

## Topic Y2 Counting principles & probability distributions (Pre-TT B) [47]

1.

(i) How many different teams of 7 people can be chosen, without regard to order, from a squad of 15? [2]

(ii) The squad consists of 6 forwards and 9 defenders. How many different teams containing 3 forwards and 4 defenders can be chosen? [2]

(Total 4 marks)

2.

20% of packets of a certain kind of cereal contain a free gift. Jane buys one packet a week for 8 weeks. The number of free gifts that Jane receives is denoted by  $X$ . Assuming that Jane's 8 packets can be regarded as a random sample, find

(i)  $P(X = 3)$ , [3]

(ii)  $P(X \geq 3)$ , [2]

(iii)  $E(X)$ . [2]

(Total 7 marks)

3.

The discrete random variable  $R$  has the following probability distribution.

|            |     |     |     |     |
|------------|-----|-----|-----|-----|
| $r$        | -2  | 0   | $a$ | 4   |
| $P(R = r)$ | 0.3 | $b$ | $c$ | 0.1 |

It is known that  $E(R) = 0.2$  and  $\text{Var}(R) = 3.56$

Find the values of  $a$ ,  $b$  and  $c$ .

**[4 marks]**

(Total 4 marks)

4.

Henry makes repeated attempts to light his gas fire. He makes the modelling assumption that the probability that the fire will light on any attempt is  $\frac{1}{3}$ .

Let  $X$  be the number of attempts at lighting the fire, up to and including the successful attempt.

(i) Name the distribution of  $X$ , stating a further modelling assumption needed. [2]

In the rest of this question, you should use the distribution named in part (i).

(ii) Calculate

(a)  $P(X = 4)$ , [3]

(b)  $P(X < 4)$ . [3]

(iii) State the value of  $E(X)$ . [1]

(iv) Henry has to light the fire once a day, starting on March 1st. Calculate the probability that the first day on which fewer than 4 attempts are needed to light the fire is March 3rd. [3]

(Total 12 marks)

5.

The time in hours to failure of a component may be modelled by an exponential distribution with parameter  $\lambda = 0.025$

In a manufacturing process, the machine involved uses one of these components continuously until it fails.

The component is then immediately replaced.

- (a) Write down the mean time to failure for a component. [1 mark]
- (b) Find the probability that a component will fail during a 12-hour shift. [1 mark]
- (c) A component has not failed for 30 hours. Find the probability that this component lasts for at least another 30 hours. [2 marks]
- (d) Find the probability that a component does **not** fail during 4 consecutive 12-hour shifts. [3 marks]
- (e) (i) State the distribution that can be used to model the number of components that fail during one hour of the manufacturing process. [2 marks]
- (e) (ii) Hence, or otherwise, find the probability that no components fail during 5 consecutive 12-hour shifts. [2 marks]
- (Total 11 marks)

6.

A group of 7 students sit in random order on a bench.

- (i) (a) Find the number of orders in which they can sit. [1]
- (b) The 7 students include Tom and Jerry. Find the probability that Tom and Jerry sit next to each other. [3]
- (ii) The students consist of 3 girls and 4 boys. Find the probability that
- (a) no two boys sit next to each other, [2]
- (b) all three girls sit next to each other. [3]
- (Total 9 marks)