WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced Subsidiary/Advanced

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983/01

MATHEMATICS S1

Statistics

P.M. WEDNESDAY, 18 January 2006

($1\frac{1}{2}$ hours)

NEW SPECIFICATION

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.

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. Two unbiased cubical dice are thrown simultaneously. Calculate the probability that

(a) the score on each die is at least 3, [3]

(b) the scores on the two dice differ by 3. [3]

2. The events A and B are such that $P(A) = 0{\cdot}5$ and $P(A \cup B) = 0{\cdot}7$. Determine the value of $P(B)$ in each of the cases when

(a) A and B are mutually exclusive, [2]

(b) A and B are independent, [4]

(c) $P(B \mid A) = 0{\cdot}3$. [3]

3. The number of machine breakdowns, X, occurring in a certain factory in a randomly chosen week may be assumed to have a Poisson distribution with mean 4.

(a) Write down the standard deviation of X. [1]

(b) Find the probability that the number of machine breakdowns in a randomly chosen week is

(i) exactly 3,

(ii) between 2 and 6 (both inclusive). [5]

(c) The cost C (in appropriate monetary units) of repairing these machines is given by

$$C = 5 + 4X.$$

Find the mean and standard deviation of C. [4]

4. A bag contains 5 red balls and 3 blue balls. A random sample of 3 balls is selected from the bag, without replacement. Calculate the probability that

(a) all the selected balls are red, [2]

(b) more blue balls are selected than red balls. [4]

5. The random variable X has the binomial distribution $\mathrm{B}(n,p)$. The mean and standard deviation of X are 20 and 4 respectively. Find the values of n and p. [6]

6. Jim has a fair cubical die with the six faces numbered 1, 2, 3, 4, 5, 6 respectively and a fair tetrahedral die with the four faces numbered 1, 2, 3, 4 respectively.
He tosses a fair coin.
If it falls 'heads', he throws the cubical die.
If it falls 'tails', he throws the tetrahedral die.

(a) Calculate the probability that he obtains a '4'. [3]

(b) Given that he obtains a '4', find the probability that he threw the cubical die. [3]

7. Wine glasses are mass produced. There is a probability of 0·05 that a randomly selected glass is defective, independently of all other glasses.

(a) **Without using tables,** find the probability that a set of 24 glasses contains exactly 2 defective glasses. [3]

(b) **Using tables,** find the probability that a set of 50 glasses contains between 3 and 5 (both inclusive) defective glasses. [3]

(c) Use a Poisson approximation to find the probability that a set of 120 glasses contains fewer than 8 defective glasses. [3]

8. The following table gives the probability distribution of the discrete random variable X, where θ is a constant.

x	1	2	3	4
$P(X = x)$	0·1	0·2	θ	$0{\cdot}7 - \theta$

(a) State the range of possible values of θ. [2]

(b) Given that $E(X) = 3$,

(i) find the value of θ,

(ii) evaluate $E(X^3)$. [7]

9. The continuous random variable X has probability density function f given by

$$f(x) = kx^2 \quad \text{for } 1 \leqslant x \leqslant 4,$$
$$f(x) = 0 \quad \text{otherwise,}$$

where k is a constant.

(a) (i) Show that

$$k = \frac{1}{21}.$$

(ii) Evaluate $E(X)$. [6]

(b) (i) Obtain an expression for $F(x)$, valid for $1 \leqslant x \leqslant 4$, where F denotes the cumulative distribution function of X.

(ii) Evaluate $P(2 \leqslant X \leqslant 3)$.

(iii) Find the median of X. [8]