15 A quality control department checks the lifetimes of batteries produced by a company.

The lifetimes, x minutes, for a random sample of 80 'Superstrength' batteries are shown in the table below.

Lifetime	$160 \leq x < 165$	$165 \leq x < 168$	$168 \leq x < 170$	$170 \leq x < 172$	$172 \leq x < 175$	$175 \leq x < 180$
Frequency	5	14	20	21	16	4

(a) Estimate the proportion of these batteries which have a lifetime of at least 174.0 minutes.
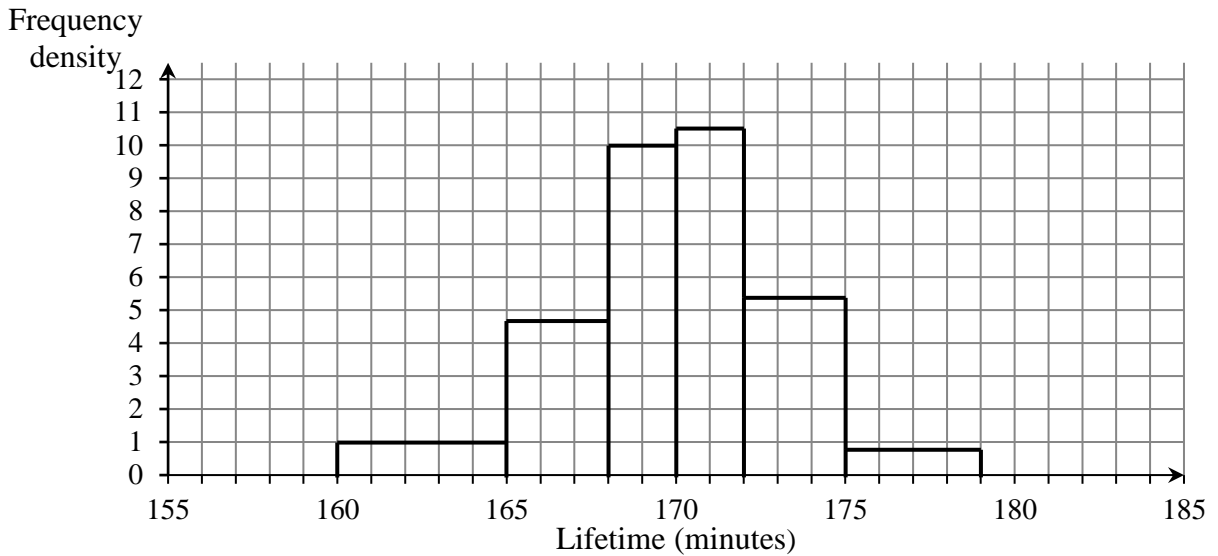
[2]

(b) Use the data in the table to estimate
- the sample mean,
- the sample standard deviation. **[3]**

The data in the table on the previous page are represented in the following histogram, **Fig 15**:

Fig. 15

A quality control manager models the data by a Normal distribution with the mean and standard deviation you calculated in part **(b)**.

(c) Comment briefly on whether the histogram supports this choice of model. **[2]**

(d) **(i)** Use this model to estimate the probability that a randomly selected battery will have a lifetime of more than 174.0 minutes.

(ii) Compare your answer with your answer to part **(a)**. **[3]**

The company also manufactures 'Ultrapower' batteries, which are stated to have a mean lifetime of 210 minutes.

(e) A random sample of 8 Ultrapower batteries is selected. The mean lifetime of these batteries is 207.3 minutes.

Carry out a hypothesis test at the 5% level to investigate whether the mean lifetime is as high as stated. You should use the following hypotheses $H_0 : \mu = 210$, $H_1 : \mu < 210$, where μ represents the population mean for Ultrapower batteries.

You should assume that the population is Normally distributed with standard deviation 3.4.
[5]