times 6 = 12$ points)

There will be no partial credit for this problem.
Even if your answer is correct, you must show your work to receive points.

Convert the following sinusoids to phasors.
Express your answer as $A \exp\{j\theta\}$.

(a) $3\sin(\omega t + \pi/2)$

Answer:

(b) $3\sin(\omega t) + 4\cos(\omega t)$

Answer:

Convert the following phasors to sinusoids. Assume the frequency is ω.
Express your answer as $A\cos(\omega t + \theta)$.

(c) $2\exp(j\pi)$

Answer:

(d) $\dfrac{j}{j+1}$

Answer:

Number conversions.

(e) Write the decimal number 11 in hexadecimal.

Answer:

(f) Write the hexadecimal number 11 in decimal.

Answer:

Problem # 2 $(4 + 4 + 2 = 10$ points)

A lightbulb is basically a resistor. The power rating of a lightbulb is the amount of power that it would dissipate if it was connected to a 100 volts DC source

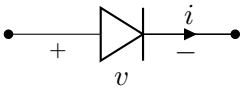
(a) A 50 watt lightbulb and a 100 watt lightbulb are connected in **series** with a 100 volt DC source. Which one glows brighter? Explain your answer.

50W bulb or **100W bulb**

(b) A 50 watt lightbulb and a 100 watt lightbulb are connected in **parallel** with a 100 volt DC source. Which one glows brighter? Explain your answer.

50W bulb or **100W bulb**

(c) This question is independent of the previous two.
How much power is absorbed by an ideal diode?



Answer:

Problem # 3 (8 points)

Mark each of the following statements as True or False.
Correct answers receive 1 point and **incorrect answers receive −1 point.**

(a) You cannot use superposition for a circuit with a diode.

Circle one: True False

(b) The deep-sleep current of the ESP32 is around **10 milli amps**.

Circle one: True False

(c) The input resistance of a voltage amplifier should be much smaller than the source internal resistance.

Circle one: True False

(d) Under MQTT, publishers need to know details of subscribers like IP addresses.

Circle one: True False

(e) A good voltmeter has low internal resistance.

Circle one: True False

(f) Op-amps need an external power supply.

Circle one: True False

(g) You can find the phasor for the signal $\sin(t) + \cos(2t)$

Circle one: True False

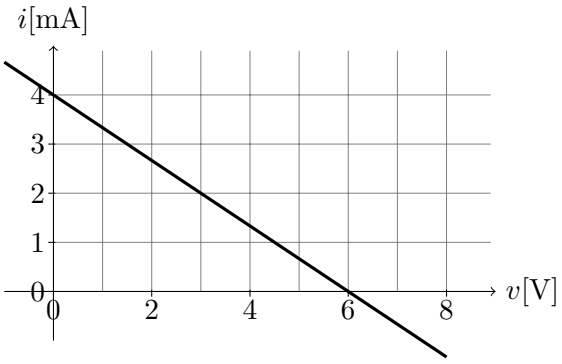
(h) I2C is used to send data over very long distances using wifi.

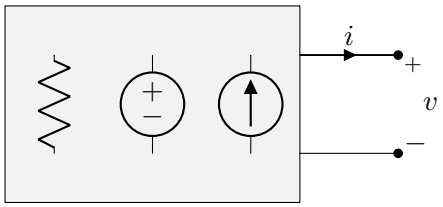
Circle one: True False

Problem # 4 $(5 + 5 = 10$ points)

There will be no partial credit for this problem.

(a) Shown below is the $i - v$ characteristic of a circuit.
The circuit contains only resistors, voltage sources, and current sources.
Find the Thevenin equivalent of this circuit.

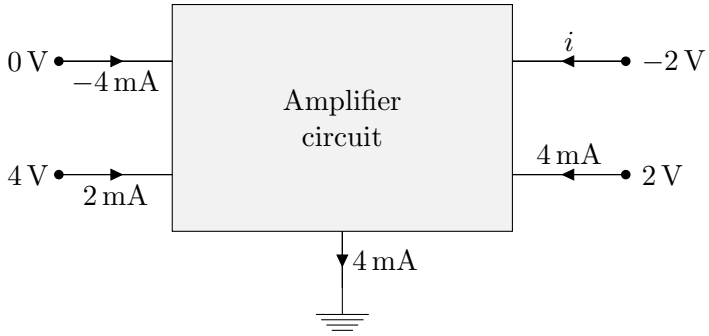




$R_{th} =$

$V_{th} =$

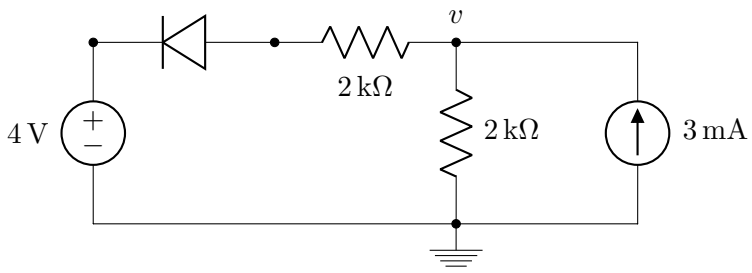
(b) Find the instantaneous power consumed by the amplifier circuit shown below.



Answer =

Problem # 5 (10 points)

Assume the diode is ideal.
Determine if the diode is ON or OFF.
Find the voltage labeled v in the diode circuit below.
There will be no partial credit for this problem.
Even if your answer is correct, you must show your work to receive points.

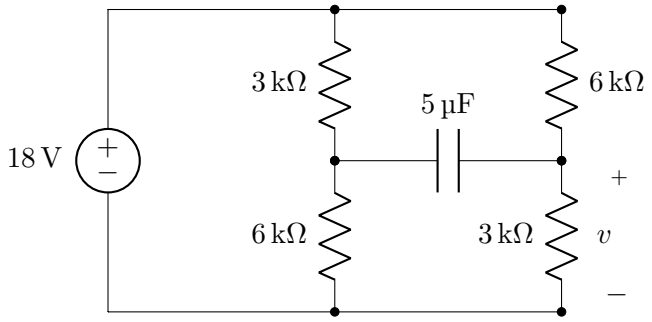


Circle one: ON or OFF
$v =$

Problem # 6 (4+6=10 points)

Consider the circuit shown below.
The capacitor is initially uncharged.
Find the steady-state value of the voltage labeled v.
Find the time constant of the circuit.

Partial credit will be awarded for this problem.
You must show your work to receive points.



steady state v =

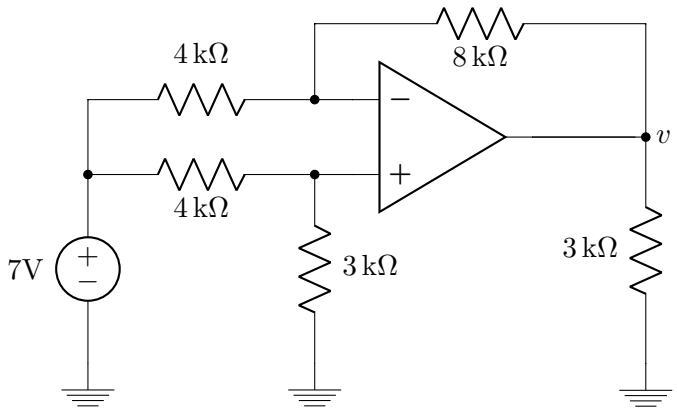
time constant =

Problem # 7 (10 points)

Consider the op-amp circuit shown below.
Assume that the op-amp behaves ideally.

Find the voltage labeled v.

Partial credit will be awarded for this problem.
You must show your work to receive points.



$v =$