1. Given a scalar function $V=(\sin(\pi x/2))(\sin(\pi y/3))e^{-2z}$, determine the magnitude and direction of the maximum rate of increase of V at point $p(1,1,0)$, and the rate of increase of V at p in the direction of the origin.(15%)

2. Write down the correct sentences for the following items.(25%)

    (A) The divergence of the gradient of any scalar field is identically zero.

    (B) Around a closed path in a magnetic circuit the algebraic sum of ampere-turns is equal to the algebraic sum of the ratios of the reluctances and fluxes.

    (C) The total outward flux of the electric field over any surface in free space is equal to the total charge enclosed in the surface divided by ε_0.

    (D) The electric field intensity in a region of time-varying magnetic flux density is conservative.

    (E) In transmission line terminology, a line is matched when the load impedance is equal to the complex conjugate of the characteristic impedance of the line.

3. Determine the force on the conducting plates of a parallel-plate capacitor with the charges $+/-Q$. The plates have an area S and are separated in air by a distance a.(15%)

4. A long, round wire of radius a and conductivity σ is coated with a material of conductivity 0.1σ. (A) What is the thickness of coating so that the resistance per unit length of the uncoated wire is reduced by 50%? (B) Assuming a total current I in the coated wire, find $\mathbf{J}$ and $\mathbf{E}$ in the core material.(15%)

5. The permittivity of a solvent at optical frequencies is $1.21\varepsilon_0$. It is found that an isotropic light source at a distance d under this solvent yields an illuminated circular area of a radius 5 m. Determine d.(10%)

6. Determine the force per unit length between two infinitely long parallel conducting wires carrying currents I_1 and I_2 in the same direction. The wires are separated by a distance x.(10%)

7. Describe the condition for defining the good conductor and good insulator.(10%)

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