ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a 12 page answer book;
- a Formula Booklet;
- a calculator;
- statistical tables (Murdoch and Barnes or RND/WJEC Publications)

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

Sufficient working must be shown to demonstrate the **mathematical** method employed.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. A bag contains 10 sweets, of which 1 is red, 2 are blue, 3 are yellow and 4 are green. Sharon chooses 2 sweets at random from the bag, without replacement. Calculate the probability that

   (a) both sweets are yellow, [2]

   (b) both sweets are of the same colour, [4]

   (c) neither of the sweets is green. [2]

2. Events A and B are such that

$$P(A) = 0{\cdot}2, \quad P(B) = 0{\cdot}4, \quad P(A{\cup}B) = 0{\cdot}52.$$

   (a) Show that A and B are independent. [5]

   (b) Calculate the probability of exactly one of the two events occurring. [2]

   (c) Given that exactly one of the two events occurs, calculate the probability that A occurs. [3]

3. (a) The random variable X has the binomial distribution $B(n, p)$.
   Given that the mean and standard deviation of X are 10 and 3 respectively, find the values of n and p. [5]

   (b) The random variable Y has the binomial distribution $B(380, 0{\cdot}016)$.
   Use a Poisson approximation to find an approximate value for the probability that Y is less than 3. [4]

4. The probability distribution of the discrete random variable X is given in the following table, where λ is a constant.

x	2	3	4	5	6
P(X = x)	0·1	0·2	0·3	λ	$0{\cdot}4 - \lambda$

   (a) Find the range of possible values of λ . [2]

   (b) Given that $E(X) = 4{\cdot}25$,

   (i) find the value of λ ,

   (ii) evaluate $Var(X)$. [6]

5. When seeds of a certain variety of flower are planted, the probability of each seed germinating is 0·8, independently of all other seeds.

    (a)   David plants 20 of these seeds. Find the probability that

        (i)   exactly 15 seeds germinate,

        (ii)   at least 15 seeds germinate.   [6]

    (b)   Beti plants *n* of these seeds and she correctly calculates that the probability that they all germinate is 0·10737, correct to five decimal places. Find the value of *n*.   [3]

6. A bag contains three balls numbered 1, 2 and 3 respectively. Jim selects one of these balls at random and he notes the number on the selected ball. He then tosses that number of fair coins.

    (a)   Calculate the probability that no head is obtained.   [5]

    (b)   Given that no head was obtained, find the probability that he tossed 2 coins.   [3]

7. The number of letters delivered to Bill's house on a weekday may be assumed to have a Poisson distribution with mean 1·2.

    (a)   Find the probability that, on a particular weekday,

        (i)   at least 3 letters are delivered,

        (ii)   no letters are delivered.   [4]

    (b)   Given that the postman made a letter delivery to Bill's house on a particular weekday, find the probability that at least 3 letters were delivered.   [3]

    (c)   In a particular week starting on a Monday, find the probability that the first letter delivery occurs on the Wednesday.   [2]

8. The continuous random variable *X* has cumulative distribution function *F* given by

$$F(x) = 0 \qquad \text{for} \quad x < 1,$$

$$F(x) = \frac{1}{10}(x^2 + x - 2) \quad \text{for} \quad 1 \leqslant x \leqslant 3,$$

$$F(x) = 1 \qquad \text{for} \quad x > 3.$$

    (a)   (i)   Evaluate $P(2 \leqslant X \leqslant 2·5)$.

        (ii)   Find the median of *X*.   [7]

    (b)   (i)   Obtain an expression for $f(x)$, valid for $1 \leqslant x \leqslant 3$, where *f* denotes the probability density function of *X*.

        (ii)   Write down the value of $f(4)$.

        (iii)   Calculate $E(X)$.   [7]