RoboJackets Electrical Training Week 0 Worksheet - Answer Key

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v1.2

Contents

1 Introduction

This is the Answer Key to the Week 0 worksheet. Only look at this sheet after you have given an honest attempt at **ALL** the questions. If you do not understand something from the worksheet, refer to your training instructors, classmates, and the additional information sheet provided.

2 Intro to Electricity

1. Measured in Ohms (Ω)
2. $-3.3V - (-5V) = 1.7V$
3. Series, Parallel. Ammeter needs to be in series otherwise it will be shorted. Voltmeters essentially have infinite resistance and if placed in series will make the circuit an open circuit.
4. $R = V/I = 5V/0.2A = 25\Omega$
5. $P = V\dot{I} = 5V \times 0.2A = 1W$
6. $470\Omega \pm 5\%$

3 Capacitors and Inductors

1. Measured in Faraday (F)
2. $C = Q/V = 0.0025C/5V = 0.0005F$
3. False. Electrolytic capacitors have electrolytes inside and have polarity.
4. False. Electrolytic capacitors are easier to achieve a higher capacitance than ceramics.
5. Mitigating fluctuation in power supply.
6. Henry (H)
7. True. For example in solenoids and relays.
8. False. Inductors are wires wrapped around a coil and display no special characteristics with DC.

4 Diodes and FETs

1. $5V/20mA = 250\Omega$
2. True. Lots of motors run at 12V and 24V and draw a lot of current while usual logic circuits runs at 5V or 3.3V and below with a very low current rating. Using FETs enables a logic circuit to use minimal power to control the flow of larger power.
3. Q equals Vss. When A equals Vdd. The upper pFET opens and the lower nFET closes, connecting the output to ground.

5 Circuit Analysis

5.1 Parallel and Series

1. $R = 1/(1/(1.2k\Omega + 1.2k\Omega) + 1/3.3k\Omega) \approx 1.39k\Omega$
2. $ECHO\_OUT = 91\Omega/(91\Omega + 47\Omega) \times ECHO\_5V \approx 3.297V$
3. $\Sigma C = (10\mu F + 20\mu F + 22\mu F + 100\mu F) = 152\mu F$
4. $\Sigma C = 1/(1/10\mu F + 1/20\mu F + 1/22\mu F + 1/100\mu F) \approx 4.8672\mu F$

5.2 Kirchoff's Law

1. Let i_1 be the current going clockwise in the left loop, i_2 be the current through, R_2 from top to down and i_3 be the current going anti-clockwise in the right loop, then:

   $12V = 4\Omega \times i_1 + 3\Omega \times i_2$

   $8V = 2\Omega \times i_3 + 3\Omega \times i_2$

   $i_1 + i_3 = i_2$

   solve for i_1, i_2 and i_3, get $i_3 \approx 2.15A$

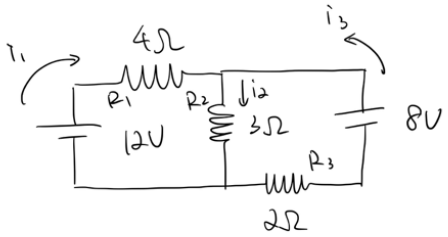

Figure 1: Annotated Circuit

6 Prototyping

1. Not connected, Connected, Not connected
2. Single-core wire, should not. Twisting the wire essentially made the wire into single-core and made metal crimps harder to grab onto the wire.
3. Pull-up resistor. To eliminate high impedance.
4. False. This is a common joke in electrical engineering. The purpose of the fuse is to break to prevent high current levels from damaging the wires.