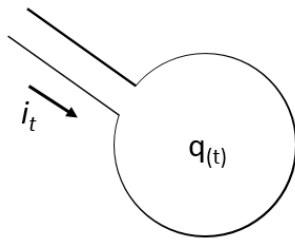


Homework 1

- (1) In a 'sack of charge' model shown below, it initially contains -4 C charge (*i.e.*, $q_{(0)} = -4\text{ C}$).



- (i) If the input current is constant as $i_t = 1\text{ A}$, how long it will take to obtain a final charge of 5 C in the sack? (3 points)
 - (ii) If the input current is time-dependent as $i_t = 2t$, then how long it will take to obtain a final charge of 5 C in the sack? (3 points)
 - (iii) If there is a 2 V voltage difference between inside and outside the sack, how much energy (in Joules) is needed for process (i) and (ii), respectively? (4 points)
- (2) Sam has an electric toy car that is labeled 12 V . He has 24 rechargeable AAA battery cells (1.5 V , $3\text{ A}\cdot\text{h}$).
- (i) Draw a schematic how Sam would place these 24 battery cells to drive the electric toy car (*i.e.*, how many in a row and how many in a column). (3 points)
 - (ii) The rechargeable battery cell loses a stable voltage output when the remaining charge is below 10% of the full charge. If the electric toy car runs on a 100 mA current, how long will the 24 battery cells last? (4 points)
 - (iii) The battery cells now have 10% of full charge. Sam uses a charger (3 V , 1 A) to charge these battery cells to full. How long it will take? (3 points)