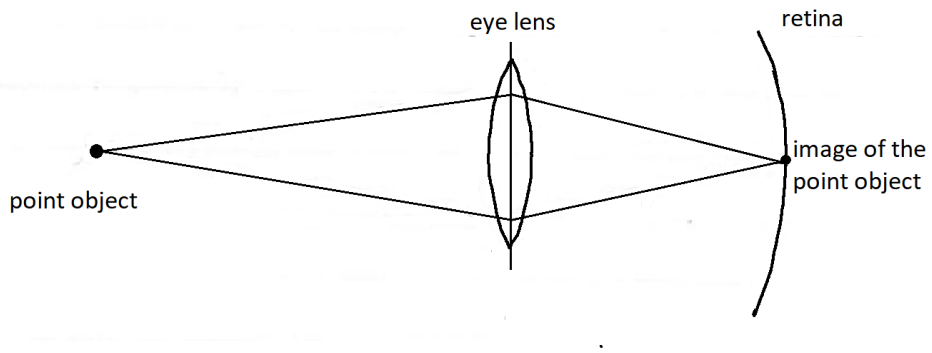
**MEDICAL PHYSICS**

**1-1 Physics of vision**

1. (a)



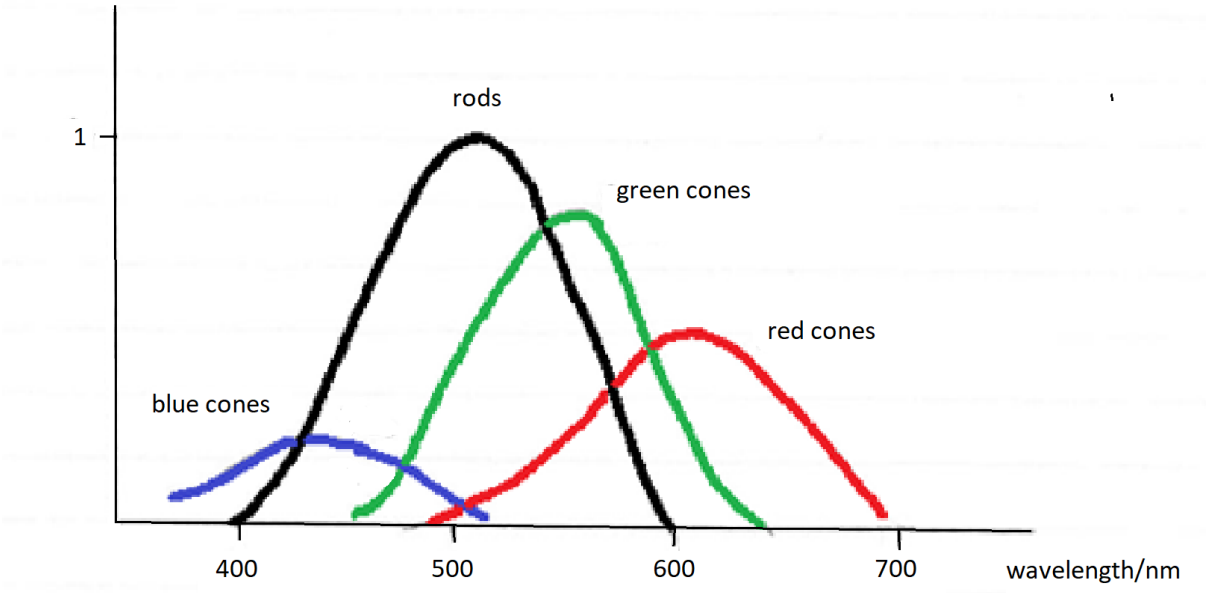

The image is focussed by the eye lens onto the retina.

(b) When viewing the nearby object, the eye muscles are taut. To view the distant object they relax. The eye lens becomes thinner and less powerful as a result so that the image will still be formed on the retina.

2. (a) (i) When the incident light becomes very intense the iris expands so that the pupil becomes smaller and less light passes through it to the eye. (Concentric muscles contract, radial ones relax). The cones and rods automatically become less sensitive.

(ii) When the incident light becomes very dim the iris contracts so that the pupil becomes dilated and more light passes through it into the eye. (Concentric muscles relax, radial ones contract). The cones switch off and the rods become more sensitive.

(b)



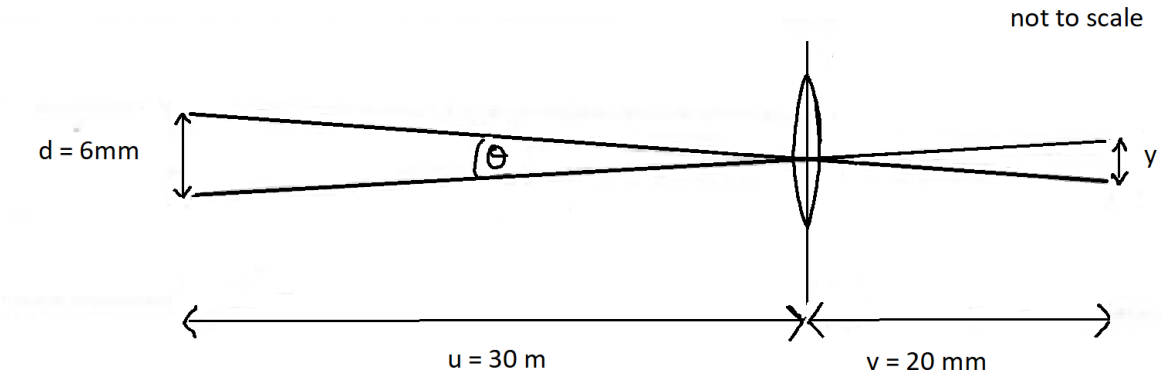

3. (a) (i) Objects in dim light at the edge of the field of view are more readily noticed than those at the centre of the field of view because the rods predominate at the edge of the retina. Rods are more sensitive at low light intensity than the cones at the centre of the retina and field of view.

(ii) The objects appear colourless because the rods do not distinguish between colours.

(b) (i) The persistence of vision is the after-image seen after a bright image disappears. It is the result of the fact that the cones take time to regain their sensitivity and register a new image.

(ii) The persistence of vision means that although the TV picture is only renewed 25 times a second, the viewer sees a continuous sequence of frames as each frame 'lingers' on the retina.

4. (a)




$d = 6 \times 10^{-3}$ m

$v = 20 \times 10^{-3}$ m

u = 30 m

Angular separation $\theta = \frac{d}{u}$

Separation of image centres, $y = \theta v = \frac{dv}{u} = \frac{6 \times 10^{-3} \times 20 \times 10^{-3}}{30} = 4.0 \times 10^{-6}$ m or 4.0 µm

(b) Retinal cell diameter = 1.5 µm

The eye can resolve the images when they are separated by at least two retinal cells. Two retinal cells would cover a distance of 3.0 µm. As 4.0 µm is greater than this, the image would be resolved.