

The examination is open book and open notes, but limited in time. You will have 2 hours. You will be apprised of the time remaining at 60 minutes, 15 minutes, 5 minutes and 1 minute. When time has expired you will be told to put down your pencils and pens. You may continue to work on the exam, but 5 points will be subtracted from your score for every minute or portion thereof which you continue. It is generally much wiser to lay out how you would answer the problem and then stop. Substantial credit can be given for the right method even if you do not complete the problem with the correct answer. Be careful not to communicate with anyone else or share or allow to be shared any answers from your exam.

The following 15 questions are worth 4 points each:

- 1.) What **unit** measures whether the spectrum coming from a particular white light source is shifted blue-ish or towards red-ish?

$^{\circ}\text{K}$ (degree Kelvin or simply Kelvin)

What **unit** measures whether the spectrum has any gaps in it, or matches daylight and incandescent light?

Color Rendering Index (CRI)

- 2.) What **unit** measures the visual brightness of a surface?

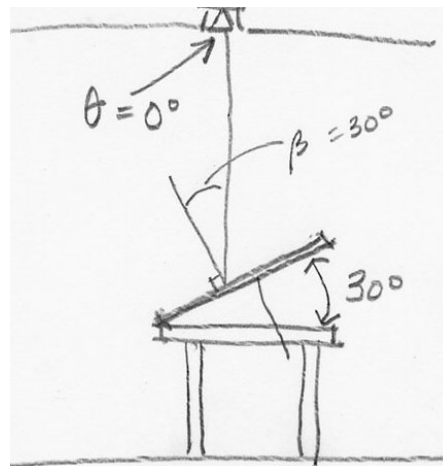
Lumens/ ft^2 or footLamberts or Lambert (SI) or cd/m^2 (candela/square meter) in new system

The unit measuring the amount of light arriving at a surface is Lumens/ ft^2 , or footcandle, or lux.

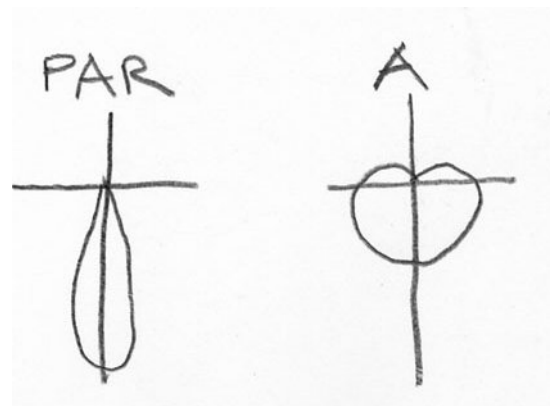
- 3.) What formula would you use to calculate the amount of light which a particular source was casting onto a drafting table tilted at 30° ?

$$E = (I / d^2) \cos \beta$$

Draw the situation, and label the angle(s) used in the equation.



- 4.) Draw a candlepower distribution curve for a PAR bulb and for an A bulb. (Label them.)



- 5.) What materials are acceptable for structural walls in Type I construction?

Steel, iron, concrete or masonry.

- 6.) There is a machine running at a steady 7000 rpm, and making noise related to its running speed and vibration. As you (slowly) walk away from it, which of the following will change? (Circle all that apply.)

- a.) => amplitude (gets quieter)
b.) pitch (no change in pitch)
c.) Steiner coefficient (fire #)
d.) frequency (no change in freq.)
e.) => volume (gets quieter)

- 7.) Is the fixture shown below: ? (Circle all that apply.)

- a.) => direct (down component)
b.) => indirect (up component)
c.) avuncular (? maternal uncle)
d.) => uplight (up component)
e.) => downlight (down component)



- 8.) Is a reverberation time of over one minute a good situation for a lecture hall?

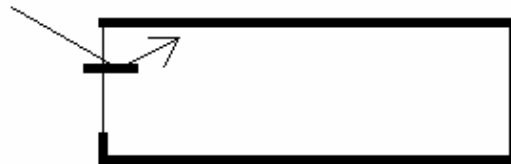
No. The reflections will interfere.

- 9.) What is the difference between graywater and blackwater?

Graywater is water used for washing or rinsing and can easily be recycled for irrigation, etc.

Blackwater contains human waste and is not easily recycled.

- 10.) Draw and explain a light shelf.



The light bounces off the top of the shelf and into the space. The shelf shades the front (which had too much light anyway.)

- 11.) Given a 200 foot long unsprinklered building, how many fire exits must there be?

200' unsprinklered => 3, sprinklered => 2

If the building is 150 foot long, unsprinklered, then the answer is 2.

- 12.) Which is best known for his use of natural lighting in buildings, Michael Graves, Peter Eisenman or Alvar Aalto? (And who do you think will still be remembered in forty years?)

Aalto, Aalto

- 13.) How many gallons of water do you use if you let the faucet run while you brush your teeth?

Teeth => 3 gallons, flush 6-8 gallons

When you throw a paper cup into the gutter, where does it go and where does it end up?

The gutter drains into the storm sewer, which drains into the bay.

- 14.) There is a pressure of 70 psi at the street main. How high can that lift

water without a pump?

$$70 \text{ psi} \times 2.3 \text{ ft/psi} = 161 \text{ ft.}$$

If the pressure is 80 psi, then
 $80 \text{ psi} \times 2.3 \text{ ft/psi} = 184 \text{ ft.}$

- 15.) What is flashover? How does it occur?

Flashover occurs when the materials in a room reach combustion temperature pretty

much at the same time. The result is something close to an explosion as all the materials ignite at once.

This is most often the case when there is a fire which heats the the air near the ceiling. The materials in the ceiling reach combustion temperatures at roughly the same time. When they ignite, they ignite the walls, in turn.

The next two questions are worth 10 points each, and may be answered from the following information:

There is a 20' x 40' x 10' room on the South side of an office building in Los Angeles. (The 40' wall is the window wall). It is noon on a clear summer day, and the sun is at an altitude of 65°. Outside the window is a parking lot and grassy area, with an average reflectance of 20%. There is a ceiling reflectance of 80%, wall reflectance of 70%, and floor reflectance of 20%. The desk height, and assumed workplane, is at 2 feet, 6 inches.

There is a uniform grid of 10 - 2' x 4' two lamp fluorescent troughers with 45° plastic louvers mounted flush on the ceiling. The designer specified a lamp with a 2950 lumen maintained output.

- 16.) If we were to calculate the illumination from natural light sources, what is the amount of light which strikes the window *directly* from the sun and sky combined? (This is an interim step in the overall problem. You may neglect the light reflected from the ground.)

The light which strikes the window from the sun is $E_{xvu} = 45 \text{ klux}$ (Any number between 40 to 50 will get credit.)

The light which strikes the window from the sky is $E_{xvk} = 10.5 \text{ klux}$ (Any number between 10 to 11 will get credit.)

The combined value is $E_{xvu} + E_{xvk} = 45 + 10.5 = 55.5 \text{ klux}$

- 17.) If we were to calculate the night time illumination in the space, what is the room cavity ratio of the space? What is the effective wall reflectance? What wall reflectance would you have to use in the CU table? (Again, this does not require you to do the entire problem, just the steps that are requested.)

The lights are on the ceiling. The distance from the work plane to the ceiling is 10 ft. - 2.5 ft. = 7.5 ft. $h_{rc} = 7.5'$. $L = 40'$, $W = 20'$.

$$RCR = 5 \times h_{rc} \times (L + W) / (L \times W) = 5 \times 7.5' \times (40' + 20') / (40' \times 20') = 2.8$$

Effective wall reflectance is wall reflectance, in this case. 70%. Since the CU table only goes as high as 50%, that is the closest percentage and is what you would use.

The next two questions are worth 10 points each, and may be answered from the following information:

There are two rooms next to one another. Each one is 20' x 30' x 10' in size and they share one of their 20' walls.

The floors are concrete, the walls are normal stud and gypsum board, and the ceilings are plaster.

Room A is a mechanical equipment room, in which there is a standing noise level of 85 dB.

Room B is an empty office space.

- 17.) What is the noise level in Room B (the office space) as a result of noise transmitted from the mechanical equipment room?

$$NR = TL + 10 \log(a_2/S)$$

where:

NR is the Noise reduction,

TL is the barrier transmission loss, in dB

a_2 is the total absorption of the receiving room, in sabins

S is the Area of barrier wall, ft^2

The STC of a stud and gypsum board wall is 33 dB.

The total absorptivity of the second room is:

ceiling: 20' x 30' x 0.05 sabins

walls: $[2 \times (20' \times 10') + 2 \times (30' \times 10')] \times 0.05$ sabins

floor: 20' x 30' x 0.0 sabins

Total: 80 sabins

The mutual surface area is 20' x 10' = 200 ft^2 . (That's the shared wall.)

$$\begin{aligned} NR &= TL + 10 \log(a_2/S) \\ &= 33 \text{ dB} + 10 \log(80/200) \text{ aha! a negative logarithm, just proceed} \\ &= 29 \text{ db} \end{aligned}$$

$$IL_2 = IL_1 - NR = 85 \text{ db} - 29 \text{ dB} = 56 \text{ dB}$$

- 18.) Let us say that the noise level in Room B, from all the different sources, were 65 dB. If we installed an acoustical tile ceiling and carpeted the space, what formula would you use to calculate the difference? (You don't have to complete the calculation, just pick the correct formula.)

$$NR = 10 \log(a_2/a_1) \leq$$

[where

NR is noise reduction, measured in dB,

a_1 is the original total absorption, in sabins,

a_2 is the resultant absorption after modification, in sabins.]

Extra Credit: Name one of the guest lecturers this semester. – 5 points

Jim Wood, Michael Gehring, Scott Ellinwod, Patrick Quigley, Andy Powell (LDA), Wayne Martin