1. The core part of this graph is just a simple y versus x plot. The x coordinates of the points to be plotted are contained in the variable `xv`, but we can't use the values in `xl` for plotting because *they are character strings*. What we need for the y coordinates is a set of equally spaced values. It is convenient to take the values to be $1, 2, 3, 4, 5$, but any 5 equally spaced values will do.

   The core part of the graph could be produced with the expression

   ```
   plot(xv, 1:5)
   ```

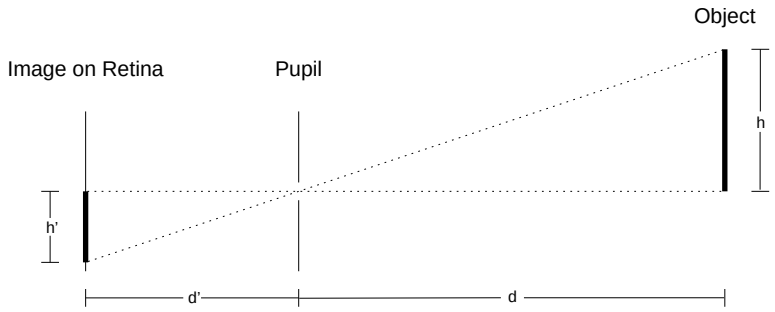
   but a large amount of customisation is needed, so it is easier to use lower level commands. The customisation includes:

   - Customised limits on the x and y limits;
   - Tick marks at the extremes of the x axis;
   - Customised axis labelling and an overall title;
   - Horizontal dotted lines must be drawn from the y axis to the points being plotted. This can be done with the `segments` function.
   - The labels on the y axis need to be drawn horizontally.

   Here is a complete program.

   ```
   plot.new()
   plot.window(xlim = c(0, 50), ylim = c(0, 6),
               xaxs = "i", yaxs = "i")
   points(xv, 1:5)
   segments(0, 1:5, xv, 1:5, lty = "dotted")
   axis(1)
   axis(2, at=1:5, lab = xl, las = 1, tick = FALSE)
   title(main = "Higher Education Levels by ...")
   title(xlab = "Percentage with higher education")
   box()
   ```

2. The eye functions as a pinhole camera, with the pupil being the pinhole and the retina being the screen which is projected onto. The following figure shows the geometry associate with a pinhole camera.



Because the triangles are similar,

$$\frac{h'}{d'} = \frac{h}{d}$$

and hence

$$h' = \frac{hd'}{d}.$$

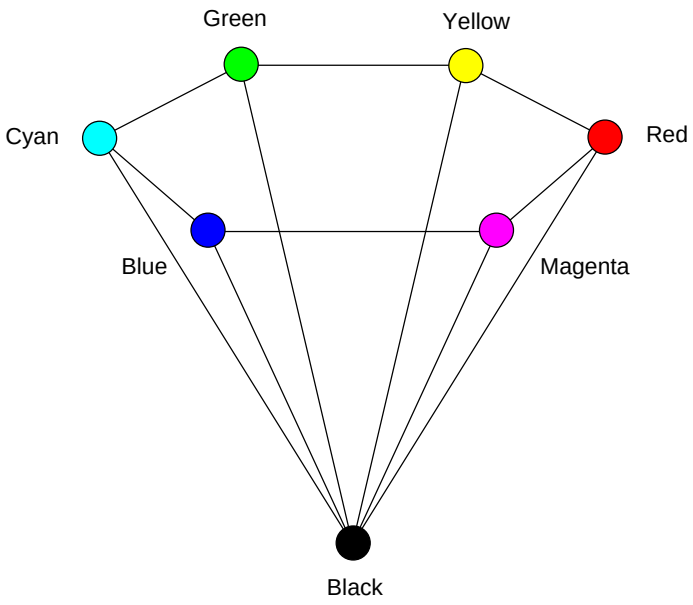
This says the size of the image of an object on the retina is inversely proportional to the distance from the pupil to the object. In simple terms, the further an objects is away, the smaller it appears to be.

When we are young we learn to adjust our estimates of the size of objects for the distance between us and those objects. This adjustment means that we don't see objects shrink as the move away, we simply alter our interpretation of their size.

While this adjustment is helpful when we look at three dimensional scenes, it can mislead us when we look at two dimensional pictures. Examples of this are the Ponzo illusion and the Müller-Lyer illusion.

3. (a) Three possible descriptions are: RGB (Red, Green, Blue), HSV (Hue, Saturation and Value) and the opponent colour description (Luminance, Red/Green and Blue/Yellow). Each of these descriptions has three parameters which can be independently varied.

   (b) The colour hexcone is presented in the figure below.



Hue is specified as the angle around the colour hexagon (counter clockwise from Red).. Saturation measures the distance from the vertical line through black to the colour, as a fraction of the distance from the the vertical line to the cone boundary. Value measure the vertical distance of the colour up the vertical axis from black as a fraction of the distance from black to white.

(c) The simplest explanation of why blue is the darkest of the primaries is that it is the primary which has the lowest value on the photopic efficiency curve. This in turn is explained by the fact that there are many fewer blue cones in the retina, and so they contribute little to the brightness signal transmitted from the eye.

(d) It is luminance which gives us most of the information about a scene or picture which we might be examining. This is probably because colour is a later adaptation which supplements the basic monochrome picture which the primitive eye generated. If all the features in a scene have the same luminance it is hard from us to detect the boundaries between the features, making it hard to see much in a picture. The visual system has very sophisticated methods for detecting and enhancing differences in luminance. These methods work only for luminance and do not work as well at detecting differences in hue or saturation.

Mark Analysis

```
> summary(marks)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   2.00   10.00   11.50   11.79   14.88   18.00

> stem(marks, 2)

  The decimal point is at the |

   2 | 0
   3 | 5
   4 |
   5 |
   6 | 0
   7 | 00005
   8 | 0
   9 | 000555
  10 | 000000
  11 | 00000000055
  12 | 000000005
  13 | 005
  14 | 05
  15 | 00000
  16 | 00055
  17 | 00
  18 | 0000
```