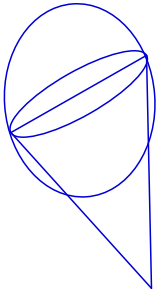
Problem 1.

a) The moon is a sphere, the radius R, the distance d



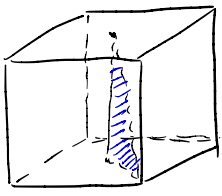
Because the disc has a normal along viewing axis, $\theta_0 = 0^\circ$

The solid angle of the moon as seen from the earth.

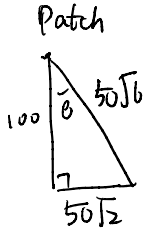
is $\frac{\text{Area} \cdot \cos\theta_0}{d^2} = \frac{\pi R^2 \cdot \cos(0)}{d^2} = \frac{\pi R^2}{d^2}$

b) Because the angle θ ranges between $0^\circ \sim 90^\circ$ in a circular plate, the solid angle varies from $0 \sim \frac{\pi R^2}{d^2}$

Problem 2



a)



$$\cos\theta = \frac{100}{50\sqrt{6}} = \frac{2}{\sqrt{6}} = \frac{\sqrt{6}}{3}$$

∴ The foreshortened area of the square patch.

$= A\cos\theta = \frac{\sqrt{6}}{3}$

b) $\text{solid angle} = \frac{A\cos\theta}{R^2} = \frac{\frac{\sqrt{6}}{3}}{(50\sqrt{6})^2} = \frac{\sqrt{6}}{45000}$

c) Since viewed from the ceiling $\theta = \frac{\pi}{2}$, solid angle $= 0$.

Problem 3.

a) Lambertian plane $7x+\sqrt{50}y+z+2=0$

$z=-7x-\sqrt{50}y-2$ $\quad p=\frac{\partial z}{\partial x}=-7$

$q=\frac{\partial z}{\partial y}=-5\sqrt{2}$

∴ The surface gradient is $(-7,-5\sqrt{2})$

b) If radience is the largest, the direction of light is parallel to the normal of the plane.

Because the point $P=(0,0,-2)$ on the plane, $x^2+y^2+(z+2)^2=400$

Get the normal vector of the plane.

$\vec{N}=\vec{PA}\times\vec{PB}=(1,0,-7)\times(0,\sqrt{2},-10)=(7\sqrt{2},10,\sqrt{2})$

light source should be $(7\sqrt{2}t,10t,\sqrt{2}t-2)$, on the sphere.

$(7\sqrt{2}t)^2+(10t)^2+(\sqrt{2}t)^2=400 \quad t=\pm\sqrt{2}$.

Light Source: $(14,10\sqrt{2},0)$ / $(-14,-10\sqrt{2},-4)$