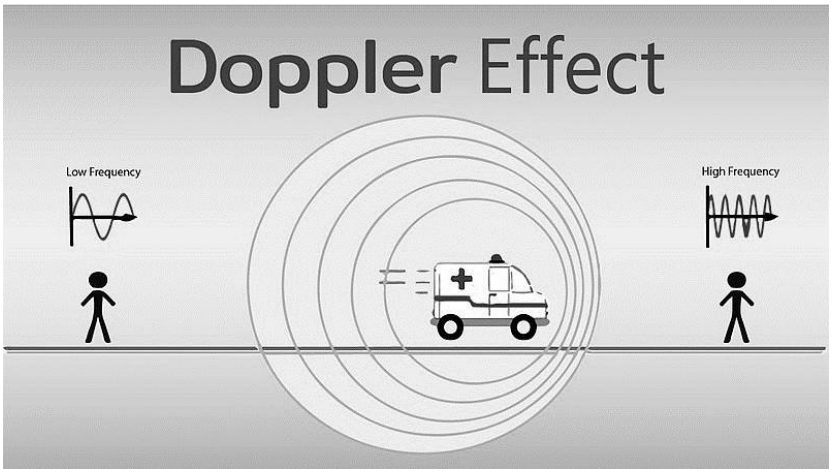
9 Doppler Effect

5 points

Introduction

Have you ever stood on the side of a road when a fast car drove past you? If you have then you might have noticed that as the car approaches you, the sound of the car's engine gets louder and sounds different. The car doesn't change its engine noise while it is moving, so what's happening? The change in the way you hear a noisy object as it moves toward or away from you is called the Doppler effect.



It happens because sound moves in waves, known as sound waves, and its frequency gets higher as the noisy object comes toward you. The frequency refers to the rate at which the waves reach you. The sound waves in front of the noisy object bunch up with less space between them. So, the waves that reach you are at a higher frequency, changing the way you hear the sound. This is known as the apparent frequency (f') and it can be calculated with this formula:

$$f' = f * \frac{c + vr}{c + vs}$$

where f is the actual frequency,
c is the speed of the sound waves in the medium,
vr is the velocity of the observer with respect to the medium and
vs is the velocity of the noisy object with respect to the medium. This velocity can be positive, negative or zero depending its direction of travel relative to the observer.

Input

The input is composed by four integer values in this order:

- actual frequency in Hz
- speed of the sound waves in the medium in meters/second
- velocity of the observer in kilometres per hour
- velocity of the noisy object in kilometres per hour

Output

The apparent frequency observed with two decimals resolution in Hz.

Example 1

Input

```
200
340
60
-50
```

Output

```
218.74 Hz
```

Example 2

Input

```
25
10
108
36
```

Output

```
50.00 Hz
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