Exercise 3B
Finding Probabilities for Normal Distributions

8 The volume of soap dispensed by a soap-dispenser on each press, X ml, is modelled as $X \sim N(6, 0.8^2)$.

   a Find: **i** $P(X > 7)$ **ii** $P(X < 5)$ **(2 marks)**

   The soap dispenser is pressed three times.

   b Find the probability that on all three presses, less than 5 ml of soap is dispensed.   **(2 marks)**

9 The amount of mineral water, W ml, in a bottle produced by a certain manufacturer is modelled as $W \sim N(500, 14^2)$.

   a Find: **i** $P(W > 505)$ **ii** $P(W < 490)$ **(2 marks)**

   A sample of 4 bottles is taken.

   b Find the probability that all of the bottles contain more than 490 ml.   **(2 marks)**

10 The heights of a large group of women are normally distributed with a mean of 165 cm and a standard deviation of 3.5 cm. A woman is selected at random from this group.

> **Problem-solving**
>
> For part **c**, formulate a binomial random variable to represent the number of women in the sample who meet Steven's criteria.

   a Find the probability that she is shorter than 160 cm.

   Steven is looking for a woman whose height is between 168 cm and 174 cm for a part in his next film.

   b Find the proportion of women from this group who meet Steven's criteria.

   A sample of 20 women is taken from the group.

   c Find the probability that at least 5 of the women meet Steven's criteria.

Exercise 3C
The Inverse Normal Distribution

7 The percentage scores, X, of a group of learner drivers in a theory test is modelled as a normal distribution with $X \sim N(72, 6^2)$.

    a Find the value of a such that $P(X < a) = 0.6$.   **(1 mark)**

    b Find the interquartile range of the scores.   **(2 marks)**

8 The masses, Y grams, of a brand of chocolate bar are modelled as $Y \sim N(60, 2^2)$.

    a Find the value of y such that $P(Y > y) = 0.2$.   **(1 mark)**

    b Find the 10% to 90% interpercentile range of masses.   **(2 marks)**

    c Tom says that the median is equal to the mean. State, with a reason, whether Tom is correct.   **(1 mark)**

9 The distribution of heights, H cm, of a large group of men is modelled using $H \sim N(170, 10^2)$. A frock coat is a coat that goes from the neck of a person to near the floor. A clothing manufacturer uses the information to make three different lengths of frock coats. The table below shows the proportion of each size they will make.

Short	Regular	Long
30%	50%	20%

    a The company wants to advertise a range of heights for which the regular frock coat is suitable. Use the model to suggest suitable heights for the advertisement.   **(4 marks)**

    b State one assumption you have made in deciding these values.   **(1 mark)**

Exercise 3D
The Standard Normal Distribution

7 a Use the percentage points table to find the values of z that correspond to the 10% to 90% interpercentile range. **(2 marks)**

A particular brand of light bulb has a life modelled as a normal distribution with mean 1175 hours and standard deviation 56 hours. The bulb life is considered 'standard' if its life falls into the 10% to 90% interpercentile range.

b Use your answer to part **a** to find the range of life to the nearest hour for a 'standard' bulb. **(2 marks)**

Exercise 3E
Finding μ and σ

11 An automated pottery wheel is used to make bowls. The diameter of the bowls, D mm, is normally distributed with mean μ and standard deviation 5 mm. Given that 75% of bowls are greater than 200 mm in diameter, find:

  a the value of μ **(2 marks)**

  b $P(204 < D < 206)$ **(1 mark)**

  Three bowls are chosen at random.

  c Find the probability that all of the bowls are greater than 205 mm in diameter. **(3 marks)**

12 A loom makes table cloths with an average thickness of 2.5 mm. The thickness, T mm, can be modelled using a normal distribution. Given that 65% of table cloths are less than 2.55 mm thick, find:

  a the standard deviation of the thickness **(2 marks)**

  b the proportion of table cloths with thickness between 2.4 mm and 2.6 mm. **(1 mark)**

  A table cloth can be sold if the thickness is between 2.4 mm and 2.6 mm. A sample of 20 table cloths is taken.

  c Find the probability that at least 15 table cloths can be sold. **(3 marks)**

13 The masses of the penguins on an island are found to be normally distributed with mean μ, and standard deviation σ. Given that 10% of the penguins have a mass less than 18 kg and 5% of the penguins have a mass greater than 30 kg,

  a sketch a diagram to represent this information **(2 marks)**

  b find the value of μ and the value of σ. **(6 marks)**

  10 penguins are chosen at random.

  c Find the probability that at least 4 of them have a mass greater than 25 kg. **(4 marks)**