

Average illuminance

- 1 a) Plot a graph of E_{AV} , the average illuminance against the average reflectance of room surfaces. Assume the lamps emit 10,000 lm and the surface area of the room is $60m^2$.

ρ_{AV}	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
E_{AV}	185 lx	208 lx	238 lx	278 lx	333 lx	417 lx	556 lx	833 lx	1667 lx

- b) Comment upon the consequences of the above graph for the following circumstances:

- i) An auditorium for performing arts,
- ii) A daylit workshop,
- iii) A sports hall used for badminton or tennis,
- iv) A nightclub,
- v) An art gallery for the display of sculpture.

- 2 Take note of the lamp wattage in your room, measure the approximate dimensions of the room and estimate the surface reflectances. (White 80%, light greys 50%, medium grey 20% dark grey 10% and black 5%). If the efficacy of an incandescent lamp is 12 lm/W what is the approximate illuminance in your study bedroom. Consider sources of error.

- 3 A 10m long by 7m wide by 3m high room is lit with general diffusing luminaires which altogether emit a total of 70,000lm. Calculate the average illuminance over the surfaces of the room if the ceiling, walls and floor respectively have reflectances of 0.7, 0.4 and 0.2.
 $\rho_{AV} = 0.43, E_{AV} = 507 \text{ lx}$

- 4 A very long corridor in a theatre has a series of pictures displayed along one wall which is lit with a number of spotlamps which direct all their light to the wall. The corridor is 2.5m high and 2.5m wide, with a ceiling, floor and opposite wall reflectance of 0.6, 0.1 and 0.2 respectively. Calculate the average illuminance on the floor if the picture wall has an average reflectance of 0.3 and is lit to an average illuminance of 300 lx.
 32 lx

- 5 a) Show that E_{AV} , the average illuminance over all the surfaces of a room is given by,

$$E_{AV} = \frac{\Phi}{A_T(1 - \rho_{AV})} \text{ lx.}$$

where: Φ = light flux introduced into the room in lumens, lm,
 A_T = total surface area of the room in m^2 ,
 ρ_{AV} = average reflectance of the surfaces in the room.

Hints - There are two methods you might use

- i) The total light flux will be the sum of all the successive interreflections, then sum the resulting geometric series,
 - ii) The total light flux absorbed at surfaces must be equal to the light flux emitted by the light source, and that light which is not reflected must be absorbed.
- b) Explain why this formula is only approximate and thus suggest how it might be possible to more accurately calculate the average illuminance over a particular room surface.