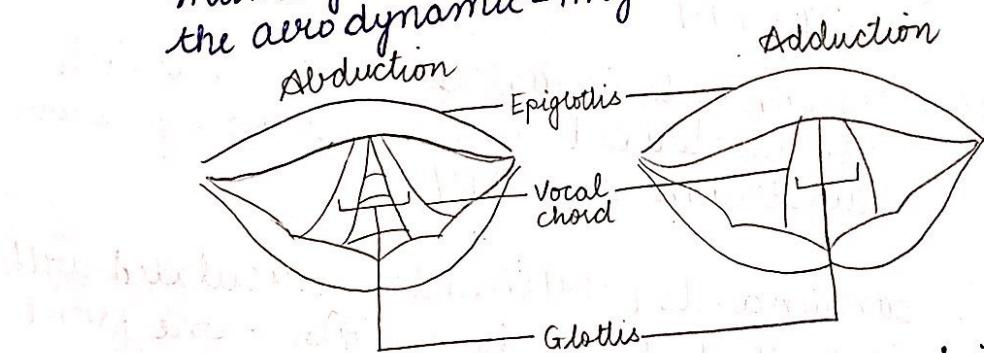


1. (a) Speech is a system of communication that uses spoken words or sound symbols. It refers to the concatenation of phones (lexicals) put together using rules of a language.

### Production of sound

Four main components involved -

- ① **Respiration:** The sub-glottal system (lungs, diaphragm, bronchi and trachea) produce the necessary energy in the form of stream of air. The build and drop of the pressure causes vocal folds to blow wide apart and suck together respectively; which brings up the next component into picture -
- ② **Phonation:** The provided airflow is further modified by the resonators - larynx. As air passes through the vocal chords when we breathe in and out - the glottis is open and the vocal chords are drawn wide apart and are elongated (abduction) and when they are held together, the pressure of the air coming from the lungs make them vibrate - and produce sound (voiced). Hence, when sounds are produced, vocal chords are contracted (adduction) - These three components, namely - airflow, elongation and adduction comprise the aerodynamic-myoelectric model of phonation.



- ③ **Resonance:** The way airflow for speech is shaped (amplification and modification) by the vocal tract resonators - pharynx (throat), oral cavity and nasal cavity. The balance of sound vibration in these areas determine the quality of speech and voice. For normal resonance, the nose

and the mouth must be closed off from each other during speech. This occurs when the velum raises and contracts the pharyngeal wall of the ~~pharynx~~ pharynx during speech. This is called "velopharyngeal closure" which allows the build up of air pressure and sound in the mouth in order to produce various speech sounds.

(4) Articulation : In the vocal tract, different articulators take different positions to articulate different speech sounds.

(b) Physiological level occurs twice in the speech chain :

(i) During production of speech (speaker) : Different articulators as directed by the brain impulse are moved and coordinated via the muscles. There are limitations on the speed with which articulators can be moved. Hence, the linguistic representations (discrete) are converted to continuous sound / speech signal. The ear is also involved in listening to this speech signal.

(ii) During perception of speech : At this stage, ears are involved in listening and sending speech signal to brain to perceive the sound - i.e. the continuous signal to be understood as a bunch of discrete linguistic representations

(c) Implosives : Stop consonants produced with ingressive (glottalic) airflow (also involve pulmonic egressive airstream mechanism)

eg. /b/

Ejectives : consonants (usually voiceless) which are produced with glottalic egressive airstream eg. /t'/

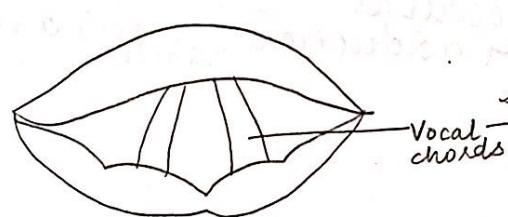
clicks : consonants (obstruents) articulated with two closures in the mouth - one front and one back. ( ~~tongue~~ <sup>Velaric</sup> egressive airstream mechanism)

Phonation is the process by which vocal folds produce certain sounds through quasi-periodic vibrations.

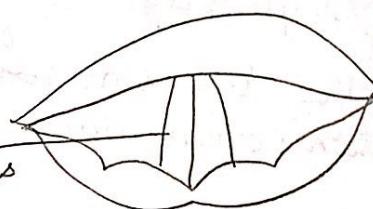
Main organs responsible for phonation - Larynx which houses the vocal folds and the glottis.

The glottis is the opening between the vocal folds and the vocal folds are membranes stretched across the larynx.

Air is brought into the lungs while breathing in and when this air is pushed up through the glottis it causes pressure to drop in the larynx, this in turn makes the vocal folds vibrate which produces voiced sounds — when vocal folds are vibrating, the glottis opening appears smaller or even closed as the tension of the vibrating vocal chords stretches them across the larynx (adduction). ~~The subglottal air pressure~~ when the vocal folds are resting, they appear open — and the passage down the larynx is unobstructed.



Open glottis  
(unobstructed larynx)



closed glottis  
(obstructed larynx)

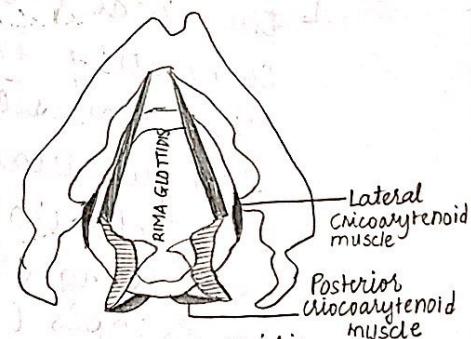
3. (a) Rima glottidis is the opening between the vocal folds (true vocal folds) and the artitenoïd cartilages in the larynx.  
in speech production:

cartridges in speech production:

Role in speech production.  
During regular breathing it is narrow wedge shaped and during phonation it is slit-like and chords close.

The shape of the glottis results as the vocal chords close.

The shape of the glottis in obstruction/unobstruction of larynx hence plays an important role in speech production.



Rima glottidis  
labelled in the  
laryngeal structure

Role in laryngeal structure -

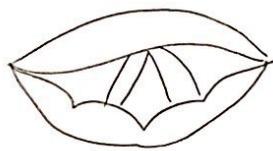
- ① opening between vocal folds
- ② It is the narrowest part of larynx
- ③ It is closed by the lateral cricoarytenoid muscles and opened by the arytenoid muscles (adductors) and posterior cricoarytenoid muscles.

All of the above are shown in diagram. ~~see~~ (last page)

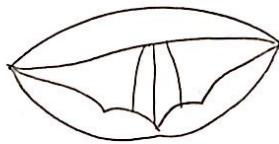
(b) States of Rima Glottidis:

- 1) when we breathe in and out, the glottis is open. That is, the vocal folds are drawn wide producing voiceless sounds.
- 2) If the vocal folds are held loosely together the pressure of the air coming ~~out~~ from the lungs make them vibrate — they open and close regularly.

① Hence the two states <sup>occur at</sup> ~~→~~ adduction (close state) and abduction (open state)



Open



Close

(c) ~~stop~~ stops

- L The vocal tract is blocked to cease the airflow completely in the production of stop. The occlusion may be made with the tongue blade, lip or glottis.
- In articulation of a stop, three phases take place:
- (i) Closing stage: The airway closes so that no air escapes (hence called stops)
  - (ii) Holding stage: The airway remains closed and a pressure difference builds up (hence called occlusive)
  - (iii) Release / Burst: The closure is opened and the released airflow produces sound.

## voiced stops:

- |b| voiced bilabial stop
- |d| voiced alveolar stop
- |ɖ| voiced retroflex stop
- |g| voiced velar stop

(3)

## Voiceless stop:

- |p| voiceless bilabial stop
- |t| voiceless alveolar stop
- |ʈ| voiceless retroflex stop
- |k| voiceless velar stop

4. (a) Pitch is the frequency of sound. Changes in pitch are caused by changes in the vibration of vocal folds. Values of

Males - 100Hz

Females - 200Hz

Children - 400Hz

i.e. long & thicker folds

(1) ~~Men~~ Men have thicker cartilages, hence ~~#~~ the vocal folds vibrate <sup>frequency</sup> slower than females. Children have short vocal chords hence produce shorter air waves and highest frequency.

(b) To increase pitch - the vocal chords need to be tensed hence the muscle that is required is a tensor - cricothyroid muscle.  
Role - Abduction - responsible for opening the glottis and to tense up muscles vocal chords (stretch & thin the vocal chords).

(1)

5. To lower pitch and make voice breathy the type phonation needed is BREATHY



(a) Nat

①

6. (a) Voiced sounds - when are produced when vocal folds come together, vibrate and produce sound i.e. when glottis is closed  
Examples: /d/, /g/, /z/



②

- Voiceless sounds - are produced when vocal folds are far apart and do not vibrate i.e. when glottis is open.  
Examples: /t/, /k/, /z/



- (b) A phoneme produced with three articulators :

/t/ ~~t~~<sup>θ</sup> <sup>th</sup> denti-alveolar stop (teeth, ridge, blade)

+ Manner - stop fricative



- (c) Two lips - Bilabial

① Two lips with tongue in front - Front vowels

Tongue between lips - Lingual

7. (a) little : ~~lɪtəl~~ /lɪtəl/

- (b) moon : /mu:n/

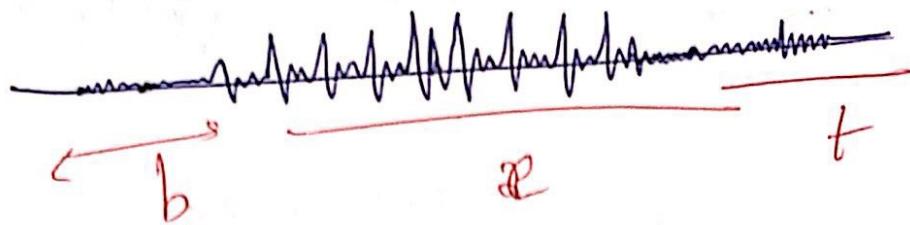
- (c) colonel : ~~kənəl~~ /kənəl/

- (d) avack : /əbæs/

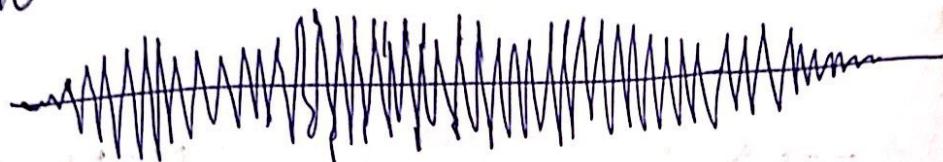
- (e) flabbergasted : /flæbəgaestid/

└ 'r' is not really uttered

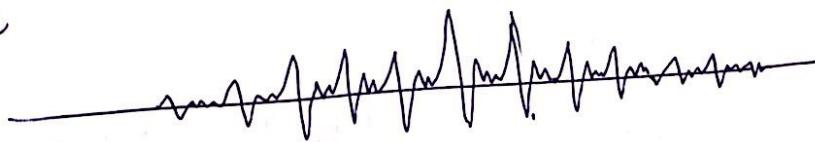
(a) bat



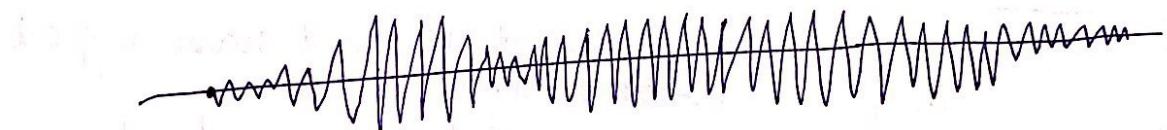
(b) man



(c) eve



(d) yawn



(e) shut



(f) jar

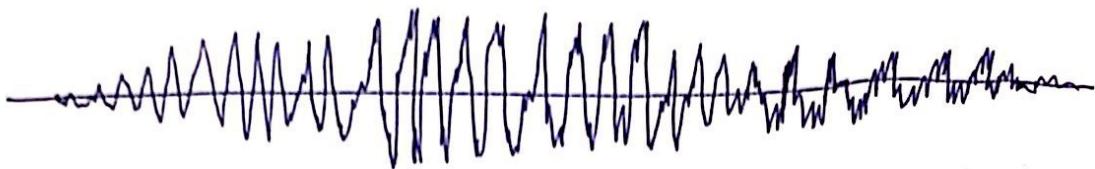


(g) bay



Consonant  
blocks  
Po'

(h) hot



(i) that



(j) lure



### Observation :

31  
21  
112

- voiced sounds are dense and have a good amplitude (~~high~~ peaks)
- vowels are quasi-periodic — periodicity is observed in case of vowels (most periodic)
- /t/ is unvoiced - hence low peaks
- /s/ & /ʃ/ have very dense waveforms.
- vowels also have highest amplitude
- approximants have lower periodicity than other vowels but higher periodicity than other consonants.

Consonants are produced by completely or partially blocking the air flow.

Palatoalveolar - /s/, /ʃ/, /tʃ/, /dʒ/

Alveolar sounds - /t/, /d/, /n/, /s/

voiced  
alveolar  
stop

voiced  
alveolar  
nasal

voiced  
alveolar  
fricative

(B)

Palatal sounds - /j/, /ŋ/

palatal  
approximant

palatal nasal

10.

(a) Three articulatory factors involved in characterization of vowels:

(1) Tongue Height  $\rightarrow$  distance b/w tongue and roof of mouth  
 $\rightarrow$  High - /i/ /u/  
Mid - /e/ /o/  
Low - /æ/ /ɑ/

(2) Tongue Tump  $\rightarrow$  how far back in the mouth the tongue is positioned  
 $\rightarrow$  Back - /u/ /o/  
Central - /ʌ/ /ə/  
Front - /i/ /e/

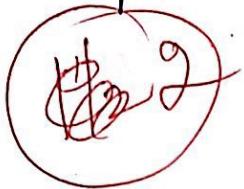
(3) Rounding  $\rightarrow$  whether the lips are rounded when the sound is made.  
 $\rightarrow$  Rounded - /u/ /o/ /ɔ/  
Unrounded - /i/ /e/ /ɑ/

(b) Sonorants are sounds produced with continuous, non-turbulent airflow in the vocal tract. So do vowels. Hence they fall under sonorants.

(c) Characteristics of vowel sounds:

- produced without obstruction of airflow (also called open sounds)
- all vowels are voiced sounds

- made with egressive airstream
- quasi-periodic
- no noise component but a characteristic patterning of formants



Velar fricative - shows periodic

Voiceless - showing isolated

formants - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Voiceless - isolated

Voiceless - high

Voiceless - low

Velar fricative - shows periodic - no noise component - no noise component

Voiceless - isolated

Voiceless - isolated - high

Voiceless - isolated - low

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component

Velar fricative - shows periodic - no noise component - no noise component