

Series & RQPS

Set – 4



प्रश्न-पत्र कोड  
Q.P. Code

465

अनुक्रमांक

Roll No.

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परीक्षार्थी प्रश्न-पत्र कोड को उत्तर-पुस्तिका के मुख-पृष्ठ पर अवश्य लिखें।

Candidates must write the Q.P. Code on the title page of the answer-book.

- कृपया जाँच कर लें कि इस प्रश्न-पत्र में मुद्रित पृष्ठ 27 हैं।
- कृपया जाँच कर लें कि इस प्रश्न-पत्र में 38 प्रश्न हैं।
- प्रश्न-पत्र में दाहिने हाथ की ओर दिए गए प्रश्न-पत्र कोड को परीक्षार्थी उत्तर-पुस्तिका के मुख-पृष्ठ पर लिखें।
- कृपया प्रश्न का उत्तर लिखना शुरू करने से पहले, उत्तर-पुस्तिका में प्रश्न का क्रमांक अवश्य लिखें।
- इस प्रश्न-पत्र को पढ़ने के लिए 15 मिनट का समय दिया गया है। प्रश्न-पत्र का वितरण पूर्वाह्न में 10.15 बजे किया जाएगा। 10.15 बजे से 10.30 बजे तक छात्र केवल प्रश्न-पत्र को पढ़ेंगे और इस अवधि के दौरान वे उत्तर-पुस्तिका पर कोई उत्तर नहीं लिखेंगे।
- Please check that this question paper contains 27 printed pages.
- Please check that this question paper contains 38 questions.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please write down the serial number of the question in the answer-book before attempting it.
- 15 minute time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.



## व्यावहारिक गणित APPLIED MATHEMATICS



निर्धारित समय : 3 घण्टे

अधिकतम अंक : 80

Time allowed : 3 hours

Maximum Marks : 80



## सामान्य निर्देश :

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख्ती से पालन कीजिए :

- (i) इस प्रश्न-पत्र में 38 प्रश्न हैं। सभी प्रश्न अनिवार्य हैं।
- (ii) यह प्रश्न-पत्र पाँच खण्डों में विभाजित है – क, ख, ग, घ एवं ङ।
- (iii) खण्ड क में प्रश्न संख्या 1 से 18 तक बहुविकल्पीय तथा प्रश्न संख्या 19 एवं 20 अभिकथन एवं तर्क आधारित 1 अंक के प्रश्न हैं।
- (iv) खण्ड ख में प्रश्न संख्या 21 से 25 तक अति लघु-उत्तरीय (VSA) प्रकार के 2 अंकों के प्रश्न हैं।
- (v) खण्ड ग में प्रश्न संख्या 26 से 31 तक लघु-उत्तरीय (SA) प्रकार के 3 अंकों के प्रश्न हैं।
- (vi) खण्ड घ में प्रश्न संख्या 32 से 35 तक दीर्घ-उत्तरीय (LA) प्रकार के 5 अंकों के प्रश्न हैं।
- (vii) खण्ड ङ में प्रश्न संख्या 36 से 38 प्रकरण अध्ययन आधारित 4 अंकों के प्रश्न हैं।
- (viii) प्रश्न-पत्र में समग्र विकल्प नहीं दिया गया है। यद्यपि, खण्ड ख के 2 प्रश्नों में, खण्ड ग के 2 प्रश्नों में, खण्ड घ के 2 प्रश्नों में तथा खण्ड ङ के 3 प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।
- (ix) कैल्कुलेटर का उपयोग वर्जित है।

### खण्ड क

इस खण्ड में बहुविकल्पीय प्रश्न हैं, जिनमें प्रत्येक प्रश्न 1 अंक का है।

1. 1 km की दौड़ में, खिलाड़ी P, खिलाड़ी Q को 18 मीटर या 9 सेकंड से हरा देता है। दौड़ पूरी करने के लिए P का समय क्या है ?
  - (A) 512 सेकंड
  - (B) 502 सेकंड
  - (C) 491 सेकंड
  - (D) 481 सेकंड
2. यदि  $x > y$  तथा  $z < 0$  हो, तो :
  - (A)  $xz > yz$
  - (B)  $xz \geq yz$
  - (C)  $\frac{x}{z} > \frac{y}{z}$
  - (D)  $\frac{x}{z} < \frac{y}{z}$





### General Instructions :

Read the following instructions very carefully and strictly follow them :

- (i) This question paper contains **38** questions. **All** questions are **compulsory**.
- (ii) This question paper is divided into **five** Sections – **A, B, C, D** and **E**.
- (iii) In **Section A**, Questions no. **1** to **18** are multiple choice questions (MCQs) and questions number **19** and **20** are Assertion-Reason based questions of **1** mark each.
- (iv) In **Section B**, Questions no. **21** to **25** are very short answer (VSA) type questions, carrying **2** marks each.
- (v) In **Section C**, Questions no. **26** to **31** are short answer (SA) type questions, carrying **3** marks each.
- (vi) In **Section D**, Questions no. **32** to **35** are long answer (LA) type questions carrying **5** marks each.
- (vii) In **Section E**, Questions no. **36** to **38** are case study based questions carrying **4** marks each.
- (viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D and 3 questions in Section E.
- (ix) Use of calculators is **not** allowed.

### SECTION A

This section comprises multiple choice questions of 1 mark each.

1. In a 1 km race, player P beats player Q by 18 metres or 9 seconds. What is P's time to complete the race ?
- (A) 512 seconds                      (B) 502 seconds  
(C) 491 seconds                      (D) 481 seconds
2. If  $x > y$  and  $z < 0$ , then :
- (A)  $xz > yz$                       (B)  $xz \geq yz$   
(C)  $\frac{x}{z} > \frac{y}{z}$                       (D)  $\frac{x}{z} < \frac{y}{z}$



3. यदि  $AB = A$  और  $BA = B$  हो, तो  $(B^2 + B)$  बराबर है :

- (A)  $2A$  (B)  $O$   
(C)  $2I$  (D)  $2B$

4.  $\Delta = \begin{vmatrix} 42 & 2 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix}$  का मान है :

- (A)  $0$  (B)  $1$   
(C)  $-3$  (D)  $-15$

5. यदि  $y = e^{-2x}$  है, तो  $\frac{d^3y}{dx^3}$  बराबर है :

- (A)  $2e^{-2x}$  (B)  $e^{-4x}$   
(C)  $4e^{-4x}$  (D)  $-8e^{-2x}$

6. फलन  $f(x) = x^2 - x + 1$  है :

- (A)  $(0, 1)$  में वर्धमान  
(B)  $(0, 1)$  में हासमान  
(C)  $(0, \frac{1}{2})$  में वर्धमान और  $(\frac{1}{2}, 1)$  में हासमान  
(D)  $(\frac{1}{2}, 1)$  में वर्धमान और  $(0, \frac{1}{2})$  में हासमान

7. अवकल समीकरण

$$y dx + x \log\left(\frac{y}{x}\right) dy - 2x dy = 0$$

की कोटि एवं घात क्रमशः हैं :

- (A)  $1, 1$  (B)  $1, 2$   
(C)  $2, 1$  (D)  $1$ , परिभाषित नहीं





3. If  $AB = A$  and  $BA = B$ , then  $(B^2 + B)$  equals :

- (A)  $2A$  (B)  $O$   
(C)  $2I$  (D)  $2B$

4. The value of  $\Delta = \begin{vmatrix} 42 & 2 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix}$  is :

- (A)  $0$  (B)  $1$   
(C)  $-3$  (D)  $-15$

5. If  $y = e^{-2x}$ , then  $\frac{d^3y}{dx^3}$  is equal to :

- (A)  $2e^{-2x}$  (B)  $e^{-4x}$   
(C)  $4e^{-4x}$  (D)  $-8e^{-2x}$

6. The function  $f(x) = x^2 - x + 1$  is :

- (A) increasing in  $(0, 1)$   
(B) decreasing in  $(0, 1)$   
(C) increasing in  $(0, \frac{1}{2})$  and decreasing in  $(\frac{1}{2}, 1)$   
(D) increasing in  $(\frac{1}{2}, 1)$  and decreasing in  $(0, \frac{1}{2})$

7. The **order** and the **degree** of the differential equation

$$y dx + x \log\left(\frac{y}{x}\right) dy - 2x dy = 0$$

are respectively :

- (A)  $1, 1$  (B)  $1, 2$   
(C)  $2, 1$  (D)  $1, \text{not defined}$





8. एक न्याय सिक्का दो बार उछाला जाता है और परिणाम नोट कर लिया जाता है । यदि इस परीक्षण में चित्तों की संख्या को दर्शाने वाला यादृच्छिक चर  $X$  हो, तो  $X$  की गणितीय प्रत्याशा (expectation) होगी :

- (A) 1 (B)  $\frac{1}{2}$   
(C)  $\frac{1}{4}$  (D)  $1\frac{1}{2}$

9. यदि वर्तमान समय, रात्रि 9:00 बजे हैं, तो 1275 घंटों के बाद कौन-सा समय होगा ?

- (A) रात्रि 11 बजे (B) रात्रि 12 बजे  
(C) रात्रि 9 बजे (D) सुबह 9 बजे

10. यदि एक प्वासों चर  $X$  के लिए,

$$P(X = k) = P(X = k + 1) \text{ है,}$$

तो  $X$  का प्रसरण होगा :

- (A)  $k - 1$  (B)  $k$   
(C)  $k + 1$  (D)  $k + 2$

11. यदि  $|t|$  का परिकल्पित मान  $t_v(\alpha)$  ( $t$  का क्रांतिक मान) से कम हो, तो निराकरणिय परिकल्पना :

- (A) अस्वीकार की जाती है ।  
(B) स्वीकार की जाती है ।  
(C) न तो स्वीकार की जाती है और न ही अस्वीकार ।  
(D) निर्धारित नहीं की जा सकती है ।

12. दो स्वतंत्र नमूनों के माध्यों के बीच के अंतर की सार्थकता की जाँच करने के लिए, स्वातंत्र्य कोटि ( $\nu$ ) \_\_\_\_\_ ली जाती है ।

- (A)  $n_1 - n_2 + 2$  (B)  $n_1 - n_2 - 2$   
(C)  $n_1 + n_2 - 2$  (D)  $n_1 + n_2 + 2$





8. A fair coin is tossed twice and outcomes are noted. If the random variable  $X$  represents the number of heads that appeared in the experiment, then the mathematical expectation of  $X$  is :

- (A) 1 (B)  $\frac{1}{2}$   
(C)  $\frac{1}{4}$  (D)  $1\frac{1}{2}$

9. What time will it be after 1275 hours, if the present time is 9:00 p.m. ?

- (A) 11 p.m. (B) 12 p.m.  
(C) 9 p.m. (D) 9 a.m.

10. If for a Poisson variate  $X$ ,

$$P(X = k) = P(X = k + 1),$$

then the variance of  $X$  is :

- (A)  $k - 1$  (B)  $k$   
(C)  $k + 1$  (D)  $k + 2$

11. If the calculated value of  $|t| < t_v(\alpha)$  (critical value of  $t$ ), then the null hypothesis :

- (A) is rejected.  
(B) is accepted.  
(C) is neither accepted nor rejected.  
(D) cannot be determined.

12. For testing the significance of difference between the means of two independent samples, the degree of freedom ( $\nu$ ) is taken as :

- (A)  $n_1 - n_2 + 2$  (B)  $n_1 - n_2 - 2$   
(C)  $n_1 + n_2 - 2$  (D)  $n_1 + n_2 + 2$



13. दिए गए मानों 23, 32, 40, 47, 58, 33, 42 के लिए, 5-वर्षीय गतिमान औसत हैं :
- (A) 38, 40, 42 (B) 40, 42, 44  
(C) 40, 42, 46 (D) 42, 44, 46
14. फ्लैट रेट पद्धति का उपयोग करते हुए, 8% वार्षिक ब्याज दर पर  $2\frac{1}{2}$  वर्षों में ₹ 20,000 का ऋण चुकाने के लिए EMI होगा :
- (A) ₹ 700 (B) ₹ 800  
(C) ₹ 900 (D) ₹ 100
15. एक मोबाइल फोन का मूल्य ₹ 12,000 है और 3 वर्ष के उपयोगी जीवन के बाद, उसका स्क्रेप मूल्य ₹ 3,000 है। तो 2 वर्ष के अंत में मोबाइल फोन का बुक मूल्य होगा :
- (A) ₹ 3,000 (B) ₹ 6,000  
(C) ₹ 5,000 (D) ₹ 7,000
16. 8 वर्षों में ₹ 50,000 जमा करने के लिए प्रत्येक 6 महीने के अंत में कितनी धनराशि जमा की जानी चाहिए, यदि धनराशि पर ब्याज 6% वार्षिक है और ब्याज अर्ध-वार्षिक संयोजित होता है ? [दिया गया है :  $(1.03)^{16} = 1.6047$ ]
- (A) ₹ 3,432.53 (B) ₹ 2,783.08  
(C) ₹ 2,480.57 (D) ₹ 2,149.93
17. असमीकरण  $2x + 3y > 6$  का आलेख है :
- (A) पूर्ण XOY-तल  
(B) अर्ध-तल जिसमें मूल-बिंदु स्थित हैं  
(C) अर्ध-तल जिसमें न तो मूल-बिंदु और न ही रेखा  $2x + 3y = 6$  के बिंदु स्थित हैं  
(D) पूर्ण XOY-तल जिसमें रेखा  $2x + 3y = 6$  के बिंदु शामिल नहीं हैं





13. For the given values 23, 32, 40, 47, 58, 33, 42; the 5-yearly moving averages are :
- (A) 38, 40, 42 (B) 40, 42, 44  
(C) 40, 42, 46 (D) 42, 44, 46
14. Using flat rate method, the EMI to repay a loan of ₹ 20,000 in  $2\frac{1}{2}$  years at an interest rate of 8% p.a. is :
- (A) ₹ 700 (B) ₹ 800  
(C) ₹ 900 (D) ₹ 100
15. A mobile phone costs ₹ 12,000 and its scrap value after a useful life of 3 years is ₹ 3,000. Then, the book value of the mobile phone at the end of 2 years is :
- (A) ₹ 3,000 (B) ₹ 6,000  
(C) ₹ 5,000 (D) ₹ 7,000
16. What sum of money should be deposited at the end of every 6 months to accumulate ₹ 50,000 in 8 years, if money is worth 6% p.a. compounded semi-annually ? [Given :  $(1.03)^{16} = 1.6047$ ]
- (A) ₹ 3,432.53 (B) ₹ 2,783.08  
(C) ₹ 2,480.57 (D) ₹ 2,149.93
17. The graph of the inequation  $2x + 3y > 6$  is the :
- (A) entire XOY-plane  
(B) half-plane that contains the origin  
(C) half-plane that neither contains the origin nor the points on the line  $2x + 3y = 6$   
(D) whole XOY-plane excluding the points on the line  $2x + 3y = 6$



18. एक रैखिक प्रोग्रामन समस्या में, यदि उद्देश्य फलन  $Z = ax + by$  का अधिकतम मान सुसंगत क्षेत्र के दो कोनीय बिंदुओं पर एकसमान है, तो बिंदुओं की संख्या जिन पर  $Z$  का अधिकतम मान है, है :

- (A) 0 (B) 2  
(C) सीमित (D) अनंत

प्रश्न संख्या 19 और 20 अभिकथन एवं तर्क आधारित प्रश्न हैं। दो कथन दिए गए हैं जिनमें एक को अभिकथन (A) तथा दूसरे को तर्क (R) द्वारा अंकित किया गया है। इन प्रश्नों के सही उत्तर नीचे दिए गए कोडों (A), (B), (C) और (D) में से चुनकर दीजिए।

- (A) अभिकथन (A) और तर्क (R) दोनों सही हैं और तर्क (R), अभिकथन (A) की सही व्याख्या करता है।  
(B) अभिकथन (A) और तर्क (R) दोनों सही हैं, परन्तु तर्क (R), अभिकथन (A) की सही व्याख्या नहीं करता है।  
(C) अभिकथन (A) सही है, परन्तु तर्क (R) ग़लत है।  
(D) अभिकथन (A) ग़लत है, परन्तु तर्क (R) सही है।

19. अभिकथन (A) : फलन  $f(x) = x^2 - x + 1$ , अंतराल  $(-1, 1)$  पर निरंतर वर्धमान है।

तर्क (R) : यदि  $f(x)$  अंतराल  $[a, b]$  पर संतत और अंतराल  $(a, b)$  पर अवकलनीय है, तो अंतराल  $[a, b]$  में  $f(x)$  निरंतर वर्धमान है, यदि सभी  $x \in (a, b)$  के लिए  $f'(x) > 0$  है।

20. एक द्विपद बंटन में,  $n = 200$  और  $p = 0.04$  है। प्वासों बंटन को द्विपद बंटन के सन्निकटन के रूप में लेते हुए :

अभिकथन (A) : प्वासों बंटन का माध्य 8 है।

तर्क (R) :  $P(X = 4) = \frac{512}{3e^8}$ .



18. In an LPP, if the objective function  $Z = ax + by$  has same maximum value on two corner points of the feasible region, then the number of points at which maximum value of  $Z$  occurs is :

- (A) 0 (B) 2  
(C) finite (D) infinite

Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.

- (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).  
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is **not** the correct explanation of the Assertion (A).  
(C) Assertion (A) is true, but Reason (R) is false.  
(D) Assertion (A) is false, but Reason (R) is true.

19. Assertion (A) : The function  $f(x) = x^2 - x + 1$  is strictly increasing on  $(-1, 1)$ .

Reason (R) : If  $f(x)$  is continuous on  $[a, b]$  and derivable on  $(a, b)$ , then  $f(x)$  is strictly increasing on  $[a, b]$  if  $f'(x) > 0$  for all  $x \in (a, b)$ .

20. In a binomial distribution,  $n = 200$  and  $p = 0.04$ . Taking Poisson distribution as an approximation to the binomial distribution :

Assertion (A) : Mean of Poisson distribution = 8.

Reason (R) :  $P(X = 4) = \frac{512}{3e^8}$ .

## खण्ड ख

इस खण्ड में अति लघु-उत्तरीय (VSA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 2 अंक हैं।

21. (क) यदि  $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$  है, तो  $k$  का वह मान ज्ञात कीजिए जिसके लिए  $A^2 - 8A + kI = 0$  है।

अथवा

- (ख) यदि  $\begin{bmatrix} x-y & 2x+z \\ 2x-y & 3z+w \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$  है, तो  $x, y, z$  और  $w$  के मान ज्ञात कीजिए।

22. क्रैमर नियम का उपयोग करके, निम्नलिखित समीकरण निकाय को हल कीजिए :

$$2x_1 + 3x_2 = 5$$

$$11x_1 - 5x_2 = 6$$

23. निम्नलिखित रैखिक प्रोग्रामन समस्या का आलेखीय विधि से हल ज्ञात कीजिए (यदि कोई हल है तो) :

व्यवरोधों

$$x - y \leq -1$$

$$-x + y \leq 0$$

$$x, y \geq 0$$

के अंतर्गत

$Z = x + y$  का अधिकतमीकरण कीजिए।

24. 6% वार्षिक, जिसे त्रैमासिक संयोजित किया गया है पर, प्रत्येक तिमाही के अंत में देय ₹ 600 की शाश्वतता का वर्तमान मूल्य ज्ञात कीजिए।



**SECTION B**

*This section comprises very short answer (VSA) type questions of 2 marks each.*

21. (a) If  $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ , find the value of  $k$  such that  $A^2 - 8A + kI = 0$ .

**OR**

(b) If  $\begin{bmatrix} x-y & 2x+z \\ 2x-y & 3z+w \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$ , find the values of  $x, y, z$  and  $w$ .

22. Using Cramer's rule, solve the following system of equations :

$$2x_1 + 3x_2 = 5$$

$$11x_1 - 5x_2 = 6$$

23. Find the solution to the following linear programming problem (if it exists) graphically :

Maximize  $Z = x + y$

subject to the constraints

$$x - y \leq -1$$

$$-x + y \leq 0$$

$$x, y \geq 0.$$

24. At 6% p.a., compounded quarterly, find the present value of a perpetuity of ₹ 600 payable at the end of each quarter.





25. (क) मान लीजिए कि किसी निवेश का शुरुआती मूल्य ₹ 20,000 है और यह 3 वर्ष में बढ़कर ₹ 50,000 हो जाता है। CAGR (चक्रवृद्धित वार्षिक वृद्धि दर) की गणना कीजिए। [लीजिए  $(2.5)^{1/3} = 1.355$ ]

अथवा

- (ख) एक व्यक्ति एक वस्तु ₹ 12,000 में खरीदता है। वर्ष के अंत में, वह इस वस्तु को ₹ 15,000 में बेच देता है। यदि मुद्रास्फीति की दर 6% थी, तो रिटर्न की नाममात्र और वास्तविक दरें ज्ञात कीजिए।

### खण्ड ग

इस खण्ड में लघु-उत्तरीय (SA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 3 अंक हैं।

26. एक कंटेनर में 50 लीटर जूस है। इसमें से 5 लीटर जूस निकाल लिया जाता है और कंटेनर में 5 लीटर पानी डाल दिया जाता है। इस क्रिया को 4 बार और दोहराया जाता है। इस क्रिया के अन्त में कंटेनर में जूस की मात्रा ज्ञात कीजिए। [लीजिए  $(0.9)^5 = 0.59049$ ]

27. (क)  $\int_0^2 x^2 dx$  का मान ज्ञात कीजिए, अतः ग्राफ पर वह क्षेत्र दर्शाइए जिसको यह क्षेत्रफल निरूपित करता है।

अथवा

- (ख) मान ज्ञात कीजिए :  $\int_0^1 \frac{e^{-x}}{1+e^x} dx$

28. प्रथम चतुर्थांश में बने ऐसे वृत्तों के कुल का अवकल समीकरण ज्ञात कीजिए जो दोनों निर्देशांक अक्षों को स्पर्श करते हैं।

29. यह दिया गया है कि एक IQ परीक्षण में उम्मीदवारों के एक समूह के अंक सामान्य बंटित होते हैं। यदि IQ परीक्षण का माध्य 100 और मानक विचलन 10 है, तो प्रायिकता ज्ञात कीजिए कि परीक्षा देने वाला उम्मीदवार 90 और 110 के बीच स्कोर करेगा।

[दिया गया है :  $P(Z < 1) = 0.8413$  और  $P(Z < -1) = 0.1587$ ]





25. (a) Assume an investment's starting value is ₹ 20,000 and it grows to ₹ 50,000 in 3 years. Calculate CAGR (Compounded Annual Growth Rate) [Use :  $(2.5)^{1/3} = 1.355$ ]

**OR**

- (b) A man bought an item for ₹ 12,000. At the end of the year, he decided to sell it for ₹ 15,000. If the inflation rate was 6%, find the nominal and real rate of return.

### SECTION C

*This section comprises short answer (SA) type questions of 3 marks each.*

26. A container has 50 litres of juice in it. 5 litres of juice is taken out and is replaced by 5 litres of water. This process is repeated 4 more times. Determine the quantity of juice in the container after final replacement.

[Use  $(0.9)^5 = 0.59049$ ]

27. (a) Evaluate :  $\int_0^2 x^2 dx$  and hence show the region on the graph whose area it represents.

**OR**

- (b) Evaluate :  $\int_0^1 \frac{e^{-x}}{1+e^x} dx$

28. Find the differential equation of all circles in the first quadrant which touches both the coordinate axes.

29. Given that the scores of a set of candidates on an IQ test are normally distributed. If the IQ test has a mean of 100 and a standard deviation of 10, determine the probability that a candidate who takes the test will score between 90 and 110.

[Given  $P(Z < 1) = 0.8413$  and  $P(Z < -1) = 0.1587$ ]





30. 20 एजेंसियों में 4-पहिया वाहन की औसत साप्ताहिक बिक्री 50 यूनिट प्रति एजेंसी थी। एक विज्ञापन अभियान के बाद, औसत साप्ताहिक बिक्री बढ़कर 55 यूनिट प्रति एजेंसी 10 यूनिट मानक विचलन सहित हो गई थी। जाँच कीजिए कि क्या यह विज्ञापन अभियान सफल रहा था। [दिया गया है :  $\sqrt{5} = 2.24$ ,  $t_{19}(0.05) = 1.729$ ]

31. (क) हाल ही में एक लेखांकन स्नातक ने एक नया व्यवसाय खोला और एक कंप्यूटर सिस्टम स्थापित किया जिसकी लागत ₹ 45,200 थी। कंप्यूटर सिस्टम का मूल्यहास रैखिक रूप से 3 वर्षों के लिए होगा और इसका स्क्रैप मूल्य ₹ 0 होगा।

(i) मूल्यहास की दर क्या है ?

(ii) एक रैखिक समीकरण ज्ञात कीजिए जो  $t$  वर्ष के अंत में कंप्यूटर सिस्टम के बुक वैल्यू का वर्णन करता है, जहाँ  $0 \leq t \leq 3$  है।

(iii) डेढ़ वर्ष के अंत में कंप्यूटर सिस्टम की बुक वैल्यू क्या होगी ?

अथवा

(ख) प्रभावी दर ज्ञात कीजिए जो 10% प्रति वर्ष की सामान्य दर के बराबर है, जो :

(i) अर्ध-वार्षिक संयोजित होती है।

(ii) तिमाही संयोजित होती है।

[दिया गया है :  $(1.05)^2 = 1.1025$ ,  $(1.025)^4 = 1.1038$ ]

### खण्ड घ

इस खण्ड में दीर्घ-उत्तरीय (LA) प्रकार के प्रश्न हैं, जिनमें प्रत्येक के 5 अंक हैं।

32. एक टंकी में तीन पाइप A, B और C लगे हैं। पाइप A और B इनलेट पाइप हैं जबकि पाइप C एक आउटलेट पाइप है। पाइप A और B टंकी को क्रमशः 3 घंटे और 4 घंटे में भर देते हैं जबकि पाइप C पूरी भरी टंकी को 1 घंटे में पूरी तरह से खाली कर देता है। यदि ये तीनों पाइप A, B और C क्रम से सुबह 5, 6 तथा 7 बजे खोले जाते हैं, तो पूरी टंकी कितने समय में खाली हो जाएगी ?





30. The mean weekly sales of a 4-wheeler was 50 units per agency in 20 agencies. After an advertising campaign, the mean weekly sales increased to 55 units per agency with standard deviation of 10 units. Test whether the advertising campaign was successful.

[Given  $\sqrt{5} = 2.24$ ,  $t_{19}(0.05) = 1.729$ ]

31. (a) A recent accounting graduate opened a new business and installed a computer system that costs ₹ 45,200. The computer system will be depreciated linearly over 3 years and will have a scrap value of ₹ 0.

(i) What is the rate of depreciation ?

(ii) Give a linear equation that describes the computer system's book value at the end of  $t^{\text{th}}$  year, where  $0 \leq t \leq 3$ .

(iii) What will be the computer system's book value at the end of the first year and a half ?

**OR**

(b) Find the effective rate which is equivalent to normal rate of 10% p.a. compounded :

(i) semi-annually.

(ii) quarterly.

[Given  $(1.05)^2 = 1.1025$ ,  $(1.025)^4 = 1.1038$ ]

### SECTION D

*This section comprises long answer (LA) type questions of 5 marks each.*

32. A cistern has three pipes A, B and C. Pipes A and B are inlet pipes whereas C is an outlet pipe. Pipes A and B can fill the cistern separately in 3 hours and 4 hours respectively; while pipe C can empty the completely filled cistern in 1 hour. If the pipes A, B and C are opened in order at 5, 6 and 7 a.m. respectively, at what time will the cistern be empty ?





33. (क)  $f(x) = -\frac{3}{4}x^4 - 8x^3 - \frac{45}{2}x^2 + 105$  द्वारा प्रदत्त फलन के लिए स्थानीय उच्चतम

और स्थानीय निम्नतम के सभी बिंदुओं को ज्ञात कीजिए ।

अथवा

(ख) अंतराल ज्ञात कीजिए जिनमें  $f(x) = 20 - 9x + 6x^2 - x^3$  द्वारा प्रदत्त फलन  $f$  निरंतर वर्धमान या निरंतर हासमान है ।

34. (क) मान लीजिए  $X$  एक यादृच्छिक रूप से चयनित स्कूल दिवस के दौरान बारहवीं कक्षा के छात्र द्वारा अध्ययन किए गए घंटों की संख्या दर्शाता है । प्रायिकता यह है कि अज्ञात स्थिरांक 'k' के लिए  $X$  के मान  $x_i$  हो सकते हैं :

$$P(X = k) = \begin{cases} 0.1 & \text{यदि } x_i = 0 \\ kx_i & \text{यदि } x_i = 1 \text{ या } 2 \\ k(5 - x_i) & \text{यदि } x_i = 3 \text{ या } 4 \end{cases}$$

(i)  $k$  का मान ज्ञात कीजिए ।

(ii) छात्र के कम-से-कम 2 घंटे अध्ययन करने की प्रायिकता ज्ञात कीजिए ।

(iii) छात्र के अधिक-से-अधिक 2 घंटे अध्ययन करने की प्रायिकता ज्ञात कीजिए ।

अथवा

(ख) एक छोटे शहर के पास एक नदी में हर 10 साल में दो बार बाढ़ आती है और वह ओवरफ्लो हो जाती है । यह मानते हुए कि प्वासों बंटन उचित है, माध्य अपेक्षा क्या है ? साथ ही 10 वर्ष के अंतराल में 3 या उससे कम ओवरफ्लो तथा बाढ़ की प्रायिकता ज्ञात कीजिए ।

[दिया गया है :  $e^{-2} = 0.13534$ ]

35. अमृता एक कार खरीदती है जिसके लिए वह ₹ 2,50,000 का अग्रिम भुगतान करती है और शेष राशि का भुगतान 2 वर्षों में ₹ 25,448 प्रत्येक की मासिक किश्त द्वारा किया जाना है ।

यदि फाइनेंसर 20% प्रति वर्ष की दर से ब्याज लेता है, तो कार की वास्तविक कीमत ज्ञात कीजिए । [दिया गया है :  $\left(\frac{61}{60}\right)^{-24} = 0.67253$ ]





33. (a) Find all the points of local maxima and local minima of the function :

$$f(x) = -\frac{3}{4}x^4 - 8x^3 - \frac{45}{2}x^2 + 105.$$

**OR**

- (b) Find the intervals in which the following function  $f$  is strictly increasing or strictly decreasing :

$$f(x) = 20 - 9x + 6x^2 - x^3.$$

34. (a) Let  $X$  denote the number of hours a Class 12 student studies during a randomly selected school day. The probability that  $X$  can take the values  $x_i$ , for an unknown constant 'k' :

$$P(X = k) = \begin{cases} 0.1 & \text{if } x_i = 0 \\ kx_i & \text{if } x_i = 1 \text{ or } 2 \\ k(5 - x_i) & \text{if } x_i = 3 \text{ or } 4 \end{cases}$$

- (i) Find the value of  $k$ .
- (ii) Determine the probability that the student studied for at least 2 hours.
- (iii) Determine the probability that the student studied for at most 2 hours.

**OR**

- (b) A river near a small town floods and overflows twice in every 10 years on an average. Assuming that the Poisson distribution is appropriate, what is the mean expectation ? Also, calculate the probability of 3 or less overflows and floods in a 10-year interval. [Given  $e^{-2} = 0.13534$ ]

35. Amrita buys a car for which she makes a down payment of ₹ 2,50,000 and the balance is to be paid in 2 years by monthly instalments of ₹ 25,448 each. If the financier charges interest at the rate of 20% p.a, find the actual price of the car. [Given  $\left(\frac{61}{60}\right)^{-24} = 0.67253$ ]



## खण्ड ड

इस खण्ड में 3 प्रकरण अध्ययन-आधारित प्रश्न हैं जिनमें प्रत्येक के 4 अंक हैं ।

### प्रकरण अध्ययन - 1

36. अपने जन्मदिन पर, प्रेमा ने अनाथालय के बच्चों को कुछ पैसे दान करने का फैसला किया ।



यदि 8 बच्चे कम होते हैं, तो प्रत्येक बच्चे को ₹ 10 अधिक प्राप्त होते हैं । परन्तु, यदि 16 बच्चे अधिक होते हैं, तो प्रत्येक बच्चे को ₹ 10 कम प्राप्त होते हैं ।

माना अनाथालय में बच्चों की संख्या  $x$  तथा प्रत्येक बच्चे को दान से मिलने वाली राशि ₹  $y$  है ।

उपर्युक्त सूचना के आधार पर, निम्नलिखित प्रश्नों के उत्तर दीजिए :

(i) दी गई स्थिति से बने  $x$  और  $y$  में रैखिक समीकरण निकाय लिखिए ।

1

## SECTION E

*This section comprises 3 case study-based questions of 4 marks each.*

### Case Study – 1

36. On her birthday, Prema decides to donate some money to children of an orphanage home.



If there are 8 children less, everyone gets ₹ 10 more. However, if there are 16 children more, everyone gets ₹ 10 less.

Let the number of children in the orphanage home be  $x$  and the amount to be donated to each child be ₹  $y$ .

Based on the above information, answer the following questions :

- (i) Write the system of linear equations in  $x$  and  $y$  formed of the given situation.

1





(ii) Write the system of linear equations, obtained in (i) above, in matrix form  $AX = B$ . 1

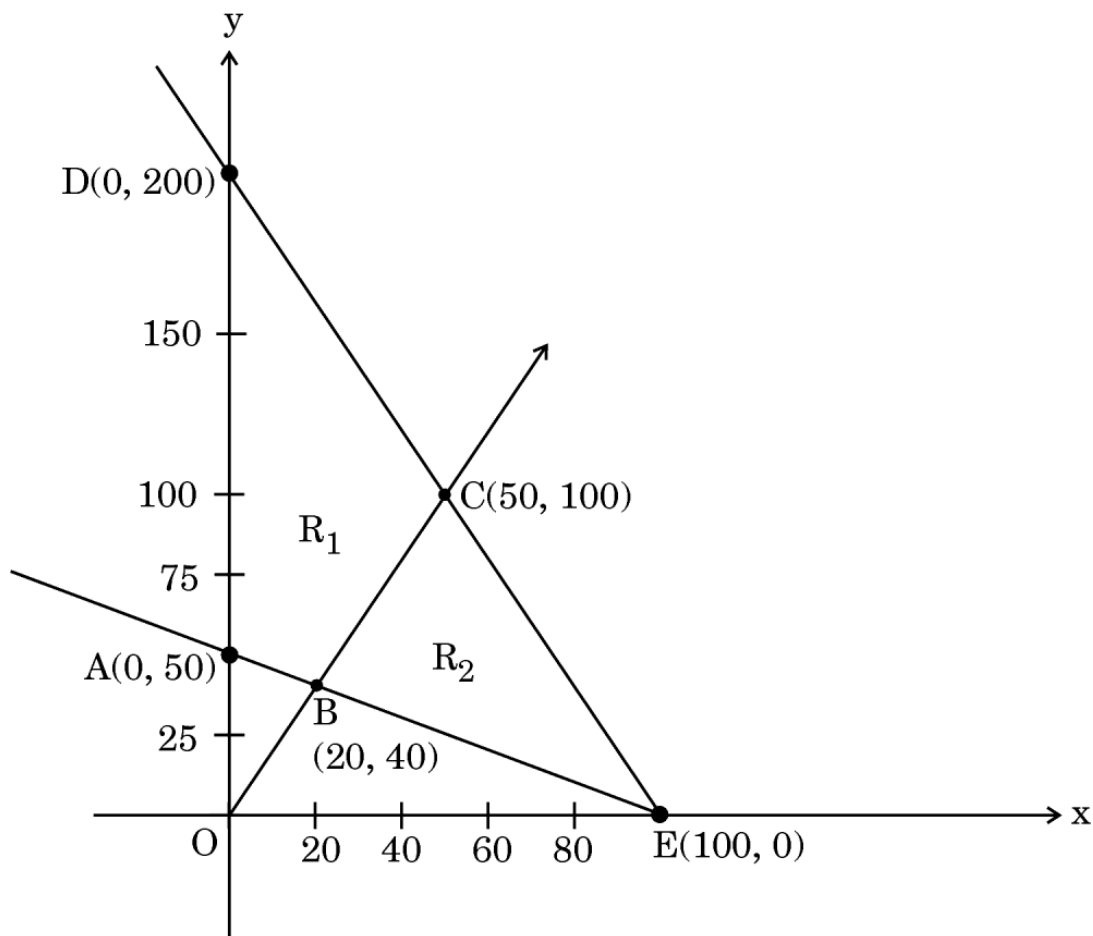
(iii) (a) Find the inverse of matrix A. 2

**OR**

(b) Determine the values of x and y. 2

### Case Study - 2

**37.** In number theory, it is often important to find factors of an integer N. The number N has two trivial factors, namely 1 and N. Any other factor, if exists, is called non-trivial factor of N. Naresh has plotted a graph of some constraints (linear inequations) with points A (0, 50), B (20, 40), C(50, 100), D(0, 200) and E(100, 0). This graph is constructed using three non-trivial constraints and two trivial constraints. One of the non-trivial constraints is  $x + 2y \geq 100$ .



उपर्युक्त सूचना के आधार पर, निम्नलिखित प्रश्नों के उत्तर दीजिए :

- (i) दो तुच्छ व्यवरोध कौन-कौन से हैं ? 1
- (ii) (क) यदि सुसंगत क्षेत्र  $R_1$  है, तो अन्य दो गैर-तुच्छ व्यवरोध क्या हैं ? 2
- अथवा
- (ख) यदि सुसंगत क्षेत्र  $R_2$  है, तो अन्य दो गैर-तुच्छ व्यवरोध क्या हैं ? 2
- (iii) यदि सुसंगत क्षेत्र  $R_1$  है, तो उद्देश्य फलन  $z = 5x + 2y$  का अधिकतम मान ज्ञात कीजिए । 1

### प्रकरण अध्ययन - 3

38. जब लंबे समय तक देखा जाता है, तो एक समय-शृंखला आँकड़े उन रुझानों की भविष्यवाणी कर सकते हैं जो विचाराधीन चर में वृद्धि या कमी या ठहराव का अनुमान लगा सकते हैं । इस तरह के विश्लेषणात्मक अध्ययन किसी व्यवसाय को भविष्य में अनुमानित बिक्री या उत्पादन की भविष्यवाणी या पूर्वानुमान के लिए लाभदायक हो सकता है ।

निम्नलिखित तालिका 1996 – 2001 के दौरान एक जिले में एक वस्तु की बिक्री को दर्शाती है :

वर्ष:	1996	1997	1998	1999	2000	2001
बिक्री (₹ लाख में) :	6.5	5.3	4.3	6.1	5.6	7.8

उपर्युक्त सूचना के आधार पर, निम्नलिखित प्रश्नों के उत्तर दीजिए :

- (i) सीधी-रेखा प्रवृत्ति का समीकरण निर्धारित कीजिए । 2





Based on the above information, answer the following questions :

- (i) What are the two trivial constraints ? 1
- (ii) (a) If  $R_1$  is the feasible region, then what are the other two non-trivial constraints ? 2
- OR**
- (b) If  $R_2$  is the feasible region, then what are the other two non-trivial constraints ? 2
- (iii) If  $R_1$  is the feasible region, then find the maximum value of the objective function  $z = 5x + 2y$ . 1

### Case Study – 3

38. When observed over a long period of time, a time series data can predict trends that can forecast increase or decrease or stagnation of a variable under consideration. Such analytical studies can benefit a business for forecasting or prediction of future estimated sales or production.

The table below shows the sale of an item in a district during 1996 – 2001 :

Year :	1996	1997	1998	1999	2000	2001
Sales (in lakh ₹) :	6.5	5.3	4.3	6.1	5.6	7.8

Based on the above information, answer the following questions :

- (i) Determine the equation of the straight-line trend. 2



- (ii) (क) वर्षों के रुझान मूल्यों को सारणीबद्ध कीजिए और वर्ष 2002 के लिए अपेक्षित बिक्री प्रवृत्ति की भी गणना कीजिए ।

2

अथवा

- (ख) निम्नलिखित आँकड़ों के लिए न्यूनतम वर्ग विधि द्वारा एक सीधी-रेखा प्रवृत्ति को फिट कीजिए :

2

वर्ष:	2004	2005	2006	2007	2008	2009	2010
लाभ (₹ '000)	114	130	126	144	138	156	164





- (ii) (a) Tabulate the trend values of the years and also compute expected sales trend for the year 2002. 2

**OR**

- (b) Fit a straight-line trend by the method of least squares for the following data : 2

<i>Year :</i>	2004	2005	2006	2007	2008	2009	2010
<i>Profit (₹ '000)</i>	114	130	126	144	138	156	164



**Marking Scheme**  
**Strictly Confidential**  
**(For Internal and Restricted use only)**  
**Senior School Certificate Examination, 2024**  
**APPLIED MATHEMATICS PAPER CODE 465**

**General Instructions: -**

1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	<b>“Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its’ leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC.”</b>
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one’s own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. <b>However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them.</b>
4	The Marking scheme carries only suggested value points for the answers These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after deliberation and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark ( ✓ ) wherever answer is correct. For wrong answer CROSS ‘X’ be marked. Evaluators will not put right ( ✓ ) while evaluating which gives an impression that answer is correct and no marks are awarded. <b>This is most common mistake which evaluators are committing.</b>
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	<b><u>In Q1-Q20, if a candidate attempts the question more than once (without canceling the previous attempt), marks shall be awarded for the first attempt only and the other answer scored out with a note “Extra Question”.</u></b>
10	<b><u>In Q21-Q38, if a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note “Extra Question”.</u></b>
11	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
12	A full scale of marks _____ (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
13	<ul style="list-style-type: none"> <li>Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines). This is in view of the reduced syllabus and number of questions in question paper.</li> </ul>
14	Ensure that you do not make the following common types of errors committed by the Examiner in the past :-

	<ul style="list-style-type: none"> <li>● Leaving answer or part thereof unassessed in an answer book.</li> <li>● Giving more marks for an answer than assigned to it.</li> <li>● Wrong totaling of marks awarded on an answer.</li> <li>● Wrong transfer of marks from the inside pages of the answer book to the title page.</li> <li>● Wrong question wise totaling on the title page.</li> <li>● Wrong totaling of marks of the two columns on the title page.</li> <li>● Wrong grand total.</li> <li>● Marks in words and figures not tallying/not same.</li> <li>● Wrong transfer of marks from the answer book to online award list.</li> <li>● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)</li> </ul> <p>Half or a part of answer marked correct and the rest as wrong, but no marks awarded.</p>
15	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0) Marks.
16	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
17	The Examiners should acquaint themselves with the guidelines given in the “ <b>Guidelines for spot Evaluation</b> ” before starting the actual evaluation.
18	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
19	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.



**MARKING SCHEME**  
**APPLIED MATHEMATICS (Subject Code-241)**  
**(PAPER CODE: 465)**

**Section A**

Q. No.	EXPECTED OUTCOMES/VALUE POINTS	Marks
	<b>SECTION A</b> Questions no. 1 to 18 are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of <b>1 mark each</b> .	
<b>1.</b>	In a 1 km race, player P beats player Q by 18 metres or 9 seconds. What is P's time to complete the race ?  (A) 512 seconds (B) 502 seconds (C) 491 seconds (D) 481 seconds	
<b>Sol.</b>	(C) 491 seconds	<b>(1)</b>
<b>2.</b>	If $x > y$ and $z < 0$ , then :  (A) $xz > yz$ (B) $xz \geq yz$ (C) $\frac{x}{z} > \frac{y}{z}$ (D) $\frac{x}{z} < \frac{y}{z}$	
<b>Sol.</b>	(D) $\frac{x}{z} < \frac{y}{z}$	<b>(1)</b>
<b>3.</b>	If $AB = A$ and $BA = B$ , then $(B^2 + B)$ equals :  (A) $2A$ (B) $O$ (C) $2I$ (D) $2B$	
<b>Sol.</b>	(D) $2B$	<b>(1)</b>
<b>4.</b>	The value of $\Delta = \begin{vmatrix} 42 & 2 & 5 \\ 79 & 7 & 9 \\ 29 & 5 & 3 \end{vmatrix}$ is :  (A) 0 (B) 1 (C) -3 (D) -15	
<b>Sol.</b>	(A) 0	<b>(1)</b>

5.	<p>If <math>y = e^{-2x}</math>, then <math>\frac{d^3y}{dx^3}</math> is equal to :</p> <p>(A) <math>2e^{-2x}</math> (B) <math>e^{-4x}</math>  (C) <math>4e^{-4x}</math> (D) <math>-8e^{-2x}</math></p>	
Sol.	(D) $-8e^{-2x}$	(1)
6.	<p>The function <math>f(x) = x^2 - x + 1</math> is :</p> <p>(A) increasing in <math>(0, 1)</math>  (B) decreasing in <math>(0, 1)</math>  (C) increasing in <math>(0, \frac{1}{2})</math> and decreasing in <math>(\frac{1}{2}, 1)</math>  (D) increasing in <math>(\frac{1}{2}, 1)</math> and decreasing in <math>(0, \frac{1}{2})</math></p>	
Sol.	(D) increasing in $(\frac{1}{2}, 1)$ and decreasing in $(0, \frac{1}{2})$	(1)
7.	<p>The <b>order</b> and the <b>degree</b> of the differential equation</p> $y dx + x \log\left(\frac{y}{x}\right) dy - 2x dy = 0$ <p>are respectively :</p> <p>(A) 1, 1 (B) 1, 2  (C) 2, 1 (D) 1, not defined</p>	
Sol.	(A) 1,1	(1)
8.	<p>A fair coin is tossed twice and outcomes are noted. If the random variable X represents the number of heads that appeared in the experiment, then the mathematical expectation of X is :</p> <p>(A) 1 (B) <math>\frac{1}{2}</math>  (C) <math>\frac{1}{4}</math> (D) <math>1\frac{1}{2}</math></p>	
Sol.	(A) 1	(1)
9.	<p>What time will it be after 1275 hours, if the present time is 9:00 p.m. ?</p> <p>(A) 11 p.m. (B) 12 p.m.  (C) 9 p.m. (D) 9 a.m.</p>	
Sol.	<p>Since correct answer is not in the options given  So, it is suggested that 1 mark may be given to all who attempted this question</p>	(1)







<b>15.</b>	A mobile phone costs ₹ 12,000 and its scrap value after a useful life of 3 years is ₹ 3,000. Then, the book value of the mobile phone at the end of 2 years is : (A) ₹ 3,000 (B) ₹ 6,000 (C) ₹ 5,000 (D) ₹ 7,000	
<b>Sol.</b>	(B) ₹ 6,000	<b>(1)</b>
<b>16.</b>	What sum of money should be deposited at the end of every 6 months to accumulate ₹ 50,000 in 8 years, if money is worth 6% p.a. compounded semi-annually ? [Given : $(1.03)^{16} = 1.6047$ ] (A) ₹ 3,432.53 (B) ₹ 2,783.08 (C) ₹ 2,480.57 (D) ₹ 2,149.93	
<b>Sol.</b>	(C) ₹ 2480.57	<b>(1)</b>
<b>17.</b>	The graph of the inequation $2x + 3y > 6$ is the : (A) entire XOY-plane (B) half-plane that contains the origin (C) half-plane that neither contains the origin nor the points on the line $2x + 3y = 6$ (D) whole XOY-plane excluding the points on the line $2x + 3y = 6$	
<b>Sol.</b>	(C) half-plane that neither contains the origin nor the points on the line $2x + 3y = 6$	<b>(1)</b>
<b>18.</b>	In an LPP, if the objective function $Z = ax + by$ has same maximum value on two corner points of the feasible region, then the number of points at which maximum value of $Z$ occurs is : (A) 0 (B) 2 (C) finite (D) infinite	
<b>Sol.</b>	(D) infinite	<b>(1)</b>

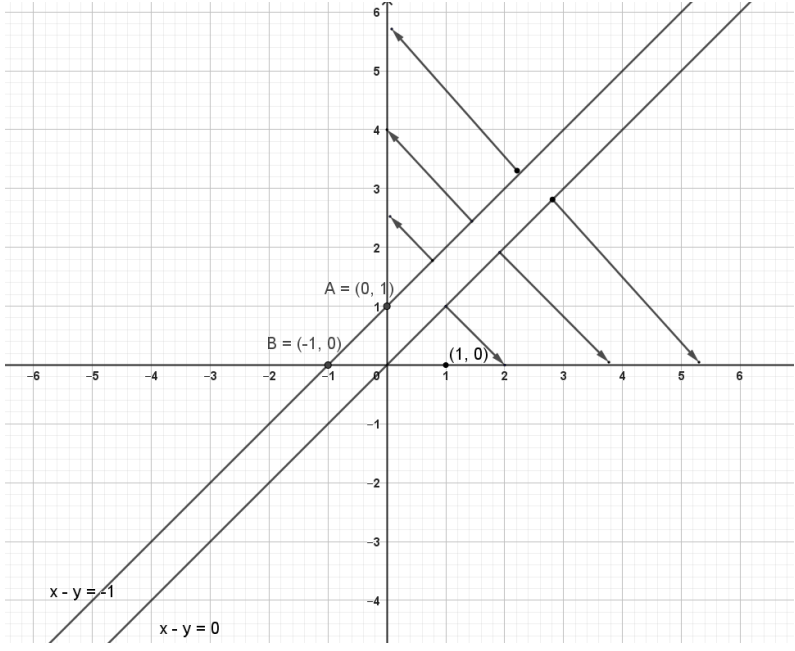


	<p>Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.</p> <p>(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).</p> <p>(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is <b>not</b> the correct explanation of the Assertion (A).</p> <p>(C) Assertion (A) is true, but Reason (R) is false.</p> <p>(D) Assertion (A) is false, but Reason (R) is true.</p>	
19.	<p>Assertion (A) : The function <math>f(x) = x^2 - x + 1</math> is strictly increasing on <math>(-1, 1)</math>.</p> <p>Reason (R) : If <math>f(x)</math> is continuous on <math>[a, b]</math> and derivable on <math>(a, b)</math>, then <math>f(x)</math> is strictly increasing on <math>[a, b]</math> if <math>f'(x) &gt; 0</math> for all <math>x \in (a, b)</math>.</p>	
Sol.	(D) Assertion (A) is false, but Reason (R) is true	(1)
20.	<p>In a binomial distribution, <math>n = 200</math> and <math>p = 0.04</math>. Taking Poisson distribution as an approximation to the binomial distribution :</p> <p>Assertion (A) : Mean of Poisson distribution = 8.</p> <p>Reason (R) : <math>P(X = 4) = \frac{512}{3e^8}</math>.</p>	
Sol.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is the not the correct explanation of the Assertion (A).	(1)
	<b>SECTION B</b>	
	<b>This section comprises very short answer (VSA) type questions of 2 marks each.</b>	
21(a).	If $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ , find the value of $k$ such that $A^2 - 8A + kI = 0$ .	
Sol.	<p>Given <math>A = \begin{bmatrix} 1 &amp; 0 \\ -1 &amp; 7 \end{bmatrix}</math>, <math>A^2 = \begin{bmatrix} 1 &amp; 0 \\ -8 &amp; 49 \end{bmatrix}</math></p> <p><math>A^2 - 8A + kI = 0</math> gives</p> $\begin{bmatrix} 1 & 0 \\ -8 & 49 \end{bmatrix} - 8 \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix} + k \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ $\Rightarrow \begin{bmatrix} 1 - 8 + k & 0 - 0 + 0 \\ -8 + 8 + 0 & 49 - 56 + k \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ $\Rightarrow k = 7$	$\left(\frac{1}{2}\right)$   $\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$



OR		
<b>21(b).</b>	If $\begin{bmatrix} x-y & 2x+z \\ 2x-y & 3z+w \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$ , find the values of x, y, z and w.	
<b>Sol.</b>	Here, $x - y = -1, 2x - y = 0, 2x + z = 5, 3z + w = 13$ Solving these equations, we get $x = 1, y = 2, z = 3, w = 4$	(1)  (1)
<b>22.</b>	Using Cramer's rule, solve the following system of equations :  $2x_1 + 3x_2 = 5$  $11x_1 - 5x_2 = 6$	
<b>Sol.</b>	Here, $D = \begin{vmatrix} 2 & 3 \\ 11 & -5 \end{vmatrix} = -43 \neq 0$  $D_1 = \begin{vmatrix} 5 & 3 \\ 6 & -5 \end{vmatrix} = -43$  $D_2 = \begin{vmatrix} 2 & 5 \\ 11 & 6 \end{vmatrix} = -43$  So, $x_1 = \frac{D_1}{D} = \frac{-43}{-43} = 1, x_2 = \frac{D_2}{D} = \frac{-43}{-43} = 1$	$\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$
<b>23.</b>	Find the solution to the following linear programming problem (if it exists) graphically : Maximize $Z = x + y$ subject to the constraints  $x - y \leq -1$  $-x + y \leq 0$  $x, y \geq 0.$	



<p><b>Sol.</b></p>	 <p>Since feasible region is empty, there is no solution to the problem.</p>	<p><math>(1\frac{1}{2})</math> for correct graph</p> <p><math>(\frac{1}{2})</math></p>
<p><b>24.</b></p>	<p>At 6% p.a., compounded quarterly, find the present value of a perpetuity of ₹ 600 payable at the end of each quarter.</p>	
<p><b>Sol.</b></p>	<p>Here, <math>R = 600, i = \frac{0.06}{4} = 0.015</math></p> <p>So, <math>PV = \frac{R}{i} = \frac{600}{0.015} = ₹ 40,000</math></p>	<p>(1)</p> <p>(1)</p>
<p><b>25 (a).</b></p>	<p>Assume an investment's starting value is ₹ 20,000 and it grows to ₹ 50,000 in 3 years. Calculate CAGR (Compounded Annual Growth Rate) [Use : <math>(2.5)^{1/3} = 1.355</math>]</p>	
<p><b>Sol.</b></p>	$CAGR = \left[ \left( \frac{50000}{20000} \right)^{1/3} - 1 \right] \times 100$ $= [(2.5)^{1/3} - 1] \times 100 = (1.355 - 1) \times 100$ $= 0.355 \times 100 = 35.5\%$	<p>(1)</p> <p>(1)</p>
<p><b>OR</b></p>		
<p><b>25 (b).</b></p>	<p>A man bought an item for ₹ 12,000. At the end of the year, he decided to sell it for ₹ 15,000. If the inflation rate was 6%, find the nominal and real rate of return.</p>	
<p><b>Sol.</b></p>	<p>Nominal rate of return = <math>\frac{15000-12000}{12000} \times 100</math></p> $= \frac{3000}{12000} \times 100 = 25\%$	<p><math>(\frac{1}{2})</math></p> <p><math>(\frac{1}{2})</math></p>





<p><b>Sol.</b></p>	<p>Here, <math>Z = \frac{X-100}{10}</math></p> <p><math>P(90 &lt; X &lt; 110) = P(X &lt; 110) - P(X &lt; 90)</math></p> <p><math>\Rightarrow P(90 &lt; X &lt; 110) = P(-1 &lt; Z &lt; 1) = P(Z &lt; 1) - P(Z &lt; -1)</math></p> <p style="text-align: center;"><math>= 0.8413 - 0.1587</math></p> <p style="text-align: center;"><math>= 0.6826</math></p>	<p><math>(\frac{1}{2})</math></p> <p><b>(2)</b></p> <p><math>(\frac{1}{2})</math></p>
<p><b>30.</b></p>	<p>The mean weekly sales of a 4-wheeler was 50 units per agency in 20 agencies. After an advertising campaign, the mean weekly sales increased to 55 units per agency with standard deviation of 10 units. Test whether the advertising campaign was successful.</p> <p>[Given <math>\sqrt{5} = 2.24</math>, <math>t_{19}(0.05) = 1.729</math>]</p>	
<p><b>Sol.</b></p>	<p>Here, <math>\mu_0 = 50</math>, <math>\bar{x} = 55</math>, <math>n = 20</math> and <math>S = 10</math></p> <p><math>H_0: \mu = 50</math> (The advertisement campaign was not successful)</p> <p><math>H_a: \mu &gt; 50</math> (The advertisement campaign was successful)</p> <p>The test statistic <math>t</math> is given by</p> <p><math>t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} = \frac{55-50}{\frac{10}{\sqrt{20}}} = \frac{2\sqrt{5}}{2} = \sqrt{5} = 2.24</math></p> <p>Degree of freedom = <math>20 - 1 = 19</math></p> <p>Here, <math>t &gt; t_{19}(0.05)</math> as <math>2.24 &gt; 1.729</math></p> <p><math>\Rightarrow</math> null hypothesis is rejected</p> <p>i.e., Advertising campaign was successful</p>	<p><math>(\frac{1}{2})</math></p> <p><b>(1 <math>\frac{1}{2}</math>)</b></p> <p><math>(\frac{1}{2})</math></p> <p><math>(\frac{1}{2})</math></p>
<p><b>31(a).</b></p>	<p>A recent accounting graduate opened a new business and installed a computer system that costs ₹ 45,200. The computer system will be depreciated linearly over 3 years and will have a scrap value of ₹ 0.</p> <p>(i) What is the rate of depreciation ?</p> <p>(ii) Give a linear equation that describes the computer system's book value at the end of <math>t^{\text{th}}</math> year, where <math>0 \leq t \leq 3</math>.</p> <p>(iii) What will be the computer system's book value at the end of the first year and a half ?</p>	
<p><b>Sol.</b></p>	<p>(i) Annual amount of depreciation = <math>\frac{45200-0}{3} = ₹ \frac{45200}{3}</math></p> <p>Rate of depreciation = <math>\frac{\frac{45200}{3}}{45200} \times 100 = 33.3\%</math></p>	<p><b>(1)</b></p>



	(ii) $v(t) = mt + C = -\frac{45200}{3}t + 45200$	(1)
	(iii) $v\left(1\frac{1}{2}\right) = -\frac{45200}{3} \times \frac{3}{2} + 45200 = ₹ 22600$	(1)
<b>OR</b>		
<b>31(b).</b>	Find the effective rate which is equivalent to normal rate of 10% p.a. compounded : (i) semi-annually. (ii) quarterly. [Given $(1.05)^2 = 1.1025$ , $(1.025)^4 = 1.1038$ ]	
<b>Sol.</b>	(i) $r_e = \left(1 + \frac{r}{200}\right)^2 - 1 = \left(1 + \frac{10}{200}\right)^2 - 1$ $= (1.05)^2 - 1 = 1.1025 - 1 = 10.25\%$	(1) $\left(\frac{1}{2}\right)$
	(ii) $r_e = \left(1 + \frac{r}{400}\right)^4 - 1 = \left(1 + \frac{10}{400}\right)^4 - 1$ $= (1.025)^4 - 1 = 1.1038 - 1 = 10.38\%$	(1) $\left(\frac{1}{2}\right)$
<b>SECTION D</b>		
<b>This section comprises of Long Answer (LA) type questions of 5 marks each.</b>		
<b>32.</b>	A cistern has three pipes A, B and C. Pipes A and B are inlet pipes whereas C is an outlet pipe. Pipes A and B can fill the cistern separately in 3 hours and 4 hours respectively; while pipe C can empty the completely filled cistern in 1 hour. If the pipes A, B and C are opened in order at 5, 6 and 7 a.m. respectively, at what time will the cistern be empty ?	
<b>Sol.</b>	Let the cistern be emptied in $n$ hours after 5 a.m. Clearly pipes A and B fill the cistern for $n$ and $n - 1$ hours respectively, while pipe C empties the tank for $n - 2$ hours $\therefore \frac{n}{3} + \frac{n-1}{4} - \frac{n-2}{1} = 0$ Solving, we get $n = \frac{21}{5}$  i.e., 4 hours 12 minutes past 5 am i.e., at 9:12 am	(1) $\frac{1}{2}$  (1) $\frac{1}{2}$  (1)  (1)





**33(a).** Find all the points of local maxima and local minima of the function :

$$f(x) = -\frac{3}{4}x^4 - 8x^3 - \frac{45}{2}x^2 + 105.$$

**Sol.**

$$f(x) = -\frac{3}{4}x^4 - 8x^3 - \frac{45}{2}x^2 + 105$$

$$f'(x) = -3x^3 - 24x^2 - 45x \text{ and } f''(x) = -9x^2 - 48x - 45 \quad (1)$$

$$f'(x) = 0 \Rightarrow x = 0 \text{ or } x^2 + 8x + 15 = 0$$

i.e.,  $x = 0, -3, -5$  (1)

At  $x = 0, f''(0) < 0 \Rightarrow 0$  is a point of local maxima (1)

At  $x = -3, f''(-3) > 0 \Rightarrow -3$  is a point of local minima (1)

At  $x = -5, f''(-5) < 0 \Rightarrow -5$  is a point of local maxima (1)

**OR**

**33(b).** Find the intervals in which the following function  $f$  is strictly increasing or strictly decreasing :

$$f(x) = 20 - 9x + 6x^2 - x^3.$$

**Sol.**

$$f(x) = 20 - 9x + 6x^2 - x^3$$

$$f'(x) = -9 + 12x - 3x^2 = -3(x^2 - 4x + 3)$$

$$= -3(x - 1)(x - 3)$$

$$f'(x) = 0 \Rightarrow x = 1, 3$$

Now intervals are  $(-\infty, 1), (1, 3)$  and  $(3, \infty)$

Intervals	Sign of $f'(x)$
$(-\infty, 1)$	-ve
$(1, 3)$	+ve
$(3, \infty)$	-ve

$\Rightarrow f(x)$  is strictly increasing in  $(1, 3)$  or  $[1, 3]$  (1/2)

And  $f(x)$  is strictly decreasing in  $(-\infty, 1) \cup (3, \infty)$  or  $(-\infty, 1] \cup [3, \infty)$  (1/2)

<b>34(a).</b>	<p>Let X denote the number of hours a Class 12 student studies during a randomly selected school day. The probability that X can take the values <math>x_i</math>, for an unknown constant 'k' :</p> $P(X = k) = \begin{cases} 0.1 & \text{if } x_i = 0 \\ kx_i & \text{if } x_i = 1 \text{ or } 2 \\ k(5 - x_i) & \text{if } x_i = 3 \text{ or } 4 \end{cases}$ <p>(i) Find the value of k.</p> <p>(ii) Determine the probability that the student studied for at least 2 hours.</p> <p>(iii) Determine the probability that the student studied for at most 2 hours.</p>	
<b>Sol.</b>	<p>(i) <math>0.1 + k + 2k + 2k + k = 1</math>  <math>\Rightarrow 0.1 + 6k = 1</math>  <math>\Rightarrow k = \frac{3}{20}</math></p> <p>(ii) <math>P(X \geq 2) = P(2) + P(3) + P(4)</math>  <math>= 2k + 2k + k</math>  <math>= 5k = \frac{3}{4}</math></p> <p>(iii) <math>P(X \leq 2) = P(0) + P(1) + P(2)</math>  <math>= 0.1 + k + 2k</math>  <math>= \frac{1}{10} + \frac{9}{20} = \frac{11}{20}</math></p>	<p>(1)</p> <p>(1)</p> <p><math>\frac{1}{2}</math></p> <p>(1)</p> <p><math>\frac{1}{2}</math></p> <p>(1)</p>
<b>OR</b>		
<b>34(b).</b>	<p>A river near a small town floods and overflows twice in every 10 years on an average. Assuming that the Poisson distribution is appropriate, what is the mean expectation ? Also, calculate the probability of 3 or less overflows and floods in a 10-year interval. [Given <math>e^{-2} = 0.13534</math>]</p>	
<b>Sol.</b>	<p>Here, mean expectation = <math>\lambda = 2</math></p> $P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$ $P(X \leq 3) = P(0) + P(1) + P(2) + P(3)$ $= e^{-2} \left( 1 + 2 + 2 + \frac{4}{3} \right)$ $= 0.13534 \times \frac{19}{3} = 0.8571 \text{ or } 0.86$	<p>(1)</p> <p>(1)</p> <p>(2)</p> <p>(1)</p>

35.	Amrita buys a car for which she makes a down payment of ₹ 2,50,000 and the balance is to be paid in 2 years by monthly instalments of ₹ 25,448 each. If the financier charges interest at the rate of 20% p.a, find the actual price of the car. [Given $\left(\frac{61}{60}\right)^{-24} = 0.67253$ ]	
Sol.	$n = 2 \times 12 = 24,$ $i = \frac{20}{1200} = \frac{1}{60}$ $EMI = \frac{Pi}{1-(1+i)^{-n}}$ $25448 = \frac{P \times \frac{1}{60}}{1-(1+\frac{1}{60})^{-24}}$ $P = 25448 \times 60 \left[1 - \left(1 + \frac{1}{60}\right)^{-24}\right]$ $P = 25448 \times 60(1 - 0.67253)$ $= ₹ 5,00,000 \text{ approx.}$ <p>Hence the actual price of the car is ₹ 7,50,000 approx.</p>	$\left(\frac{1}{2}\right)$ $\left(\frac{1}{2}\right)$ (1) (1) $\left(\frac{1}{2}\right)$ (1) $\left(\frac{1}{2}\right)$
<b>SECTION E</b> <b>This section comprises of 3 case-study based questions of 4 marks each.</b>		



36.

On her birthday, Prema decides to donate some money to children of an orphanage home.



If there are 8 children less, everyone gets ₹ 10 more. However, if there are 16 children more, everyone gets ₹ 10 less.

Let the number of children in the orphanage home be  $x$  and the amount to be donated to each child be ₹  $y$ .

Based on the above information, answer the following questions :

- (i) Write the system of linear equations in  $x$  and  $y$  formed of the given situation. 1
- (ii) Write the system of linear equations, obtained in (i) above, in matrix form  $AX = B$ . 1
- (iii) (a) Find the inverse of matrix  $A$ . 2
- OR**
- (b) Determine the values of  $x$  and  $y$ . 2

Sol.

- (i) Let number of children be  $x$  and the amount donated to each child be ₹  $y$

$$\therefore (x - 8)(y + 10) = xy \text{ and } (x + 16)(y - 10) = xy$$

i.e.,  $5x - 4y = 40$  and  $5x - 8y = -80$

(ii)  $A = \begin{bmatrix} 5 & -4 \\ 5 & -8 \end{bmatrix}, X = \begin{bmatrix} x \\ y \end{bmatrix}, B = \begin{bmatrix} 40 \\ -80 \end{bmatrix}$

 $\left(\frac{1}{2}\right)$  $\left(\frac{1}{2}\right)$ 

(1)



(iii) (a)  $|A| = -40 + 20 = -20 \neq 0$

$\text{adj}(A) = \begin{bmatrix} -8 & 4 \\ -5 & 5 \end{bmatrix}$

$\Rightarrow A^{-1} = -\frac{1}{20} \begin{bmatrix} -8 & 4 \\ -5 & 5 \end{bmatrix} = \frac{1}{20} \begin{bmatrix} 8 & -4 \\ 5 & -5 \end{bmatrix}$

OR

(iii) (b)  $X = \begin{bmatrix} x \\ y \end{bmatrix} = A^{-1}B$

$= \frac{1}{20} \begin{bmatrix} 8 & -4 \\ 5 & -5 \end{bmatrix} \begin{bmatrix} 40 \\ -80 \end{bmatrix}$

$= \frac{1}{20} \begin{bmatrix} 640 \\ 600 \end{bmatrix} = \begin{bmatrix} 32 \\ 30 \end{bmatrix}$

$\Rightarrow x = 32, y = 30$

$(\frac{1}{2})$

(1)

$(\frac{1}{2})$

$(\frac{1}{2})$

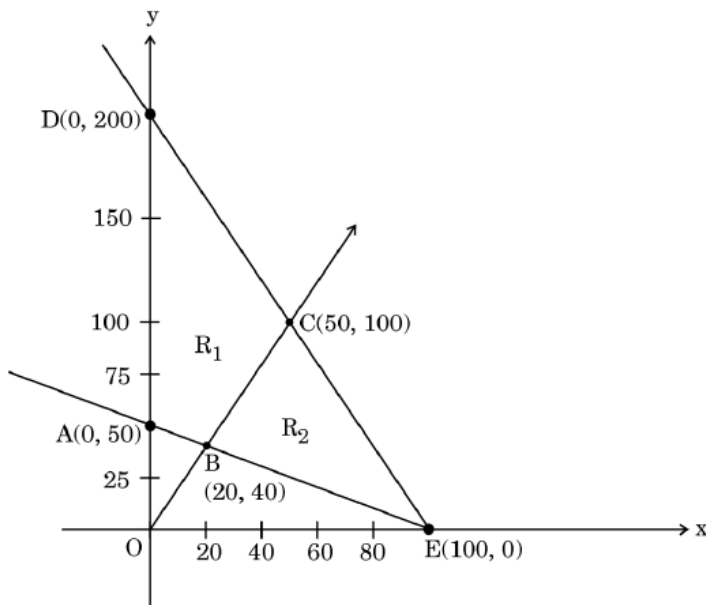
(1)

$(\frac{1}{2})$

37.

**Case Study - 2**

In number theory, it is often important to find factors of an integer N. The number N has two trivial factors, namely 1 and N. Any other factor, if exists, is called non-trivial factor of N. Naresh has plotted a graph of some constraints (linear inequations) with points A (0, 50), B (20, 40), C(50, 100), D(0, 200) and E(100, 0). This graph is constructed using three non-trivial constraints and two trivial constraints. One of the non-trivial constraints is  $x + 2y \geq 100$ .



	<p>Based on the above information, answer the following questions :</p> <p>(i) What are the two trivial constraints ? <span style="float: right;">1</span></p> <p>(ii) (a) If <math>R_1</math> is the feasible region, then what are the other two non-trivial constraints ? <span style="float: right;">2</span></p> <p style="text-align: center;"><b>OR</b></p> <p>(b) If <math>R_2</math> is the feasible region, then what are the other two non-trivial constraints ? <span style="float: right;">2</span></p> <p>(iii) If <math>R_1</math> is the feasible region, then find the maximum value of the objective function <math>z = 5x + 2y</math>. <span style="float: right;">1</span></p>	
<b>Sol.</b>	<p>(i) <math>x \geq 0, y \geq 0</math> <span style="float: right;">(1)</span></p> <p>(ii) (a) <math>2x - y \leq 0,</math> <math>2x + y \leq 200</math> <span style="float: right;">(1)</span> <span style="float: right;">(1)</span></p> <p style="text-align: center;"><b>OR</b></p> <p>(ii) (b) <math>2x + y \leq 200,</math> <span style="float: right;">(1)</span> <math>2x - y \geq 0</math> <span style="float: right;">(1)</span></p> <p>(iii) Corner points of <math>R_1</math> are <math>A(0,50), B(20,40), C(50,100)</math> and <math>D(0,200)</math> <span style="float: right;">(<math>\frac{1}{2}</math>)</span></p> <p><b><math>Z_A = 100; Z_B = 180; Z_C = 450; Z_D = 400</math></b> <span style="float: right;">(<math>\frac{1}{2}</math>)</span></p> <p>So, <math>Z</math> is maximum at <math>C</math> and maximum value of <math>Z = 450</math> <span style="float: right;">(<math>\frac{1}{2}</math>)</span></p>	



38.

When observed over a long period of time, a time series data can predict trends that can forecast increase or decrease or stagnation of a variable under consideration. Such analytical studies can benefit a business for forecasting or prediction of future estimated sales or production.

The table below shows the sale of an item in a district during 1996 – 2001 :

<i>Year :</i>	1996	1997	1998	1999	2000	2001
<i>Sales (in lakh ₹) :</i>	6.5	5.3	4.3	6.1	5.6	7.8

Based on the above information, answer the following questions :

(i) Determine the equation of the straight-line trend. 2

(a) Tabulate the trend values of the years and also compute expected sales trend for the year 2002. 2

**OR**

(b) Fit a straight-line trend by the method of least squares for the following data : 2

<i>Year :</i>	2004	2005	2006	2007	2008	2009	2010
<i>Profit (₹ '000)</i>	114	130	126	144	138	156	164



Sol.

(i)

Year ( $x_i$ )	Index Number ( $y$ )	$x = \frac{x_i - A}{0.5}$	$x^2$	$xy$
1996	6.5	-5	25	-32.5
1997	5.3	-3	9	-15.9
1998	4.3	-1	1	-4.3
1999	6.1	1	1	6.1
2000	5.6	3	9	16.8
2001	7.8	5	25	39
$n = 6$	$\sum y = 35.6$	$\sum x = 0$	$\sum x^2 = 70$	$\sum xy = 9.2$

(1) for correct table

$$a = \frac{\sum y}{n} = \frac{35.6}{6}, b = \frac{\sum xy}{\sum x^2} = \frac{9.2}{70} = 0.13$$

( $\frac{1}{2}$ )

∴ Equation of straight-line trend is given by

$$y = a + bx = 5.9 + 0.13x$$

( $\frac{1}{2}$ )

(ii) (a) Trend Values

$$1996 \quad 5 \cdot 9 + (-5) \times 0 \cdot 13 = 5 \cdot 25$$

$$1997 \quad 5 \cdot 9 + (-3) \times 0 \cdot 13 = 5 \cdot 51$$

$$1998 \quad 5 \cdot 9 + (-1) \times 0 \cdot 13 = 5 \cdot 77$$

$$1999 \quad 5 \cdot 9 + (1) \times 0 \cdot 13 = 6 \cdot 03$$

$$2000 \quad 5 \cdot 9 + (3) \times 0 \cdot 13 = 6 \cdot 29$$

$$2001 \quad 5 \cdot 9 + (5) \times 0 \cdot 13 = 6 \cdot 55$$

(1) mark for correct trend values

Expected sales trend for 2002

$$= 5.9 + 0.13 \left( \frac{2002 - 1998.5}{0.5} \right)$$

$$= ₹ 6.81 \text{ lakhs}$$

( $\frac{1}{2}$ )

( $\frac{1}{2}$ )

OR

(ii) (b)





Year ( $x_i$ )	Profit ( $y$ )	$x = x_i - A$	$x^2$	$xy$
2004	114	-3	9	-342
2005	130	-2	4	-260
2006	126	-1	1	-126
2007	144	0	0	0
2008	138	1	1	138
2009	156	2	4	312
2010	164	3	9	492
$n = 7$	$\sum y = 972$	$\sum x = 0$	$\sum x^2 = 28$	$\sum xy = 214$

$$a = \frac{\sum y}{n} = \frac{972}{7} = 138.86, b = \frac{\sum xy}{\sum x^2} = \frac{214}{28} = 7.64$$

So, required equation of straight- line trend is

$$y = a + bx = 138.86 + 7.64x$$

**(1) for  
correct  
table**

$(\frac{1}{2})$

$(\frac{1}{2})$

