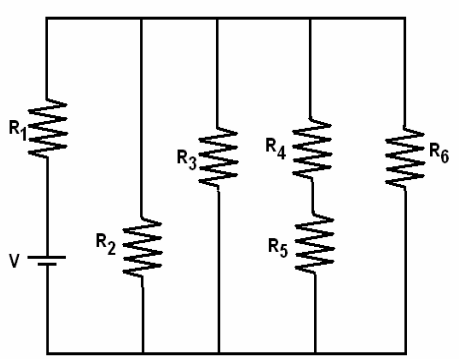
PENNSYLVANIA SCIENCE OLYMPIAD 2006 STATE FINALS
CIRCUIT LAB C DIVISION

ANSWER KEY

SECTION 1

/5 **1. SCHEMATIC DIAGRAM**



/18 **2. THEORETICAL QUANTITIES**

Resistor	Resistance Ω	Current A	Voltage V
R_1	220	0.0341	7.51
R_2	12000	0.00000406	0.487
R_3	18	0.0271	0.487
R_4	39	0.00677	0.264
R_5	33	0.00677	0.223
R_6	1800	0.000271	0.487

/3 **3. 14.3 Ω**

/3 **4. 234.3 Ω**

/3 **5. 0.257 J**

/2 **6. 209 - 231 Ω**

/2 **7. 32-35 mA**

/2 **8. 7.50-7.54 V**

/2 **9. 0.46 - 0.50 V**

/2 **10. 0.24 - 0.27 V**

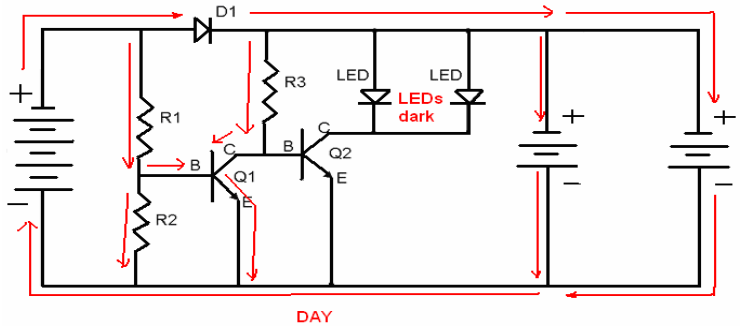
SCHOOL CODE

SCHOOL NAME

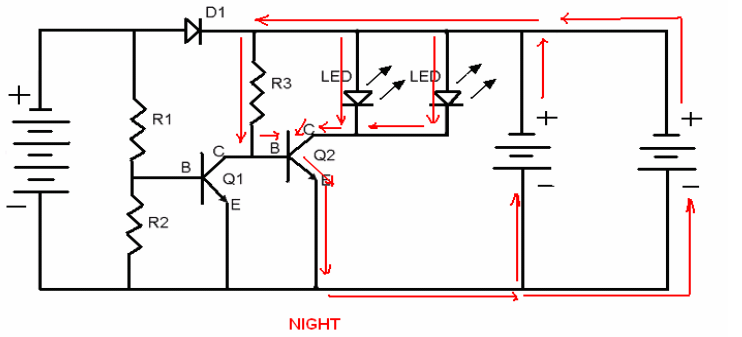
PARTICIPANTS

SECTION 2

/6 **1.**



/8 **2.**



/2 **3. N-type and P-type; pn-junction**

/4 **4. Doping with phosphorus produces an extra valence electron for n-type silicon, while doping with boron produces an extra "hole" for p-type silicon.**

/2 **5. Photoelectric effect**

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SECTION 3

/2 **1.** 2.50 seconds

/2 **2.** 2.5E-5 F or 25 μF

/4 **3.** C_1 = 3.75E-5 F, C_2 = 7.5E-5 F

/2 **4.** 1.25E-3 C

/2 **5.** 2.08E-2 J

/2 **6.** 0.5 mA or 0.0005 A or 5E-4 A

/2 **7.** 10 volts

/2 **8.** 16.7 volts

/2 **9.** increase

/4 **10.** The capacitors would discharge, and the current would start at 0.5 mA and decrease, reaching effectively zero (full discharge) after roughly 5 time constants (12.5 seconds)

+5 **BONUS**

Wheatstone Bridge

SECTION 4

/2 **1.** Resistor

/2 **2.** Variable resistor / Rheostat

/2 **3.** Photoresistor

/2 **4.** NPN transistor

/2 **5.** Capacitor

/2 **6.** Preset variable resistor

/2 **7.** Polarized capacitor

/2 **8.** Thermistor

/2 **9.** LED light-emitting diode

/2 **10.** Beeper / buzzer

/2 **11.** Switch

/2 **12.** Battery

/2 **13.** Zener Diode

/18 **14. - 19. THEORETICAL QUANTITIES**

Resistor	Current	Voltage Drop
R_1	0.468 A	5.61 V
R_2	0.193 A	6.39 V
R_3	0.274 A	18.4 V

/4 **20.** Short across R_7

/8 **21. - 24. Voltmeter Resistances**

Resistor	Resistance
R_1	400000 Ω or 400 kΩ
R_2	90000 Ω or 90 kΩ
R_3	9000 W or 9 kΩ
R_4	600 Ω

/2 **25.** Terminal 4

/2 **26.** Three

/3 **27.** R_3, R_9, and R_{12}

/2 **28.** NONE

/2 **29.** 19900 Ω or 19.9 kΩ

/2 **30.** Nothing - not a continuous circuit