

## Measurement of the Electric Charge with a NPN Transistor

You will measure the electric charge “e” by using the current turn-on characteristics of an NPN transistor. The collector current can be parameterized as

$V_{RC} = I_0 R_C (e^{\frac{qV_b}{kT}} - 1) \sim I_0 R_C e^{\frac{qV_b}{kT}}$  when  $T = 300K$  where  $I_C$  is the collector current and  $V_b$  is the base voltage. The transistor turn-on is indicated by an increasing collector current ( $V_C = I_C R_C$ ) as the base voltage  $V_b$  is increased. Record  $V_b$  and  $V_C$  at several points during the turn on.

- 1) Read the lab materials carefully to understand the concepts.
- 2) The NPN transistor circuit should be powered to +24V.
- 3) Use the fine grain potentiometer to vary  $V_b$ . Record  $V_b$  and  $V_{RC}$  at 8 points between  $V_b = 360mV$  to  $600mV$ .
- 4) Graph  $B_b$  versus  $V_{RC} = \ln(I_0 R_C) + \frac{q}{kT} V_b$  and fit to a straight line with slope  $= \frac{q}{kT}$ .

$V_b$ (mV)	$V_{RC}$ (V)
360	
400	
430	
460	
500	
530	
560	
600	

5) Determine  $q$  and the  $\Delta q$ .  $q =$  \_\_\_\_\_  $+/-$  \_\_\_\_\_

6) What is the percent difference between your measurement and the accepted value ?

%  $\Delta =$  \_\_\_\_\_