A QUEST ON HEARING AIDS

REGISTER NO. M 9405

AN INDEPENDENT PROJECT SUBMITTED AS PART FULFILMENT
FOR THE FIRST YEAR M. Sc (SPEECH AND HEARING)
TO THE UNIVERSITY OF MYSORE.

ALl INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE -570 006

MAY 1995

DEDICATED TO

MY BELOVED AMMAMMA

"You're always been my inspiration

To walk in your footsteps is

The highest form of respect I can give you"

CERTIFICATE

This is to certify that the independent project untitled, A QUEST *ON HEARING* AIDS *is a bonafide. work done in part fulfilment for First year* degree *of Master of Science (Speech and Hearing) of the student with register number.* M 9405

Mysore.
1995

Dr. (Miss) S. Nikam
Director
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Mysore-570 006

CERTIFICATE

This is to certify that the independent project entitled, ***A QUEST ON HEARING AIDS*** *has bezn prepared* under *my supervision and guidance.*

Mysore
1995

Dr. (Miss) S. Nikam
GU1DE

DECLARATION

I here *by declare that this independent project entitled,* ***A QUEST ON*** **HEARING** ***AIDS is*** *the result of my own study under the guidance of Dr.* ***(Miss)*** **S. Ni*kam,*** *Professor and Head* of *the Department of Audiology, All India Institute* Of Speech *and Hearing, Mysore and has not been Submitted earlier at any University any any other diploma on degree.*

Mysore
1995 *Reg.No. M 9405*

ACKNOWLEDGEMENTS

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Dearest Achan and ***Amma***

You're the dearest, most important thing in all the would to me ... because you have never stopped believing in me. I owe *my life to you.*

Chechi and Rajeshettan,

You'll always be *a part of my life, my hope and my inspiration, for all that* I *achieve, through all my life's journeys, all* I *want is to love you always.*

Dearest Suchi, you are such a blessing to me, for you've been there, through the good times and the bad, holding back the loneliness and giving me enough smiles to

last a life time. Wish I *had the wonds to tell you how special you are.*

Dear ***Sheeja,*** *a special friend is one of life's most beautiful gifts. That's what you are to* me. Your *support, love and caring has always meant much. You'll always* be *a part of my life that* I treasure.

Dear ***Mareena****, thanks for beinq such a wonderful pal. You hold a special place in my heart.*

My dearest ***Valliamma,*** *you've always been there to share my happiness and sorrows, to connect me, when* I *faltered and to encounage me time and again, thanks is inadequate for all your love.*

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I *thank Mr. B.K. Venkatesk, for his computer proccessing of this report.*

Last, but not the least, I *thank all those people who helped me, directly or indirectly, to get this report in this manner.*

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INTRODUCTION

INTRODUCTION

"The ear is the organ of language learning"

- Aristotle

Normal hearing is vital for the development of speech and language skills from our birth. Hence the effects of hearing loss is profound both in adults and in children. Hearing loss can be differentiated depending on the pathology and degree of loss. Depending on the pathology it can be divided into conductive hearing loss, sensori-neural hearing loss, mixed hearing loss and central loss. Depending on the degree it can be classified as mild, moderate, moderately severe, severe and profound hearing loss.

The most outstanding problem arising out of a hearing loss is the breakdown in communication, and helping the hearing impaired individual overcome this problem is the task of aural rehabilitation clinicians. One of the major steps in rehabilitation of the hard-of-hearing is the fitting of an appropriate amplification device. The purpose of amplification is to utilise the individual's residual hearing to the fullest extent possible and the hearing aid is the major avenue for this purpose.

A hearing aid may be described as "any instrument that brings sound more effectiveliy to the listener's ear. It may simply collect more sound energy from the air, it may prevent the scattering of sound during transmission or it may provide additional energy usually from the battery of an electrical amplifier" (Silverman, Taylor and Davis, 1960). The hearing aid is of utmost importance to minimise if not completely eliminate/ overcome the problems of a hard-of-hearing individual.

From the time it was developed the hearing aid has undergone numerous modifications. This is well evident from the fact that hearing aid has changed from large horn-shaped ones to miniaturised ones. The earliest attempts of men to overcome their hearing problem was to "cup their ears". This paved the way for the mechanical hearing aids, followed by electrical hearing aids and finally the present day electronic hearing aids in the 1950s.

The contemporary electronic hearing aids are private, portable public address systems. Its basic operation is a three-step process. First the sound waves (acoustic energy) are transduced into corresponding electrical waveforms (electrical energy) by the hearing aid microphone. Second, these electrical waveforms are

amplified by the electronic circuit of the hearing aid through the utilisation of additional electrical energy provided by a battery. Third, the amplified electrical waveforms are transduced back to sound waves, more intense than those impinging upon the mic, by the hearing aid earphone and delivered to the wearer's ear.

There are different types of hearing aids classified on the basis of placement like body-worn hearing aids, behind the ear, in the ear, spectacle and in the canal hearing aids. These represent increasing levels of sophistication. Again the body level hearing aids could be AC hearing aids (output being a receiver) or BC hearing aids (output being a vibrator). Yet another type is the implantable hearing aids or the ccchlear implants.

The hearing aid is coupled to the ear by means cf the ear mold. The ear mold also provides an acoustic seal to minimise the possibility of feedback. There are three basic styles/types of ear molds. The standard mold, open mold and skeleton mold. Through proper ear mold selection and modification a variety of acoustic effects can be achieved. Thus ear molds are in integral determinant of the hearing aids acoustic output.

The selection of the type of hearing aid would depend on a number of auditory factors and non-auditory factors. Auditory factors would be gain requirement, auditory discrimination ability and dynamic range and non-auditory factors like age, finance, psychological acceptance of the hearing aid by the patient, etc. An individual who wears a hearing-aid of the present day design reaps the benefits which have accumulated through years of research, development, trial and error, and the steady development of the electronic art. These benefits include acoustical tonal fidelity, high power, reduction in physical size, wearing comfort as well as virtually total concealment.

This project is a question bank which deals with various aspects of hearing aids such as the genesis and metamorphosis of hearing aids, the different components constituting a hearing aid, types of hearing aids, electro-acoustic measurement of hearing aid performance, electronic and acoustic modifications of hearing aids, ear molds, hearing aid selection, fitting, use and benefit.

OBJECTIVES OF THE PROJECT

> The major objective of undertaking this project is to get collective information about different aspects of hearing aids.

> To serve as a guide for trainers and examiners.

> To monitor students' knowledge in understanding the subject.

> To evaluate trainees after training programme.

> Another utility is to serve as a reference for examiner and interviews purposes.

HISTORY AND DEVELOPMENT OF HEARING AIDS

Fill in the blanks

1. Many authors consider this as the first hearing 'aid'

2. The first commercial hearing aid was devised by in the year_____.

2. The earliest of the mechanical hearing aids were the _____or_____.

4._____was made by F.C. Rein for King Goa of Portugal –> SATOCIUC NEORHT (ANAGRAM)

5. "Deaf aids" refer to_____.

6. The earliest bone conduction hearing aids were _____or_____.

7. Hearing fan was invented by_____and was known as_____.

8. In the 1800s this was used with people who had collapsed external auditory canal_____.

9. The akoulallion was modified to the smaller

10. The mechanical hearing aids served upto _____ degree of hearing losses.

11. The mechanical hearing aids is another name for _____hearing aids.

12. Carbon hearing is another name for_____ hearing aids.

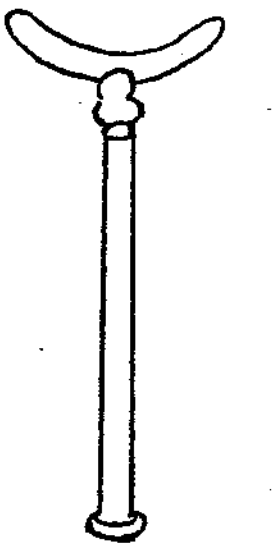
13. Carbon hearing aids consisted of ___ _____ and_____.

14. The BC electric hearing aids were first made in the year_____.
15. The first hearing aid with a directional mic was invented by_____in the year_____.
16. The microphone most popularly in use now with hearing aids all over the world is the_____microphone.
17. The first eyeglass hearing aids were manufactured in the year_____.
18. The first hearing aid with integrated circuit was made by_____in the year_____and was used with a_____type of hearing aid.
19. The transistor was invented by _._____and _____in the year_____.
20. The pentode vacuum tube hearing aids were perfected in the year_____and it had the advantages of _____,_____and_____.

Answer in a few sentences

1. Mention some of the disadvantages of the hearing aids which used a triode.
2. What was the disadvantage of carbon hearing aids that were overcome by vacuum tube hearing aids ?
3. Give a few disadvantages of the pre-electric hearing aids.
4. Mention a few advantages of the transistor hearing aids over vacuum tube aids.
5. Name two major drawbacks of carbon hearing aids.
6. Name some of the kinds of microphones that have been

used with hearing aids.

7. Why are the electret microphones preferred over conventional condensor microphones ?
8. What is the important feature of a directional microphone ?
9. Give one advantage and one disadvantage each of (a) magnetic, (b) ceramic and (c) condensor microphones
10.  This was made by Giovanni Paladini. Name it what is it ? How is it placed

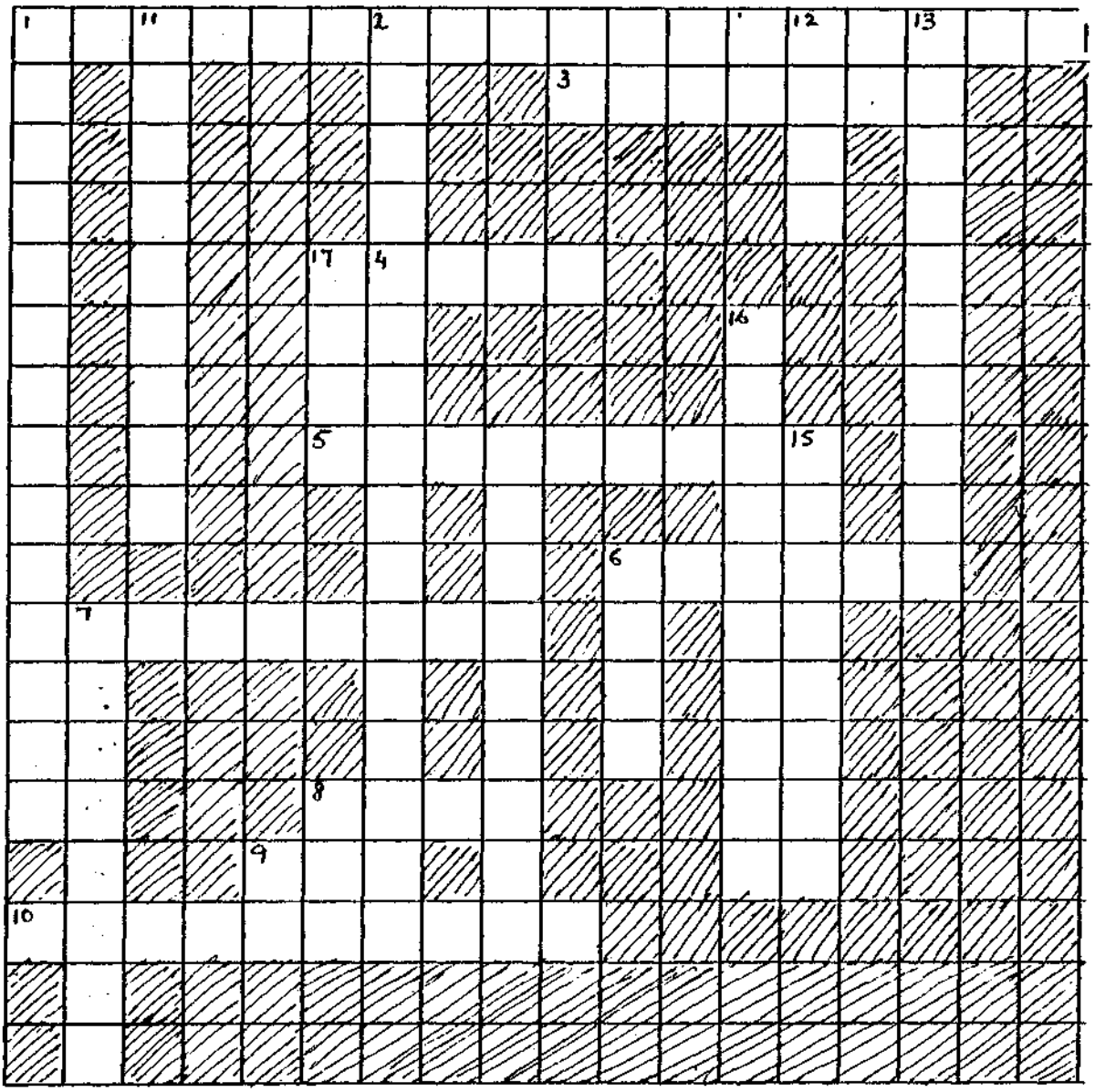
I. Match the following

1. F.C. Rein, 1800	a. First electric hearing aid
2. Giovanni Paladine	b. First directional hearing aid
3. Richard Rhodes	c. Acoustic throne
4. Dr. Ferdinant Alt, 1900	d. Described CROS
5. Hutchison, 1899	e. Fonifer-
6. Earl C. Hanson, 1921	f. Akoulallion
7. Willico,1969	g. First vacuum tube hearing aid
8. wullstein and Wugand, 1962	h. Audiphone (hearing fans)

II. Match the following

1.	Triode vacuum tube invented.	a. 1931
2.	First volume control for an electric hearing aid	b. 1926
3.	First electric bone conduction receiver	**c** 1936
4.	First custom ear moulds	d. 1912
5.	First electric eyeglass hearing aid	e. 1906
6.	First AGC in a hearing aid.	f. 1923
7.	First hearing aid with a telecoil	g. 1947
8.	First wearable vacuum tube hearing aid	h. 1936
9.	First electronic 'Master hearing aid'	i. 1964
10.	First hearing aid with Ic	j. 1937

Cross word puzzle



Clues

Across

1. Most of the contemporary hearing aids are of this type.(6)

2. Quasi-digital hearing aids is a synonymm for this hearing aid. (12)

3. He invented the first directional hearing aid. (7)
4. H, L and N are the settings of this important control on a hearing aid. (4)
5. One of the types of ear level hearing aids. (9)
6. The output transducer of a hearing is a _____ (8)
7. Bone anchored aid uses this metal implant under skin over the
8. OTE's are also known as. (3)
9. Peri-meatal hearing aid is a variety of this hearing aid. (3)
10. One of the disadvantages of body level aids due to mic placement. (10)

Down

1. This was made by F.C. Rein for the King Goa of Portugal --> STOCIUC NEORHT (Anagram) (14)
2. This kind of ITC hearing aids has all their electronics entirely within the EAM and terminate close to tympanic membrane. (15)
11. This was a modified smaller version of akoulallion. (9)
12. These transducers in hearing aids converts the acoustic energy into a weak analogous electric current. (4)
13. These hearing aids can serve upto profound hearing losses. (4,5)
15. These microphones are most commonly used contemporary hearing aids. (8)

16. This is,, the most commonly used type of custom ITE. (10)
17. This was first described by Wullenstein and Wigant. (4)
6. The first electric hearing aid was invented by this person. (4)
7. This input transducer is used in hearing aids while speaking over the telephone. (8)

Answers

Fill in the blanks

1. Hand cupped behind the ear
2. F.C. Rein in 1800
3. Speaking trumpets or hearing trumpets
4. Acoustic throne
5. Mechanical hearing aids
6. Wooden rods or metal rods
7. Richard Rhodes, Rhode's audiphone
8. Ear inserts
9. Akouphone
10. Mild
11. Pre-electric
12. Electric
13. Carbon microphone, earphone and battery
14. 1930
15. Willico in 1969
16. Electret
17. 1954

18. Zenith, 1964, BTE
19. Bardeen and Shockley in 1947
20. 1931,stability in performance, long life, and greater power of amplification.

Answer in a few sentences

1. They were expensive, cumbersome and difficulties were encountered with the amplifier.
2. The carbon hearing aids gave only limited acoustic gains. This was overcome by vacuum tube hearing aids.
3. The pre-electric aids gave only narrow frequency range, mild degree of amplification, was cumbersome and unhygienic.
4. The transistor hearing aids were smaller, more sturdy, requires virtually no warm up period, lower voltage and dramatic miniaturisation.
5. The two major drawbacks of carbon hearing aids were limited amplification provided and narrow frequency response.
6. Crystal, ceramic, condensor, electret and directional are some of the kinds of microphones used with hearing aids.

1.. The electret mics has an extremely broad and flat frequency response, it is rugged and sensitive and it is free of problems with mechanical feedback or cloth rubbing.

8. The directional microphone has both front and rear openings. Sound impinging from the rear is attenuated a significant number of decibels sufficient for the wearer to focus on the sound coming from the front.

9. a. Magnetic

Advantage: Ideal frequency response over a range of frequencies most important for speech.

Disadvantage: Do not permit miniaturisation.

b. Ceramic

Advantage: Permitted extended low frequency amplification.

Disadvantage: High impedance problems.

c. Condensor

Advantage: Has a broad frequency response.

Disadvantage: Have a large voltage need so does not permit miniaturisation

10. 'Fonifero': It is a bone conduction hearing aid. The curved portion at one end was rested on the throat of the speaker and the listener's end was placed against teeth, forehead or mastoid area.

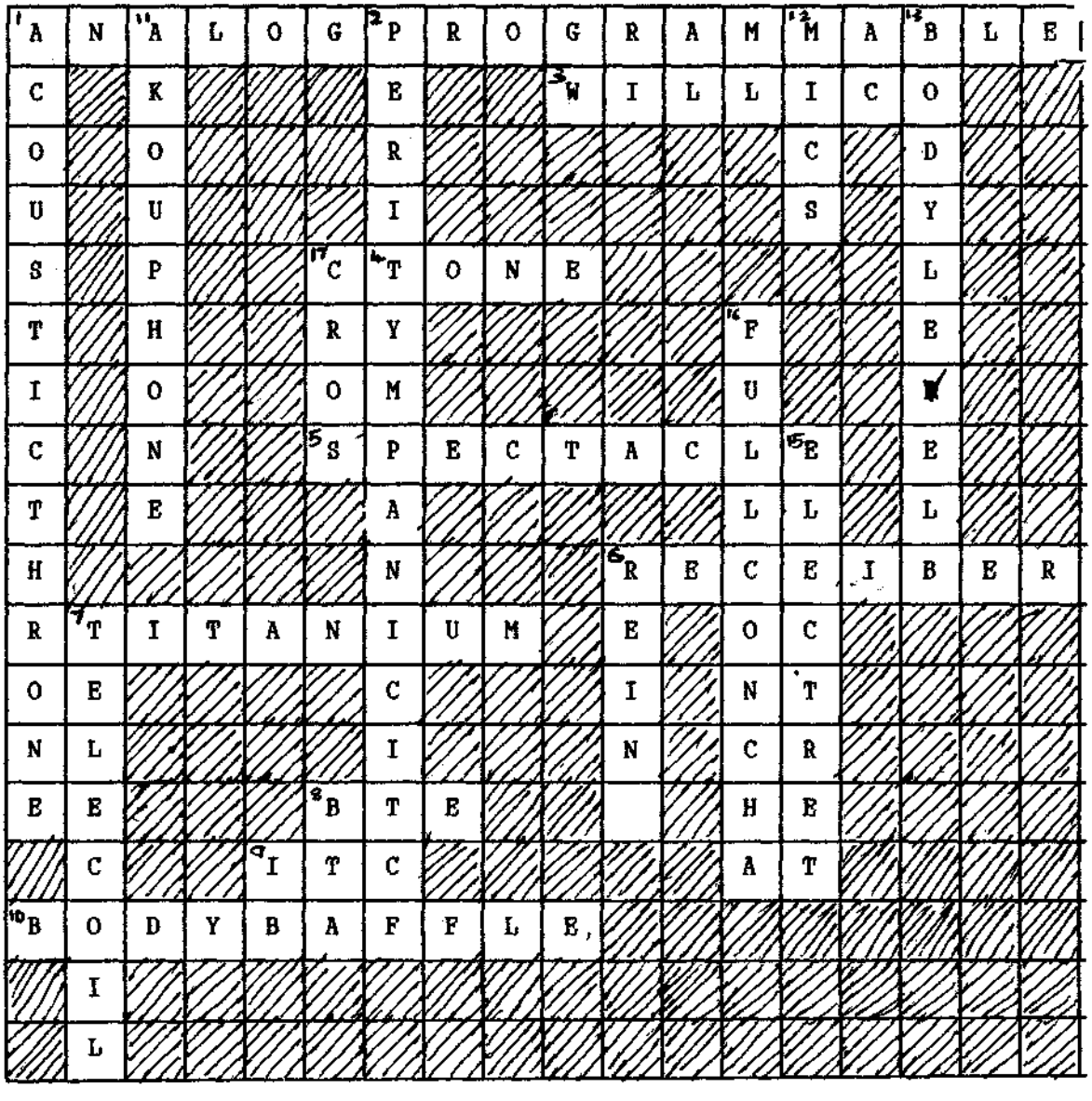
I. Match the following

1 - c
2 - e
3 - h
4 - a
5 - f
6 - g
7 - b
8 - d

II. Match the following

1 - e
2 - d
3 - f
4 - b
5 - a
6 - c
7 - h
8 - j
9 - g
10 - i

Cross word puzzle



TYPES OF HEARING AIDS

Fill in the blanks

1. Based on the category hearing aids can be classified as _____and_____hearing aids.
2. Based on the different kinds of mic used hearing aids could be classified as_____and _____
3. _____and_____are the two different types of ITEs.
4. Custom-molded ITCs are of_____and_____ types.
5. The first wearable digital aid was demonstrated by _____in the year
6. Based on output transduction hearing aids are categorised as_____and_____hearing aids.
7. OTE is a synonym for_____hearing aids.
8. _____and_____are the types of ITC hearing aids.

Choose the correct answer

1. Customs ITEs can be classified based on
   a. Physical location
   b. Dimensions within the concha
   c. a and b
   d. None of the above

2. _____ is the most commonly used type of custom ITE.

a. Low profile

b. Full concha

c. Half concha

3. The peri-meatal ITC hearing aid has most of the components placed.

a. Within the concha and some in cartilagenous portion of ear canal.

b. Within the external auditory meatus close to the tympamic membrane.

c. None of the above.

4. Multiband hearing aids are more common in

a. Implantable hearing aids

b. Programmable hearing aids

c. None of the above

5. ITCs are mostly of the

a. Customs type

b. Modular type

6. Almost all conventional hearing aids are _____ in nature

a. Analog

b. Digital

c. Programmable

State whether true or false

1. Programmable hearing aids, quasi-digital hearing aids, analog hearing aids with digital control all refer to one and the same.
2. ITEs require less amplifier gain than the outside the ear mic locations.
3. Telephone use in much more effective with ITC than with an ITE.
4. The smaller the hearing aid the greater the opportunity to utilise the natural enhancement provided by the pinna and ear canal.
5. The smaller the hearing aid the lesser the electronic flexibility.
6. The modular ITE is different from ITE in terms of power supply source and electronics.
7. ITC aids are more limited in gain and output than ITE aids.

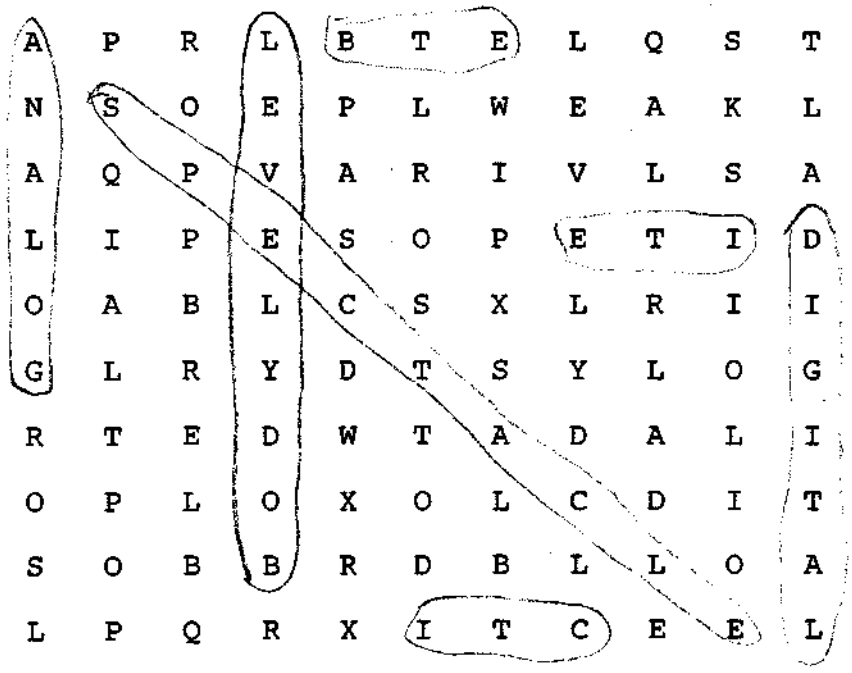
Answer in one or two sentenses

1. Differentiate between digital and quasi-digital hearing aids.
2. Mention some of the benefits of peri-tympanic ITC hearing aids.
3. What are various ways in which hearing aids can be classified ?
4. What is the advantage of small receivers as in ITCs over large receivers.

5. Mention a few advantages of intra-auricular aids over BTEs.
6. What are the kinds of implantable hearing aids ?
7. What are the major components of a programmable hearing aid ?
8. Give some advantages and limitations of digital hearing aids.
9. How is an adaptive hearing aid different from a non-adoptive hearing aid ?
10. What degrees of hearing impairement do body level, BTE spectacle, ITE and canal aids serve respectively ?

Puzzle

Identify the different types of hearing aids.



ANSWERS

Fill in the blanks

1. Mild, moderate and strong class hearing aids.
2. Directional hearing aids and omnidirectional hearing aids.
3. Custom ITE and modular ITE.
4. Regular and mini types.
5. Nurley- and Spencer in 1983.
6. Air conduction and bone conduction.
7. BTE
8. Peri-meatal and peri-tympanic ITC hearing aids.

Choose the correnct answer

1 - c

2 - b

3 - a

4 - b

5 - a

6 - a

State whether true or false

1 - True

2 - True

3 - True

4 - True

5 - True

6 - False

7 - True

Answer in one or two sentiences

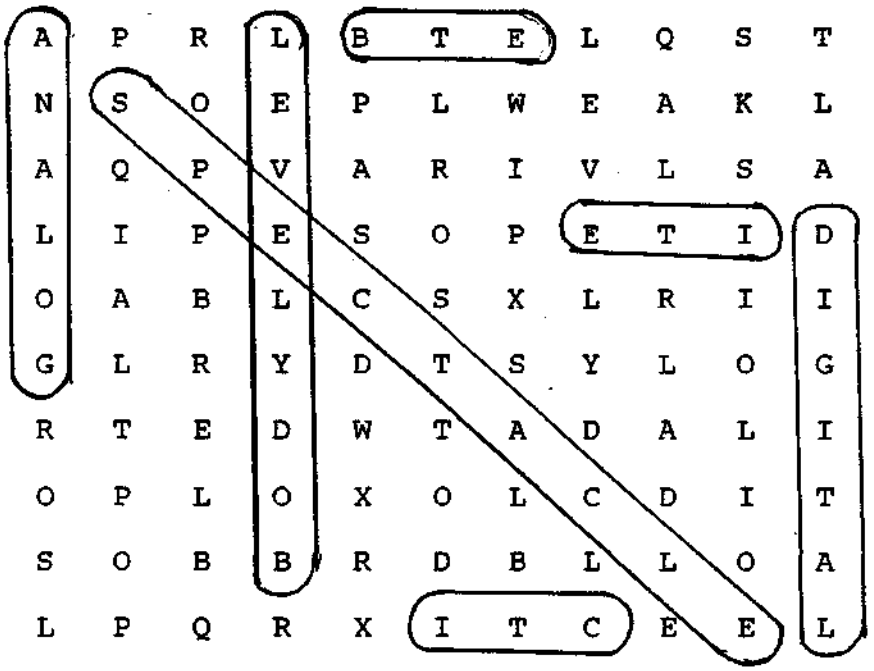
1. In digital hearing and the input signal is ddigitized and a DSP chip is used whereas in quasi-digital hearing aids, while, Quasi digital hearing aids feature conventional amplifiers and filters controlled by an external digital source.
2. Cosmetic appeal, reduced gain output requirements, greater high frequency gain, elimination of occlusion effect, improved performance in noise and feedback reduction are some of the benefits of peri-tympanic ITC hearing aids.
3. Hearing aids can be classified based on
   a. Manner of placement
   b. Category
   c. Mode of operation
   d. Different technology and
   e. Components (mics) used
4. Smaller receivers provide an extended upward frequency response.
5. Intra-auricular aids:-
   - Provide smoother responses due to shorter transmission distance from receiver to ear drum.
   - Reduces wind noise interference.
   - Provides some directionality.
   - Enhances high frequency sounds in 2-5 kHz region.

6. Cochlear, mastoid and middle ear implants.
7. CMOS (Complimentory Metal Oxide Semicondutor), RAM (Random Access Memory) and an external microprocessor.
8. Advantages
   - Eliminates background noise and feedback problems.
   - Greater flexibility and control of performance characteristics.
   - Stability of performance.

   Disadvantages
   - Large housing requirements
   - Low battery life due to high current draw.
9. Non-adaptive hearing aids includes circuitory that does not change the basic performance of the hearing aids once its controls are set. Tone, output trimmers and fixed functions switches, while adaptive hearing aids include circuitary that has a processing function that alters the performance of the aid during changing input signal environments, eg. AGC, ASP, etc.
10. Upto profound loss, upto severe loss, upto moderately severe loss, upto moderate loss respectively.

Puzzle

Identify the different types of hearing aids.



BASIC COMPONENTS OF HEARING AIDS

Fill in the blanks:

1. _____Is a variable resistor used in hearing aids to select the most effective listening level.

2. _____is a circuit in hearing aid that is developed to alter its frequency response/ i.e., to provide high or low frequency emphasis.

3. _____is used to make or break the circuit in a hearing aid.

4. If high frequency emphasis is needed_____filter is used and if low frequency emphasis is needed _____filter is used in hearing aids.

5. The class_____emplifiers are used in low gain hearing aids, where the peak gain does not exceed 50 dB.

6. A high pass filter in a hearing aid actually _____ the low frequency gain rather than_____the high frequency gain.

7. The output stage of a hearing aid amplifier is identified as having class_____ or_____operations.

8. The tone control settings on a hearing aid could be ,_____or_____.

9. _____ is a flexible, conducting wire connecting the hearing aid receiver to amplifier in body level hearing aids.

10. _____ and _____ are the two types of hearing amplifier used usually.

11. The battery compartment of a hearing aid could be _____, _____ or _____ types.

12. _____ increases the amplitude of the weak electric AC voltages picked up by the microphone.

13. The initial voltage of a hearing aid battery is

14. _____ is the most common type of earphone used in body level hearing aids.

15. Receivers of the ear level aids are generally of _____ type,

16. Based on the number of paris cords may be of 2 types _____ and _____ cords.

17. The amplification provided by a hearing aid derives its power from the hearing aid _____.

18. Greater the gain and the output requirement of a hearing aid _____ its current drain.

19. _____ and _____ are the two main types of hearing aid batteries used currently.

20. With use, as the battery voltage decreases the volume control can be increased upto _____ of the full volume control range.

21. _____ is another name for hearing aid earphones.

22. _____ and _____ are the two types of hearing aid receivers.

23. Cords can be classified based on _____, _____, _____, _____ and

24. The purpose of this in a hearing aid is to allow the hearing impaired individual to speak over the telephone utilising amplifications _____.

25. _____ and _____ are alternate inputs available with hearing aids.

26. As the current drain increases battery life

27. When tested in a free field the _____ microphone has a heart shaped polar pattern (cardiod).

28. Directional hearing aids have good directionality at _____frequenices and directionality is maintained upto_____Hz.

29. The cord of a hearing aid is terminated at both ends by

•

30._____and_____are the transducers used in hearing aids.

31._____converts the sound pressures that impinge upon its diaphragm into small analogue electrical signals.

32. If tested in free space of a_____mic picks up sound equally from all directions.

33. When worn over the ear a pressure mic has omnidirectionality only at_____frequencies.

34. Based on the configuration you could have_____, _____or_____cords.

/ 35. The_____mic is used in present day hearing aids.

36. Some of the advantages of using electret mics are ,_,_____. and

37. At the_____end of the cord, the cord emerges from the plug along the same plane as contact pins, and in the_____end the cord emerges at right angles to the contact pins.

38. In this type of hearing and amplifier circuit the entire circuit function is formed on a single semiconductor material.

State whether true or false

1. Hearing aid cells have a relatively flat discharge rate.
2. The same receiver that is used with Y-cord can be used with V-cord.
3. A class A amplifier allows for more output at high frequency than does class B.
4. Class B amplifier uses the battery power more efficiently than a class A amplifier.
5. Microphones could be defined as acoustic mechanoelectric transducers.
6. Class A amplifiers have a constant current drain regardless of whether the input signal level is low or high.
7. When a pressure microphone is worn over the ear it has a circular polar sensitivity at all frequencies.
8. The final or output stage of hearing is also called as power stage.
9. It is possible to have a three pin Y-cord.
10. Y-cord could be used with asymmetrical losses,
11. The volume control of hearing aid has taper characteristics-.

12. A hearing aid provides signifificant gain once its volume control has been advanced beyond 50% of its total range.
13. The volume control does not alter the input signal to the aid but adjusts the amount of amplicatxon of the input signal.

Choose the corrent answer

1. This class of amplifier does not have a constant current drain.
    a. Class A
    b. Class B
    c. Class C
2. The class _____amplifier has its integrated output amplifier chip built inside the receiver.
    a. Class A
    b. Class B
    c. Class D
3. Hearing aid earphones are
    a. Acoustic mechanoelectric transducers
    b. Electro-mechanical acoustic transducers
4. Which of the following configuration is not possible ?
    a. 2 pin V cord
    b. 2 pin Y cord
    c. 3 pin V cord
    d. 3 pin Y cord

5. Which of these cells is rechargeable ?
   a. Silver oxide
   b. Nickel cadmium -
   c. Zinc air
6. This cord is used with a push-pull amplifier.
   a. 2 pin
   b. 3 pin
   c. single pin
7. This type of cell has the highest voltage
   a. Silver oxide
   b. Nickel cadmium
   c. Zinc air
   d. Mercury

Match the following

I. 1. Class A amplifier	a) Pulse-width modulated
2. Class B amplifier	b) Single ended output stage
3. Class D amplifier	c) Push pull
	d) Single ended input stage
II. 1. Class A	a) High gain
2. Class B	b) Low gain
	c) Moderate gain
III. 1. V-cord	a) Parallel connection
2. Y-cord	b) Series connectors
	c) Biserial connection

IV. Accessories of cords

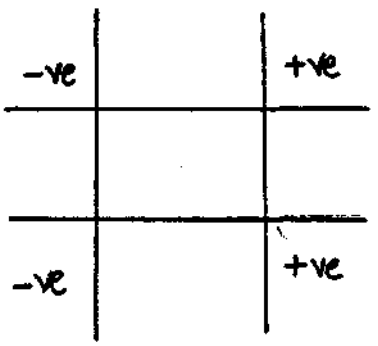
1. Canal t y p .	a) Snaps on to receiver
2. Half moon couplers	b) For BTE aids threaded performed connector
3. Threaded coupler	c) Maintains full opening of mold to make quick and easy replacement of tubing
4. Elbow fitting	d) Soft rubber test tips with flexible tubing attached
5. Female adaptor	e) For BTE threading plaster connetor with a reinforcing metal band

V. Tone control

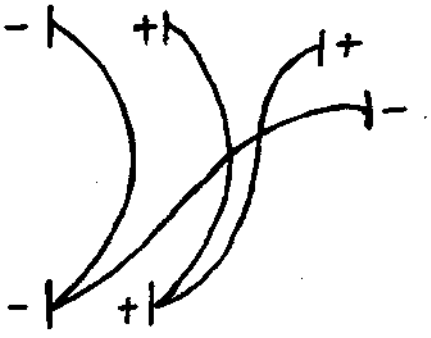
1. H1	a) High frequency suppression
2. H2	b) Low frequency suppression
3. L	c) Greater" low frequency suppression
4. N	d) No frequency response alteration

VI. Connections of cord

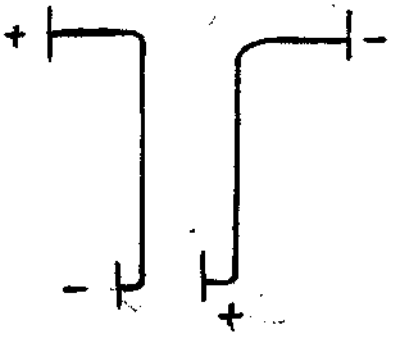
1.	a) Y cord



2. b) S cord



3. c) V cord

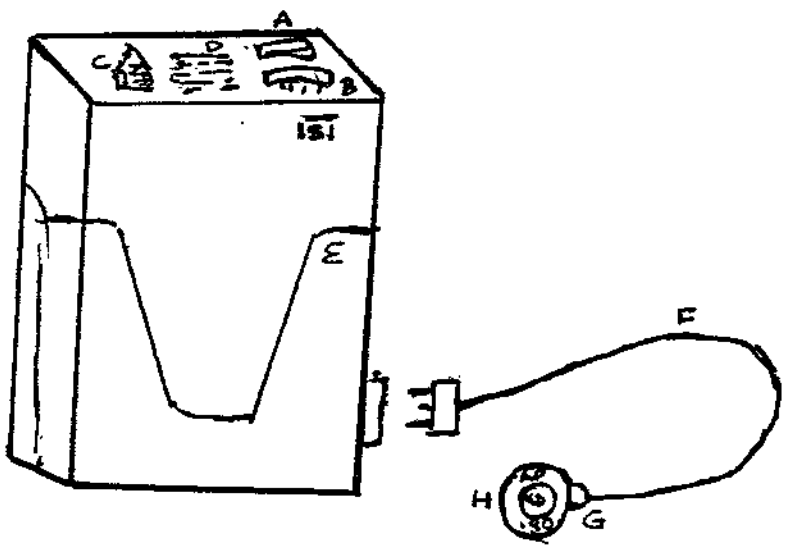


Answer in one or two sentences

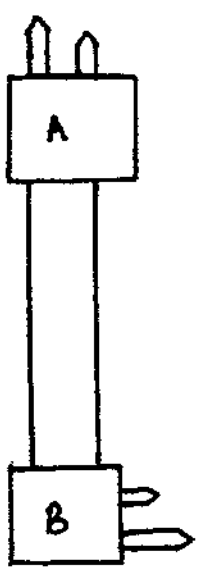
1. Mention a few advantages of class D amplifiers over class B amplifiers.
2. How many stages of amplification does a hearing aid have ?
3. Mention the names of some of the controls on hearing aids.
4. Mention a few advantages of class B amplifiers over class A amplifiers.
5. Mention two disadvantages of silver oxide cells.
6. What is the function of trimmer control in hearing aids ?

7. Mention two disadvantages of nickel cadmium cells.
8. What are the usual types of cells used with hearing aids ?
9. What are the precautions to be taken while using a battery ?
10. What are some of the advantages and disadvantages of using zinc air cells with hearing aids ?

1. Name the different parts of the hearing aids

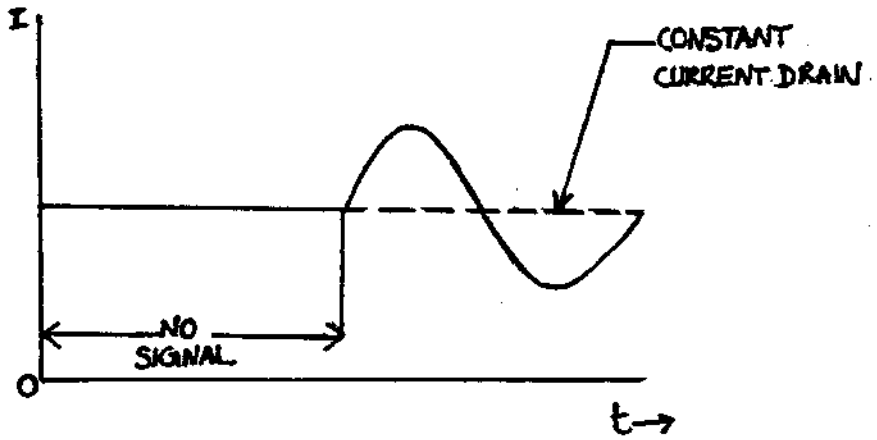


2. Which is the adiflex and angleflex end of this cord ?

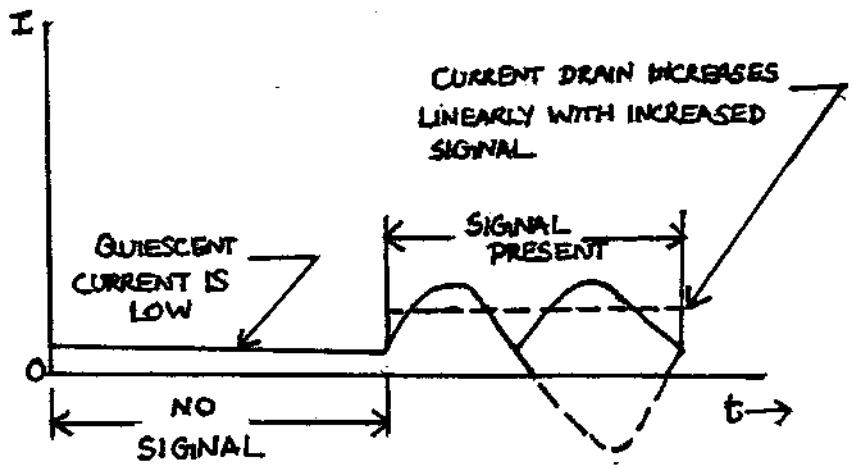


3. What class of amplifiers do these waveforms represent ?

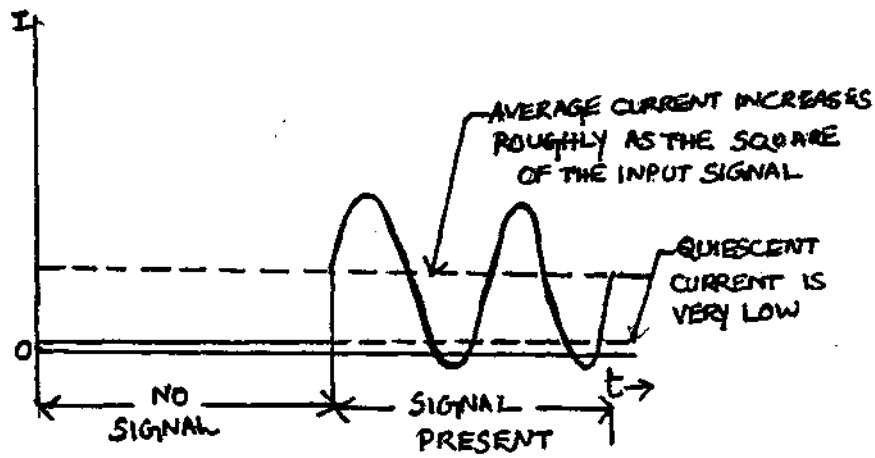
i.



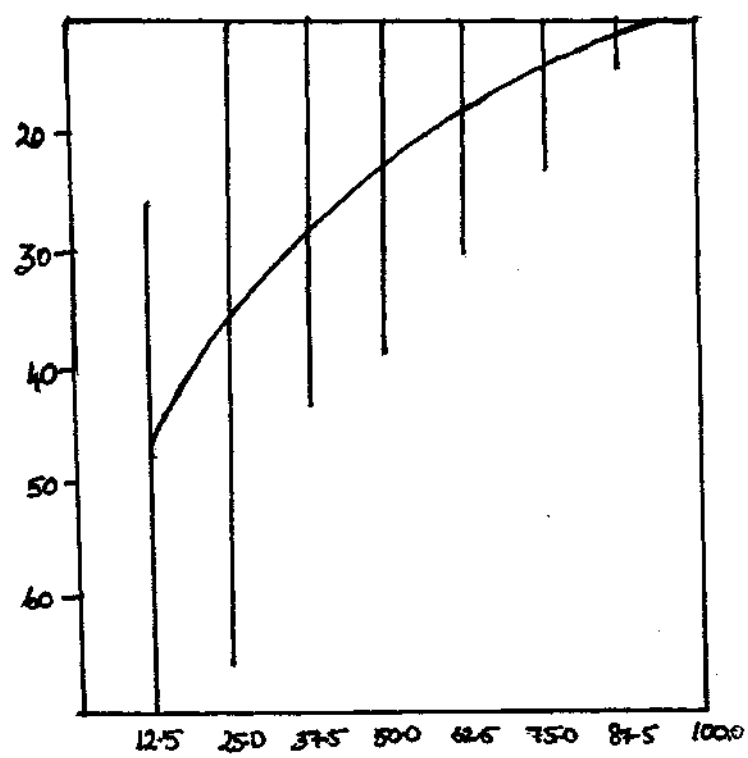
ii.



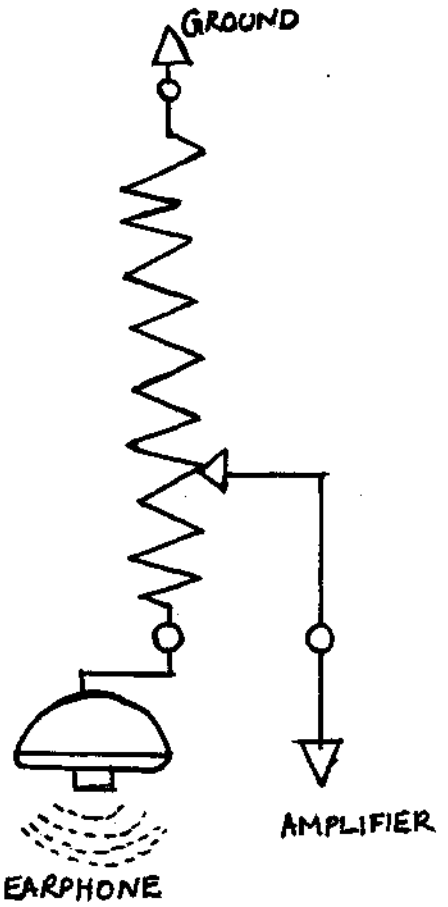
iii.



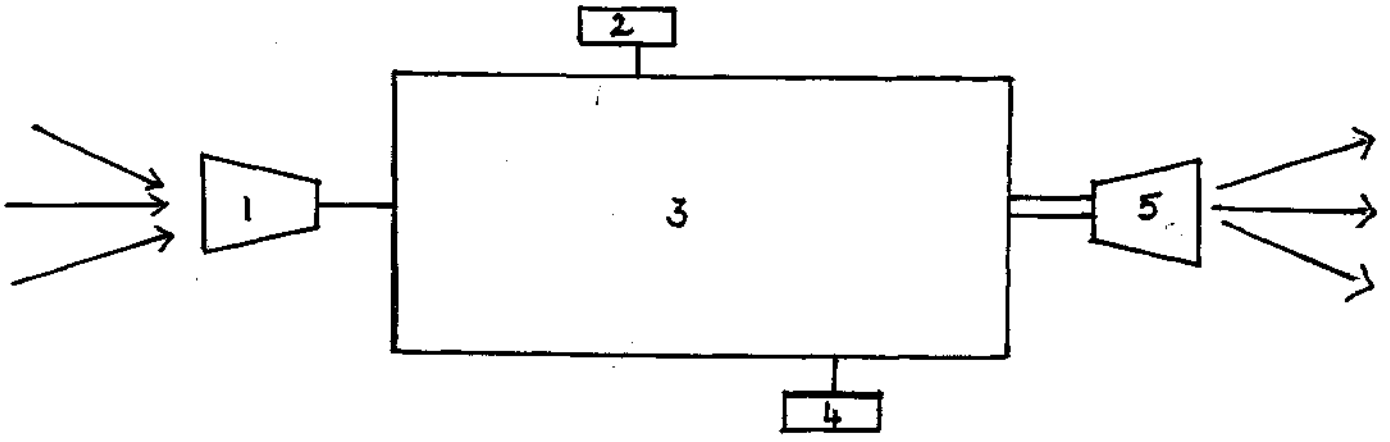
4. How will you interpret this graph ?



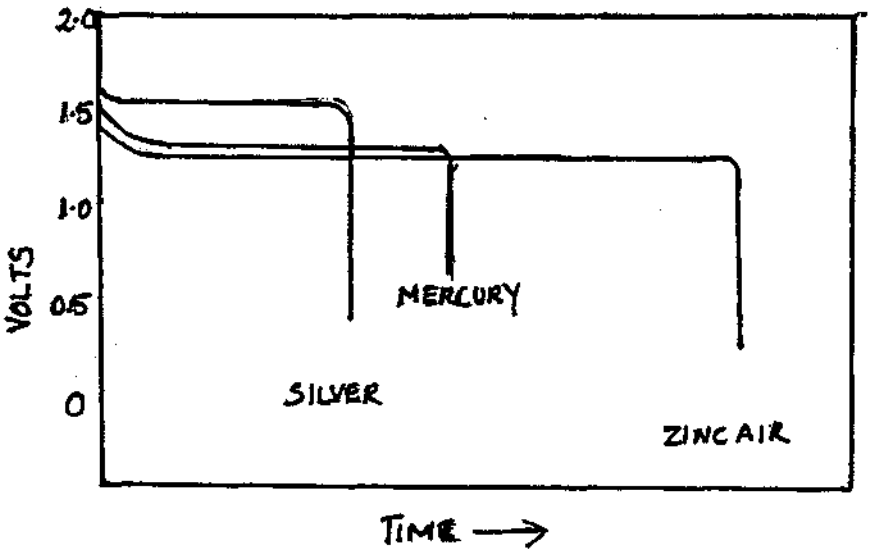
5. What does this schematic diagram represent ?



6. Of this is a block diagram of a sample hearing aid mark the important components.



7. How will you interpret this graph ?



Anagrams

1. How many different components of a body level hearing aid can you identify ?
   a. LFMAPIERI
   b. ORCIPMENHO
   c. RODC
   d. CIEVREER
   e. TTRBAEY
2. How many controls of a hearing aid can you make out ?
   a. RIMTERM
   b. LEMUVO
   c. PODTUT
   d. NOTE

ANSWERS

1. Volume control
2. Tone control
3. on-off switch
4. High pass, low pass
5. Class A
6. Suppresses, emphasizing
7. A, B or D
8. H, N or L
9. Cord
10. Monolithic IC and hybrid IC
11. Bottom sliding, swinging or open, close type
12. Amplifiers
13. 1.5 Volts
14. Moving iron magnetic earphone
15. Balanced armature magnetic type
16. 2 pin and 3 pin
17. Battery
18. Greater
19. Zinc aid and mercury
20. 2/3 rds
21. Receiver
22. Air conduction and bone conduction
23. Size, configuration, plugs, connection and number of pins.

24. Telecoil
25. Telecoil and electrical input from TV, radio, etc.
26. Decreases
27. Directional
28. Low, 4000
29. Plugs
30. Microphone and receiver
31. Microphone
32. Pressure
33. Low
34. S, V or Y cord
35. Electret
36. Good sensitivity, flat and wide band frequency response, low internal noise, insensitivity to mechanical vibration.
37. Adiflex, angleflex
38. Monolithic circuit

State whether true or false

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

8. True

9. False

10. False

11. True

12. False

13. True

Choose the correct answer

1. b

2. c

3. b

4. d

5. b

6. b

7. a

Match the following

I.	**1-b**	**IV.**	**1-d**	**V.**	**1-b**
	2-c		**2-e**		**2-c**
	3-a.		**3-b**		**3-a**
II.	**1-b**		**4-c**		**4-d**
	2-a		**5-a**	**VI.**	**1-b**
III.	**1-a**				**2-c**
	2-b				**3-a**

Answer in one or two sentences

1. - Fewer components and required space.
   - Higher output saturation levels and signal headroom
   - Reduced battery current.

2. A hearing aid could have three or more stages of amplification.
3. Volume control, tone control, on-off switch, bass control, trimmer control, output control, AGC control, etc. are some of the controls on hearing aids.
4. - Relatively higher gain
   - Utilises battery power more efficiently,
   - They allow more output at high frequencies than class A amplifiers
5. - High cost
   - Relatively short operating life
6. When set to a lower level, this control can be used to keep an instrment's gain below feedback even when the user turns the volume control full on. It can also be used to prevent overload when the $SSPL_{90}$ has been reduced due to tolerance reasons.
7. - Need for daily recharging
   - User's inability to know the battery's conditions of charge.
8. Zinc air, mercury, silver oxide and nickel cadmium cells.
9. - Battery should be removed if the hearing aid is not being used to prevent drainage.
   - Battery terminals have to be cleaned regularly to avoid corrosion.

- When not in use batteries must be stored in cool dry place.

10. Advantage: It has a long life.

    Disadvantages:

    - When they are used with high current drain hearing aids the air activation is not sufficient to accommodate the hearing aids required current drain (motor boating).
    - After the seal is removed, the cell begins to discharge slowly, even when the hearing aid is not in use.

3. i) Class A

   ii) Class B

   iii) Class D

4. Taper characteristics of volume control

5. Volume control

6. 1 - Mic

   2 - Volume control

   3 - Amplifier

   4 - Battery

   5 - Receiver

7. Silver, mercury and zinc air cells gives constant voltage output throughout its life. Battery life is greater for zinc air cells compared to the other two, and silver cells have greatest voltage of all these cells.

1. A - On-off switch
   B - Volume control
   C - Tone control
   D - Mic
   E - Clip
   F - Cord
   G - Plug
   H - Receiver
2. A - Adiflex end
   B - Angleflex end

Anagrams

1. a. Amplifier
   b. Microphone
   c. Cord
   d. Receiver
   e. Battery
2. a. Trimmer
   b. Volume
   c. Output
   d. Tone

ELECTRO ACOUSTIC CHARACTERISTICS OF HEARING AIDS

Hey ! How informed are you about electro acoustic characteristics of hearing aids. Try this quiz and find out. So get ready here we go !!

1. What do you mean by electro acoustic characteristics of hearing aids ?

a. Measurements of sensitivity of hearing aids - go to 5

b. Measurements of impedance of hearing aids - go to 9

c. Measurement of input-output functions of hearing aids - go to 13

2. The amount in decibels by which the SPL developed by the hearing and earphone in the coupler exceeds the SPL in free field is

   a. Gain —> go to 10

   b. SSPL 90 —> go to 14

3. Perfectly right, IEC was the first to publish standards for electro acoustic characteristics back upto 2.

4. No RTG simulates the 'Use' position of gain setting in hearing aids. It is not used as volume setting for measurement of $SSPL_{90}$. Moreover the range of frequencies tested do not exceed 8000 Hz, go back to 20.

5. Poor start. I am afraid electro acoustic measurements are not measurements of sensitivity of hearing aids, go back to 1.

6. Absolutely right. The $SSPL_{90}$ is aided measured using a constant insput signal at 90 dB and in the range of

200 to 8000 Hz and volume control is turned full on - go to 15.

7. Who were the first to publish standards for electro acoustic characteristics ?

   a. IEC - go to 3

   b. ANSI - go to 11

8. No, again the volume control setting used, for measurement of $SSPL_{90}$ is full on and not RTG.

9. No, electro acoustic measurements are not measurements of hearing aid impedance - go back to 1.

10. Nice going, gain is the difference between output level and the input level - jump to 20.

11. Wrong, ANSI has given standards on electro acoustic characteristics but that was in the year 1971 - get back to 7.

12. What differentiates high level AGC aids from low level AGC aids ?

    a. Slewing rate —> go to 25

    b. Level at which AGC knee occurs —> go to 30

    c. AGC flutter —> go to 35

13. Good start,.electro acoustic characteristics of hearing aids are indeed the changes effected in a signal as it is transduced from acoustic to electric to acoustic energy - jump back to 7.

14. Wrong, SSPL90 represents the maximum root mean square sound pressure level obtainable in the coupler from a earphone of a hearing aid - journey back to 2.
15. Which is the coupler that reproduces the ear drums impedances of a typical adult human ear ?
    a. Zwislocki —> go to 23
    b. 2 CC coupler —> go to 17
16. Good, the formula for computing the L_n is indeed
    $L_n = L_2 - (L_{ave} - 60)$"—> Now on to 27.
17. No, most of the average male adults have a ear canal volume of 1.2 CC. Therefore a 2 CC coupler does not reproduce the ear drum impedances of a typical adult human ear. The 2 cc coupler actually under estimates the SPL developed in the ear canal. Return to 15 and try again.
18. Sorry, you have got it all wrong. This formula does not indicate anything - retreat to 37.
19. You are off course, Strong gain hearing aids actually have the maximum amount of distortion compared to mild or moderate gain hearing aids - try 29 again.
20. Which of the following represents the settings used for measurement of $SSPL_{90}$ according to ANSl.
    a. i/p = 90 dB, Vol-RTG, Freq. 100-8000 Hz —> go to 4
    b. i/p = 90 dB, Vol-Fullon, Freq. 200-8000 Hz —> go to 6,
    c. i/p = 90 dB, Vol-RTG, Freq. 200-5000 Hz —> go to 8

21. Yes. Distortion is greatest in mild gain hearing aids. The amount of distortion varies inversely with the power category of hearing aids - go to 12.
22. Sorry. To measure the range of frequency response as input of 60 dB is given through the range from 200 to 5000 Hz and the gain control a set to RTG - try 33 again.
23. That is right. The Zwislocki coupler has a volume of 1.2 cc which simulates the volume of ear canal of an average male adult and also it reproduces the ear drums impedance of a typical adult human ear - Try 29.
24. You are wrong again. To measure the average full on gain. You give an input of 60 dB through a frequency range of 200-5000 Hz and gain control is set to full on - Try 33 again.
25. No, slewing rate refers to the rate of gain change that the compressor can effect - go again to 12.
26. Correct. This set "up is used for measurement of harmonic distortion to 37 again.
27. This kind of ASP circuit in hearing aids is intended for wearers having high frequency hearing loss, put who need more high gain for quiet sounds than they do for loud sounds.

    a. BILL —> go to 31
    b. K-amp —> go to 38

28. Wrong. Harmonic distortion arises where the output contains frequencies that were not present in the input —> go back to 39.

29. Which category of hearing aids produce the greatest amount of distortion.

    Strong gain hearing aids —> go to 19.

    Mild gain hearing aids —> go to 21.

30. Absolutely right. The high level AGC aids are differentiated from the low level AGC aids depending on the level at which the AGC knee (thredhold of compression) occurs. The higher the level at which AGC knee occurs the higher the level of that AGC aid and vice versa. Now proceed to 33.

31. Wrong. BILL is intended for wearers who frequently find themselves in noisy environment especially where low frequency noise predominates. Because they reduce low frequency amplification at high levels - try 27 again.

32. Correct. That was a good one. Wrap it all up with 40.

33. Identify the electro acoustic characteristic that is measured with the hearing aid set in the reference test position and with an input SPL of 70 dB for the input frequencies of 500, 800 and 1600 Hz.

    a. Frequency response —> go to 22

    b. Average full-on gain —> go to 24

    c. Harmonic distortion —> go to 26

34. The instrumentation for electro acoustic measurements include signal generator, hearing aid test box, regulating system, measuring system and harmonic analysis.

35. Sorry, AGC flutter refers to the distortion that occurs when the release time is faster than attack time —> turn back to 12.

36. Wrong. Intermodulation distortion arises when the output contains summation or. difference frequencies of input.

37. If, L2 = SPL in the coupler due to internal noise.

Lave = Average SPL in the coupler resulting from the 1000, 1600 and 2500 Hz signals.

L_n = Equivalent input noise level.

Which of the following expressions are correct ?

a. $L_n = L_{ave} - (L_2 - 60)$ --> go to 18

b. $L_n = L_2 - (L_{ave} - 60)$ ---> go to 16

38. Terrific. R-amp is indeed intended for such wearers since it reduces the high frequency at high levels - advance 1 number to 39.

39. This results when the frequency response curve of the hearing aid favours or supresses some frequencies more than the others.

a. Harmonic distortion —> go to 28

b. Frequency distortion —•> go to 32

c. Intermodulation distortion --> go to 36.

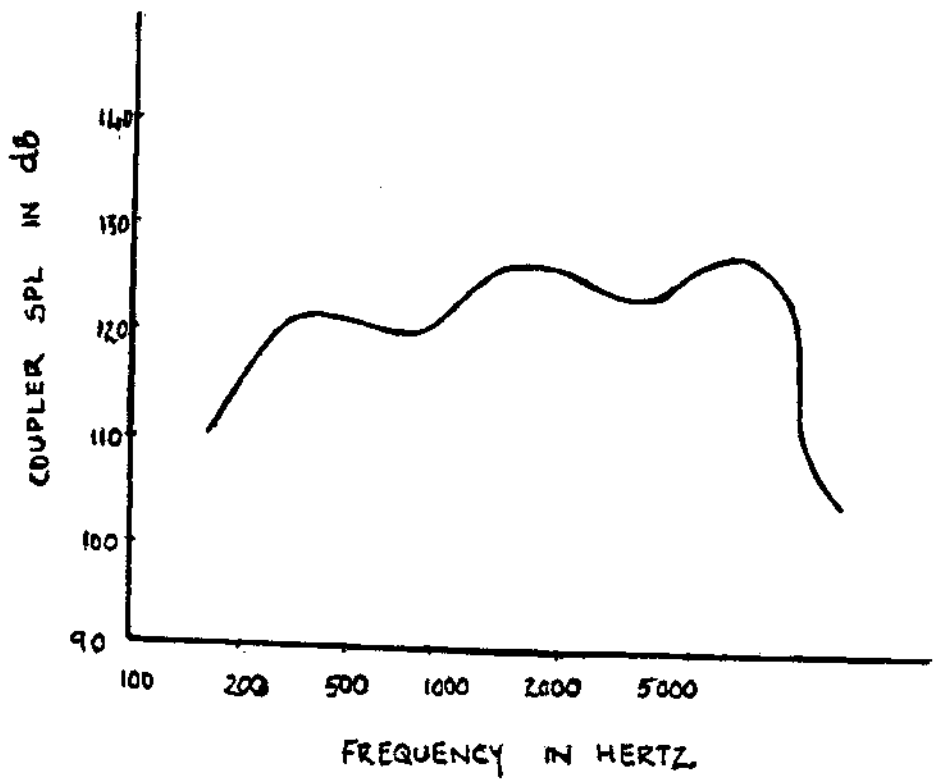
40. Well. That it ! The fastest route took 23 steps. 1-13-7-3-2-10-20-6-15-23-29-21-12-30-33-26-37-16-27-38-39-32 and 40.

One more question before you go.

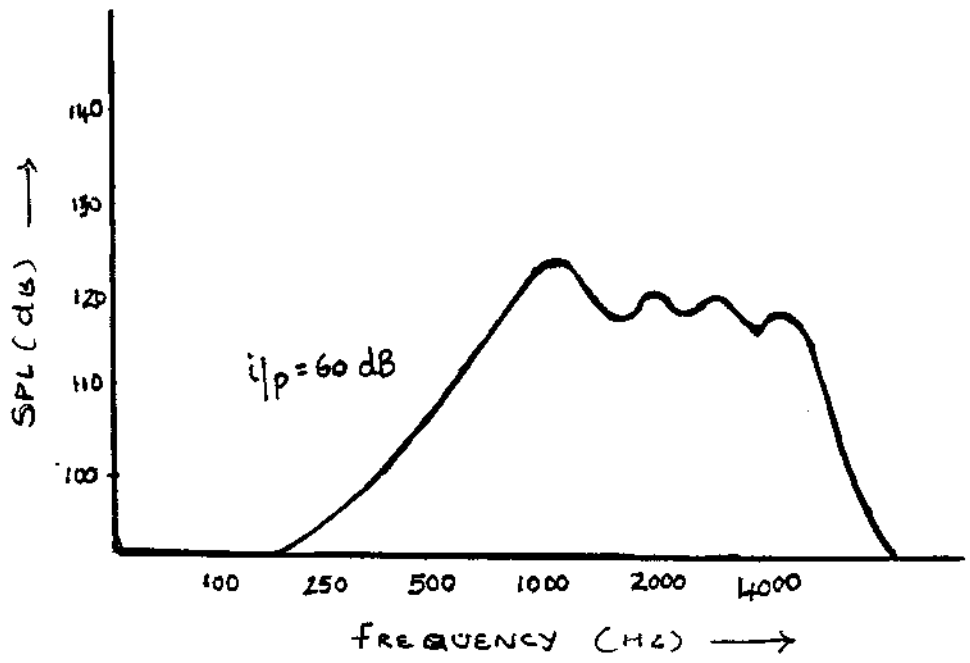
What essential instrumentation is required for electro acoustic measurements - go to 34 for the answer.

Learn through visuals

1. What does this curve represent ?

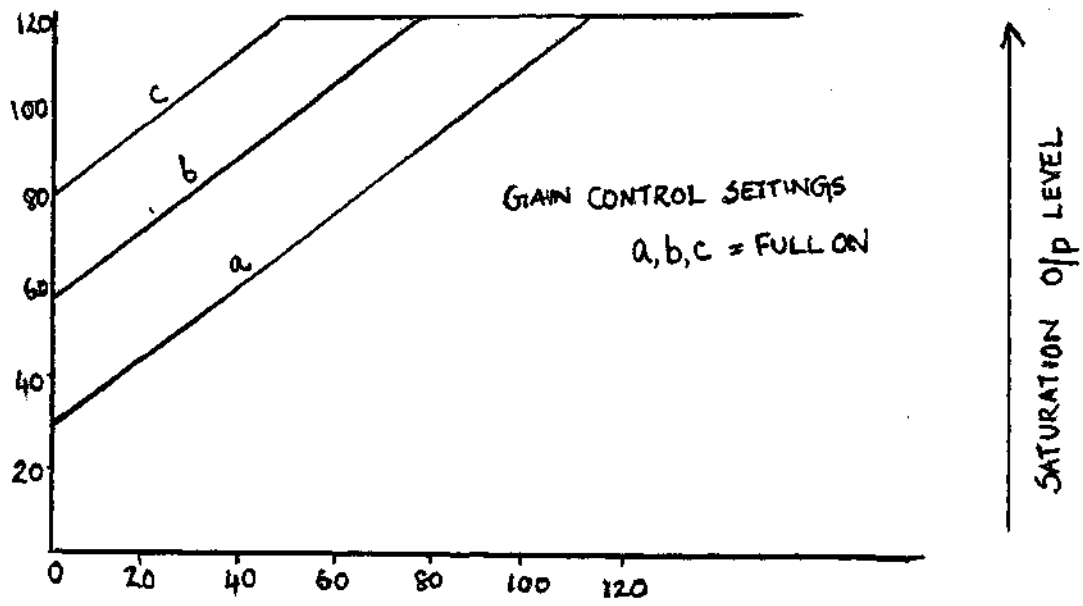


2.

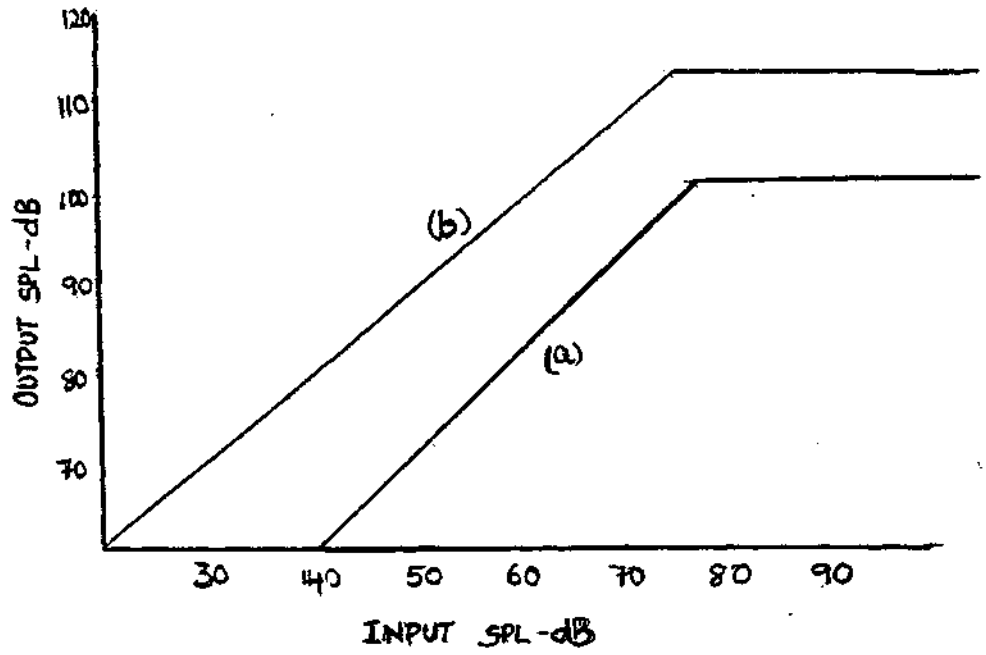


What does this curve represent ? and what is tthe gain control setting for this measurement ?

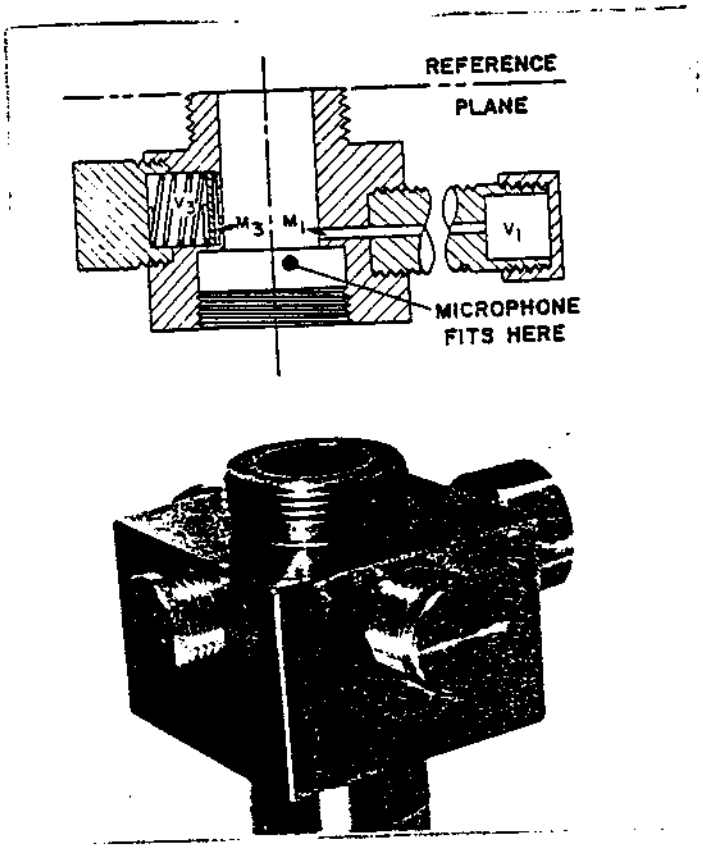
3. This graph represents the transfer functions of a linear aid. What is plotted along the abscissa and ordinate ? How do you interpret this graph.



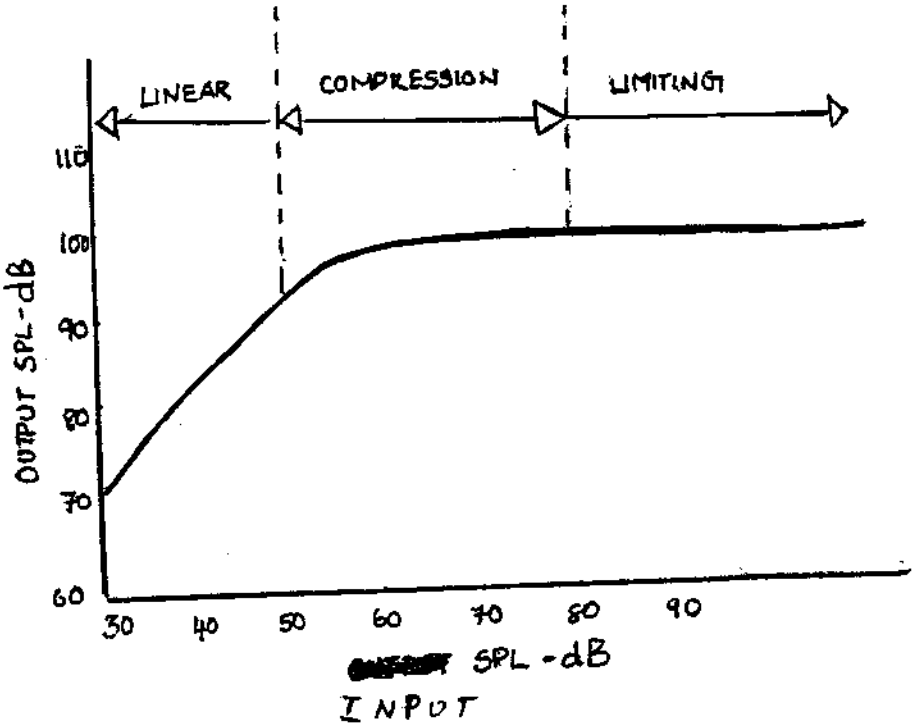
4. What does the graph 'a' represent ?



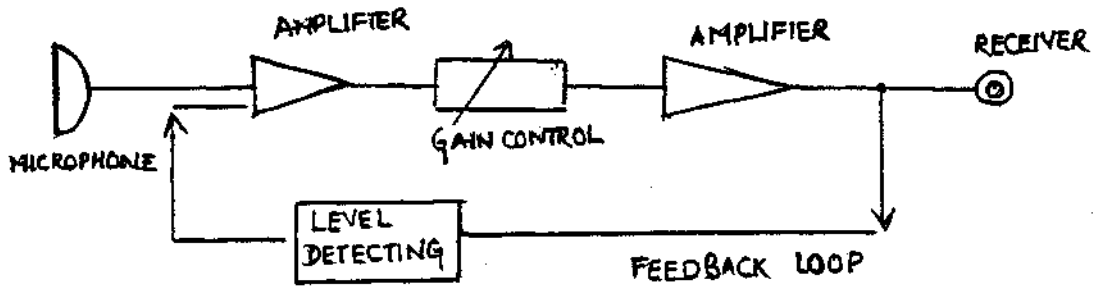
5. Can you identify this ?

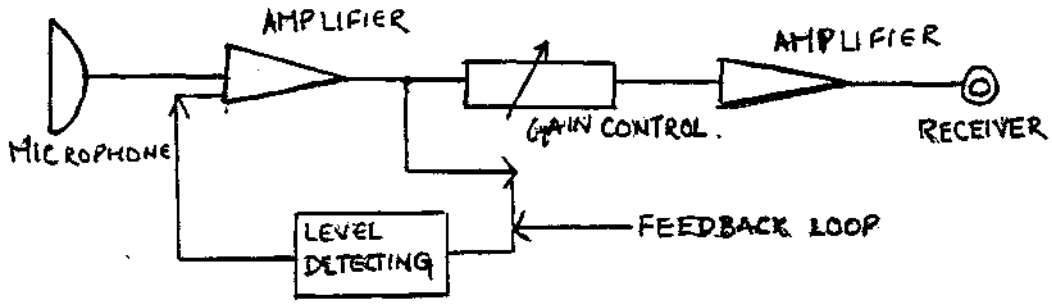


6. What does this graph indicate ? How will you interpret it ? At which point does the AGC knee occur ?



7. What do these two block diagrams represent ? How are they different ?





Fill in the blanks

Increase or decrease

1. As the frequency increases, distortion_____.
2. Distortion level decreases as the power category of the hearing aid_____.
3. As amplitude distortion increases, speech discrimination ability_____.
4. As the gain setting of a hearing aid increases, distortion_____.

5. In describing the transfer function of hearing aids we could say that as input SPL increases, output SPL _____ by the same number of decibels upto the point where the saturation output of a hearing aid is reached. Following which further increase in input results in_____of output.
6. In the case of input controlled AGC, both the gain and maximum available output are_____as the volume control in increased.
7. In the selective frequency or bandwidth compression circuits, as the input level_____the cut off frequency moves upward.
8. In the BILL type of LDFR bass_____at high levels.
9. In the TILL type of LDFR treble_____at low levels.
10. There is an_____in the SPL is the ear simulator compared to the coplext.

Would you say that ...

1. Electro acoustic measures are measurements of input output functions of hearing aids.

|Yes/No]

2. The functioning of the monitoring system in electro acoustic measurements is to regulate voltage to the loudspeaker to compensate for its frequency irregularities.

|Yes/No|

3. The acoustic energy transfer functions are significantly different for the 2 CC coupler and a real ear.

|Yes/No|

4. Comparison of hearing aid performances measured in a 2 CC coupler and in a real ear does not demonstrate a pattern of significant differences.

| Yes/No |

5. Harmonic distortion is more annoying than intermodulation distortion.

|Yes/No |

6. Inadequate headroom may result in distortions at high input levels and hence subjective judgements of poor quality and poor speech clarity.

|Yes/No|

7. Greater the gain setting of a hearing aid the greater the harmonic distortion.

|Yes/No 1

8. Speech intelligibity will not suffer in the presence of intermodulation distortion and transient distortion.

| Yes/No |

9. Harmonic and intermodulation distortion results from amplifier non-linearity.

[Yes/No|

10. It is vital to proper fitting to know the maximum output capability of a hearing aid.

|Yes/No|

11. The hearing aid has linear input-output relations.

|Yes/No|

12. The compression ratio indicates the degree of compression.

|Yes/No|

13. The 2 cc coupler should not be used for tests above 7000 Hz as the one inch microphone used with it falls of rapidly in response above 8000 Hz.

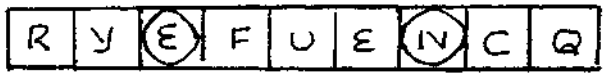
|Yes/No|

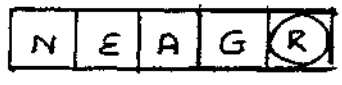
14. Equivalent input noise level can misleading for AGC aids.

|Yes/No|

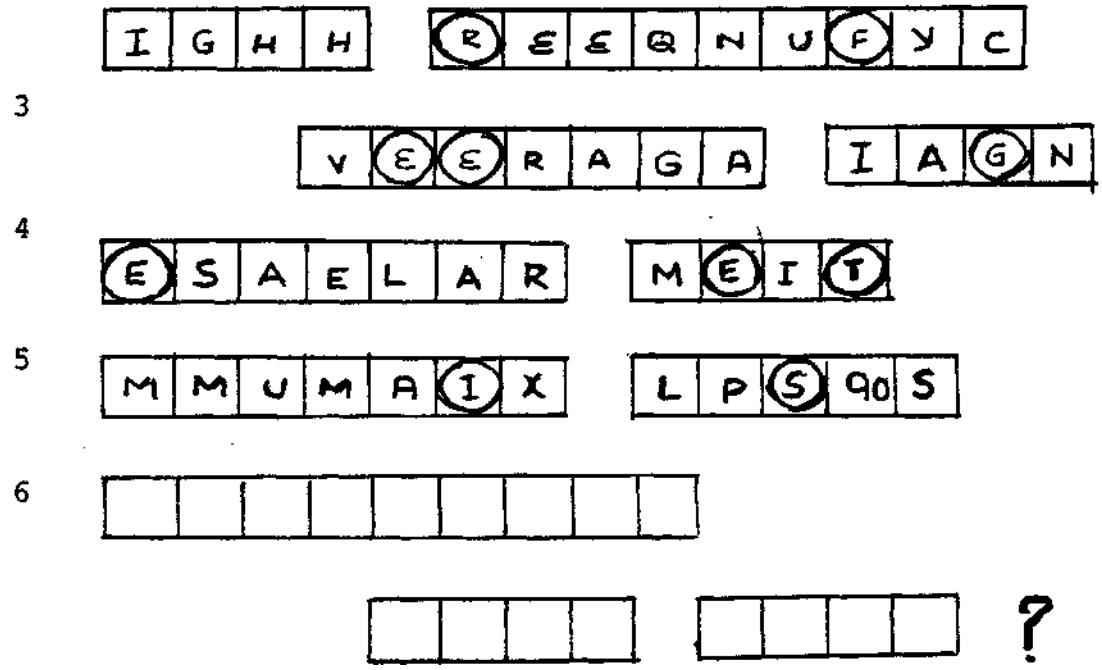
Jumble

Unscramble these letters to obtain a few common electro acoustic characteristics that are measured. Now use the letters that are circled and derive another electro acoustic characteristic. If you don't succeed you could use the clue given.

1 



2 



Clue: It simulates the 'use' position of gain setting in hearing aids.

EXPAND THE FOLLOWING

1. HAIC
2. SSPL
3. IEC
4. HFA-SSPL$_{gQ}$
5. RTG
6. L_n
7. AGC
8. KEMAR
9. AVC
10. FOG
11. PC
12. LDC
13. LL

14. AT
15. RT
16. CR
17. ASP
18. FOR
19. LDFR
20. K-AMP™
21. BILL
22. TILL
23. PILL

Give another name for ...

1. Couplers
2. Anechoic chamber
3. Saturation sound pressure level
4. Amplitude distortion
5. Peak clipping
6. Peak rounding
7. Compression
8. AGC knee
9. FFR ASP circuits
10. Frequency distortion
11. Zwislocki coupler

Questions with something in common

1. The first part of each of these words is the same. Find out the second part.
   a. High frequency average _____
   b. High frequency average _____

2. The second part of these words is distortion. Find out the first part.

   a._____distortion

   b._____distortion

   c._____distortion

   d._____distortion

   e._____distortion

   f._____distortion

3. The second part of these words is gain find out the first part.

   a._____gain

   b._____gain

   c._____gain

4. All these electro acoustic characteristics use a common input of 60 dB SPL for measurement. Name them.

5. Identify the common gain control setting used by all of these characteristics, frequency response, total harmonic distortion, L , battery current.

6. What is the common term to all these following tests ?

   Temperature tests.

   Shock tests

   Humidity tests

   Vibration tests

Match the following

Characteristic	Input SPL
1. $SSPL_{9Q}$	a - 60-
2. Max. $SSPL_{90}$	b - 70
3. Avg. $SSPLg_{0}$	c - 90
4. Avg. full on gain	d - 50-90
5. RTG	e - Abrupt
6. Frequency response	55-80
7. Total harmonic distortion	80-55
8. Equivalent input noise level	
9. Input output curves	
10. Attack and release times	

11. Characteristic	Gain control setting
1. $SSPL_{90}$	a. RTG
2. Total harmonic distortion	b. Full on
3. Attack and release times	c. Full on
	d. RTG

III. These circuits are intended for

1. Wearers who find themselves in noisy environments	a. PILL b. TILL
2. Wearers having high frequency hearing loss but who need more high frequency gain for soft sounds than they do for loud sounds	c. BILL

IV. 1. Compression limiting	a. Highs reduced at high levels
2. Wide dynamic range compression	b. Gain reduced at high levels
3. BIEL	c. Either lows or highs reduced at high levels
4. TILL	d. Gain increased at low levels
5. PILL	e. Lows reduced at high levels v
V. 1. HA-1	a. Ear simulator
2. HA-2	b. Measurements with earmold
3. Zwislocki coupler	c. Measurements without earmold
VI. 1. Percentage total harmonic distortion	a. L2 - (L_{ave} - 60)
2. Equivalent input noise level	b. 1000 Hz alternating magnetic field of strength 10 inA
3. Induction coil	c. 100 $\sqrt{\frac{P_2^2 + P_3^2 + \ldots + P_n^2}{P_1^2 + P_2^2 + \ldots + P_n^2}}$

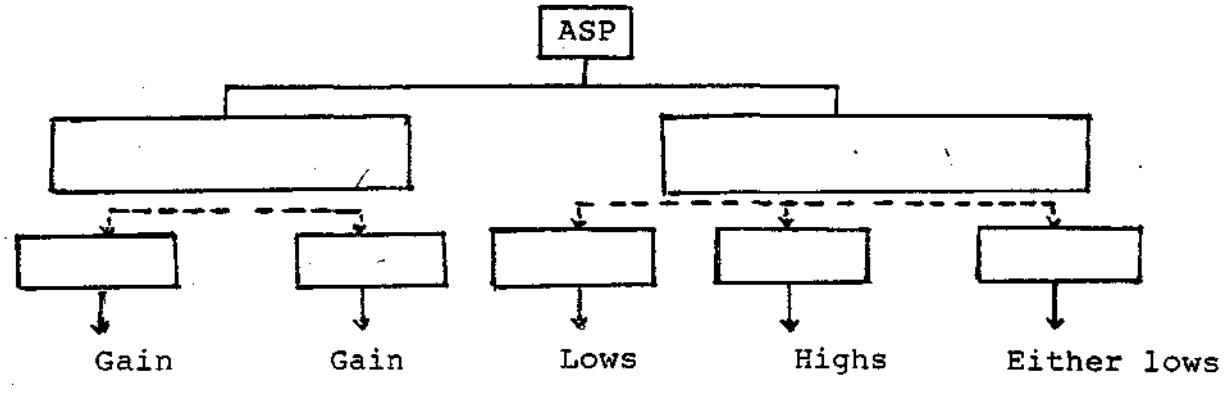
Answer in a word or a sentence (not exceeding three sentences)

1. Define SSPL
2. Mention . some of the electro acoustic performance characteristics of hearing aids that are usually measured
3. Mention some of the environmental tests done on hearing aids.
4. Mention two advantages and one disadvantage of peak clipping.

5. What are the time constants with reference to AGC hearing aids.
6. Define attack time and release time.
7. Which are the two major kinds of ASP circuits ?
8. Mention two methods used to preserve heardrooms.
9. What **are** the various standards available for electro acoustic characteristics ?
10. How will you determine the useful frequency range of a hearing aids ?
11. What is the rationale for substracting 17 dB from HFASSPL 90 for adjusting the gain control to RTG position ?

The following figure gives an outline for the classification of the ASP type hearing aids (proposed by Killion, Staab and Preves, 1990), if the empty blocks are filled in. Iry and do it. Clues for each type have been provided at the bottom.

Fill up the blocks



increased at high levels

increased at low levels

decreased at high levels

decreased at high levels

or highs decreased at high levels

Fill in the blanks

1. The anechoic chamber is used in electro acoustic measurements to make the test space free of _____ batvernirroe (Anagram).
2. The acoustically "dead" room used in electro acoustic measurements is known as_____or _____
3. The range over which temperature testing on hearing aid is done is_____to_____.
4. Random noise generated due to the rubbing of clothing against the mic in body worn aids or the inherent noise generated by the electronic circuitary in aids refer to

5. When the hearing aid is unable to duplicate a sudden decay or alteration of the waveform, this results in _____GGININR (Anagram).
6. Gain of the hearing aid with volume control turned full on is_____.
7. Non-linear distortion is also known as_____.
8. This distortion can result from rapid fluctuation of the amplitude or frequency of the stimulus or both

9. _____results when the phase angle between the fundamental frequency and any of its,hormonics or between any two frequencies of a complex wave changes'.

10. Frequencies at which maximum distortion occurs were _____in ear level than in body level aids.
11. The average output saturation SPL calculated from frequencies 1000, 1600 and 2500 Hz is called _____ $SSPL_{90}$.
12. _____and_____are two common kinds of non-linear distortion.
13. The K-amp circuit gives_____treble, emphasis.
14. The K-amp circuit as this type of ASP circuit.
15. The circuits that reduce gain at high levels and/or increase gain at low levels but do not change the frequency response of hearing aid are called

16. The terms limiting level, compression ratio, slow rate and time constants all refer to_____.
17. This device has four acoustical networks allowing for simulation of the acoustic impedance of human ear drum

18. _____was the first to describe 2 CC coupler in the year_____.
19. _____and_____are output limiting systems used in hearing aids.
20. The rate of gain change in MS/dB that the hearing aid circuit can handle is called_____.
21. Threshold of compression is also known as_____.
22. The formula for determining the % THD is_____.

23. _____ is defined as the removal by electronic means, of one (unsymmetrical) both extremes (symmetrical) of AC amplitude peaks at a predetermined level.

24. Multichannel compressors were designed by _____ in the year _____.

25. LDHR ASP circuits automatically change the _____ and _____ of the hearing aid as a function of input signal.

26. The K-amp circuit was designed by _____ in the year _____.

27. _____ refers to the level at which the saturation output of the hearing aid is limited.

28. To prevent the entire frequency spectrum from getting compressed on AGC circuitary, the knee has to be set so that the _____ do no activate the AGC circuit except at high levels.

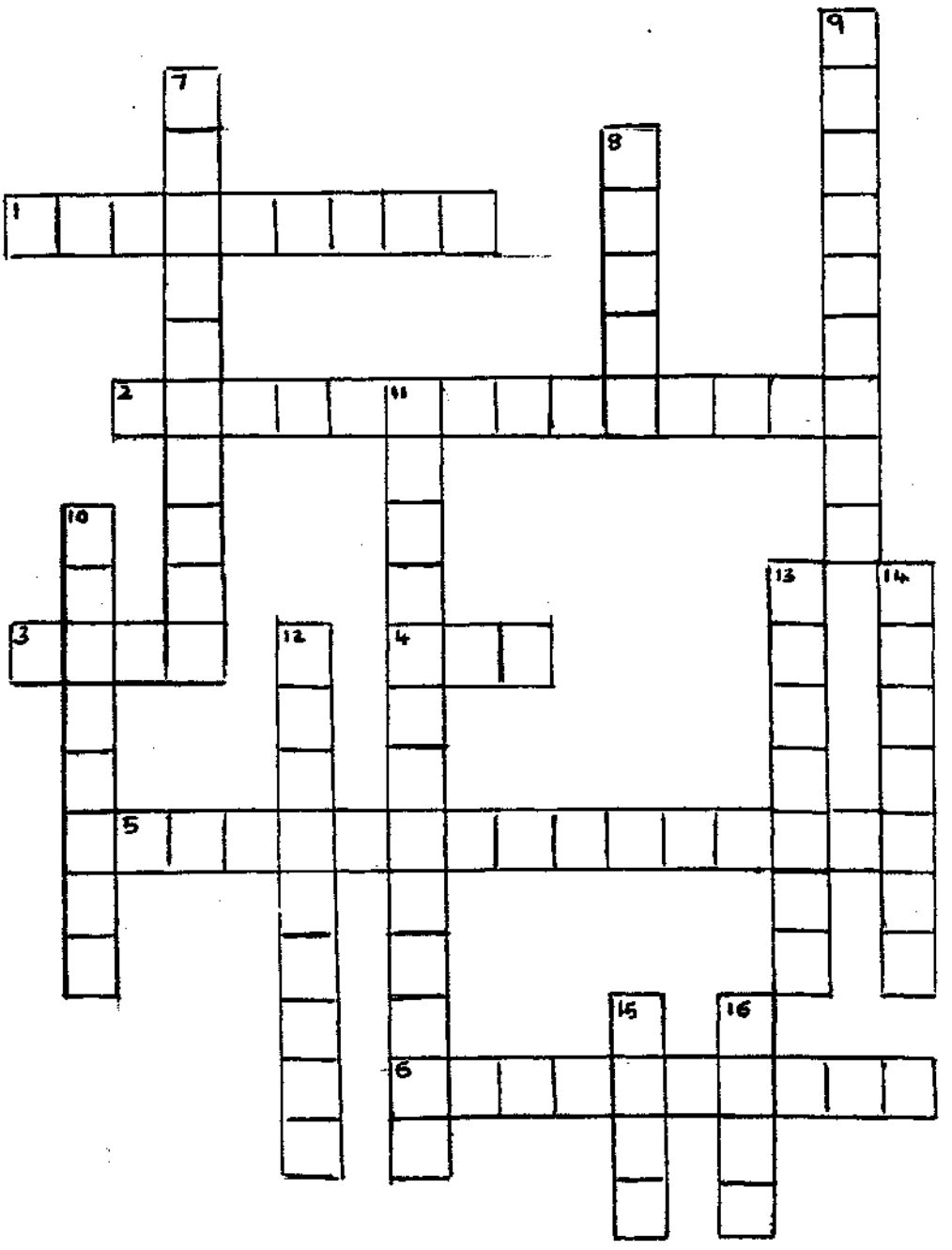
29. The quotient of a change in level of the input divided by the corresponding change in level at the output on the compression's portion of transfer function is

30. _____ is a form of non-linear amplification that is evidenced by a gradual ever diminishing decrease in output with each successive increase in input.

31. The limiting systems in hearing aids have a built-in monitoring circuit that automatically reduces the electronic gain of the hearing aid as a function of the magnitude of the signal being amplified _____.

32. While doing electro acoustic measurements the temperature, relative humidity and atmospheric pressure should be _____, _____ and _____ according to IS 1984.

Crossword puzzle



Across

1. This coupler reproduces the eardrum impedances of a typical adult human ear.
2. The useful range of frequency response.
3. The amount in decibels, by which the SPL developed by the hearing aid earphone in the coupler exceeds the SPL in free field.
4. This setting simulates the 'use' position of gain setting in hearing aids - abbreviated.
5. The ratio of the power of the output signal at frequencies other than those delivered to the hearing aid to the power of the signals that were applied to the hearing aid gives this distortion.
6. This kind of feedback occurs when the output signal from the hearing aid is picked up by its own microphone and reamplified.

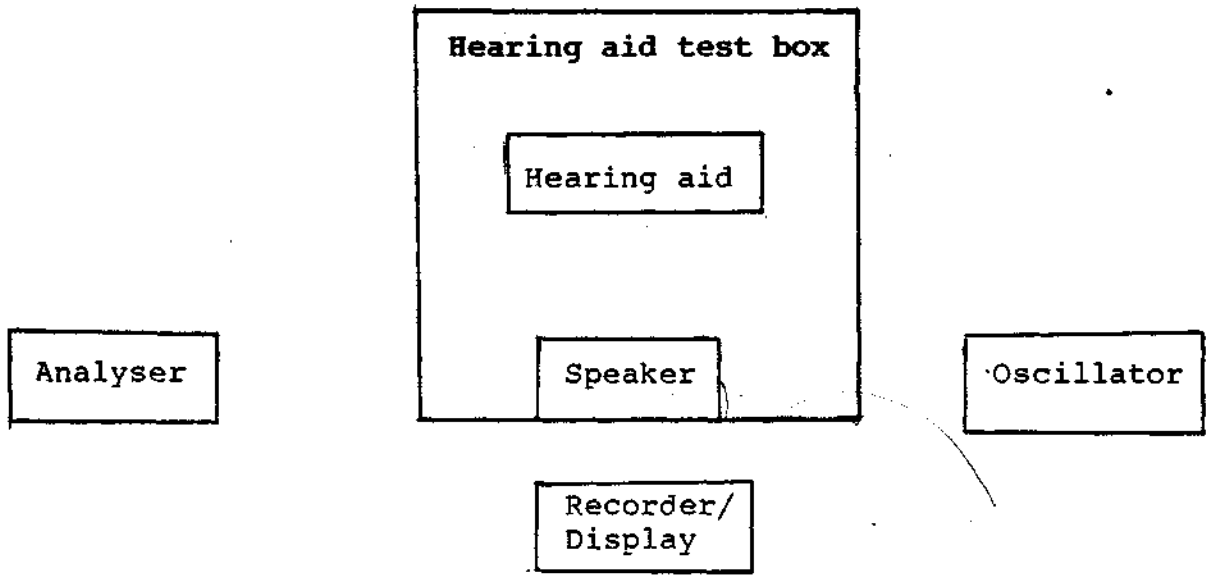
Down

7. The failure of a system to transmit or reproduce a reviewed waveform with exactness. (10)
8. Identify this acronym its got a head and torso and has the dimensions of an average human adult, moreover its got a Zwislocki coupler inside its head. (5)
9. This distortion occurs when a hearing aid is unable to duplicate the initial sharp attack (rise time) or the sudden decay (fall time) of a sound. (9)

10. This is defined as the difference in db between the combination of the peak input level plus the gain, and the level at which peak clipping occurs.
11. Vibration testing, temperature testing, shock testing, humidity testing, etc. are all examples of _____ tests. (13)
12. Distortion level is_____proportional the power category of aids. (9)
13. K-amp TM circuit was designed by him in the year 1990. (7)
14. This distortion arises when the output contains multiples or harmonics of the fundamental frequency of the input signal. (8)
15. The maximum SPL obtainable in the coupler from a earphone of a hearing aid (abbreviated). (4)
16. This is the most versatile of all ASP circuits (abbreviated). (4)

Instrumentation for measurement: of electro acoustic characteristics

Draw arrows from one block to another to complete the instrumentation set up for electro acoustic measurements.


Hearing aid test box
Hearing aid
Analyser
Speaker
Oscillator
Recorder/
Display

ANSWERS

1. $SSPL_{90}$ curve
2. Frequency response curve, RTG
3. Ordinate - Output SPL

   Obscissa - Input SPL

   As the gain control is advanced from a LC the gain in the linear portion of the curve increases, but when saturation level reaches, no further increase occurs.
4. Peak clipping.
5. Automatic gain control (compression).

   The input/output curves of AGC aid has three main components.

   —> a linear section where increments on input SPL cause equal increment in output SPL.

   —> a compression section where increments on input SPL cause smaller increment in output SPL.

   —> a limiting factor where increments on input SPL do not significantly increase output SPL.
6. (a) Output - Controlled AGC

   (b) Input - Controlled AGC

   In the output control AGC, the amplified gain changes on the volume control setting. In the output controlled AGC on the other hand because the feedback circuit occurs before the volume control, control of

amplifier gain always occurs at the same input level regardless of where the volume control is set.

5. Zwislocki coupler

Fill in the blanks

1. Decreases
2. Increases
3. Decreases
4. Increases
5. Increases, decreases
6. Increased
7. Increases
8. Decreases
9. Increases.
10. Increase

Would you say that

1. Yes
2. Yes
3. Yes
4. No
5. No
6. Yes
7. Yes
8. No
9. Yes
10. Yes
11. No
12. Yes
13. Yes
14. Yes

Jumble

1. Frequency range
2. Harmonic distortion
3. High frequency average gain
4. Release time
5. Maximum $SSPL_{90}$
6. Reference Test Gain

Expand the following

1. Hearing Aid Industry Conference
2. Saturation Sound Pressure Level
3. International Electrotechnical Commission
4. High Frequency Average Saturation Sound Pressure Level
5. Reference Test Gain
6. Equivalent Input Noise Level
7. Automatic Gain Control
8. Kemar -
9. Automatic Volume Control
10. Full On Gain
11. Peak Clipping
12. Linear Dynamic Compression-
13. Limiting Level
14. Attack Time
15. Release Time
16. Compression Ratio
17. Automatic Signal Processing
18. Fixed Frequency Response
19. Level Dependent Frequency Response
20. Killion-amp
21. Bass Increases at Low Levels
22. Treble Increases at Low Levels
23. Programmable Increases at Low Levels

Give another name for ...

1. Artificial ear
2. Hearing aid test box
3. Maximum power output
4. Non-linear distortion
5. Peak limiting
6. Diode clipping
7. Automatic Igain control
8. Treshold of compression
9. AGC circuits
10. Linear
11. Ear simulator

Questions with something in common

1. a. Full on gain
   b. $SSPL_{90}$
2. a. Harmonic
   b. Intermodulation
   c. Transient
   d. Extraneous
   e. Frequency
   f. Amplitude
3. a. Full on
   b. High frequency average
   c. Reference test

4. Full on gain, RTG, frequency response, equivalent input noise level.
5. RTG
6. They are all environmental tests

Match the following

I. a **- 3, 4, 5, 6, 8**
b - 7
c **- 1, 2**
d **- 9**
e **- 10**

II. **1 - b**
2 - a
3 - c

III. **1 -** c
2 - b

IV. **1 - b**
2 - d
3 - e
4 - a
5 - c

V. **1 - b**
2 - c
3 - a

VI. **1 -** c
2 - a
3 - b

Answer in a **word or a sentence**

1. SSPL is defined as the maximum root mean square SPL obtainable in the coupler from the earphone of a hearing aid.
2. Gain, $SSPL_{90}$, RTG, frequency response curve, equivalent input noise level, harmonic distortion, current drain, attack and release time.
3. Temperature, shock, humidity, vibration.

4. Advantages

- Construction is simple
- Requires very little space to accomplish effective instantaneous output limiting.

Disadvantage

- Harmonic distortion occurs above the limiting level.

5. Attack time and release time.

6. **Attack time** is defined as the length of time required for the feedback circuit to set the new gain value following a strong input signal.

Release time is defined as the length of time required for the reduced gain to return to normal amplification after the strong input signal is no longer present.

7. FFR and LDFR circuits.

8. a. Lowering the input SPL to the hearing aid by use of volume control or AGC circuit.

b. Raising the $SSPL_{90}$ in linear aids by using amplifiers having low output impedance receivers.

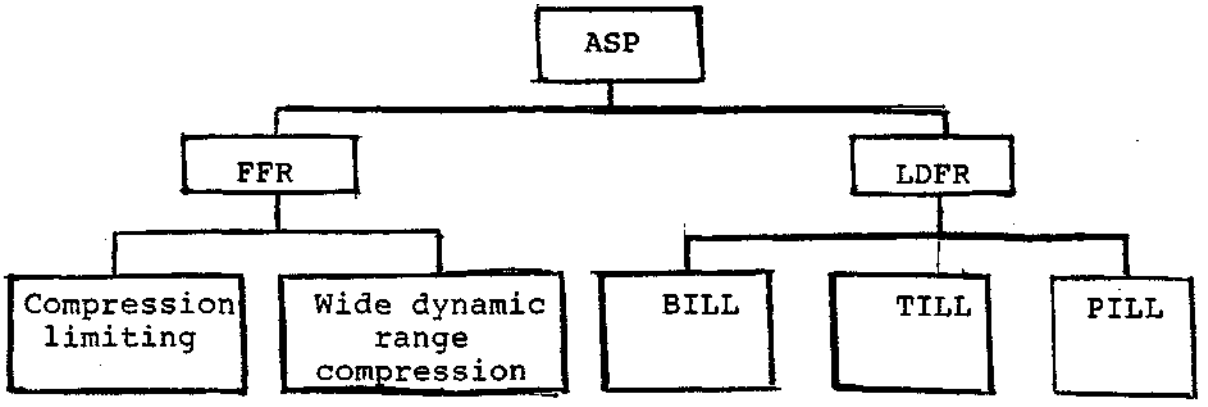
9. HAIC, ANSI and IEC and BIS, etc.

10. Gave a 60 dB SPL input with the volume control of the hearing aid set to RTG, the range of 200 to 5000 Hz being considered. Now record the output of the hearing aid across different frequency calculate the average of the response levels at 1000, 1600 and 2500 Hz and substract 20 dB from this draw a line parallel to the

abscissa at this level. The range is determined by the distances between the points on the frequency response curve that this line intersects.

11. The average intensity of speech is about 60 dB over a distance of 1 m. But speech spectra has peaks also. The level of these peaks is about 17 dB. Therefore 17 dB is substracted from the HFA SSPLQQ to account for this also.

Fill up the blocks



Fill in the blanks

1. Reverberation
2. Anechoxc room
3. - 20°F to + 140°F
4. Extraneous distortiorf
5. Ringing
6. Full on gain
7. Amplitude distortion
8. Transient distortion
9. Phase distrotion

10. Higher

11. High frequency average $SSPL_{go}$

12. Harmonic and intermodulation

13. Most

14. TILL

15. FFR ASP circuits

16. AGC hearing aids

17. Zwislocki coupler

18. Romanow (1942)

19. Peak clipping, compression

20. Slew rate

21. AGC knee

22. $100\sqrt{\frac{P_2^2 + P_3^2 + \ldots + P_n^2}{P_1^2 + P_2^2 + \ldots + P_n^2}}$

23. Peak clipping

24. Villchur, 1973

25. Gain and frequency response

26. Killion (1990)

27. Limiting level

28. Low frequencies

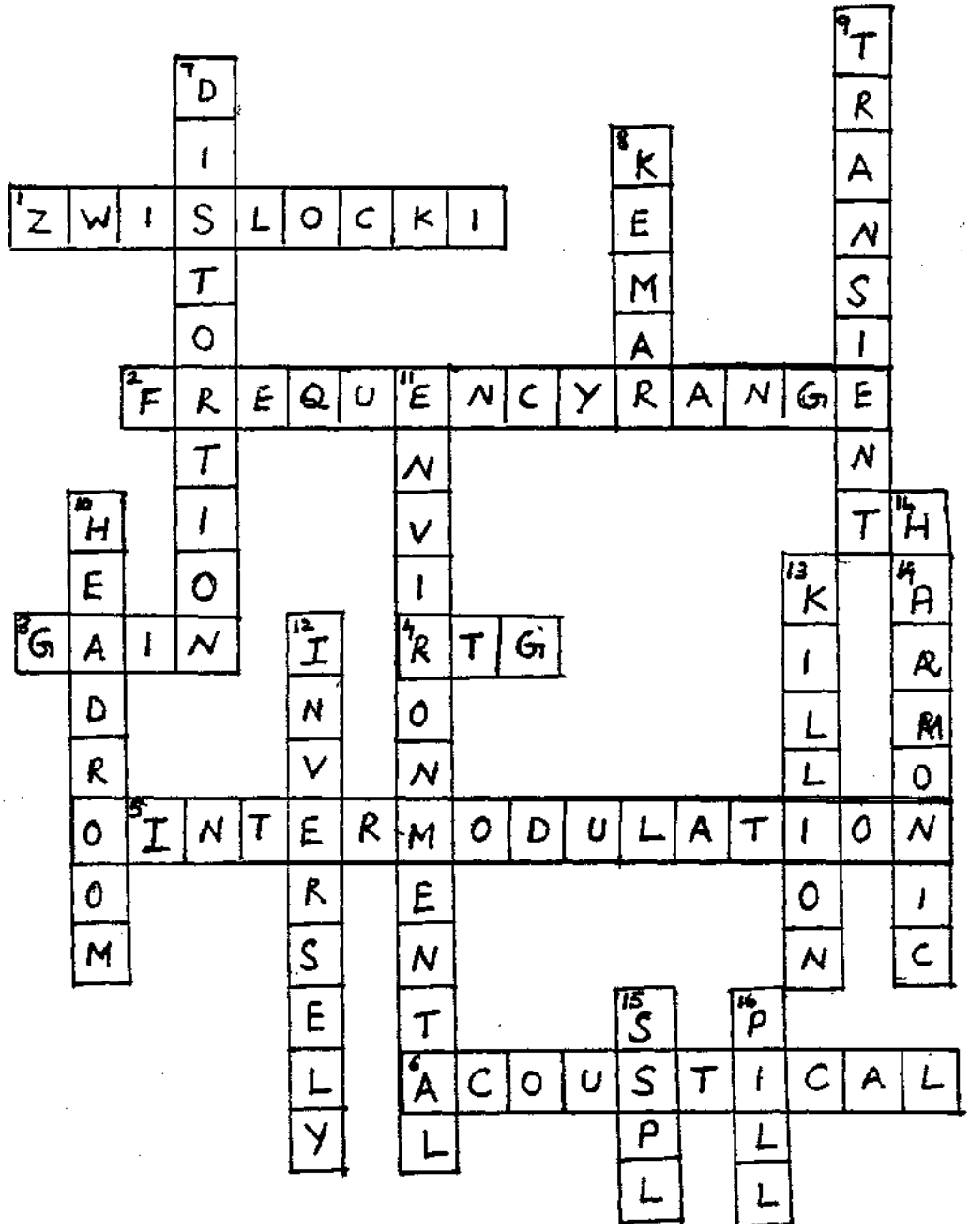
29. Compression ratio

30. Curvilinear compression

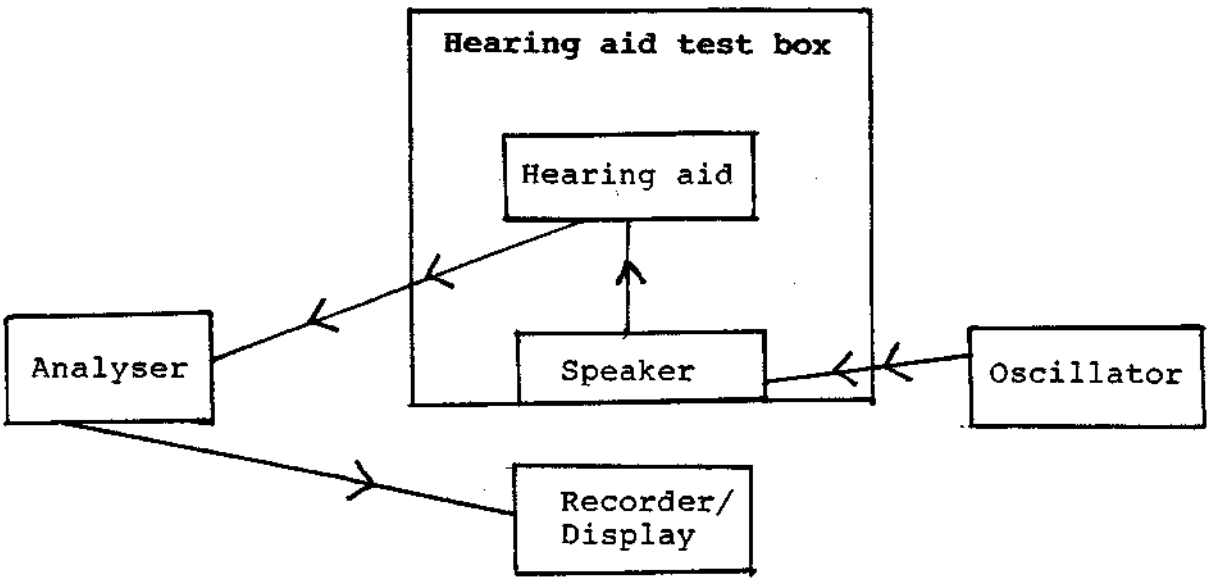
31. AGC circuits

32. 15-35°C, less than 80%, 86-106 kdapa.

Crossword puzzle



Instrumentation for measurement: of electro acoustic characteristics



EAR MOLDS : ACOUSTIC AND STRUCTURAL CONSIDERATIONS

Fill in the blanks

1. _____ is a plastic insert designed to conduct the amplified sound from the hearing aid receiver to the canal as effectively as possible.
2. The type of ear mold used is determined by the patients _____ and _____.
3. The various styles of ear mold that are used include _____, _____, _____ and _____ molds.
4. _____ is the ear mold of preference when the least amount of acoustic modification of the signal is desired or when a high gain is needed.
5. The two variations of skeleton mold are and _____.
6. This kind of ear mold has the maximum cosmetic appeal _____.
7. _____ refers to a plastic tube to couple the hearing aid and ear mold in all personal amplification systems other than body and all in the ear type aids.
8. Increasing the length of the tubing will result in a minimal _____ in output above 1500 Hz.
9. Increase in the internal diameter of the tubing results in _____ in energy in the third formant region.
10. _____ is an opening from the face of a ear mold to its sound input channel, which is an intentionally produced leak.

11. Venting is used to attenuate_____frequencies.

12. The three vent sizes that are usually used are_____,
_____and_____'

yl3. The three kinds of vents generally drilled in a ear mold are_____,_____' and_____vents.

14. When a diagonal vent is used_____frequency attentuation occurs.

15. Shorter the vent and greater its diameter_____is the reduction in low frequency energy.

16. The three kinds of adjustable vents that are in widespread use are_____,_____and _____

17. The_____or_____vents when drilled into a ear mold, intersects the main sound bore at some point.

18._____consists of a permanently installed clear styrene seating ring and a removable polythene venting plug available in five different sizes.

19. PVV is a versatile method for the_____rather than the user.

20._____is a vent than can be adjusted by the patient himself with a screw type knob located on the face of the ear mold.

21._____is a plastic plug which is about 4.3 mm in length and has a hole that runs through the entire length of the plug.

22. Venting_____the MPO of a hearing aid.

23. _____ are acoustical resistances that can be placed at appropriate locations in the tubing transmission line to smooth peaks in response.

24. Horns are used in ear molds to enhance the _____ frequency transmission.

25. Larger the cross-sectional area at the mouth of the horn _____ the high frequency transmission.

26. The impedance of a mass of air in a section of tubing is directly proportional to the _____ and inversely proportional to the _____.

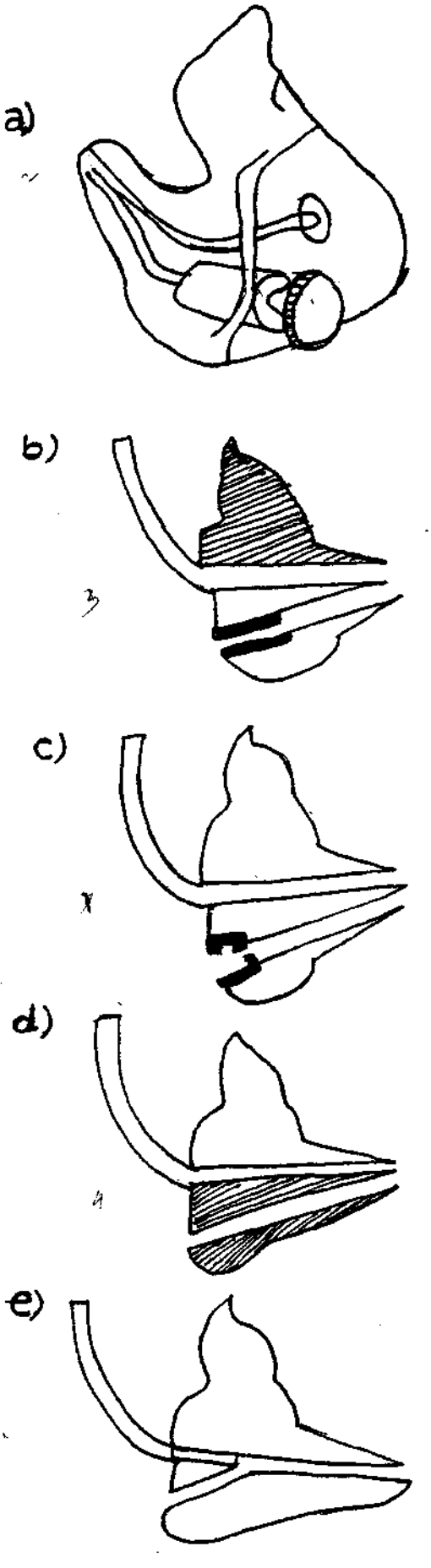
27. _____ and _____ are generally used as dancers in ear molds.

28. Some of the advantages of using a vent are _____, _____ and _____.

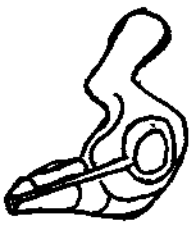
I. Match the following

1. Receiver mold	a. Consists of canal portion and used for moderate gain instruments
2. Shell mold	b. Consists of canal plus the lower one-half of the concha rim.
3> Skeleton mold	c. Has a full canal and a thin plate covering the bowl of ear
4. Canal mold	d. Full, solid mold, with metal or plastic snap ring for the appropriate sized nubbin.
5. Canal lock mold	e. Consists of canal and a thin frame around the bowl of ear.
6. Canal mold	f. Used to couple and hold an ITE hearing aid
7. All in the ear mold	g. All of canal portion is eliminated except for small part used to retain tubing.

II. 1. PW
2. VVV
3. SAV
4. Parallel vent
5. Side branch vent

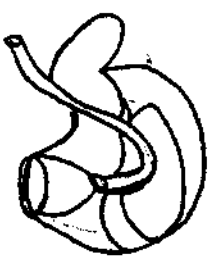


III. 1 d

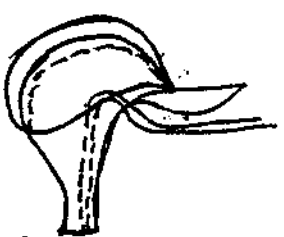


c 2.

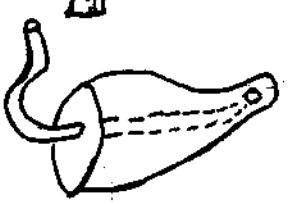
1 3.



c 4.



b 5.



a. Shell mold

b. Canal mold

c. Open mold

d. Receiver mold

e. Skeleton mold

f. Horn mold

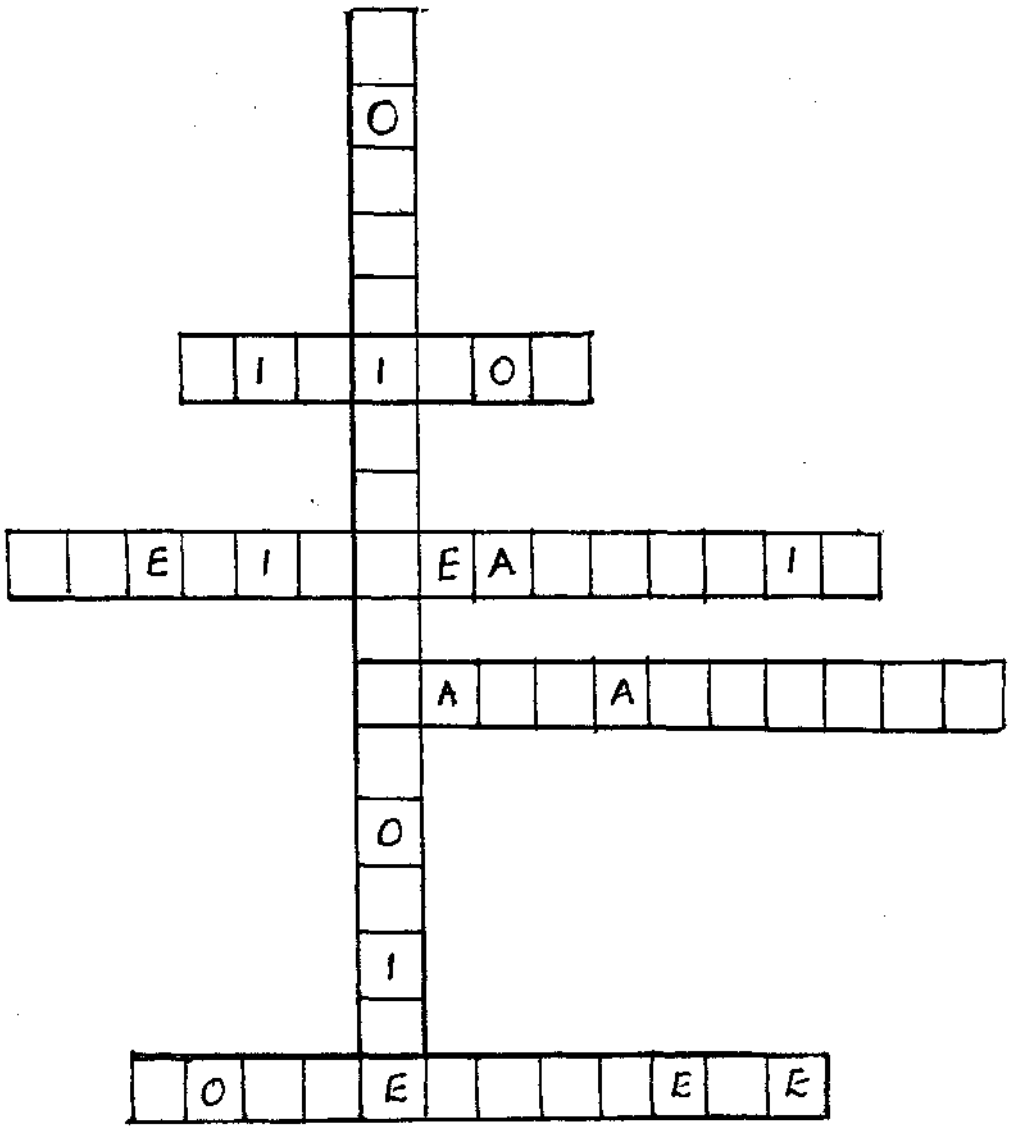
State whether true or false

1. When maximum amount of low frequency attentuation is desired the open ear mold is used in conjunction with electronic high frequency emphasis from the aid.

2. The impedance of a mass of air in a section of tubing is directly proportional to the diameter of the tubing and inversely proportional to its length.
3. When a horn is used, the low frequency resonance points are shifted upwards in frequency.
4. For maximal control of venting the diameters of the SAV and PW inserts should be kept relatively small and the vent channel should be short with a large diameter.
5. The hearing aid response can be modified by altering the tubing length and inside diameter.
6. The length of the tubing has minimal influence on the first formant (F1) and causes minor variations in second (F_2) and third (F3) formant.
7. In the VVV the frequency response is altered by the user and not the dispenser.
8. A larger diameter bore increases high frequencies.
9. Hard acrylic is the most commonly used ear mold material.
10. Parallel and diagonal vents have the same frequency response above the resonant frequency of vent associated resonance.
11. A tighter seal can be obtained with a soft mold

Puzzles

1. Fill in the empty blocks and see how many ear mold materials you can identify.

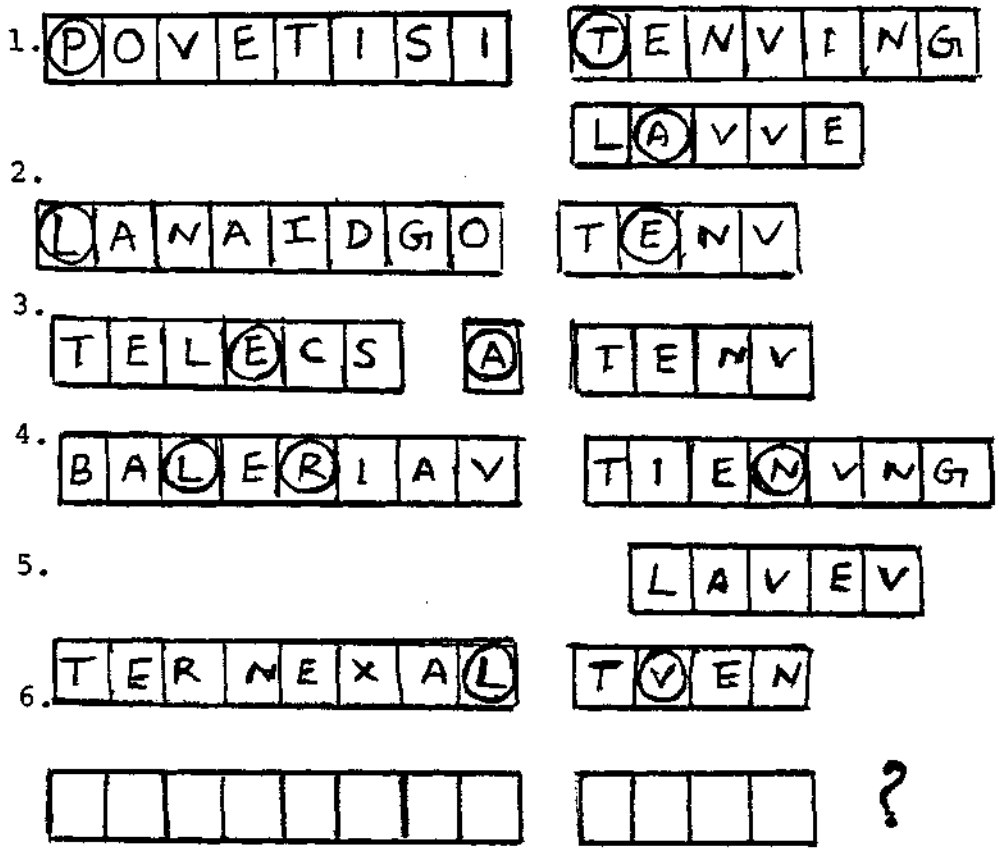


2. How many different kinds of ear mold can you identify here ?

S	H	E	L	L	Q	R	S	T	U	V	R
K	P	C	A	N	A	L	L	O	C	K	E
E	O	S	T	X	L	R	R	I	J	K	V
L	I	P	V	Y	L	A	L	M	N	U	E
E	P	E	E	V	I	A	N	P	Q	R	I
T	I	O	R	N	X	A	J	A	C	U	C
O	L	R	T	U	X	O	T	P	C	T	E
N	A	L	L	I	N	T	H	E	E	A	R

Jumble

Unscramble the letters given below to form names of different types of vents used with ear molds. Use the letters circled to form yet another variety of vent. You could use the clue given below.



ANSWERS

Pill in the blanks

1. Ear mold
2. Hearing loss and desired acoustic effect
3. Receiver, shell, skeleton, canal and open molds
4. Custom made regular ear mold
5. 3/4th skeleton and semi-skeleton
6. Canal mold
7. Tubing
8. Decrease
9. Decrease
10. Vent
11. Low
12. Small, medium and large
13. Parallel, diagonal and external
14. High
15. Greater
16. Positive Venting Valve (PW), Variable Venting Valve (VVV) and Select-A-Vent (SAV)
17. Diagonal or Side branch
18. PVV
19. Dispenser
20. VW
21. SAV

22. Reduces
23. Dampers
24. High
25. Better
26. Length, diameter of tube
27. Sintered filters and lambs wool
28. Static pressure equalisation, improved quality of sound, altered frequency response for better speech discrimination in quiet and noise.

Match the following

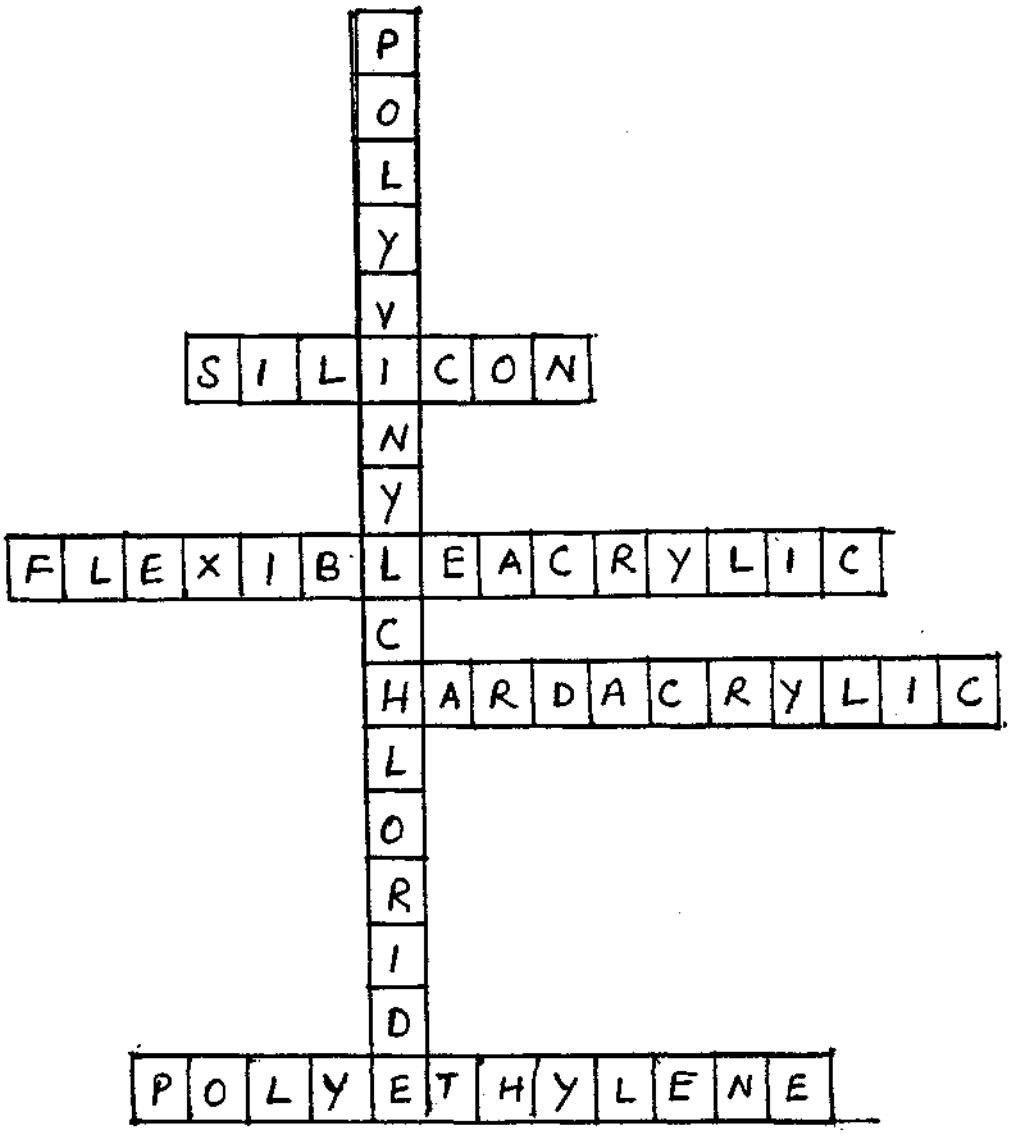
I. 1 - d	**II. 1 - c**	III. **1 -** d
2 - c	**2 - a**	**2 - c**
3 - e	**3 - b**	**3 - e**
4 - a	**4 - ed**	**4 - a**
5 - b	**5 - de**	**5 - b**
6 - g		
7 - f		

State whether true or false

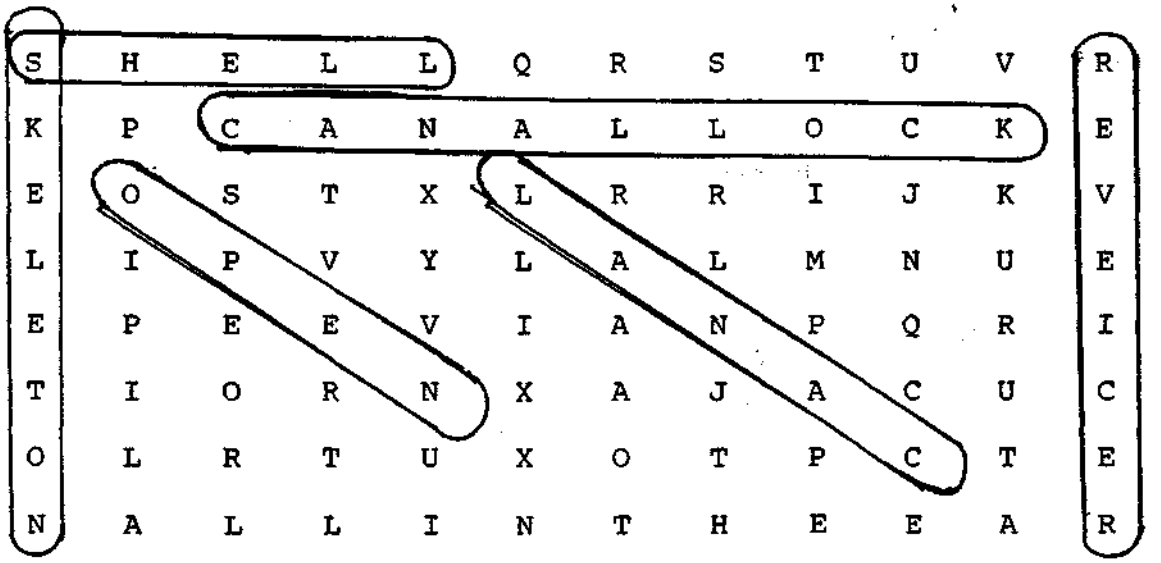
1. True
2. False
3. True
4. True
5. True
6. True
7. True
8. True
9. True
10. False
11. True

Puzzles

1.


POLYVINYL
SILICON
FLEXIBLE ACRYLIC
CHLORIDE
HARD ACRYLIC
POLYETHYLENE

2.


SHELL
CANALLOCK
KELETON
REVEICER

Jumble

1. POSITIVE VENTING VALVE
2. DIAGONAL VENT
3. SELECT A VENT
4. VARIABLE VENTING VALVE
5. EXTERNAL VENT
6. PARALLEL VENT

SPECIAL APPLICATIONS OF AMPLIFICATION

Choice the correct answer

1. Trans cranial cros was given by
    a. Blackard (1988)
    b. Green (1988)
    c. Sullivian (1988)
2. How many microphones does cros plus utilize ?
    a. 4
    b. 3
    c. 2
3. Deaf generally have a - cornered audiogram
    a. Left
    b. Right
    c. Top
4. _____utilizes the head shadow by using the natural attentuation of the head to provide more amplification of the high frequencies without feedback.
    a. Multicros
    b. Hi-cros
    c. Iros
5. In which of the following conditions does the person with unilateral loss face the (i) greatest problem, • and (ii) in which condition' is he at an advantage to a normal listener ?
    a. Speech and noise on side of good ear
    b. Speech and noise on side of bad ear
    c. Speech on good ear side, noise on bad ear side
    d. Noise on good side, speech on bad side

6. CROS design can be incorporated into
    a. only body level aids
    b. only ear level aids
    c. both
7. In the deaf the ears generally behave as narrow band _____filters.
    a. Low pass
    b. High pass
    c. Band pass
8. Slow play technique of frequency transposition was described by_____and_____.
    a. Tiffany and Bennet (1961)
    b. Harford and Barry (1961)
    c. Blackard and Kerry (1961)
9. If speech originates on one side of the head, the signal intensity will be lower by_____dB at the ear on opposite side.
    a. 6.4 dB
    b. 13 dB
    c. 7 dB

Fill in the blanks

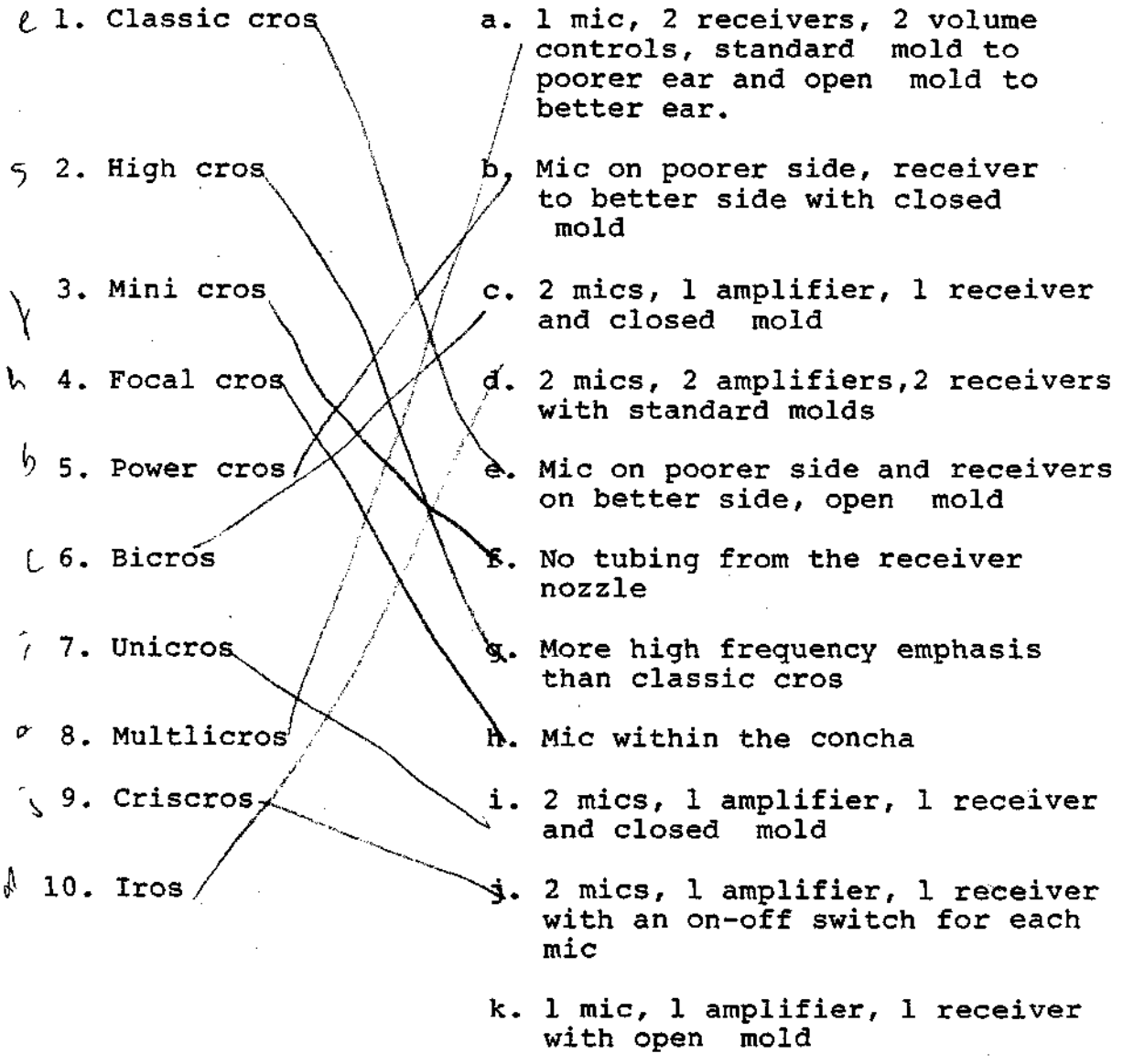
1. When a bilaterally hearing impaired individual uses one hearing aid, delivering sound to one ear, it is called _____amplification.

2. When a person wears one hearing aid delivering sound to both ears via a Y-card it is called _____ amplification.
3. Wearing two separate hearing aids, one to each ear is called_____amplification.
4. The term squelch effect was proposed by_____-
5. Improvement in sound quality using binaural amplification _ _ _ is because of _, , and _____.
6. CROS is generally prescribed for patients with _____hearing loss.
7. Pseudobinaural amplification is available only with _____hearing aids.
8. Binaural amplification is not considered if the difference between ears through speech range is greater than_____dB.
9. ^Head shadow effect was reported by_____, _____and_____in the year_____.
10. Fros is similar to IROS with the exception that •
11. _____utilizes a complete hearing aid to the unaidable ear plus a complete bicros arrangement.
12. In Bi Fros 270 2 mics are placed on the_____and 1 in each_____.

13. If a standard mold was used with CROS it would result in

14. _____ and _____ are the two approaches available with cros aids since standard molds cannot be used.

I. Match the following



II. 1. FROS — a. 2 mics, 1 receiver

2. BIFROS — b. 2 mics,2 amplifiers,3. receivers

3. Double fros — c. 4 mics, 2 receivers

4. BIFROS-270 — d. 1 mic, 1 amplifier, 1 receiver

III. 1. Bicros — a. One unaidable ear and one aidable with high frequency loss

2. Open bicros — b. Severe bilateral hearing loss

3. Unicros — c. Mild high frequency loss

4. Multicros — d. Profound loss in one ear moderate loss in the other

5. Iros — e. Asymmetrical losses, both ears aidable

6. Cris-cr,os — f. One unaidable, one aidable and a wide variety of listening needs.

IV. 1. Tillman, Kasten and Horner — a. Coined the term cros

2. Harford and Barry — b. Cris cros

3. Donlavy — c. Squelch effect

4. Green — d. Head shadow effect

5. Ross — e. Unicros

6. Johansson — f. Iros

7. Koen'g , — g. Frequency coding

State whether true or false

1. Binaural amplification helps to overcome the head shadow effect.

2. Monaural amplification for an ipsilateral hearing loss creates in essence a unilateral hearing loss with its related difficulties.
3. Less effort is required for comfortable listening when binaural system is used.
4. Sound quality is worse with binaural aids compared to monaural amplification.
5. The Y-cord provides bilateral, not.binaural hearing.
6. The phase, time, intensity and spectrum cues are available from pseudobinaural aids.
7. Pseudobinaural aids can be used effectively with asymmetrical hearing losses.
8. Binaural aids are prescribed for most asymmetrical losses.
9. The basic cros aids could be prescribed with conventional ear molds.
10. Unicros contains all the components of a true binaural system except that there is only one mic.

VC. Iros can only be used in instances requiring low gain.

12. FROS, BIFROS, double FROS and BIFROS 270 can be used with all ear level hearing aids.
13. Bifros is not a true binaural system.
14. The transposer developed by Johansson cannot be used for music or environmental sounds.

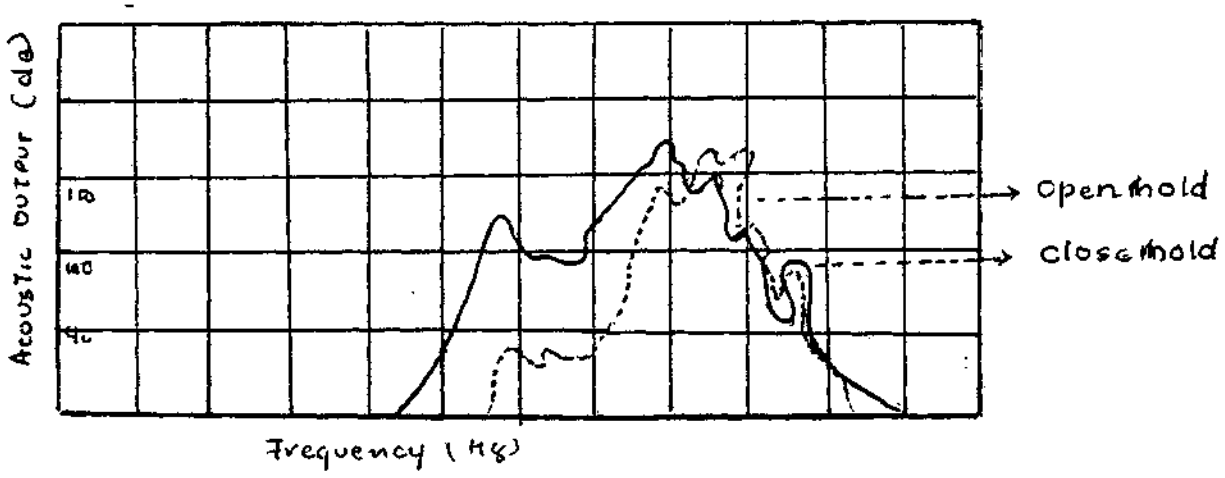
Name the following

1. The technique of frequency transposition in which high frequency consonant information above 4000 Hz is shifted downward into the range below 1500 Hz.
2. The method of frequency transposition employing tape playback of speech at slower speeds than those used in original recording.
3. This design of FROS aims at front back localisation.
4. The design of FROS which is similar to BICROS.
5. The rationale for this CROS design is that if adequate gain can be achieved ipsilaterally without feedback there is no reason to locate the mic on contralateral ear.
6. This design of cros can be considered an epitome of flexibility.
7. This instrument can be used as classic cros, bicros, open bicros or conventional monaural aid.
8. This is same as classic cros except that there is no tubing from receiver nozzle.
9. This is a combination of monaural instrument for poor ear and a classic or high cros for better ear.
10. This design of cros has the mic placed at the canal end of tubing or within the aid case.
11. Cros aids were developed in order to overcome this effect.
12. The ability to interpret speech in the presence of background noise.

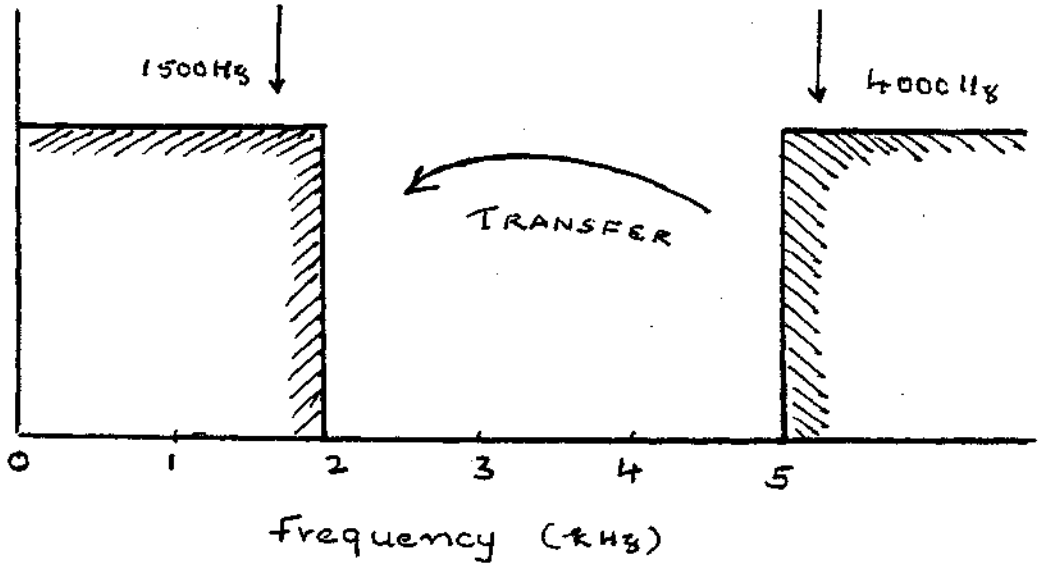
13. Koenig's effect refers to this.

Learn through visuals

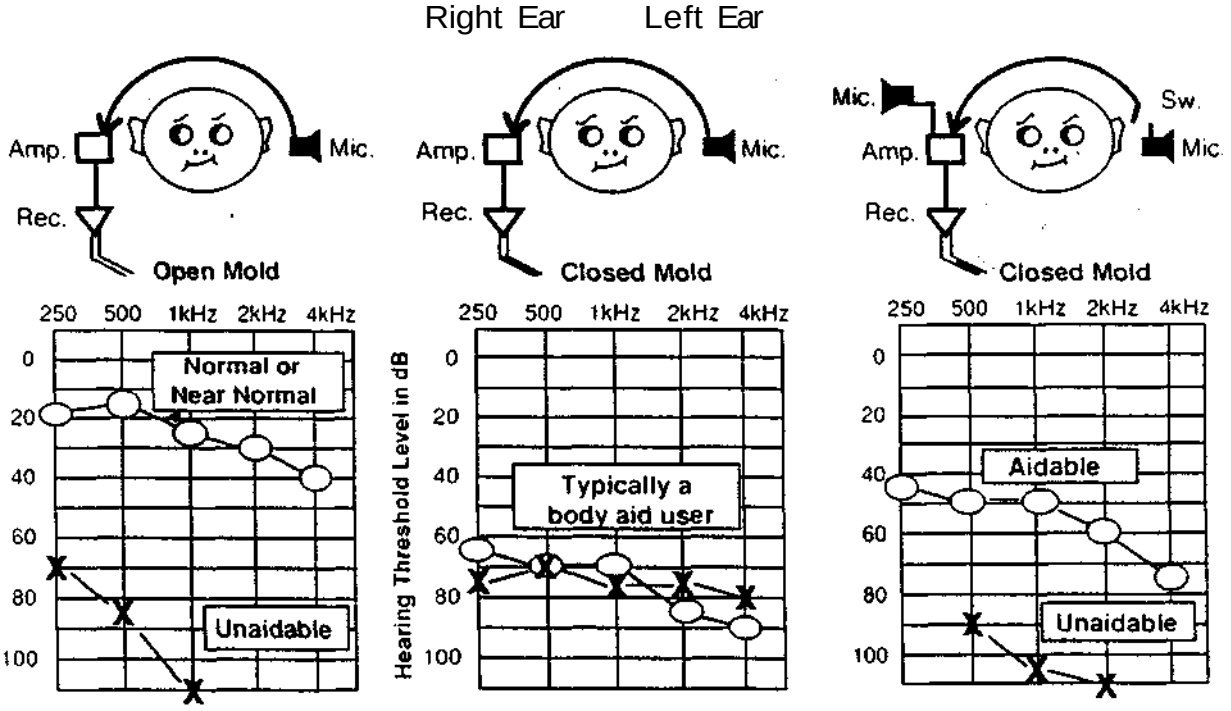
1. How would you interpret this graph ?



2. What does this diagram indicate ?



3. What variations of CROS do these diagrams depict ?



How many variations of cros can you identify in this puzzle. You could move in any direction horizontally, vertically or diagonally, in all directions.

C P A N Q L F F I S S I S O A S O R

L C R O P R R Q I M S P R R S T I K

A C M R P S O F U S O R C S I R C L

S R O I R O S L I Z G A E C K E P S

S O R P N T T N F L P L D S Y E O O

I S K M R I R O P E N B I C R O S R

C S G Q C A C T Q R U A R S F S T F

C I L R H A P R S N V T I O O A C E

R N O L L P L P O W E R C R O S C L

O S V C B I F R O S A A C C E N Y B

S O R C H G I H A N A I S I C L O U

R O S P R S R O B U N S I B P E D O

S K I J R O C K R U H T A I E A R D

Answer in one or two sentences

1. Mention some of the advantages of binaural amplification.
2. Mention two advantages of the pseudobinaural system one the monoaural.
3. Describe the classic CROS configuration.
4. Mention two advantages of pseudobinaural aids over binaural aids.
5. What are the different conditions under which you would consider a ear unaidable.
6. Mention a few disadvantages of pseudobinaural aids.
7. Mention some of the benefits of CROS.
8. What are the factors that determine candidacy for binaural amplification.
9. Mention the advantage of using an open mold with CROS.
10. Mention the two methods of frequency transposition that are used.
11. What are the major problems faced by a person with unilateral hearing loss ?
12. What are the factors that determine candidacy for CROS aids ?
13. Mention two advantages of using FROS.
14. What do you mean by frequency transposition ?
15. How does the coding technique of frequency transposition

16. Why is binaural amplification not recommended for most asymmetrical losses.
17. What is the disadvantage of the slow play technique of frequency transposition ?
18. How will you expand CROS and FROS ?

ANSWERS

Choose the correct answer

1 - c	6 - b
2 - b	7 - a
3 - a	8 - a
4 - b	9 - a
5 - (i) d	
(ii) **c**	

Fill **in the blanks**

1. Monaural
2. Pseudobinaural
3. Binaural
4. Koenig
5. Better localisation, improved speech intelligibility, greater ease of listening and improved spatial balance.
6. Unilateral
7. Body level
8. 15 dB
9. Tillman, Kasten and Homer (1963)
10. Mic is placed in the frame rather than temple piece of eye glasses.
11. CROS plus
12. Frame, temple piece
13. Prevention of the sound entering the better ear normally.
14. No mold or open mold.

Match the following

I. 1 - e
2 - g
3 - f
4 - h
5 - b
6 - c
7 - i ^
8 - a
9 - j
10 - d
11 - k

II. 1 - d
2 - b
3 - a
4 - c

III. 1 - d
2 - a
3 - e
4 - f
5 - c
6 - b

IV. 1 - d
2 - a
3 - e
4 - f
5 - b
6 - g
7 - c

State whether true or false

1. True
2. True
3. True
4. False
c. True
I. False
7. False
8. False
9. False
10. True
11. True
12. False
13. False
14. True

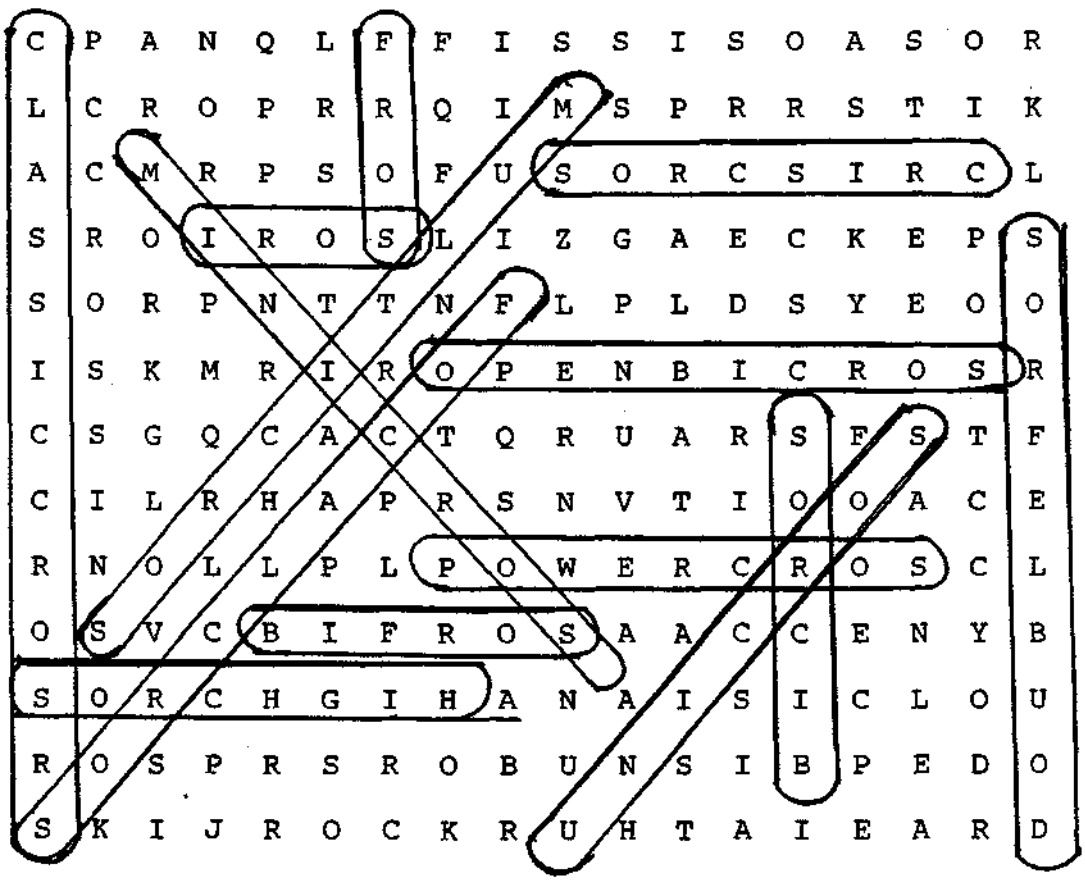
Name the following

1. Coding
2. Slow play
3. BIFROS 270
4. Double FROS
5. IROS
6. Multicros
7. Multicros
8. Mini cros
9. Uni pros
10. Focal cros
11. Head shadow effect
12. Squelch effect
13. Squelch effect

Learn -through visuals

1. When an open mold is used there is damping action on the low frequency components of speech. A typical cros aid with an open mold gives little or no gain below 800 Hz and relatively uniform gain over 1500 Hz.
2. It is a diagramatic representation of the frequency transposition principle. It indicates that the high frequency components above 4000 Hz is shifted downward into the range below 1500 Hz.
3. Classic CROS, power CROS, BICROS.

Puzzle



Answer in one or two sentences

1. Better sound localisation, increased speech discrimination in noise, greater ease of listening, better spatial balance and improved sound quality.

2. > Both ears are receiving auditory stimulation
   > Somewhat better speech discrimination
3. In the classic CROS configuration, mic is placed on the side of the head with the bad ear, the signals are then directed from the receiver into the good ear by a tubing or non-occluding type ear mold extending into the open ear canal.
4. (i) Lower initial cost than binaural
   (ii) Lower operating cost through less battery consumption than binaural aids.
5. (a) a ear with severe to profound degree of loss
   (b) a ear with severe discrimination problem
   (c) a ear in which use of ear mold is medically contraindicated
   (d) a ear which has a severe tolerance problem
6. Although both ears are stimulated the discrimination and localisation is not significantly better than monaural. Since two receivers are used impedance mismatch is created that causes distortion of output signal. And since the signal is split there is a small loss in the output reaching each ear.
7. > Increased ease of hearing speaker from the side of poor ear.
   > Improvement in auditory localisation ability.

8. > Needs of the client, i.e., whether the client is frequently confronted with situations that demand functional binaural hearing.
   > Financial status of the client.
   > Symmetry of hearing loss, if there is more than 15 dB. difference between ears through the speech range binaural amplification is not considered.
9. > Allows sound to enter normally into the better ear from the normal side.
   > Enhances high frequency amplification.
   > Marked decrease in low frequency amplification and concomittent increase in speech discimination.
   > Leaves the useful pinna resonance effect unaltered.
10. Slow playing of recorded material and frequency coding.
11. > Decreased speech intelligibility due to head shadow effect.
    > Increased difficulty in hearing in groups and in noise.
    > Auditory localisation confusion.
12. > The communication demands placed on the person's hearing.
    > Status of hearing in better ear.
    > Person's motivational level.
    > Age and age of onset.

13. > Increases separation between the mic and receiver allowing greater gain.

    > Decrease in background noises resulting from back to front head shadow.

14. Compression of the component frequencies of the speech spectrum into a much narrower band width and shift them downward into the region of better residual hearing.

15. The coding technique has two channels a conventional hearing and amplifiercircuit and a transposer circuit. The transposer channel high pass filters the consonant information, compresses the band by amplitude compression, then low pass filters the signal to place the 3 k to 6 k Hz information into a range below 1500 Hz. This transposed speech is then mixed with the conventional hearing aid signal and presented to the ear.

16. Binaural amplification is not recommended for asymmetrical losses as

    > The better ear can compensate satisfactorily.

    > The worse ear may cause the performance of the better ear to degenerate through the increased distortion presented to the auditory system.

17. There is marked impairement of speech intelligibility.

18. CROS - Contralateral routing of off side signals

    FROS - Frontal routing of signals

COCHLEAR IMPLANTS

Fill in the blanks

1. In cochlear implants compression of the signal occurs at the speech coding unit because_____.
2. If a Cochlear implant system has multiple electrodes it could serve as_____channel or_____channel implants.
3. Transmission of information in a multi channel system can be done in_____or_____ways.
4. _____was the first person to work on electrical stimulation of the auditory system in the year_____.
5. The various systems of cochlear implants are different in terms of_____,_____,_____,_____and
6. If only one electrode is used then only _____ configuration is possible in cochlear implants.
7. _____and_____are the two methods used to relay signals from the speech processing unit to the internal components of cochlear implant system.
8. The transmitter coil in cochlear imlants which receives information from the speech coding unit is placed _____the skin.
9. The_____transmitts signals to a surgically implanted receiver coil placed_____the skin of the ma^toid.
10. _____is designed to provide direct stimulation to the auditory nerve.
11. The receiver coil of cochlear implants is connected to

l 2._____is the kind of transmission in cochlear implants which involves a direct hard wire connection through the skin via an external plug mounted on the skin.

13._____refers to the number of differentially processed signals delivered to the electrodes in cochlear implants.

14._____is the kind of transmission system in cochlear implants, where the signal is transmitted across the skin using a radiofrequency link or passive magnetic induction.

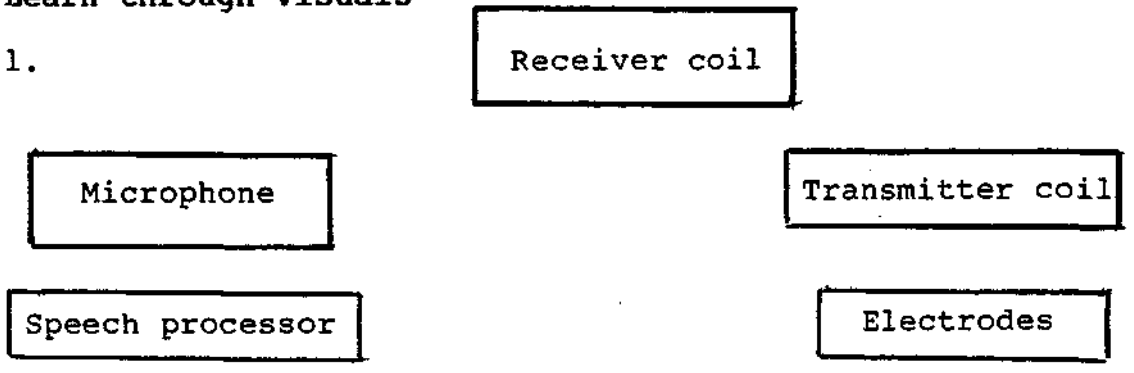
True or false

1. The stimulus in a cochlear implant system is the density of electric current flow from an active to a ground electrode.
2. Cochlear implants are designed to restore some hearing by bypassing the defective sensory mechanism directly stimulating the auditory nerve.
3. With bipolar stimulation in cochlear implants current flows from a single active electrode to a remotely placed ground electrode.
4. Cochlear implants use only a single pair of electrodes.
5. The number of channels in cochlear implants is synonymous With the number of electrodes.
6. Majority of the cochlear implant recepients are post-lingually deafened adults.

7. If only one electrode is used in a cochlear implant only one signal can be delivered to it.
8. Facial nerve paralysis could be a complication of implantation.
9. In the speech processing unit of cochlear implants compression takes place.
10. Cochlear implant is a type of hearing aid.
11. Gochlear implantation enables speech discrimination at normal levels.

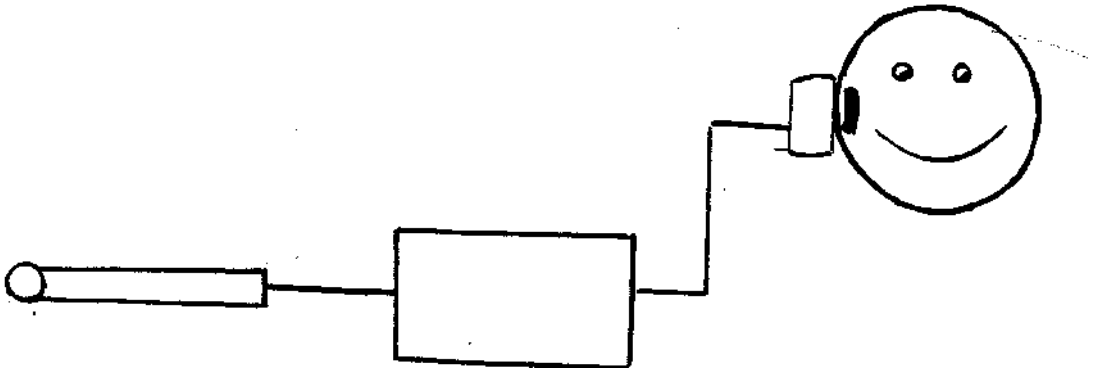
Learn through visuals

1.



Here are the basic components of a cochlear implant. Arrange them in the right order with arrows.

2. The following figure is a schematic representation of



Choose the correct answer

1. Extra cochlear placement of electrodes in cochlear implants is usually on
   a. oval window
   b. round window
   c. antrum
2. Candidates for cochlear implants are those with pure tone hearing threshold
   a. Greater than 90 dB HL
   b. Less than 90 dB HL
   c. Greater than 60 dB HL
3. Intra cochlear placement of electrodes in cochlear implants is on the_____.
   a. Scala vestibuli
   b. Scala tympani
   c. Scala media
4. In an implant system electrical signal from mic is fed to a_____.
   a. Receiver coil
   b. Transmitter coil
   c. Speech processor

Puzzle

What basic components of a cochlear implant can you identify in this puzzle ?

[Directions | | , —> <----.// , \\ , |-->]

S	**P**	**E**	**E**	**C**	**H**	**T**	**S**
M	**T**	**L**	**R**	**R**	**P**	**0**	**I**
I	**R**	**E**	**E**	**D**	**R**	**U**	**I**
C	**A**	**C**	**C**	**T**	**0**	**L**	**K**
R	**N**	**T**	**E**	**U**	**C**	**M**	**N**
0	**S**	**R**	**I**	**V**	**E**	**0**	**P**
P	**M**	**0**	**V**	**W**	**S**	**R**	**Q**
H	**I**	**D**	**E**	**T**	**S**	**L**	**T**
0	**T**	**E**	**R**	**C**	**0**	**I**	**I**
N	**T**	**S**	**X**	**X**	**R**	**T**	**R**
E	**E**	**Y**	**U**	**W**	**I**	**L**	**R**
U	**R**	**C**	**0**	**I**	**L**	**W**	**T**

Answer in two or three sentences

1. In cochlear implants which kind of electrode placement is used more often ? Why ?
2. What do you mean by serial transmission and parallel transmission in multichannel cochlear implant system ?
3. What is the function of speech processor in cochlear implant ?
4. What are the two basic approachesto process and code speech for presentation in cochlear implant systems ?
5. Mention some of the factors that determine candidacy for cochlear implants.
6. How many electrodes are employed in cochlear implants ?
7. What are the basic components used in cochlear implants ?
8. Mention a few advantages of cochlear implants.
9. What are the major disadvantages of cochlear implants ?

ANSWERS

Fill in the blanks

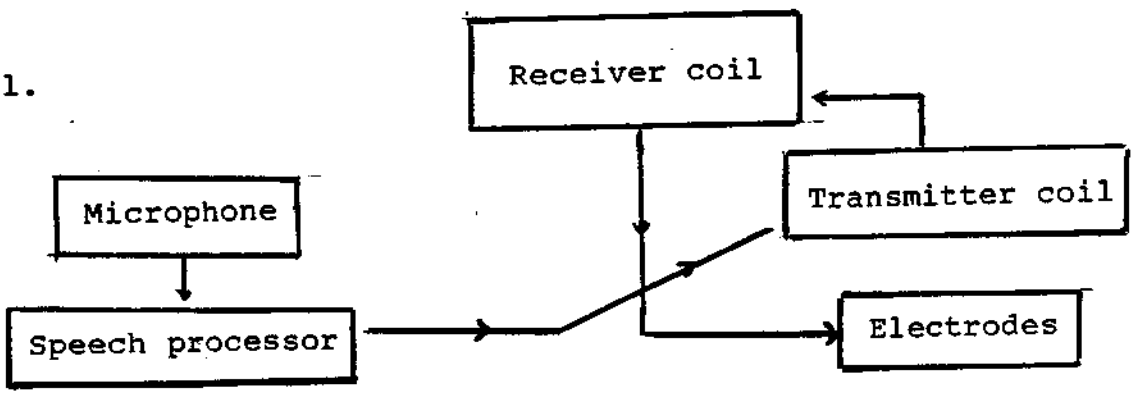
1. The dynamic range of hearing for electrical stimulation is very less.
2. Single channel or multiple channel
3. Serial or parallel
4. Alessandro Volta in 1800
5. Type of transmission, relay system, electrode configuration, number of electrodes, number of channels of information and placement of electrodes.
6. Monopolar
7. Percutaneopus and transcutaneous
8. Outside
9. Transmitter coil, under
10. Cochlear implants
11. Electrodes
12. Percutaneous
13. Number of channels
14. Transcutaneous

True or false

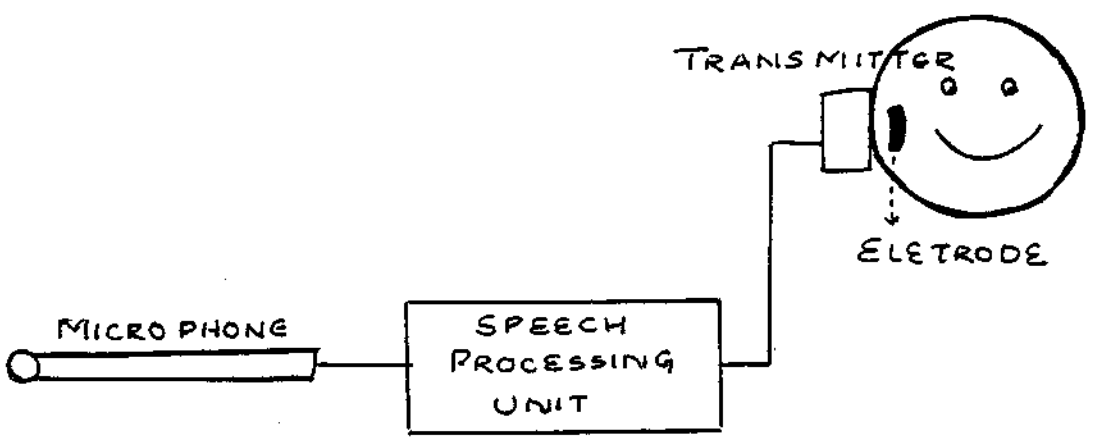
1. True
2. True
3. False
4. False
5. False
6. True
7. True
8. True
9. True
10. False
11. False

Learn through visuals

1.



2.

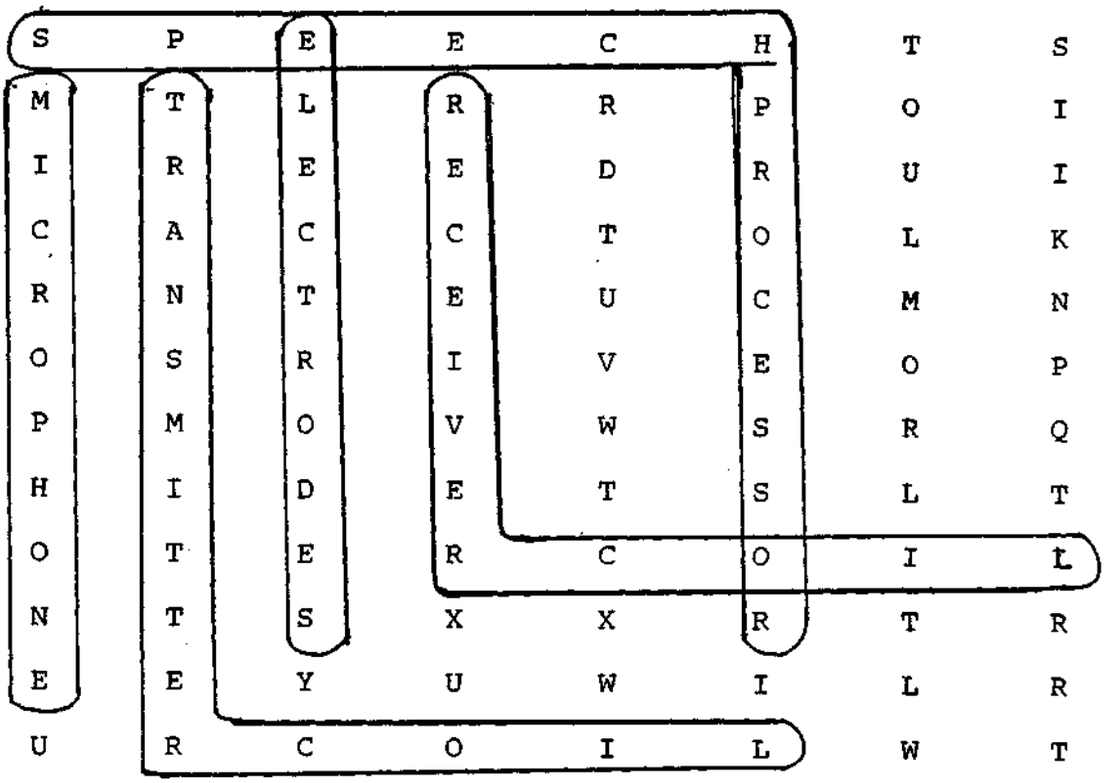


Choose the correct answer

1 - b 3 - b

2 - a 4 - c

Puzzle



Answer in two or **three sentences**

1. Intra cochlear placement is used more often as it allows for more efficient stimulation of the auditory nerve fibres.
2. In parallel transmission information is sent to multiple electrode sites at the same time. In serial transmission information is sent rapidly in sequence from the processor to the internal receiver and in turn to the electrodes.
3. It manipulates the signal into discrete electrical or digital patterns. In addition compression of the signal is also carried out.

4. Either present all of the information in the acoustic speech signal or extracting those features that are believed to be important for speech recognition from the accostic signal and presenting them in a codified manner.
5. > Pure tone threshold greater than 90 dB HL
   > Post-lingual deafness
   > No physical or mental contraindications
6. Single or multiple electrodes.
7. Mic, speech processor, transmitter, electrodes.
8. Decrease in inherent distortion of amplifiers, elimination of feedback, increased fidelity, improved intelligibility, elimination of ear mold, improved cosmetic appearance, elimination of clothing and wind noises.
9. - Surgery is required for insertion, removal and repair of device.
   - Risk of infection and irritation.
   - Questionable acoustic performance.

HEARING AID SELECTION

True or false

1. BSERA can be used as an objective procedure for selection of hearing aids.
2. Tolerance check is not very important for selection of hearing aids.
3. The prescriptive procedures for hearing aid selection are objective.
4. Orthotelephonic gain and etymotic gain are synonymes of insertion gain.
5. For very young children generally ear level hearings aids are prescribed.
6. ITE hearing aids could be prescribed for severe to profound losses.
7. In hearing aid selection for children generally a body level hearing aid with a V-cord is prescribed.
8. Programmable hearing aids are normally prescribed for fluctuating hearing losses.
9. NAL procedure for hearing aid selection uses a 1/2 gain rule.
10. The gain requirements in conductive loss is greater than that of SN loss.
11. A master hearing aid duplicates any of the commercially available hearing aid.
12. If the dynamic range is less than 45 dB, a person is a poor candidate for a hearing aid.

13. In selection of hearing aids the ear with a better speech discrimination should be aided.

Fill in the blanks

1._____and_____are the kinds of procedures that could be used for hearing aid selection.

2. The objective methods of hearing aid selection include _____,_____**and**_____.

3. The subjective methods of hearing aid selection includes _____and_____methods.

4. The hearing aid selection technique based on the notion that frequency response and gain characteristics of hearing aids should attempt to compensate for the characteristics of a given hearing loss is_____.

5. The hearing aid selection procedure that involves comparing several hearing aids to select the one that yielded best results is_____.

6. The two main groups of factors that determine a hearing impaired adults candidacy for amplification are _____ and_____

7._____,_____and_____are three non-auditory factors affecting hearing aid selection.

8. With respect to hearing aid selection it is important that the MPO of the hearing aid selected is_____ than the paitents TD.

9. Selection of the type of hearing aids depend on _____ and_____.

10. Generally ear level instruments could be used for upto _____degree of hearing losses.

ll. If the dynamic range is greater than_____dB the person is considered a good candidate for hearing aid.

12. Testing for hearing aid trial could be_____or

13. If a person has speech_____testing is done and if a person does not have speech_testing is done in hearing aid selection.

14. Non-verbal testing could be_____or_____.

15._____is the increase in SPL at the ear drum with the hearing aid in place and operating, compared with the SPL at the ear drum without the hearing aid.

16. The term insertion gain was introduced by_____in the year_____.

17._____and_____'_ are synonymes for insertion gain.

18. _____ is defined as the difference between unaided and aided sound field thresholds.

19. The gain requirement for conductive loss patients is about_____percentage of the hearing loss in dBs.

Answer in two or three sentences

1. Mention a few disadvantages of the Carhart's comparitive procedure of hearing aid selection.

2. What were the salient features of Carhart's comparitive procedure ?
3. Mention some of the auditory factors that affect hearing aid selection.
4. Mention some of the tests that could be used for discrimination testing.
5. How does discrimination testing help in hearing aid selection ?
6. Is the eliciation of threshold of discomfort important in hearing aid selection and why ?
7. If you have to select a hearing aid only for one ear for a client with bilateral hearing loss, what factors would you consider in determining the aided ear ?
8. What are the different variables in hearing aid selection ?
9. In hearing aid selection what is the general rule to be followed in deciding the ear to be aided based on the pure tone thresholds ?
10. What signs of overamplification do you come across while doing hearing aid selection for the elderly ?
11. What are the factors that determine the candidacy for hearing aid selection for persons with conductive hearing loss ?
12. List the names of a few comparitive procedures that have been used for hearing aid selection.

Match the following

I.	1. Lybarger	a. Equal loudness procedure
	2. McCandless and Lyregaard	b. 1/3 gain rule (revised NAL)
	3. Byrne and Dillon	c.1/2 gain rule
	4. Watson and Khudsen	d. POGO
		e. Bisection of dynamic range
II.	1. Wallenbels	a. Gain = MCL - 60 at any- frequency at 500 Hz gain = MCL - 70
	2: Shapiro	b. Gain = Optimum hearing level - 65 dB
	3. Zelnick	c. Gain = MCL + 2 0 - 6 5 dB SPL
	4. Cox	d. Software with three procedures for UCL-POGO for gain - NAL-R/COX
	5. Pascoe and Skinner	e. Preferred listening level for speech is assumed to be at the mid point of the range between the upper limits of comfortable loudness and threshold for an individual
	6. Humes	
III.	1. Quality judgement procedures	a. De Filipo and Scott (1978)
	2. Judgement of speech intelligibility	b. Jeffress (1960)
	3. Speech tracking	**c** Zerlin (1962) d. Carhart (1964)
		e. Pascoe and Skinner (1976)

IV. Hearing loss in dB	Need for amplification
1. 0-25	a. Frequent need
2. 55-80	b. No need
3. 40-55	c. Part time need for special occasions
4. 25-40	d. Great need, partial help
5. 80+	e. Area of greatest satisfaction

Give the formulae for measuring the gain and output requirement for the following prescriptive procedures of hearing aid selection.

a. POGO I

b. POGO II

c. NAL

ANSWER

True or false

1. True *(?)*
2. False
3. False
4. True
5. False
6. False
7. True
8. True
9. False
10. True
11. False
12. True
13. True

Fill in the blanks

1. Subjective procedures and objective procedures
2. Immittance measures, BSERA measures, insertion gain measures.
3. Prescriptive and comparitive
4. Prescriptive technique
5. Comparitive procedure
6. Auditory factors, non-auditory factors
7. Motivation, affordability, listening needs
8. Less
9. Degree of loss and aff ordability
10. Severe
11. 45 dB
12. Verbal or non-verbal
13. Verbal, Non-verbal

14. BOA or conditioned responses.

15. Insertion gain

16. Ayers in 1953

17. Orthotelephonic gain and etymotic gain

18. Functional gain

19. 90 %

Answer in **two** or three sentences

1. > Its too lengthy and time consuming

   > The measurements of full-on gain suggested by Carhart need not be obtained as they provide little information regarding the client's aided performance in real life situations.

   > According to this procedure the instrument that provides most appropriate gain, the best word recognition score and most acceptable sound quality should be selected. But a single instrument may not meet all these criteria.

   > Another problem so that of method of pre-selection of instruments.

2. > It involved training, counselling and a hearing aid trial period as well as audiometric tests.

   > Audiometric tests included unaided measurements followed by aided measurements with three different instruments.

   > Unaided measurements included a speech reception threshold, measure of tolerance, word recognition score.

> Aided measurements included: speech reception threshold at full on gain and MCL measurement of UCL at full on gain and MCL measurement of word recognition at MCL.

3. - Degree of loss.
   - Type of loss
   - Configuration of hearing loss
   - Threshold of discomfort.
   - Discrimination ability
   - Dynamic range .
4. PAL-PB word lists, CID-W22 word lists, modified rhyme tests, NU-CHIPS, SSI.
5. Discrimination testing helps in the selection of the ear which has to be aided. Generally hearing aid is prescribed to the ear for which discrimination ability is best.
6. Yes. Elicition of threshold of discomfort is very important in hearing aid selection, because the hearing aid, a client will wear must not amplify signals that will reach levels that . cause discomfort. Moreover, it also provides the dynamic range of hearing, which is. one of the factors that determine the selection of the aided ear.
7. The ear to be aided should be
   - the ear in which discrimination ability is the best.
   - ear in which there is no recruitment problem.

- ear in which amplification will result in hearing being restored to as near normal as possible.
- ear which has a wider dynamic range.

8. - determining which ear has to be aided
   - determining gain characteristics
   - determining frequency response
   - de termining maximum output
   - determining type of instrument
   - determining type of earmould .
   - alternatives like CROS aids
9. The general rule to be followed is that if the hearing loss in the better ear is less than 65 dB, aid the poorer ear. If it is more than 65 dB, aid the better ear.
10. Stuttering or stopping to respond.
11. Hearing aids are considered for persons with conductive hearing loss when
    - surgery is contraindicated due to diseases like diabetes, ear malformation, active ear discharge, old age, etc.
    - patient refuses to undergo surgery.,
    - after surgical intervention there is no improvement.
    - there is congenital stapes fixation as there is risk of dead ear if operated.
12. - Carhart's Procedure(1946)
    - Quality Judgement Procedure by Jeffers (1960)
    - Speech Intelligibility Judgement by Zerlin (1962)
    - Speech Tracking by Defilippo and Scott (1978)

Match the following

I. 1 - o
2 - d
3 - b
4 - a

II. a - 2
b - 1
c - 3
d - 6
e - 4

III. 1 - b
2 - **c**
3 - a

IV. 1 - b
2 - e
3 - a
4 - c
5 - d

(a) POGO I

Prescribed gain = 0.5 x AC threshold for frequencies other than 250 Hz and 500 Hz

At 250 Hz, gain = (0.5 x AC threshold) - 10 dB

At 500 Hz, gain = (0.5 x AC threshold) - 5 dB

Prescribed output = Average of threshold of discomfort (UCL) at 500 Hz, 1 kHz and 2kHz.

(b) POGO II

Prescribed gain is different at different frequencies.

Frequency	**Gain**
125 Hz	(0.5 x AC threshold) - (15 + x)
250 Hz	(0.5 x AC threshold) - (10 + x)
500 Hz	(0.5 x AC threshold) - (5 + x)
750 Hz	(0.5 x AC threshold) - (2 + x)
1 kHz	(0-5 x AC threshold) + x
2 kHz	(0.5 x AC threshold) + x
4 kHz	(0.5 x AC threshold) + x

Here x = 0 if hearing loss is less than 65 dB.

x = 0.5 x (AC threshold - 65 dB), if hearing loss is greater than 65 dB.

(c) NAL

This uses l/3rd gain rule.

Frequency	**Gain**
250 Hz	(0.31 x AC threshold + x) - 17
500 Hz	(0.31 x AC threshold + x) - 8
750 Hz	(0.31 x AC threshold + x) - 3
1 Hz	(0.31 x AC threshold + x) + 1
1.5 kHz	(0.31 x AC threshold + x) + 1
2 kHz	(0.31 x AC threshold + x) - 1
3 kHz	(0.31 x AC threshold + x) - 2
4 kHz	(0.31 x AC threshold + x) - 2
6 kHz	(0.31 x AC threshold + x) - 2

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