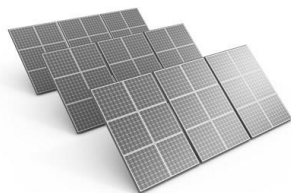# Unit 2 : PARTICLES & WAVES
Inverse Square Law

Irradiance

1. A satellite is orbiting the Earth where the irradiance of the
   Sun's radiation is 1.4 kW m^{-2}.
   Calculate the power received by the satellite's solar panels if
   they have an area of 15 m^2.

2. At a certain point on the Earth's surface, the Sun's radiation has
   an irradiance of 200 W m^{-2}.
   What area of solar cells would be required to produce a power
   output of 1 mW?

3. The irradiance of illumination at a distance of 2.0 m from a point source of light is 6.4 W m^{-2}.
   What is the irradiance at a distance of (a) 1.0 m
   (b) 4.0 m?

4. A point source of light causes an irradiance of 4.8 W m^{-2} at a distance of 2.4 m. What is the
   irradiance at a distance of   (a) 1.5 m
   (b) 3.0 m?

5. The irradiance of illumination at a distance of 1.2 m from a point source of light is 9.0 W m^{-2}.
   At what distance from the light is the irradiance 1.0 W m^{-2}?

6. A point source of light causes an irradiance of 1.5 Wm^{-2} at a distance of 6.0 m. At what distance
   from the light is the irradiance (a) 2.0 Wm^{-2}
   (b) 1.2 Wm^{-2}?

7. A pupil measures the light intensity of a 100 W light bulb as 2 W m^{-2} at a distance of 2 m.
   Calculate the intensity that would be measured at a distance of 1 m from the light bulb.

8. A small bulb illuminates a surface measuring 0.50 m x 0.50 m from a
   distance of 2.25 m.

   (a) If the irradiance of the illumination is 20 mW m^{-2}, how many joules of
       light energy reach the surface each second?

   (b) How many joules of energy reach the surface if the bulb is moved to a
       distance of 1.5 m?

9. A technician uses the following apparatus to investigate the relationship between the irradiance of the light from a lamp and the distance from it.
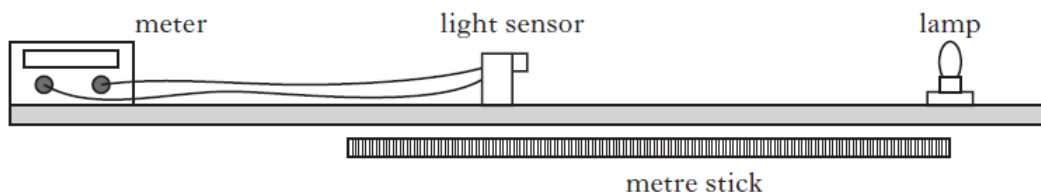
The results of the experiment are shown below.

Distance between light sensor and lamp/m	Irradiance/units
0·10	242
0·15	106
0·20	60
0·25	39

(a) Use all the results to determine whether or not the lamp acts like a point source of light in this experiment.

(b) Estimate the irradiance at a distance of 0.4 m from the source.

(c) Explain how the results would differ if the lamp were replaced with a laser.

10. Monochromatic light of frequency 5.00×10^{14} Hz is incident on a 1.00 m^2 surface. What is the irradiance at the surface if there are 2.00×10^{19} photons arriving every second?

11. Calculate the irradiance of 5.0×10^{20} photons of red light (f = 4.5×10^{14} Hz) incident on an area of 1.0 m^2.

12. How many photons are arriving at a 1.00 m^2 surface each second when monochromatic light of frequency 6.50×10^{14} Hz causes an irradiance at the surface of 2.40 W m^{-2}?

13. How many photons of blue light of wavelength 450 nm would fall per second on to an area of 1 cm^2 to produce an irradiance of 4 W m^{-2}?

14. How many photons of red light (650 nm) arrive at a surface measuring 20 cm x 25 cm each second if the irradiance at the surface is 0.24 W m^{-2}?