5. Kim and Tom are both learning to tune a violin.

Kim's teacher asks her to tune the *A-string* of her violin to the correct frequency in hertz (Hz).

When Kim tunes the *A-string*, its frequency may be modelled by a Normal distribution.

When Kim first starts learning, she tunes the *A-string* with a mean frequency of 443 Hz and a standard deviation of 6 Hz.

The correct frequency for the *A-string* is 440 Hz.

Find the probability that Kim tunes the *A-string*

(a) lower than the correct frequency,

(2)

(b) more than 5 Hz away from the correct frequency.

(2)

After practising for a month, Kim tunes the *A-string* with a standard deviation of 4.5 Hz.

She claims that the mean frequency when she tunes the *A-string* is now less than 443 Hz.

Kim's teacher asks Kim to tune the *A-string* 20 times and finds that the mean frequency is 442 Hz.

(c) Test at the 5% level of significance whether or not there is evidence to support Kim's claim.

You should state your hypotheses and show your working clearly.

(4)

When Tom tunes the *A-string*, its frequency, T Hz, may be modelled by $T \sim N(\mu, \sigma^2)$

Given that $P(T < 438) = 0.2$ and that $P(T > 445) = 0.1$

(d) find the value of μ and the value of σ, giving your answers, in Hz, to 1 decimal place.

(6)