APPENDIX 2: FIELDS

Appendix 2.1: Charges Moving Between or Through Parallel Plates

Illustrative Example 1

Two plates are 0.050 m apart and have an electric field of 0.025 N/C with the upper plate being positive. If an electron is placed on the negative plate between the two plates, what is the final velocity of the charge as it hits the positive plate?

Solution:

Find the force acting on the charge.

$F_E = qE = (-1.6 \times 10^{-19}\ \text{C})(0.025\ \text{N/C}) = 4 \times 10^{-21}\ \text{N}$

$F_{net} = F_E$, therefore, $ma = qE$ or

$$a = \frac{qE}{m} = \frac{4.0 \times 10^{-21}\ \text{N}}{9.11 \times 10^{-31}\ \text{kg}} = 4.4 \times 10^{9}\ \text{m/s}^2$$

Then the final velocity is:

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta d \\ &= 0 + 2\left(4.4 \times 10^{9}\ \text{m/s}^2\right)\left(0.050\ \text{m}\right) \\ &= 4.4 \times 10^{8}\ \text{m}^2/\text{s}^2 \\ \therefore v_f &= 2.1 \times 10^{4}\ \text{m/s} \end{aligned}$$

Illustrative Example 2

An alpha particle (mass = 6.65 x 10^{-27} kg, charge = +2) with a velocity of 1.2 x 10^{6} m/s enters the region between horizontal parallel plates that are 0.040 m apart and 0.10 m long. The potential difference between the two plates is 4500 V with the upper plate positive. When the alpha particle exits the plates, how far has it dropped and what is its new velocity?

First, list and organize the kinematic information (answers in parentheses are solved below):

$v_{1x} = 1.2 \times 10^{6}$ m/s	$v_{1y} = 0$ m/s
$v_{2x} = 1.2 \times 10^{6}$ m/s	$v_{2y} =$
$a_x = 0$	$a_y = \left(-5.41 \times 10^{12} \text{ m/s}^2\right)$
$d_x = 0.10$ m	$d_y = \left(1.88 \times 10^{-2} \text{ m}\right)$
$t = \left(8.33 \times 10^{-8} \text{ s}\right)$	$t = \left(8.33 \times 10^{-8} \text{ s}\right)$

$$t = \frac{d_x}{v_x} = \frac{0.10\ m}{1.2 \times 10^{6}\ m/s} = 8.33 \times 10^{-8}\ s$$

$$a = \frac{F_e}{m} = \frac{qE}{m} = \frac{q\left(\frac{V}{\Delta d_y}\right)}{m} = \frac{qV}{m\Delta d_y} = \frac{\left(2 \times 1.6 \times 10^{-19}\ C\right)\left(4500\ V\right)}{\left(6.65 \times 10^{-27}\text{ kg}\right)\left(0.040\text{ m}\right)} = 5.41 \times 10^{12}\text{ m/s}^2$$

$$d_y = v_{1y}t + \frac{1}{2}a_y t^2 = 0 + \frac{1}{2}at^2 = \frac{1}{2}\left(5.41 \times 10^{12}\text{ m/s}^2\right)\left(8.33 \times 10^{-8}\text{ m/s}\right) = 1.88 \times 10^{-2}\text{ m}$$

$$v_{2y} = v_{1y} + a\Delta t = 0 + \left(5.41 \times 10^{12}\text{ m/s}^2\right)\left(8.33 \times 10^{-8}\text{ s}\right) = 4.51 \times 10^{5}\text{ m/s}$$

Appendix 2.2: Space Exploration Issues

Identify and Discuss Issues Pertaining to Space Exploration

Historical Perspective

- <http://www.solarviews.com/eng/history.htm>
- <http://calspace.ucsd.edu/spacegrant/california/new/kids/history_space.html>

Issues

1. Technological advancement

   This relates to the drive to spread genetic material and ensure the success of not just the species, but of one type of genetic material. The wider the distribution of a species, the better the chance of survival. Perhaps the best reason for exploring space is the built-in genetic predisposition to expand into all possible niches.

   <http://adc.gsfc.nasa.gov/adc/education/space_ex/essay1.html>

2. Promotion of global co-operation

3. Social and economic benefits
   - Exploration also allows resources to be located. Resources translate into power and success at survival. Whether the success be financial, political, or genetic, additional resources are always a boon when used wisely.

     <http://adc.gsfc.nasa.gov/adc/education/space_ex/essay1.html>
   - <http://www.maxwell.af.mil/au/aul/school/pmcs/nq13econ.htm>

4. Allocation of resources shifted away from other pursuits
   - <http://www.sepp.org/space/mars.html>

5. Possibility of disaster
   - <http://www.sepp.org/space/riskmross.html>
   - <http://www.house.gov/beauprez/issues/nasa.htm>
   - <http://news.bbc.co.uk/1/hi/talking_point/2718035.stm>

Notes