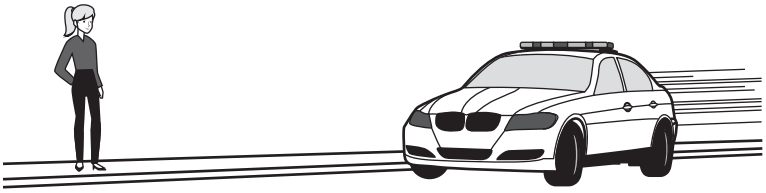
5. A person is standing at the side of a road. A police car approaches and then passes the person at a constant speed of 31 m s^{-1}. A siren on the police car emits sound with a frequency of 440 Hz.



(a) (i) Calculate the frequency of the sound heard by the person as the police car approaches.

The speed of sound in air is 340 m s^{-1}. **3**

Space for working and answer

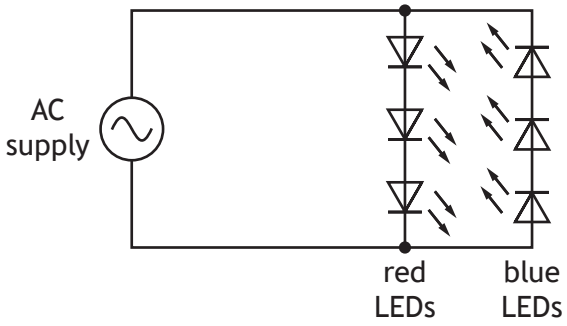
(ii) State whether the frequency of the sound heard by the person as the police car moves away is greater than, the same as, or less than the frequency heard by the person as the police car approached.

You must justify your answer. **2**

[Turn over

5. (continued)

(b) The emergency lights on top of the police car consist of an array of red LEDs and blue LEDs. A simplified diagram of the lighting circuit is shown.



The red LEDs and blue LEDs each flash twice per second.

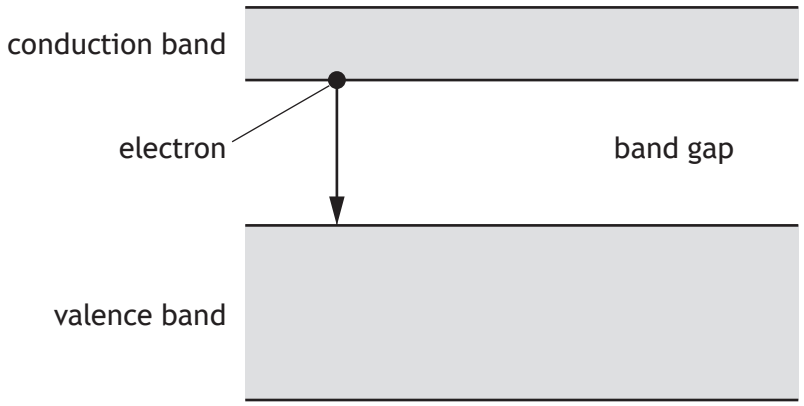
(i) Determine the period of the AC supply used. **1**

Space for working and answer

(ii) Explain why the red LEDs and the blue LEDs do not light at the same time. **2**

5. (b) (continued)

(iii) An energy band diagram for a red LED is shown.



A photon of wavelength 625 nm is emitted when an electron falls from the conduction band to the valence band, across the energy band gap.

(A) Determine the energy of the emitted photon. **4**

Space for working and answer

(B) Explain, in terms of the energy band gaps, the difference between photons emitted by the red LEDs and photons emitted by the blue LEDs. **2**