# Guidance on final exam grading

**Problem A1:**

E field = voltage divided by distance.

Displacement current is (10 epilon0) times times derivative of E field times capacitor plate area.

Resistance = (capacitor plate distance)/(conductivity * capacitor plate area).

Conduction current = voltage / resistance.

**Problem A2:**

a.) $$S_{av} = \hat{a}_z \frac{|\tilde{E}|^2}{2\eta} \qquad \text{W/m}^2$$

b.) E x H = S
+X x ? = -Z
H points in -y direction

c.) Sigma / (epsilon * omega) = 17975. So good conductor.

d.) $$\alpha = \sqrt{\pi f \mu \sigma} \quad \Big| \quad \beta = \sqrt{\pi f \mu \sigma}$$

e.) $$\eta = (1+j)\frac{\alpha}{\sigma}$$

$$\Gamma = \frac{E_0^r}{E_0^i} = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1} = \frac{\sqrt{\epsilon_{r1}} - \sqrt{\epsilon_{r2}}}{\sqrt{\epsilon_{r1}} + \sqrt{\epsilon_{r2}}}$$

f.) **Skin Depth:** $\delta_s = \frac{1}{\alpha}$

**Problem A3:**

a.) Linear polarization. Inclination angle = arctan(1) = 45 degrees or pi/4 rad. Students can report in either degrees or rad

b.) Elliptical polarization.

**Elliptical polarization auxiliary angle:** $\psi_0 = tan^{-1}(\frac{a_y}{a_x})$

**Elliptical polarization rotation angle** (γ): $tan2\gamma = (tan2\psi_0)cos\delta$

for $-\pi/2 \leq \gamma \leq \pi/2$)

**Elliptical polarization ellipticity angle** (χ): $sin2\chi = (sin2\psi_0)sin\delta$

for $-\pi/4 \leq \chi \leq \pi/4$)

**Problem A4:**

a.) Use critical angle expression from Exam 4 crib sheet. Within the critical angle, light will be partially transmitted into the air. At greater than the critical angle, it will reflect completely off the boundary.

b.) Refer to Brewster angle equations on crib sheet 4. There will be a Brewster angle for the parallel-polarized component of the light but not for the perpendicular-polarized component.

c.) Use the two reflection coefficient expressions from the Exam 4 crib sheet. The reflection coefficient will differ between the two polarizations.

To calculate power transmitted, set an arbitrary amplitude for incident light and calculate the power it contains. Use this for both polarizations. Determine the 2 transmission coefficients and resulting E-field amplitudes for the 2 polarizations. Then calculate the power for the 2 polarizations and the percentage loss for each one compared to the incident power.

d.) Use the normal incidence reflection coefficient from crib sheet 4. This time, the reflection is the same regardless of polarization.
e.) Typo- there is no e
f.) Perpendicular polarization.