ROLL NUMBER				

SET	A

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2022
APPLIED MATHEMATICS - 241

CLASS: XII
DATE: 15-09-2022

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 80

GENERAL INSTRUCTIONS:

1. All questions are compulsory however in some questions of 2-, 3- and 6-marks internal choice is given. Students are expected to attempt any one out of the two.
2. Section A (Q-1 to Q -20) contains 20 one-mark questions.
3. Section B (Q-21 to Q -25) contains 5 two-mark questions.
4. Section C (Q-26 to Q -33) contains 8 three-mark questions
5. Section D (Q-34 to Q -35) contains 2 four-mark questions (Case study type)
6. Section E (Q-36 to Q -38) contains 3 six-mark questions.

1. In what ratio must a grocer mix two varieties of rice costing Rs 85 per kg and Rs 100 per kg respectively to get a mixture worth Rs 92 per kg?
(a) 7: 8 (b) 8: 7 (c) 5: 7 (d) 7: 5

2. If A_{ij} is the cofactor of the element a_{ij} of the determinant $\begin{vmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}$, then the value of $a_{32}A_{32}$ is

(a) 110 (b) 22 (c) -110 (d) -22

3. If the first derivative of a function is given by $f'(x) = (x-1)^2(x-2)(5x-8)$, then at which of the points f has neither local maxima nor local minima
a) x = 1 b) x = 2 c) $x = \frac{8}{5}$ d) none of the three

4. In context to binomial distribution which of the following is true:
(a) Mean < Variance (b) Mean > Variance
(c) Mean = Variance (d) not enough evidence to conclude

5. Identify the sampling method used: Choosing 3 students from each classroom to rate the lunch quality.
a) convenience sampling b) simple random sampling
c) stratified sampling d) systematic sampling

6. Identify which of the following is an example of seasonal variation
   a) decrease in import of wheat due to a war
   b) decrease in death rate due to advanced medicines
   c) increase in sales of air conditioners during summer
   d) recovery in business

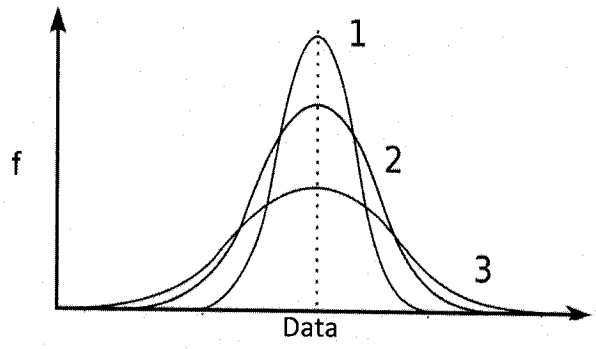
7. In a 500 m race, Anil beats Sunil by 20 m or 4 seconds. Then Anil's time over the course is
   (a) 25 seconds (b) 96 seconds (c) 100 seconds (d) 104 seconds

8. If $A = \begin{pmatrix} 3 & -2 \\ 1 & 1 \end{pmatrix}$, then $|3A|$ is equal to

   (a) 45 (b) 40 (c) 9 (d) 15

9. A point x = c is called the critical point of a function if
   a) f is defined at c
   b) $f'(c) = 0$
   c) f is not differentiable at c
   d) all the above individually or together

10. Which of the adjacent graphs depict the least variance?
    a) 1
    b) 2
    c) 3
    d) not enough data to reach at a conclusion



11. The choice of one-tailed test and two-tailed test depends upon

    a) Null hypothesis b) alternate hypothesis
    c) degrees of freedom d) standard deviation

12. $x \equiv 4(\text{mod}7)$, then positive values of x are
    (a) {4, 11, 18, ...} (b) {11, 18, 21, ...} (c) {4, 8, 12, ...} (d) {1, 8, 15, ...}

13. If matrix $A = \begin{pmatrix} 5 & -2 \\ -7 & 3 \end{pmatrix}$, then write the adjoint of matrix A.

For Q14 & 15 use the following information
A firm produces articles out of which 0.1 % are usually defective. They pack them in box containing 500 articles. If a wholesaler purchase 200 such cases.
(Given $e^{-0.5} = 0.6065$)

14. The value of parameter of Poisson distribution $\lambda =$ _____.

15. The number of boxes expected to be free of defective items will be _____.

16. If two runners A and B complete a 100 metres race in 36seconds and 48 seconds respectively, then A will defeat B by _____metres

17. If a matrix P = $\begin{pmatrix} 2 & 3 \\ -1 & 2 \end{pmatrix}$, then the matrix P^2 = _____

18. State true or false for the following statement.
Quota sampling and convenience sampling are examples of non-probability sampling.

19. From a college 6 students are selected on random sampling basis and their marks in Hindi are found to be 63, 63, 64,66, 60 and 68. Using one sample t-test, the calculated t value is 1.777 and the t critical value for degrees of freedom 5 and at 5% level of significance is 2.571.
Write the null and alternate hypothesis and interpret your agreement with the idea that the average marks in Hindi of the college are 66?

20. State true or false for the following statement.
The value of (327689 x 253217) mod 4 is 2.

21. If 52 ≡ x (mod 7), then write first 6 positive values of x.

22. If $x^3y + x^2 = y^2$ then find the value of $\frac{dy}{dx}$.

OR

If y = log(1+t) $-\frac{1}{1+t}$ and x = $t^2 + 2t$ then find $\frac{dy}{dx}$.

23. A boat covers 60 km in 5 hours running downstream. While returning, it covers the same distance in 7.5 hours. What is the speed of the stream?

24. The cost of producing x tons of steel is given by C(x) = $\frac{1}{10}x^3 - 5x^2 + 1000$. Find the rate of change of marginal cost when x = 100 tons.

25. A pipe fills a tank in 2 hours and another pipe fills the same tank in 4 hours. But a third pipe empties the full tank in 6 hours. If all of them are opened together, how much time will it take to fill the tank?

OR

Solve for real value of x : $\frac{1}{2}\left(\frac{3x}{5} + 4\right) \geq \frac{1}{3}(x - 6)$

26. What will be the last two digits of the product 7213 x 5436 x 3892 ?

27. Solve the following system of equations using Cramer's rule.
2x – 3y = 3 , 3x + 2y = 11

28. For the probability distribution given below,

X	0	1	2	3
P(X)	k	3k	3k	k

find the value of
i) k
ii) Find E(X)

29. What is the need of sampling? Explain any two types of probability sampling methods. Give at least one example in each case.

OR

Write a short note on representative and unrepresentative sample. Also give the significance of unrepresentative sample.

30. The following table relates to the sales of company (in millions) during 2004 to 2010:

Year	2004	2005	2006	2007	2008	2009	2010
Sales	18	20	23	25	24	28	30

Compute the trends by the method of moving averages, assuming that 3-year cycle is present in the above series.

31. Find the least non-negative remainder when 3^{100} is divided by 7

OR

Ritu can row downstream 20 km in 2 hours and against stream 4km in 2 hours. Find her speed of rowing in still water and also find the speed of the stream.

32. If $\begin{pmatrix} x & -5 & -1 \end{pmatrix}\begin{pmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{pmatrix}\begin{pmatrix} x \\ 4 \\ 1 \end{pmatrix} = 0$, find the value of x.

OR

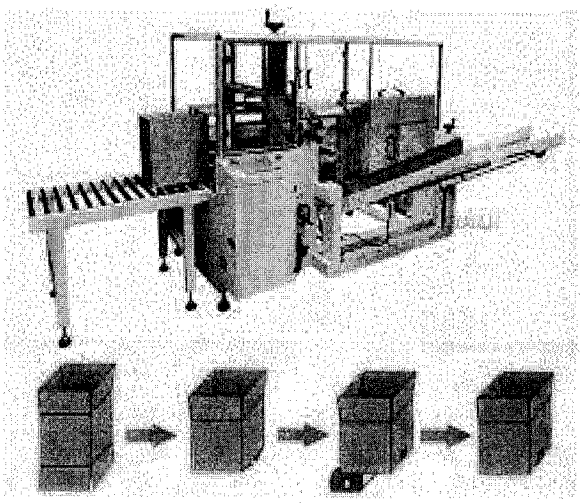
There are two families *A* and *B*. In family *A*, there are 2 men, 3 women, and one child. In family *B*, there are 1 man, 2 women and 2 children. The recommended daily allowance for calories is : Man-2400, Women-1900, Child-1800 and proteins : Man-55 gm, Women-45 gm, Child-33 gm. Represent the above information by matrices.
Using matrix algebra, calculate the total requirement of calories and protein for each of two families.

33. If X is a binomially distributed random variable with $E(X) = 2$ and var $(X) = \frac{4}{3}$.
Find $P(X = 5)$.

34. **Case Based Question-1**

(for degrees of freedom 9 and 5% level of significance, the table value of t = 2.26)

Ten cartons are taken at random from an automatic packing machine. The mean net weight of the 10 cartons is 11.8 kg. and standard deviation is 0.15 kg. It is intended to check if the sample mean differ significantly from the intended weight of 12 kg.
a) Establish the null and alternate hypothesis and calculate the t test value.
b) Does the sample mean differ significantly from the intended weight of 12 kg? Justify your claim using the information along with the picture.



35. **Case Based Question-2 (*Attempt any four MCQ from the following)***

The following table relates to the tourist arrivals (in millions) during 2004 to 2010 in India:

Year (T)	2004	2005	2006	2007	2008	2009	2010
Tourist arrivals(Y)	18	20	23	25	24	28	30

For fitting a straight-line trend by the method of least squares

(i) the value of $\sum x$, where x = T – 2007 is equal to
a) 1 b) 0 c) varies from question-to-question d) data insufficient

(ii) In this case for the line of best fit Y = a + b x , the value of a is
a) 25 b) 28.67 c) 24 d) 26.4

(iii) The line of best fit is
a) Y = 25 + 1.5 x b) Y = 24 + 1.5 x c) Y = 24 + 1.89 x d) Y = 26.4 + 1.89 x

(iv) For predicting the number of tourists that would arrive in the year 2014, the value of x is
a) 7 b) 5 c) 4 d) 8

(v) The predicted number of tourist for the year 2014 are
a) 32 b) 35 c) 34 d) 37

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36. Big Bazar Fruit Mart sells variety packs. The small pack contains three bananas, two apples, and one orange for Rs 180. The medium pack contains four bananas, three apples, and three oranges for Rs 305. The family size contains six bananas, five apples, and four oranges for Rs 465.
Formulate the system of linear equations for the above situation and using matrix method find at price should Big Bazar charge for his lunch-box special that consists of one banana, one apple, and one orange?

OR

Find the inverse of the matrix A = $\begin{pmatrix} a & b \\ c & \frac{1+bc}{a} \end{pmatrix}$ and show that $aA^{-1} = (a^2 + bc + 1)I_2 - aA$

37. The price per unit for a commodity is $p = 100 + x$ and cost function is $C(x) = \frac{1}{3}x^3 - 7x^2 + 111x + 50$.
i) Find the profit function
ii) Find the number of units at which profit will be maximum.
iii) Find the maximum profit.

OR

An open box is to be made from a piece of cardboard measuring 24 cm x 24 cm by cutting off equal squares from the corners and turning up the sides. Find the height of the box for maximum volume.

38. In a CBSE school exam, scores of 300 student of class XII are recorded at the end of the session. The average score for the batch was 700 and the standard deviation was calculated to be 180.
(i) Taniya scored 800 marks in total out of 1000. Find out how has Taniya scored compared to his batchmates in the whole district.
(ii) Lavanya scored 420 marks in the same batch. What can you say about her performance as compared to the batch of 300 students?
(iii) How much has Varsha scored if she has done better than 44.83% of his batchmates?

Use the following extract from the probability table against the z scores.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545

******END OF THE QUESTION PAPER******

ROLL NUMBER					

SET	B

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2022
APPLIED MATHEMATICS - 241

CLASS: XII
DATE: 15-09-2022

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 80

GENERAL INSTRUCTIONS:

1. *All questions are compulsory however in some questions of 2-, 3- and 6-marks internal choice is given. Students are expected to attempt any one out of the two.*
2. *Section A (Q-1 to Q -20) contains 20 one-mark questions.*
3. *Section B (Q-21 to Q -25) contains 5 two-mark questions.*
4. *Section C (Q-26 to Q -33) contains 8 three-mark questions*
5. *Section D (Q-34 to Q -35) contains 2 four-mark questions (Case study type)*
6. *Section E (Q-36 to Q -38) contains 3 six-mark questions.*

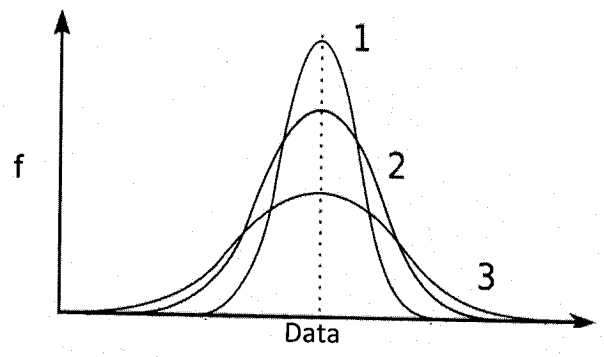
1. If $A = \begin{pmatrix} 2 & -2 \\ -1 & 3 \end{pmatrix}$, then $|4A|$ is equal to :

   (a) 64 (b) - 64 (c) 128 (d) -128

2. In a 100 m race, Karan beats Prateek by 20 m or 4 seconds. Then Karan's time over the course is
   (a) 20 seconds (b) 16 seconds (c) 10 seconds (d) 12 seconds

3. Identify which of the following is an example of seasonal variation:
   a) decrease in import of wheat due to a war
   b) decrease in death rate due to advanced medicines
   c) increase in sales of warm cloths during winter.
   d) recovery in business

4. Which of the adjacent graphs depict the least variance?
   a) 1
   b) 2
   c) 3
   d) not enough data to reach at a conclusion



5. If the first derivative of a function is given by $f'(x) = (x-2)^2(x-1)(5x-3)$, then at which of these points f has neither local maxima nor local minima

a) x = 2 b) x = 1 c) x = $\frac{3}{5}$ d) none of the three

6. In what ratio must a shopkeeper mix two varieties of sugar costing Rs 80 per kg and Rs 100 per kg respectively to get a mixture worth Rs 90 per kg?

(a) 7 : 8 (b) 8 : 7 (c) 5 : 7 (d) 7 : 5

7. In context to binomial distribution which of the following is true:

(a) Mean < Variance (b) Mean > Variance

(c) Mean = Variance (d) not enough evidence to conclude

8. If C_{ij} is the cofactor of the element a_{ij} of the determinant $\begin{vmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}$, then the value of $a_{23}C_{12}$ is

(a) 184 (b) 152 (c) -184 (d) 126

9. Identify sampling method used: Choosing 2 students from each section to rate the lunch quality among class 12 students.

a) convenience sampling b) simple random sampling

c) stratified sampling d) systematic sampling

10. A point x = a is called the critical point of a function if

a) f is defined at a b) $f'(a) = 0$

c) f is not differentiable at a d) all the above individually or together

11. The choice of one-tailed test and two-tailed test depends upon

a) Null hypothesis b) alternate hypothesis

c) degrees of freedom d) standard deviation

12. $x \equiv 4(\text{mod}7)$, then positive values of x are

(a) {4, 11, 18, ...} (b) {11, 18, 22, ...} (c) {4, 8, 12, ...} (d) {1, 8, 15, ...}

13. If matrix $A = \begin{pmatrix} 5 & -2 \\ -7 & 3 \end{pmatrix}$, then write the adjoint of matrix A.

For Q14 & 15 use the following information

A firm produces articles out of which 0.1 % are usually defective. They pack them in box containing 500 articles. If a wholesaler purchase 100 such cases.

(Given $e^{-0.5} = 0.6065$)

14. The value of parameter of Poisson distribution $\lambda =$ _____.

15. The number of boxes expected to be free of defective items will be _____.

16. If two runners A and B complete a 300 metres race in 45seconds and 54 seconds respectively, then A will defeat B by _____metres

17. If a matrix A = $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$, then the matrix A^5 = _____

18. State true or false for the following statement.
Quota sampling and convenience sampling are examples of non-probability sampling.

19. From a college 6 students are selected on random sampling basis and their marks in Hindi are found to be 63, 63, 64,66, 60 and 68. Using one sample t-test, the calculated t value is 1.777 and the t critical value for degrees of freedom 5 and at 5% level of significance is 2.571.
Write the null and alternate hypothesis and interpret your agreement with the idea that the average marks in Hindi of the college are 66?

20. State true or false for the following statement.

The value of (327673 x 253225) mod 4 is 3.

21. If 45 ≡ x (mod 8), then write first 6 positive values of x.

22. If $3x^2 + x^3y = 2y^2$ then find the value of $\frac{dy}{dx}$.

OR

If y = log(2+t) $-\frac{1}{2+t}$ and x = $t^2 + 4t$ then find $\frac{dy}{dx}$.

23. A boat covers 30 km in 2.5 hours running downstream. While returning, it covers the same distance in 3 hours. What is the speed of the stream?

24. The cost of producing x tons of steel is given by C(x) = $\frac{1}{10}x^3 - 5x^2 + 1000$. Find the rate of change of marginal cost when x = 100 tons.

25. A pipe fills a tank in 2 hours and another pipe fills the same tank in 4 hours. But a third pipe empties the full tank in 6 hours. If all of them are opened together, how much time will it take to fill the tank?

OR

Solve for real value of x : $\frac{1}{2}\left(\frac{3x}{5} + 4\right) \geq \frac{1}{3}(x - 6)$

26. What will be the last two digits of the product : 5213 x 4436 x 7892 ?

27. Solve the following system of equations using Cramer's rule.
3x – 2y = 2 , 2x + 3y = 10

28. For the probability distribution given below,

X	0	1	2	3
P(X)	k	4k	3k	2k

find the value of i) k ii) Find E(X)

29. What is the need of sampling? Explain any two types of probability sampling methods. Give at least one example in each case.

OR

Write a short note on representative and unrepresentative sample. Also give the significance of unrepresentative sample.

30. The following table relates to the sales of company (in millions) during 2000 to 2006:

Year	2000	2001	2002	2003	2004	2005	2006
Sales	12	15	16	18	19	20	22

Compute the trends by the method of moving averages, assuming that 3-year cycle is present in the above series.

31. Find the least non-negative remainder when 5^{83} is divided by 8

OR

Vinay can row downstream 20 km in 2 hours and against stream 4km in 2 hours. Find her speed of rowing in still water and the speed of the stream.

32. If $(a \quad -5 \quad -1)\begin{pmatrix}1 & 0 & 2\\ 0 & 2 & 1\\ 2 & 0 & 3\end{pmatrix}\begin{pmatrix}a\\ 4\\ 1\end{pmatrix} = O$, find the value of a.

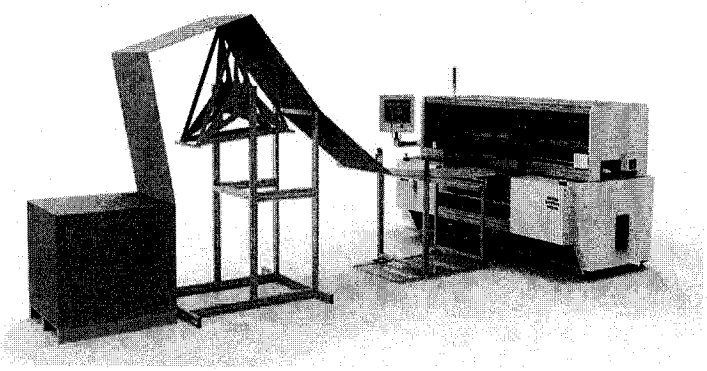
OR

There are two families *A* and *B*. In family *A*, there are 2 men, 3 women, and one child. In family *B*, there are 1 man, 2 women and 2 children. The recommended daily allowance for calories is : Man-2400, Women-1900, Child-1800 and proteins : Man-55 gm, Women-45 gm, Child-33 gm. Represent the above information by matrices.
Using matrix algebra, calculate the total requirement of calories and protein for each of two families.

33. If *X* is a binomially distributed random variable with $E(X) = 2$ and var $(X) = \frac{4}{3}$.
Find $P(X = 3)$.

34. **Case Based Question**
Ten cartons are taken at random from an automatic packing machine. The mean net weight of the 10 cartons is 11.8 kg. and standard deviation is 0.15 kg. It is intended to check if the sample mean differ significantly from the intended weight of 12 kg.
a) Establish the null and alternate hypothesis and calculate the t test value.
b) Does the sample mean differ significantly from the intended weight of

(for degrees of freedom 9 and 5% level of significance, the table value of t = 2.26)



12 kg? Justify your claim using the information given above the picture.

35. **Case Based Question (*Attempt any four MCQ from the following)***

The following table relates to the tourist arrivals (in millions) during 2004 to 2010 in India:

Year (T)	2004	2005	2006	2007	2008	2009	2010
Tourist arrivals(Y)	18	20	23	25	24	28	30

For fitting a straight-line trend by the method of least squares

(i) the value of $\sum x$, where x = T – 2007 is equal to:
a) 1 b) 0 c) varies from question-to-question d) data insufficient

(ii) In this case for the line of best fit Y = a + b x , the value of a is
a) 25 b) 28.67 c) 24 d) 26.4

(iii) The line of best fit is
a) Y = 25 + 1.5 x b) Y = 24 + 1.5 x c) Y = 24 + 1.89 x d) Y = 26.4 + 1.89 x

(iv) For predicting the number of tourists that would arrive in the year 2014, the value of x is
a) 7 b) 5 c) 4 d) 8

(v) The predicted number of tourist for the year 2014 are
a) 32 b) 35 c) 34 d) 37

36. An automobile manufacture uses three different types of trucks T_1 , T_2 *and* T_3 to transport the number of station wagons, sedan cars and hatchback cars as shown in the following matrix:

$$\begin{array}{l} \\ \textit{station wagons} \\ \textit{sedan} \\ \textit{hatchback} \end{array} \begin{array}{c} \textit{Trucks} \\ \begin{matrix} T_1 & T_2 & T_3 \end{matrix} \\ \begin{bmatrix} 2 & 6 & 9 \\ 3 & 7 & 12 \\ 6 & 6 & 8 \end{bmatrix} \end{array}$$

(i) Find the inverse of the above matrix.
(ii) Determine the number of trucks of each type required to supply 58 stations wagons, 75 sedan cars and 62 hatchback cars to a dealer in Kanpur.
(iii) If a dealer in Jaipur orders 46 station wagons, 60 sedan cars and 64 hatchback cars, how many trucks of each type does the factory need to make this delivery.

OR

Find the inverse of the matrix A = $\begin{pmatrix} a & b \\ c & \frac{1+bc}{a} \end{pmatrix}$ and show that $aA^{-1} = (a^2 + bc + 1)I_2 - aA$

37. The price per unit for sales of set of toys is given by $3p = 75 + x$ and cost function is

C(x) = $\frac{1}{25}x^2 + 3x + 100$.

i) Find the profit function

ii) Show that the profit will be maximum when nearly 30 set of toys are produced.

iii) At what price the profit will be maximum.

OR

A window is in the form of a rectangle surmounted by a semi-circular opening. The total perimeter of the window is 10 m. Find the dimensions of the window to admit maximum light through the whole opening.

38. In a College Annual Exam, scores of 500 students of class XII are recorded at the end of the session. The average score for the batch was 600 and the standard deviation was calculated to be 150.

(i) Taniya scored 800 marks in total out of 1000. Find out how has Taniya scored compared to his batchmates in the whole district.

(ii) Lavanya scored 420 marks in the same batch. What can you say about her performance as compared to the batch of 300 students?

(iii) How much has Varsha scored if she has done better than 44.83% of his batchmates?

Use the following extract from the probability table against the z scores.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545

******END OF THE QUESTION PAPER******