SSSS Circuit Lab Test

Multiple choice: 1 point each

1. d
2. c
3. b
4. a
5. d
6. c
7. d
8. c
9. a
10. d
11. b
12. a
13. d
14. a

Short answer:

1. This is a voltaic cell, the earliest battery, invented by Alessandro Volta. Label the components and their composition
   a. Blue: Electrolyte; saltwater brine or sulfuric acid (either is acceptable)
   b. Orange: Cathode, copper
   c. Gray: Zinc, anode
2. Use the diagram below. All the charges are equidistant from each other, with a distance of d:
   a. Magnitude: 9.37 N, Direction: 16.1° or .281 radians (either is acceptable)
   b. -3 V
   c. Magnitude: 32.55 V/m (or N/C), Direction: 32.76° or .572 radians (either is acceptable)
3. 4 points, 1 per question: Given a cylindrical graphite ($\rho=3*10^{-3}$ $\Omega*m$) wire with radius r and height l, answer the following. Assume the wire is ohmic:
   a. 0.038 Ω
   b. 2.62 A

c. 26.18 C

d. 2.62 J

4. 6 points, 1 per question: Give the threshold for current in order for one to experience these:

a. 1 mA

b. 5 mA

c. 6-16 mA

d. 17-99 mA

e. 100 mA and above

5. A hydroelectric power plant transmits electricity at 100 kV. When it reaches my house, the voltage is now 99 kV, before getting transformed to 120 V.

a. 16500 coils

b. 169.71 V

c. 480 W

6. Write a simplified Boolean expression for O in terms of A, B, and C

!B + !A*!C

7. Two electrons are 5 nm apart. What is the magnitude of force experienced by them?

9.24 E-24 N

8. What is the internal resistance of the battery if the current at node A is 7 mA?:

100.3 Ω

9. The magnitude of an electric field at a distance x (in meters) from a point P is given by the equation: E = 3x-1

a. 4.25 E-9 N

b. Potential = $(-3/2)x^2 + x$

10. Consider a large charged conductive plate

a. 0

b. 1129 N/C or V/m

11. What is the voltage drop, current, and power dissipated for each resistor?

Resistor	V	I	P
R1	3	.015	.045

R2	2.5	.01	.025
R3	3	.005	.015
R4	1	.01	.01
R5	.5	.003	.0017
R6	.5	.0017	.0008
R7	1.5	.015	.0225

12. A parallel-plate capacitor (5 nF) with a dielectric made of air has a separation of .5 mm.
    a. .28 m^2
    b. 20000 N/C or V/m
    c. 2.5 E-7 J
13. Charge Q (5 nC) is moving at 5 $\mu m/s$ when it encounters a magnetic field of 0.02 T, as shown below.
    a. Magnitude: 5 E-16   Direction: down
    b. .025 m
14. What value of R1 should be used for the following circuit if D1 has a forward voltage of 2.5V and D2 has a forward voltage of 3V, and both LEDs use a current of 20 mA?

225 Ω (also acceptable: resistance $\geq$ 225Ω)

15. Given the following circuit, answer the following:
    a. 8 E-5 C
    b. .03 s
    c. 1.11 E-15
16. What are the values of I_1, I_2, and I_3 in the circuit below?

I_1 = .0175 A, I_2 = .0085 A, I_3 = -.009 A

17. Fill in the table with the correct base SI units

Resistance (Ω)	$kgm^2s^{-3}A^{-2}$
Voltage (V)	$kgm^2s^{-3}A^{-1}$

Coulombs (C)	sA
Teslas (T)	$kgs^{-2}A^{-1}$
Watts (W)	kgm^2s^{-3}
Farad (F)	$s^4A^2m^{-2}kg^{-1}$

18. 2 wires are placed parallel to each other.
    a. Same direction: attract; different directions: repel
    b. 2 E-5 N/m
19. Draw a schematic of a circuit that can be used to change the direction of current through a load (such as controlling the direction of a motor)
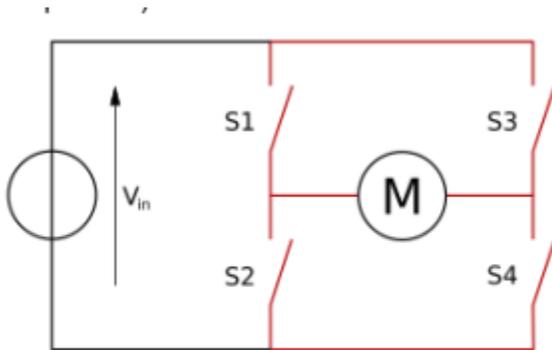
20. A solenoid with an iron core (μ=.25 H/m) with 25 turns, a length of 3 cm, and has a current of 1.5 A flowing through it. What is the magnetic field inside the solenoid?

312.5 Tesla

21. Use this circuit to answer the following questions:
    a. 400 Ω
    b. 937.5 Ω
    c. Wheatstone bridge, used to measure unknown resistances (or capacitances, inductance, impedance, etc), soil analysis, etc.
22. How much power does R6 dissipate in the following circuit?

0.17 W

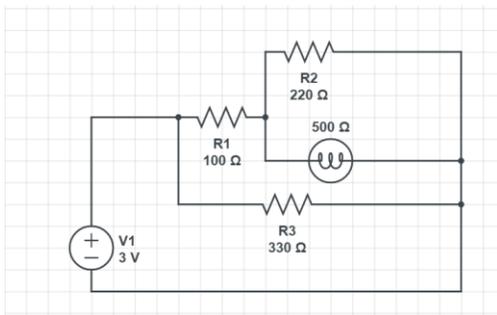23. Given the following diagram of a motor:

a. A: Commutator; B: brushes; C: Magnets/stator

b. Clockwise

24. Draw a schematic for the thevenin equivalent of this circuit (from point A

RTH
282.6 Ω

VTH
459.5 V

to point B)

Lab:

R2
220 Ω

500 Ω

R1
100 Ω

R3
330 Ω

V1
3 V
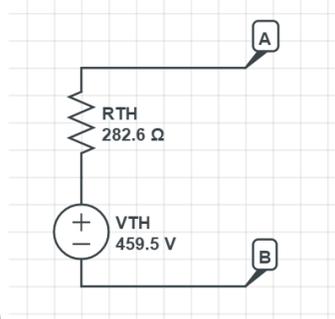
1.

Multimeter should take 2 measurements and a calculation should be done to get approximately 6.6 mW from the measurements

2. Build a circuit that fully charges (5τ) the 470 µF capacitor in 1.34 seconds using the following resistors of 100, 250, and 500 Ω, and the given battery. Use a stopwatch to check.

R1
100 Ω

R2
250 Ω

R3
500 Ω

C1
470 µF
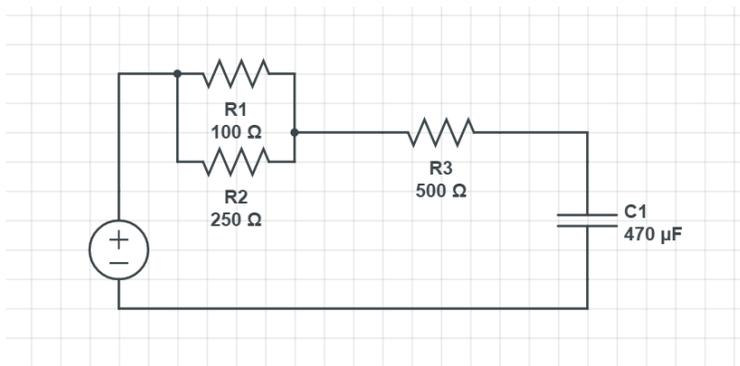
3. Construct a circuit using the provided op-amp and various resistors to have an output voltage 2 times the input voltage

output

OUTPUT(1)
SUPPLY VOLTAGE 2
OUTPUT(2)
GROUND

INPUT-(1)
INPUT+(1)
INPUT+(2)
INPUT-(2)

+

-
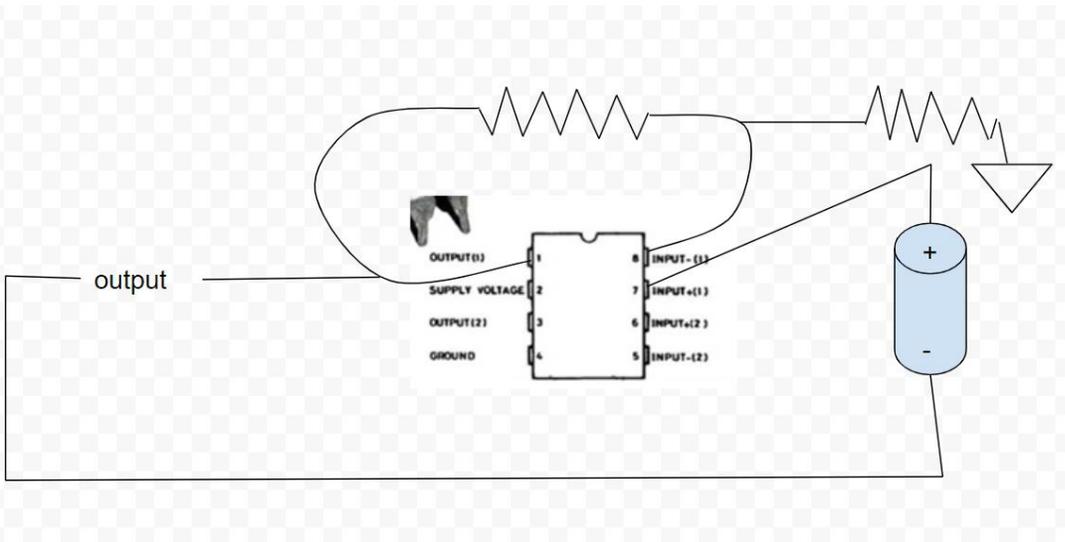
Both resistors can be any value as long as they are equal

(Make sure supply voltage and ground are connected to respective parts of a power supply)