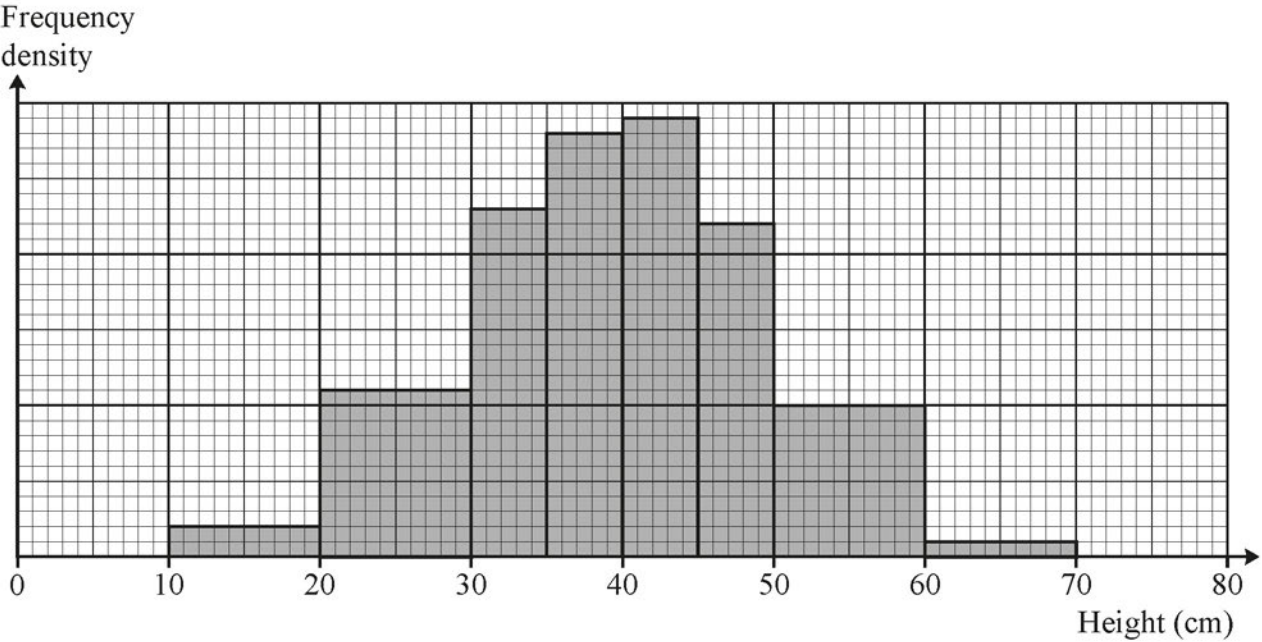9   The heights, in centimetres, of a random sample of 150 plants of a certain variety were measured. The results are summarised in the histogram.

Frequency density / Height (cm)

One of the 150 plants is chosen at random, and its height, X cm, is noted.

(a) Show that $P(20 < X < 30) = 0.147$, correct to **3** significant figures.   [2]

Sam suggests that the distribution of X can be well modelled by the distribution $N(40, 100)$.

(b) (i) Give a brief justification for the use of the normal distribution in this context.   [1]

   (ii) Give a brief justification for the choice of the parameter values 40 and 100.   [2]

(c) Use Sam's model to find $P(20 < X < 30)$.   [1]

Nina suggests a different model. She uses the midpoints of the classes to calculate estimates, m and s, for the mean and standard deviation respectively, in centimetres, of the 150 heights. She then uses the distribution $N(m, s^2)$ as her model.

(d) Use Nina's model to find $P(20 < X < 30)$.   [4]

(e) (i) Complete the table in the Printed Answer Booklet to show the probabilities obtained from Sam's model and Nina's model.   [2]

   (ii) By considering the different ranges of values of X given in the table, discuss how well the two models fit the original distribution.   [2]