EE1111A Electrical Engineering Principles and Practice

Quiz 2

Semester 1, AY20-21

(Correct answers are highlighted)

1. An electric vehicle moving at the speed of 60 km/h is brought to stop at a traffic light in 10 seconds. Regenerative braking can recover 60% of the energy lost in bringing the car to halt. If the recovered energy is to be stored in a 148 V battery, what is the most appropriate charging current specification for the battery? The mass of the vehicle is 1600 kg.

A. 20 A

B. 50 A

C. 100 A

D. 200 A

2. You did a simple experiment to characterize a battery pack. First you connected a 10 Ω resistor across the battery pack and measured the voltage across and current through the resistor. The measured values were 12.73 V and 1.27 A, respectively. Then you repeated the experiment with a 20 Ω resistor. The measured values were 13.33 V and 0.67 A, respectively. Meters used for measurement can be assumed to be ideal. What are the open circuit voltage and the internal resistance of the battery pack?

A. 14 V, 1 Ω

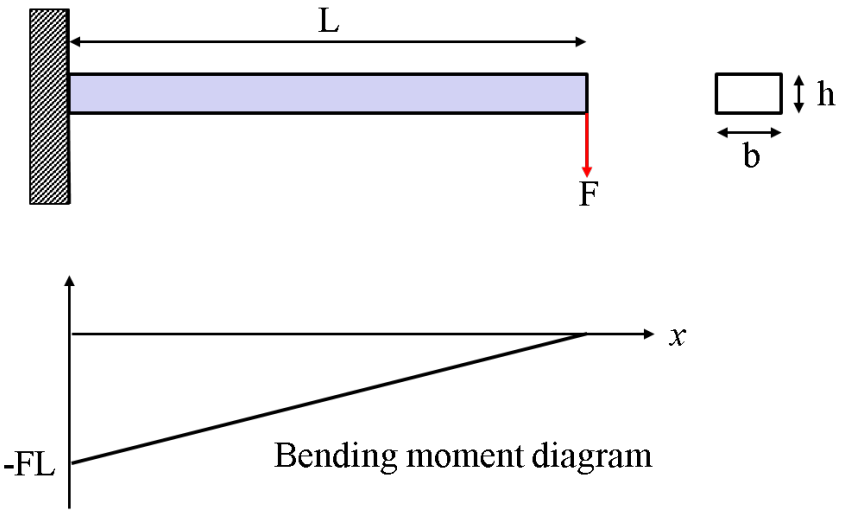
B. 16 V, 1 Ω

C. 14 V, 0.5 Ω

D. Cannot be determined with the information provided

3. ~~A 1 m long cantilever beam has uniform cross-section throughout its length. The cross-section is rectangular with width (b) 10 cm and thickness (h) 6 cm. When a load (10 N) was hung from the free end, the beam could hold the load, but it was deformed permanently. Which of the following statements is TRUE?~~

Question not in scope.



Question not in scope.

~~A. Yield strength of the material is 150 kPa and ultimate strength is 300 kPa~~

~~B. Yield strength of the material is 200 kPa and ultimate strength is 300 kPa~~

~~C. Yield strength of the material is 75 kPa and ultimate strength is 150 kPa~~

~~D. Yield strength or ultimate strength can not be determined using the information given~~

~~Rationale~~

~~Calculated bending stress is 167 kPa. The beam did not fail implying that the bending stress is less than ultimate strength. But the beam was deformed permanently meaning that the bending stress is greater than yield strength.~~

~~Yield strength of 150 kPa and ultimate strength 300 kPa is the correct answer.~~

~~However, option D is also TRUE because we cannot determine the yield strength and ultimate strength. We can only tell the range for these two.~~

4. The label of a battery shows 12 V, 10 Ah, and continuous discharge rate of 10C. Among the four options given, which is the largest electrical load connected to this battery without causing any damage?

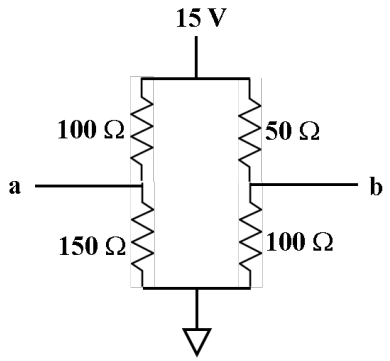
A. 250 W

B. 500 W

C. 1000 W

D. 1500 W

5. Find the Thevenin equivalent of the circuit between the open terminals ‘b’ and ‘a’.



A. *VTh*=1 *V*, *RTh*=93.3 Ω

B. *VTh*=10 *V*, *RTh*=93.3 Ω

C. *VTh*=1 *V*, *RTh*=107 Ω

D. *VTh*=10 *V*, *RTh*=107 Ω

6. You measured the open circuit voltage and the short circuit current of a solar panel which were Voc =10 V and Isc =5 A.The solar panel is now connected to a capacitor (1 mF) which was initially NOT charged. Which of the following statements is TRUE?

A. Initially the current flowing into the capacitor will be 5 A and this will gradually fall to 0 A.

B. Initially the voltage across the capacitor will be 10 V and this will gradually fall to 0 V.

C. The capacitor will charge instantly to 10 V because there is no resistor in the circuit.

D. The capacitor will charge up, but will not reach 10 V. Instead, it will reach the voltage corresponding to the maximum power point of the solar cell.

7. The measured open circuit voltage and short circuit current of a solar panel are Voc =10 V and Isc =5 A, respectively. This panel is then connected to an inductor (1 mH) at t = 0. Which of the following statements is TRUE?

A. Initially the current flowing into the inductor will be 0 A and this will gradually increase to 5 A

B. Initially the voltage across the inductor will be 0 V and this will gradually increase to 10 V

C. After a long period of time passes, the energy stored in the inductor will be 125 mJ

D. After a long period of time passes, the energy stored in the inductor will be 0 mJ

8. You have been given twenty (20) solar mini-panels, each with Voc =10 V and Isc =5 A. The mini-panels will be wired up to create a single large panel. Which of the following statements is FALSE?

A. It is possible to create a large panel with an overall Voc =100 V.

B. It is possible to create a large panel with an overall Voc =50 V.

C. It is possible to create a large panel with an overall Isc =5 A.

D. It is possible to create a large panel with an overall Isc =1 A.

9. You have been given a small circuit element with two wires poking out of it, but no one knows if it is a resistor or something else. Which of the following statements is TRUE?

A. You can find out if it is a resistor by using only an ammeter and a battery

B. You can find out of it is a resistor by using only an ammeter, a battery, and one other resistor.

C. You can find out if it is a resistor by using only an ammeter, a battery, and a potentiometer.

D. You can find out if it is a resistor by using only an ammeter, a voltmeter, a battery, and a potentiometer.

Rationale

Two answers were accepted, although the voltmeter is not really necessary because with the battery and ammeter, voltage can be calculated:

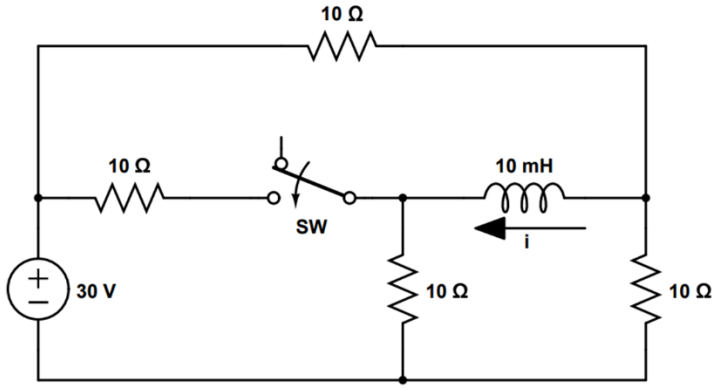
You can find out if it is a resistor by using only an ammeter, a battery, and a potentiometer.

You can find out if it is a resistor by using only an ammeter, a voltmeter, a battery, and a potentiometer.

10. Given three identical resistors, how many different resistor values can you create by combining the resistors in different series and parallel configurations? (You are not required to use all three of them in each arrangement – the goal is to maximize the count of available resistance values. Do not include 0 Ω in your count.)

A. 3
B. 4
C. 5
D. 6

11. The switch in the circuit below is open for a long time. The switch is closed at t=0.

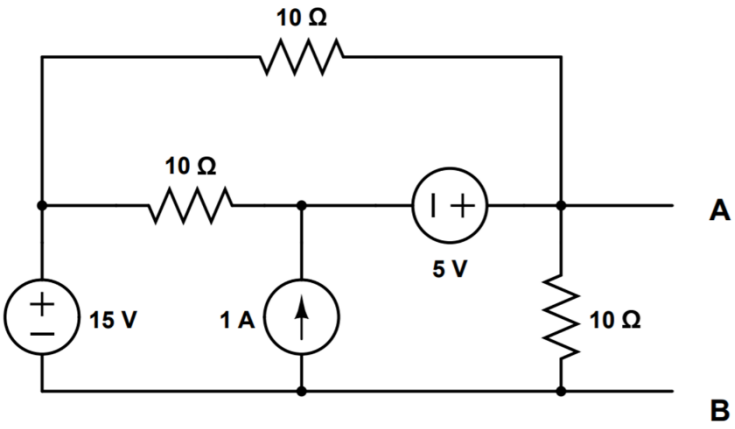


Which option gives the closest values for answers to following questions?

i. What is the current i flowing in the inductor, immediately after the switch is closed?
ii. What will be the final steady-state current in the inductor?
iii. How long will it take after the switch is closed for the inductor current to reach the final steady-state value?

A. 1 A, ii. 0A, iii. 5ms
B. i. 1 A, ii. 0A, iii. 1ms
C. i. 2 A, ii. 1A, iii. 1ms
D. i. 2 A, ii. 1A, iii. 5ms

12. Refer to the circuit below. If a conductor is used for shorting nodes A and B, how much current will flow through the conductor?



A. 2.5A
B. 3 A
C. 4 A
D. 4.5A

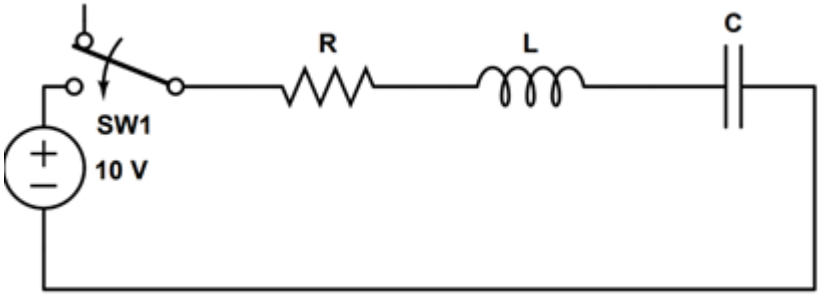
13. A system model is given by $\frac{dx}{dt} = 2^x + x^2$. The initial value of x(0)=0.

Using Euler's method and time-step 0.1 sec, which option gives the closest value of the predicted value of x at time t= 0.3 sec.

A. 0.3217
B. 0.4068
C. 0.2034
D. 0.6546

Question not in scope.

14. In the circuit below, R=1000 Ω, L=1 μH, C=1 pF. The switch SW1 is closed at t=0s.



Which option gives the closest answers for the following questions?

i. What will be the current in the circuit, immediately after the switch is closed?
ii. What will be the final voltage across the capacitor in steady-state?
iii. What will be the angular frequency of the oscillations if any?

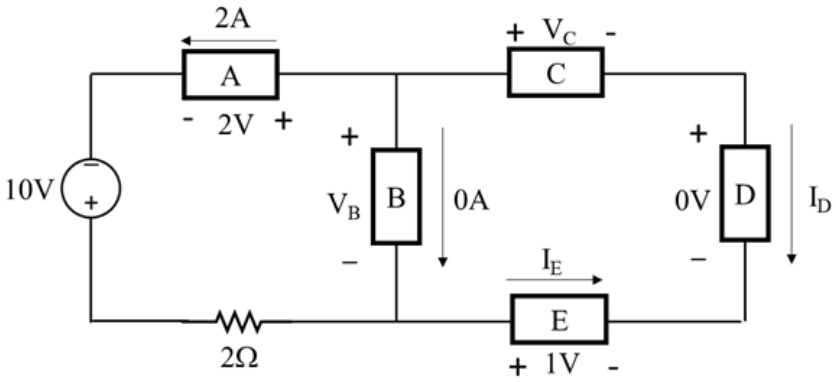
A. 0.01 A, ii. 10 V, iii. 866 Mrad/sec
B. i. 0 A, ii. 10 V, iii. 866 Mrad/sec
C. i. 0 A, ii. 10 V, iii. No oscillations
D. i. 10 A, ii. 10 V, iii. 866 Mrad/sec

15. A capacitor was charged to 5V and discharged through a resistor of unknown value. The capacitor voltage comes to within 1% of zero in 10 sec.

How long will the capacitor take to fully charge (within 1% of final value) if the same resistor and capacitor are connected in series with a 10V source?

A. 5 sec
B. 20 sec
C. 10 sec
D. cannot be determined

16. Determine the unknown currents IE, ID and the unknown voltages VC and VB. Based on your calculated values, identify elements B, C, D, E. Which of the following statements describe elements B, C, D, E most correctly?



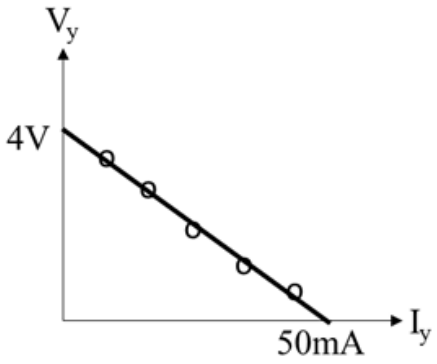
A. B – Voltmeter, C – Resistor, D – Ammeter, E – Voltage Source

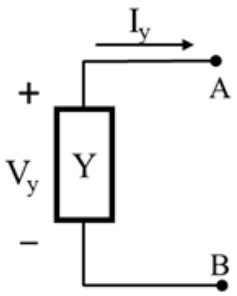
B. B – Voltage Source, C – Voltmeter, D – Resistor, E – Ammeter

C. B – Ammeter, C – Resistor, D – Voltmeter, E – Voltage Source

D. B – Voltmeter, C – Voltage Source, D – Ammeter, E – Resistor

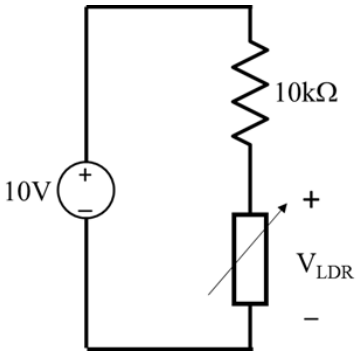
17. An unknown circuit Y is provided to you and you measure the voltages and currents at terminals A-B using different resistor loads. The measurement results are shown in the plot below. It is known that circuit Y consists only of ideal resistors and sources. Using circuit Y and a 1μF capacitor load, what is the time taken to fully charge this capacitor?





A. 300 μs
B. 80 μs
C. 200 μs
D. 400 μs

18. A Light Dependent Resistor (LDR) is connected in series with a 10kΩ resistor. The resistance of a light dependent resistor depends on the brightness of the environment. Using the same practical voltmeter in the same voltage measurement range (0V to 10V), you measure VLDR in different environments. Which of the following statements is most correct?



	Bright	Dark
V_{LDR}	0.50V	8.20V

A. The value of 0.50V is more accurate.
B. The value of 8.20V is more accurate.
C. The values of 0.50V and 8.20V are both accurate.
D. None of the other options.

RATIONALE

The correct answer in this question is option A : The value of 0.50V is more accurate.

Explanation:

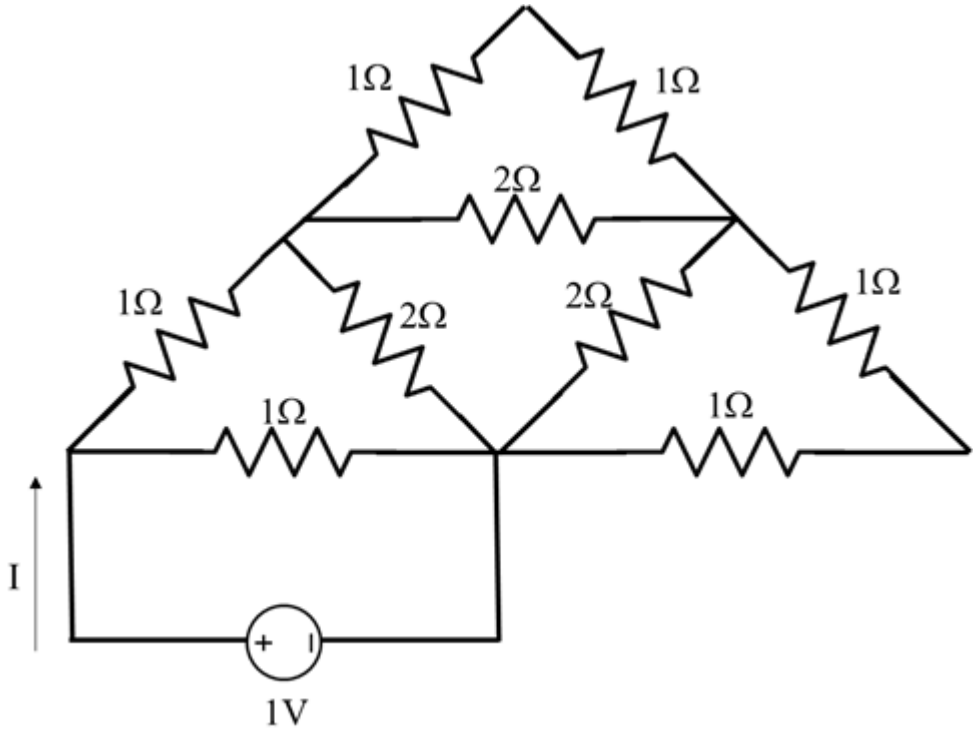
Based on the voltages measured in bright and dark environments, it can be inferred that :

1) The resistance of the LDR is small (much smaller than 10kohm) in a bright environment

2) The resistance of the LDR is large (much larger than 10kohm) in a dark environment

Given that a practical voltmeter has a finite large resistance, it will draw some current when measuring voltage. As such, the measurement of the voltage when the resistance of the LDR is small is more accurate.

19. What is current I in the circuit below?



A. 0.5A
B. 0.67A
C. 0.8A
D. 1.5A

- END OF QUIZ -