Homework #01

READINGS: Electronics Workbook 1 (**ew1.pdf**).: Pages 1-27
Man of High Fidelity (**armstrong.pdf**): Chapters 1-3

General rules for written homework assignments:

1. Show your work and formulas, not just the answer.
2. If you can't get the answer using algebra, try another method such as trial and error, "homing in" on the answer.
3. If you are stuck, write down why. Writing promotes clarity in thinking.
4. This assignment is due at the beginning of the next class. There will be a one question quiz on this homework after the lecture.

NOTE: The symbol for "ohms" is the capital Greek letter Omega (Ω). The values of the three resistors shown in Figure 1 are thus 4Ω = 4 ohms, 5Ω = 5 ohms, and 6Ω = 6 ohms.

1.1) Find the total resistance, in ohms, R_{ab} (*between point **a** and point **b***), R_{ac} (*between points **a** and **c***) and R_{ad} (*between points **a** and **d***) for the three series resistors in the circuit of Figure 1.

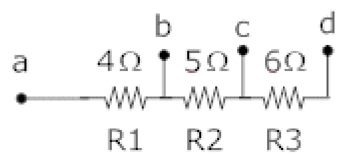

Figure 1.1 Three Series Resistors

1.2) Find R_{ab} the total resistance, in ohms, between point **a** and point **b**, for the two parallel resistors in the circuit of Figure 2.

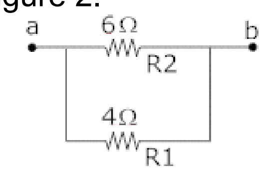

Figure 1.2 Two Parallel Resistors

1.3) Find R_{ab} the resistance, in ohms, between point **a** and point **b**, for the three resistors in the circuit of Figure 3.

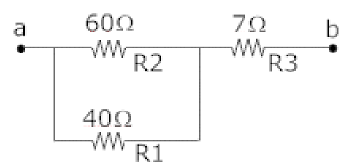

Figure 1.3 Series and Parallel Resistor Combinations

1.4) Find **I** the **current *through*** R_3, the **4Ω resistor**, in Figure 4.

1.5) Now find V_3 the **voltage *across*** resistor R_3 in Figure 4.

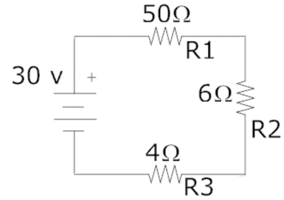

Figure 1.4 A Three Resistor Series Circuit

Homework #02

READINGS: Electronics Workbook 1 (ew1.pdf): Pages 28-65.
Armstrong (armstrong.pdf): chapters 4 – 6.

General rules for written homework assignments:

1. Show your work and formulas, not just the answer.
2. If you can't get the answer using algebra, try another method such as trial and error, "homing in" on the answer.
3. If you are stuck, write down why. Writing promotes clarity in thinking.
4. This assignment is due at the beginning of the next class. There will be a one question quiz on this homework after the lecture.

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1. Armstrong Reading Questions

(Please Note, there will also be Armstrong questions on the Midterm.)

2.A1) What was Armstrong's Mother's maiden name?

2.A2) By 1917, What circuit was Armstrong receiving invention royalties of about $500/month (same buying power as $10,350/month today!) for?

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2. Voltage Dividers

2.B1) Find $\mathbf{V_{ab}}$, the voltage across $\mathbf{R_2}$ from **a** to **b**, in Figure 2.1, *on the right*, using the voltage divider equation.

Compare HW#2 Figure 1 to HW#1 Figure 4 until it is clear to you why the answer to HW#1.4b must be the same as the answer to HW#2.1 here.

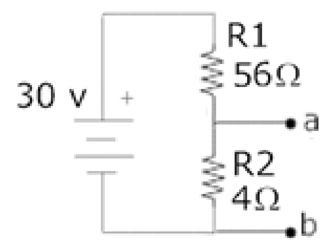

Figure 2.1 Voltage Divider Circuit

2.B2a) Find the ***current*** **I** leaving the **30V source** in Figure 2, *on the right*.

(Hint-start by combining the two **20 ohm** resistors).

2.B2b) Find the voltage $\mathbf{V_{ab}}$ from **a** to **b** (across $\mathbf{R_3}$).

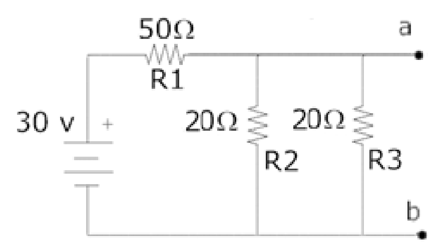

Figure 2.2 Series/Parallel Voltage Divider Circuit

2.B3) Using the voltage divider equation find the voltage $\mathbf{V_{ab}}$ from **a** to **b** (across $\mathbf{R_2}$) in Figure 3.

Then examine and compare Figures 2 and 3 until it is clear to you why the answer to #2b must be the same as the answer to #3.

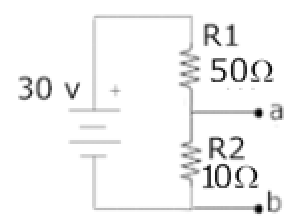

Figure 2.3 Voltage Divider Circuit

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3. Power Dissipation in Resistors

(***NOTE: 1 mA = 0.001 Amp***)

2.B4) Find the power dissipated in a **130 ohm** resistor carrying **60mA**

2.B5a) Find the power dissipated in a **100 ohm** resistor carrying **60 mA**.

2.B5b) Is the calculated power level for the 100 ohm resistor within the ratings of a **1/2 watt** resistor? (Yes, No)
Note: This question presumes the resistor is in an open, well-ventilated, space.
If a resistor is used in an enclosed space, e.g. inside a small box, it is good practice not to exceed 50% of the stated power rating.

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4. Charging Capacitors

4.a. Consider a capacitor being charged through a resistor from a 16-volt source. (*presume the input voltage is exactly 16 volts*).

2.B6a) What is the *approximate* **theoretical** value of voltage across the capacitor after **one time constant**?

2.B6b) What is the *approximate* **theoretical** value of voltage across the capacitor after **5 time constants**?

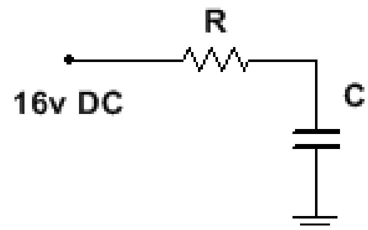

Figure 2.3 Resistor-Capacitor Circuit

4.b. If a capacitor is charged to exactly **16 volts** and is then **discharged** through a switch into a resistor.

2.B7a) What is the *approximate* voltage across the resistor, $\mathbf{V_R}$, after **one time constant**?

2.B7b) What is the *approximate* voltage across the resistor, $\mathbf{V_R}$, after **5 time constants**?

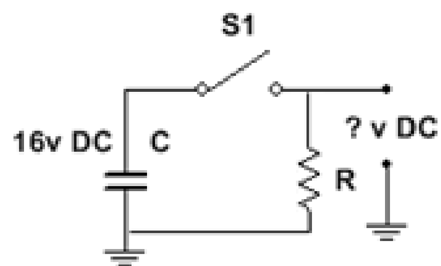

Figure 2.5 Capacitor as Voltage Source Circuit

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5. Calculating Time Constants

2.B8) With a series resistor of **100KΩ**, what value of capacitance would be required to have a time constant of **1 minute**?

(*Due to current leakage in real electrolytic capacitors, the actual charging times will be slower. Ignore this effect and calculate an approximate, **ideal**, estimate of the time constant.*)

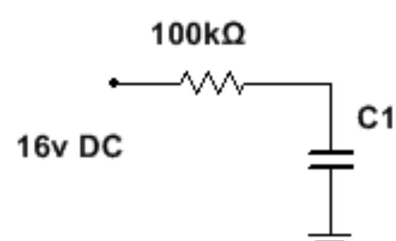

Figure 2.6 RC Time Constant Circuit

Homework #03

READINGS: Electronics Workbook 1 (ew1.pdf): Pages 66-76.
Armstrong (armstrong.pdf): Chapters 7 - 9.

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

Part 3A. Armstrong Questions

3.A1a) Armstrong "kept all grim details of his work from the family."
What work and why grim?

3.A2b) Who said "Leave it on Major…I want to see if my name's on it" when there was a report from the Missing Persons Bureau?

Part 3B. Scientific Notation, Electronic Abbreviations

3.B1. Give answers to the following mathematical equations using E notation

Example 1: $\mathbf{10^2 \times 10^3}$ = ? Answer **1E5** *(which equals* $\mathbf{10^5}$ *or* ***100,000)***

Example 2: $\mathbf{3\times10^2 \times 10^{-3}}$ = ? Answer **3E-1** *(which equals* $\mathbf{3 \times 10^{-1}}$ *or* ***0.3)***

3.B1a) $\mathbf{10^3 \times 10^4}$ **=**

3.B1b) $\mathbf{10^4 \times 10^5}$ **=**

3.B1c) $\mathbf{10^3 \times 10^{-4}}$ **=**

3.B1d) $\mathbf{10^7 \times 10^{-9}}$ **=**

3.B1e) $\mathbf{10^7 \div 10^9}$ $\mathbf{= 10^7 / 10^9 =}$

3.B2. Rewrite the given electronic quantities using the abbreviations: **K** (kilo) for E3 or **M** (mega) for E6 or **m** (milli) for E-3 or **µ** (Greek mu, micro) for E-6 as appropriate. Abbreviate volts as **V**, amps as **A** and Farads as **F**.

Example : $\mathbf{10^3}$ **ohms**=? Answer: **1K ohms** or **1KΩ** or **1K** *(ohms is commonly assumed when resistors are involved (in general other units* ***must*** *be stated)*

3.B2a) **1.3 E6 ohms**, using **M**

3.B2b) **470E3 ohms**, using **K**

3.B2c) **300E-6 farads**, using **µ**

3.B2d) $\mathbf{5.7 \times 10^{-3}}$ **amps**, using **m**

3.B2e) **1200 volts**, using **K**

Part 3C. Diode Voltage Drops

3.C1. In this problem *use the approximation that the voltage across a forward biased diode is approximately 0.6 volt*. Assume all the diodes in this problem are forward biased.

Example: A **1K resistor and a diode are connected in series to a 15 volt source. Find the current through the resistor**.
Answer : **(15 - 0.6)volts/1K = 14.4 mA**

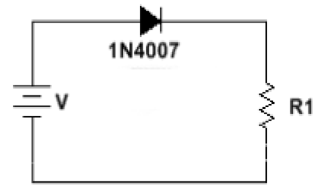

Figure 3.1 Series Diode-Resistor Circuit

Include sketches of the schematic diagrams for each part.

3.C1a) *Repeat this problem with* **2 diodes in series**.

3.C1b) *Repeat this problem with* **3 diodes in series**.

3.C1c) *Repeat this problem with* **4 diodes in series**.

Part 3D. RESISTORS IN PARALLEL "PROOFS"

We saw in class that if any two resistors R1 and R2 are connected in parallel, the resulting resistance is the product **R1•R2** divided by the sum (**R1 + R2**). You may use this fact in the following proofs**:**

3.D1) Prove that: **If two equal resistances R and R are connected in parallel, the resulting resistance is always one half of R**.

3.D2) Prove that: **If three equal resistors R and R and R are connected in parallel, the resulting resistance is always one third of R**.

3.D3) Prove that: **If four (4) equal resistors R and R and R and R are connected in parallel the resulting resistance is always one fourth of R**.

3.D4) SOLVE: If **four (4) 2000 ohm resistors are connected in parallel**, what is the resulting resistance? *(Give numerical answer in ohms.)*

Homework #04

READINGS: Electronics Workbook 1 (ew1.pdf): Pages 77 - END.
Armstrong (armstrong.pdf): Chapters 10 - 11.

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

4.A1) From your Armstrong readings recall the passage: "Sarnoff was furious. He issued an edict that anyone who allowed Armstrong to (???) again would promptly be fired." *What did Armstrong do?*

4.A2) The signature by the Notary on Armstrong's crucial document appeared to be forged. *What was the explanation?*

Transistor Circuits and Gain

4.1. We will use a **2N5551** NPN Silicon Bipolar Junction Transistor in this course. The published $\mathbf{h_{FE}}$ for this transistor is in the range of **60-250**. A transistor's $\mathbf{h_{FE}}$ is the $\mathbf{I_C/I_B}$ current amplification which is also written as $\mathbf{H_{FE}}$ or called ***Beta***. The value of $\mathbf{h_{FE}}$ varies somewhat with the circuit's collector current and can vary quite a bit from transistor to transistor even with the same type number as will be seen in our lab experiments.

4.2. We will approximate $\mathbf{V_{BE}}$ (the voltage measured from base to emitter) as **0.6 volts**

4 3. We will approximate the **2N5551**'s $\mathbf{h_{FE}}$ as **200**.

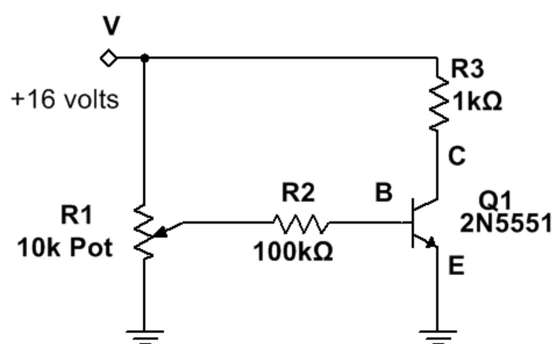

Figure 4.1 Transistor Circuit

SHOW ALL WORK CLEARLY

4.B1 What would the collector current $\mathbf{I_C}$ have to be if the base current $\mathbf{I_B}$ is ***0.02 mA*** ?

4.B2 What would the collector current $\mathbf{I_C}$ have to be if the voltage from the potentiometer slider to ground is approximately ***5.0 volts*** ?

4.B3 If the base current is ***0.2mA*** and $\mathbf{h_{FE} = 200}$ the collector current will be much less than ***40 mA***. Calculate the circuit's saturation current.

> *NOTE : There is a point at which an increase in base current no longer produces in increase in collector current, because the available voltage in the circuit limits the current. This condition, called "saturation" limits the actual collector current and thus the gain of the circuit. In Figure 4.1 we would calculate the saturation current as the supply voltage divided by the resistance in the collector emitter circuit as if the collector-emitter junction were short-circuited.*

Homework #05

READINGS: Electronics Workbook 2 (ew2.pdf): Pages 1-50, 90.
Armstrong (armstrong.pdf): Chapters 12 - 13.
Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

5.A1) What did Armstrong order when he was persuaded to take off time from his research to go to a fancy French restaurant?

5A2) When FM threatened AM radio's profits, what dirty scheme was cooked up and was successful in setting back, at least for a time, the commercial progress of FM? (known as *the really dirty scheme*)

Review Problems

5.B1) Convert decimal **37** to binary
5.B2) Convert decimal **38** to binary
5.B3) Convert binary **1 0 0 0 0 0 0 0 1** to decimal

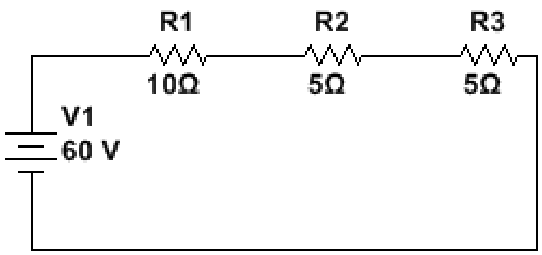

Figure 5.1 Series Circuit

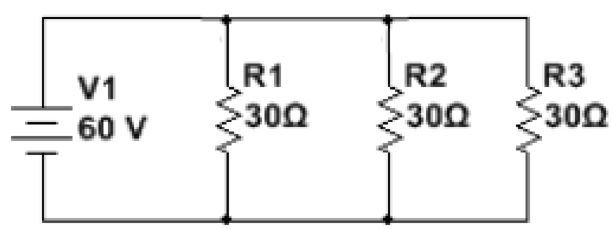

Figure 5.2 Parallel Circuit

5.B4) Referring to **Figure 5.1 Series Circuit:**
5.B4a) Find the total resistance of the three resistors in series.
5.B4b) Find I.
5.B4c) Find the voltage across each resistor, $\mathbf{V_{R1}}$, $\mathbf{V_{R2}}$, and $\mathbf{V_{R3}}$.
5.B4d) Do the three voltages add up to the supply voltage?
5.B4e) Find the power being dissipated in each resistor $\mathbf{R_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$.
5.B4f) Add up the three powers to find the total power leaving the source.
5.B4g) Find the total power leaving the source another way - use the total equivalent resistance of the three resistors. Do you get the same answer?

5.B5) Referring to **Figure 5.2 Parallel Circuit:**
5.B5a) Find $\mathbf{I_1}$, $\mathbf{I_2}$ and $\mathbf{I_3}$. (these are the currents in $\mathbf{R_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$)
5.B5b) Find total **I** leaving the source by adding the currents found in **5.B5a**.
5.B5c) Find the power being dissipated in each resistor $\mathbf{R_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$.
5.B5d) Find the total power leaving the source.
5.B5e) Find the equivalent resistance of the three resistors in parallel.
5.B5f) Find the total current leaving the source using just the supply voltage and the equivalent resistance. Does result agree with part **5.B5b** above?
5.B5g) Find the total power leaving the source using just the source voltage and the equivalent resistance. Does the result agree with part **5.B5d** above?

Homework #06

READINGS: Electronics Workbook 2 (ew2.pdf): Pages 51-79, 90.
Armstrong (armstrong.pdf): Chapters 14 - END.

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

6.A) Of the twenty-one (21) individual FM lawsuits filed in 1954, how many were ultimately victorious for Armstrong?

Try problems 6.B – 6.D ***before*** *looking at the Hints Section.*

6.B) Find the voltages across the **1Kohm** resistors in Figure 6.1.

6.B1) Find $\mathbf{V_{R2}}$
6.B2) Find $\mathbf{V_{R4}}$
6.B3) Find $\mathbf{V_{R6}}$

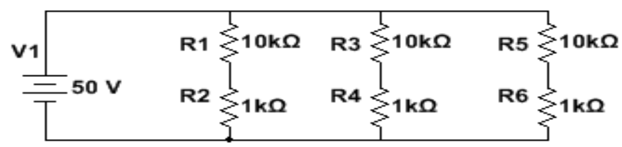

Figure 6.1 Series-Parallel Resistor Circuit

6.C) Find the currents in **R1**, **R2** and the Diode **D1** in Figure 6.2
6.C1) Find $\mathbf{I_{R1}}$
6.C2) Find $\mathbf{I_{R2}}$
6.C3) Find $\mathbf{I_{D1}}$

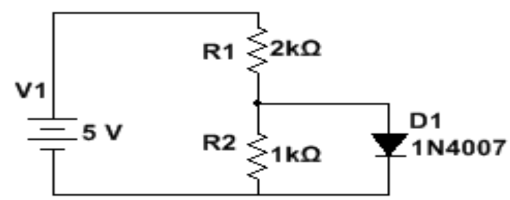

Figure 6.2 Series-Parallel Resistor/Diode Circuit

6.D) For the transistor circuit of Figure 6.3:

If $\boldsymbol{h_{FE}=10}$ (given)
find the collector current, $\boldsymbol{I_C}$.

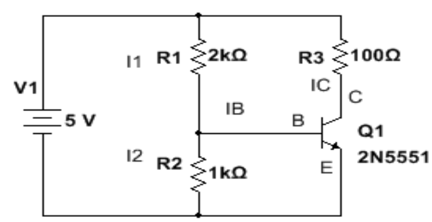

Figure 6.3 Transistor Circuit

6.R Review Problems
6-R1) Convert decimal **59** to binary.

6-R2) Covert binary **110011** to decimal.

6-R3) Round the following numbers to ***3*** *significant digits*:
6-R3a) 9.875 **6-R3**b) 9.87499 **6-R3**c) 3.105 **6-R3**d) 0.003105 **6-R3**e) 0.00310499

Hints

6.B) *Use the Voltage Divider Equation*
6.C) *Voltage across forward biased diode approx 0.6 volts*
6.D) *Base-Emitter junction is a forward biased diode, thus* V_{BE} *is approximately* ***0.6 volts****.*
Compare to Figure 2. Same I_{R1}, I_{R2}, *and* $I_{D1}=I_B$. $I_C = I_B \times h_{FE}$ *just as long as the circuit allows that much current to flow in the collector, which it does here:* ***5V/100 ohms = 5V / 0.1K = 50mA***

Homework #07

READINGS: Electronics Workbook 2 (ew2.pdf): Pages 80 - END, pages 5 and 12.
Be sure to study the CD4013 and the CD4017 ICs

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

7.1) Audio Amplifier REVIEW Questions (Review the Notes!)

7-1a) Does negative feedback increase or decrease amplification?

7-1b) Does negative feedback increase or decrease distortion?

7-1c) Does negative feedback widen (i.e., improve) frequency response or narrow (i.e., make worse) frequency response?

7.2) Binary to Decimal Conversion REVIEW Questions

7-2) Convert the following binary number to decimal**: 1 1 1 1 0**

You may find it useful to use the following table:

2^7 = **128**	2^6 = **64**	2^5 = **32**	2^4 = **16**	2^3 = **8**	2^2 = **4**	2^1 = **2**	2^0 = **1**

Table 7.1 Binary Code to Decimal Chart

Homework #08

READINGS: Electronics Workbook 2 (ew2.pdf): Review Page 12.
Be sure to study the CD4013 and the CD4017 ICs

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

8.1a Drawing a Logic Circuit *(Estimated sketching time: under 2 minutes)*
On a separate piece of paper copy the schematic on the bottom lower left of **Electronics Workbook 2, page 5**, which shows how to make an **OR** Gate out of three (3) **NAND** Gates. Be sure to label your circuit's inputs and outputs: *Gate 1 In, Gate 2 In, Gate 1 Out, Gate 2 Out, and Gate 3 Out.*
8.1b) *A single **CD4011** IC contains four (4 or quad) 2-input **NAND** gates - thus this circuit can actually be implemented using a single IC! Add the pin numbers for the **CD4011** to your sketch.*

8.2 Creating a Truth Table for a Logic Circuit
8.2a) Using truth tables (entering the symbols **0** and **1** only) prove that the three **NAND** gates of problem 1, above, will actually perform the **OR** function, i.e., fill in the 5 columns of the truth table below.

Gate 1 In	Gate 2 In	Gate 1 Out	Gate2 Out	Gate 3 Out
0	0			
0	1			
1	0			
1	1			

Table 8.1 Three NAND Gate Truth Table

8.2b) Are the leftmost two columns and the last column of Table 8.1 consistent with a logical **OR**? **Yes** or **No** ? - *if NOT, please correct your work <grin>*
8.3) Refer to Figure 8.2 and write out the truth table for the circuit.

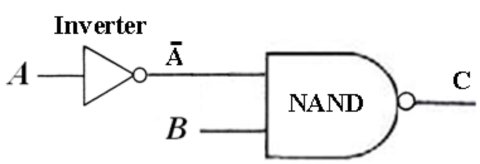

Figure 8.2 Inverter/NAND Gate Circuit

A	NOT A	B	C
0	1	0	
0	1	1	
1	0	0	
1	0	1	

Table 8.2 Inverter/NAND Gate Truth Table

8.4) Refer to Figure 8.3 and write out the truth table for the circuit.

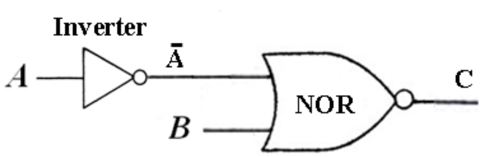

Figure 8.3 Inverter/NOR Gate Circuit

A	NOT A	B	C
0	1	0	
0	1	1	
1	0	0	
1	0	1	

Table 8.3 Inverter/NOR Gate Truth Table

Homework #09

READINGS: Electronics Workbook 2 (ew2.pdf): Review Page 37.

Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

CD4017 Counter Review

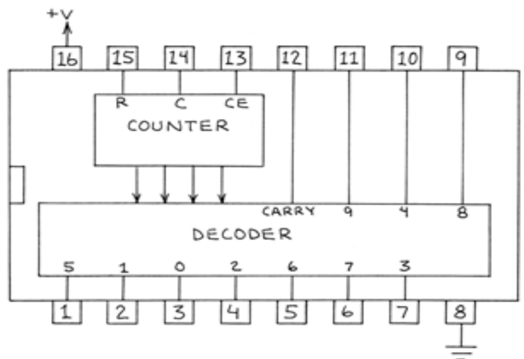

Figure 9.1 CD4017 Decade Counter IC

Notes:

1) *The CD4017 is powered by connecting pin 16 to +Vcc and pin 8 to ground.*
2) *The **4017** counts, or "is clocked by," **rises** of the input clock line*
3) Note that the "clock enable" line actually disables the clock when high.
4) IC *Pin 14 is marked "**Clk**" meaning "Clock input pin"*
5) The ten states of the **CD4017** Decade Counter are labeled **0 - 9** to represent the count of clock pulses after reset.
6) Your first step is to label each of the diagrams (figures 9.1 – 9.4) and mark each pin with its function *(e.g., mark pin 15 as "reset", mark pin 11 as "output count 9", mark pin 13 as "clock enable").*

===

Additional Hints - things to consider in this type of problem:

a) Where are clock pulses coming from? *In this problem from a standard clock source (e.g., periodic pulses).*
b) Will the counter count all the way back to count zero or will the clock enable pin go high at some point and halt further counting?
c) Will the counter count all the way back to zero or will the reset pin go high at some point causing a direct reset back to count 0?
d) Will the output be very brief because the output line going high forces the counter to reset *(triggers the reset line)*?
e) Will the output line go high and stay high because in going high it causes a halt *(disables the clock)*?
f) Will the output be normal width *(from rise to rise of the clock pulse)* because the output line does not cause either a reset or a halt of the counter?

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9.1a) In figure 9.2, after the **CD4017** counter has been reset, how many input clock pulses are required to get one output pulse? _______ ***pulse(s)***

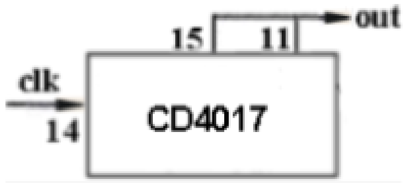

Figure 9.2 The ***CD4017*** *Decade counter with pins **11** and **15** connected together and Output from pin **11***

9.1b) Choose *one* answer:
- a) The output pulse is very brief, just wide enough to reset the counter.
- b) The output pulse has a width equal to the space between rises of the input clock.
- c) The output pulse goes high and stays high.

9.2a) ***(5 points)*** In figure 9.3, after the **CD4017** counter has been reset, how many input clock pulses are required to get one output pulse? _______ ***pulse(s)***

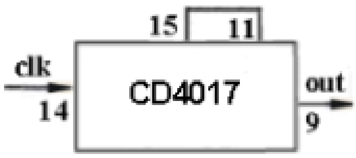

Figure 9.3 The ***CD4017*** *Decade counter with pins **11** and **15** connected together and Output from pin **9***

9.2b) Choose *one* answer:
- a) The output pulse is very brief, just wide enough to reset the counter.
- b) The output pulse has a width equal to the space between rises of the input clock.
- c) The output pulse goes high and stays high.

9.3a) In figure 9.4, after the **CD4017** counter has been reset, how many input clock pulses are required to get one output pulse? _______ ***pulse(s)***

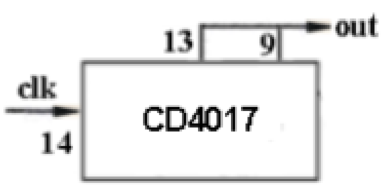

Figure 9.4 The ***CD4017*** *Decade counter with pins **9** and **13** connected together and Output from pin **9***

9.3b) Choose *one* answer:
- a) The output pulse is very brief, just wide enough to reset the counter.
- b) The output pulse has a width equal to the space between rises of the input clock.
- c) The output pulse goes high and stays high.

9.4a) In figure 9.5, after the **CD4017** counter has been reset et, how many input clock pulses are required to get one output pulse? _______ ***pulse(s)***

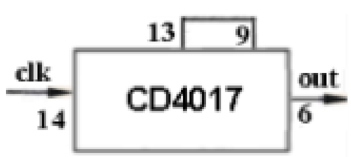

Figure 9.5 The ***CD4017*** *Decade counter with pins **9** and **13** connected together and Output from pin **6***

9.4b) Choose *one* answer:
- a) The output pulse is very brief, just wide enough to reset the counter.
- b) The output pulse has a width equal to the space between rises of the input clock.
- c) The output pulse goes high and stays high.

Homework #10

READINGS: You should have finished reading Electronics Workbook 2 (ew2.pdf) Workbook 2 last week, if not, finish it now! THIS IS THE LAST HOMEWORK!
Assignment is due at the beginning of the next class, a one question quiz on this homework occurs after the lecture.

Part 10.1 Binary and Decimal Number Review
10.1a) For binary (*base 2*) numbers: is the highest weighted bit at the extreme Left or at the extreme Right?

10.1b) For decimal (*base ten*) numbers: is the highest weighted bit at the extreme Left or at the extreme Right?

*(Hint: If your answers to 10.1a and 10.1b are **not** both the same, please review this material!)*

Part 10.2: Four-Stage Shift Register Problems

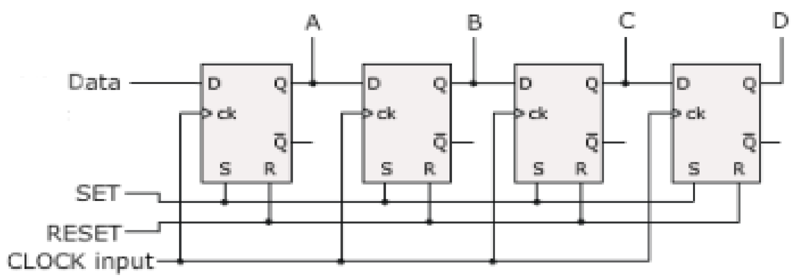

Figure 10.1 4-Stage Shift Register

Consider a **4-stage shift register** made from four **D-type flip-flops** and sitting horizontally on a table with the serial **Data input** at the left.

10.2) If an experimenter enters a **1** (by holding the **Data** line **high**, raising and then lowering the **clock** input) and then enters a **0**, then a **1**, then a **0** so that all four flip-flops have outputs that correspond to numbers he entered (**1010**);

10.2a) In Figure 10.1, which Flip-Flop contains the last number entered:
The one at the extreme Left (A) or at the extreme Right (D): Write A or D: _____

10.2b) Convert the binary number in the shift register to decimal (*base ten*). The decimal number is: _____

10.3) In the circuit of Figure 10.1, **if** an experimenter enters a **0** (by holding the **Data** line **low**, raising and then lowering the **clock** input) and then entering a **1**, then a **0**, then a **1** so that all four flip-flops have outputs that correspond to numbers he entered (**0101**).

10.3a) Convert the binary number in the shift register to decimal (*base ten*). The decimal number is: _____

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Homework #11

Review Problems

NOTE: Problems were taken directly from previous Final Exams in this course!

Part A. CD4017 Decade Counter Review

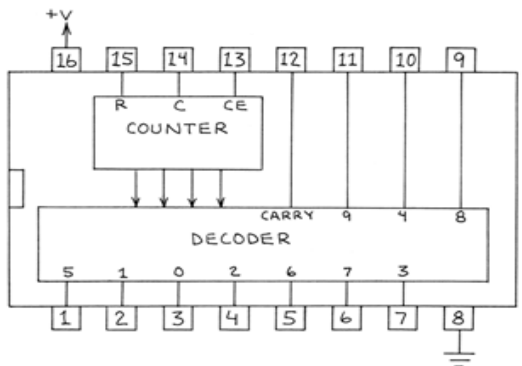

Figure 11.1 CD4017 pin assignments

11.1) Refer to the **CD4017** pin assignments above and the circuit of Figure 11.2:

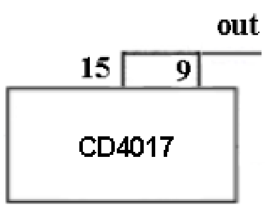

Figure 11.2 CD4017 Decade Counter Circuit

11.1a) *After* the counter has been reset, how many input pulses are required to get the output line to rise? _____ ***pulses***

11.1b) Will the output:
a) be a very brief pulse
b) be a "normal" width pulse with duration of clock pulse rise to next clock pulse rise
c) go high and stay high

11.2) Refer to the **CD4017** pin assignment diagram above and the circuit of Figure 2.

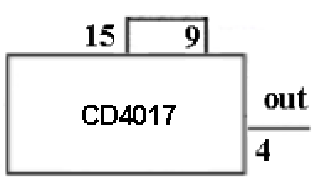

Figure 11.3 CD4017 Decade Counter Circuit

11.2a) *After* the counter has been reset, how many input pulses are required to get the output line to rise? _____ ***pulses***

11.2b) Will the output:
a) be a very brief pulse
b) be a "normal" width pulse with duration of clock pulse rise to next clock pulse rise
c) go high and stay high

Part B. Four-Stage Shift Register Review

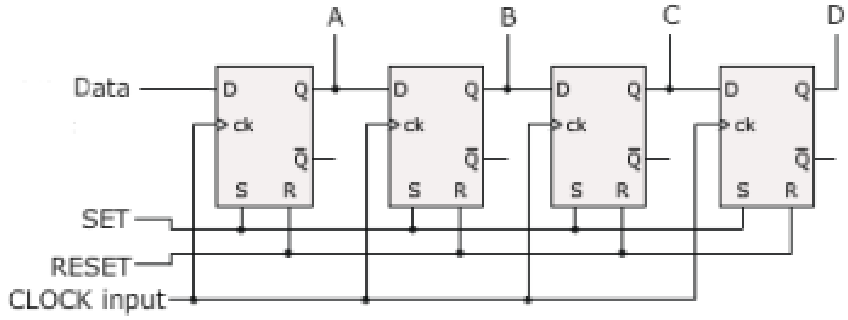

Figure 11.4 Four-Stage Shift Register

11.3) Consider the **4-stage shift register** of Figure 11.4, above, made from four **D-type flip-flops** and sitting horizontally on a table with the serial **data** input at the left. An experimenter enters a **0**, then a **1**, then a **0**. *The experimenter then checks your student ID number and enters a **0** if it is **even** or a **1** if it is **odd**.*
11.3a) Write down the last digit in your Student ID _____ **(Last Digit Student ID)**
11.3b) Now write down the binary number in the shift register.
The binary number is: __________ **(Binary)**
11.3c) Convert the number in the shift register to decimal (*base ten*). The decimal number is __________ **(Decimal)**

Part C. 555 Timer Review

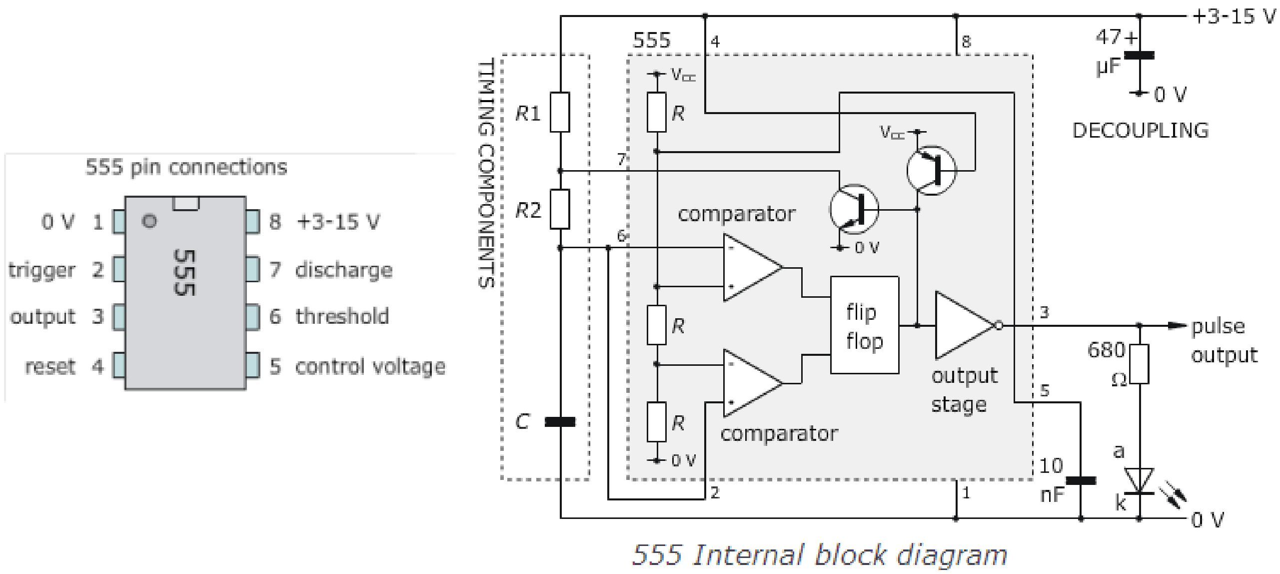

Figure 11.5. The NE555 Timer IC

11.4) Choose correct answer within each pair of parentheses:

To **set** the 555 timer's internal flip-flop, Pin **(1 2 3 4 5 6 7 8)** should be brought **(below** *or* **above)** a voltage that is **(1/3** *or* **2/3)** of the supply voltage.

Homework #12

Review Problems

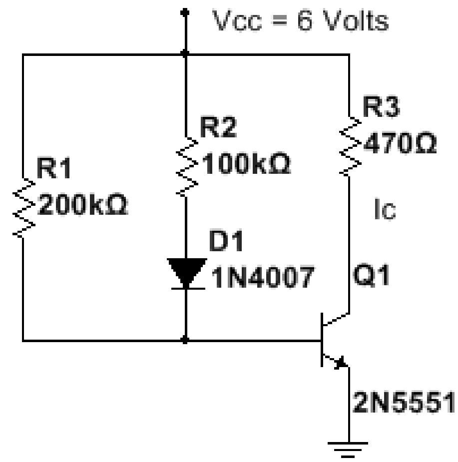

Figure 12.1 Transistor Test Circuit

12.1) Figure 12.1 is the hardest problem (*at least many found it to be*) from a recent FINAL exam.

a. Use **Vcc=6 volts** per the schematic on the right. *(Note that just as on the Midterm, on the actual exam, each student had a different Vcc.)*

b. Given that $\mathbf{h_{FE} = 100}$ for the transistor, find the collector current. *(You may use the approximation that the voltage across a forward biased diode will be approximately **0.6** volts. This includes the base-emitter voltage of NPN transistors.)*

This problem should actually be slightly easier than homework 6's transistor problem.

Show all work and PROVE that the answer is $\mathbf{I_C = 7.50}$ **mA**
Hint: *There are two currents that make up the base current.*

12.2) You are working on two **CD4017** Decade Counter circuits. The following are some of the most common errors for the **CD4017** IC:

Error 1: Reset line is tied high
Error 2: Reset line is tied low
Error 3: CE (clock enable/disable) is tied low
Error 4: CE is tied high
Error 5: An output line is grounded
Error 6: An output line is tied high

Match the problems noted for circuit with the most likely wiring errors above:

12.2a) Circuit **A** has a **CD4017** counter has **two** output lines **high**
Select from 1, 2, 3, 4, 5, or 6:
The most likely the error is **ERROR # _____**

12.2b) Circuit **B** has a **CD4017**, properly powered, with **no** output lines **high**
Select from 1, 2, 3, 4, 5, or 6:
The most likely the error is **ERROR # _____**

