

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

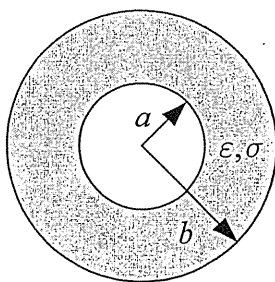
Problem 1 (20 Points)

Two conducting spheres are both centered at the origin as shown.

Sphere 1 has the radius a and its potential is 1 volt. *Sphere 2* has radius b ($b > a$) and is grounded (0 volt).

Between the spheres is a medium with permittivity ϵ and conductivity σ . Please find

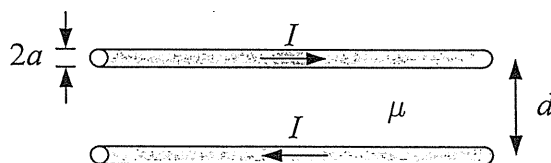
- (a) the *electric flux density* D at any r , $a < r < b$, and the *total electric charges* on *Sphere 1*, and
- (b) the *electric current density* J at any r , $a < r < b$, and the *total electric currents* flow out of *Sphere 1*.



Problem 2 (10 Points)

Please find the *inductance per meter* of a two-wire transmission line, with wire radius a ,

separation d , and the medium around has permeability μ as shown, assuming the currents are uniformly distributed on the surface of each conductor.



Problem 3 (20 Points)

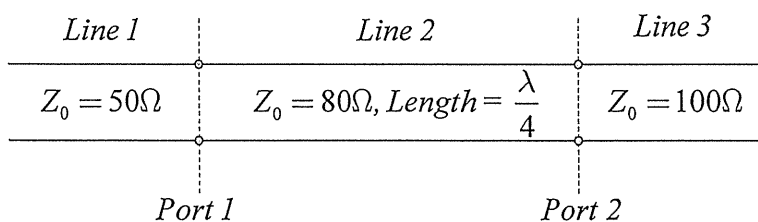
An electromagnetic wave in free space has $\vec{H}(x,t) = (10\hat{a}_y - 20\hat{a}_z)\sin(\omega t - 40x) A/m$.

Please find ω and \vec{E} .

Problem 4 (20 Points)

A transmission-line circuit is as shown. *Line 1* is infinite long and its characteristic impedance is 50Ω . *Line 2* is a quarter-wavelength long and its characteristic impedance is 80Ω . *Line 3* is infinite long and its characteristic impedance is 100Ω . A continuous wave is sent from *Line 1* to the right. Please find

- (a) the *input impedance* at *Port 1*,
- (b) the *reflection coefficient* at *Port 1*,
- (c) the *voltage standing wave ratio* on *Line 2*, and
- (d) the *transmitted coefficient* at *Port 2*.



Problem 5 (10 Points)

What are the *polarizations* (ex., *linear, circular, elliptic, and left-hand, right-hand*) of the following electromagnetic waves? (a) $\vec{E} = [(2 + j)\vec{a}_y + (2 - j)\vec{a}_z] e^{-jkx}$ and (b) $\vec{E} = \sin(\omega t - ky)\vec{a}_x - \cos(\omega t - ky)\vec{a}_z$.

Problem 6 (20 Points)

A metallic parallel-plate waveguide, in the air, with separation $d = 5 \text{ cm}$, is as shown. The propagating electromagnetic wave is 10 GHz and is operated as the TE_3 mode. Please find

- (a) the wave number β in the z -direction and *phase velocity* v_p in the z -direction, and
- (b) the wave impedance in the z -direction ($\equiv E_x / H_y$).

