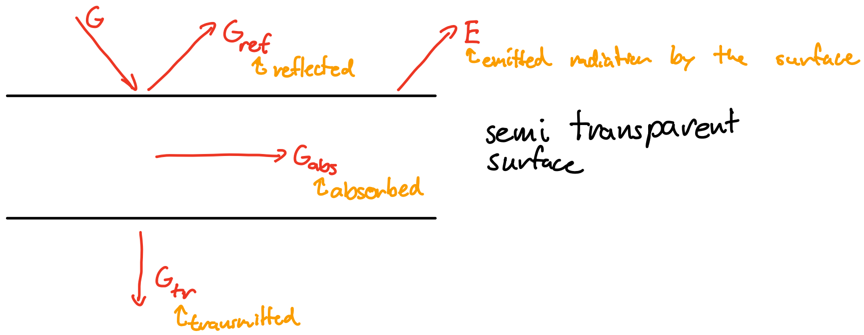
14A - 2ND CLASS



$G_{ref} = \overset{\text{reflextivity}}{\rho} G \qquad 0 \le \rho \le 1$

$G_{abs} = \overset{\text{absorbtivity}}{\alpha} G \qquad 0 \le \alpha \le 1$

$G_{tr} = \overset{\text{transmitivity}}{\tau} G \qquad 0 \le \tau \le 1$

$$G = G_{ref} + G_{abs} + G_{tr}$$
$$= \rho G + \alpha G + \tau G$$

$$\underline{\rho + \alpha + \tau = 1}$$

$J = E + G_{ref}$

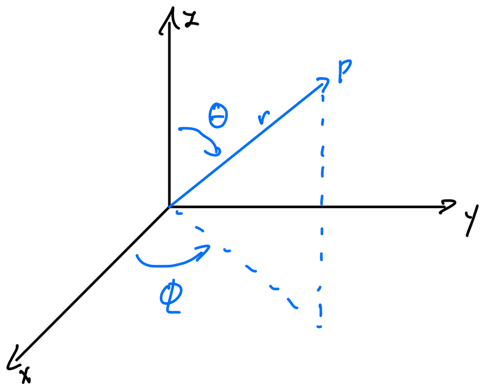
$J = \epsilon \sigma T_s^4 + \rho G$

For an opaque medium

$\tau = 0$

$G_{tr} = 0$

SPHERICAL COORDINATES

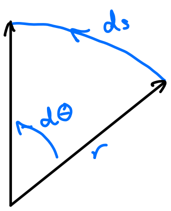


θ = zenith angle
Φ = azimuthal angle

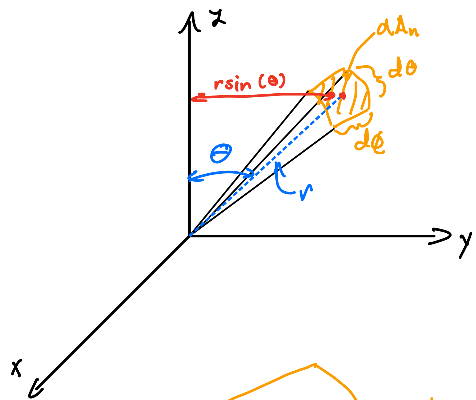
the surface is the xy plane

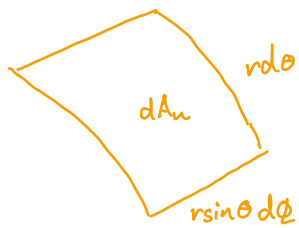
"all angles" means the hemisphere above the point on the surface

ANGLES



$$d\theta = \frac{ds}{r}$$





$$dA_n = r^2 \sin\theta \, d\theta \, d\Phi$$

$$d\omega = \frac{dA_n}{r^2}$$ solid angle

$$\boxed{d\omega = \sin\theta \, d\theta \, d\Phi}$$ steradian

$$\omega_h = \int_0^{2\pi}\int_0^{\pi/2} \sin\theta \, d\theta \, d\Phi$$

$$= \int_0^{2\pi} d\Phi \underbrace{\int_0^{\pi/2} \sin\theta \, d\theta}_{=1}$$

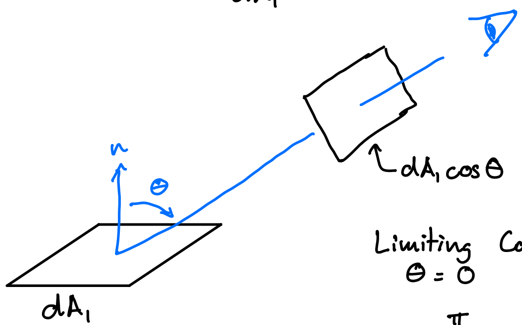
$\boxed{\omega_h = 2\pi}$ steradians ← for the entire hemisphere

RADIATION INTENSITY

I_λ = spectral ("per unit wavelength") intensity $\left[\frac{W}{m^2 \cdot sr \cdot \mu m}\right]$

= rate of radiant energy
- per unit area normal to the (θ, ϕ) direction
- per unit solid angle
- per unit wavelength

$$I_\lambda(\lambda, \theta, \phi) = \frac{\overbrace{dq}^{\text{rate of radiant energy}}}{dA_1 \cos\theta \, d\omega \, d\lambda}$$



Limiting Cases:

$\theta = 0$ $\quad dA_1 \cancelto{1}{\cos\theta} = dA_1$

$\theta = \frac{\pi}{2}$ $\quad dA_1 \cancelto{0}{\cos\theta} = 0$

$$dq = I_\lambda(\lambda, \theta, \phi) \, dA_1 \cos\theta \, d\omega \, d\lambda$$

$$\frac{dq}{d\lambda} = dq_\lambda = I_\lambda(\lambda, \theta, \phi) \, dA_1 \cos\theta \, d\omega$$

$$\frac{dq_\lambda}{dA_1} = dq_\lambda'' = I_\lambda(\lambda, \theta, \phi) \cos\theta \, d\omega$$