

MATH7019: Sample Test 1

Name:

Student Number:

Answer all questions. Marks may be lost if necessary work is not clearly shown.

Useful Formulae: Binomial and, respectively, Poisson Distributions

$$\mathbb{P}[X = k] = \binom{n}{k} p^k (1 - p)^{n-k}$$

$$\mathbb{P}[X = k] = \frac{\lambda^k e^{-\lambda}}{k!}$$

1. Write down the bending moment due to the following loads on a 5 m beam:
 - (a) Point loads of 10 and 12 kN at $x = 2$ and $x = 3$ respectively.
 - (b) A U.D.L. of 16 kN m^{-1} from $x = 2$ to $x = 3$ and a point load of 32 kN at $x = 1$.
 - (c) a linear load varying from 8 kN m^{-1} at $x = 0$ to 18 kN m^{-1} at $x = 5$.

2. A light beam of span 6 m is simply supported at its endpoints. Between the points $x = 4$ m and $x = 6$ m there is a U.D.L. of 72 kN m^{-1} . At the point $x = 2$ m there is a load of 72 kN. Express the Bending Moment M in terms of step functions. Solve the differential equation

$$EI \frac{d^2 y}{dx^2} = -M$$

to find the deflection y at any point on the beam. At both ends the deflection is zero.

3. A light beam of span 6 m has both ends embedded in walls. Between the points $x = 3$ m and $x = 6$ m there is a U.D.L. of 24 kN m^{-1} . Express the Bending Moment M in terms of step functions. Solve the differential equation

$$EI \frac{d^2 y}{dx^2} = -M$$

to find the deflection y at any point on the beam.

4. Bricks are sold in batches of 100. A number of these batches were inspected for faulty bricks and the results are recorded in the table below

| | | | | | |
|-------------------------|----|----|----|---|---|
| Number of Faulty Bricks | 0 | 1 | 2 | 3 | 4 |
| Number of Batches | 35 | 45 | 15 | 5 | 0 |

Calculate the average number of faulty bricks per batch. By using the Binomial Distribution calculate the probability that a batch will contain less than three faulty bricks.

5. The average number of vehicles arriving at a particular interchange is 1080 per hour. Using the Poisson Distribution calculate the probability of four or more vehicles arriving at this interchange in a five second period.