1. Initial displacement is equal from left- and right-going waves.
   Images travel each way.
   Invariant reflection at fixed ends look like 180° rotated version shifted in.
   Canaliculare looks displacement at 20° at both ends.

2. Free lateral movement at B would result in a non-invariant reflection:
   Resultant.

If we equate string displacement with volume velocity, fixed point at A is like a closed tube end, and free point at B is like an open end.

3. Reflection is a low-pass filter:
   \[ |R(t)| \]
   \[ A \quad \text{(t)} \]
   \[ B \]
   \[ A \]
   \[ B \]
   \[ \text{higher frequency modes are attenuated relative to lowest mode at each reflection} \]
   \[ \text{for large T, waveform is dominated by fundamental mode} \]
   \[ \text{for sinusoidal standing waves} \]

4. A is a narrow-band spectrum (analysis time window ~30ms)
   B is a wide-band spectrum (analysis time window ~5ms)
   B also has a lower energy floor in its graphs are flatter.
   E.g. A shows energy in range 0-60dB, B shows 0-60dB (or whatever)
   hence can see more low-level energy features in B.

5. From A, we have a pitched vowel between t = 0.2 - 0.75.
   Fundamental frequency peak \( \approx 220 \text{ Hz} \) (by dividing freq. of 10th harmonic by 10).
   Pitch contour rises then falls.
   From B, have noise between t=0.4-0.7, the vowel (formants at 600Hz, 1400Hz, 2800Hz), then a stop, then more frication (sibilant).
   [Actually, the speech is "six"]

6. A shows harmonics close to pitch, but pitch is ignored in English ASR.
   B shows the formants, which are the important features for ASR.
   - B is preferable for speech recognition.
2. Pip at A is unmasked → just audible at around 0 dB SPL (depending on listener's condition)
   B is simultaneously masked → inaudible until within ~10 dB of masker → just noticeable ~ 50 dB SPL
   C is subject to forward masking → less than simultaneous
   → somewhere in between maybe 20-30 dB SPL?

3. Masking effect is much less at 4 kHz for every at 1 kHz.
   In separate critical bands. Ear is more sensitive at 4 kHz
   → A unnoticeable 0 dB SPL
   B ~ 20 dB SPL or less
   C ~ 10 dB SPL or less.

4. Masking suggests detection via energy envelope displacement.
   Frequency selectivity & band pass filtering before energy
   Forward masking suggests sluggish smoothing of energy before
   measuring wave form eg. 
   sound → filter back energy smoothing → ideal detector

4. a) In (x1, x2) space, z is nearest A1 → classify to A
   b) Equalizing variance in each dimension "stretches" graph vertically so 4 points lie roughly in a square:

5. Alternative approaches: Decision boundaries form (near - no perfect fit)
   - Grass models
   - Neural network etc.

6. Call by k - nearest neighbors eg. find 3 nearest neighbors and vote
   Basically, problem is nearly impossible to decide with so little training data and apparently highly overlapped classes.