ROLL NUMBER					

SET	A

INDIAN SCHOOL MUSCAT
FINAL EXAMINATION 2022
APPLIED MATHEMATICS (241)

CLASS : XII
DATE: 26.11.2022

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 80

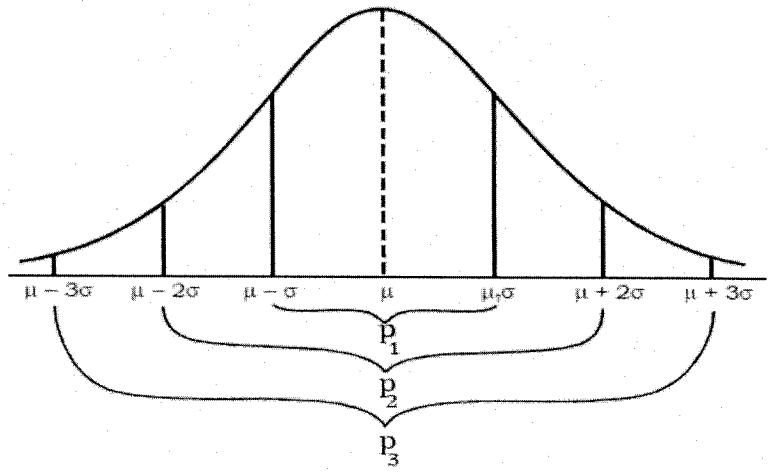
GENERAL INSTRUCTIONS:

(a) This question paper consists of 38 questions divided into five sections A, B, C, D and E.
(b) Section-A has18 MCQs and 2 Assertion-Reason based questions of **one mark** each (Q1 to Q 20).
(c) Section-B has 5 questions of **two marks** each (Q 21 to Q 25).
(d) Section-C has 6 questions of **three marks** each (Q 26 to Q 31).
(e) Section-D has 4 questions of **five marks** each (Q 32 to Q 35).
(f) Section- E comprises of 3 Case-study questions of **four marks** each (Q 36 to Q 38).
(g) There is no overall choice. However, internal choice has been provided in some questions.

SECTION – A (Questions 1 to 20 carry 1 mark each)

MULTIPLE CHOICE QUESTIONS:

1.	In a 100 m race, A beats B by 10 m and C by 13 m. In a race of 180 m, B will beat C by (A) 7m (B) 6m (C) 10m (D) 11m
2.	Which of the following statements is incorrect? (A) A function f(x) attains local minimum value at x = a if $f''(x) > 0$ (B) A function f(x) attains local maximum value at x = a if $f''(x) < 0$ (C) If a function is either increasing or decreasing in whole of its domain then no critical point exists on its domain. (D) f(x) is increasing on (a, b) if $x_1 < x_2 \Rightarrow f(x_1) > f(x_2)$ *for all* $x_1, x_2 \in (a, b)$
3.	At what rate converted semi-annually will the present value of a perpetuity of ₹450 payable at the end of each 6 months be ₹20,000? (A) 9% (B) 6 % (C) 4.5% (D) 5%
4.	A person invested ₹2, 00,000 in a fund for 1 year. At the end of the year the investment was worth ₹ 2, 16,000. The rate of interest for this investment is (A) 8% (B) 10% (C) 6% (D) 5%
5.	Mr. Ajeet takes a loan of ₹1,00,000 with 10% annual interest rate for 5 years. The EMI under flat rate system is (A) ₹1000 (B) ₹5000 (C) ₹2500 (D) ₹3000

6.	What is the least value of 'x' that satisfies $x \equiv 7(\text{mod } 4)$, where $7 < x \leq 13$? (A) 7 (B) 9 (C) 10 (D) 11
7.	If $A = [a_{ij}]$ be a skew-symmetric matrix of order n, then (A) $a_{ij} = \frac{1}{a_{ji}}$ for all i, j (B) $a_{ij} \neq 0$ for all i, j (C) $a_{ij} = 0$, where $i = j$ (D) $a_{ij} \neq 0$, where $i = j$
8.	The given curve represents a normal distribution curve with mean μ and standard deviation σ. Probabilities p_1, p_2 and p_3 are marked in the figure. The value of $(p_2 - p_1)$ is (A) 13.5 % (B) 9% nearly (C) 27% nearly (D) 5% nearly 
9.	$-6(mod7)$ is equal to (A) 6 (B) 1 (C) 3 (D) 5
10.	A machine costing ₹50,000 has a useful life of four years. The estimated scrap value is ₹10,000. Using straight line method, the annual depreciation will be (A) ₹12500 (B) ₹11000 (C) ₹10000 (D) ₹15000
11.	The function f(x) = $(x-2)^4 - 4$ has (A) minimum value of 2 and maximum of 4 (B) minimum value of 4 and maximum of 2 (C) minimum value of -4 and no maximum value (D) no minimum value and maximum of -4
12.	If R(x) is the revenue function then the rate of change of marginal revenue is given by (A) R'(x) (B) R(x) – C(x) (C) P'(x) (D) R''(x)
13.	Mr X took a loan of ₹2,000 for 6 months. Lender deducts ₹200 as interest while lending the money. In order to find the effective rate of interest we first need to find the value of i . Here the value of i is (A) 0.10 (B) 0.11 (C) 0.12 (D) 0.15
14.	If $y = Ae^{5x} + Be^{-5x}$, then $\frac{d^2y}{dx^2}$ is equal to (A) 5 y (B) - 25 y (C) 15 y (D) 25 y

15. Match the following columns to complete the sentence and choose the correct option

Trend component	**Pattern of variation**	**Time period of variation**
I. Secular trend	a. is a regular periodic variability	i. over a period more than a year
II. Cyclical trend	b. has smooth, regular variations	ii. within a period of one year
III. Seasonal trend	c. has oscillatory variation	iii. over a long term period

(A) I – a – ii ; II – b – iii ; III – c – I (B) I – b – iii ; II – c – i ; III – a – ii

(C) I – b – ii ; II – c – i ; III – a – iii (D) I – b – ii ; II – a – iii ; III – c – i

16. If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix}$, then the value of x is

(A) ± 6 (B) 3 (C) 6 (D) ± 3

17. A fire in a factory delaying production for some weeks is

(a) Cyclical Trend (b)Secular Trend (c) Irregular Trend (d) Seasonal Trend

18. For a Poisson's Distribution, if $\lambda = 1$ then $P(2) =$

(A) $\frac{e}{2}$ (B) $\frac{1}{2e}$ (C) $\frac{2}{e}$ (D) 2e

19. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : (4, 2) lies in the half plane represented by $4x + 6y - 28 < 0$

Reason R : Because it lies on the line $4x + 6y = 28$

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Both **A** and **R** are correct and **R** is the correct explanation of **A.**

(b) Both **A** and **R**are correct but **R** is NOT the correct explanation of **A.**

(c) **A** is correct but **R** is not correct.

(d) **A** is not correct but **R** is correct.

20. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : For storing and transporting *Covishield vaccine* a safe range of temperature is $+2°$ *to* $+ 8°$ *Celsius* temperature so It is safe to transport the vaccine in a temperature-controlled truck, which maintains temperature between 40°F *to* 45°F.

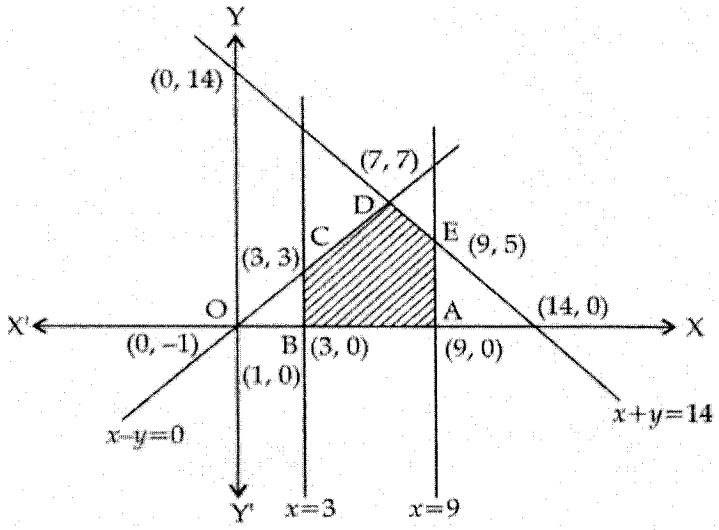
(Conversion is given by $C = \frac{5}{9}(F - 32)$ where C and F are temperature in degree Celsius and degree Fahrenheit respectively)

Reason R : For $\mathbf{2 \leq C \leq 8}$ the range of F is $\mathbf{35.6 \leq F \leq 46.4}$

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Both **A** and **R**are correct and **R** is the correct explanation of **A.**

(b) Both **A** and **R**are correct but **R** is NOT the correct explanation of **A.**

	(c) **A** is correct but **R** is not correct. (d) **A** is not correct but **R** is correct.
	SECTION – B (Questions 21 to 25 carry 2 marks each)
21.	A man rows to a place 46 km distance and back in 11 hours 30 minutes. He found that he can row 5 km with the stream in the same time as he can row 4 km against the stream. Find the speed of the stream.
22.	A person invested ₹15000 in a mutual fund and the value of investment at the time of redemption was ₹25000. If CAGR for this investment is 8.88%, calculate the time for which the amount was invested? [*Given* log(1.667) = 0.2219 & log(1.089) = 0.037]
23.	What sum of money invested now could establish a scholarship of Rs 5000 which is to be awarded at the beginning of every year forever, if money is worth 8% per annum. **OR** Find the force of interest corresponding to effective rate of 10% , given that $\log_e 1.10 = 0.0953$
24.	In a linear programming problem to minimize Z = 2x + y the student obtained the following graph and shaded the feasible region but forgets what is to be done next. Help him to find the minimum value of Z 
25.	Find matrix A, if $A - B = \begin{bmatrix} 2 & 0 \\ 4 & -2 \end{bmatrix}, A + 2B = \begin{bmatrix} 0 & 2 \\ 0 & 4 \end{bmatrix}$. (OR) If matrix $\begin{bmatrix} -2 & x-y & 5 \\ 1 & b & 4 \\ x+y & z & 7 \end{bmatrix}$ is symmetric. Find the values of x, y, z and b.
	SECTION – C (Questions 26 to 31 carry 3 marks each)
26.	Find the intervals in which the function $f(x) = 2x^3 - 24x + 107$ is (i) strictly increasing (ii) strictly decreasing

27.	Find the remainder when 19^{127} is divided by 4 **OR** Insert appropriate sign of inequality: $\sqrt{3}(\sqrt{50}+\sqrt{32})$ _____ $2\sqrt{54}+3\sqrt{24}$ Show your working .
28.	A and B are two square matrices of same order. If $AB = B^{-1}$ then show that $A^{-1} = B^2$ **OR** Show that the matrix B^TAB is symmetric or skew symmetric accordingly when A is symmetric or skew-symmetric.
29.	A couple wishes to purchase a house for ₹15, 00,000 with a down payment of ₹4,00,000. If they can amortize the balance at an interest rate 9% per annum compounded monthly for 10 years, find the monthly instalment (EMI). Also find the total interest paid. [$Given\ 1.0075^{-120} = 0.4079$]
30.	Find the absolute maximum and minimum values of the function f given by $f(x) = \frac{1}{3}x^3 - 3x^2 + 5x + 8$ in $[0,4]$.
31.	A machine costing ₹50,000 is to be replaced at the end of 10 years, when it will have a salvage value of ₹5000. To provide money at that time for a machine costing the same amount, a sinking fund is set up. If equal payments are placed in the fund at the end of each quarter and the fund earns 8% compounded quarterly, then what should each payment be? [$Given\ 1.02^{40} = 2.208$]
	SECTION – D (Questions 32 to 35 carry 5 marks each)
32.	Rahul, Priya and Raj went for shopping vegetables. Rahul brought 500gm tomato, 2kg potatoes and 1 kg apples. Priya brought 1kg tomato, 1 kg potatoes and 2 kg apples. Raj brought 1 kg tomatoes, 2 kg potatoes only. Rahul, Priya and Raj paid Rs.200, Rs.310 and Rs.140 respectively. (i) Represent the given information into a system of linear equations. (ii)Express the equations in the matrix form AX = B . (iii)Use matrices to find the cost of 1kg tomatoes, 1 kg potatoes and 1 kg apples. **OR** If $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ are two square matrices, (i) find AB (ii) Hence solve the system of following linear equations: $x - y = 3,\ 2x + 3y + 4z = 17$ and $y + 2z = 7$

33. A random variable X has the following probability function

X	0	1	2	3	4	5	6	7
P(X)	0	a	2a	2a	3a	a^2	$2a^2$	$7a^2 + a$

(i) Find a

(ii) Find P(X > 6)

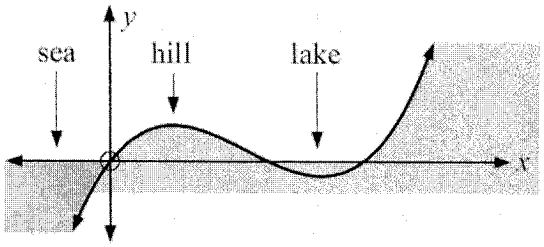
(iii) Find mean of the distribution

OR

In a manufacturing unit inspection, from a lot of 20 baskets which include 6 defectives baskets, a sample of 2 baskets is drawn at random with replacement.
(i) Prepare the binomial distribution of the number of defective baskets.
(ii) Also find E(X) and Var(X) for the random variable X

34. Solve the LPP graphically: Maximize $Z = x + 2y$

subject to the constraints $x + 2y \geq 100$; $2x - y \leq 0$; $2x + y \leq 200$; $x, y \geq 0$.

35. 

Alongside is a land and sea profile where the x-axis is sea level and y-values give the height of the land or sea bed above (or below) sea level and

$$y = \frac{1}{10}x(x-2)(x-3) \text{ km.}$$

a) Find where the lake is located relative to the shore line of the sea.

b) Find $\frac{dy}{dx}$

c) Find the maximum height of the hill and maximum depth of the lake w.r.t. x - axis

OR

A given product can be manufactured at a total cost C (x) = Rs ($\frac{x^2}{100} + 100x + 40$) , where x is the number of units produced. The price at which each unit can be sold is given by: p = Rs ($200 - \frac{x}{400}$). Determine the production level x at which the profit is maximum. What is the price per unit and the total profit at this level of production?

SECTION – E- CASE STUDY (Questions 36 to 38 carry 4 marks each)

36. An investigator polls common cold sufferers, asking them to estimate the number of hours of physical discomfort caused by their most recent colds. Assume that their estimates approximate a normal curve with a mean of 83 hours and a standard deviation of 20 hours.

(a) What proportion suffered for fewer than 61 hours?

(b) What proportion of sufferers estimate that their colds lasted longer than 48 hours?

(c) What is the estimated number of hours for the least suffering 5 percent?

OR

(c) What is the estimated number of hours for the most suffering 5 percent?

Given: $P(z<1.1) = 0.8643$
$P(z<1.75) = 0.9599$
$P(z<1.64) = 0.95$

37. Three taps A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed, A and B can fill the remaining part in 7 hours.

(i) What fraction of the tank is still empty after 2 hours?

(ii) What fraction of the tank is filled by tap A and B together in one hour after tap C is closed?

(iii) How many hours will be taken by tap C alone to fill the tank?

38. Mr. Vikas runs a bread factory and the record of his sales of bakery items for the period of 2015 - 2019 is as follows:

Year	2015	2016	2017	2018	2019
Sales (in ₹ thousands)	35	42	46	41	48

Based on the above information, answer the following questions. Show steps to support your answers.

(i) By taking year 2017 as origin, use method of least-squares to find the best-fit trend line equation for Mr. Vikas's business. Show the steps of your working.

OR

Demonstrate the technique to fit the best-suited straight-line trend by the method of 3-years moving averages. Also draw the trend line.

(ii) What are the estimated sales for Mr. Vikas's business for year 2022?

(iii) Mr. Vikas wishes to grow his business to yearly sale of ₹ 67400. In which year will he be able to reach his target?

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