REVIEW QUESTIONS IN SELECTED AREAS OF AUDIOLOGY

by

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Reg.No. 4.

An independent project submitted in part fulfillment for the Degree of Master of Science, (Speech and Hearing)

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dedicated to

"my parents"

C E R T I F I C A T E

This is to certify that the Independent project entitled "Review Questions in Selected Areas of Audiology" is a bonafide work done in part fulfillment for the Degree of Master Science (Speech & Hearing) of the student with Register No.

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C E R T I F I C A T E

This is to certify that this independent project has been prepared under my supervision and guidance.

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D E C L A R A T I 0 N

This independent project is the result of my own study undertaken under the guidance of Dr.S.Nikam, Professor and Head of Department of Audiology, All India Institute of Speech and Hearing, and has not been submitted earlier at any other University for any other Diploma or Degree.

Mysore,

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Date:

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CHAPTER - I

INTRODUCTION

In the field of Speech and Hearing, there are training programs in several different parts of the country and also at several different levels. The major aim of a training program is the development of 'critical skill'. Such skills in the field of speech and hearing would include the knowledge of structure and function of the organs of Speech Hearing, clinical procedures for testing, etc.

An important aspect of the training program is the selection of suitable samples for determining the level of competency reached. Level of competency differs with different levels of training. The compromises that can be made when trainees show unequal levels of competencies should be considered. Quantification of professional experience (like equating it to a per centage of marks) is helpful in evaluating the candidates.

In India, preparation of evaluation procedures acquires added significance because of students and

staff coming from multilingual background. Because of variation in the knowledge and usage of English, students might face difficulty in understanding and answering the questions.

Appraisal and evaluation of the effectiveness and on-going assessment of goals and objectives of training program is essential. Even with prescribed syllabus, training programs differ in terms of the emphasis placed on different areas. The questions included in this project is an attempt at attaining the necessary uniformity.

Another objective is to get collective information about different aspects so that this can serve as a guide to those appearing for interviews and conducting interviews.

Tests are designed to measure one's comprehension of the materials basic to the field. This can be considered as a reference for setting questions.

The given set of questions are designed to function as a self-study guide as well as a supplemental

text for courses in Audiology and Hearing Sciences. It covers some aspects of the fundamentals of Audiology. The questions include the subject areas that individuals should be familiar with training in Audiology. Its main purpose is to evaluate individual's background in the field of Audiology.

Other objectives include (1) framing questions of various types covering the selected aspects, and (2) reducing subjectivity and ambiguity.

It can be utilized in the following ways:

a) Can be used in short term and refresher courses.
b) Can be administered periodically to evaluate the students.
c) Can be used to evaluate trainees before and after the training program.
d) Can be used to monitor students' knowledge in understanding of subject.
e) Can be used to discriminate students' abilities in respective areas.

f) Answers to the given questions can be analysed using "item analysis". Hence can be arranged in gradation.

Types of Questions:

Both qualitative and quantitative questions are included. Qualitative questions have descriptive responses; quantitative ones have simple calculations, selection among answers etc.

The different types included are:

1. Multiple choice.
2. Matching.
3. Fill in the blanks.
4. Single word answers.
5. Short-answers.
6. Problem solving.
7. Labelling the figures etc.

Topics covered: include 3 main parts. Part one has questions and answers about Anatomy and Physiology of

the ear.

Part two deals with Psychophysics of Auditions.

Part three is about questions regarding Instrumentation, Calibration and Measurement aspects.

CHAPTER - II

ANATOMY AND PHYSIOLOGY OF THE AUDITORY SYSTEM

Ear down the years

What does the history of the ear tell? Few important names and dates.

1. Bartolomews Eustachiens described the eustachian tube in _____

2. Transformer action of outer ear was first described by _____ in 1946.

3. Transformer action of middle ear was described by _____ in 1851.

4. Transformer action of inner ear was described by Bekesy in _____ .

Answers

1. 1563.
2. Wiener and Ross.
3. Weber.
4. 1953.

Match Making Bureau

This bureau consists of 2 sets of items. The task is to match the right ones. Many of the items consist of parts of the ear which indicate positions in their names.

I.	1. Lateral semicircular canal	a. Anterior
	2. Posterior semicircular canal	b. Horizontal
	3. Anterior vertical canal	c. Posterior

II.	a. Organ of Corti	i. Acoustic medullar center.
	b. Cochlear nucleus	ii. Acoustic papilla.
		iii. Organ of spirale.

III.	a.Medical	i. Malleolar ligament
	b. Lateral	ii. Ceniculate body
		iii. Lemniscus

IV.	a. Superior	1. Colliculus
	b. Inferior	2. Olivery complex.
		3. Malleolar ligament.

V.	1. Horizontal	a.division of facial nerve.
	2. Vertical	b. semicircular canal.

VI.	1. Superior wall	i. Membranous wall
	2. Lateral wall	ii. Labyrinthine wall
	3. Medial wall	iii. Carotid wall
	4. Posterior wall	iv. Tegmental wall
	5. Anterior wall'''	v. Mastoid wall

VII.	1. Outer spiral fibres	i. Afferent fibres innervating inner Hair cells
	2. Inner radical fibres	ii. Efferent fibres innervating inner hair cells
	3. Tunnel or outer radial fibres.	iii. Afferent fibres innervating outer hair cells
	4. Inner spiral fibres	iv. Efferent fibres innervating outer hair cells.

VIII.	1. Superior malleolar ligament.	i. Connects malleus with tympanic membrane.
	2. Lateral malleolar ligment.	ii. Anterior process to anterior wall of middle ear.
	3. Ligament supporting' incus.	iii. From short process to fossa incudis.
	4. Annular ligament	iv. From oval footplate to Fenesta vestibuli.
	5. Anterior malleolar ligament.	v. Connects malleus'to tegmen tympani.

Answers

I. 1. - (b)

2 . - (c)

3. - (a)

II. a. - (ii) and (iii)

b. - (i)

III. a. - (ii)

b. - (i) and (iii)

IV. a. - (2) and (3)

b. - (1)

V 1. - (a) and (b)

2. - (a) and (b)

VI. 1 - iv)

2 - i)

3 - ii)

4 - v)

5 - iii)

VII 1. iii)

2. - i)

3. - iv)

4. - ii)

VIII. 1. - v)

2. - i)

3. - iii)

4. - iv)

5. - ii)

Number Game

Many questions in this need filling in of appropriate numbers. Few require keeping the number constant and selecting the appropriate items. The section also includes measures like length, weight, time etc.

1. Name those which occur in pairs in the auditory system.
2. Name those which occur in 'threes'.
3. The 3+2 combination in the middle ear is formed by _____and_____.
4. The number of outer hair cells is _____ and number of inner hair cells is _____.
5. The number of neurons originally is_____. By the time they reach the cortex they sum up to_____.
6. Outer hair cell contains _____ hairs; inner hair cellcontains_____hairs.
7. Only_____efferent fibres enter_____ cochlea.
8. _____% of efferent fibres originate from_____ superior olivery complex and form crossed olivocochlear bundle.

9. About_____% of afferent fibres connect with '___ _____ while remaining innervate_____.

Ratios

1. Efficiency of Bone conduction to air conduction is in the ratio of_____.

2. Audible sound pressure range between threshold of hearing and feeling corresponds to a ratio of

3. The ratio of intensities which represent the extremes of intensity range is_____.

Angles

1. The pinna is inclined to the head at an angle of_____.

2. The angle of inclination of tympanic membrane is_____ (with its upper wall).

3. The inclination of Eustachian tube at birth is _____ and in adult it is_____.

Resonating Hertz

1. Resonating frequency of Concha is_____.

2. Resonating frequency of earcanal is _____.

3. Earcanal-eardrum resonant frequency is_____.

Millimeters and Centimeters

1. The length of pinna is_____mms.

2. Length of the external auditory meatus is_____cms.

3. Length of the eustachian tube is _____ mms.

4. Length of the tensor tympani is_____mms.

5. Length of the Stapedius muscle is_____mms.

6. Length of the Cochlear channels is_____ mm.

7. Length of the basilar membrane is_____ mm.

8. Thickness of the tympanic membrane is _____ mm.

9. Diameter of the concha is_____cm.

10. Diameter of the earcanal is_____cm.

11. Diameter of the tympanic membrane is_____mm.

Milligrams and Grams

1. Weight of the tympanic membrane is_____mg.

2. Weight of malleus is_____mg.

3. Weight of incus is_____mg.

4. Weight of Stapes is_____mg.

Squares and cubes

I.

1. Cross-sectional area of external auditory meatus is_____Cm^2 .

2. Area of tympanic membrane is _____ Cm^2

3. Effective area of tympanic membrane is_____mm^2 .

4. Area of the footplate is mm^2

5. Area of the round window is _____ mm^2

6. Area of helicotrema is mm^2

i. Volume of Concha is Cm^3

ii. Volume of ear canal is _____ Cm^3

iii. Volume of middle ear cavity is Cm^3

iv. Volume of ossicles is Cm^3

v. Volume of cochlea is_____mm^3

Milliseconds and Seconds

a. Latency of conttraction of muscles to sudden onset of a tone is_____msec.

b. Maximal tension in muscles is attained in_____msec.

c. Refractory phase of auditory fibre is_____sec.

d. Maximum discharge rate of neurons is_____times/sec.

e. Conduction velocity of neuron is_____m/sec.

f. Absolute refractory period is equal to_____msec.

g. Relative refractory period is equal to_____msec.

Answers

1. 2 meati, 2 muscles, 2 windows, 2 media (through which sound travels in the ear), 2 fluids in inner ear, 2 labyrinths, 2 sensory systems, 2 types of hair cells, 2 divisions of the auditory nerve, 2 types of innervation of hair cells, 2 refractory periods, 2 layers of cells in Reissner's membrane.

2. 3 layers in tympanic membrane, 3 semicircular, cochlear partition, ossicles, 3 cranial nerves (5th, 7th, 8th), rows of outer hair cells, 3 membranes in inner ear, 3 types of cells in Stria Vasculaiis, 3 modes of sound energy transformation in ear.

3. Ossicles, muscles.

4. 12000. 3500.

5. 30000, 9,000,000.

6. 80-100, 50.

. 7.500.-----

8.75% contralateral.

9. 90-95%, inner hair cells, outer hair cells.

Ratios

1. 1 : 100

2. 1 : 100,0000

3. 1 to 10^{14} or 10^{18}

Angles

1. 15

2. 140

3. 0

Resonating Hertz

1. 4.5 or 5 KHz

2. 2.5 to 2.6 KHz

3. 2 KHz

Millimeters and Centimeters

1. 60 - 75 (67) mms.

2. 2 - 3 cms.

3. 35 - 38 mms.

4. 25 mms.

5. 6 mms.

6. 35 mms.

7. 34 mms.

8. 0.1 mm.

9. 1-2 cms.

10. 0.7 cm.

11. 7.9 to 7.9 mm.

Milligrams and grams

1. 14 mg.

2. 23-27 mg.

3. 25-32 mg.

4. 2.05 - 4.34 (2.86) mg.

Squares and Cubes

I. 1. 0.3 to 0.5 Cm^2

2. 0.5 to 0.9 Cm^2

3. 42.9 to 55 mm^2

4. 3.2 mm^2

5. 2 mm^2

6. 0.08 to 0.04 mm^2

II. i) 2.5 Cm^3

ii) 1.0 Cm^3

iii) 2.0 Cm^3

iv) 0.50 to 0.8 Cm^3

v) 98.1 mm^3

Milliseconds and Seconds

a) 14 to 16 msec.

b) 100 to 150 msec.

c) 1/1000 sec.

d) 100 times/sec.

e) 120 m/sec.

f) 0.5 msec.

g) 0.5 to 20.0 msec.

Increase / Decrease: More / Less

1. Frequency of tone increases: firing rate of auditory nerve fibre_____.

2. As basilar membrane proceeds from base to apex, its width_____.

3. When eardrum and middle ear are stiffened, there is a _____ amount of energy reflected off the eardrum.

4. In transformer action, the tympanic membrane and ossicles_____the force, but_____the amplitude of vibration.

5. Contraction of intra-aural muscles_____ transmission of lew tones, and slightly_____for certain tones in middle range.

6. The scala tympani cantains the round window at its end. (basal, apical).

7. Basilar membrane is stiffer at the_____end of the cochlea (basal, apical).

8. Osseous spiral lamina is located on_____of the spiral (inside, outside).

9. Transmission across a synapse occurs in _____ direction.

10. Contraction of middle ear muscles is a _____ action.

Answers

1. increases.
2. increases.
3. greater.
4. increase, decrease.
5. reduce, increase.
6. basal.
7. basal.
8. inside.
9. single.
10. reflex.

Shapes and sizes

Let us know how few letters stand for shapes of some parts of the ear. The section includes some common names associated with parts of the ear.

1. What do U, V, W and S stand for with reference to ear?

2. Name the parts of the ear associated with the following ones:

i) Tube iv) Hammer vii) Anvil x) Round
ii) Snail v) Spindle viii) Triangle xi) Oval
iii) Funnel vi) Stirrup ix) Circle.

Alterations

You may have to cut, replace or expand the words to find out answers to these questions.

1. Remove one and find one new in a different location 'Hair cells'.

2. From the word 'Hear', remove one letter and you get _____. Now remove one more letter and expand the remaining. You will reach higher point in the auditory system.

3. In the word 'vestibuli', replace one letter and get the name of a division of the inner ear.

Answers

Shapes and Sizes

1. U - internal genu of facial nerve in the ear.
   V - inverted V stands for the tunnel of corti.
   W - pattern of cilia of hair cells viewed from above in organ of corti.
   S - shape of external ear canal.

2. i) auditory canal or auditory tube.
   ii) Cochlea.
   iii) pinna.
   iv) malleus
   v) tensor tympani
   vi) stapes
   vii) Incus
   viii) Shape of Scala media
   ix) Circular fibres in tympanic membrane.
   x) Window.
   xi) Window.

Alterations

1. Air cells.
2. Ear - AR - Auditory Radiations.
3. Vestibule.

Questions with something in "common"

Here the game is to play with surnames of parts of the ear, expansions of initials and finding out the counter parts.

1. All of us have the same first name. Find out our surnames.

a) Pars_____ c) pars _____

b) Pars_____ d) Pars _____

e) Pars_____ f) Pars_____ g) Pars _____

2. All of us have the same surname. Find out our first name.

a)_____tympani d)_____tympani

b)_____tympani e)_____tympani

c)_____tympani

3. We have same initials but if you expand them, you get different names.

i) T.M v) A.R

ii) R.M. vi) S.L

iii) S.V vii) S.C

iv) S.G.

4. Find out the counterparts of the words given below.

a) Scala b) Tympanic c) Tegmen d) Reticular e) Sulcus.

5. My first name is 'Superior'. Tell my full name.

a) Superior_____ c) Superior _____

b) Superior_____ d) Superior _____

6. My first name is "Spiral". Find out the other half of my name.

Spiral i)_____

ii) _____

iii)_____

iv) _____

V)_____

vi)_____

7. a) 'Crus' is my first name; I am found in inner ear.

b) 'Crus' is my middle name; I am found in outer ear.

c) 'Crus' is my last name; I am found in middle ear.

What are my names?

8. Find out the common associates of the following:

a) Corti
b) Duct
c) Window
d) Endolymphatic
e) Vestibular
f) Crista ampularis
g) Macula
h) Synaptic
i) ductus
j) Auditory

Answers

1. a) flaccida
   b) recta
   c) tensa
   d) pectinata
   e) externa
   f) interna
   g) media

2. a) Tensor
   b) Scala
   c) Tegmen
   d) Sinus
   e) Chorda

3. i) Tympanic membrane
   Tectorial membrane
   ii) Reticular membrane
   Reissner's membrane
   iii) Scala vestibuli
   Stria Vascularis
   iv) Sebacious glands
   Spiral ganglion
   v) Acoustic reflex
   Auditory radiations

vi) Spiral limbus
Spiral ligament
Spiral lamina

vii) Supporting cells
Sensory cells
Semicircular canal
Sulcus cell

4. a) Vestibuli and Tympani
b) autrum, membrane, aditus, cavity and sulcus.
c) Tympani and antrae
d) Lamina and membrane
e) Inner and outer

5. a) quardrant
b) olivary complex
c) semicircular canal
d) malleolar fold

6. i) limbus, ii) ganglion, iii) ligament
iv) lamina, v) fibres, vi) prominance.

7. a) Crus commune
b) Anterior crus of helix
c) Stapes crus

8. a) Pillars of corti. Organ of corti and Tunnel of corti.

   b) Cochlear duct, Endolymphatic and Perilymphatic duct.

   c) Oval and round window.

   d) Duct and Sac.

   e) Nerve, membrane, crust and apparatus.

   f) of lateral, posterior and anterior semicircular canals.

   g) of utricle and saccule

   h) Cycle, cleft, bar and body

   i) Reuniens, utriculosaccularis and endolymphaticus

   j) pathway, canal, tube, placode, vesicle, ossicle and nerve.

Alphabets of the Auditory System

Let us see how many things you can find out from these letters about the ear. Questions include finding the starters of words, missing middle and ending letters of words.

1. The following have their beginning and ending letters same. Fill in the "missing middle". The number of letters to fill in is given in brackets.

i) M_____m (7)
ii) T_____t (3)
iii) s_____s (4)
iv) Si_____s (7)
v) L_____(9)
vi) S_____s (14)
vii) S_____s (15)
viii) S_____s (13)
ix) B___b (2)
x) E_____e (12)
xi) J___i (4)
xii) S_____s (13)
xiii) S_____s (21)

2. The following 2 words end with 'se' and they are in connection with the nerve. What are they?

3. Complete these words whose starting letter is '0'.

4. Write the following words which have 'a' as their ending letter.

5. The following words end with '1'.

6. This set of words end with 's'.

7. Write the words rhyming with the following and ending with same letter.

a) Utricle c) Ampulla e) Helix

b) Auricle d) Tragirs f) Cochlea

Answers

1. i) Manubrium
   ii) Tract
   iii) Stapes
   iv) stapedius
   v) Lateral wall
   vi) Sulcus Terminalis
   vii) Sulcus Auricularis
   viii) Stria vascularis
   ix) Bulb
   x) Eustachian tube
   xi) Incudi
   xii) Sebaceous glands
   xiii) Sacculus enddymphaticus

2. Synapse and Impulse.

3. Ossicle, Olivery complex. Osseous lamina, Oval window, Otolyth, Organ of Corti, Outer hair cell.

4. Concha, Co-chlea, Cilia, Pinna, Ampulla, Cupula, Helicotrema, Lamina, Fenestra rotunda.

5. Wall, lateral, Spiral, Radial, Ventral, Tubal, Oval, Internal, Dorsal, Axial, Neural, Canal, Medial, Tectorial, External, Mechanical, electrical, acoustical, chemical, signal, stapedial, epithelial, temporal.

6. Tragus, Incus, Stapedius, Stapes, meatus, lemniscus, malleus, colliculus, sebacious, aditus, ceruminous, tractus, annulus, limbus, petrous, modiolus, canaliculus, anterior crus, fenestra ovalis, stria vascularis, superior crus, nervus intermedius, Incisura Terminalis, Ductus cochlearis, nervus stapedius, cochlearifermis, Fossa triangularis, ductus-endolymphaticus.

7. a) Saccule.
   b) Lobule.
   c) Cupula.
   d) antitragus
   e) Anthelix
   f) Cilia.

True or False

1. Basal turn of the Cochlea corresponds to low frequency waves; Apical turn responds to high frequency waves.

2. Without elastic round window, liquid transmission won't occur.

3. With tympanic membrane perforation, protection to the round window is minimum.

4. The two middle ear muscles are antagonistic.

5. Bone conduction thresholds are completely valid measure of the function of cochlear reserve.

6. Endolymph has high protein content.

7. Perilymph has low sodium content.

8. Perilymph has high negative electric potential.

9. Endolymph has high potasium content.

Answers

1. False
2. True
3. True
4. True
5. False
6. False
7. False
8. False
9. True

Name the following

1. Tiny passage through which subtle physiological events (transmission and conversion of energy) take place in the inner ear.

2. A part of the auditory system is lost in ponds. Fish it out.

3. What holds the ossicular chain rigidly?

4. Which part of the ear is blamed for being prominent and serving little in hearing?

5. Footplate of stapes seals the 'threshold' to inner ear. What is this threshold?

6. There is an earplug in the prenatally developing auditory system. What is that?

7. Name the supporting cells of hair cells in the inner ear.

8. Which ossicles move as a unit?

9. What holds the tympanic membrane?

10. A pin is lost in the ear. Where should we look for if?

ll. Name the nerves in the external ear.

12. Name the nerves in the middle ear.

13. Name the non-auditory structures in the middle ear.

Answers

1. Scala media
2. Pons.
3. The 2 muscles.
4. Pinna.
5. Oval window
6. Meatal plug.
7. Inner border cells, inner phalangeal cells, inner and outer pillars, Hensen's cells, Claudius cells, inner sulcus cells, outer sulcus cells, Boetteher cells.
8. Malleus and incus
9. Handle of malleus
10. Pinna
11. Facial nervel (Temporal and posterior-auricular branches) and vagus nerve.
12. Facial nerve and trigeminal nerve.
13. Fallopian canal and chorda tympani.

Cochlea to Cortex

1. The fibrous lattice work through which cilia of the hair cells protrude is called_____.

2. The neural impulse consists of minute changes in _____

3. The region of functional contract between neural structures is called a_____.

4._____is transmitted across the synapse.

5. First order neurous extend from the_____to the_____.

6. The structure in which ascending auditory neurous of auditory system have their first neuron to neuron synapee is the

7. Pathway by which neurous cross from one side to the other at the level of superior olivary complex is called _____

8. Pathway by which neurous go from the superior olivary complex to inferior colliculus is_____.

9. Two subcortical neural centres providing the opportunity for visual and auditory information to be integrated are _____and_____.

10. At what subcortical levels within the auditory system, do neural pathways cross the midline?

11. The last place before neurons reach the Cortex, at which they all synapse is_____.

12. Cochlea receives an afferent supply, efferent supply and also_____.

13. Tonotopic organization starts from_____.

14. The cell bodies of neurons innervating cochlea make up_____.

15. From the spiral ganglion the nerve fibre are myelinated and here the electrical activity is a typical _____

16. The fibres innervating outer hair cells in afferent system are_____.

17. The fibres innervating inner hair cells in afferent pathway are known as_____.

18. The afferent innervation to inner hair cells is _____; while that to outer hair cells is_____.

19. In efferent system, the fibres innervating outer hair cells form the_____or_____fibres.

20. In efferent connection, the fibres innervating the inner hair cells form_____.

21. The efferent innervation to inner hair cells is _____and that of outer hair cells is_____.

22. Fibres of eighth nerve exhibit_____and_____ refractory periods. They exhibit_____response.

23. Inner hair cells are sensitive to _____ and help in_____of frequency.

24. Outer hair cell system are important in_____.

25. Outer hair cells are highly sensitive and determine the_____; The inner hair cells operate at _____levels.

26. Removal of entire cortex produces loss of_____dB.

27. Destruction of one cochlea results in hearing loss of_____dB.

28. Destruction of both cochlea results in_____.

29. In an animal with one Cerebral hemisphere already removed. The destruction of one cochlea causes additional loss of_____dB (whether the same side or other cochlea is removed doesn't matter).

30. Removal of Cerebral Cortex of a single hemisphere is followed by a small loss of acuity. It is_____dB at 1KHz. (Loss is same whether right or left hemisphere is removed).

Answers

1. reticular lamina
2. electrical voltage
3. synapse
4. Neural impulse
5. Cochlea, medulla
6. Cochlear nucleus.
7. Trapezoid body
8. lateral lemniscus
9. Cerebellum, Colliculus.
10. Medulla (Trapezoid body) and inferior colliculus.
11. Medial geniculate.
12. sympathetic innervation.
13. Basilar membrane.
14. Spiral ganglion.
15. neural spike.
16. Outer spiral fibres.
17. inner radial fibres
18. many to one, one to many
19. outer radial or tunnel radial fibres
20. inner spiral fibres
21. one to many, one to many.
22. absolute, relative
    all or none

23. place of excitation, fine discrimination.
24. Spotial summation.
25. threshold; syprathreshold.
26. 70-75 dB.
27. 3 dB.
28. total deafness.
29. 10 dB.
30. 2-5 dB.

Answer the following questions

1. 'Pinna is missing'. Does it play a significant role in hearing or not?

2. What is threshold of hearing?

3. Hearing by bone conduction is distorted. Why?

4. What are 'Tonal lacunae' and 'Tonal islands'?

5. What are the 2 functions of tympano-ossicular system?

6. What helps to keep the tympanic membrane tight and flexible?

7. What is the region inside the spiral of co-chlea called?

8. Failure of the external auditory meatus to canalize might result in what?

9. What feature allows the easy spread of infection from one sensory system to other in the ear?

10. Basilar membrane holds the hair cells. What structures support this?

11. The ear canal contains fluid. Whether hearing is affected or not?

12. What does a spark do in the eardrum?

13. What happens if oval window is closed?

14. What happens if both windows are closed?

15. What is the consequence if both windows are free but attacked by vibrations identical in pressure and phase?

16. How does protective mechanism to inner ear function?

17. What causes nonlinearity in mechanical performance of auditory mechanism?

18. What is the peculiarity of Reissner's membrane?

19. What are neurotransmitters?

Answers

1. It does not affect hearing.
2. It is the sound pressure on the tympanic membrane which makes the sound just audible.
3. The vibrations must be intense to set the bones of the skull into movement for hearing through bone conduction.
4. Tonal lacunae are isolated regions of frequencies to which the ear is not sensitive.
5. Tonal islands are the sensitive regions between tonal lacunae.

5. i) Transmission of vibrations.
   ii) Protection of round window.
6. Tensor tympani muscle.
7. Modiolus.
8. A significant conductive hearing loss.
9. The communication of fluids.
10. Spiral lamina and ligament.
11. Hearing is affected.
12. It hits, the drum with a devastating effect and usually the entire drum is destroyed. ,.

13. The inner ear fluids will be wrongly mobilized.

14. Perception of sound doesn't take place.

15. There will be no movement of the labyrinthine fluids.

16. At high intensities, the mode of vibration of stapes alters, so that instead of pivoting at its posterior pole, it rocks about long axis of the foot plate. This reduces the resulting movement of fluid in inner ear and hence protects it.

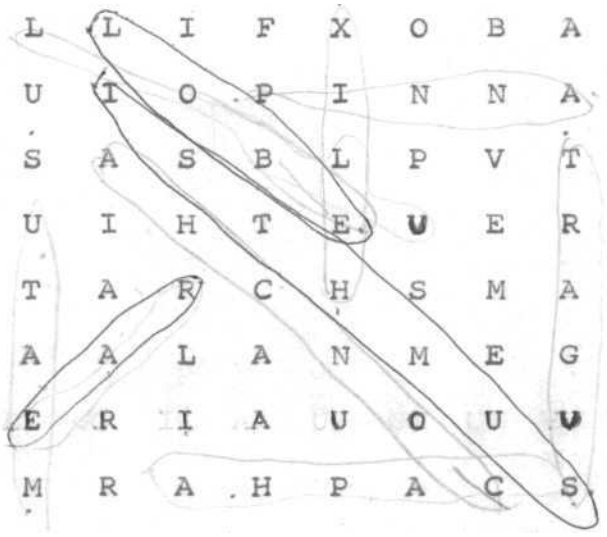
17. (i) The loose coupling of malleoincudal joint.
(ii) various elastic structures like the tympanic membrane, ligaments of ossicles, basilar membrane etc.

18. In the trauma by noise induced hearing loss, this membrane has the capacity of self-repair.

19. Neurotransmitters are chemical substances which alter membrane permeability in a way that governs the transmission of impulses from one neuron to next.

Ear in puzzle

Outer Ear

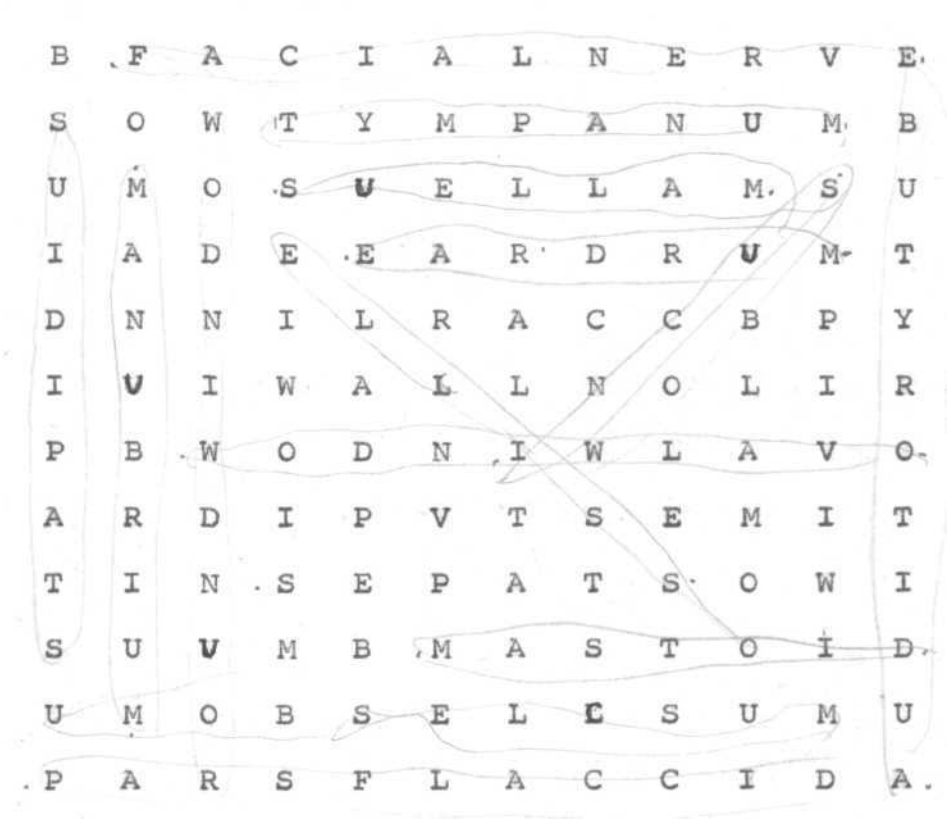


You can go in vertical, horizontal, upward, downward, forward and backward and diagonal directions. Try and find out 9 names belonging to outer ear.

Answers

Pinna	Helix
Tragus	Isthmus
Meatus	Scapha
Concha	Ear
Lobe	

52
Middle ear

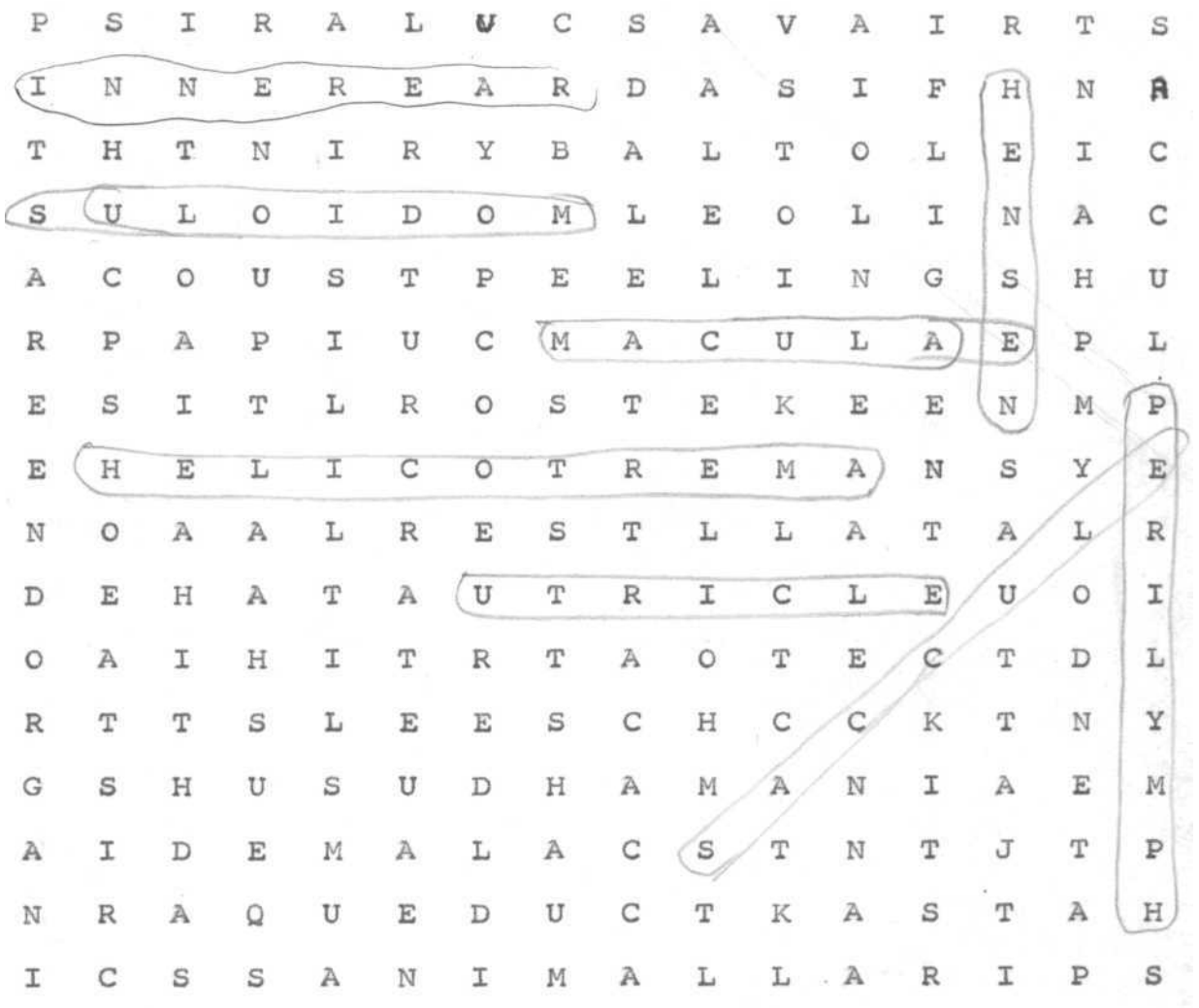


Same directions. But you need to get 16 parts, in connection with middle ear.

Answer

Facial Nerve
Malleus
Eardrum
Stapes
Oval window
Auditory tube
Manumbrium
Tympapnum
Muscles
Incus
Stapedius
Round window
Umbo
Pars flaccida
Mastoid
Ossicles

Inner Ear



Inner ear sounds more complicated. 22 parts belonging to it have to be found out in this puzzle.

Answer:

Co-chlea	Stria vascularis
Helicotrema	Endorgan
Modiolus	Philymph
Utricle	Endoly mph
Maculae	Cristae
Labyrinth	Ampulla
Aqueduet	Ductus reunieng
Hair cell	Spiral lamina
Vestibule	Pillars
Scala media	Hensen
Saucele	Inner ear

Problems

1. Express power law in terms of a formula.

2. Formula for power level is

PWL=

3. There is an amplifier. Find the dB gain of it, if output is 50 volts and input is 2 volts.

4. There are 2 generators in a room. Each generates 80dB IL. If the two are simultaneously on, what will be the overall intensity level in room?

5. Area of tympanic membrane is 55 mm^2. Area of footplate is 3.2 mm^2 . What is the ratio of pressure increase from tympanic membrane to footplate?

6. Given: the lever action ratio as 1.31:1 and Areal ratio = 14:1. Calculate the increase in dB at the footplate.

77. The length of external auditory meatus is 3 cm. What is the consequence if it were more longer?

8. Impedance formula is

$F = Ma + Kx + Rv$

i) Here mass is contributed by_____.

ii) Stiffness is contributed by_____.

iii) Resistance is that of_____.

Answers

1. N in sones = $2^{\frac{L-40}{9}}$

Where L = loudness level in phone.

2. PNL = $10 \log \frac{WI}{Wo}$

$Wo = 10^{-12}$ waits

3. $dB.gain = 20.\log 10 \frac{50(Volts)}{2(Volts)}$

$= 20 \log_{10} 25 = 28dB.$

4. $N_{dB} = 10 \log_{10} \frac{PI}{Po}$

$80 = 10 \log_{10} \frac{PI}{10^{-16}}$

$10^8 = \frac{PI}{10^{-16}}$ $\therefore$ $PI = 10^{-16} \times 10^8 = 10^{-8}$ walts/Cm^2

There are 2 generators:

Therefore, overall intensity (P-) = 2×10^{-8}

$dB\ IL = \log_{10} \frac{2x10^{-8}}{10^{-16}}$ $\log_{10} 2 \times 10^8$

= 83 dB IL.

5. $\frac{\text{Area of Footplate}}{\text{Area of tympanic membrane}} = \frac{3.2 \text{ mm}^2}{55 \text{ mm}^2}$

$= 17.1$

The ratio of pressure increase from tympanic membrane to footplate = 17:1

6. Lever action ratio is 1.31:1

Areal ratio is 14:1

Increase in dB is given by considering the 2 ratios together and calculating the dB value.

2 ratios but together = 1.31 x 14 = 18.3

$dB = 20 \log_{10} 18.3$

= 25 dB.

7. The resonant frequency of the external auditory meatus, reduces.

8. i) Ossicular chain.

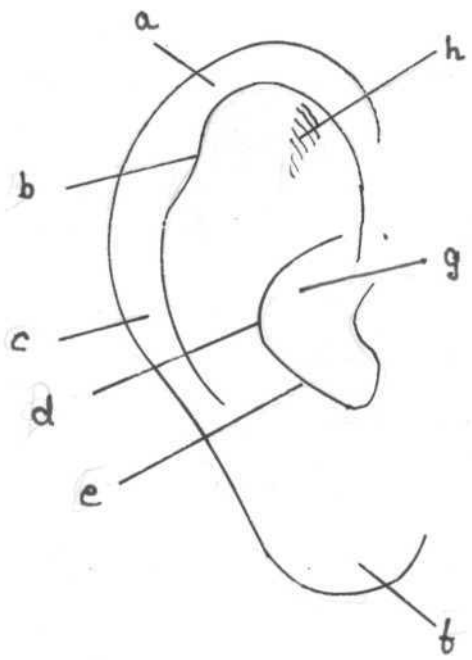
ii) Stapes footplate

iii) Air in middle ear.

Figures of importance

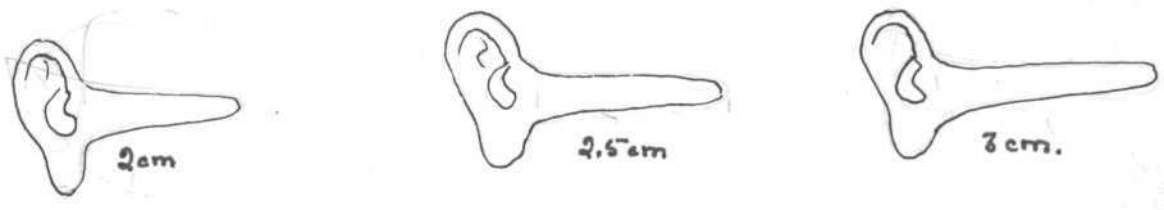
I. External_Ear and Eustachian Tube

1. Label the following

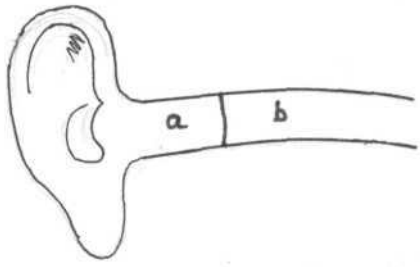


2. Pick the odd one out

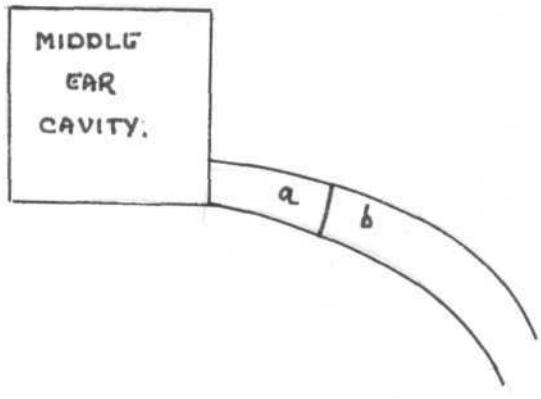
(a) (b) (c)



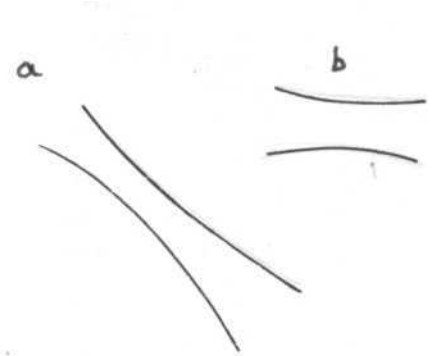
3. Locate the sebacious glands in the figure.



4. Label the bony and cartilagenous parts in the eustac&ian tube

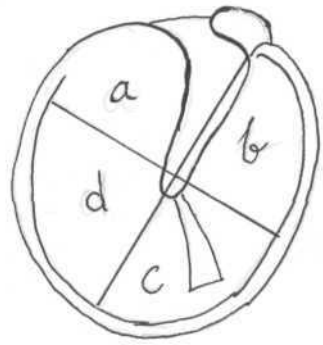


5. Find out which eustachian tube belongs to that of children and which belongs to adults.

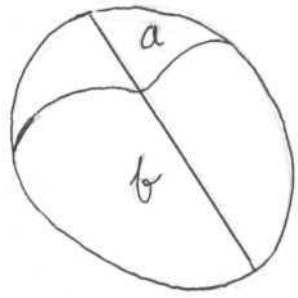


II. Tympanic Membrane:

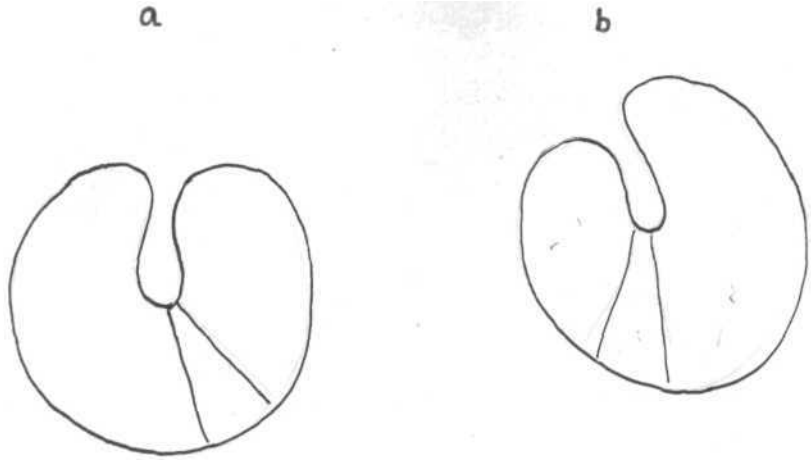
1. Label the quadrants of the tympanic membrane



2. Locate 'pars tensa' and 'parsfloccida' in this.

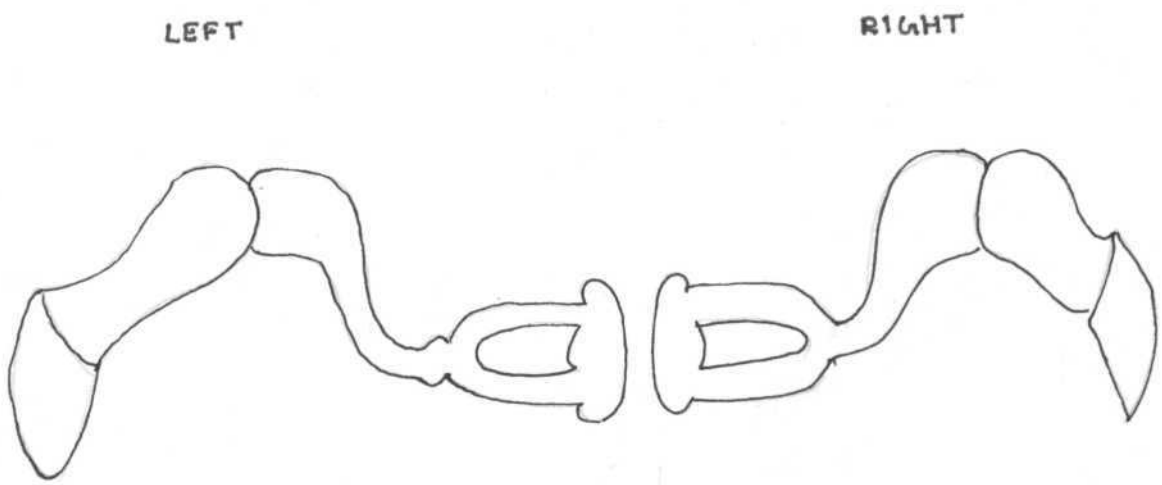


3. Which of the following belongs to right and which belongs to left ear?

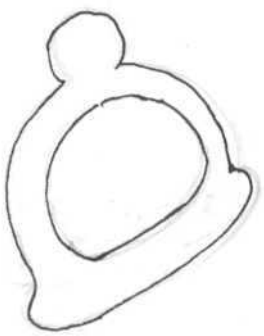


III. Middle ear

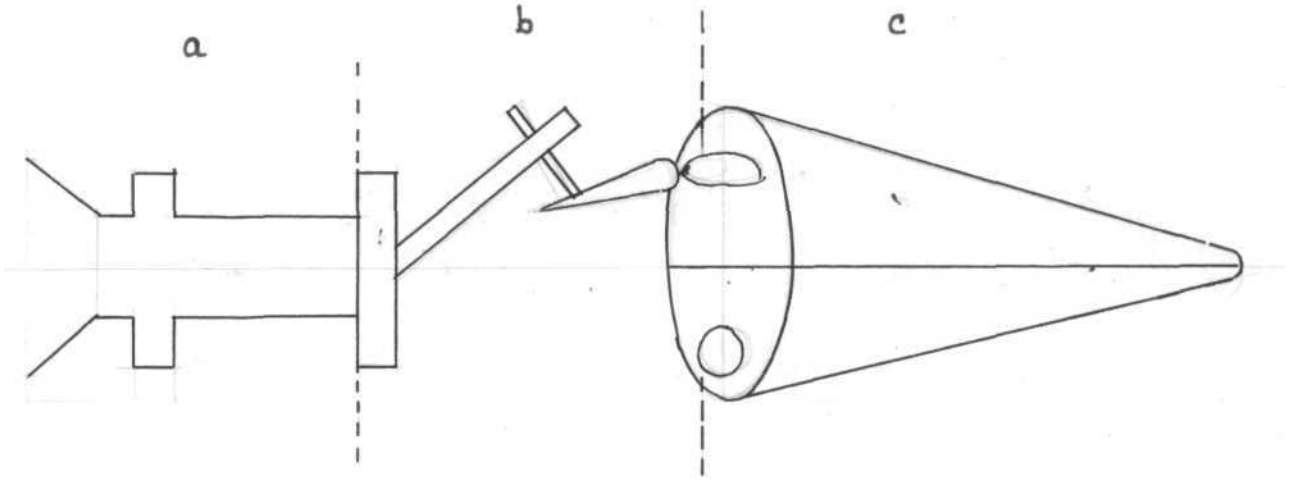
1. What's wrong here?



2. What is absurd in the scapes?

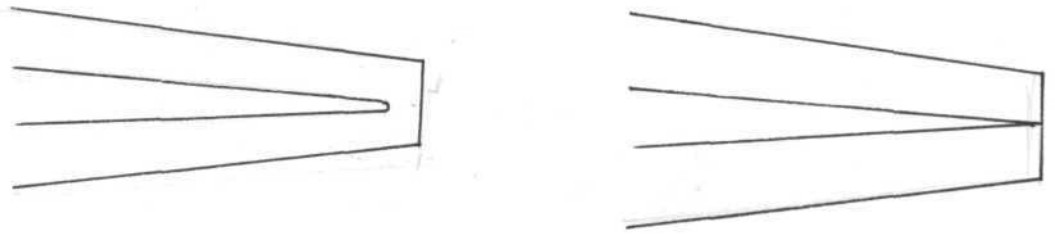


3. What is represented in the following figure? Name the different divisions.

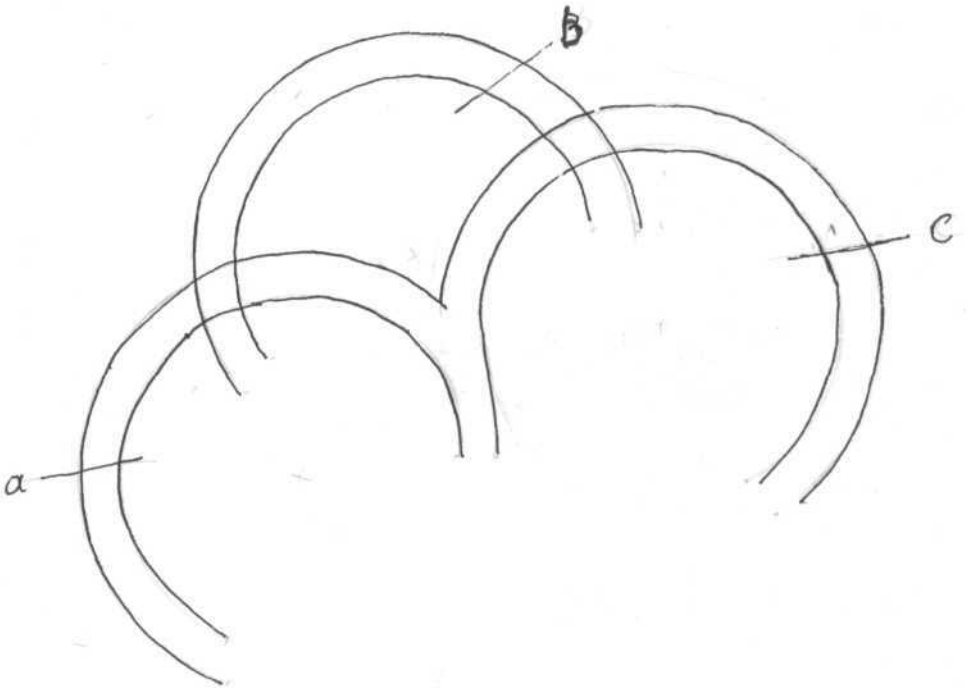


IV. Inner Ear

1. Which is the correct one?

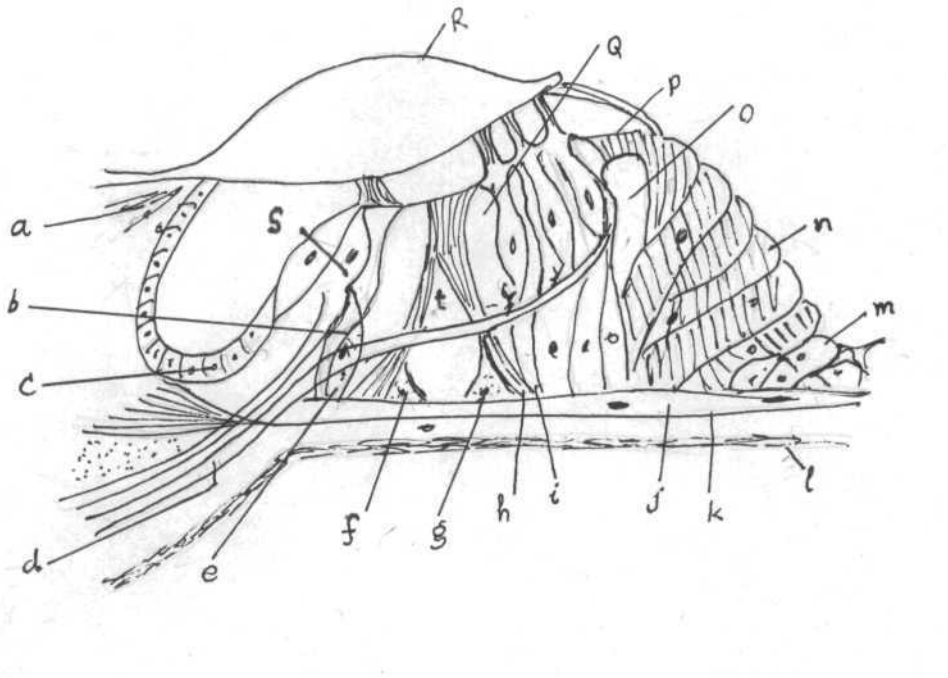


2. Name the semicircular canals.



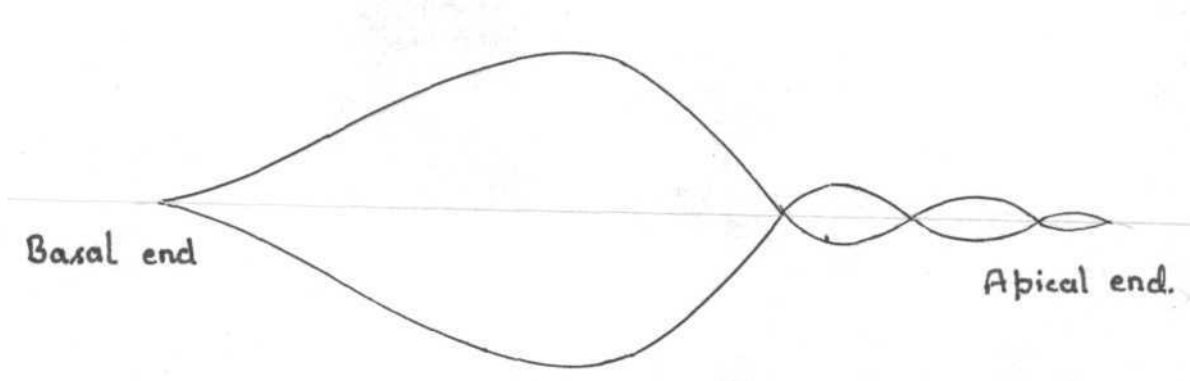
3. This incomplete face has something to do with the ear. Find it out.

4. Label the following:

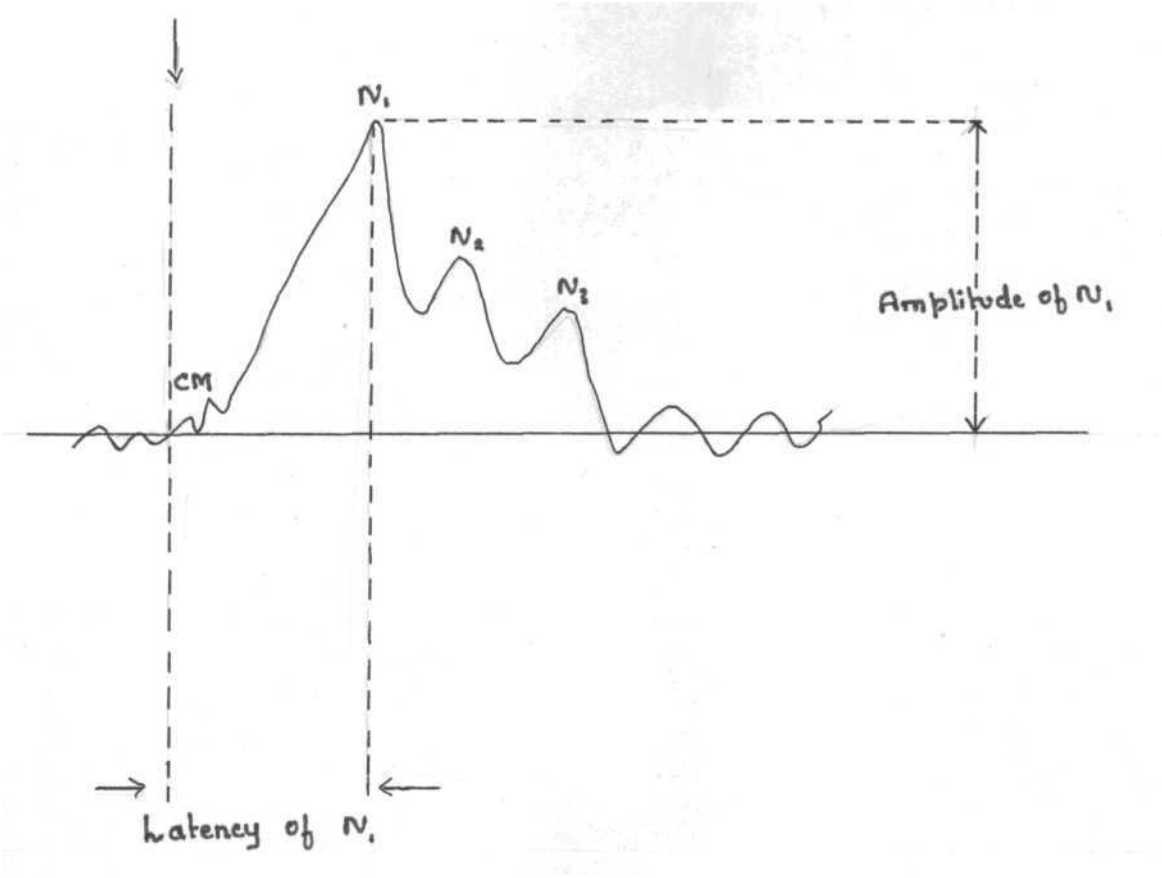


V. Curves:

1. What observations you draw from this figure?



2. What information you get from the curve below?



Answers

I External ear & eustachian tube:

1. a. Scaphoid fossa
   b. Darwin's tubercle
   c. Helix
   d. Anthelix
   e. Antitragus
   f. Lobule
   g. Concha
   h. Triangular fossa

2. MM.

3. (a).

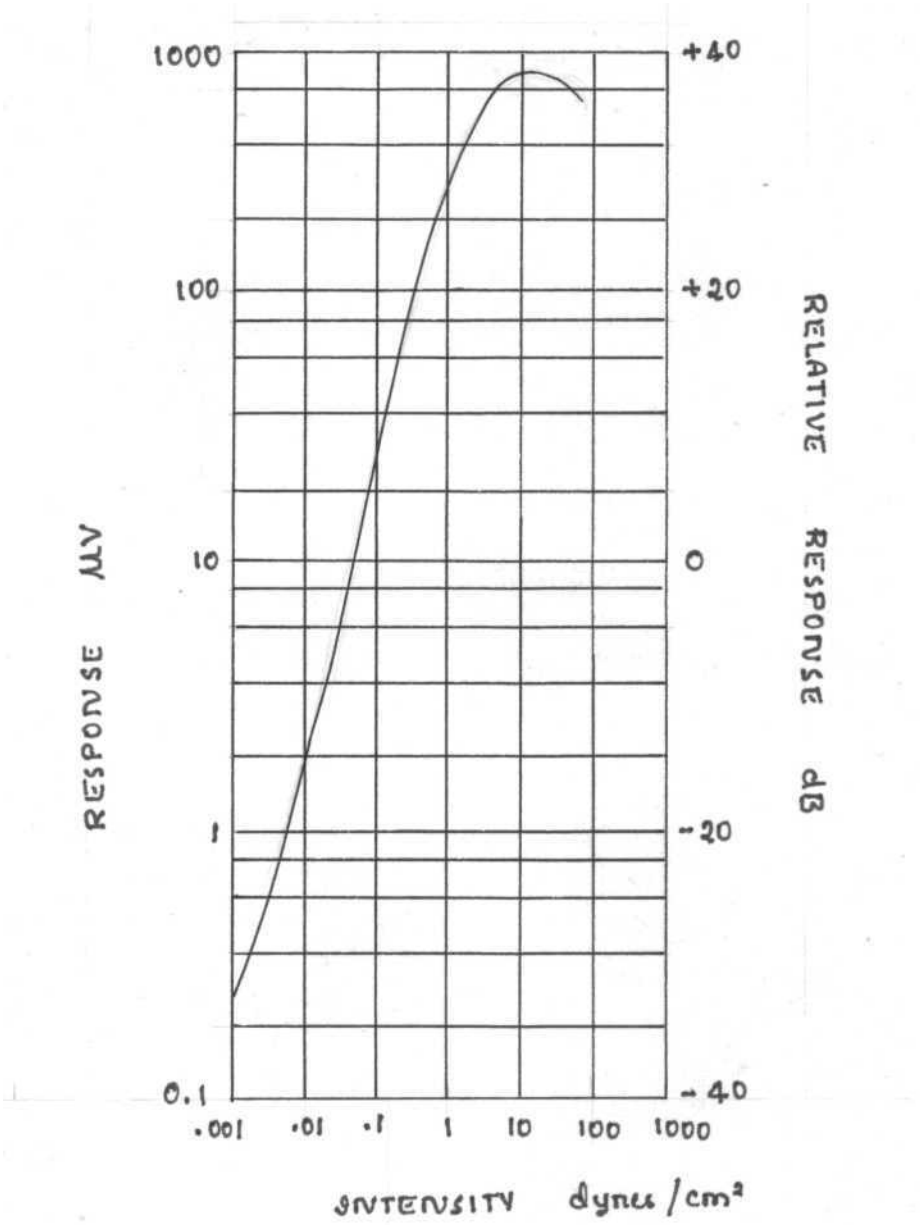
4. (a) Bony
   (b) Cartilagenous

5. (a) adults
   (b) children

II. Tympanic Membrane

1. (a) Posterior superior
   (b) Anterior superior
   (c) Anterior inferior
   (d) Posterior inferior

3. What does this curve represent? Explain.



2. (a) Pars flaccida

(b) Pars tensa

3. (a) right ear

(b) left ear

III. Middle ear

1. The labels right and left have been interchanged.

2. One Crus is longer.

3. (a) Outer ear representing acoustic filter.

(b) Middle ear representing mechanical transformer.

(c) Inner ear.

IV. Inner Ear

1. (a)

2. (a) Posterior vertical

(b) Lateral.

(c) Anterior vertical.

3. (a) auditory cortex

(b) Medial geniculate body

(c) Inferior colliculus

4. (a) Limbus
(b) Spiral nerve fibres
(c) Border cells
(d) Nerve fibres
(e) Inner phalangeal cells
(f) Basilar cells
(g) Blood vessel
(h) Pillar of Corti
(i) Cuter phalangeal cell
(j) Homogenous substance
(k) Transverse fibres
(1) Connective fibres
(m) Cells of Claudius
(n) Cells of Hensen
(o) Outer tunnel
(p) Reticular lamina
(q) Space of Nuel
(r) Tectorial membrane
(s) Inner hair cell
(t) Inner tunnel

Basilar membrane

V. Curves:

1. Traveling wave

An undulating wave is seen to travel from one end of the basilar membrane to the other. It's amplitude is varied continually and also its pattern from moment to moment.

As the wave proceeds, its amplitude rises steadily to a maximum and then rapidly falls towards zero. The upper wave represents the pressure caused in Cochlea by

by outward thrust of Stapes. The lower wave corresponding to inward thrust of Stapes.

Wave represented in this figure indicate maximum displacement near middle of basilar membrane.

2. Action potential curve:

Peak N, represents the actionpotential peak. CM indicates that the response is of Cochlear microphonics.

N, comes from the auditory nerve while CM is from the Cochlea.

Latency is the time gap between onset of stimulus and occurence of peak.

Amplitude is taken from the maximum peak level.

The curve gives information regarding the auditory nerve.

3. Cochlear microphonic input - output function is represented in tne figure. It is characterized by 3 regions.

i) The first region is a straight line and here the Co-chlear microphonic is directly proportional to the strength of the stimulating sound. The relationship between the 2 is linear.

ii) Second region extends between departure from linearity and maximum of function. It is characterized by increasing amount of distortion (nonlinearity).

iii) It is the microphonic function beyond maximum which decreases with further increase in intensity.

CHAPTER - III

PSYCHOPHYSICS

1. The term 'psychoacoustics' was coined by whom?

2. What is 'auditory sensation'?

3. What is the main assumption in MAF technique?

4. What is the assumption in MAP?

5. Why should the variations in results be accounted for the method used?

6. 3 main factors influencing frequency discrimination are _____ and _____.

7. 2 conditions under which a normally effective auditory stimulus may fail to arouse a sensation include

   i)

   ii)

8. What is 'masking level difference'?

Answers

1. Fechner in 1860.

2. it is the perception of any stimulus whose frequency, intensity conditions are such that it falls between the threshold of audibility and feeling.

3. The sound pressure as measured by the microphone is the same sound pressure that is effective in eliciting a threshold response.

4. It is assumed that the equivalent volume (ie. volume of coupler = equivalent volume enclosed under the earphone being worn by the listener) is primary factor and others are relatively insignificant.

5. Because it is presumed that the sound pressure to elicit a threshold is constant.

6* frequency, intensity and duration.

7. i) When stimulus is accompanied by another sound which obliterates or masks it.

ii) When the stimulus is preceded by a sound which leaves the organism unresponsive or fatigued

8. It is the difference between the threshold obtained in monaural and biaaural masking situations.

I. Select an answer among the two correctly:

1. A stimulus can be detected provided it is presented at _____ intense sound pressure.

(Highly, appropriately)

2. The sound pressure required to hear a tone depends upon the way in which the sound pressure is _____.

(measured, perceived)

3. Frequency discrimination tends to _____ as sound pressure increases.

(improve, worsen)

4. As one increases the frequency of the stimuli, the difference between the stimuli must become _____ in order for the listener to perceive the difference.

(larger, smaller)

5. As duration is lengthened, the increment between 2 stimulus values must be made _____ in order for the listener to perceive the difference between the 2 stimuli.

(lesser, greater)

6. Loudness is a_____method of magnitude estimation.

(direction, indirect)

7. For short durations, loudness declines as duration is

(highly, less)

9. The upper limen is the average point at which the listener judges the variable to be the same as the standard on a_____trial.

(ascending, descending)

10. Intensity differences are important in the localization of frequencies_____ 300 Hz.

(above, below)

11.Phase differences aid in localization of_____ frequencies.

(low, high)

12. The larger the difference between upper and lower limens the_____the differential sensitivity.

(greater, lesser)

13. The frequencies for which absolute threshold is _____are the same frequencies for which intensity discrimination is best.

(largest, smallest)

II. You need to select among 2 or 3 answers appropriately.

1. The intensity of a sound can be measured directly with instruments. If intensity of a sound is measured today and will be measured tomorrow, it will be

(different, seme, higher, lower)

2. In the method of constant stimuli, the stimuli are presented to the listener in a_____order.

(random, serial)

3._____type of error can bias our results.

(variable, constant)

4. Variability of results under identical situations is called_____error.

(variable, constant)

5. In the method of adjustment, point of subjective equality lies_____between upper and lower limens.

(3/4 way, 1/2 way, 1/4 way)

6. Constant error is a_____tendency.

(systematic, random)

7. Masking level difference is a measure of _____ or binaural release from masking.

(masking, unmasking)

8. The binaural advantage can only be realized if the stimuli are presented to 2 ears not at the same SPL but at_____.

(equal intensity level, equal loudness level)

9. To maintain equal loudness as one changes the frequency, it is necessary to change the _____

lO. Minimum audible angle is _____

11. Our measures of intensity are only as precise and certain as our_____.

12. Formula for Difference Limen with given upper limen and lower limen is_____.

Answers

I.

1. appropriately.
2. measured.
3. improve.
4. larger.
5. greater.
6. indirect.
7. shortened.
8. highly.
9. descending.
10. above.
11. low.
12. greater.
13. smallest.

II.

1. same
2. random
3. constant
4. variable
5. ½ way
6. systematic
7. unmasking
8. equal loudness level
9. sound pressure
10. 1/3 to ½°
11. instrument.
12. $DL = \frac{(L_U - L_1)}{2}$

True or False

1. Audiograms help in comparing degree of the problem with normals whereas SPL plotted against frequency does not.

True/False

2. We appreciate speech because of discriminability and otherwise not.

True/False

3. The terms 'Temporal extent' and 'perceived duration' are equivalent.

True/False

4. The magnitude of variable error is predictable in any procedure.

True/False

5. An observer's ability to detect a difference between 2 physical stimuli is constant.

True/False

6. The terms 'adaptation' and 'fatigue' are not the same.

True/False

7. The binaural gain of 3dB at threshold is a great advantage for normal hearing persons.

True/False

Answers

1. True.
2. True.
3. False.
4. False.
5. False.
6. True.
7. False.

This section deals with numbers and names.

1. Our ear is capable of discriminating changes as small as the following:

a) 1 or 2 parts in 10
b) 1 or 2 parts in 1000
c) 1 or 2 parts in 100
d) in frequency
e) in intensity
f) in duration.

2. i) Interaural difference in intensity is _____dB

ii) Interaural difference in time is _____secs.

iii) Interaural difference for phase is _____ (at 100 Hz).

3. Difference in optimal performance in moraurai Vs binaural listening for

i) intensity discrimination is _____

ii) frequency discrimination is _____

4. a) 2 other names for difference limen include _____ and_____.

b) Physchological response to physical stimuli is called by the name_____.

c) 3 other names for "frequency filtering" are_____, _____and_____.

Answers

1. a) - f)
   b) - d)
   c) - e)

2. i) 0.5 dB
   ii) 0.000012 sec.
   iii) 0.3

3. i) 0.2 dB.
   ii) 3%

4. a) Differential threshold. Just noticeable difference.
   b) Sensation.
   c) Frequency selectivity, Frequency analysis and Frequency resolution.

CHAPTER - IV

INSTRUMENTS AND CALIBRATION

A. Noise measurement

1. Why noise measurement?

2. Which are the 2 most widely used criteria of noise exposure?

3.What is ONEL?

4. What are the 2 differences between ISO and OSHA?

5. The method of noise measurement depends on many factors. What are they?

6. How to measure

   a) steady noise?

   b) when noise level varies with time?

   c) when noise varies unpredictably?

7. Which are the absolute methods of noise measurement?

8. Support instruments used with SLM include:

9. Noise measurement includes the following fields:

B. Sound and Instruments

1. What is sound?

2. What is audiometry?

3. What are the 2 important functions of an audiometer?

4. What are the advantages of a microprocessor?

5. Various parameters of audiometric calibration are _____and_____.

6. Calibration types include _____ and_____.

7. Subjective Calibration can be done in 3 ways. What are they?

8. Objective-biological calibration can be done using _____, _____and .

9. Objective calibration includes_____and_____.

10. What is a microphone?

11. What is a earphone?

12. What is harmonic distortion in dBs?

13. Intensity calibration includes_____and _____.

14. Frequency calibration includes_____,_____, and_____.

15. Time characteristics of a tone includes_____ and_____.

16. _____ is used for measuring the sound level.

17. SLM can be calibrated using a_____or

18. The first speech audiometer_____was used as a group screening instrument.

19. Audiometers used tor diagnostic puposes can be of_____or_____type.

20. For TDH- 39 earphone,

i) the frequency range is_____.

ii) the impedance value is_____.

21. Two advantages of circumanral phones over supraawsel are_____and_____.

22._____is the lab reference SLM.

23. Integrating SLM measures_____.

C. Calibration

1. For puretones, the air conduction output calibration measurements are done at_____dial setting, and for bone-conduction at _____.

2. The attenuator should be linear with 0.3 of interval step (or 1.5 dB, whichever is smaller). This is according to_____.

3. Harmonic distortion can be expressed as or_____.

4. While measuring puretone's distortion, the SLM scale selected is_____.

5.For bone conduction, maximum permissible total harmonic distortion is_____except at 250 Hz where it is allowable upto_____.

6. In the output SPL of noise signal calibration, attenuator dial is set at_____.

7. In speech and white noise calibration, the output level is measured with SLM in _____setting.

8. Distortion should be measured at_____and _____ harmonics.

9. Rise and decay times are controlled by_____.

10. i) Period of the tone =_____+_____.

ii) A duty cycle =_____.

11. In Vu meter calibration one checks

a) _____

b) _____

c) _____

Answers

A. Noise

1. 1) Because of adverse effects of noise.
   2) In industrial set up (for compensation cases)
   3) Noise control
   4) For construction of audiometric rooms, and to check noise levels in them periodically.
   5) In community; a noise source might create disturbances.

2. ISO's R 1999 and America's OSHA.

3. It is the occupational noise exposure limit, which is equal to 90dB (A).

4. i) The way in which they express noise exposure.
   ii) duration limits at noise levels other than 90 dB (A).

5. i) What the noise problem is?
   ii) The ultimate use of data obtained for future references.

6. a) SLM can be used directly to evaluate noise dose.
   b) Partial noise doses are computed and summed.
   c) Noise dosemeters can be used.

7. Precision method, Engineering method and Survey method.

8. Tape recorder (for data recording) and Level recorder (for frequency spectrogram).

9. Free field measurements.

Reverberant field or diffuse field method.

Semireverberant field method.

Anechoic hemispherical space.

Anechoic full space.

Sound pressure measurements in field conditions (field method).

B. Sound and Instruments

1. It is fast oscillatory movement of air which produces pressure variations detectable by ear.

2. It is the measurement of a person's hearing ability as compared to a refeference hearing level.

3. i) It produces a variable sound level at standardized frequencies in an earphone, and

ii) It records the minimum level that subject can hear and compares it to a reference threshold level for each frequency and for each ear.

4. i) Precise testing results

ii) Elimination of source of human variables in manual testing and self recording audiometry.

iii) It is advantageous especially in occupational hearing conservation.

5. intensity, frequency and time characteristics.

6. objective and biological.

7. (1) Biological method (using reference threshold levels of a person from a calibrated audiometer).

(2) Testing persons with normal hearing and finding out average threshold.

(3) Loudness balance technique - which needs matching output of a calibrated audiometer to the one to be calibrated.

8. impedance bridge, few subjects and audiometer to be calibrated.

9. Acoustic checks, and Laboratory Calibration.

10. It is a transducer which converts acoustical energy into electrical one.

11. It is a transducer that converts electrical energy into acoustical energy.

12. It is the dB difference between the fundamental and its respective harmonics.

13. Output SPL and attenuation linearity.

14. Frequency analysis, frequency response, frequency bandwidth and harmonic distortion.

15. Temporal parameters (rise, decay times), and phase characteristics.

16. Sound level meter.

17. Pistonphone or acoustic calibrator.

18. Western Electric 4A.

19. Manual or automatic

20. i) 100 to 8000 Hz.
    ii) 10 ohms.

21. greater attenuation of noise and constant threshold responses.

22. Type '0'. .

23. steady level of time varying noise.

C. Calibration

1. 60 dB HL, 40 dB HL.

2. ANSI, 1969.

3. decibels or percentage.

4. linear.

5. 3%, 6-12%.

6. 80 dB HL.

7. linear.

8. second and third.

9. interruptor switch.

10. i) $\frac{\text{on-time}}{\text{on-time + off-time}}$

ii) $\frac{\text{on time}}{\text{period}} \times 100$

11. a) overshoot or under shoot.
b) response time of the needle, and
c) relative accuracy of Vu meter in dB scale.

True/False

1. TDH- 39 MX 41/AR earphone cannot be used to simulate a free field sound source.

2. Circumaural headset is calibrated as the standard, NBS- 9A coupler.

3. TDH- 39 MX 41/AR earphone is appropriate when constant eardrum sound pressure is desired.

4. One has to keep the intensity level constant while calibrating AC output level for all frequencies.

5. Distortion factor meter gives distortion in decibels.

6. Distortion should be measured at all harmonics.

Answers

1. True.
2. False.
3. True.
4. True.
5. False.
6. False.

A. Intensity Calibration

1. A.C output level calibration proceedure using frequency analyzer requires

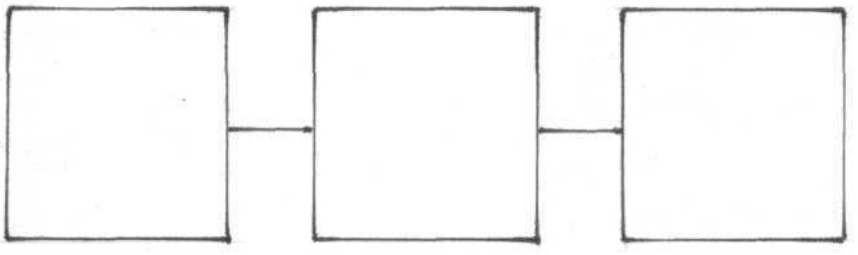
Frequency analyzer (B & K 2107)
Preamplifier (B & K 2627)
Artificial ear (4152) and condenser microphone.

Connect these instruments.

2. Ac output level calibration using a SLm requires

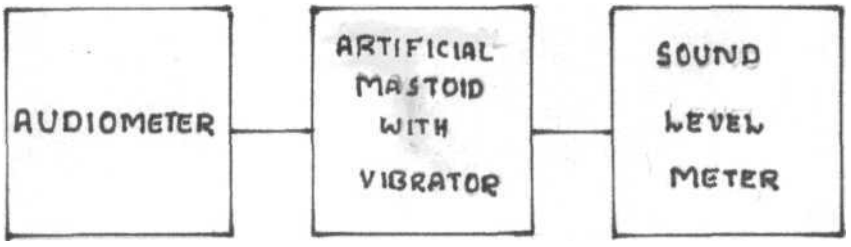
Sound level meter (B & K 2203 with
Octave filter set 1613)
Artificial ear (4152)
Condenser microphone (4144)

Label the above in the figure below



3. B.C output level calibration using frequency analyzer needs

4._____Calibration with sound level meter requires the following.



B. Frequency Calibration

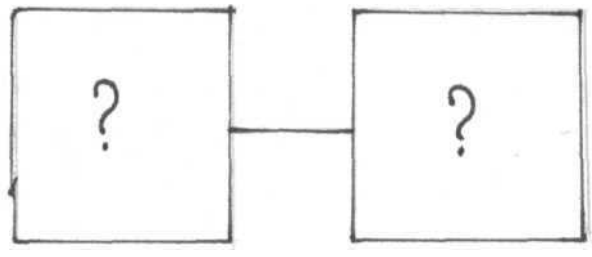
1. Puretone frequency analysis can be done by using _____or_____.

2. Frequency analysis can be done by_____or _____ measurement.

3. One usually employed for frequency analysis is _____measurement.

4. Acoustic measurement can be done using_____methods.

5. Puretone frequency analysis employing frequency counter requires the following.



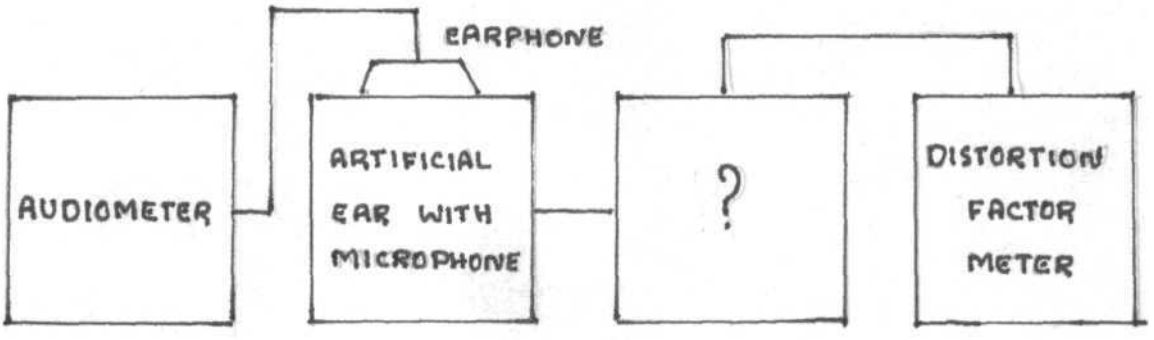
6. For finding out frequency characteristics of a noise signal equipment required include,

Artificial ear, condenser Microphone, Audio-frequency analyzer, level recorder, pre-amplifier - connect them.

C. Distortion Measurements

1, Distortion can be measured using_____, _____ and_____.

2. Set up for total harmonic distortion measurement is



3. Pure-tone total harmonic distortion measurement using sound level meter with octave filter set requires

Artificial ear, condensory microphone, sound level meter and octave filter set.

Make the necessary connections.

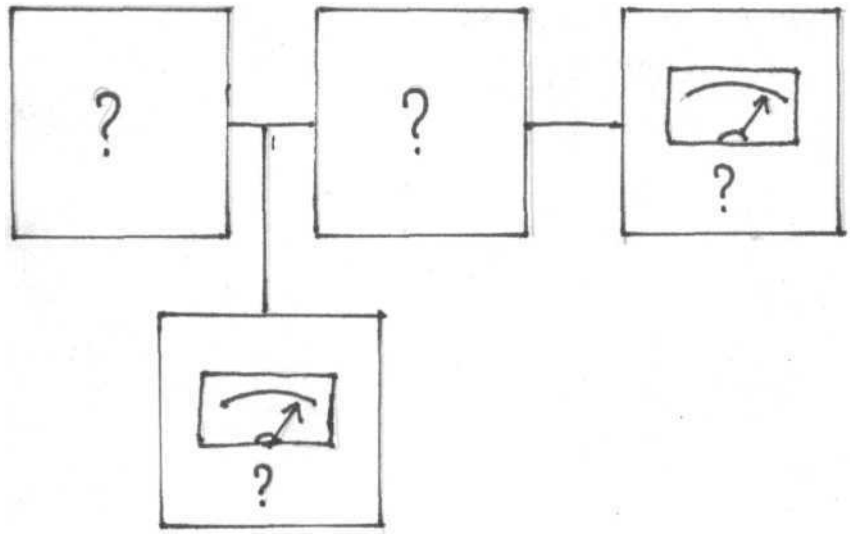
4. The difference between SPL of the fundamental frequency and harmonics should be atleast_____dB.

D. Speech-unit calibration

1. For speech, similar equipment and procedures (as for puretone calibration) are needed, but _____ is set for _____ testing.

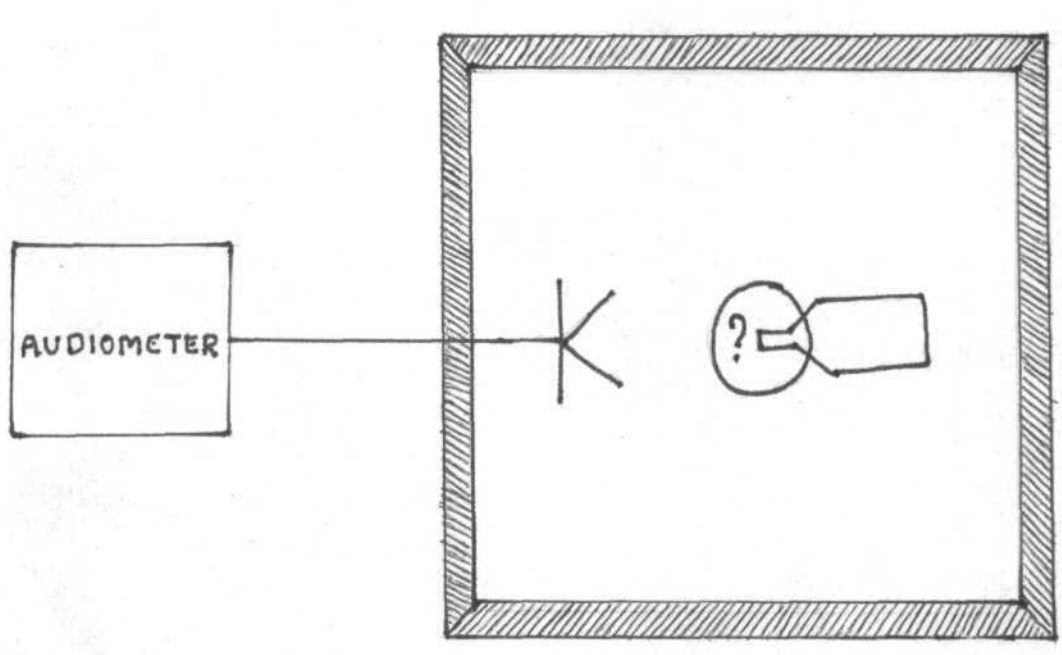
2. For speech output level calibration, the equipment required include Artificial ear, condensor microphone, sound level meter and _____.

3. For Vu meter calibration one needs Audio-oscillator, Electronic Switch, Ac milli voltmeter and linear attenuator.



4. Sound field calibration of speech is done by _____procedure, which requires a

5. The setup for above is



E. Noise - intensity calibration

1. Same equipment and procedure as employed in puretone Ac output level calibration is required.

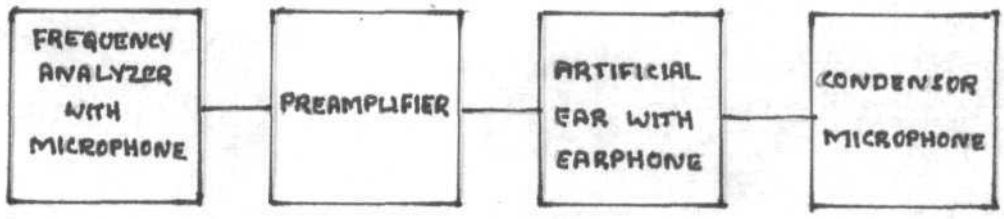
True/False

2. To avoid interference by ambient noise in these measurements, the output should be measured at a higher level. Hence the attenuator is set at_____.

3. If output is measured through a insert receiver (using a_____cc coupler), these outputs can't be compared directly to earphone measured (expected SPLs) using a_____cc coupler. Why?

Answers

A. Intensity Calibration



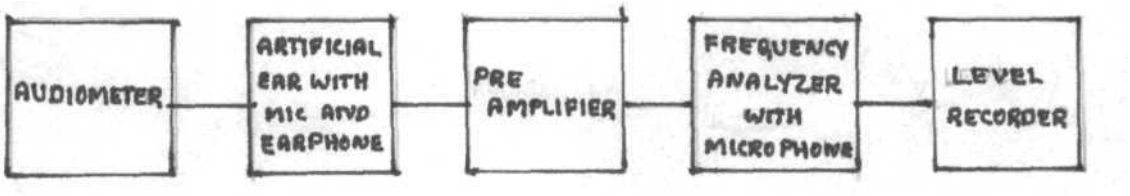
2. Sim With filter - Artificial ear with microphone - Audiometer

3. ? Artificial mastoid with bone vibrator.

4. B.C. output level.

B. Frequency calibration

1. Electronic counter or oscilloscope
2. acoustic or electrical
3. electrical
4. real-ear
5. Audiometer _____ Counter.
6.

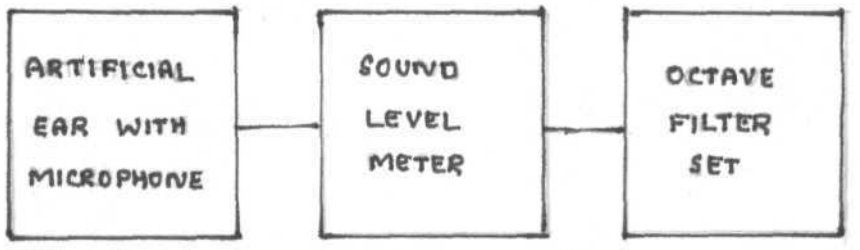


C. Distortion Measurements

1. Frequency analyzer, Distortion factormeter and sound level meter.

2. ? — Sound level meter

3.



4. 30.

D. Speech Unit Calibration

1. audiometer, Speech.

2. Beat frequency oscillator (or a standard signal source).

3. Audio-oscillator —— Electronic switch ——— Audiometer

Voltmeter

4. Loudspeaker output level calibration, freefield calibration setup.

5. ? Subject's head position.

E. Noise - intensity calibration.

1. True.

2. 80 dB HL

3. 2y 6

It is because thresholds are shows to vary as much as 20 dB between insert receivers and earphones.

EVALUATION SHEET

To the readers

1. Did you have difficulty in understanding the questions? if so,

   a. Were the questions ambiguos?
   b. Were the questions not very specific?
   c. Were the questions irrelevant?
   d. If none of the above, please specify the problem encountered along with the chapter, pase and questions.

2. Did you find this question bank useful? If so, mention for what purpose(s) it was useful, like for interview, examination, teaching etc.

Your suggestions for making this work more useful are welcome.

B I B L I 0 G R A P H Y

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