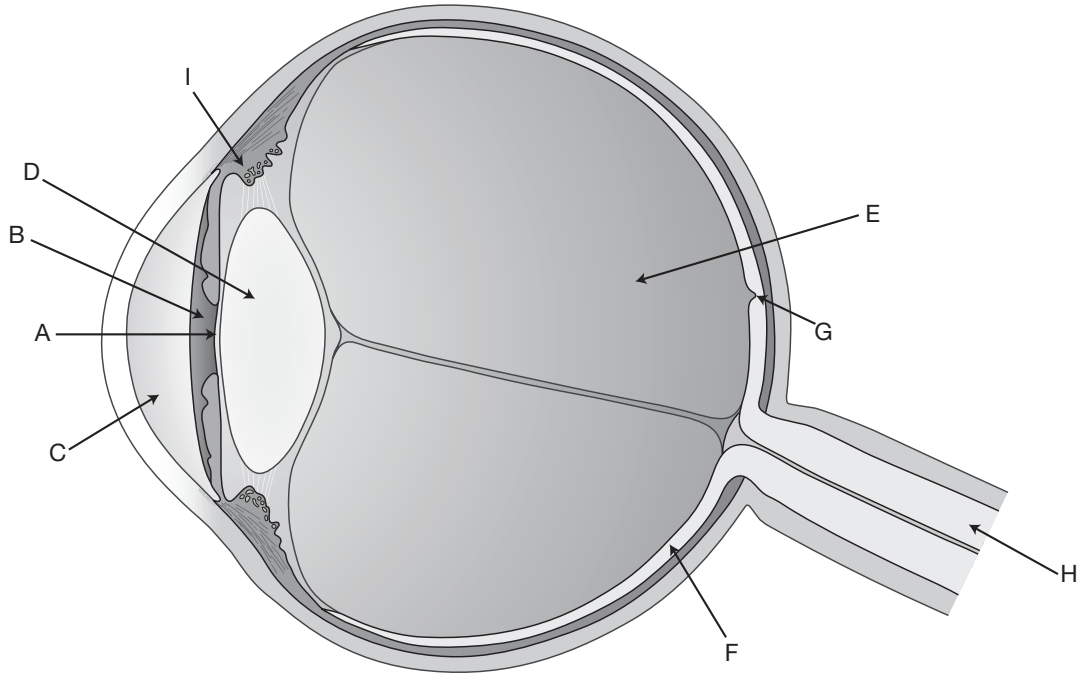
A1 The eye and sight. © IBO 2007

A.1.1 Describe the basic structure of the human eye. © IBO 2007

A.1.1.1 Identify the parts of the human eye by annotating the diagram.



A.1.1.2 Outline two processes used by the eye to produce the clearest image of a distant object on the retina.

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A.1.1.3 Describe the nature of the image formed on the retina.

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A.1.1.4 Using the components of the eye listed below, identify the sequence in which light travels from an object to the retina.

Vitreous humour, retina, aqueous humour, lens, cornea.

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A.1.1.5 An eye is often described as the equivalent of a camera. Complete the table by identifying the parts of the eye that are equivalent to the camera parts.

Camera part	Aperture	Lens	Screen	Focusing system
Human eye part				

A.1.2 State and explain the process of depth of vision and accommodation.

A.1.2.1 Identify which of the following is the best estimate of the focal length of a 'normal' human eye.

(A) 10 cm
(B) 25 cm
(C) 50 cm
(D) Infinity

A.1.2.2 Explain what is meant by the near point.

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A.1.2.3 Explain what is meant by the far point.

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A.1.2.4 Discuss what is meant by accommodation. Include in your discussion how it is achieved by the human eye for the near point and the far point.

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A.1.2.5 When a 'normal' human eye is most relaxed, identify the distance away from the eyes at which an object will be in focus.

(A) The object is at the focal length of the 'normal' eye, i.e. about 25 cm.
(B) The object is about 10 m away.
(C) The object is at infinity.
(D) The object is very close to the eye, about 10-15 cm.

A.1.2.6 Draw ray diagrams to help explain the following.

(a) Explain why an object at the near point is not clear.

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(b) Explain why an object at the far point is seen with the least stress on the eyes.

A.1.2.7 Explain what is meant by depth of vision.

A.1.2.8 Explain why depth of vision is essential for us.

A.1.2.9 Discuss three methods used by the human eye to achieve depth of vision.

A.1.2.10 Identify which one of the following is a significant process that occurs in the human eye.

(A) Reflection.
(B) Refraction.
(C) Diffraction.
(D) Polarisation.

A.1.2.11 Identify which one of the following is the best description of the image formed in the human eye.

(A) Real, upright, reduced and without colour.
(B) Virtual, reduced, inverted and coloured.
(C) Real, inverted, and reduced.
(D) Real, actual size and inverted.

A.1.2.12 Explain what is meant by stereoscopic vision, referring to the processes involved in achieving this.

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A.1.2.13 Identify which one of the following is predominantly responsible for accommodation.

(A) Ciliary muscles.

(B) Pupil.

(C) Iris.

(D) Cornea.

A.1.2.14 If an eye does not focus an image on the retina and instead at a spot too close or too far away, what could be done?

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A.1.2.15 Identify the location in the human eye with the greatest concentration of cones.

(A) Iris.

(B) Fovea.

(C) Cornea.

(D) Optic nerve.

A.1.3 State that the retina contains rods and cones, and describe the variation in density across the surface of the retina.

A.1.3.1 Identify where rods and cones are situated in the eye.

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A.1.3.2 Identify which one of the following statements best describes the relative properties of rods and cones at low light intensity.

(A) Rods are sensitive and cones are relatively insensitive.

(B) Both rods and cones are sensitive.

(C) Both rods and cones are insensitive.

(D) Cones are sensitive and rods are relatively insensitive.

A.1.3.3 Identify which one of the following statements best describes the relative properties of rods and cones for light response and colour.

(A) Cones have a slow response and are sensitive to colour.

(B) Rods have a fast response but are insensitive to colour.

(C) Cones have a fast response but are insensitive to colour.

(D) Rods have a slow response and are sensitive to colour.

A.1.3.4 Outline the consequence of the very low concentration of rods around the fovea.

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A.1.3.5 Identify which one of the following is closest in value to the number of rods and cones in a 'normal' human eye.

(A) About 6.5 million rods and 120 million cones.

(B) About equal number of rods and cones, 100 million each.

(C) About 50 million rods and 100 million cones.

(D) About 120 million rods and 6.5 million cones.

A.1.3.6 Identify the three colours that cones are sensitive to and identify the one colour to which the cones are most sensitive.

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A.1.3.7 The ratio of the number of rods to the number of cones in the human eye is about:

(A) 1:20

(B) 20:1

(C) 1:100

(D) 100:1

A.1.4 Describe the function of the rods and of the cones in photopic and scotopic vision.

A.1.4.1 Explain what is meant by photopic vision and scotopic vision.

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A.1.4.2 Explain whether rods or cones are used in each of photopic vision and scotopic vision.

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A.1.4.3 Referring to rods and cones, outline the cause of colour blindness.

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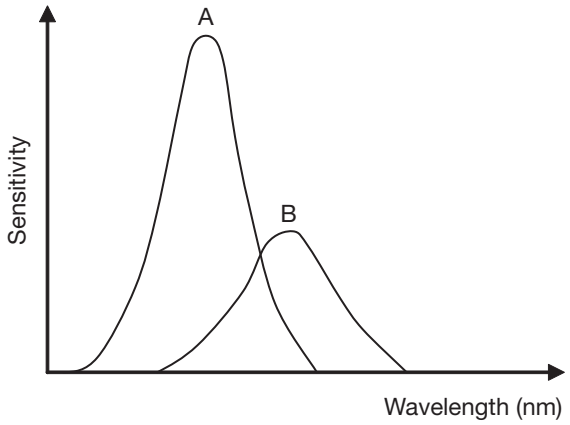
A.1.4.4 The light spectral response graph for scotopic and photopic vision of a 'normal' human eye is shown.



(a) Identify which graph is of rods and which is of cones. Explain your answer.

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(b) Which of the graphs is an appropriate representation of scotopic vision? Explain your reasoning.

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A.1.4.5 Suggest why vision at night is a slow response.

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A.1.4.6 Explain why there is a blind spot in our eye.

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A.1.4.7 Identify which are the three wavelengths of maximum absorbance for cones, called short (S), medium (M) and long (L) respectively.

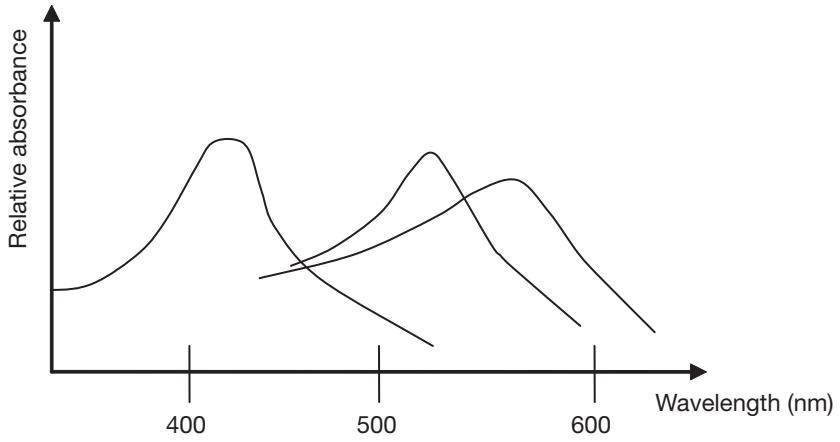
(A) 400 nm, 600 nm and 900 nm.

(B) 430 nm, 530 nm and 630 nm.

(C) 450 nm, 550 nm and 650 nm.

(D) 430 nm, 530 nm and 560 nm.

A.1.4.8 The spectral response curves for a person's three types of cones, S, M and L are shown.

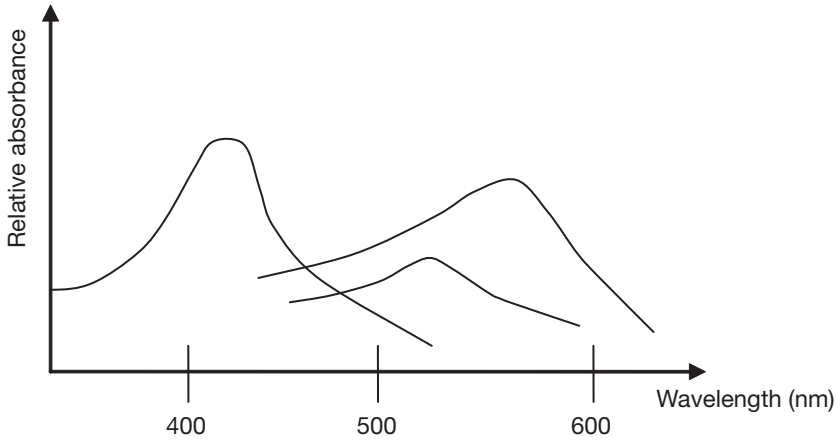


(a) Annotate each curve as S, M or L.

(b) Sketch the light response curve for rods on the same graph, showing the relative location of the principal wavelength for rods.

(c) Discuss whether it is appropriate to nominate the S, M and L spectra for cones as blue, green and red respectively.

(d) The light spectral response graph for another person is different, as shown. Describe this person's perception of coloured images.



A.1.4.9 Suggest why rods are the main providers of the sense of vision at night.

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A.1.4.10 Suggest why vision at night generally does not allow great clarity of colour.

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A.1.5 Decribe colour mixing of light by addition and subtraction.

A.1.5.1 Describe the main processes for colour addition and colour subtraction.

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A.1.5.2 Identify the resulting colours when the following occur.

(a) Red and green colours are added. .....

(b) Red, green and blue colours are added. .....

(c) All secondary colours are added. .....

A.1.5.3 Explain what primary colours are and identify examples.

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A.1.5.4 Explain what secondary colours are and identify examples.

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A.1.5.5 Referring to absorption and reflection of light, explain why a wall painting with blue pigment appears blue.

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A.1.5.6 Referring to absorption and reflection of light, explain why white light when transmitted through a certain filter appeared red.

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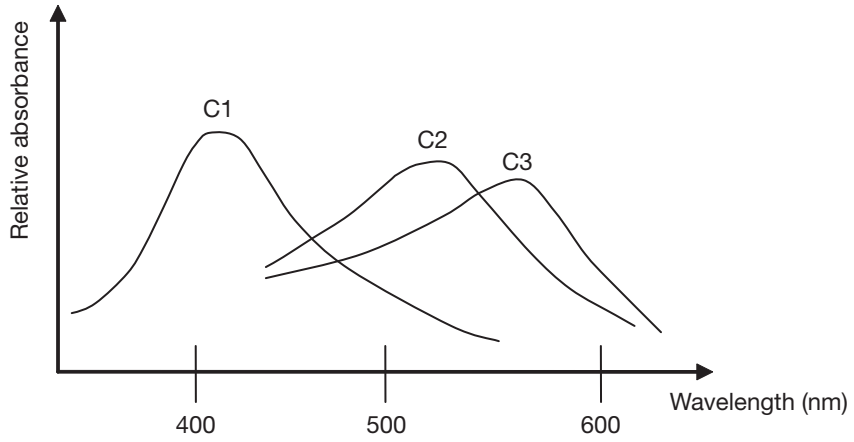
A.1.5.7 The graph shows the spectral colour response for three kinds of cones, C1, C2 and C3.



(a) Identify which cones are short, medium and long.

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(b) Explain why the cones are called short, medium and long, referring to the corresponding colours they are most sensitive to.

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A.1.5.8 A certain filter blocks out blue light from a white light source.

(a) Explain why this is an instance of colour subtraction and colour addition.

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(b) Deduce the colour of the transmitted light.

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A.1.5.9 Identify what colour a red glass will appear when blue light is shone on it.

(A) Red.

(B) Blue.

(C) Black.

(D) Magenta.

A.1.6 Discuss the effect of light and dark, and colour, on the perception of objects.

A.1.6.1 Explain how a two-dimensional picture can achieve an effect of three dimensions.

A.1.6.2 Discuss how colour can be used to make a room look smaller, larger, warmer or cooler than it actually is.

(a) Smaller.

(b) Larger.

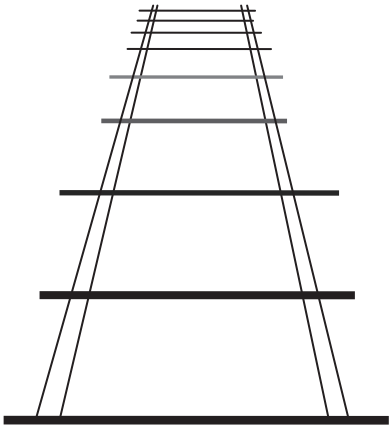
(c) Warmer.

(d) Cooler.

A.1.6.3 Discuss how shadows from buildings can be interpreted by the brain in our perception of a building's size.

A.1.6.4 Explain how spatial depth can be realised on a flat surface, using an illustration as an example.

A.1.6.5 For the drawings below, describe the illusion created, referring to both the factual information and the illusion.



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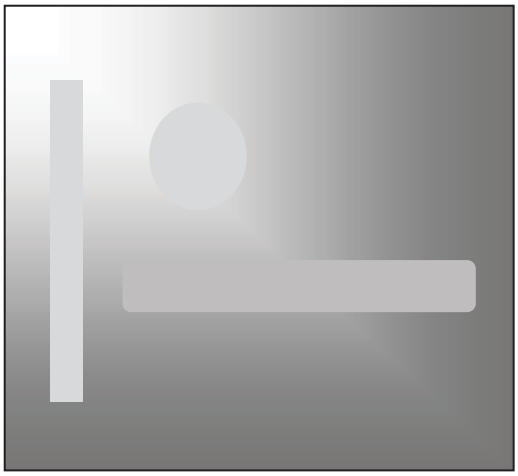

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Notes