

THE HUMAN EYE & EAR



Checklist

Make sure you ...

- Describe the structure and state the functions of the parts of the human eye.
- State what is meant by binocular vision.
- Describe the changes that occur in the human eye for each of the following:
 - Accommodation
 - Pupil reflex/pupillary mechanism
- Describe each of the following visual defects using diagrams, and state how each visual defect is treated:
 - Short-sightedness
 - Long-sightedness
 - Astigmatism
 - Cataracts
- Describe the structure and state the functions of the different parts of the human ear.
- Describe the functioning of the human ear in:
 - Hearing (include the role of the organ of Corti, without details of its structure)
 - Balance (include the role of maculae and cristae, without details of their structure)
- Describe the cause and state the treatment of the following hearing defects:
 - Middle ear infection (treatment using grommets)
 - Deafness (treatment using hearing aids and cochlear implants)



Test Yourself

Question 1

Which one of the following does not perform a protective function in the eye?

- A sclera
- B conjunctiva
- C eyelid
- D vitreous humour

Question 2

Which one of the following will not occur when a bright light is shone into a person's eyes?

- A lens flattens and becomes less convex
- B pupil becomes smaller
- C circular muscle of iris contracts
- D longitudinal muscles of iris lengthen

Question 3

Which sequence below is correct with regard to the passage of light through the eye to form an image on the retina?

- A cornea → conjunctiva → lens → vitreous humour → retina
- B conjunctiva → cornea → lens → aqueous humour → retina
- C conjunctiva → cornea → lens → vitreous humour → retina
- D cornea → lens → vitreous humour → aqueous humour → retina



Question 4

All of the following could result in hearing loss except...

- A rupture of the tympanic membrane.
- B tightening of the ligaments linking the ossicles to one another.
- C damage to the microscopic hairs within the cochlea.
- D no fluid movement within the semi-circular canals of the inner ear.

Question 5

Which one of the following contains cells that are sensitive to light?

- A. retina
- B. cornea
- C. optic nerve
- D. lens

Question 6

The function of the Eustacian tube in the ear is to

- A bring food and oxygen to the middle ear
- B remove waste products from the middle ear
- C let air equalize pressure on either side of the tympanum
- D remove excess perilymph from the inner ear

Question 7

The sacculus and the utriculus give information about the

- A position and movement of the head
- B condition of the muscles
- C position of the head
- D condition of the joints

Question 8

The shape of the lens in the human eye may be altered by contraction or relaxation of the

- A optic nerve
- B muscles of the ciliary body
- C muscles of the iris
- D pupil

Question 9

A light stimulus is converted into a nervous impulse in the

- A blind spot
- B iris
- C retina
- D optic nerve



Exam Questions

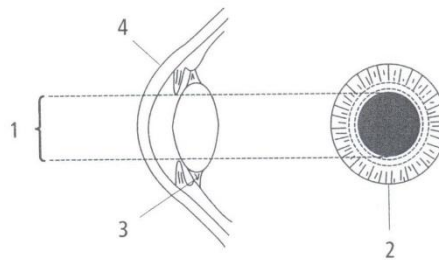
Question 1

- 1.1 Which one of the following parts of the eye is most important in refracting light from a distant object?
- A pupil
 - B lens
 - C retina
 - D cornea
- 1.2 Static balance (gravity) is sensed by the
- A semicircular canals
 - B cochlea
 - C organ of Corti
 - D maculae
- 1.3 The part of the ear where a sound wave is changed into a vibration is called the
- A organ of Corti
 - B tympanic membrane
 - C ossicles
 - D pinna
- 1.4 Which one of the following parts of the body are most involved in helping a blind-folded man standing on one leg to keep his balance?
- A brain, muscles, organ of Corti
 - B brain, cochlea, maculae
 - C muscles, semicircular canals
 - D brain, cochlea, semicircular canals
- 1.5 The shape of the lens in the human eye may be altered by contraction or relaxation of the...
- A optic nerve
 - B muscles of the ciliary body
 - C muscles of the iris
 - D pupil



Question 2

Study the diagram that shows the anterior and longitudinal section of the human eye and answer the questions that follow.



- 2.1 Identify parts numbered 1 – 3 (3)
- 2.2 Give the function of structure numbered 3. (1)
- 2.3 Name the condition responsible for:
 - a) the size of structure 1 in the diagram
 - b) the shape of the lens in the diagram (2)

A person in a darkened room is asked to cover one eye. A dim electric bulb, positioned at varying distances from the person (not all measurements were at different distances), is switched on at one-minute intervals for a period of 10 seconds. During this period the diameter of the pupil of the eye is measured. The results obtained are shown in the table below.

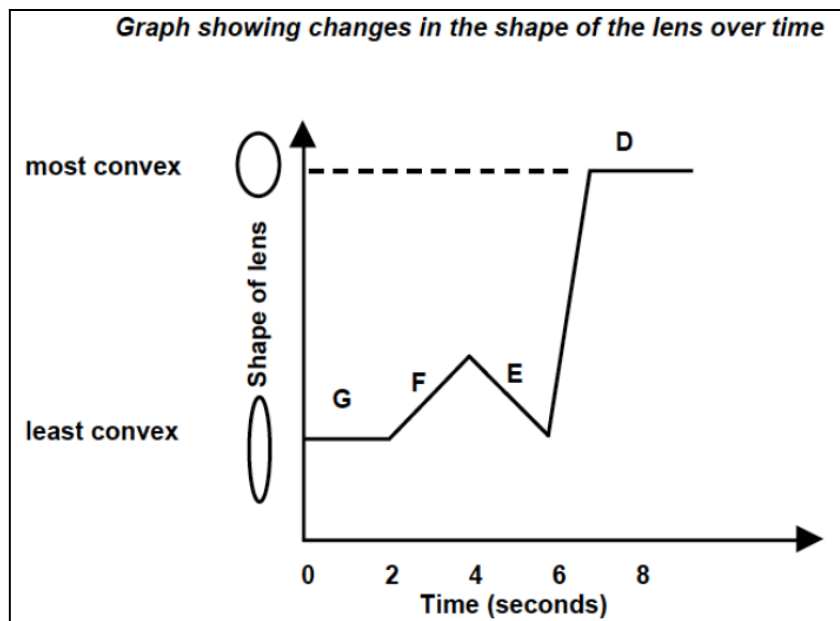
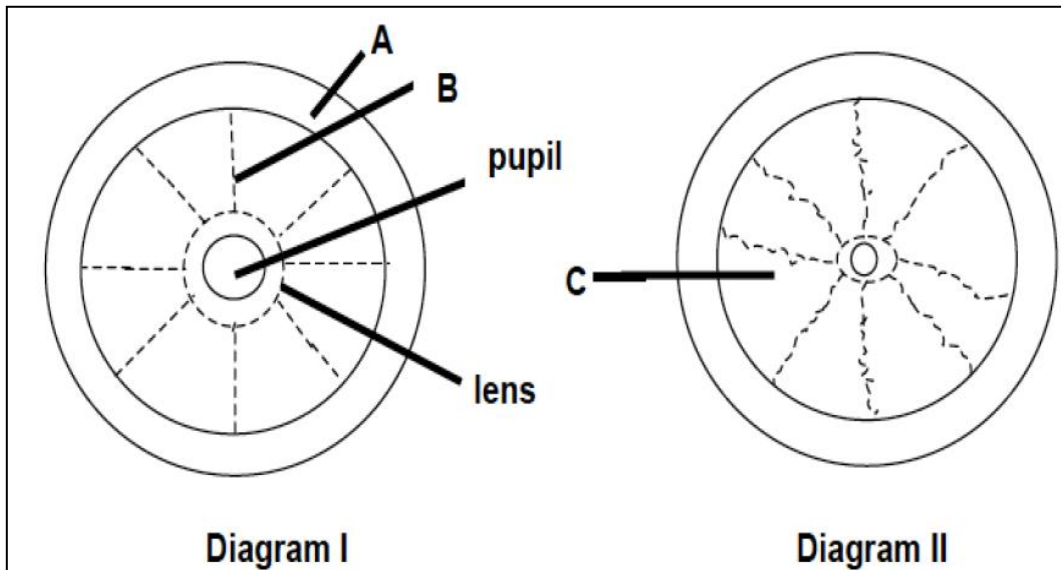
Time intervals in minutes	1	2	3	4	5	6	7	8	9
Diameter of pupil in mm	2	4	5	5	8	7	3	1	6

- 2.4 Provide an appropriate title for this table. (2)
- 2.5 Which structure in the eye controls the size of the pupil? (1)
- 2.6 Plot a line graph of the results in the table above. (8)
- 2.7 Between which two measurements did the following change in the diameter of the pupil occur: largest decrease? (1)
- 2.8 Why did the diameter of the pupil remain the same during the third and the fourth time intervals? (2)



Question 3

Study Diagrams I and II that illustrate the lens and parts of one layer of the human eye, as well as the graph below, and answer the questions that follow.

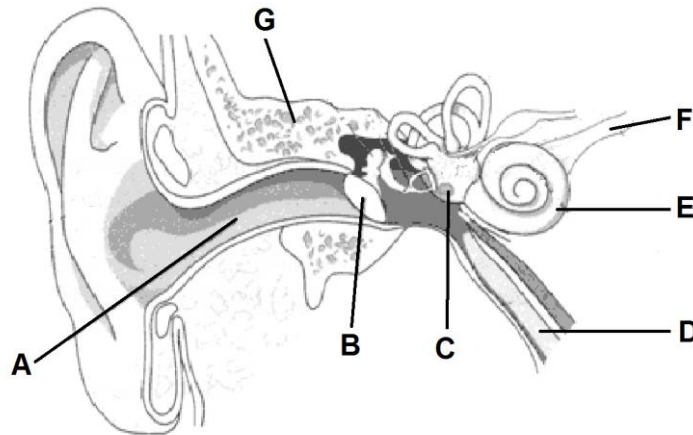


- 3.1 Identify parts A and B. (2)
- 3.2 Which Diagram (I or II) shows part of the eye... (1)
- (i) where the ciliary muscles are contracted (1)
 - (ii) under dim light conditions (1)
- 3.3 Explain your answer in QUESTION.3. 2 (i). (2)
- 3.4 Which letter on the graph indicates each of the following: (1)
- (i) The eye looking at a nearby stationary object (1)
 - (ii) The eye looking at an object moving towards the viewer (3)
- 3.5 Explain the significance of the elastic nature of the lens. (3)



Question 4

The diagram below illustrates the structure of the human ear.

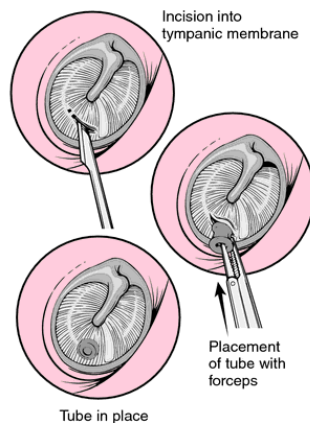


- 4.1 Label structures:
B - _____ C - _____ (2)
- 4.2 Make an X on the diagram to indicate the region where fluid pressure waves cause tiny cilia to bend for the sensation of hearing. (1)
- 4.3 What type of secretion is formed in part A and why? (2)
- 4.4 Explain the function of part F in the process of hearing. (2)
- 4.5 Identify passage D and state its function. (3)
- 4.6 Of what substance is the part labelled G made? (1)

Question 5

A mother is concerned about her 1 year old son. He cries constantly while holding his ear; he is unsteady on his feet, he has a blocked nose; high temperature and small yellow stains on his pillow. The mother thinks he has *otitis media*

- 5.1 What is *otitis media*? (2)
- 5.2 Give FOUR reasons why you would support the mother's diagnosis. (4)
- 5.3 What can the mother do to alleviate his discomfort until he can see a doctor? (1)
- 5.4 Give TWO reasons why it is important to see a medical doctor if the ear infection continues. (2)



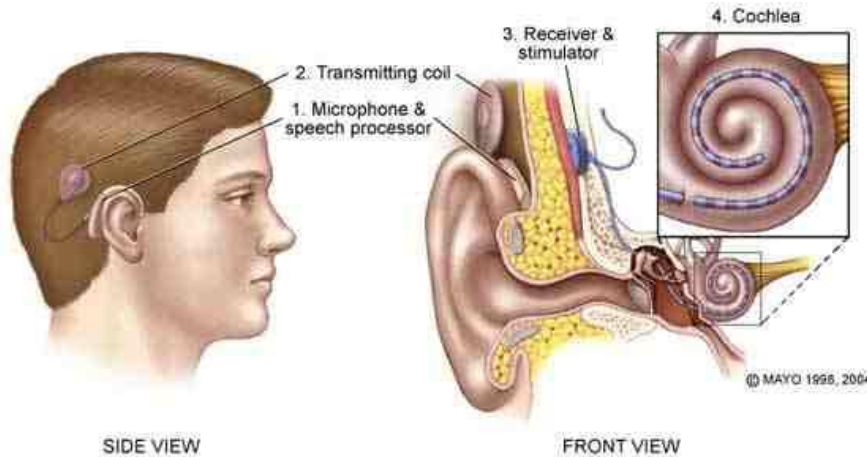
The doctor suggests a procedure called a myringotomy, a surgical procedure that can help treat the infection. The diagram below illustrates the myringotomy



- 5.6 What do you think a myringotomy is?
5.7 What do you think is the purpose of the 'tube'?

Question 6

Study the representation of a cochlear implant below and answer the questions that follow



- 6.1 What is a cochlea implant? (2)
6.2 List the parts comprising the external part of the cochlear implant. (2)
6.3 What is the function of the receiver? (2)

Question 7

Describe how hearing and balance occurs in the human ear. (17)



Additional Question

Question 1

Read the passage below regarding the eye and answer the questions that follow.

'Sometimes the lens of the eye becomes clouded - a disease called a cataract. This causes blurred vision and eventually blindness. The problem usually occurs in old age and is particularly common in developing countries. In India, 5.5 million people are unable to see because they have cataracts. The cure is simple - remove the clouded lens and fit the patient with glasses. However, there are few eye hospitals in India and most patients cannot afford the treatment.

One solution to this problem has been the setting up of Eye Camps, where a tent or local building is turned into a clinic. A temporary operating theatre is set up and patients are examined and treated. Surgeons may operate on up to 200 patients in a day, removing a diseased lens in five minutes. Ten days later the bandages are removed and the patient is fitted with glasses - their sight restored.'

- 1.1 Explain how a cataract causes blurred vision and blindness. (2)
1.2 State two reasons why India still has a large percentage of its population suffering from cataracts. (2)
1.3 Explain why glasses are still needed by the patients after an operation to remove their cataracts. (2)
1.4 While it is possible for light rays to reach the retina following a cataract operation, one of the functions of the lens is not replaced by the removal of the diseased lens and the fitting of glasses. What important function is being referred to here and why is it necessary? (2)



Answers

Test Yourself

1. D
2. A
3. C
4. B
5. A
6. C
7. A
8. B
9. C

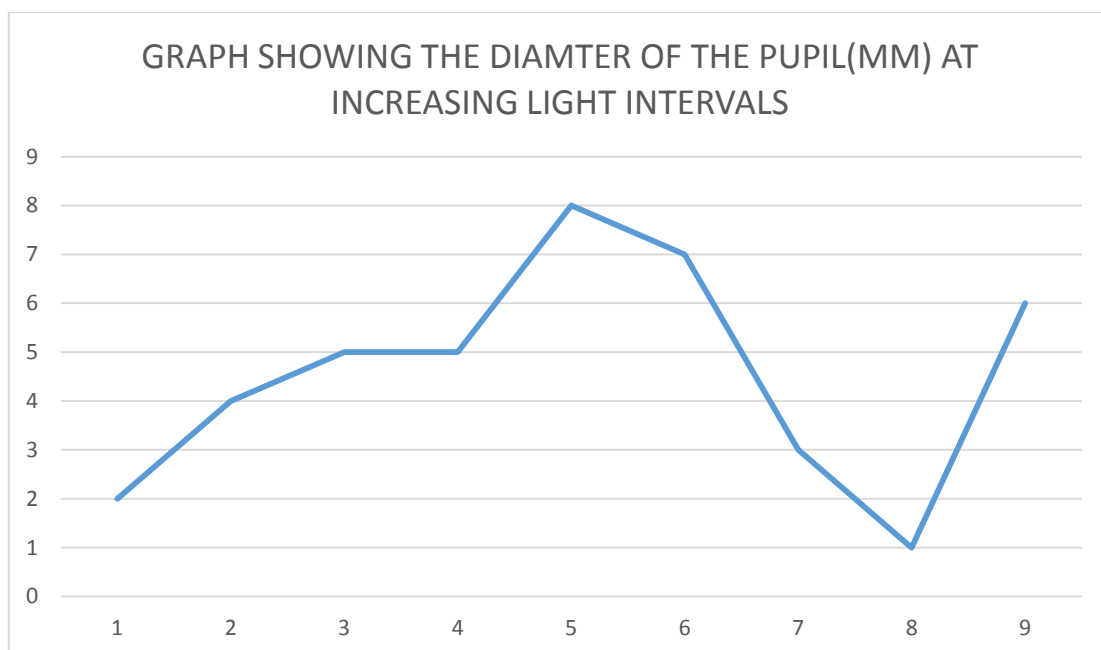
Exam Questions

Question 1

- 1.1 D
- 1.2 D
- 1.3 B
- 1.4 C
- 1.5 B

Question 2

- 2.1 1 = pupil
2 = iris
3 = ciliary body (3)
- 2.2 contracts or relaxes to focus the image using the lens (1)
- 2.3 a) amount of light present (1)
b) distance of object from eye / focus (1)
- 2.4 Table showing the diameter of the pupil after increasing time intervals. (2)
- 2.5 iris (1)
- 2.6 (GRAPH BELOW)





- 2.7 betw 6 and 7 min ✓(no units, no marks) (1)
2.8 Light source was the same✓ distance✓ from the person (2)

Question 3

- 3.1 A: Ciliary body/Ciliary muscle ✓
B: Suspensory ligament ✓
- 3.2 (i) Diagram 2✓
(ii) Diagram 1✓
- 3.3 Suspensory ligament✓ slackens ✓
- 3.4 (i) D ✓
(ii) F✓
- 3.5 Can change its shape ✓
to focus image onto the yellow spot ✓
irrespective of the distance from the eye ✓OR for near or distant vision ✓OR
for accommodation ✓

Question 4

- 4.1 B = eardrum / tympanum / tympanum ✓
C = round window ✓ (2)
- 4.2 X drawn on cochlea ✓ (1)
- 4.3 wax ✓ traps dust and insects ✓ (2)
- 4.4 transmits nerve impulses ✓ to the (auditory) part of the brain ✓ (2)
Eustachian tube ✓
- 4.5 equalise pressure between middle ✓ ear and on other side of ear drum ✓ etc (3)
- 4.6 bone ✓ (1)

Question 5

- 5.1 middle ear infection
- 5.2 pain, fever, unbalanced, puss, blocked nose
- 5.3 pain relief –tablets, drops etc
- 5.4 He might need antibiotics to to help clear up the infection, as the infection could lead to hearing loss
- 5.5 A procedure that involves a small cut ion the tympanic membrane to drain the fluid out of the middle ear is inserted in the hole
- 5.6 Unblocks the Eustachian tube by allowing air in and allows the fluid to seep out to help with the infection

Question 6

- 6.1 It is an electrical device that is surgically implanted under the skin to help people with severe or total deafness
- 6.2 Microphone and speech transmitter and
- 6.3 Picks up sound from the environment and processes it to electrical signals



Question 7

Hearing

- Sound waves are directed into the auditory canal by the pinna
- The sound waves make the tympanic membrane vibrate and the vibrations are passed on to the ossicles in the middle ear
- The ossicles make the oval window vibrate and this causes pressure waves to be set up in the inner ear
- These vibrations also cause the organ of Corti to be stimulated and it generates impulses which are sent to the cerebrum along the auditory nerve
- The cerebrum interprets the impulses as sound

Balance

- Sudden changes in speed and direction causes the endolymph within the semicircular canals to move.
- The movement of the fluid stimulates the cristae in the ampullae – situated at the base of the semi circular canal
- When the direction of the head changes, gravitational pull stimulates maculae – in the sacculus and utriculus.
- Within the cristae and maculae the stimuli are converted to impulses
- These impulses are sent to the brain by the vestibular branch of the auditory nerve.

(any 17)

ASSESSING THE PRESENTATION OF THE ESSAY

Marks	Description	Synthesis
3	Explained all hearing and balance fully without irrelevant information.	(3)
2	Explained hearing and balance competently with little/no irrelevant information.	(20)
1	Explained one of hearing or balance fully with little/no irrelevant information.	
0	Not attempted/nothing written other than question number/no correct information.	

Additional Question

Question 1

- 1.1 too little/no light passes through the lens ✓
Thus less or no light to form an image on the retina ✓ etc (2)
- 1.2 poverty thus cannot afford operation ✓
Too few clinics where they live ✓ (2)
- 1.3 to take over the role of the removed lens by bending the light rays (refraction) ✓
To form an image on the retina ✓ (2)
- 1.4 the ability of the lens too change shape / become more convex or rounded (accommodation)
✓To allow the person to see close up ✓ (2)