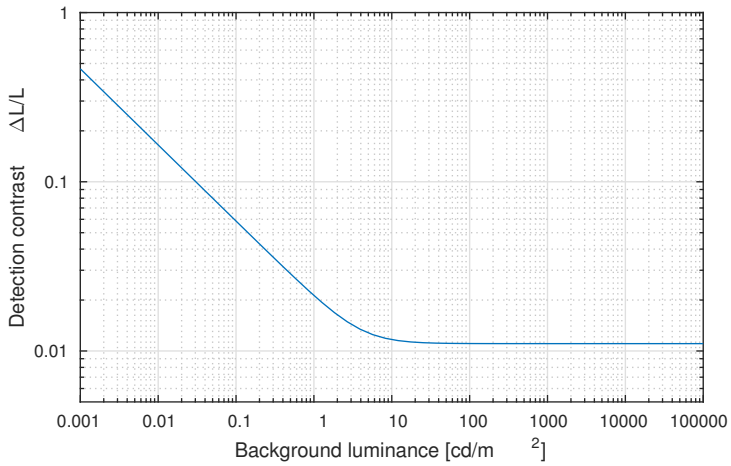
COMPUTER SCIENCE TRIPOS Part II – 2016 – Paper 8

1 Advanced Graphics (RKM)

(*a*) Answer the questions below, referring to the contrast-versus-intensity function in the plot shown below when appropriate.



(*i*) Why is luminance usually plotted using the logarithmic scale? [2 marks]

(*ii*) Why are stars visible at night but not in the day-time? Justify your answer referring to the contrast-versus-intensity plot above. [3 marks]

(*iii*) Is the sensitivity of the visual system higher when it operates in a bright environment or in a dim environment? Explain why. [3 marks]

(*iv*) Why is the power of 1/3 function used in CIE Lab and CIE Luv colour spaces? [2 marks]

(*b*) You are given a gray-scale high dynamic range image I represented in absolute luminance units of cd/m^2. The image is to be viewed on a target display with the peak luminance $L_{\text{peak}} = 100\,\text{cd/m}^2$ and the black level $L_{\text{black}} = 1\,\text{cd/m}^2$ (both values measured in the dark environment). The display is viewed in a bright environment and the amount of the light reflected from the screen was measured to be $L_{\text{refl}} = 2\,\text{cd/m}^2$.

(*i*) Calculate the effective dynamic range (contrast) of that display in the bright environment and express it as a contrast ratio N:1. Show the formula as well as the final answer. [2 marks]

(*ii*) What operation needs to be performed on the image I to make it twice as bright? Express the final result as luminance. [2 marks]

(*iii*) How can the contrast of image I be reduced by a factor of 2 so that the luminance values equal to L_{peak} do not change? Express the final result as luminance. [3 marks]

(*iv*) Write pseudo-code that adds glare to image I. The glare is modelled as a point spread function g. Your formula must exclude the glare that is naturally produced in the eye when viewing the target display described above. Use the $*$ symbol for the convolution operator. Express the final result as luminance. [3 marks]