5.04.2016 – N4

Show your work for each problem using numbers, sketches, or words.

Name:_____

0) The top card in a deck may overhang the bottom card by up to n card widths (without dropping).

Find the value of n. Do you think that $n_{Earth} = n_{Mercury}$.

Hint: Custom Poker Cards (63mm x 88 mm).

1) A point charge q is placed on the planar separation boundary between two homogeneous infinite dielectrics with permittivities ε_1 and ε_2. Find the potential φ, the field strength E, and the induction D.

2) A point charge q lies on a straight line which is the line of intersection of three planes, the angles between the planes being α_1, α_2, $\alpha_3 = 2\pi - \alpha_1 - \alpha_2$. The space between each pair of planes is filled with homogeneous dielectrics with permittivities ε_1, ε_2 and ε_3. Find the potential φ, the field strength E, and the induction D.

3) It is the truth that:

$$6 \cdot \int_0^{\infty} \frac{dx}{e^{a\cdot\sqrt{x}} + 1} = \left(\frac{\pi}{a}\right)^2, \quad a > 0$$

4) The equation $3y = z^3 + 3xz$ defines $z(x, y)$ implicitly as a function of x and y. Verify that $z(x, y)$ is a solution of

$$x \cdot \frac{\partial^2 z}{\partial y^2} + \frac{\partial^2 z}{\partial x^2} = 0$$

5) A cart rolls on a long table with velocity $\beta = \frac{v_x}{c}$. A smaller cart rolls on the first cart in the same direction with velocity $\beta = \frac{v_x}{c}$ relative to the first cart. A third cart rolls on the second cart in the same direction with relative velocity $\beta = \frac{v_x}{c}$, and so on up to n carts. What is the velocity $v_x(n)$ of the nth cart in the frame of the table? What does $v_x(n)$ tend to as $n \to \infty$?