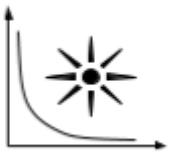
Particles and Waves

Irradiance.



1.
An overhead projector has a lamp of power 300 W.
Assuming all of the power is transferred to light, calculate the irradiance when the light is projected on a screen of dimensions 3m x 4m.

[25 Wm^{-2}]

2.
A cinema lamp has a power of 3kW. Assuming all the power is transferred into light energy and the light is shone onto a screen of dimensions 10 m by 5 m, calculate the irradiance of the light at the screen.

[60 Wm^{-2}]

3.
A 100 W bulb projects all of its light into a spherical light shade which has a radius 50 cm.
Assuming that only 30% of the light bulb's power is transferred to light, determine the irradiance of the light on the lamp's surface.

(surface area of a sphere is given by $A = 4\pi r^2$)

[1.7Wm^{-2}]

4.
In the city of Dundee on a typical July afternoon, at noon, the Sun's irradiance on the ground is given as 900 Wm^{-2}
Calculate the energy falling on a 2m^2 solar panel in a time of 1 hour.

[6.48 x 10^6 J]

5.
Light is shone onto a black piece of card whose dimensions are 50 cm by 50 cm. The irradiance of the light at the surface is 150 Wm^{-2}.
Determine how much light energy is absorbed by the card in 2 hours.

[270,000 J]

6.
The international space station needs 90kW of electrical power.
Assuming all the light energy falling onto its solar panels is converted to electrical energy and the irradiance at the solar panels surface is 36 Wm^{-2}, then calculate the solar panel area needed.

[2,500 m^2]

7.
A laser beam makes a circular spot of radius 0.80 mm on a screen. It has a power rating of 5.0 mW.
Calculate the irradiance of the laser beam.

[2,500 Wm^{-2} to 2sf]

8.
The irradiance of a laser beam's spot on a screen is 1.0 kWm^{-2}. The radius of the laser's beam spot on the screen is 1.0 mm.
Calculate the power of the laser beams light.

[3.0mW 850]

9.
In laser eye surgery a pulsed laser delivers 0.2mJ of energy in a burst lasting 0.8 ms onto a retina.
The area of the pulse is 7.1 x 10^{-6} m^2

Determine the irradiance of the laser pulse on the retina.

[35 000 Wm^{-2}]

10.
A black tile on a roof has an area of 0.025 m^2. Solar energy is incident on the tile's surface with irradiance 100 Wm^{-2}
Assuming all the energy is absorbed by the tile, calculate the total energy absorbed in one hour.

[9000 J]

The tile has mass 0.5 kg and a specific heat capacity of 850 Jkg^{-1} C^{-1}
Determine the temperature rise of the tile.

[21 C]