Question

You are given three parallel panes of glass. Each pane will transmit 70%, reflect 20%, and absorb 10% of the light that falls on it.

If a light source is placed on one side of the three panes, what is the total percentage of light that passes through to the other side?

Answer

343/902 =~ 0.380266075388 =~ 38.03%.

Solution

Let's call the panes of glass 1, 2, and 3, where the light starts by going through pane 1 first and whose goal is to go through pane 3.

Let:

a = Portion of light that will escape traveling from pane 1 to pane 2.

b = Portion of light that will escape traveling from pane 2 to pane 1 (in other words going backwards).

c = Portion of light that will escape traveling from pane 2 to pane 3.

d = Portion of light that will escape traveling from pane 3 to pane 2 (in other words going backwards).

We can set up these equations:

a = 0.7 c + 0.2 b

b = 0.2 a

c = 0.7 + 0.2 d

d = 0.7 b + 0.2 c

We have four equations and four unknowns, thus we have enough information to solve for all variables, but we only need to for a.

We can set up these equations as a matrix:

1	-0.2	-0.7	0	0
-0.2	1	0	0	0
0	0	1	-0.2	0.7
0	-0.7	-0.2	1	0

Let's call matrix M:

1	-0.2	-0.7	0
-0.2	1	0	0
0	0	1	-0.2
0	-0.7	-0.2	1

Let's call matrix N:

0	-0.2	-0.7	0
0	1	0	0
0.7	0	1	-0.2
0	-0.7	-0.2	1

determ(M) = 0.902

determ(N) = 0.490

a = determ(N)/determ(M) = 0.49/0.902 = 490/902 =~ 0.543237251

However, not all the light makes it to state a. 70% of it, to be exact. So, the ratio of all the light to the light that escapes pane 3 is 0.7 * 490/902 = 343/902 =~ 38.03%.