



Optics & Photometrics

SAFETY AND TRAINING PROGRAM

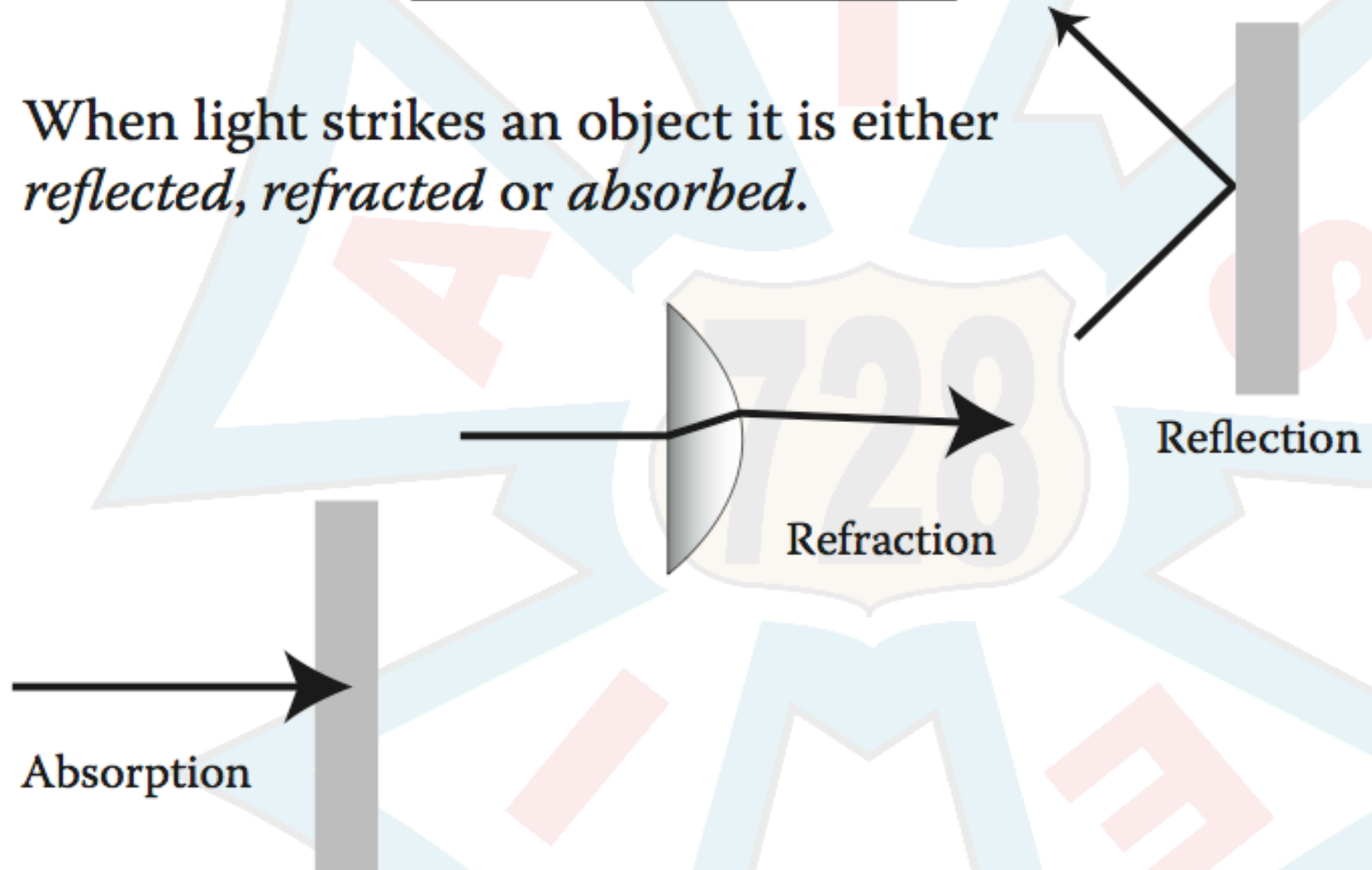
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PRINCIPLES

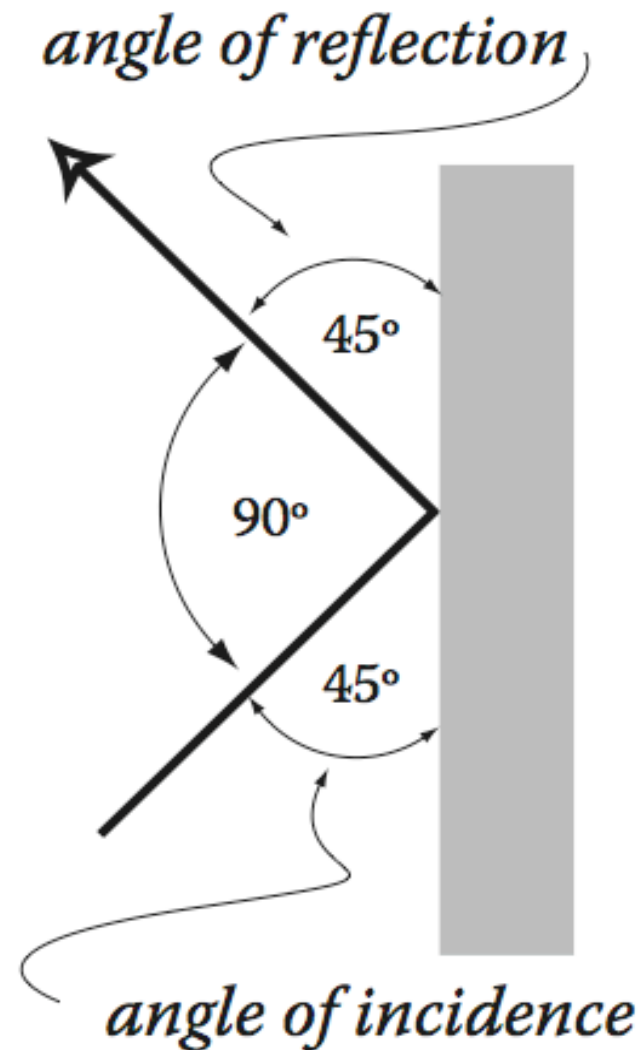
When light strikes an object it is either *reflected*, *refracted* or *absorbed*.



REFLECTION

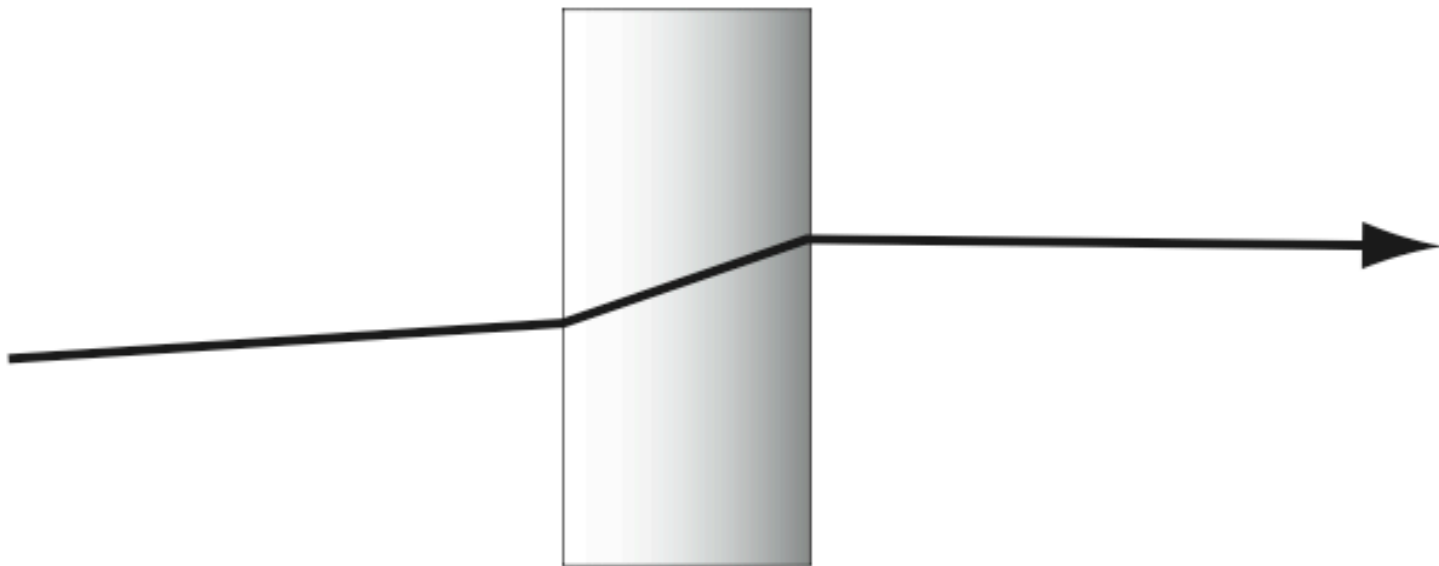
When light strikes an object it cannot penetrate, it bounces off of the surface of the object.

The *angle of incidence* is equal to the *angle of reflection*.



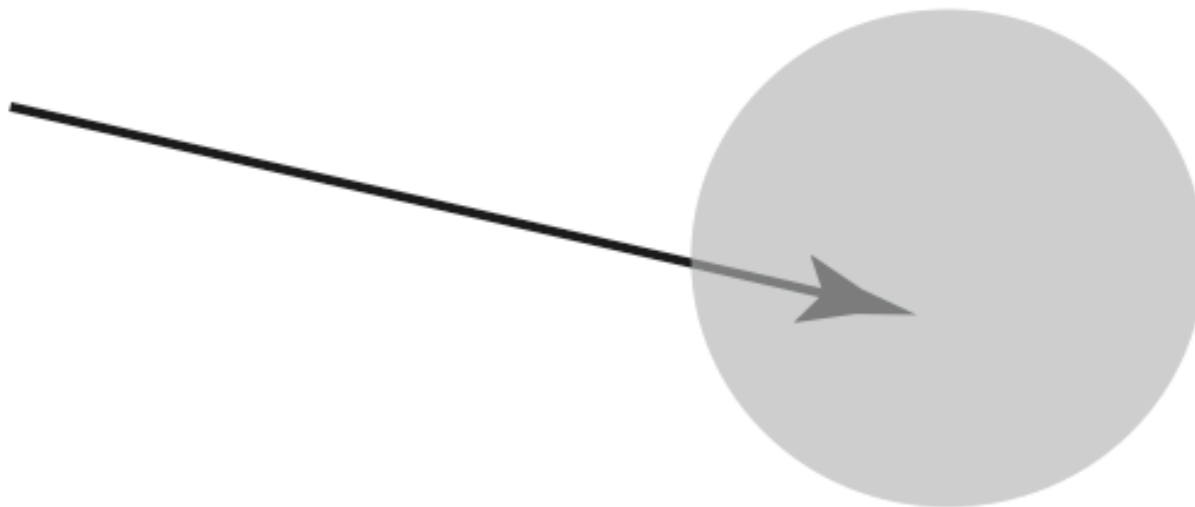
REFRACTION

When light penetrates a clear object it bends. The amount of bend varies upon the angle of incidence and the density, material and shape of the object.

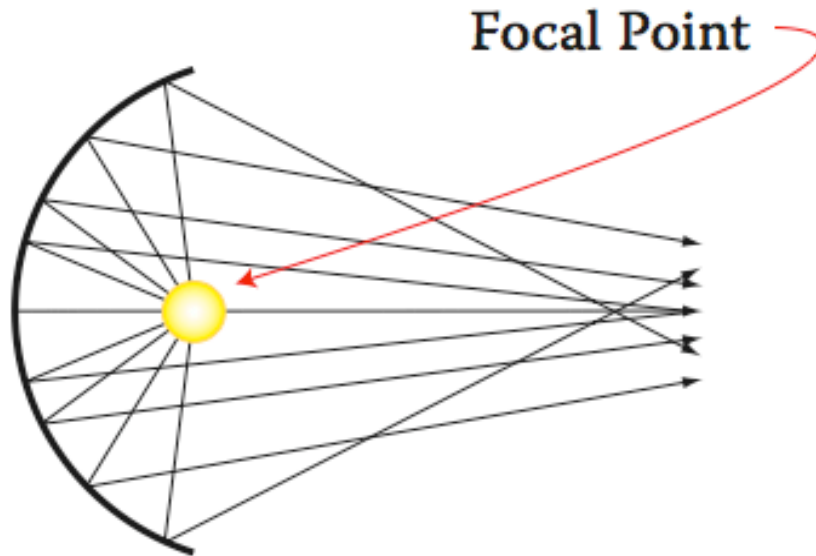


ABSORPTION

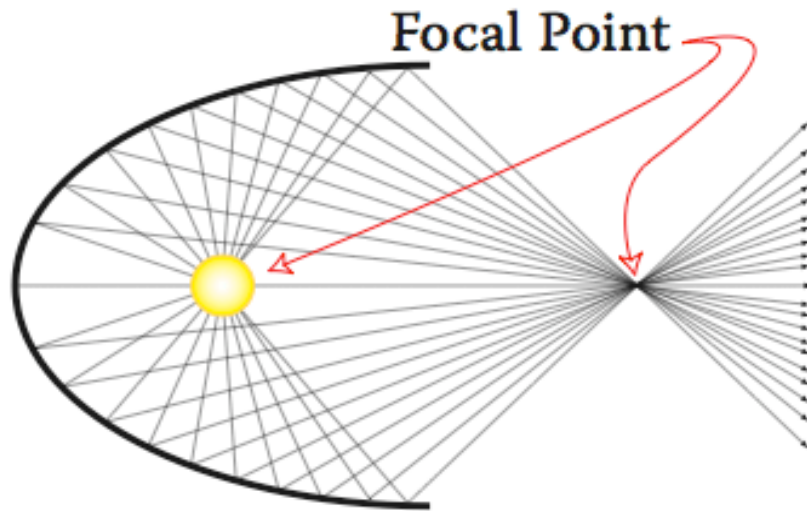
Absorption occurs when light strikes an object and is not reflected or refracted. Texture, color, and material all affect absorption. True (full) absorption does not occur with exception of Black Holes.



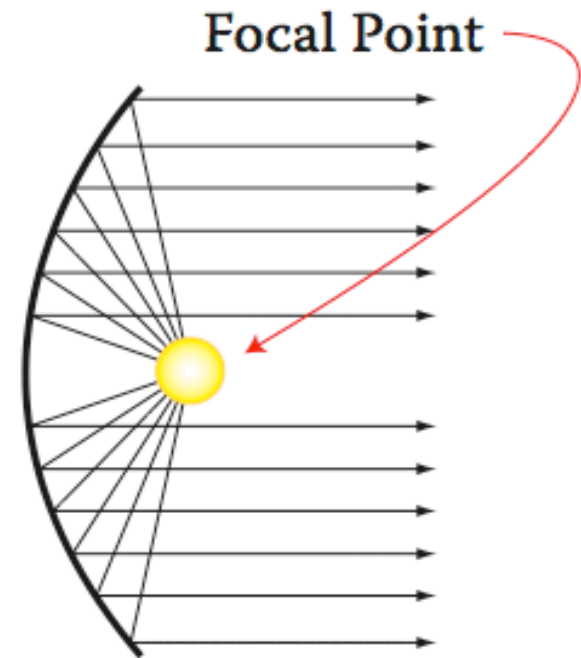
REFLECTORS



SPHERICAL REFLECTOR



ELLIPSOIDAL REFLECTOR



PARABOLIC REFLECTOR

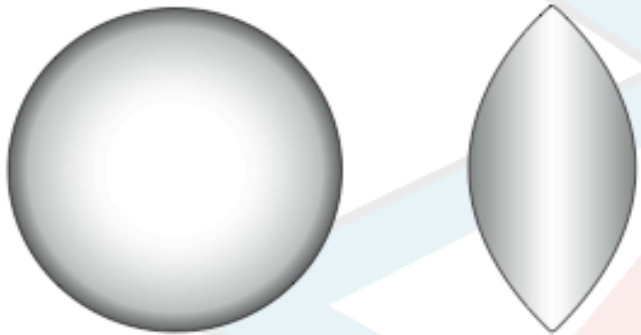
LENSES



PLANO-CONVEX LENS



FRESNEL LENS



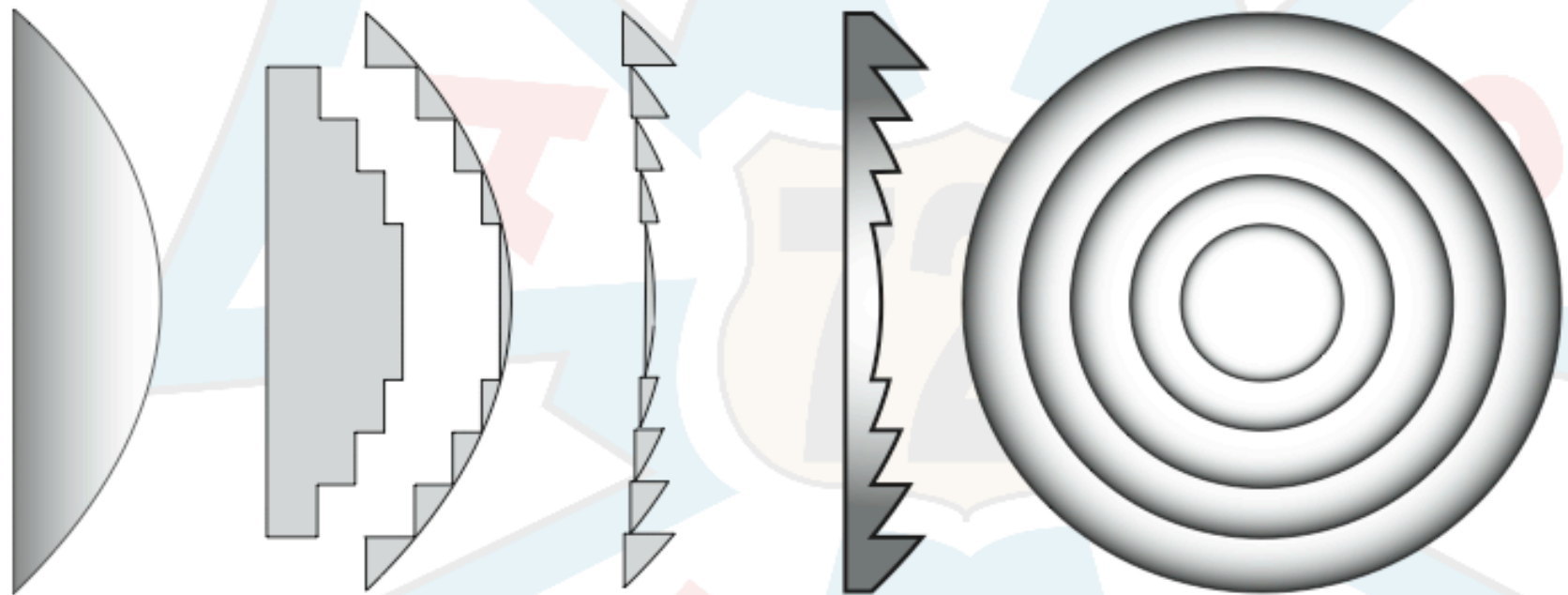
CONDENSOR LENS



CONCAVE LENS

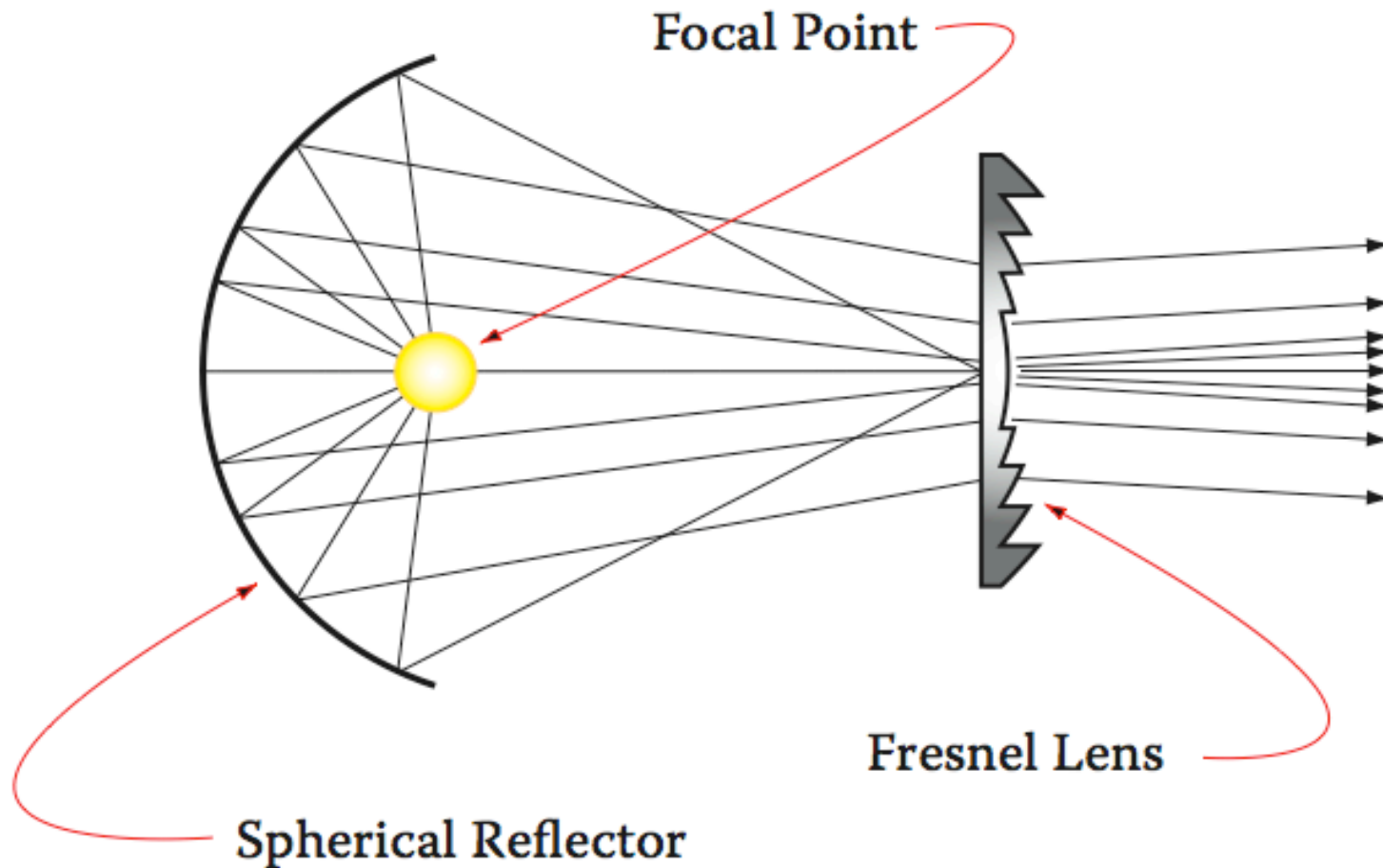


FRESNEL LENS



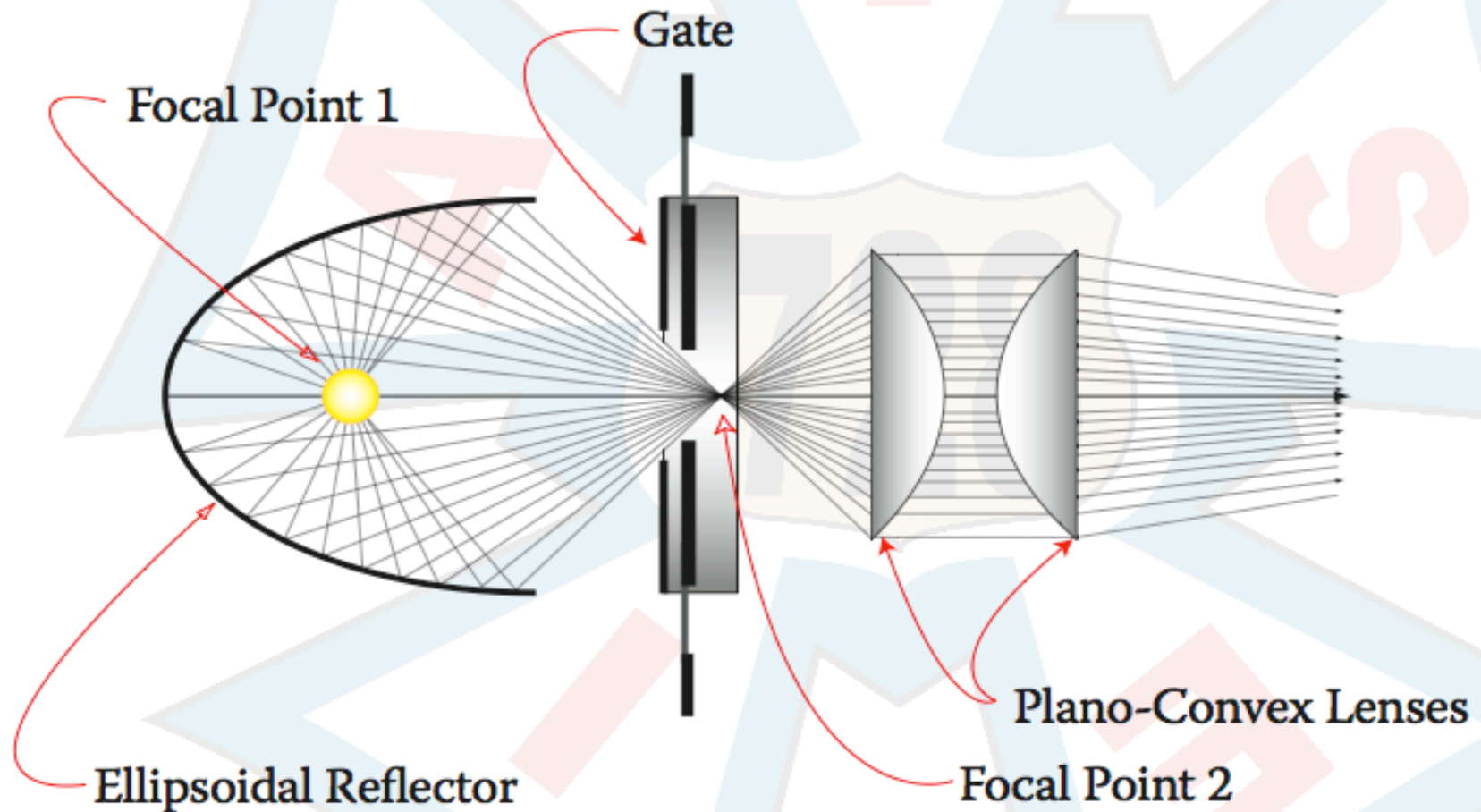
OPTICAL SYSTEMS

FRESNEL SPOTLIGHT



OPTICAL SYSTEMS

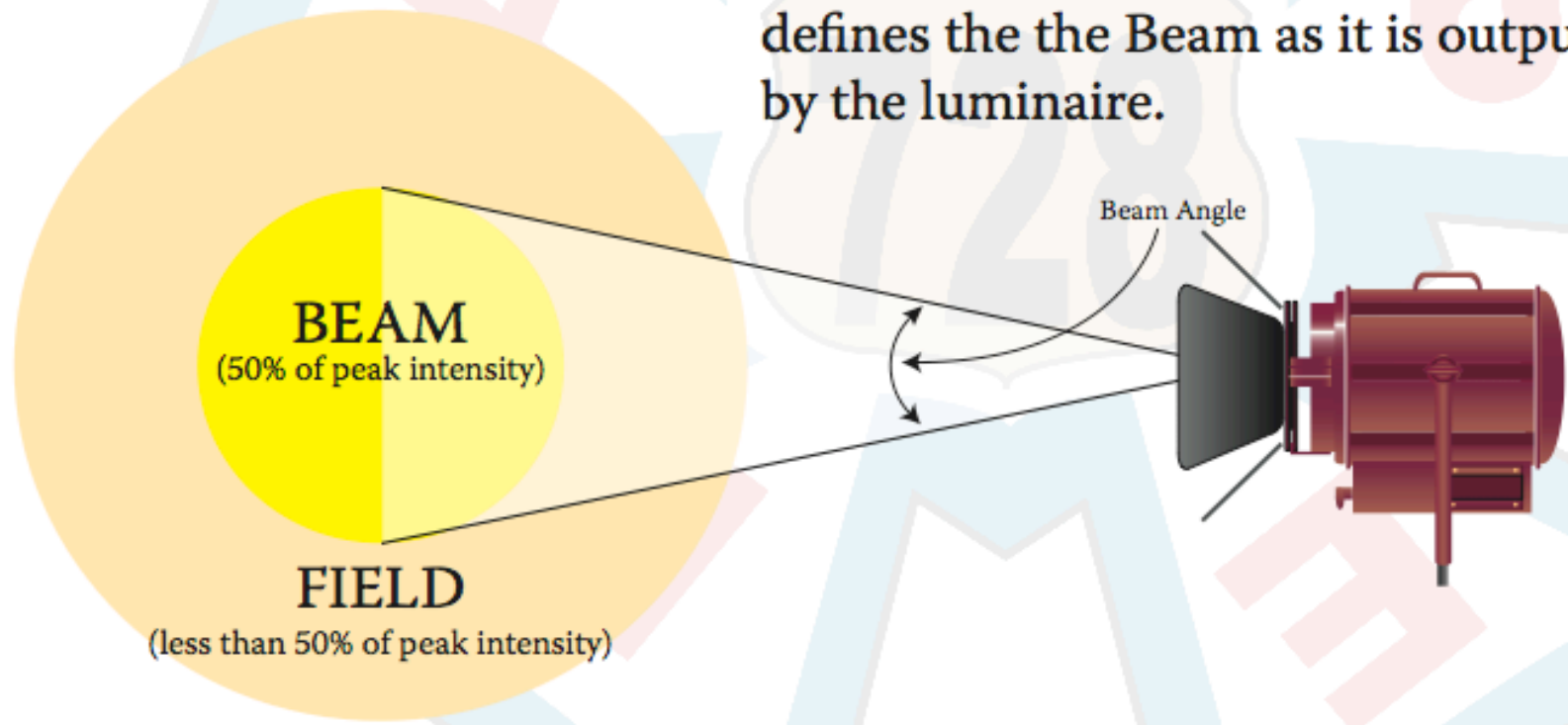
ELLIPSOIDAL REFLECTOR SPOTLIGHT (ERS)



BEAM ANGLE

The “beam” of a light is defined by the area of the light field that is 50% of the peak intensity of the output of the light.

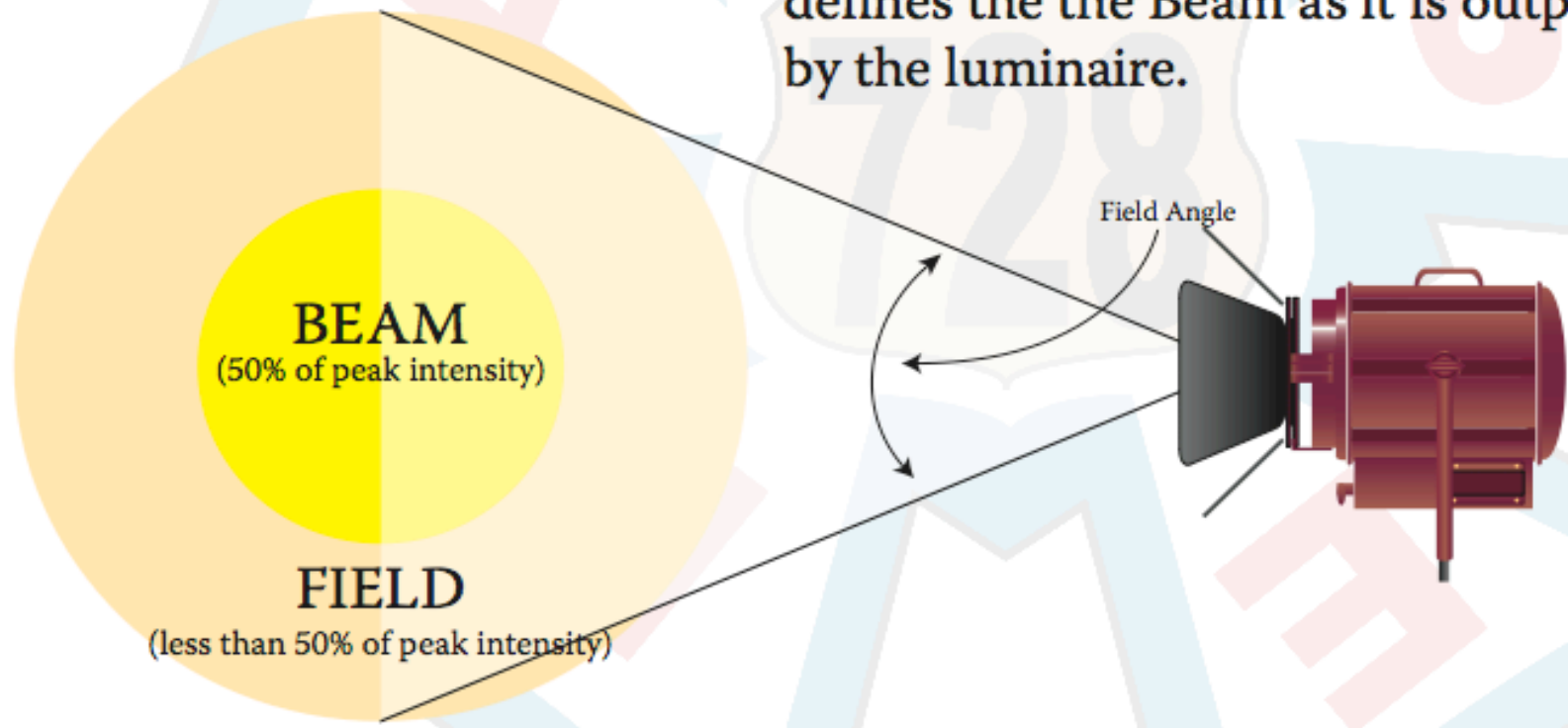
The “beam angle” is the angle which defines the the Beam as it is output by the luminaire.



FIELD ANGLE

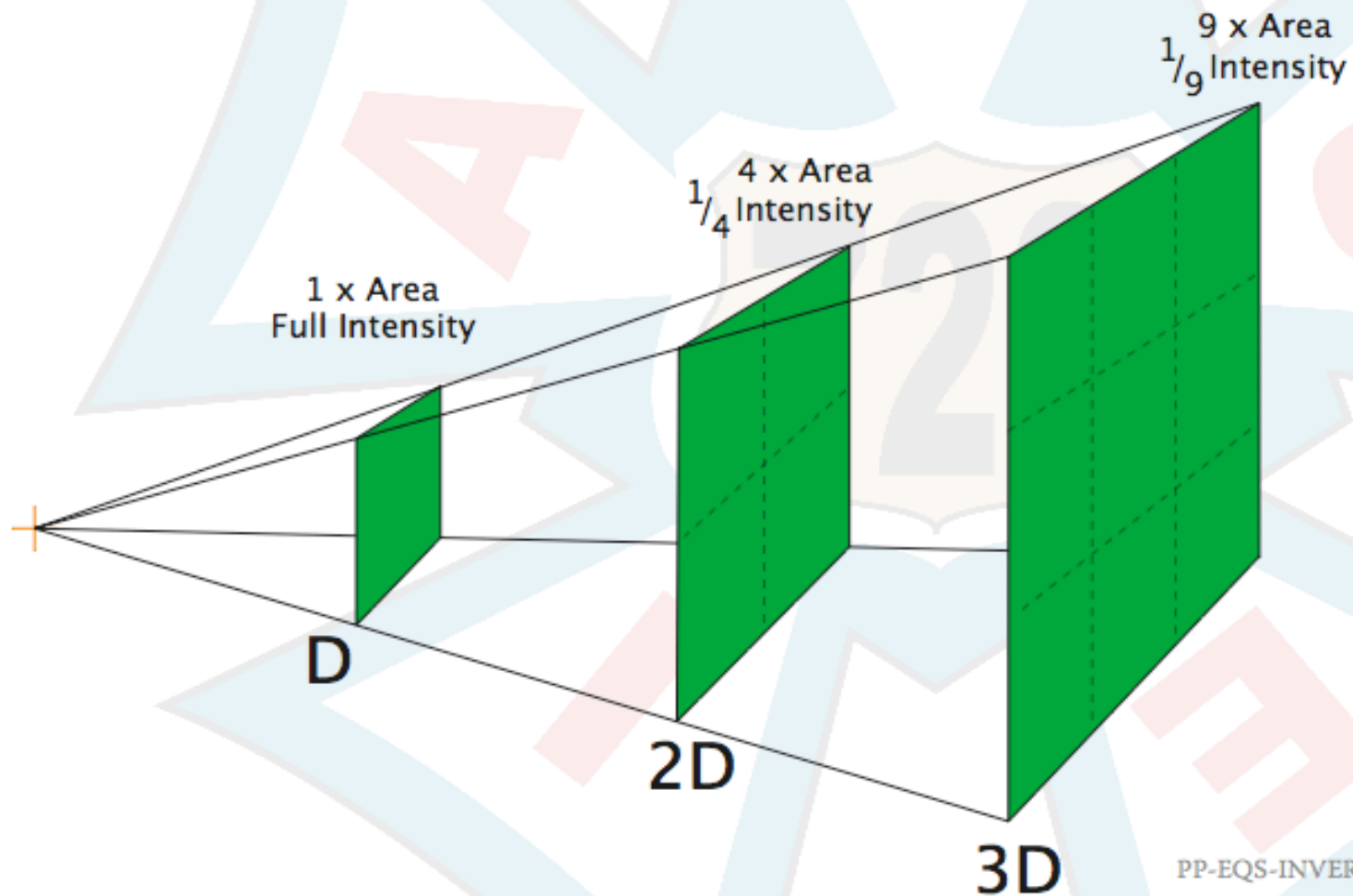
The “field” of a light is defined by the area of the light field that is less than 50% of the peak intensity of the output of the light.

The “field angle” is the angle which defines the the Beam as it is output by the luminaire.



INVERSE SQUARE LAW

Intensity is proportional to the inverse square of the distance.



TRINITY OF EXPOSURE

| Film Speed | Shutter Speed | Light Intensity |
|------------|-----------------------|--------------------|
| ASA | Frames/sec 1/? sec | footcandles lux |

The result of the calculation of these three factors determines the setting of the aperture of the lens. The specific setting is known as the *f-stop*.

Change one factor, and at least one of the others must change.

| ASA | Shutter Speed | footcandles | f-stop |
|-----|---------------|-------------|--------|
| 100 | 24fps | 100 | 2.8 |
| 100 | 48fps | 200 | 2.8 |
| 50 | 24fps | 200 | 2.8 |

CAMERA LENSES

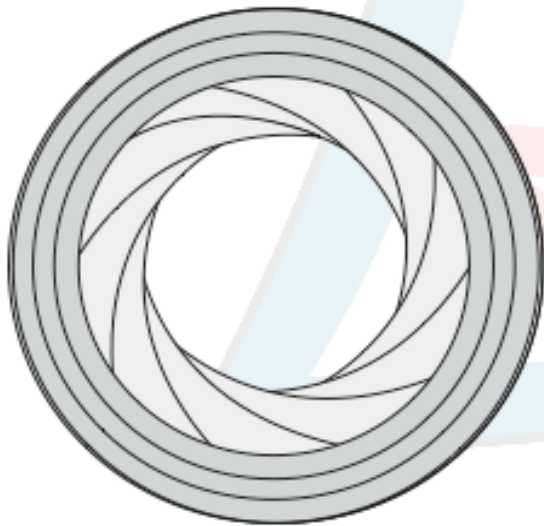


Camera lenses focus light onto a focal plane to expose an image on film.

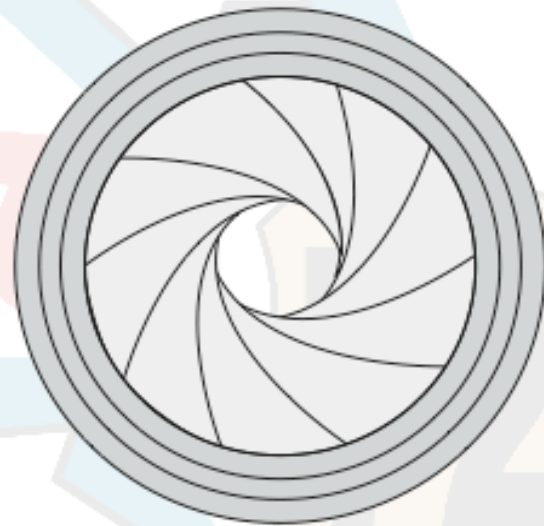
Lenses are rated by minimum light level and focal length.

APETURE

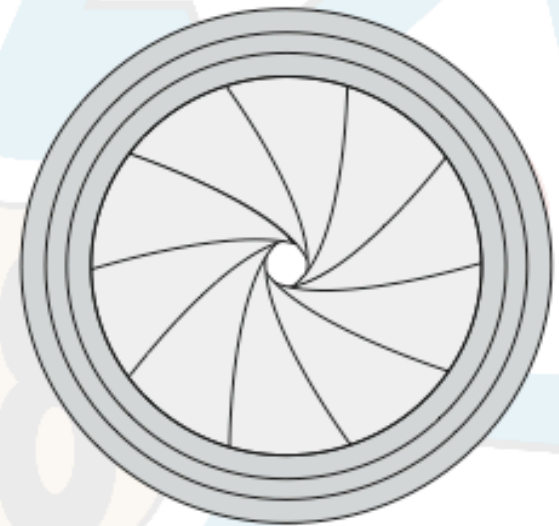
f 2.8



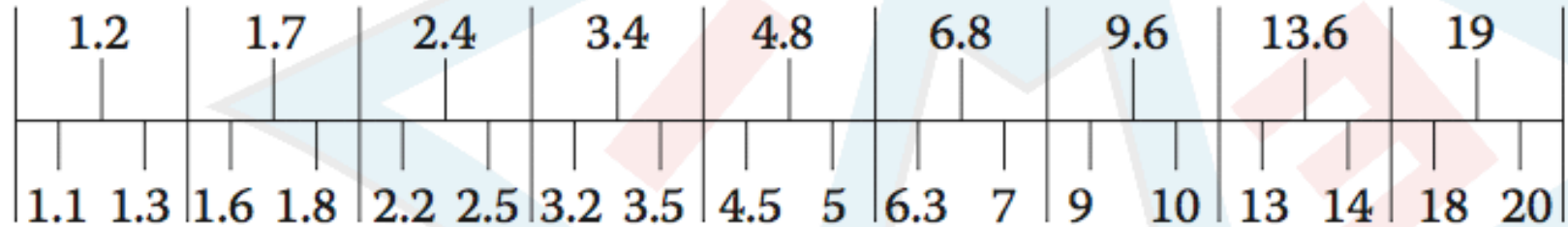
f 5.6



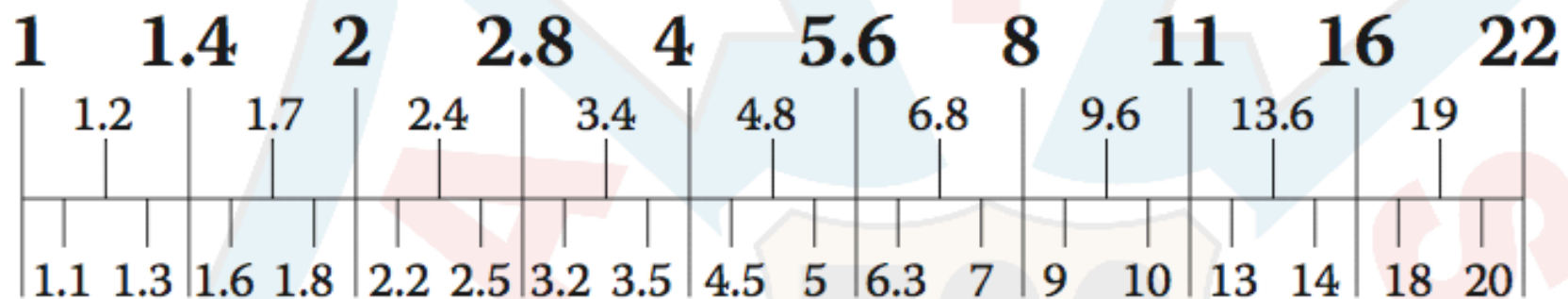
f 16



1 1.4 2 2.8 4 5.6 8 11 16 22



f-Stops



F-stop settings are inscribed on the aperture ring of the camera by the manufacturer. The larger the f-stop, the smaller the aperture and higher the level of light required. The smaller the number, the larger the aperture and lower the level of light required.

FOOTCANDLES & F-STOPS

Doubling the footcandles is equal to increasing the stop by 1 major increment. Cutting the footcandles in half reduces the stop by 1 major increment.

footcandles 8 16 32 64 128 256 512 1024 2048 4096

ASA 160

f-stop 1 1.4 2 2.8 4 5.6 8 11 16 22

footcandles 4 8 16 32 64 128 256 512 1024 2048

ASA 320

f-stop 1 1.4 2 2.8 4 5.6 8 11 16 22