

SECTION A (40 MARKS)

Answer all the questions in this Section

1. A and B are Mutually exclusive events such that $P(A) = 0.5$ and $P(B) = 0.4$

Find

(i) $P(A \cap B)$

(ii) $P(A \cup B)$

(05marks)

2. A particle is projected with a velocity of 40 ms^{-1} at an angle of elevation 30° . Find how long the particle is at least 9 meters above the point of projection.

(05marks)

3. The table below shows an extract of $\cos x^\circ$

$x = 30$	$6'$	$12'$	$18'$
$\cos x^\circ$	0.8652	0.8643	0.8634

Use linear interpolation or extrapolation to find

(i) $\cos 30^\circ 25'$

(ii) $\cos^{-1}(0.8647)$

(05marks)

4. The weights of Packets of wheat flour in a certain factory are normally distributed with mean 3.0 kg and Variance 2.89 Kg^2 . Find the probability that a random sample of 150 packets has sample mean between 2.8 kg and 3.3 kg

5. Three forces of magnitudes 5 N , 10 N and 8 N act along the sides AB , BC and AC respectively of an equilateral triangle ABC . Find the resultant force and show that the line of action of the resultant force intersects AB at a distance of $\frac{1}{3}a$ from A .

(05 marks)

6. Using 2010 as the base year, the price of indices of a commodity in 2012 and 2015 are 118 and 125. Calculate the price index of the Commodity in 2010 and 2015 when 2012 is taken as the base Year

(05 marks)

7. A particle is initially moving with a velocity of $-2\mathbf{i} + 5\mathbf{j}$. Its acceleration at a time t is given by $\mathbf{a} = -4t\mathbf{i} + 6t\mathbf{j} + 2t\mathbf{k} \text{ ms}^{-2}$. Find the speed of the particle when $t = 3$

(05 marks)

8. Given that the values of $x = 4.3$ and $Z = 0.001$ are rounded off with the Corresponding percentage errors of 0.5 and 0.05 , Find the relative error in $x - z$. correct your answer to 3 Significant

(05 marks)

SECTION B (40 MARKS)

Answer any five questions from this section. All questions Carry equal marks

9. (a) A uniform rod AB of mass 15kg hangs Vertically with end A freely hinged to a fixed point. The rod is pulled aside a horizontal force F applied at B until it rests in equilibrium making an angle of 25° with the downward Vertical. Determine the Value of F . (05 marks)
- (b) A ladder AB rests with its end A on a rough horizontal floor and the other end B against a rough Vertical wall, the coefficients of friction being μ_1 and μ_2 at the floor and on the wall respectively, if the Center of gravity of the ladder is at a distance a and b from the ends A and B, show that when the ladder is limiting equilibrium, the inclination of the ladder with the horizontal is $\tan^{-1} \left(\frac{a - b\mu_1\mu_2}{(a+b)\mu_1} \right)$ (07marks)
10. (a) The weights of 400 books in a bookshop are normally distributed with mean 50g and standard deviations 8g. Given that 99.4% of the books weigh more than 42g. Find how many books weigh less than 52.48g. (05marks)
- (b) A random sample of 100 taxis brispected on a road on a particular day gave the ages (in years), X , Summarized below; $\Sigma x = 560$, $\Sigma x^2 = 3284$. Determine the:
 (i) Un biased estimate for the Variance of all the taxis on the road
 (ii) 91.86% Confidence limits for the mean age of all the taxis that appear on the road. (07marks)
11. (a) Use the trapezium rule with 7 ordinates to evaluate $\int_1^4 \frac{1}{x(1+x^2)} dx$ correct to three decimal places.
- (b) Calculate the exact value of $\int_1^4 \frac{1}{x(1+x^2)} dx$
- (c) Determine the percentage error made in your estimate in (a). Suggest how you can improve your accuracy. (12marks)
12. A continuous random Variable X has a probability density function defined by
- $$f(x) = \begin{cases} k(3-x) & 1 \leq x \leq 2 \\ k & 2 \leq x \leq 3 \\ k(x-2) & 3 \leq x \leq 4 \\ 0 & \text{otherwise} \end{cases} \quad \text{where } K \text{ is a constant.}$$
- (a) Sketch the graph of $f(x)$ and find the value of k .
- (b) Determine the cumulative distribution function $F(x)$.
- (c) Calculate $P(2.4 < X < 3.5)$ (12marks)

13(a) Forces of magnitudes $2N$, $2N$, $3N$, $4N$, $5N$ and $\sqrt{2}N$ act along sides \overline{AB} , \overline{BC} , \overline{DC} , \overline{AD} , \overline{AC} and \overline{BD} respectively, where $ABCD$ is a square of side $1m$. Find the:

- resultant force, (08 marks)
- Equation of the line of action of the resultant force

(b) The diagram below shows a mass of $5kg$ lying on a rough plane inclined at 30° to the horizontal. From the $5kg$ mass, a light inextensible string passes up the line of greatest slope and over a smooth fixed pulley carrying a mass of $3kg$ hanging freely. The Tension in the string is just sufficient to prevent the $5kg$ mass from sliding down the slope.



Determine the Coefficient of friction between the $5kg$ mass and the rough plane (04 mark)

14. (a) show that the equation $e^x + x = 10$ has a root between 2 and 3.

(b) Using Newton's Raphson method Calculate the root of the equation. Correct to three decimal places (12 marks)

15(a) Two events X and Y are such that $P(X) = \frac{1}{2}$, $P(X/Y) = \frac{2}{3}$ and $P(Y) = \frac{3}{7}$

Find $P(x \text{ or } y)$ (05 marks)

(b) The table below shows the distribution of marks of students in a test

Score	Frequency
$20 \leq x < 30$	4
$x < 45$	3
$x < 50$	9
$x < 65$	21
$x < 75$	3
$x < 80$	5
$x < 100$	14

Draw a (i) diagram and use it to estimate the total mark (7 marks)
 (ii) Calculate the mean score.

16. A particle of mass 4 kg is initially at rest in the point A(2, 2, 3) m. The particle is acted upon by the force of

$$F = \begin{pmatrix} 4t \\ t^2 \\ 5 \end{pmatrix} \text{ Newton, where } t \text{ is the time in seconds.}$$

Find the

- (a) Acceleration at time t (5 marks)
- (b) Speed of the particle after 3 seconds (5 marks)
- (c) Displacement of the particle after 3 seconds (5 marks)

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