CLASS 12 · CBSE APPLIED MATHEMATICS (241)

Applied Mathematics Solved Board Papers

Chapter-wise and year-wise CBSE board questions with complete step-by-step solutions

5 years · 2022–2026

- ✓ Part A: every question sorted chapter-wise, grouped by marks, with full solutions
- ✓ Part B: complete board papers, each followed by its solutions
- ✓ Board weightage table and most-asked topics for every chapter
- ✓ Every EMI, sinking fund, CAGR, t-test, trend and LPP worked step by step
- ✓ All 9 CBSE papers since Applied Mathematics began in 2022: every main paper and every compartment paper the board has published

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WHAT YOU GET

Every CBSE Applied Maths board paper. Every question solved. Sorted chapter-wise.

9	344	5	14	14
board papers	solved questions	years · 2022–26	chapters	diagrams

✗ Questions scattered across years	→ ✓ All in one place, chapter-wise
✗ Don't know what to study first	→ ✓ Weightage + most-asked topics
✗ Answers without working	→ ✓ Every step of every numerical
✗ Few practice papers for a new subject	→ ✓ All 9 board papers since 2022

PART A — Chapter-wise

- ✓ Weightage table
- ✓ Most-asked topics
- ✓ Every question + solution

PART B — Full papers

- ✓ Exactly as set by CBSE
- ✓ Solutions after each paper
- ✓ Timed 3-hour practice

2026 · 465	**2026** · 465/7 (Supplementary)	**2025** · 465	**2025** · 465/S (Supplementary)	**2024** · 465
2024 · 465/S (Supplementary)	**2023** · 465	**2022** · 465 (Term 2)	**2022** · 465 (Term 2, Supplementary)	

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CLASS 6–12 · ALL SUBJECTS

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How to use this book

Part A puts every board question of a chapter together, from 1-mark MCQs to 5-mark long answers and case studies. Finish a chapter in your notes, then solve its Part A questions without looking at the solutions. Check your answer, mark the ones you got wrong, and repeat them a week later.

Each question shows where it was asked, for example **CBSE 2026 · 465 · Q13**. Use the weightage table and the most-asked topics chart at the start of each chapter to decide what to revise first.

Part B gives full papers. In the last month before the exam, sit with a clock and write one paper in 3 hours, then check it with the solutions that follow the paper.

Solutions are written the way the board awards marks: formula first, then substitution, working and the answer with its unit; tables for trend and moving averages; and every corner point listed for LPPs. Write your answers the same way.

Contents

Part A · Chapter-wise questions with solutions

1. Numbers, Quantification and Numerical Applications 34 Qs
2. Numerical Inequalities 13 Qs
3. Matrices 16 Qs
4. Determinants 28 Qs
5. Differentiation 7 Qs
6. Applications of Derivatives 26 Qs
7. Integration and its Applications 22 Qs
8. Differential Equations and Modelling 17 Qs
9. Probability Distributions 45 Qs
10. Inferential Statistics 23 Qs
11. Index Numbers and Time-based Data 20 Qs
12. Perpetuity, Sinking Funds and EMI 37 Qs
13. Returns, Growth and Depreciation 29 Qs
14. Linear Programming 27 Qs

Part B · Full board papers, each followed by its solutions

1. CBSE 2026 · 465 solutions
2. CBSE 2026 · 465/7 (Supplementary) solutions
3. CBSE 2025 · 465 solutions
4. CBSE 2025 · 465/S (Supplementary) solutions
5. CBSE 2024 · 465 solutions
6. CBSE 2024 · 465/S (Supplementary) solutions
7. CBSE 2023 · 465 solutions
8. CBSE 2022 · 465 (Term 2) solutions
9. CBSE 2022 · 465 (Term 2, Supplementary) solutions

344 questions in all. Questions are taken from the CBSE Class 12 Applied Mathematics (241, paper code 465) board papers, first set in 2022, and the solutions are our own, checked against the official marking schemes wherever the board published one.

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CHAPTER 1

Numbers, Quantification and Numerical Applications

Board weightage 2022–2026

Year	2022	2023	2024	2025	2026
Questions per paper	–	7	5	5	3.5
Marks per paper	–	13	12	9	9

Most asked topics



34 different questions from 7 papers. Repeated questions are shown once with every year they were asked.

1 mark: MCQ and Assertion–Reason

CBSE 2026 · 465/7 (Supplementary) · Q2 — 1 mark

In a 300 m race, player A beats player B by 22.5 m or 6 seconds. B's time to complete the race is:

(A) 80 seconds (B) 82 seconds
(C) 76 seconds (D) 90 seconds

Solution

B covers the last 22.5 m in 6 s, so B's speed $= \frac{22.5}{6} = 3.75$ m/s. B's time for 300 m $= \frac{300}{3.75} = 80$ s. **(A)**

CBSE 2025 · 465/S (Supplementary) · Q1 — 1 mark

The smallest positive integer (mod 11) to which 282 is congruent, is :

(A) 3 (B) 7
(C) 9 (D) 17

Solution

$282 = 11 \times 25 + 7$, so $282 \equiv 7 \pmod{11}$, and $0 \leq 7 < 11$. **(B)**

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CBSE 2025 · 465/S (Supplementary) · Q2 — 1 mark

A man can row 6 km/h in still water. It takes him twice as long to row up as to row down the river. Then, the speed of the stream is :

(A) 2 km/h
(B) 4 km/h
(C) 6 km/h
(D) 8 km/h

Solution

Let the stream speed be s km/h. Upstream speed $= 6 - s$, downstream speed $= 6 + s$. Twice the time over the same distance means half the speed: $6 + s = 2(6 - s) \Rightarrow 3s = 6 \Rightarrow s = 2$ km/h. **(A)**

CBSE 2025 · 465 · Q1 — 1 mark

$-41 \bmod 9$ is

(A) 5
(B) 4
(C) 3
(D) 0

Solution

$-41 = 9 \times (-5) + 4$ with $0 \leq 4 < 9$, so $-41 \bmod 9 = 4$. **(B)**

CBSE 2024 · 465/S (Supplementary) · Q1 — 1 mark

In what ratio must water be mixed with milk to gain $16\frac{2}{3}\%$ on selling the mixture at cost price ?

(A) 1 : 6
(B) 6 : 1
(C) 3 : 2
(D) 2 : 3

Solution

Let milk cost ₹ 1 per litre. To gain $16\frac{2}{3}\% = \frac{1}{6}$ while selling at ₹ 1 per litre, ₹ 1 of sale must cost ₹ $\frac{6}{7}$, i.e. 1 litre of mixture contains $\frac{6}{7}$ litre of milk and $\frac{1}{7}$ litre of water.
Water : milk $= \frac{1}{7} : \frac{6}{7} = 1 : 6$. **(A)**

CBSE 2024 · 465/S (Supplementary) · Q2 — 1 mark

In a 100 m race, A can beat B by 25 m and B can beat C by 4 m. By how much can A beat C in the same race ?

(A) 32 m
(B) 28 m
(C) 24 m
(D) 20 m

Solution

When A runs 100 m, B runs 75 m. When B runs 100 m, C runs 96 m, so when B runs 75 m, C runs $\frac{96}{100} \times 75 = 72$ m.
A beats C by $100 - 72 = 28$ m. **(B)**

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CBSE 2024 · 465 · Q1 — 1 mark

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

Solution

Q covers 18 m in 9 s, so Q's speed $= 2$ m/s and Q takes $\frac{1000}{2} = 500$ s. P finishes 9 s earlier: $500 - 9 = 491$ s. **(C)**

CBSE 2024 · 465 · Q9 — 1 mark

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.

Solution

Working in mod 24: $1275 = 24 \times 53 + 3$, so $1275 \equiv 3 \pmod{24}$. 9 p.m. + 3 hours = 12 midnight (12 a.m.). None of the options is correct (12 p.m. is noon).

Answer as per the CBSE marking scheme: no option is correct; 1 mark was given to every candidate who attempted it.

CBSE 2023 · 465 · Q1 — 1 mark

The last (unit) digit of $(22)^{12}$ is:

(a) 2
(b) 4
(c) 6
(d) 8

Solution

The unit digit of 22^{12} is that of 2^{12}. Unit digits of powers of 2 repeat in the cycle 2, 4, 8, 6 (length 4). $12 = 4 \times 3$, so 2^{12} ends like $2^4 = 16$: unit digit 6. **(c)**

CBSE 2023 · 465 · Q2 — 1 mark

The least non-negative remainder, when 3^{15} is divided by 7 is:

(a) 1
(b) 5
(c) 6
(d) 7

Solution

$3^3 = 27 \equiv 6 \equiv -1 \pmod{7}$. So $3^{15} = (3^3)^5 \equiv (-1)^5 = -1 \equiv 6 \pmod{7}$. **(c)**

CBSE 2023 · 465 · Q5 — 1 mark

The ratio in which a grocer mixes two varieties of pulses costing ₹ 85 per kg and ₹ 100 per kg respectively so as to get a mixture worth ₹ 92 per kg, is:

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

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Solution

By alligation, cheaper : dearer $= (100 - 92) : (92 - 85) = 8 : 7$. **(b)**

2 marks: very short answer

CBSE 2026 · 465/7 (Supplementary) · Q21(a) — 2 marks

In a 10 km race, A, B and C, each running at uniform speed get the gold, silver and bronze medals respectively. If A beats B by 1 km and B beats C by 1 km, then find by how many metres does A beat C.

Solution

When A runs 10 km, B runs 9 km: speed A : B $= 10 : 9 = 100 : 90$.
When B runs 10 km, C runs 9 km: B : C $= 10 : 9 = 90 : 81$.
So A : B : C $= 100 : 90 : 81$: when A runs 10,000 m, C runs $\frac{81}{100} \times 10000 = 8100$ m.
A beats C by $10000 - 8100 =$ **1900 m**.

CBSE 2026 · 465/7 (Supplementary) · Q21(b) — 2 marks

Find: $(486 + 729) \bmod 12$

Solution

$486 + 729 = 1215 = 12 \times 101 + 3$. So $(486 + 729) \bmod 12 = 3$.
(Or: $486 \equiv 6$, $729 \equiv 9 \pmod{12}$; $6 + 9 = 15 \equiv 3$.)

CBSE 2026 · 465 · Q21 — 2 marks

A man in a boat goes 12 km downstream and comes back to the starting point by rowing non-stop in a total time of 3 hours. If the speed of the stream is 3 km/h, find the speed with which the man can row the boat in still water.

Solution

Let the speed be u km/h: $\frac{12}{u+3} + \frac{12}{u-3} = 3 \Rightarrow \frac{24u}{u^2-9} = 3 \Rightarrow u^2 - 8u - 9 = 0 \Rightarrow (u - 9)(u + 1) = 0$.
$u = 9$ km/h.

CBSE 2025 · 465/S (Supplementary) · Q21(a) — 2 marks

Two pipes P and Q together can fill a tank in 10 minutes. If pipe P takes 15 minutes less than Q to fill the tank alone, then find the time taken by pipe Q to fill the tank alone.

Solution

Let Q fill the tank alone in x minutes; then P takes $(x - 15)$ minutes.
$\frac{1}{x} + \frac{1}{x-15} = \frac{1}{10} \Rightarrow 10(2x - 15) = x(x - 15) \Rightarrow x^2 - 35x + 150 = 0 \Rightarrow (x - 30)(x - 5) = 0$.
$x = 5$ is rejected (P's time $5 - 15$ would be negative), so $x = 30$.
Pipe Q alone fills the tank in **30 minutes**.

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CBSE 2025 · 465/S (Supplementary) · Q21(b) — 2 marks

In a 200 m race, A beats B by 35 m or 7 seconds. Find the time taken by A to complete the race.

Solution

B covers the last 35 m in 7 seconds, so B's speed $= \frac{35}{7} = 5$ m/s.
B's time for 200 m $= \frac{200}{5} = 40$ s.
A finishes 7 s earlier: A's time $= 40 - 7 =$ **33 seconds**.

CBSE 2025 · 465 · Q21(a) — 2 marks

The cost of Type I sugar is ₹ 25 per kg and Type II sugar is ₹ 35 per kg. If both Type I sugar and Type II sugar are mixed in the ratio 3:2, find the price per kg of the mixture.

Solution

Mean price $= \frac{3\times25+2\times35}{3+2} = \frac{75+70}{5} =$ ₹ 29 per kg.

CBSE 2025 · 465 · Q21(b) — 2 marks

Pipe A can fill a tank in 1 hour and Pipe B can fill it in $1\frac{1}{2}$ hours. If both the pipes are opened in the empty tank, how much time will they take to fill the tank?

Solution

Part filled per hour: A $= 1$, B $= \frac{2}{3}$; together $= \frac{5}{3}$. Time $= \frac{3}{5}$ h $= 36$ minutes.

CBSE 2025 · 465 · Q22 — 2 marks

A boat goes 3.5 km upstream and then returns. Total time taken is 1 hour and 12 minutes. If the speed of the current is 1 km/h, then find the speed of the boat in still water.

Solution

Let the speed be b km/h. Total time $\frac{3.5}{b-1} + \frac{3.5}{b+1} = \frac{12}{10}$ h.
$\frac{3.5\times2b}{b^2-1} = 1.2 \Rightarrow 7b = 1.2b^2 - 1.2 \Rightarrow 6b^2 - 35b - 6 = 0 \Rightarrow (6b+1)(b-6) = 0.$
$b = 6$ km/h (speed cannot be negative).

CBSE 2025 · 465 · Q23 — 2 marks

A runs $\frac{3}{2}$ times as fast as B. If A gives B a start of 40 m, how far must the winning post from the starting point be, so that A and B reach at the same time?

Solution

Let the race be d m. In the same time A runs d and B runs $d - 40$; distances are in the ratio of speeds:
$\frac{d}{d-40} = \frac{3}{2} \Rightarrow 2d = 3d - 120 \Rightarrow d = 120$ m.

CBSE 2024 · 465/S (Supplementary) · Q21(a) — 2 marks

Evaluate (137 + 995) (mod 12).

Solution

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$137 = 12 \times 11 + 5 \Rightarrow 137 \equiv 5 \pmod{12}$; $995 = 12 \times 82 + 11 \Rightarrow 995 \equiv 11 \pmod{12}$.
$(137 + 995) \bmod 12 = (5 + 11) \bmod 12 = 16 \bmod 12 = 4$.

CBSE 2024 · 465/S (Supplementary) · Q21(b) — 2 marks

Find the unit's digit of 12^{12}.

Solution

The unit's digit is $12^{12} \pmod{10}$.
$12 \equiv 2 \pmod{10} \Rightarrow 12^4 \equiv 2^4 = 16 \equiv 6 \pmod{10}$.
$12^{12} = (12^4)^3 \equiv 6^3 = 216 \equiv 6 \pmod{10}$.
The unit's digit of 12^{12} is **6**.

CBSE 2023 · 465 · Q21(a) — 2 marks

Two pipes A and B can fill a tank in 24 minutes and 32 minutes respectively. If both the pipes are opened simultaneously, after how much time should B be closed so that the tank is full in 18 minutes?

Solution

Let B be closed after n minutes. A works for all 18 minutes and B for n minutes:
$\frac{18}{24} + \frac{n}{32} = 1 \Rightarrow \frac{3}{4} + \frac{n}{32} = 1 \Rightarrow \frac{n}{32} = \frac{1}{4} \Rightarrow n = 8$.
Pipe B must be closed after **8 minutes**.

CBSE 2023 · 465 · Q21(b) — 2 marks

In a one-kilometre race, A beats B by 30 seconds and B beats C by 15 seconds. If A beats C by 180 metres, then find the time taken by A to run 1 kilometre.

Solution

Let A take t seconds for 1 km. Then B takes $t + 30$ s and C takes $t + 30 + 15 = t + 45$ s. So A beats C by 45 seconds, which equals 180 m.
C runs 180 m in 45 s, so C runs 1000 m in $\frac{45}{180} \times 1000 = 250$ s.
$t + 45 = 250 \Rightarrow t = 205$. A takes **205 seconds**.

3 marks: short answer

CBSE 2026 · 465 · Q26(a) — 3 marks

(i) Apply addition modulo to positive integers 17 and 13 for modulo 30.
(ii) Find subtraction modulo 8 for numbers 11 and 3.

Solution

(i) $17 + 13 = 30 = 30 \times 1 + 0$, so $17 +_{30} 13 = 0$.
(ii) $11 - 3 = 8 = 8 \times 1 + 0$, so $11 -_8 3 = 0$.

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CBSE 2026 · 465 · Q26(b) — 3 marks

Three pipes A, B and C can together fill a tank in 8 hours. After working at it together for 2 hours, B is closed and A and C fill the remaining part in 9 hours. Determine the time in which pipe B alone can fill the tank.

Solution

A + B + C fill $\frac{1}{8}$ per hour; in 2 hours $\frac{1}{4}$, leaving $\frac{3}{4}$.
A + C fill $\frac{3}{4}$ in 9 hours: rate $\frac{3/4}{9} = \frac{1}{12}$ per hour.
B alone: $\frac{1}{8} - \frac{1}{12} = \frac{1}{24}$ per hour, so B fills the tank in **24 hours**.

CBSE 2025 · 465 · Q26 — 3 marks

Find the units digit in 7^{295}.

Solution

Units digits of powers of 7: $7^1 \to 7$, $7^2 \to 9$, $7^3 \to 3$, $7^4 \to 1$, then repeat (cycle of 4).
$295 = 4 \times 73 + 3$, so 7^{295} has the same units digit as $7^3 = 343$.
Units digit $= 3$.

CBSE 2024 · 465/S (Supplementary) · Q26(b) — 3 marks

A man goes 12 km downstream and comes back to the starting point by swimming non-stop in 3 hours. If the speed of the stream is 3 km/h, find the speed with which the man can swim in still water.

Solution

Let the man's speed in still water be x km/h. Downstream speed $= (x + 3)$ km/h, upstream speed $= (x - 3)$ km/h.
$\frac{12}{x+3} + \frac{12}{x-3} = 3 \Rightarrow 12(2x) = 3(x^2 - 9) \Rightarrow x^2 - 8x - 9 = 0 \Rightarrow (x - 9)(x + 1) = 0.$
$x = -1$ is rejected, so $x = 9$.
The man can swim in still water at **9 km/h**.

CBSE 2024 · 465 · Q26 — 3 marks

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 $(0.9)^5 = 0.59049$]

Solution

Each operation leaves $\left(1 - \frac{5}{50}\right) = 0.9$ of the juice. After 5 operations: juice $= 50 \times (0.9)^5 = 50 \times 0.59049 = 29.5245$ litres.

CBSE 2023 · 465 · Q26(a) — 3 marks

A bottle is full of dettol. One-third of its dettol is taken away and an equal amount of water is poured into the bottle to fill it again. This operation is repeated three times. Find the final ratio of dettol to water in the bottle.

Solution

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Let the bottle hold x litres. Each operation removes $\frac{1}{3}$ of the content and leaves $\frac{2}{3}$ of the dettol. Dettol left after 3 operations $= x\left(1-\frac{1}{3}\right)^3 = \frac{8x}{27}$. Water $= x - \frac{8x}{27} = \frac{19x}{27}$.
Dettol : water $= 8 : 19$.

CBSE 2023 · 465 · Q26(b) — 3 marks

A pipe A can fill a tank in 3 hours. There are two outlet pipes B and C from the tank which can empty it in 7 and 10 hours respectively. It all the three pipes are opened simultaneously, how long will it take to fill the tank?

Solution

Net part filled per hour $= \frac{1}{3} - \frac{1}{7} - \frac{1}{10} = \frac{70-30-21}{210} = \frac{19}{210}$.
Time $= \frac{210}{19} = 11\frac{1}{19}$ hours.

4 marks: case-based / source-based

CBSE 2026 · 465/7 (Supplementary) · Q37 — 4 marks

Pulses are a good source of protein, vitamins and minerals. Rice is a source of carbohydrate which is the main fuel source for a human body.
A grocer has two varieties A and B of pulses costing ₹ 75 per kg and ₹ 125 per kg respectively. Also, he has two varieties P and Q of rice costing ₹ 74 per kg and ₹ 84 per kg respectively.
Based on the above information, answer the following questions:
(i) If the pulses A and B are mixed in the ratio 2 : 3, then find the cost (per kg) of the resulting mixture. [1]
(ii) In what ratio must the grocer mix the rice P and Q so that he gets a resulting mixture costing ₹ 78 per kg? [1]
(iii)(a) If another variety C of pulses is mixed with pulses A and B such that A : B : C = 2 : 3 : 6 and the cost of the resulting mixture is ₹ 160 per kg, then find the price per kg of C. [2]
OR
(iii)(b) If another variety R of rice is mixed with rice P and Q such that P : Q : R = 3 : 2 : 8 and the cost of the resulting mixture is ₹ 88 per kg, then find the price per kg of R. [2]

Solution

(i) Mean price $= \frac{2\times75+3\times125}{2+3} = \frac{150+375}{5} =$ ₹ 105 per kg.
(ii) By alligation, P : Q $= (84-78) : (78-74) = 6 : 4 = 3 : 2$.
(iii)(a) Let C cost ₹ c per kg: $\frac{2\times75+3\times125+6c}{11} = 160 \Rightarrow 525+6c = 1760 \Rightarrow c = \frac{1235}{6} \approx$ ₹ 205.83 per kg.
OR (iii)(b) Let R cost ₹ r per kg: $\frac{3\times74+2\times84+8r}{13} = 88 \Rightarrow 390+8r = 1144 \Rightarrow r = \frac{754}{8} =$ ₹ 94.25 per kg.

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CBSE 2024 · 465/S (Supplementary) · Q38 — 4 marks

For providing water to the families of a colony, a large water tank with two inlet pipes A and B and an outlet pipe C, is installed. Pipes A and B can fill the tank in 10 hours and 12 hours respectively; whereas pipe C can empty the tank in 15 hours.

Based on the above information, answer the following questions :

(i) If both pipes A and B are opened together, then find the time in which the tank will be filled completely. [1]

(ii) If both pipes A and C are opened together, then find the time in which the tank will be filled completely. [1]

(iii)(a) If all the three pipes A, B and C are opened together, then find the time in which the tank will be filled completely. [2]

OR

(iii)(b) Pipes A and B are opened together for some time and then pipe B is turned off after some time. If the tank is completely filled in 6 hours, then after how many hours is pipe B turned off ? [2]

Solution

(i) Part filled by A and B in 1 hour $= \frac{1}{10} + \frac{1}{12} = \frac{11}{60}$. Time $= \frac{60}{11} = 5\frac{5}{11}$ hours.

(ii) Part filled by A and C in 1 hour $= \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$. Time $= 30$ hours.

(iii)(a) Part filled by A, B and C in 1 hour $= \frac{1}{10} + \frac{1}{12} - \frac{1}{15} = \frac{6+5-4}{60} = \frac{7}{60}$. Time $= \frac{60}{7} = 8\frac{4}{7}$ hours.

OR (iii)(b) Let B be turned off after t hours. A works for all 6 hours and fills $\frac{6}{10}$ of the tank, so B must fill $1 - \frac{6}{10} = \frac{4}{10}$.

$\frac{t}{12} = \frac{4}{10} \Rightarrow t = 4.8$ hours. Pipe B is turned off after 4.8 hours (4 h 48 min).

5 marks: long answer

CBSE 2024 · 465 · Q32 — 5 marks

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?

Solution

Work per hour: A $= \frac{1}{3}$, B $= \frac{1}{4}$, C $= -1$.

5 to 6 a.m. (A alone): $\frac{1}{3}$ filled.

6 to 7 a.m. (A + B): $\frac{1}{3} + \frac{1}{4} = \frac{7}{12}$; total $= \frac{1}{3} + \frac{7}{12} = \frac{11}{12}$.

From 7 a.m. all three: net rate $= \frac{1}{3} + \frac{1}{4} - 1 = -\frac{5}{12}$ per hour (emptying).

Time to empty $\frac{11}{12}$: $\frac{11/12}{5/12} = \frac{11}{5}$ h $= 2$ h 12 min.

The cistern will be empty at **9:12 a.m.**

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CBSE BOARD PAPER

2026 · Q.P. Code 465

Time: 3 hours
Maximum marks: 80

Section A: MCQs and Assertion–Reason (1 mark each)

1. The real x for which $2(2x+3) - 10 < 6(x-2)$ is: 1

(A) $x > 2$ (B) $x > 3$
(C) $x > 4$ (D) $x > -4$

2. The number of all possible matrices of order 3×2 with each entry 1 or 2 is: 1

(A) 6 (B) 16
(C) 24 (D) 64

3. If $AB = A$ and $BA = B$, then $(B^2 + B)$ is equal to: 1

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

4. The value of $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$ is: 1

(A) 5 (B) -7
(C) 9 (D) 0

5. General solution of differential equation $y \log y \, dx - x \, dy = 0$ is: 1

(A) $y = \log |cx|$ (B) $y = e^{|cx|}$
(C) $y = e^{c+x}$ (D) $\log y = |c + x|$

6. If $\int_0^{40} \frac{dx}{2x+1} = \log k$, then the value of k is: 1

(A) 3 (B) 9
(C) $\frac{9}{2}$ (D) $\frac{3}{2}$

7. If $x = t^2$ and $y = t^3$, then $\frac{d^2y}{dx^2}$ is equal to: 1

(A) $\frac{3}{2}$ (B) $\frac{3}{4t}$
(C) $\frac{1}{2t^2}$ (D) $\frac{3}{2t}$

8. The rate of change of the area of a circle with respect to its radius r (in cm²/s), when $r = 6$ cm, is: 1

(A) 10π (B) 12π
(C) 8π (D) 11π

9. Let X be a discrete random variable, then the variance of X is: 1

(A) $E(X^2)$ (B) $E(X^2) - [E(X)]^2$
(C) $E(X^2) + [E(X)]^2$ (D) $\sqrt{E(X^2) - [E(X)]^2}$

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10. If 'm' is the mean of a Poisson distribution, then its variance is given by: 1

(A) m^2 (B) $\sqrt{m}$

(C) m (D) $\frac{m}{2}$

11. The total area under a standard normal curve is: 1

(A) 1 (B) $\sqrt{2}$

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

12. For the purpose of t-test of significance, if a random sample of size 34 is drawn from a normal population, then the degree of freedom (v) is: 1

(A) 32 (B) 33

(C) 34 (D) 35

13. The range of variable t of the t-distribution is: 1

(A) $(0, 1)$ (B) $(1, 2)$

(C) $(-1, 1)$ (D) $(-\infty, \infty)$

14. The present value of a perpetuity of ₹ R payable at the end of each period, when the money is worth i per period is: 1

(A) Ri (B) $R + \frac{R}{i}$

(C) $\frac{R}{i}$ (D) $R - Ri$

15. 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% per annum is: 1

(A) ₹ 700 (B) ₹ 800

(C) ₹ 900 (D) ₹ 100

16. If an investment of ₹ 10,000 becomes ₹ 60,000 in 4 years, then the Compound Annual Growth Rate (CAGR) is: 1

(A) $\frac{\sqrt[4]{6}-1}{100}$ (B) $\frac{\sqrt[4]{6}+1}{100}$

(C) $(\sqrt[4]{6} - 1) \times 100$ (D) $(\sqrt[4]{6} + 1) \times 100$

17. A machine costs ₹ 45,000 with an estimated useful life of 5 years and a scrap value of ₹ 10,000. The annual depreciation of the machine is: 1

(A) ₹ 8,000 (B) ₹ 7,000

(C) ₹ 6,000 (D) ₹ 5,000

18. The maximum value of the function $z = 7x + 5y$, subject to the constraints $x \leq 3$, $y \leq 2$, $x \geq 0$, $y \geq 0$ is: 1

(A) 10 (B) 21

(C) 31 (D) 29

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19. Assertion (A): $\int \frac{1}{\sqrt{9-x^2}}dx = \sin^{-1}\frac{x}{3} + C$ 1

Reason (R): $\int \frac{1}{\sqrt{a^2-x^2}}dx = \sin^{-1}\frac{x}{a} + C$

(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.

20. Assertion (A): In sinking fund, a fixed amount at regular intervals is deposited. 1

Reason (R): In Savings Bank Account, any amount, any time can be deposited.

(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.

Section B: Very short answer (2 marks each)

21. A man in a boat goes 12 km downstream and comes back to the starting point by rowing non-stop in a total time of 3 hours. If the speed of the stream is 3 km/h, find the speed with which the man can row the boat in still water. 2

22. **(a)** Solve the following differential equation: $\frac{dy}{dx} = \frac{2-y}{x+1}$ 2

OR

(b) If $\int_a^b x^3\,dx = 0$ and $\int_a^b x^2\,dx = \frac{2}{3}$, then find the values of 'a' and 'b'. 2

23. **(a)** For a Poisson distribution, if mean $(m) = 1$, then find $P(r = 1)$. 2

OR

(b) Find the mean and standard deviation of the Binomial distribution $B\left(4, \frac{1}{3}\right)$. 2

24. Calculate 3-yearly moving averages for the following data: 2

Years (t)	2013	2014	2015	2016	2017	2018	2019	2020
Variables (x)	3	5	7	10	12	14	15	16

25. A man takes a personal loan of ₹ 2,00,000 at an interest rate of 15% p.a. compounded monthly, to be repaid by equal monthly instalments in 4 years. Calculate the EMI, using reducing balance method. [Given: $(1.0125)^{-48} = 0.55$] 2

Section C: Short answer (3 marks each)

26. **(a)** (i) Apply addition modulo to positive integers 17 and 13 for modulo 30. 3

(ii) Find subtraction modulo 8 for numbers 11 and 3.

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OR

(b) Three pipes A, B and C can together fill a tank in 8 hours. After working at it together for 2 hours, B is closed and A and C fill the remaining part in 9 hours. Determine the time in which pipe B alone can fill the tank. 3

27. Using Cramer's rule, show that the following system of linear equations is consistent and hence solve it: 3

$2x - 3y + 5z = 11$

$3x + 2y - 4z = -5$

$x + y - 2z = -3$

28. **(a)** Find the intervals in $\mathbb{R}$ for which the function $f(x) = x^4 - 2x^2$ is increasing or decreasing. 3

OR

(b) Find: $\int \frac{2x+1}{18 - 4x - x^2} dx$ 3

29. A soap manufacturing company was distributing a particular brand of a soap through a large number of retail shops. Before a heavy advertisement campaign, the mean sales per week per shop was 140 dozen. After the campaign, a sample of 26 shops was taken and mean sales was found to be 147 dozen with standard deviation 16. Can you consider the advertisement campaign effective? [Given $t_{25}(0.05) = 2.06$] 3

30. A company XYZ Ltd. has issued a bond having a face value of ₹ 10,000 paying annual dividend at 8.5% p.a. The bond will be redeemed at par at the end of 10 years. Find the purchase value of this bond, if the investor wishes a yield rate of 8%. [Given: $(1.08)^{-10} = 0.46319349$] 3

31. Solve the following Linnear Programming Problem (LPP) graphically: 3

Maximize $z = 3x + 5y$

subject to the constraints:

$x + 2y \leq 2000$

$x + y \leq 1500$

$y \leq 600$

$x \geq 0, y \geq 0$

Section D: Long answer (5 marks each)

32. Solve the following inequation: $\frac{2x-1}{12} - \frac{x-11}{3} < \frac{3x+1}{4}$, $x \in \mathbb{R}$ 5

33. **(a)** Find the consumer's surplus for the demand function $p = 25 - x - x^2$, where the prevailing market price $p_0 = 19$. 5

OR

(b) Solve the following initial value differential equation: $(x-1)\frac{dy}{dx} = 2xy$, when $y(2) = 1$. 5

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34. **(a)** Two cards are drawn at random and one by one with replacement from a well-shuffled pack of 52 playing cards. Find the probability distribution of the number of aces. Also, find its mean and variance. 5

OR

(b) It is given that 2% of the screws manufactured by a company are defective. Use Poisson distribution to find the probability that a packet of 100 screws contains (i) no defective screw, (ii) one defective screw. 5

35. Mr. Arya wants to know the amount he should pay for a gold mine expected to yield an annual return of ₹ 4 lakh for the next 10 years, after which it will be worthless. Find the amount he should pay for the mine, if he wants to yield 18% annual return on his investment and also set up a sinking fund to replace the purchase price. Assume that the sinking fund earns 10% annually. [Use $(1.1)^{10} = 2.5937$] 5

Section E: Case studies (4 marks each)

36. Three schools A, B and C organised a mela for collecting funds for helping the rehabilitation of flood victims. They sold hand-made fans, mats and plates from recycled material at a cost of ₹ 25, ₹ 50 and ₹ 10 each respectively. The number of articles sold are given below: 4

Articles \ School	A	B	C
Hand-made fans	50	30	35
Mats	60	35	40
Plates	40	50	25

Based on the above information, answer the following questions:
(i) What is the price matrix? [1]
(ii) What is the sales matrix? [1]
(iii)(a) What is the matrix of funds collected by School B? [2]
OR
(iii)(b) What is the total amount of funds collected by Schools A and C? [2]

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37. 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. **4**

Mathematically, for finding a line of best-fit to represent a trend, many methods are available. Methods like moving averages and least squares are some of the techniques to predict such trends.

Mr. Nitin runs a soap-making factory and the record of his sales of soaps for the period 2018 – 2024 is as follows:

Year	2018	2019	2020	2021	2022	2023	2024
Sales (in ₹ thousands)	80	90	92	83	94	99	92

Based on the above information, answer the following questions:

(i) Obtain the trend line to the given data. [1]

(ii) Find the average change in the sales. [1]

(iii)(a) Find the sum of the differences between the actual sales and the trend values (for 2018 – 2024). [2]

OR

(iii)(b) What are the expected sales for the year 2025? [2]

38. A man has ₹ 15,000 for purchasing rice and wheat. A bag of rice and a bag of wheat cost ₹ 1,800 and ₹ 1,200 respectively. He has a storage capacity of 10 bags. He earns a profit of ₹ 100 and ₹ 90 per bag of rice and wheat respectively. Assuming that he can sell all the items that he can buy, he purchases x bags of rice and y bags of wheat. **4**

Based on the above information and by formulation of Linear Programming Problem (LPP), answer the following questions:

(i) Write the objective function which represents the total profit from the sale of total bags of both types. [1]

(ii) Write the constraints that relate the total cost of both types of bags. [1]

(iii)(a) How many bags of each type should the man buy to get maximum profit? [2]

OR

(iii)(b) Find the profit that the man can earn by selling all the bags. [2]

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Q1 $4x + 6 - 10 < 6x - 12 \Rightarrow 4x - 4 < 6x - 12 \Rightarrow 8 < 2x \Rightarrow x > 4$. **(C)**

Q2 6 entries, each with 2 choices: $2^6 = 64$. **(D)**

Q3 $B^2 = (BA)B = B(AB) = BA = B$, so $B^2 + B = 2B$. **(D)**

Q4 $R_3 \to R_3 - R_2$, $R_2 \to R_2 - R_1$ give two equal rows $(3, 3, 3)$, so the determinant is 0. (Directly: $1(45 - 48) - 2(36 - 42) + 3(32 - 35) = -3 + 12 - 9 = 0$.) **(D)**

Q5 Separating: $\frac{dy}{y \log y} = \frac{dx}{x} \Rightarrow \log|\log y| = \log|x| + \log c \Rightarrow \log y = cx \Rightarrow y = e^{cx}$. **(B)**

Q6 $\int_0^{40} \frac{dx}{2x+1} = \frac{1}{2}\left[\log|2x+1|\right]_0^{40} = \frac{1}{2}\log 81 = \log 9$. So $k = 9$. **(B)**

Q7 $\frac{dy}{dx} = \frac{3t^2}{2t} = \frac{3t}{2}$; $\frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{3t}{2}\right) \cdot \frac{dt}{dx} = \frac{3}{2} \cdot \frac{1}{2t} = \frac{3}{4t}$. **(B)**

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Q8 $A = \pi r^2$, $\frac{dA}{dr} = 2\pi r = 12\pi$ cm²/cm. **(B)**

Q9 $\mathrm{Var}(X) = E(X^2) - [E(X)]^2$ ((D) is the standard deviation). **(B)**

Q10 For a Poisson distribution, mean = variance $= m$. **(C)**

Q11 It represents the total probability: 1. **(A)**

Q12 One-sample t-test: $v = n - 1 = 33$. **(B)**

Q13 t can take any real value. **(D)**

Q14 $PV = \frac{R}{i}$ ((B) is a perpetuity due, paid at the beginning). **(C)**

Q15 Interest $= 20000 \times 0.08 \times 2.5 = 4000$; EMI $= \frac{24000}{30} =$ ₹ 800. **(B)**

Q16 $\mathrm{CAGR} = \left[\left(\frac{60000}{10000}\right)^{1/4} - 1\right] \times 100\% = (\sqrt[4]{6} - 1) \times 100\%$. **(C)**

Q17 Linear method: $\frac{45000 - 10000}{5} =$ ₹ 7000. **(B)**

Q18 Corners $(0,0), (3,0), (3,2), (0,2)$: $z = 0, 21, 31, 10$. Maximum 31. **(C)**

Q19 R is the standard formula; with $a = 3$ it gives A. **(A)**
(The CBSE marking scheme awarded the full 1 mark to every candidate who attempted this question.)

Q20 Both statements are true, but R (about savings accounts) does not explain A. **(B)**

Q21 Let the speed be u km/h: $\frac{12}{u+3} + \frac{12}{u-3} = 3 \Rightarrow \frac{24u}{u^2-9} = 3 \Rightarrow u^2 - 8u - 9 = 0 \Rightarrow (u-9)(u+1) = 0$.
$u = 9$ km/h.

Q22(a) Separating: $\frac{dy}{2-y} = \frac{dx}{x+1} \Rightarrow -\log|2-y| = \log|x+1| + \log|C|$
$\Rightarrow \log|(2-y)(x+1)| = -\log|C| \Rightarrow (x+1)(2-y) = k$ (k an arbitrary constant).

Q22(b) $\frac{b^4 - a^4}{4} = 0 \Rightarrow b^4 = a^4 \Rightarrow b = \pm a$. $\frac{b^3 - a^3}{3} = \frac{2}{3} \Rightarrow b^3 - a^3 = 2$.
$b = a$ gives $0 \neq 2$, so $b = -a$: $-2a^3 = 2 \Rightarrow a = -1, b = 1$.

Q23(a) $P(r) = \frac{e^{-m} m^r}{r!}$; $P(1) = \frac{e^{-1} \cdot 1}{1!} = \frac{1}{e}$.

Q23(b) $n = 4, p = \frac{1}{3}, q = \frac{2}{3}$. Mean $= np = \frac{4}{3}$; variance $= npq = \frac{8}{9}$; SD $= \sqrt{\frac{8}{9}} = \frac{2\sqrt{2}}{3}$.

Q24 3-yearly totals: 15, 22, 29, 36, 41, 45 (centred on 2014–2019).

year	2014	2015	2016	2017	2018	2019
MA	5	7.33	9.67	12	13.67	15

Q25 $i = \frac{15}{1200} = 0.0125$, $n = 48$.
$EMI = \frac{P\,i}{1-(1+i)^{-n}} = \frac{200000 \times 0.0125}{1 - 0.55} = \frac{2500}{0.45} =$ ₹ 5,555.56.

Q26(a) (i) $17 + 13 = 30 = 30 \times 1 + 0$, so $17 +_{30} 13 = 0$.
(ii) $11 - 3 = 8 = 8 \times 1 + 0$, so $11 -_8 3 = 0$.

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Q26(b) A + B + C fill $\frac{1}{8}$ per hour; in 2 hours $\frac{1}{4}$, leaving $\frac{3}{4}$.
A + C fill $\frac{3}{4}$ in 9 hours: rate $\frac{3/4}{9} = \frac{1}{12}$ per hour.
B alone: $\frac{1}{8} - \frac{1}{12} = \frac{1}{24}$ per hour, so B fills the tank in **24 hours**.

Q27 $D = \begin{vmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{vmatrix} = 2(0) + 3(-2) + 5(1) = -1 \neq 0$: the system is consistent with a unique solution.

$$D_x = \begin{vmatrix} 11 & -3 & 5 \\ -5 & 2 & -4 \\ -3 & 1 & -2 \end{vmatrix} = 11(0) + 3(10 - 12) + 5(-5 + 6) = -1.$$

$$D_y = \begin{vmatrix} 2 & 11 & 5 \\ 3 & -5 & -4 \\ 1 & -3 & -2 \end{vmatrix} = 2(10 - 12) - 11(-6 + 4) + 5(-9 + 5) = -2.$$

$$D_z = \begin{vmatrix} 2 & -3 & 11 \\ 3 & 2 & -5 \\ 1 & 1 & -3 \end{vmatrix} = 2(-6 + 5) + 3(-9 + 5) + 11(3 - 2) = -3.$$

$x = \frac{D_x}{D} = 1, y = \frac{D_y}{D} = 2, z = \frac{D_z}{D} = 3.$

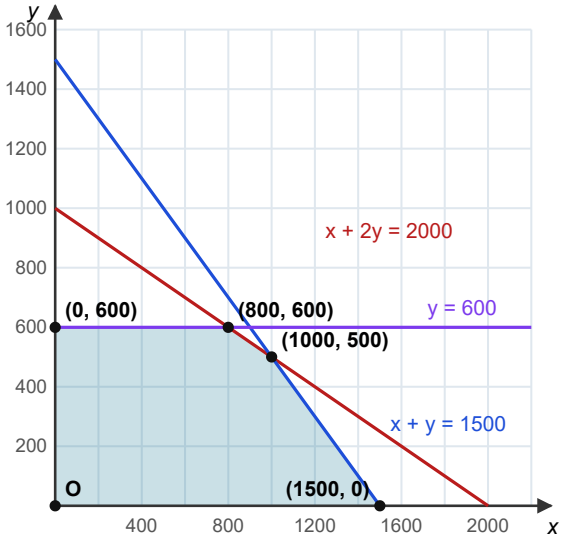
Q28(a) $f'(x) = 4x^3 - 4x = 4x(x-1)(x+1) = 0 \Rightarrow x = -1, 0, 1.$
$(-\infty, -1)$: $f' < 0$; $(-1, 0)$: $f' > 0$; $(0, 1)$: $f' < 0$; $(1, \infty)$: $f' > 0$.
Increasing on $(-1, 0) \cup (1, \infty)$; decreasing on $(-\infty, -1) \cup (0, 1)$.

Q28(b) $\frac{d}{dx}(18 - 4x - x^2) = -(2x + 4)$, so $2x + 1 = -(-4 - 2x) - 3$.
$I = -\int \frac{-4-2x}{18-4x-x^2}dx - 3\int \frac{dx}{22-(x+2)^2}$
$= -\log|18 - 4x - x^2| - \frac{3}{2\sqrt{22}} \log\left|\frac{\sqrt{22}+x+2}{\sqrt{22}-x-2}\right| + C.$

Q29 $H_0 : \mu = 140$ (not effective). $t = \frac{\bar{x}-\mu}{s/\sqrt{n-1}} = \frac{147-140}{16/\sqrt{25}} = \frac{7\times5}{16} = 2.19$, d.f. 25.
$2.19 > 2.06$: H_0 is rejected; the campaign was effective.

Q30 Annual coupon $R = 8.5\%$ of $10000 = ₹\ 850$; $i = 0.08$, $n = 10$, redemption $F = ₹\ 10{,}000$.
$V = R \cdot \frac{1-(1+i)^{-n}}{i} + F(1+i)^{-n} = 850 \times \frac{0.53680651}{0.08} + 10000 \times 0.46319349$
$= 5703.57 + 4631.93 = ₹\ 10{,}335.50.$

Q31



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Corners of the feasible region: $O(0,0)$, $(1500,0)$, $(1000,500)$ [from $x+y=1500$, $x+2y=2000$], $(800,600)$ [from $x+2y=2000$, $y=600$], $(0,600)$.
z: 0, 4500, 5500, 5400, 3000.
Maximum $z=5500$ at $x=1000$, $y=500$.

Q32 Multiply by 12 (positive, sign unchanged): $2x-1-4(x-11)<3(3x+1)$
$\Rightarrow 2x-1-4x+44<9x+3 \Rightarrow -2x+43<9x+3 \Rightarrow 40<11x \Rightarrow x>\frac{40}{11}$.
Solution set: $\left(\frac{40}{11},\infty\right)$.

Q33(a) $25-x-x^2=19 \Rightarrow x^2+x-6=0 \Rightarrow (x+3)(x-2)=0 \Rightarrow x_0=2$.
$CS=\int_0^2(25-x-x^2)dx-p_0x_0=\left[25x-\frac{x^2}{2}-\frac{x^3}{3}\right]_0^2-38=\left(50-2-\frac{8}{3}\right)-38=\frac{22}{3}\approx 7.33$.

Q33(b) $\frac{dy}{y}=\frac{2x}{x-1}dx=\left(2+\frac{2}{x-1}\right)dx$.
$\log|y|=2x+2\log|x-1|+C$. At $x=2$, $y=1$: $0=4+0+C \Rightarrow C=-4$.
$\log y=2x-4+\log(x-1)^2 \Rightarrow y=(x-1)^2e^{2x-4}$.

Q34(a) $p=\frac{4}{52}=\frac{1}{13}$, $q=\frac{12}{13}$, $n=2$.
$P(0)=\left(\frac{12}{13}\right)^2=\frac{144}{169}$; $P(1)=2\cdot\frac{1}{13}\cdot\frac{12}{13}=\frac{24}{169}$; $P(2)=\frac{1}{169}$.
Mean $=\Sigma xP=\frac{24+2}{169}=\frac{2}{13}$; $E(X^2)=\frac{24+4}{169}=\frac{28}{169}$; variance $=\frac{28}{169}-\frac{4}{169}=\frac{24}{169}$ (= npq).

Q34(b) $m=np=100\times 0.02=2$.
(i) $P(0)=e^{-2}\approx 0.1353$. (ii) $P(1)=\frac{e^{-2}2}{1!}=2e^{-2}\approx 0.2707$.

Q35 Let the price be ₹ x. Return needed $=0.18x$; the rest of the annual income, $400000-0.18x$, goes into the sinking fund, which must grow to x in 10 years:
$400000-0.18x=\frac{x\times 0.1}{(1.1)^{10}-1}=\frac{0.1x}{1.5937}=0.062747x$.
$400000=x(0.18+0.062747)=0.242747x \Rightarrow x\approx$ ₹ 16,47,807.
(The marking scheme rounds $\frac{0.1}{1.5937}$ to 0.0627 and gets ₹ 16,48,125.25; full marks were given for any attempt.)

Q36 (i) Price matrix (fans, mats, plates): $P=\begin{bmatrix}25 & 50 & 10\end{bmatrix}$ (a 1×3 row matrix).
(ii) Sales matrix (rows: fans, mats, plates; columns: A, B, C): $S=\begin{bmatrix}50 & 30 & 35\\ 60 & 35 & 40\\ 40 & 50 & 25\end{bmatrix}$.
(iii)(a) Funds of School B = price matrix × B's column of sales:
$$\begin{bmatrix}25 & 50 & 10\end{bmatrix}\begin{bmatrix}30\\35\\50\end{bmatrix}=[25\times 30+50\times 35+10\times 50]=[750+1750+500]=[3000].$$
School B collected ₹ 3,000.
(iii)(b) $PS=\begin{bmatrix}25 & 50 & 10\end{bmatrix}\begin{bmatrix}50 & 30 & 35\\ 60 & 35 & 40\\ 40 & 50 & 25\end{bmatrix}=$
$\begin{bmatrix}1250+3000+400 & 750+1750+500 & 875+2000+250\end{bmatrix}=\begin{bmatrix}4650 & 3000 & 3125\end{bmatrix}$.
Funds of A and C $=4650+3125=$ ₹ 7,775.

Q37 Take the middle year 2021 as origin: $x=\text{year}-2021$.

Year	y	x	x^2	xy
2018	80	-3	9	-240
2019	90	-2	4	-180
2020	92	-1	1	-92
2021	83	0	0	0
2022	94	1	1	94
2023	99	2	4	198
2024	92	3	9	276
Total	630	0	28	56

(i) Since $\Sigma x = 0$: $a = \frac{\Sigma y}{n} = \frac{630}{7} = 90$, $b = \frac{\Sigma xy}{\Sigma x^2} = \frac{56}{28} = 2$. Trend line: $y_c = 90 + 2x$ (origin 2021, x in years, y in ₹ thousand).

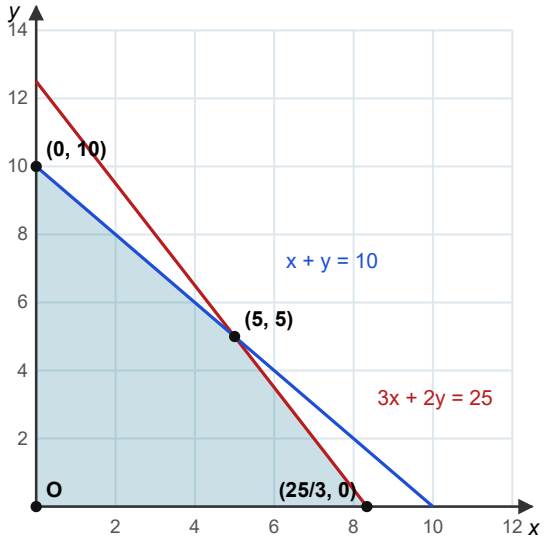
(ii) The average change in sales is $b = 2$, i.e. sales rise by ₹ 2,000 per year on average.

(iii)(a) Trend values: 2018: $90 - 6 = 84$; 2019: 86; 2020: 88; 2021: 90; 2022: 92; 2023: 94; 2024: 96 (total 630).

Differences $y - y_c$: $-4, 4, 4, -7, 2, 5, -4$; their sum $= 0$. (By least squares, $\Sigma(y - y_c) = 0$ always.)

(iii)(b) For 2025, $x = 4$: $y_c = 90 + 2 \times 4 = 98$, i.e. expected sales ₹ 98,000.

Q38



(i) Maximise $Z = 100x + 90y$.

(ii) Cost: $1800x + 1200y \leq 15000$, i.e. $3x + 2y \leq 25$. (The other constraints are storage $x + y \leq 10$ and $x \geq 0, y \geq 0$.)

(iii)(a) Corner points of the feasible region: $O(0, 0)$; $\left(\frac{25}{3}, 0\right)$ on $3x + 2y = 25$; the intersection of $3x + 2y = 25$ and $x + y = 10$: subtracting $2(x + y) = 20$ gives $x = 5$, $y = 5$; and $(0, 10)$.

Corner	$Z = 100x + 90y$
$(0, 0)$	0
$\left(\frac{25}{3}, 0\right)$	833.33
$(5, 5)$	950 (maximum)
$(0, 10)$	900

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He should buy 5 bags of rice and 5 bags of wheat.

(iii)(b) Maximum profit $Z = 100 \times 5 + 90 \times 5 =$ ₹ 950.

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