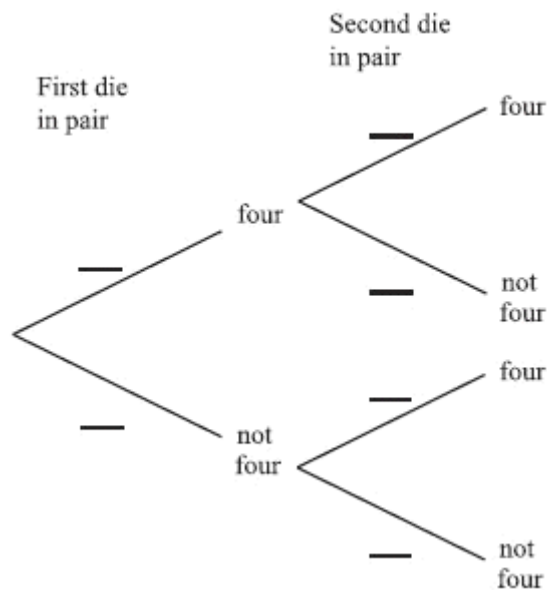


BINOMIAL, NORMAL DISTRIBUTIONS - IB SAMPLE PROBLEMS

1. A pair of fair dice is thrown.

(a) Copy and complete the tree diagram below, which shows the possible outcomes.



(3)

Let E be the event that **exactly** one four occurs when the pair of dice is thrown.

(b) Calculate $P(E)$.

(3)

The pair of dice is now thrown five times.

(c) Calculate the probability that event E occurs **exactly** three times in the five throws.

(3)

(d) Calculate the probability that event E occurs **at least** three times in the five throws.

(3)

(Total 12 marks)

2. A box contains 35 red discs and 5 black discs. A disc is selected at random and its colour noted. The disc is then replaced in the box.

(a) In eight such selections, what is the probability that a black disc is selected

(i) exactly once?

(3)

(ii) at least once?

(3)

(b) The process of selecting and replacing is carried out 400 times.

What is the expected number of black discs that would be drawn?

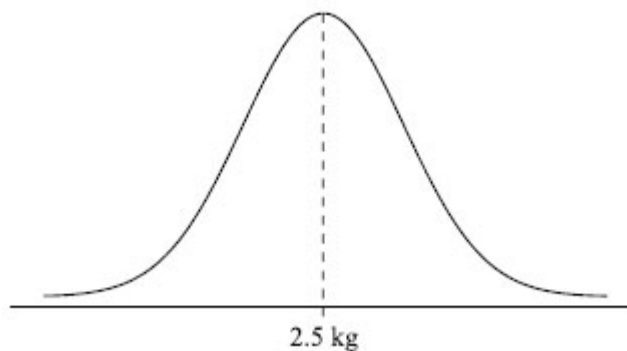
(2)

(Total 8 marks)

3. The weights of chickens for sale in a shop are normally distributed with mean 2.5 kg and standard deviation 0.3 kg.

(a) A chicken is chosen at random.

- (i) Find the probability that it weighs less than 2 kg.
- (ii) Find the probability that it weighs more than 2.8 kg.
- (iii) Copy the diagram below. Shade the areas that represent the probabilities from parts (i) and (ii).



- (iv) **Hence** show that the probability that it weighs between 2 kg and 2.8 kg is 0.7936 (to four significant figures)

(7)

(b) A customer buys 10 chickens.

- (i) Find the probability that all 10 chickens weigh between 2 kg and 2.8 kg.
- (ii) Find the probability that at least 7 of the chickens weigh between 2 kg and 2.8 kg.

(6)

(Total 13 marks)

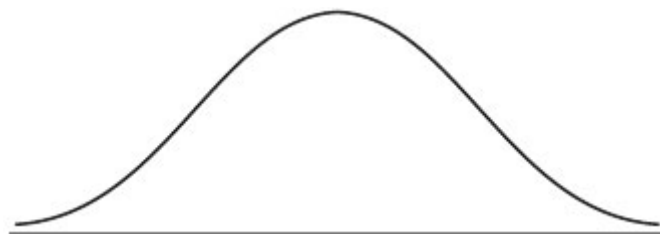
4. The heights of certain plants are normally distributed. The plants are classified into three categories.

The shortest 12.92% are in category A.

The tallest 10.38% are in category C.

All the other plants are in category B with heights between r cm and t cm.

(a) Complete the following diagram to represent this information.



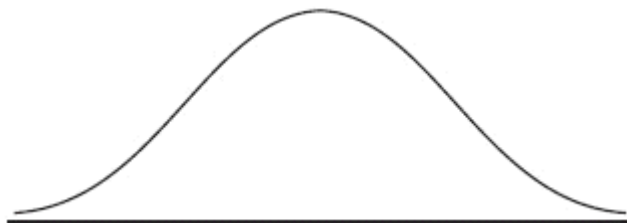
(2)

- (b) Given that the mean height is 6.84 cm and the standard deviation 0.25 cm, find the value of r and of t .

(5)

(Total 7 marks)

5. The weights of a group of children are normally distributed with a mean of 22.5 kg and a standard deviation of 2.2 kg.
- (a) Write down the probability that a child selected at random has a weight more than 25.8 kg.
- (b) Of the group 95% weigh less than k kilograms. Find the value of k .
- (c) The diagram below shows a normal curve.



On the diagram, shade the region that represents the following information:

87% of the children weigh less than 25 kg

(Total 6 marks)

6. The heights of boys at a particular school follow a normal distribution with a standard deviation of 5 cm. The probability of a boy being shorter than 153 cm is 0.705.

- (a) Calculate the mean height of the boys.
- (b) Find the probability of a boy being taller than 156 cm.

(Total 6 marks)

7. The heights of certain flowers follow a normal distribution. It is known that 20% of these flowers have a height less than 3 cm and 10% have a height greater than 8 cm.

Find the value of the mean μ and the standard deviation σ .

(Total 6 marks)

8. In a large school, the heights of all fourteen-year-old students are measured.

The heights of the girls are normally distributed with mean 155 cm and standard deviation 10 cm.

The heights of the boys are normally distributed with mean 160 cm and standard deviation 12 cm.

(a) Find the probability that a girl is taller than 170 cm. (3)

(b) Given that 10% of the girls are shorter than x cm, find x . (3)

(c) Given that 90% of the boys have heights between q cm and r cm where q and r are symmetrical about 160 cm, and $q < r$, find the value of q and of r . (4)

In the group of fourteen-year-old students, 60% are girls and 40% are boys.

The probability that a girl is taller than 170 cm was found in part (a).

The probability that a boy is taller than 170 cm is 0.202.

A fourteen-year-old student is selected at random.

(d) Calculate the probability that the student is taller than 170 cm. (4)

(e) Given that the student is taller than 170 cm, what is the probability the student is a girl? (3)

(Total 17 marks)