

[**N.B.** – The figures of the right margin indicate full marks. Read the stems carefully and answer the associated questions. Answer any **FIVE** questions taking at least two questions from each group]

Group - A

1.  $P(A|B) = \frac{1}{8}, P(A) = \frac{1}{2}, P(B) = \frac{1}{5}$
- (a)

(b) Find  $P(A \cap B)$ .

(c) Find  $P(A|\bar{B})$ .

(d) Are the probabilities  $P(A|B)$  and  $P(B|A)$  equal? Justify
2. In a survey of 150 people, it is found that 70 own a car, 90 own a house, and 50 own both.

(a) Are the events of owning a car and owning a house independent?

(b) If a person is selected randomly, and if they do not own a house, what is the probability that they own a car?
3. The probability density function of a continuous random variable is

$$f(x) = \begin{cases} f(z) = \frac{2}{9}(3z - z^2); 0 \leq x \leq 3 \\ 0, \end{cases} \qquad \text{otherwise}$$

- (a) Examine whether the probability density function is appropriate.

(b) Find the probability that the value of  $z$  is not more than 2.

Group - B

4. The probability mass function (pmf) of a football striker scoring no. of hattricks during the course of a league season is given below
- $$P(x) = \frac{|2 - x|}{k}; x = 0, 1, 2, 3, 4, 5$$
- (a) What is a random variable?

(b) Is probability a discrete variable? Explain in brief.

(c) Find the value of k.

(d) Find the probability that the no. of hattricks would be less than the expectation.

5. A random variable is distributed as below:

$$P(X) = \frac{3-|4-x|}{k}; x = 2, 3, 4, 5, 6$$

- (a) What is the Expectation equivalent to?

(b) Find the value of k.

(c) Determine the value of the expectation.

(d) Find  $V(2X - 1)$

6. The probability density function (pdf) of a continuous random variable is given below:

$$f(x) = \frac{1}{30}(k + 2x); 2 < x < 5$$

(a) What is a random variable?	1
(b) Is probability a discrete variable? Explain in brief.	2
(c) Find the value of k.	3
(d) Determine the expectation and variance.	4

“Absence of evidence is not evidence of absence. ”  
– Carl Sagan

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Group - A

1. At CityHub High School, each student studies at least one language— Spanish, French, or Latin—and no student studies all three languages. 100 students study Spanish, 80 study French, 40 study Latin, and 22 study exactly two languages.

- (a) What is a sample space?1
- (b) In how many ways can 3 books be chosen from a set of 8 books?2
- (c) How many students are there at the High School?3
- (d) If a student is selected at random, what is the probability that the student studies only one language?4

2. An unbiased coin is tossed 10 times.

- (a) If a coin is flung 3 times, how many outcomes are generated?1
- (b) If a coin is flung n times, show how many outcomes are generated.2
- (c) What is the probability of getting a) at least 3 heads, b) at most 3 heads?3
- (d) Are these probabilities equal? a) Getting at least 2 heads & b) Getting at least 2 tails. Also justify logically.4

3. The probability density function of a continuous random variable is

$$f(x) = \begin{cases} k(x + 1), & 0 \leq x \leq 1 \\ 0, & otherwise \end{cases}$$

- (a) What is a random variable?1
- (b) Find the value of k2
- (c) Find the probability that the values of x would lie between 0 and 0.5.3
- (d) What is the probability that X is greater than 0.8?4

Group - B

4. The joint probability function of two random variables X & Y is given below:

$$P(x, y) = \frac{1}{21}(x + y); x = 1, 2, 3 \text{ \& } y = 1, 2$$

- (a) What is a probability density function (pdf)?1
- (b) What is P(X=a) in a pdf, where a is an arbitrary number?2
- (c) Find the marginal probabilities.3
- (d) Find  $P(x|y), P(x|1)$  and  $P(y|4)$ 4

5. The probability distribution of a random X is provided below:

X	-1	0	1	2	3
P(x)	$\frac{3}{20}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{20}$

- (a) What is the expectation of a constant m?1
- (b) Find  $E(X)$ .2

- (c) Find  $E(Y)$ , where  $Y = \frac{X}{2}$  3
- (d) Find Variance of  $(2X+3)$ . 4

6. Bangladesh foreign debt has been increasing rapidly in recent years. The Bangladesh bank provides the follwoing data.

Fiscal Year	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Debt	41.17	45.81	56.01	62.63	68.55	81.62	95.45	98.94	~130.00

- (a) Name the components of time series. 1
- (b) What are linear and non-linear trends? 2
- (c) Find 3-yearly moving avergae from the data and plot. 3
- (d) Whaich components of time series may underlie the data? Analyze. 4

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