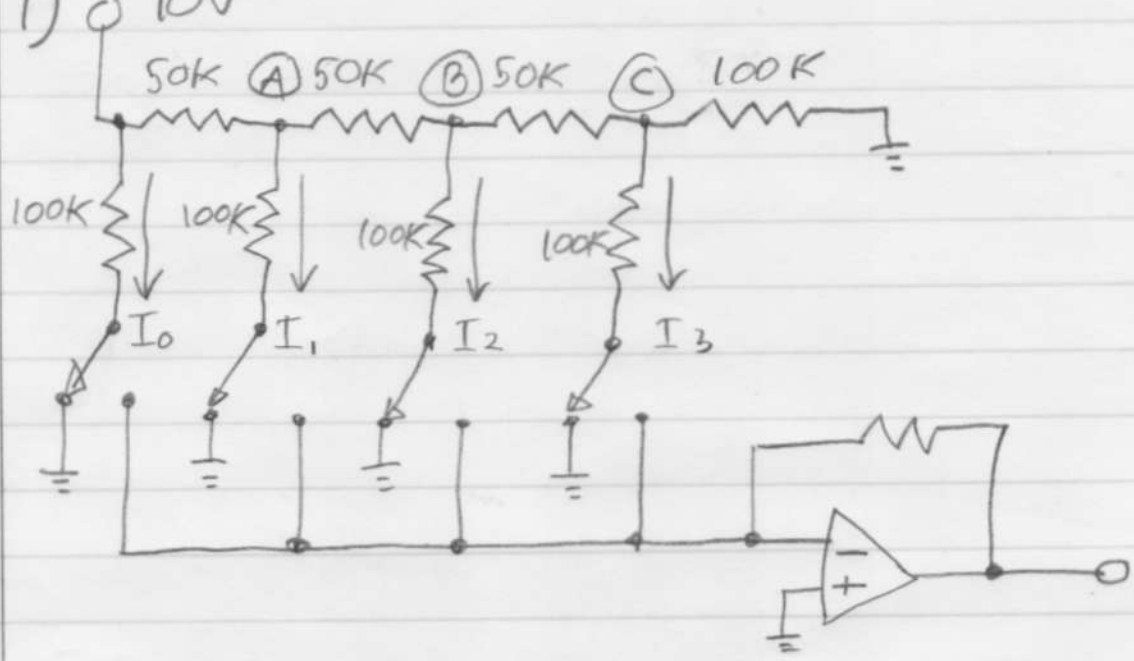
PHYS 335 - SPRING QUARTER 2013

HOMEWORK 5 SOLUTIONS V1.0

1)



EITHER SWITCH POSITION IS A GROUND — REAL OR VIRTUAL. THEREFORE CURRENTS DON'T DEPEND ON SWITCH POSITIONS. NOTICE CURRENT ENTERING NODE (C) FROM THE LEFT: IT DIVIDES EQUALLY THROUGH TWO 100K RESISTORS. AS FOR NODE (B), THE RESISTANCE "LOOKING" RIGHT IS 100K (THAT IS, 50K + 100K||100K = 100K). HENCE CURRENT ENTERING (B) SPLITS EVENLY. THE SAME HOLDS FOR NODE (A). HENCE, AT EACH NODE, CURRENT SPLITS EQUALLY.

THE CURRENT I_0 IS $10V/100K\Omega = 100\mu A$. HENCE $I_1 = 50\mu A$, $I_2 = 25\mu A$, AND $I_3 = I_4 = 12.5\mu A$.

2) FOR $V_{REF} = 10V$ WITH 16 "STEPS", EACH STEP IS $10V/16 = 0.625$ V/COUNT.

$7.21V / 0.625 V/\text{COUNT} \approx 11.5$ COUNTS.
HENCE, THE 4 MSBs ARE 1011.

THE SECOND ADC SEES INPUT
$7.21V - 11 \text{ COUNTS} \times 0.625 V/\text{COUNT} = 0.335V.$

NOTICE THE "STEP SIZE" (LEAST COUNT) IS X16 SMALLER THAN THAT OF THE FIRST ADC: $(10V/16)/16 V/\text{COUNT} = 0.039$ V/COUNT.
SO, AGAIN
$0.335 V / 0.039 V/\text{COUNT} \approx 8.6$ COUNTS.
HENCE, THE FOUR LSBs ARE 1000
AND THE COMPLETE 8-BIT OUTPUT IS
1011 1000

(YOU CAN QUIBBLE ABOUT WHETHER TO ASSIGN COUNT THRESHOLDS AT THE BOTTOM, TOP, OR MIDDLE OF A STEP.)