

The Eye

Mark Scheme



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1. The human eye is an incredibly complex sensory organ that allows us to see by processing light from our environment, playing a vital role in how we interact with and understand our surroundings.

Circle the letter of the correct answer for each question below.

- a) The figure below shows the iris and a pupil of an eye in different light conditions.
Which characteristic of living organisms is this an example of?

A – is the only correct answer.	1 mark
	Total: 1 mark

- b) The figure below shows a common defect of the eye.
What is the defect and which lens could be used to correct it?

B – is the only correct answer.	1 mark
	Total: 1 mark

- c) Which part of the eye is responsible for focusing light rays onto the retina by changing its shape?

C – is the only correct answer.	1 mark
	Total: 1 mark

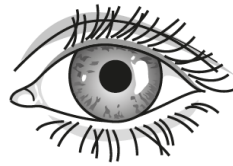
- d) The retina at the back of the eye contains light-sensitive cells.
Which type of light-sensitive cell is primarily responsible for vision in dim light and detecting movement, but not for colour vision?

B – is the only correct answer.	1 mark
	Total: 1 mark

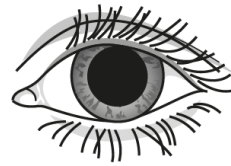
(Total for Question 1 is 4 marks)

2. A person walks from a bright space into a dark room.

The figure below shows one of the person's eyes in both of the different light conditions.



A



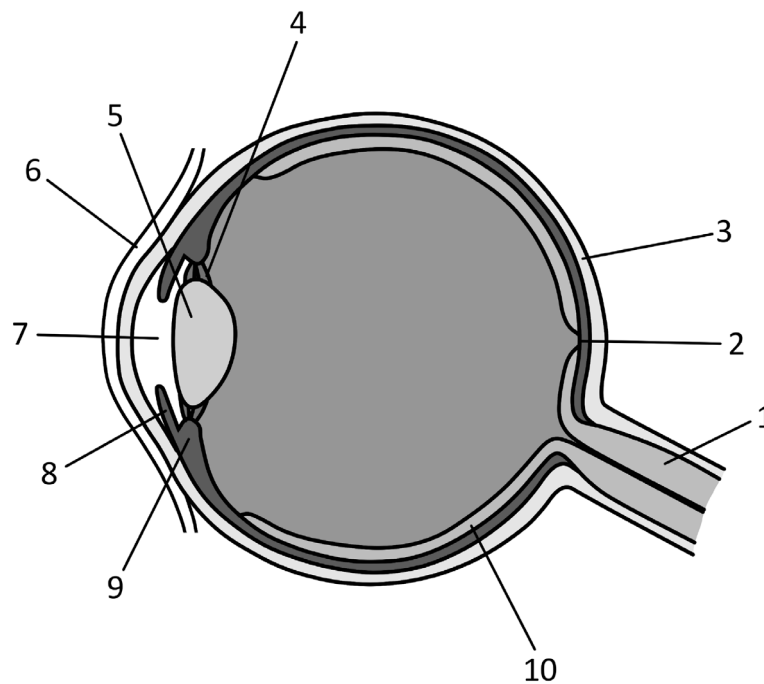
B

- a) Figure 2 shows one of the person's eyes when they enter the dark room.

Explain how this can be determined and how this change occurred.

An explanation to include the following:	
It's eye B because the pupil is wider/dilated to let more light in.	1 mark
This happens because the <u>radial muscles contract</u> and the <u>circular muscles relax</u> .	1 mark
	Total: 2 marks

- b) The figure below shows an unlabelled eye.



1. Optic nerve.

2. Blind spot

3. Sclera.

4. Suspensory ligaments.

5. Lens

6. Cornea.

7. Pupil.

8. Iris.

9. Ciliary muscle.

10. Retina.

Award 1 mark for each correct pair of labels.	
	Total: 5 marks

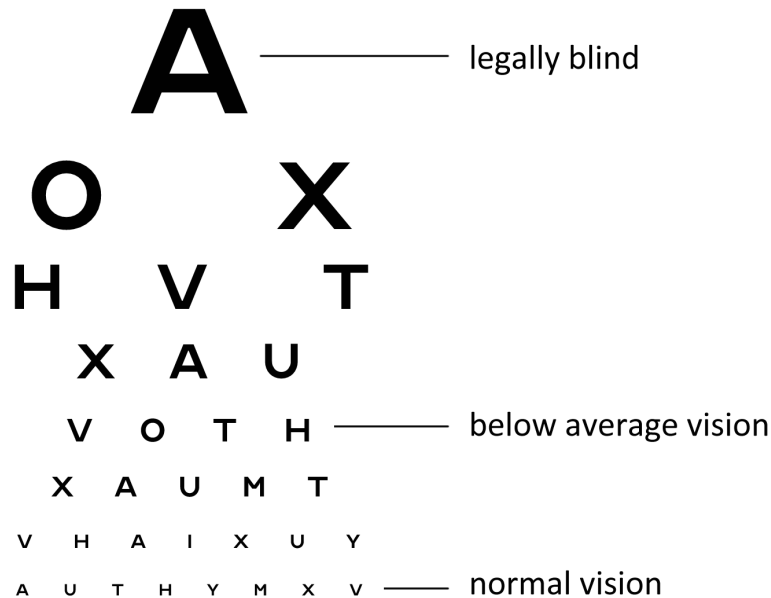
- c) Describe how light is focused onto the retina in the human eye. Explain how the brain then processes the information from the retina to allow us to see.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	A simple or limited answer. A few relevant points are made, but they may lack detail or be poorly sequenced. The answer may only address one aspect of the question (either focusing or brain processing).
Level 2	3 - 4	A clear description or explanation is given, but there may be some omissions. The answer addresses both aspects of the question, but one part may be less detailed than the other. The sequence is mostly logical.
Level 3	5 - 6	A detailed and coherent description and explanation is provided. The answer clearly addresses both how light is focused and how the information is processed by the brain. The stages are presented in a logical sequence. Appropriate scientific terminology is used throughout (e.g., refract, retina, optic nerve, impulse).

Description of focusing light: • Light enters the eye and is refracted (bent). • Refraction occurs first at the cornea. • The lens provides further/fine refraction. • The light is focused onto the retina. • (For detail) The ciliary muscles and suspensory ligaments can change the shape of the lens to adjust focus. Explanation of processing information: • The retina contains light-sensitive cells / photoreceptors (or named examples: rods and cones). • These cells are stimulated by the light. • The light energy is converted into electrical signals / nerve impulses. • These impulses travel along the optic nerve. • The impulses are sent to the brain. • The brain interprets / processes the impulses to form an image. • (For detail) The brain corrects the inverted image from the retina. Guidance To access Level 3 (5-6 marks), candidates must include points from both the focusing of light and the processing of information by the brain. An answer that only describes one part, no matter how detailed, is limited to Level 2 (4 marks maximum). Accept: • bends light for refracts light. • electrical signals or signals for impulses. • light receptor cells or photoreceptors for rods and cones. Do not accept: light reflects off the lens/cornea.	
Total: 6 marks	

(Total for Question 2 is 13 marks)

3. The figure below shows a Snellen chart. A Snellen chart is used by opticians to test a person's vision. The quality of the person's vision is judged by the lowest row of letters they can read.



An optician tested the eyesight of 420 people.

40% of these people could read the normal vision row without wearing glasses.

The rest of the people need glasses to correct their vision.

- a) Determine the number of people who will need glasses to correct their vision.

$100\% - 40\% = 60\%$ or $0.6(0) \times 420$	1 mark
$= 252$	1 mark
	Total: 2 marks

An optician can use the chart to diagnose Myopia.

- b) Explain what Myopia is and how would it be corrected.

An explanation to include two of the following:	
Myopia is short-sightedness / cannot see distant objects clearly.	1 mark
The light is focused in front of the retina.	1 mark
It is corrected using a concave / diverging lens.	1 mark
	Total: 2 marks

- c) Which structure in the eye is capable of changing the shape of the lens.

Ciliary muscle(s)	1 mark
	Total: 1 mark

Cataracts are a medical condition that can have an adverse effect on a person's vision.

A



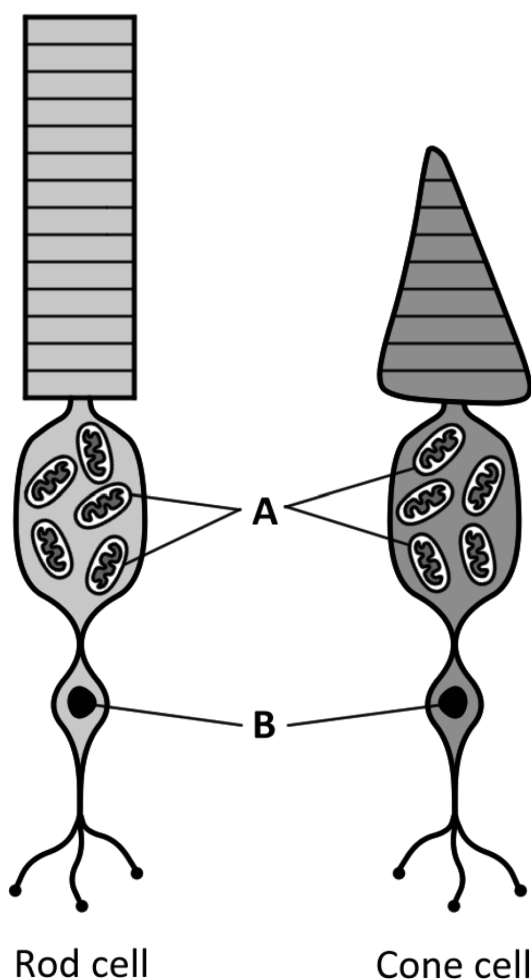
- d) Cataracts are quite common. Particularly in older people.
State what cataracts are and give the treatment for them.

A cataract is a clouding of the lens.	1 mark
Accept: lens becomes milky or cloudy.	
Treatment: The cloudy lens is replaced with an artificial / plastic lens.	1 mark
	Total: 2 marks

- e) Describe why a person with cataracts would see the image shown in the figure above.

The cloudy lens scatters / diffuses the light.	1 mark
Allow: light cannot pass through properly / is blocked.	
This prevents the light from being focused clearly / properly onto the retina.	1 mark
Accept: - The idea of a blurred / unclear image forming on the retina is required. - A sharp image cannot be formed	
	Total: 2 marks

4. The figure below shows two light receptor cells from the human eye, rod cells and cone cells.



- a) Which part of the eye contains light receptor cells?

Retina.	1 mark
	Total: 1 mark

- b) Identify organelle Y and state its function.

Identification: mitochondrion / mitochondria.	1 mark
Function: <u>aerobic respiration</u> or to release / provide energy / ATP.	1 mark
	Total: 2 marks

- c) Describe how the role of a rod cell is different from the role of a cone cell.

A description to include any two of the following:	
- Rod cells detect light of low intensity / work in dim light. - Cone cells detect light of high intensity / work in bright light. - Rod cells do not detect colour / only detect black and white. - Cone cells detect colour.	
To gain 2 marks, candidates must provide two distinct points of comparison. A single comparative statement can be awarded 1 mark.	
	Total: 2 marks

- d) Explain how light is focused onto the back of the eye. Your answer should describe the main structures involved and the pathway of light.

An explanation to include three of the following:	
• Light is refracted / bent. • By the cornea. • (and by the) lens. • To be focused onto the retina.	
	Total: 3 marks

(Total for Question 4 is 8 marks)

5. The optic nerve carries impulses from the retina to the brain.

The length of a human optic nerve is approximately 4.5 cm. An impulse takes 0.85 milliseconds (ms) to travel this entire distance.

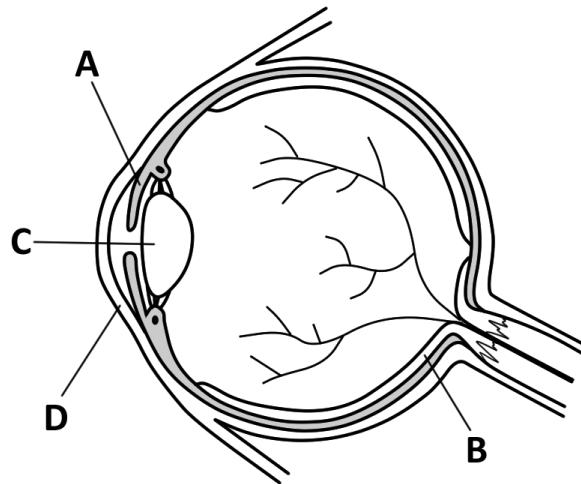
Calculate the speed of this impulse in metres per second (m/s). Show your working.

Give your answer to **two** significant figures.

Conversion of distance: 4.5 cm = 0.045 m	1 mark
Conversion of time: 0.85 ms = 0.00085 s	1 mark
Substitution into formula: speed = 0.045 / 0.00085	1 mark
Answer rounded to 2 significant figures: 53 (m/s)	1 mark
	Total: 4 marks

(Total for Question 5 is 4 marks)

6. The figure below shows a section through a human eye.



Identify each labelled part of the eye in the figure above and give the function of each of the labelled parts of the eye.

General	There are 8 potential marking points available. Award credit for any correct point up to a maximum of 6 marks. A mark for a function can only be awarded if it correctly corresponds to the identified structure. If a structure is misidentified, no marks can be awarded for its stated function. Accept phonetic spellings of scientific terms (e.g., kornear, optec nerve), provided the meaning is unambiguous.
A: Iris	Function: Accept 'controls how much light gets in'. Do not accept 'controls the lens' or 'focuses light'.
B: Optic Nerve	Function: Accept electrical signals or nerve signals/messages. Do not accept sends pictures to the brain or carries light. The term messages alone is insufficient and must be qualified.
C: Lens	Function: Accept bends light. The key idea is focusing light onto the retina. Allow 'changes shape to focus light'.
D: Cornea	Function: The primary function is the initial, major refraction of light. Accept bends light. As an alternative function, allow '(transparent layer that) protects the eye'.
Lens vs. Cornea	If a candidate states that both the lens and cornea 'refract light', award the mark for each. However, stronger answers will distinguish between the initial refraction (cornea) and fine, adjustable focusing (lens).
	Total: 6 marks

(Total for Question 6 is 6 marks)