If Z is the standard normal distribution, find the following probabilities using technology. In each case sketch the regions.

a $P(-0.86 \leqslant Z \leqslant 0.32)$
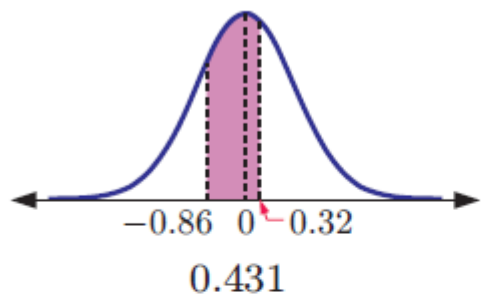
b $P(-2.3 \leqslant Z \leqslant 1.5)$

c $P(Z \leqslant 1.2)$

d $P(Z \leqslant -0.53)$

e $P(Z \geqslant 1.3)$

f $P(Z \geqslant -1.4)$

5 **a**

−0.86 0 0.32

0.431

b

−2.3 0 1.5

0.922

c

0 1.2

0.885

d

−0.53 0

0.298

e

0 1.3

0.096 8

f

−1.4 0

0.919
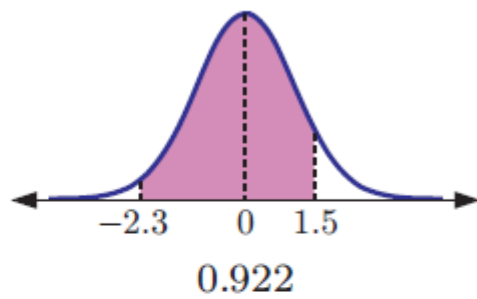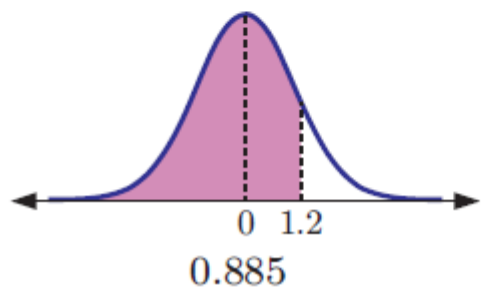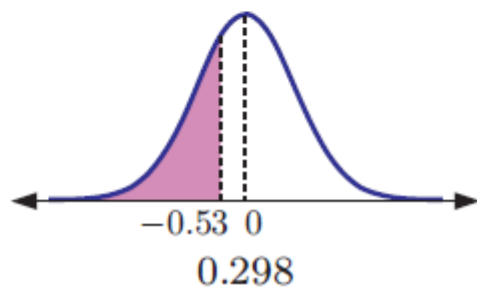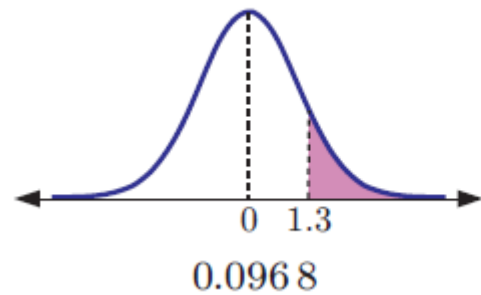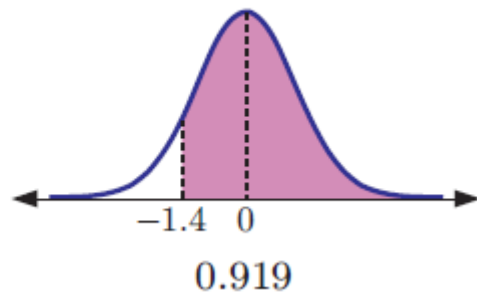
A machine produces metal bolts. The lengths of these bolts have a normal distribution with mean 19.8 cm and standard deviation 0.3 cm.

If a bolt is selected at random from the machine, find the probability that it will have a length between 19.7 cm and 20 cm.

The table shows Emma's midyear exam results. The exam results for each subject are normally distributed with the mean μ and standard deviation σ shown in the table.

a Find the z-score for each of Emma's subjects.

b Arrange Emma's subjects from 'best' to 'worst' in terms of the z-scores.

Subject	Emma's score	μ	σ
English	48	40	4.4
Mandarin	81	60	9
Geography	84	55	18
Biology	68	50	20
Maths	84	50	15

6 The length of fish from a particular species is normally distributed with mean 35 cm and standard deviation 8 cm. The fisheries department has decided that the smallest 10% of the fish are not to be harvested. What is the size of the smallest fish that can be harvested?

1 The IQs of students at school are normally distributed with a standard deviation of 15. If 20% of students have an IQ higher than 125, find the mean IQ of students at school.

2 The distances an athlete jumps are normally distributed with mean 5.2 m. If 15% of the jumps by this athlete are less than 5 m, what is the standard deviation?

3 The weekly income of a bakery is normally distributed with a mean of $6100. If 85% of the time the weekly income exceeds $6000, what is the standard deviation?

4 The arrival times of buses at a depot are normally distributed with standard deviation 5 minutes. If 10% of the buses arrive before 3:55 pm, find the mean arrival time of buses at the depot.

6 The diameters of pistons manufactured by a company are normally distributed. Only those pistons whose diameters lie between 3.994 cm and 4.006 cm are acceptable.

  a Find the mean and the standard deviation of the distribution if 4% of the pistons are rejected as being too small, and 5% are rejected as being too large.

  b Determine the probability that the diameter of a randomly chosen piston lies between 3.997 cm and 4.003 cm.

8 Pedro is studying Algebra and Geometry. He sits for the mid-year exams in each subject.

Pedro's Algebra mark is 56%, and the class mean and standard deviation are 50.2% and 15.8% respectively.

In Geometry he is told that the class mean and standard deviation are 58.7% and 18.7% respectively.

What percentage does Pedro need to have scored in Geometry, to have an equivalent result to his Algebra mark?