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QUESTION WORKBOOK

The physics of the eye

Medical physics · Year 13

AQA 3.10.1

17 questions · 51 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 State the nature of the image formed on the retina of a normal eye, and name the part of the eye at which most of the refraction happens. [2]

A2 State what is meant by the near point and the far point of an eye, and give the value of each for a normal eye. [2]

A3 State what is meant by accommodation, and name the part of the eye that changes. [2]

A4 Calculate the power of a converging lens of focal length 0.40 m. A second lens has a power of −4.0 D: calculate its focal length and state what kind of lens it is. [2]

A5 State the unit of lens power and what it is equivalent to in SI base terms. [1]

A6 State what is meant by myopia and by hypermetropia. [2]

SECTION B · Standard

B1 An eye has its retina 22 mm behind its lens, and its far point is at infinity. Calculate the power of the eye when it is relaxed. [3]

B2 The same eye, with its retina 22 mm behind its lens, now focuses on an object 0.30 m away. Calculate the focal length of the eye in this state. [3]

B3 A short-sighted eye has its far point 0.25 m from the eye. Calculate the power of the spectacle lens needed for distant vision, and state what kind of lens it is. [3]

B4 A long-sighted eye has its near point 0.75 m from the eye. Calculate the power of the lens that would allow this eye to read at the normal 0.25 m. [3]

B5 A person with a normal eye, whose retina is 23 mm behind the lens, looks at a child 1.8 m tall standing 10 m away. Calculate the magnification and the height of the image on the retina. [3]

B6 Explain what astigmatism is, and state the three quantities a prescription to correct it must give. [3]

B7 Explain why rods allow the eye to see in very dim light but resolve much less detail than cones. [3]

SECTION C · Stretch

C1 An eye has its retina 23 mm behind its lens. Its far point is at infinity and its near point is 0.40 m away. Calculate the power of the eye at each of these two limits, hence the range of power accommodation provides, and the focal length of the eye at its near point. State, with a reason, which defect of vision this eye has. [5]

C2 A short-sighted eye has its far point 0.20 m away and its near point 0.12 m away. Calculate the power of the lens that corrects the eye for distant vision. With that lens worn, determine how far from the lens the nearest object it can focus now lies, and comment on the result. [5]

C3 A faint star is easier to see when you look slightly to one side of it than when you look straight at it, and when seen that way it appears colourless. Explain both observations in terms of the receptors of the retina. [5]

C4 The eye can just resolve two points that subtend an angle of about 3.0×10^{-4} rad at it. Calculate the smallest separation of two points that can be distinguished at the near point of 0.25 m, and explain what feature of the retina sets this limit. [4]