ISC EXAMINATION PAPER - 2024
ACCOUNTS
Class-12th
(Solved)

Maximum Marks: 80
Time allowed: Three hours

*(Candidates are allowed **additional 15 minutes** for **only** reading the paper. They must **NOT** start during this time)*

This Question Paper contains three sections.
***Section A** is **compulsory** for all candidates.*
*Candidates have to attempt all questions from **Section B***
There are internal choices provided in each section.
The intended marks for questions or parts of questions are given in the brackets [].
All calculations should be shown clearly.
All working, including rough work, should be done on the same page as, and adjacent to, the rest of the answer.

SECTION A (60 MARKS)

*Answer **all** questions*

Question 1

In subparts (i) to (iv), choose the correct option and in subparts (v) to (x) answer the questions as instructed.

(i) On the date of admission of Ajay as a partner, the Balance Sheet of the firm of Nita and Rita showed a balance of ₹ 80,000 in the Workmen Compensation Reserve.

Choose the correct option to record the effect of a workmen compensation claim of ₹ 90,000 on the accounts of the partnership firm. **[1]**

(a) The Revaluation Account to be credited with ₹ 10,000.

(b) The Revaluation Account to be debited with ₹ 10,000.

(c) The Capital Accounts of Nita and Rita to be debited with ₹ 90,000.

(d) The Capital Accounts of Nita and Rita to be credited with ₹ 90,000.

(ii) Credit Access Grameen Ltd., a listed NBFC -- MFI (Micro Finance Institution), is all set to enter the bond market next week to raise upto ₹ 1,000 crore in non-convertible debentures, as it looks to diversify its liability profile.

(Source: Economic Times, 20 August, 2023)

According to the provisions of the Companies Act, 2013, what is the maximum amount of these non-convertible debentures which Credit Access Grameen Ltd. will redeem out of its capital? **[1]**

(a) ₹ 100 crore **(b)** ₹ 150 crore
(c) ₹ 900 crore **(d)** ₹ 1,000 crore

(iii) Choose the correct order in which a partnership firm, at the time of its dissolution, will apply the amount realised from the sale of its assets, including any amount contributed by the partners, towards the payment of:

P Partners' loan
Q Firm's debts
R Balance of partners' capital
S Surplus divided amongst the partners in their profit-sharing ratio **[1]**

(a) P, Q, R, S **(b)** Q, P, S, R
(c) S, P, Q, R **(d)** Q, P, R, S

(iv) Tulip Ltd. allotted 45,000 Equity shares of ₹ 10 each to the public. The first and final call of ₹ 2 per share was not received on 1,000 shares, which were forfeited by the company. Later, 600 of the forfeited shares were reissued at ₹ 7 fully paid up.

What is the Subscribed Capital of the company? **[1]**

(a) ₹ 4,49,200 **(b)** ₹ 4,50,000
(c) ₹ 4,40,000 **(d)** ₹ 4,46,000

(v) **Assertion:** A revaluation account is prepared at the time of dissolution of a partnership.

Reason: A revaluation account is prepared to determine the net gain / loss on realisation of assets and settlement of liabilities. **[1]**

Which one of the following is correct? :

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.

(c) Both Assertion and Reason are false.

(d) Assertion is true but Reason is false.

(vi) A firm having a debtor of ₹ 30,000 from whom the amount was due on 30th June, 2023, gets dissolved on 31st March, 2023. The debtor cleared his dues on the date of dissolution of the firm at a discount of 4% per annum.

Give the journal entry passed by the firm to realise the payment from the debtor. **[1]**

(vii) Xylo Ltd. issued 9,000, 7% Debentures of ₹100 each at a *certain rate of discount*. After writing off the discount on the issue of debentures, the company was left with a balance of ₹ 35,000 in its Securities Premium out of the original amount of ₹ 71,000.

At what rate of discount did the company issue these Debentures? **[1]**

(viii) The Annual Report of ITC Ltd., for the financial year 2021-22, showed Claims against the Company not acknowledged as debts of ₹ 880.58 crores including Third party claims arising from disputes relating to contracts aggregating ₹ 29.22 crores.

(Source: Annual Report of ITC Ltd. 2021-22)

Mention the heading and the sub-heading under which this item would have been shown in the Notes to Accounts accompanying the Balance Sheet of ITC Ltd. as at 31st March, 2022. **[1]**

(ix) Deepa and Pia are in partnership sharing profits and losses in the ratio of 3:2. They admit Charu as a partner for 1/5 share in the profits. The capitals of Deepa and Pia, before adjusting the loss of ₹ 5,000 on revaluation of assets and liabilities, are ₹ 30,000 and ₹ 20,000 respectively.

It is decided that Charu will contribute 25% of the combined capitals of Deepa and Pia.

What is Charu's capital contribution?

(x) The Balance Sheet of Anjum Ltd. as at 31st March, 2022, had outstanding 1,000, 8% Debentures of ₹ 100 each. These debentures were to be redeemed by the company on 31st March, 2023.

Give the journal entry for the amount *due* to the Debenture holders on 31st March, 2023, including the interest on debentures due to them. **[1]**

Question 2

The Balance Sheet of Hari, Jacob and James as at 31st, March, 2023, stood as follows: **[3]**

Balance Sheet of Hari, Jacob and James

As at 31st March, 2023

Liabilities		(₹)	Assets	(₹)
Capital Accounts			Fixed Assets	3,50,000
Hari	3,40,000		Debtors	2,50,000
Jacob	1,90,000		Bank	1,50,000
James	2,20,000	7,50,000		
		7,50,000		**7,50,000**

Jacob died on 30th June, 2023.

His drawings from 1st April, 2023, upto the date of his death amounted to ₹ 1,00,000.

According to the partnership deed, Jacob was:

(a) To be charged with interest on drawings @4% per annum.

(b) Entitled to his share of interim profits for which his capital account was credited with ₹ 1,10,000.

(c) Entitled to his share in the non-purchased goodwill of the firm.

The firm's non-purchased goodwill on the date of Jacob's death had no value.

The final amount due to Jacob by the firm was transferred to his executor's loan account.

You are required to prepare the Interim Balance Sheet of the reconstituted firm as at 30th June, 2023.

OR

Kamal, Ali and John are partners in a firm. On Kamal's retirement from the firm on 30th June, 2023, his capital account stood at 40,000 after all adjustments.

The partners decided that Kamal be paid 50%of the amount due to him immediately and the balance, along with interest @ 6% per annum, be paid on 30th June, 2024.

The firm closes its books on 31st March every year.

You are required to prepare Kamal's Loan Account till it is finally closed. **[3]**

Question 3

On 1st April, 2022, Harbour Ltd. issued 50,000, 6% Debentures of ₹ 100 each to the public at a discount of 5% to be redeemed after three years at a premium of 7%.

On this date, the company also issued 1,00,000 Equity shares of ₹ 10 each at a premium of ₹ 2 per share.

Both the issues were fully subscribed.

You are required to prepare the following accounts for the year 2022-23 in the books of Harbour Ltd.:

Harbour Ltd.:

(i) 6 % Debentures Account.

(ii) Loss on issue of Debentures Account. **[3]**

Question 4

On 1st April, 2022, the following balances appeared in the books of Alpha Pvt. Ltd.

9% Debentures (redeemable on 31 st March, 2023, at a premium of 2%) ₹ 50,00,000

Debenture Redemption Reserve ₹ 5,00,000

The Debenture Redemption Invest 1st April, 2022, was realised at 101% on the date of redemption and the debentures were redeemed on the due date.

You are required to prepare the following accounts for the year 2022-23 in the books of Alpha Pvt. Ltd.

(i) Debenture holders' Account.

(ii) Debenture Redemption Investment Account. **[3]**

OR

On 1st April, 2022, Resorts Ltd. (a listed construction company) had 60,000, 5% Debentures of ₹ 100 each due for redemption at par on 31st March, 2023.

As per the law, investment was made in a fixed deposit of a bank on 30th April, 2022, earning interest @ 5% per annum.

Tax @ 10% was deducted by the bank on the interest.

You are required to pass necessary journal entries in the year of redemption of debentures, including entries for interest on Debenture Redemption Investment. (Ignore the interest on Debentures)

Question 5

On 1st April, 2020, Anish started a business with a capital of ₹ 3,00,000. **[3]**

During the three years ending 31st March, 2023, the results of his business were:

Year		(₹)
2020-21	Loss	20,000
2021-22	Profit	34,000
2022-23	Profit	46,000

From the year 2020-21 to the year 2022-23, Anish withdrew 30,000 from the firm for his personal use.

On 1st April, 2023, he admitted Danish into partnership on the following terms:

(a) Goodwill of the firm to be valued at two years' purchase of the average profits of the last three years.

(b) Danish to have 1/4 share in the future profits.

(c) Danish's capital to be equal to 1/4 of Anish's capital determined on 1st April, 2023, after the goodwill compensation has been taken into account.

You are required to give:

(i) The formula to calculate goodwill by the Average Profit Method.

(ii) The value of self-generated goodwill of the firm.

(iii) Danish's capital contribution.

Question 6

The following balances have been extracted from the books of Meadow Ltd. as at 31st March, 2023. **[6]**

Particulars	**(₹)**	**Particulars**	**(₹)**
Capital Reserve	1,20,000	Bank Overdraft	40,000
Plant and Machinery (at cost)	6,00,000	Bills Receivables	20,000
Land and Building	6,80,000	Patents	80,000
Statement of Profit & Loss (Dr)	1,70,000	Sundry Debtors	90,000
Short-term Loans and Advances	50,000	Provision for Doubtful Debts	10,000
Cash & Bank Balances	1,60,000	Inventories	30,000
Trade Payables	90,000	Share Capital	12,20,000
Accumulated depreciation on Plant and Machinery	1,00,000	5%Debentures (1/5 of the Debentures to be redeemed on 31st March, 2024)	3,00,000

Additional information:

- The company had issued 1,25,000 Equity shares of ₹ 10 each which were all applied for and allotted to the public. These shares were fully called up by the company.
- There were calls-in arrears @ ₹ 2 per share on 15,000 shares out of which 5,000 shares were forfeited by the company.

You are required to:

(i) Show the Share Capital in the Notes to Accounts.

(ii) Give the amount for each of the following:

(a) Short-term borrowings

(b) Current Assets

(c) Property, Plant and Equipment and Intangible Assets

(i) Property, Plant and Equipment

Question 7 **[6]**

Amay and Sujoy are partners sharing profits and losses in the ratio of 3: l. Their Balance Sheet as at 31st March, 2023, is given below.

Balance Sheet of Amay and Sujoy

As at 31st March, 2023

Liabilities		(₹)	Assets		(₹)
Bills Payable		70,000	Land and Building		1,65,000
Capital Accounts:			Stock		60,000
Amay	1,30,000		Sundry Debtors	70,000	
Sujoy	1,25,000	2,55,000	Less: Provision for		
			Doubtful Debts	(10,000)	60,000
			Cash in hand		40,000
		3,25,000			**3,25,000**

On 1st April, 2023, they admit Malay as a new partner for 1/4 share in the profits on the following terms:

(a) Malay to bring his share of capital of ₹ 1,20,000 and to pay ₹ 10,000 in cash for his share of goodwill.

(b) Stock worth ₹ 45,000 to be taken over by Amay at ₹ 25,000.

(c) Bills Payable of ₹ 20,000 to be honoured by Sujoy, for which he is not to be reimbursed.

(d) The capitals of Amay and Sujoy to be adjusted on the basis of Malay's Capital and his share in the profits, any surplus to be readjusted through current account and deficiency through cash.

You are required to prepare the Partners' Capital Accounts.

OR

Mitu and Ritu are partners sharing profits and losses in the ratio of 2:3. An extract of their Balance Sheet as at 31st March, 2023, is given below.

Balance Sheet of Mitu and Ritu (an extract)

As at 31st March, 2023

Liabilities	(₹)	Assets	(₹)
Workmen Compensation Reserve	30,000	Investments	80,000
		(Market Value ₹ 76,000)	
General Reserve	40,000	Sundry Debtors	1,00,000
Investment Fluctuation Reserve	10,000	Profit & Loss A/c	55,000

On 1 April, 2023, they admit Nitu as a new partner for 1/5 share in the profits on the following terms regarding the treatment of the reserves and the accumulated losses:

(a) Accumulated losses, if any, to be written off.

(b) A workmen compensation claim of ₹ 10,000 to be adjusted against the Workmen Compensation Reserve. The balance of the reserve is not to be distributed.

(c) Any loss in the value of investments to be adjusted against the Investment Fluctuation Reserve. The balance of the Investment Fluctuation Reserve is to be distributed.

(d) Provision for doubtful debts to be created to the extent of 10% of the debtors from the General Reserve. The remaining amount in the General Reserve is to be distributed.

You are required to pass necessary journal entries to record the above adjustments at the time of Nitu's admission. **[6]**

Question 8

Adit and Shiv were partners sharing profits and losses in the ratio of 5:4. They dissolved their partnership firm on 31st March 2023, when their Balance Sheet showed the following balances: **[6]**

Particulars	(₹)
Adit's Capital	40,000
Shiv's Capital	30,000
Adit's Current A/c(Cr.)	3,000
Shiv's Current A/c (Dr.)	6,000
Loan by the firm to Shiv	22,000
Profit & Loss Account(Dr.)	4,500

On the date of dissolution of the firm:

(a) The firm suffered a loss of ₹ 18,000 upon realisation of assets and settlement of liabilities.

(b) The expenses of dissolution of ₹ 3,000, to be borne by Shiv, were paid by the firm on his behalf.

(c) The firm had furniture of ₹ 15,000. Adit took over some pieces of the furniture at ₹ 9,000 (being 10% less than the book value). Shiv took over the remaining furniture at 80% of its book value.

You are required to prepare the Partners' Capital Accounts.

Question 9

Tanuj and Ravi are partners in a business with capital balance of ₹ 1,50,000 and ₹ 1,00,000 respectively on 1st April, 2022.

Their partnership deed contains the following clauses:

(a) Interest on capital to be allowed @ 10% per annum.

(b) Interest on drawings to be charged @ 4% per annum.

(c) Tanuj to be allowed a commission @ 5% of the trading profit *after* charging commission.

(d) Ravi to be allowed an annual commission of ₹ 10,000.

Additional information:

During the year 2022-23:

- Tanuj withdrew ₹ 6,000 at the end of every quarter.
- The trading profit of the firm was ₹ 84,000.
- The firm's divisible profit was ₹ 46,360.
- On 1st October, 2022, Ravi permanently withdrew ₹ 20,000 from his capital.

You are required to do the following:

(i) Pass the journal entries to record: **[6]**

(a) The permanent withdrawal made by Ravi.

(b) The distribution of the divisible profits between the partners.

(c) The adjusting entry for commission due to Ravi.

(ii) Calculate the interest on capital allowed to: **[2]**

(a) Tanuj (b) Ravi

(iii) Calculate the commission allowed to Tanuj. **[1]**

(iv) Calculate the interest on drawings charged from Tanuj. **[1]**

OR

Amit and Iqbal are partners in a business. Their partnership deed contained the following clauses:

(a) Interest on drawings to be charged @ 6% per annum.

(b) Amit to get a salary of ₹ 1,000 per month.

(c) Iqbal to get an annual commission of ₹ 10,000.

(d) Any partner taking a loan from the firm to be charged interest on it @ 8% per annum.

Additional Information	Amit (₹)	Iqbal (₹)
Drawings made on 1st May, 2022		30,000
Borrowed from the firm on 1st July, 2022	10,000	
Capital Balances on 31st March, 2023	75,000	10,000 (Dr.)
Divisible profits for the year 2022-23 credited to the Partners' Capital Accounts	9,000	9,000

You are required to:

(i) Give the *closing journal entry* for interest on loan due from Amit. **[1]**

(ii) Find the opening capital balance of the partners on 1st April, 2022, by preparing the Partners' Capital Accounts for the year 2022-23. **[9]**

Question 10 **[10]**

Gama Ltd. issued 20,000 Equity shares of ₹10 each to the public, payable as follows:

₹ 2 on Application

₹ 3 on Allotment (on 1st November, 2022)

₹ 5 on First & Final Call (on 1st March, 2023)

Applications were received for 25,000 shares. The directors of the company accepted applications for 20,000 shares and refunded the application money on the remaining shares.

One shareholder who was allotted 30 shares paid the first and final call with allotment.

Another shareholder did not pay his allotment on 20 shares when due but paid it with the first and final call along with interest on calls-in-arrears.

The directors of the company charged interest on calls-in-arrears at the rate provided in Table F of the Companies Act, 2013. No interest was allowed on calls-in-advance.

You are required to pass journal entries to record the above transactions in the books of Gama Ltd.

OR

(A) Roxy Ltd. issued Equity shares of ₹ 10 each payable as: **[9]**

₹ 4 on Application and Allotment; ₹ 2 on First Call; ₹ 4 on Second and Final Call. Following is an extract of the Journal of Roxy Ltd.

Journal of Roxy Ltd. (An extract)

Date	Particulars		L.F.	Debit (₹)	Credit (₹)
	Share First Call A/c	Dr.		28,000	
	To Share Capital A/c				28,000
	(Being first call due on __??__ Shares @ ₹ 2 each)				
	Bank A/c	Dr.		??	
	Calls in arrears A/c	Dr.		2,000	
	To Share First Call A/c				28,000
	(Being first call received on _??_ shares)				
	Share Capital A/c	Dr.		??	
	To Shares Forfeited A/c				4,000
	To Calls in arrears A/c				??
	(Being __??__shares of ₹ 10 each forfeited for non-payment of first call)				
	Share Second & Final Call A/c	Dr.		52,000	
	To Share Capital A/c				52,000
	(Being second & final call due on __??__ shares @ ₹ 4 each)				
	Bank A/c	Dr.		??	
	Calls in arrears A/c	Dr		10,000	
	To Share Second & Final Call A/c				52,000
	(Being second call received on __??_shares)				
	Share Capital A/c	Dr.		??	
	To Shares Forfeited A/c				??
	To Calls in arrears A/c				10,000
	(Being __??__shares of ₹ 10 each forfeited for non-payment of final call)				
	Bank A/c	Dr.		??	
	Shares Forfeited A/c	Dr.		??	
	To Share Capital A/c				??

	(Being 1,500 forfeited shares, including those on which the first call was not received, reissued @ ₹6 per share fully called up)			
	Share Forfeiture A/c Dr. To Capital Reserve A/c (Being _____??_____)		??	??

You are required to complete the journal entries by filling up the missing information represented by '??', including the number of shares and narration, if any.

(B) Savt Ltd. forfeited 50 shares of ₹100 each issued at a premium of 10%, on which allotment money of ₹ 30 per share (including premium) and first and final call of ₹ 40 per share were not received.

What is the minimum amount per share at which the company can reissue these shares?

SECTION B (20 MARKS)

*Answer **all** questions*

Question 11

In subparts (i) and (ii) choose the correct options and in subparts (iii) to (v) answer the questions as instructed.

(i) What is the difference between Total Assets and Current Liabilities? **[1]**

(a) Total Liabilities **(b)** Shareholders' Funds **(c)** Total Debt **(d)** Capital Employed

(ii) While preparing its Cash Flow Statement, which of the following will be classified by a company as its *Cash Outflow* from Investing Activities? **[1]**

P Investment in Government Securities

Q Investment in bank deposits (having maturity of six months)

R Proceeds from redemption of liquid mutual fund units

S Proceeds from bank deposits with original maturity of less than three months

(a) P and Q **(b)** R and S **(c)** Only P **(d)** Only R

(iii) A company has a Quick Ratio of 1.8 : 1. Mention whether this ratio will improve / reduce / not change after it sells a machine worth ₹ 1,20,000 at a loss of ₹ 30,000. **[1]**

(iv) State whether creditors would prefer lending to a company with a high Debt-Equity Ratio or a low Debt-Equity Ratio. Give a reason. **[1]**

(v) An extract of the Balance Sheet of Nova Ltd. shows: **[1]**

Particulars	31.3.2023	31.3.2022
Share Capital (Equity shares @ ₹ 10 each)	8,00,000	5,00,000
Securities Premium	70,000	1,70,000

During the year 2022-23, the company raised its share capital by issuing bonus shares to the shareholders at the beginning of the year in the ratio of 1:5 (one bonus share was issued for every five equity shares). The balance shares were issued for cash to the public.

How many shares were issued for cash by the company?

Question 12 **[3]**

Following is the Comparative Income Statement of Violet Ltd. for the years ending 31.3.2023 and 31.3.2022.

You are required to present the Comparative Income Statement in its complete form after calculating the missing information represented by "??".

Comparative Income Statement of Violet Ltd.

For the year ending 31.3.2023 and 31.3.2022

Particulars	31.3.2023 (₹)	31.3.2022 (₹)	Absolute change	% Change
Revenue from Operations	??	7,098	364	??
Expenses	8,998	7,931	??	??
Net Profit	??	(833)	(703)	??

Question 13

Based on the following information of Neon Ltd., answer the questions given below in relation to the Cash Flow Statement of the company for the year 2022-23.

Particulars	31.3.2023 (₹)	31.3.2022 (₹)
Provision for Tax	80,000	50,000
7% Debentures	8,00,000	3,00,000
Unclaimed Dividend	6,000	—
Plant & Machinery (at book value)	1,00,000	1,00,000
Land	4,50,000	6,00,000

Note: Dividend proposed in the years 2021-22 and 2022-23 were ₹ 30,000 and ₹ 40,000 respectively.

Additional information:

During the year 2022-23, the company:

(a) Provided ₹ 75,000 for tax.

(b) Issued 7% Debentures at a discount of 5%.

(c) Purchased Plant & Machinery for ₹ 40,000.

(i) What is the amount of tax paid by the company? **[1]**

(ii) Give the reason for the opening book value and closing book value of Plant & Machinery remaining the same, despite the purchase of a machine during the year. **[1]**

(iii) What is the inflow of cash from the issue of 7% Debentures? **[1]**

(iv) Give the company's outflow of cash for dividend paid to the shareholders. **[1]**

(v) State with reason whether Neon Ltd. will consider the *decrease* in the amount of land as an Operating Activity or as an Investing Activity, while preparing its Cash Flow Statement. **[2]**

OR

From the following Balance Sheets of Halogen Ltd., you are required to prepare a Cash Flow Statement (as per AS 3) for the year 2022-23. **[6]**

Balance Sheets of Halogen Ltd.

As at 31st March, 2023 and 31st March, 2022

Particular	Note No.	31.3.2023 (₹)	31.3.2022 (₹)
I **EQUITY AND LIABILITIES**			
1. Shareholders' Funds			
(a) Share Capital		4,50,000	4,00,000
(Equity shares @ ₹ 10 each			
(b) Reserves and Surplus		1,06,000	(20,000)
(Statement of P/L)			
2. Non-Current Liabilities			
Long-term Borrowings		6,00,000	4,00,000
(15% Debentures)			
3. Current Liabilities			
Short-term Provisions		50,000	70,000
(Provision for Tax)			
Total		**12,06,000**	**8,50,000**

II	**ASSETS**			
1.	**Non-Current Assets**			
	Property, Plant & Equipment & Intangible Assets			
	(i) Property, Plant & Equipment	**1.**	4,80,000	7,00,000
2.	**Current Assets**			
	(a) Current Investments		2,56,000	10,000
	(b) Cash & Bank Balances		4,70,000	1,40,000
	(Cash at Bank)			
	TOTAL		**12,06,000**	**8,50,000**

Notes to Accounts:

Particulars	31.3.2023 (₹)	31.3.2022 (₹)
1. Property, Plant & Equipment		
Plant & Machinery	7,42,000	9,00,000
Less: Accumulated Depreciation	(2,62,000)	(2,00,000)

Additional information:

During the year 2022-23, the company:

(a) Issued additional debentures on 1st October, 2022.

(b) Sold Plant & Machinery, the book value of which was ₹ 1,20,000 (accumulated depreciation ₹ 38,000), for ₹ 50,000.

Question 14 **[6]**

Answer any *three* of the following questions.

(i) From the following particulars of Hind Ltd., calculate the preference dividend paid by the company.

Particular	
Net profit before Tax	₹ 20,00,000
Equity Shares of ₹ 10 each (Market Value ₹ 15)	₹ 40,00,000
Tax Rate	30%
Earning per share	₹ 2.75

(ii) Calculate the Current Ratio (up-to two decimal places) of Windlas Biotech Ltd. from the following extract of its Annual Report of 2021-22.

Particular	(₹) (in millions)
Opening Inventory of consumables (raw materials)	264.79
Closing Inventory of consumables (raw materials)	389.85
Opening Inventory of finished goods and work-in-progress	149.82
Closing Inventory of finished goods and work-in-progress	197.24
Current Assets (other than inventory of consumables and of finished goods and work-in-progress)	3,229.23
Current Liabilities	936.52

(Source: Annual Report 2021-22 of Windlas Biotech Ltd.)

(iii) For the year 2022-23, the Return on Investment of Yolo Ltd. was 20%; its Capital Employed being ₹ 50,00,000.

(a) You are required to give the formula used by Yolo Ltd, to calculate the Return on Investment.

(b) You have been provided with two components for calculating Return on Investment. Calculate the missing third component.

(iv) Calculate the Working Capital Turnover Ratio of Moonlight Ltd., (up-to two decimal the places) from the following particulars.

Particular	
Cash	₹ 10,00,000
Short-term Loans and Advances	₹ 3,00,000
Inventory	₹ 2,00,000
Trade Payables	₹ 5,00,000
Cost of Revenue form operations	₹ 12,00,000
Gross Profit on Cost of Revenue from Operations	25%

ANSWERS

SECTION A

1. (i) Option (b) is correct.

***Explanation*:** Following journal entry will be passed:

Workmen Compensation Reserve A/c	Dr.	80,000
Revaluation A/c	Dr.	10,000
To Claim Against Workmen Compensation A/c		9,0000

(ii) Option (d) is correct.

***Explanation*:** As per the SEBI guidelines, A listed NBFC is not needed to create DRR (Debenture Redemption Reserve). It means, it can redeem 100% of its debentures out of capital.

(iii) Option (d) is correct.

(iv) Option (a) is correct.

***Explanation*:** Remaining balance in share forfeiture A/c:

Credit balance of share forfeiture for 1000 shares

$= 1000 \times 8 = ₹\ 8,000$

For 400 (that were not reissued) shares

$= 400 \times 8 = 3,200$

Subscribed capital:

44,600 shares @ ₹ 10 cash =	4,46,000
Add: Share forfeiture A/c =	3,200
	4,49,200

(v) Option (c) is correct.

***Explanation*:** Revaluation A/c is prepared at the time of reconstitution of the partnership which determine the net gain/loss on revaluation of assets and reassessment of liabilities.

(vi) Cash A/c Dr. 29,700

To Realisation A/c 29,700

[Being debtors paid their amount due]

Working Note: Calculation of rebate given to debtors:

$= 30,000 \times \frac{4}{100} \times \frac{3}{12}$

$= ₹\ 300$

Annual amount received from debtors

$= 30,000 - 300$

$= ₹\ 29,700$

(vii) Securities premium amount utilised towards writing off discount on issue of debentures:

$= ₹\ 71,000 - ₹\ 35,000$

$= ₹\ 36,000$

Total value of debentures issued

$= 9,000 \times 100$

$= ₹\ 9,00,000$

Rate of discount on issue of debentures:

$= \frac{36,000 \times 100}{9,00,000}$

$= 4\%$

(viii) This item would have been shown under the major head 'contingent liabilities' in the notes to accounts in the balance sheet of ITC Ltd. as at 31st March 2022.

(ix) Adjusted capital of Deepa

$30,000 - \left(\frac{3}{5} \times 5,000 \text{ [loss on revaluation]}\right)$

$= ₹\ 30,000 - ₹\ 3,000$

$= ₹\ 27,000$

Adjusted capital of Pia

$20,000 - \left(\frac{2}{5} \times 5,000 \text{ [loss on revaluation]}\right)$

$= ₹\ 20,000 - 2,000$

$= ₹\ 18,000$

Total adjusted capital of Deepa and Pia

$= ₹\ 27,000 + 18,000$

$= ₹\ 45,000$

Charu's capital $= 25\%$ of 45,000

$= ₹\ \frac{25}{100} \times 45,000$

$= ₹\ 11,250$

(x)

In the books of Anjum Ltd.

Journal Entries

Date	Particulars		L.F.	Amount Dr. (₹)	Amount Cr. (₹)
	Interest on Debentures A/c	Dr.		8,000	
	To Debenture holders' A/c				8,000
	(Being interest due on debentures for one year)				
	8% Debentures A/c	Dr.		1,00,000	
	To Debenture holders' A/c				1,00,000
	(Being amount due to debentures holders)				

2. Calculation of amount to be transferred to Jacob's executor's A/c:

Dr. **Jacob's Capital A/c** **Cr.**

Particulars	(₹)	Particulars	(₹)
To Drawing A/c	1,00,000	By Balance b/d	1,90,000
To Interest on drawings		By P&L Suspense A/c	1,10,000
$\left[1,00,000 \times \frac{4}{100} \times \frac{3}{12}\right]$	1,000		
To Executor's Loan A/c	1,99,000		
	3,00,000		**3,00,000**

Balance Sheet of Hari and James

Liabilities		(₹)	Assets	(₹)
Capital A/c			Fixed Assets	3,50,000
Hari	3,40,500		Debtors	2,50,000
James	2,20,500	5,61,000	Bank (1,50,000 – 1,00,000)	50,000
Executor's Loan A/c		1,99,000	P&L Suspense A/c	1,10,000
		7,60,000		**7,60,000**

Note: ₹1,000 of interest on drawing have been adjusted to remaining partners' capital A/c

OR

Dr. **Kamal's Capital A/c** **Cr.**

Date	Particulars	Amount Dr. (₹)	Date	Particulars	Amount Cr. (₹)
2024			2023		
March 31	To Balance c/d	20,900	June 30	By Kamal's Capital A/c	20,000
			2024		
			March 31	By Interest A/c $\left[20,000 \times \frac{6}{100} \times \frac{9}{12}\right]$	900
		20,900			20,900
2024			2024		
June 30	To Cash A/c	21,200	Apr. 01	By Balance b/d	20,900
			June 30	By Interest A/c $\left[20,000 \times \frac{6}{100} \times \frac{3}{12}\right]$	300
		21,200			**21,200**

3. (i) Dr. **6% Debentures A/c** **Cr.**

Date	Particulars	Amount Dr. (₹)	Date	Particulars	Amount Cr. (₹)
2023			2022		
March 31	To balance c/d	50,00,000	Apr. 01	By Debentures App. & Allot. A/c	47,50,000
				By Discount on issue of deb. A/c	2,50,000
		50,00,000			**50,00,000**

Dr. **Loss on Issue of Debentures A/c** **Cr.**

Date	Particulars	Amount Dr. (₹)	Date	Particulars	Amount Cr. (₹)
2022			2023		
Apr. 01	To 6% Debentures A/c	2,50,000	March 31	By Securities Premium Reserve A/c	2,00,000
Apr. 01	To Premium on Redemption of Debenture A/c	3,50,000	March 31	By Balance c/d	4,00,000
		6,00,000			**6,00,000**

4. (i) Dr. **Debenture Holders' Account** **Cr.**

Date	Particulars	Amount (₹)	Date	Particulars	Amount (₹)
2023			2023		
March 31	To Bank A/c	51,00,000	March 31	By 9% Debenture A/c	50,00,000
			March 31	By Premium on Redemption of Debenture A/c	1,00,000
		51,00,000			**51,00,000**

Dr. **Debenture Redemption Investment Account** **Cr.**

Date	Particulars	Amount (₹)	Date	Particulars	Amount (₹)
2022			2023		
Apr. 01	To Bank A/c	7,50,000	March 13	By Bank A/c	7,50,000
		7,50,000			**7,50,000**

OR

Date	Particulars		L.F.	Amount Dr. (₹)	Amount Cr.(₹)
2022					
April 30	Debenture Redemption Investment A/c	Dr.		9,00,000	
	To Bank A/c				9,00,000
	(Being investment made as per law)				
2023					
Mar.	Bank A/c	Dr.		9,37,125	
31	TDS deducted on interest A/c	Dr.		4,125	
	To DRI A/c				9,00,000
	To Interest received A/c				41,250
	(Being investment encashed)				

Mar. 31	5% Debentures A/c To Debenture holders' A/c (Being Debenture amount due)	Dr.		60,00,000	60,00,000
Mar. 31	Debenture holders' A/c To Bank A/c (Being debentures redeemed)	Dr.		60,00,000	60,00,000
Mar. 31	Interest received A/c To Statement of P & L (Being int. on DRI transferred to statement of P & L)	Dr.		41,250	41,250

Note: Interest on DRI is for 11 months.

5. (i) Goodwill = Average profit × Number of years' purchases

Here, $$\text{Average profit} = \frac{\text{Total profits}}{\text{No. of years}}$$

(ii) $$\text{Average profit of the firm} = \frac{(20,000) + 34,000 + 46,000}{3}$$

$$= \frac{60,000}{3} = ₹\ 20,000$$

$$\text{Self generated goodwill of the firm} = 20,000 \times 2$$

$$= ₹\ 40,000$$

(iii) Adjusted capital of Anish as at 31st March, 2023:

3,00,000 – 30,000 (drawing) – 20,000 (loss adjusted) + 34,000 (profit adjusted) + 46,000 (profit adjusted)

= 3,30,000

$$\text{Goodwill compensation} = \left(40,000 \times \frac{1}{4}\right)$$

$$= 10,000$$

Anish's capital after the goodwill compensation has been taken into account

$$= 3,30,000 + 10,000$$

$$= ₹\ 3,40,000$$

$$\text{So, Danish's capital} = \frac{1}{4} \text{ of } 3,40,000$$

$$= ₹\ 85,000$$

6. (i) **In the books of Meadow Ltd.**

An Extract of Notes to Accounts

Particulars	Amount	Amount
Share Capital:		
Authorised Capital:		
..... Shares of ₹ ..... each		
Issued Capital:		
1,25,000 equity shares @ ₹ 10 each	12,50,000	
Subscribed Capital:		

Subscribed and fully paid up		
1,10,000 equity shares @ ₹ 10 each	11,00,000	
Subscribed and fully paid up		
10,000 equity shares @ ₹ 10 each	1,00,000	
Less: Calls in Arrears (10,000 × 2) (20,000)	80,000	
Add: Share forfeiture A/c (5,000 × 8)	40,000	
	12,20,000	

(ii) (a) Amount of Short - term borrowings = Bank overdraft + Mature Debenture = 40,000 + 60,000 = 1,00,000

(b) Current Assets = Short-term loans and advances + Cash and bank balances + Bills Receivables – Provision for bad debts + Sundry Debtors + Inventories

= 50, 000 + 1,60,000 + 20,000 + 90,000 – 10,000 – 30,000

= ₹ 3,40,000

(c) Property, Plant and Equipment:

Plant and Machinery	6,00,000
(–) Accumlated Depreciation	(1,00,000)
	5,00,000
Land and Building	6,80,000
	11,80,000

7. Dr. **Revalution A/c** **Cr.**

Particulars	Amount (₹)	Particulars	Amount (₹)
To Stock A/c	20,000	By Bills Payable A/c	20,000
	20,000		**20,000**

Dr. **Partners' Capital A/c** **Cr.**

Particulars	Amay	Sujoy	Malay	Particulars	Amay	Sujoy	Malay
To Stock A/c	25,000			By Balance b/d	1,30,000	1,25,000	
To Sujoy's current A/c		37,500		By Cash A/c			1,20,000
				By Premium for Goodwill A/c	7,500	2,500	
To balance c/d	2,70,000	90,000	1,20,000	By Cash A/c	1,57,500		
	2,95,000	**1,27,500**	**1,95,000**		**2,95,000**	**1,27,500**	**1,20,000**

Working Note:

Malay's capital of 1,20,000 is for 1/4 share

So, Total capital of the firm = 1,20,000 × 4 = ₹ 4,80,000

$$\text{Amay's new profit share} = \frac{3}{4}\times\frac{3}{4}=\frac{9}{16}$$

$$\text{Sujoy's new profit share} = \frac{3}{4}\times\frac{1}{4}=\frac{3}{16}$$

Malay's share $= \frac{1}{4} \times \frac{4}{4} = \frac{4}{16}$

Amay's new Capital in the firm $= \frac{9}{16} \times 4,80,000$

$= ₹\ 2,70,000$

Sujoy's new Capital of the firm $= \frac{3}{16} \times 4,80,000$

$= ₹\ 90,000$

Amay's adjusted capital $= ₹\ 1,30,000 + ₹\ 7,500 - 25,000$

$= ₹\ 1,12,500$

Amount to be brought in by in cash $= ₹\ 2,70,000 - 1,12,500$

$= ₹\ 1,57,500$

Sujoy's adjusted capital $= ₹\ 1,25,000 + 2,500$

$= ₹\ 1,27,500$

Amount to be credited to his current A/c $= 1,27,500 - 90,000 = ₹\ 37,500$

OR

In the books of the firm

Journal Entries

Date	Particulars		L.F.	Amount (Dr.) (₹)	Amount (Cr.) (₹)
	Mitu's Capital A/c	Dr.		22,000	
	Ritu's Capital A/c	Dr.		33,000	
	To P & L A/c				55,000
	(Being accumulated loss written off)				
	Workmen's Compensation Reserve A/c	Dr.		10,000	
	To Claim on Workmen Compensation A/c				10,000
	(Being claim on WCR admitted)				
	Nitu's Current A/c	Dr.		4,000	
	To Mitu's Capital A/c				1,600
	To Ritu's Capital A/c				2,400
	(Being WCR adjusted as not to be distributed)				
	Investment Fluctuation Reserve A/c	Dr.		10,000	
	To Investment A/c				4,000
	To Mitu's Capital A/c				2,400
	To Ritu's Capital A/c				3,600
	(Being Investment Fluctuation reserve adjusted)				
	General Reserve A/c	Dr.		40,000	
	To Provision for bad debts				10,000
	To Mitu's Capital A/c				12,000
	To Ritu's Capital A/c				18,000
	(Being General Reserve adjusted)				

8. Dr. **Partners' Capital A/c** **Cr.**

Particulars	Adit	Shiv	Particulars	Adit	Shiv
To Realisation A/c (Loss)	10,000	8,000	By Balance b/d	40,000	30,000
To Bank A/c (Realisation exp. paid)		3,000	By Adit's A/c	3,000	
To Realisation A/c (Asset taken)	9,000	4,000	By Bank A/c		15,000
To Loan to Shiv		22,000			
To P&L A/c	2,500	2,000			
To Shiv's Current A/c		6,000			
To Bank A/c	21,500				
	43,000	**45,000**		**43,000**	**45,000**

9. (i) **In the books of Tanuj and Ravi**

Journal Entries

Date	Particulars		L.F.	Amount (Dr.) (₹)	Amount (Cr.) (₹)
	Ravi' Capital A/c	Dr.		20,000	
	To Bank A/c				20,000
	(Being capital withdrawn by Ravi)				
	Profit & Ravi's Commission Loss Appropriation A/c	Dr.		46,360	
	To Tanuj's Capital A/c				23,180
	To Ravi's Capital A/c				23,180
	(Being divisible profit distributed)				
	Ravi's Commission A/c	Dr.		10,000	
	To Ravi's Capital A/c				10,000
	(Being commission allowed)				

(ii) Calculation of interest on capital allowed to:

(a) $$\text{Tanuj} = 1,50,000 \times \frac{10}{100} = ₹\ 15,000$$

(b) $$\text{Ravi} = 1,00,000 \times \frac{10}{100} \times \frac{6}{12} + 80,000 \times \frac{10}{100} \times \frac{6}{12}$$

$$= ₹\ 5,000 + ₹\ 4,000$$

$$= ₹\ 9,000$$

(iii) Commission allowed to Tanuj:

$$\text{Trading profit} = 84,000$$

$$\text{Commission to Tanuj} = 84,000 \times \frac{5}{105}$$

$$= ₹\ 4,000$$

(iv) Interest on Tanuj's drawings:

$$\text{Average Period} = \frac{9 \text{ months} + 0 \text{ months}}{2} = 4.5 \text{ months}$$

$$\text{Interest on drawings} = (6{,}000 \times 4) \times \frac{4}{100} \times \frac{4.5}{12}$$

$$= 24{,}000 \times \frac{4}{100} \times \frac{4.5}{12}$$

$$= ₹\ 360$$

OR

(i) Interest on Amit's Loan A/c Dr. 600

To Profit & Loss A/c 600

(Being interest on partner's loan account closed)

Note: $\text{Interest on Amit's loan} = 10{,}000 \times \frac{8}{100} \times \frac{9}{12}$

$= ₹\ 600$

(ii) Dr. Partners' Capital A/c Cr.

Particulars	Amit	Iqbal	Particulars	Amit	Iqbal
To Drawings A/c		30,000	By Balance b/d	54,600	2,650
To Interest on Drawings A/c		1,650	By Salary A/c	12,000	
To Interest on Amit's Loan A/c	600		By Commission A/c		10,000
To Balance c/d	75,000		By P & L Appropriation A/c	9,000	9,000
			By Balance c/d		10,000
	75,600	**31,650**		**75,600**	**31,650**

Hence, Opening Capital of : Amit = ₹ 54,600

Iqbal = ₹ 2,650

10. In the books of Gama Limited

Journal Entries

Date	Particulars		L.F.	Debit (₹)	Credit (₹)
	Bank A/c	Dr.		50,000	
	To Equity Share Application A/c				50,000
	(Being application money received)				
	Equity Share Application A/c	Dr.		50,000	
	To Equity Share Capital A/c				40,000
	To Bank A/c				10,000
	(Being application money adjusted)				
2022	Equity Share Allotment A/c	Dr.		60,000	
Nov 01	To Equity Share Capital A/c				60,000
	(Being allotment money due)				
	Bank A/c	Dr.		60090	
	Calls in Arrears A/c	Dr.		60	
	To Equity Share Allotment A/c				60,000

	To Calls in Advance				150
	(Being allotment money received)				
2023	Equity Share First and Final Call A/c	Dr.		1,00,000	
Mar. 01	To Equity Share Capital A/c				1,00,000
	(Being First and Final call due)				
	Bank A/c	Dr.		99,910	
	To Equity Share First & Final Call A/c				99,850
	To Calls in Arrears A/c				60
	(Being call money received)				
	Sundry Members A/c	Dr.		02	
	To Interest on Calls in Arrears A/c $\left[60 \times \frac{10}{100} \times \frac{4}{12}\right]$				02
	(Being interest due on arrears)				
	Bank A/c	Dr.		02	
	To Sundry Members A/c				02
	(Being interest received)				
	Interest on Calls in Arrears A/c	Dr.		02	
	To Statement of P&L				02
	(Being interest transferred to Statement of P&L				

OR

Journal of Roxy Ltd.

Date	Particulars		L.F.	Debit (₹)	Credit (₹)
	Share First Call A/c	Dr.		28,000	
	To Share Capital A/c				28,000
	(Being first call due on 14,000 Shares @ ₹ 2 each)				
	Bank A/c	Dr.		26,000	
	Calls in Arrears A/c	Dr.		2,000	
	To Share First Call A/c				28,000
	(Being first call received on 13,000 shares)				
	Share Capital A/c	Dr.		6,000	
	To Shares Forfeited A/c				4,000
	To Calls in arrears A/c				2,000
	(Being 1,000 shares of ₹ 10 each forfeited for non-payment of first call)				
	Share Second & Final Call A/c	Dr.		52,000	
	To Share Capital A/c				52,000
	(Being second & final call due on 13,000 shares @ ₹ 4 each)				

Bank A/c	Dr.		42,000	
Calls in Arrears A/c	Dr.		10,000	
To Share Second & Final Call A/c				52,000
(Being second call received on 10,500 shares)				
Share Capital A/c	Dr.		25,000	
To Shares Forfeited A/c				15,000
To Calls in Arrears A/c				10,000
(Being 2,500 shares of ₹ 10 each forfeited for non-payment of final call)				
Bank A/c	Dr.		9,000	
Shares Forfeited A/c	Dr.		6,000	
To Share Capital A/c				15,000
(Being 1,500 forfeited shares, including those on which the first call was not received, reissued @ ₹6 per share fully called up)				
Share Forfeiture A/c	Dr.		1,000	
To Capital Reserve A/c				1,000
(Being profit on re-issue of shares transferred to capital reserve)				

(B) The maximum discount allowed on reissue of shares is equal to amount of forfeiture. Here balance available in Share Forfeiture A/c = 50 × 40 = ₹ 2000.

Minimum amount at which these shares can be reissued = ₹ 5,000 – ₹ 2,000 = ₹ 3,000

$$\text{Minimum amount per share} = \frac{₹\,3,000}{50} = ₹\ 60 \text{ per share}$$

SECTION B

11. (i) Option (d) is correct.

***Explanation*:** Capital employed refers to the total amount of capital invested in the business, which includes both equity and debt.

(ii) Option (a) is correct.

***Explanation*:** R is a cash inflow while for S, maturity is less than three months, so it is cash and cash equivalents.

(iii) $$\text{Quick Ratio} = \frac{\text{Liquid Assets}}{\text{Current Liabilities}}$$

Here, machine is being sold out which is not a liquid asset and ₹ 90,000 of its proceeds will increase cash (liquid asset).

Hence, ratio will improve.

(iv) Creditors world prefer lending to a company with low debt equity ratio because a lower debt-equity ratio indicates that the company relies less on debt financing and has a stronger equity position.

(v) Total proceed from the issue of shares = ₹ 8,00,000 – ₹ 5,00,000 = ₹ 3,00,000

$$\text{Proceed from the issue of bonus shares} = \frac{5,00,000}{5} = ₹\ 1,00,000$$

Proceed from the issue of equity shares for cash = ₹ 3,00,000 – ₹ 1,00,000 = ₹ 2,00,000

$$\text{Number of shares issued for cash} = \frac{2,00,000}{10} = 20,000$$

12. **Comparative Income Statement of Violet Ltd.**

For the year ending 31.3.2023 and 31.3.2022

Particulars	31.3.2023 (₹)	31.3.2022 (₹)	Absolute change (₹)	% Change
Revenue from Operations	7,462	7,098	364	5.13
Expenses	8,99,8	7,931	1,067	13.45
Net Profit	(1,536)	(833)	(703)	(84.39)

13. (i) Dr. **Provision for Tax A/c** **Cr.**

Particulars	Amount (₹)	Particulars	Amount (₹)
To Bank A/c (Tax paid Bal. fig.)	45,000	By Balance b/d	50,000
To Balance c/d	80,000	By Profit & Loss A/c	75,000
	1,25,000		**1,25,000**

Hence, Tax Paid by the company = ₹45,000.

(ii) Depreciation of ₹ 40,000

Dr. **Plant & Machinery A/c** **Cr.**

Particulars	Amount (₹)	Particulars	Amount (₹)
To Balance b/d	1,00,000	By Depreciation A/c	40,000
To Cash A/c (Purchase)	40,000	By Balance c/d	1,00,000
	1,40,000		**1,40,000**

(iii) Proceeds from issue of 7% Debentures = 95% of ₹ 5,00,000

$$= 5,00,000 \times \frac{95}{100}$$

= ₹ 4,75,000

(iv) Proposed dividend of previous year is taken into account which is ₹ 30,000 (out of which ₹ 6000 are still unclaimed)

Hence, outflow of cash for dividend paid = ₹ 30,000 – ₹ 6,000 = ₹ 24,000

(v) Company will consider it is an investing activity because land is a non-current assets which does not form due normal course of business operations. It is just like an investment for the company and investment in long term assets fall under the category of investing activities.

OR

Cash Flow Statement

for the year ended 31st March, 2023

Particulars	Amount (₹)	Amount (₹)
(A) Cash flows from Operating Activities		
Net profit before tax (Note No. 4)	1,76,000	
Add: Depreciation on fixed assets	1,00,000	
Loss on sale of plant and machinery	32,000	
Interest paid on debentures	75,000	

	-	
Operating profit before working capital changes	3,83,000	
Add/Loss change in working capital	-	
	3,83,000	
Less: Tax paid for 2022	(70,000)	
Net cash from Operating Activities	3,13,000	3,13,000
(B) Cash flows from Investing Activities		
Sale of Plant and Machinery (50,000 + 38,000)	88,000	
Net cash flow from Investing Activities	88,000	88,000
(C) Cash flow from Financing Activities		
Proceeds from issue of share capitals	50,000	
Proceeds from issue of debentures	2,00,000	
Interest paid on debentures	(75,000)	
Net cash from financing Activities	1,75,000	1,75,000
Net increase in cash and cash equivalents		5,76,000
Add: Cash and cash equivalents in the beginning		
(10,000 + 1,40,000)		1,50,000
Cash and cash equivalents at the end (2,56,000 + 4,70,000)		7,26,000

Note: 1

Dr. **Accumulated Depreciation A/c** **Cr.**

Particulars	(₹)	Particulars	(₹)
To Fixed Asset (transfer to fixed Assets)	38,000	By Balance b/d	2,00,000
To Balance c/d	2,62,000	By Depreciation A/c (bal. fig.)	1,00,000
	3,00,000		**3,00,000**

Note: 2

Dr. **Plant and Machinery A/c** **Cr.**

Particulars	(₹)	Particulars	(₹)
To Balance b/d	9,00,000	By Bank A/c (Sale)	50,000
		By Accumulated Dep. A/c	38,000
		By Loss on Sale	32,000
		By Bank A/c (Additional ma. sale)	38,000
		By Balance c/d	7,42,000
	9,00,000		**9,00,000**

Note-: 3 Calculation of interest on debentures

$$= 4,00,000 \times \frac{15}{100} + 2,00,000 \times \frac{15}{100} \times \frac{6}{12}$$

$= 60,000 + 15,000$

$= ₹\ 75,000$

Note 4 : Calculation of Net Profit before Tax:

P & L balance on 31st March 2023	1,06,000
Less: P & L balance on 31st March 2022	(20,000)
	1,26,000
Add: Provision for taxation for 2023	50,000
Net profit before tax	1,76,000

14. (i) Tax = ₹ 20,00,000 × 30% = ₹ 6,00,000

Net profit after tax = ₹ 20,00,000 – ₹ 6,00,000 = ₹ 14,00,000

$$\text{Number of equity shares} = \frac{40,00,000}{10} = 4,00,000$$

$$\text{EPS} = \frac{\text{Net profit after Tax and Preference Dividend}}{\text{Number of Equity Shares}}$$

$$2.75 = \frac{\text{Net profit after Tax and Preference Dividend}}{4,00,000}$$

Net profit after Tax and Preference Dividend = 4,00,000 × 2.75 = ₹ 11,00,000

Preference Dividend = ₹ 14,00,000 – ₹ 11,00,000 = ₹ 3,00,000

(ii) Current Assets = Inventories (at the end including raw-material, finished goods and work in progress) + Other Current Assets

$$\text{Current Assets} = (389.85 + 197.24) + 3229.23$$

$$= 587.09 + 3229.23$$

$$= ₹\ 3816.32$$

$$\text{Current Liabilities} = 936.52$$

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

$$= \frac{3816.32}{936.52}$$

$$= 4.08 : 1$$

(iii) (a) $$\text{Return on Investment} = \frac{\text{Net Profit Before Interest Tax and Dividend}}{\text{Capital Employed}} \times 100$$

(b) The missing third component is Net Profit Before Interest Tax and Dividend

$$20 = \frac{\text{Net Profit Before Interest Tax and Dividend}}{50,00,000} \times 100$$

$$\text{Net profit before int. tax and divided} = 50,00,000 \times \frac{20}{100}$$

$$= ₹\ 10,00,000$$

(iv) $$\text{Working Capital Turnover ratio} = \frac{\text{Revenue from Operations (Net sales)}}{\text{Working Capital}}$$

Note: Revenue from Operation = Cost of Revenue from operations + Gross profit.

= 12,00,000 + 25% of 12,00,000

= 12,00,000 + 3,00,000

= ₹ 15,00,000

Working capital = Current Assets – Current liabilities

Here, Current Assets = Cash + Inventory + Short term loans and advances

= 10,00,000 + 2,00,000 + 3,00,000

= ₹ 15,00,000

Current Liabilities = ₹ 5,00,000

Working capital = 15,00,000 – 5,00,000

= ₹ 10,00,000

$$\text{Working Capital Turnover Ratio} = \frac{15,00,000}{10,00,000} = 1.5 \text{ times}$$

■■

ISC EXAMINATION PAPER - 2024
MATHEMATICS
Class-12th
(Solved)

Maximum Marks: 80
Time allowed: Three hours

*(Candidates are allowed **additional 15 minutes** for **only** reading the paper. They must **NOT** start during this time)*

This Question Paper consists of three sections A, B and C.
*Candidates are required to attempt all questions from **Section A** and all questions **EITHER** from **Section B OR Section C**.*
Section A:** Internal choice has been provided in two questions of two marks each, **two questions of four marks each and two questions of six marks each.
Section B:** Internal choice has been provided in **one question of two marks and one question of four marks.
Section C:** Internal choice has been provided in **one question of two marks and one question of four marks.
All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [].
Mathematical tables and graph papers are provided

SECTION A - 65 MARKS

Question 1

In subparts (i) to (x) choose the correct options and in subparts (xi) to (xv), answer the questions as instructed.

(i) Let L be a set of all straight lines in a plane. The relation R on L defined as 'perpendicular to' is: **[1]**

(a) Symmetric and Transitive
(b) Transitive
(c) Symmetric
(d) Equivalence

(ii) The order and the degree of differential equation $1+\left(\frac{dy}{dx}\right)^2=\frac{d^2y}{dx^2}$ are: **[1]**

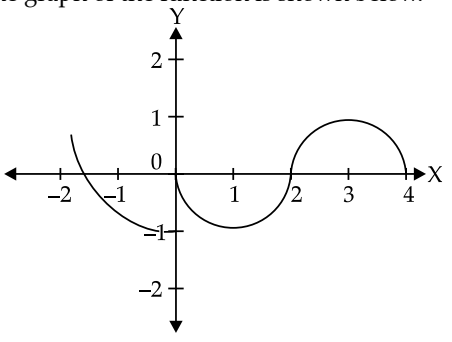
(a) 2 and $\frac{3}{2}$ **(b)** 2 and 3

(c) 3 and 4 **(d)** 2 and 1

(iii) Let A be a non-empty set.
Statement 1: Identity relation on A is Reflexive.
Statement 2: Every Reflexive relation on A is an Identity relation. **[1]**

(a) Both the statements are true.
(b) Both the statements are false.
(c) Statement 1 is true and Statement 2 is false.
(d) Statement 1 is false and Statement 2 is true.

(iv) The graph of the function is shown below. **[1]**



Of the following options, at what values of x is the function / NOT differentiable?

(a) At $x = 0$ and $x = 2$
(b) At $x = 1$ and $x = 3$
(c) At $x = -1$ and $x = 1$
(d) At $x = -1.5$ and $x = 1.5$

(v) The value of $\text{cosec}\left(\sin^{-1}\left(\frac{-1}{2}\right)\right)-\sec\left(\cos^{-1}\left(\frac{-1}{2}\right)\right)$ is equal to: **[1]**

(a) -4 **(b)** 0
(c) -1 **(d)** 4

(vi) The value of $\int_1^{\sqrt{3}}\frac{dx}{1+x^2}$ is: **[1]**

(a) $\frac{\pi}{2}$ **(b)** $\frac{2\pi}{3}$

(c) $\frac{\pi}{6}$ **(d)** $\frac{\pi}{12}$

(vii) **Assertion:** Let the matrices $A=\begin{pmatrix}-3 & 2\\ -5 & 4\end{pmatrix}$ and $B=\begin{pmatrix}4 & -2\\ 5 & -3\end{pmatrix}$ be such that $A^{100}B = BA^{100}$

Reason: $AB = BA$ implies $A^nB = BA^n$ for all positive integers n. **[1]**

(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(c) Assertion is true and Reason is false.
(d) Assertion is false and Reason is true.

(viii) If $\int(\cot x - \text{cosec}^2 x)e^x dx = e^x f(x) + c$ then $f(x)$ will be: **[1]**

(a) $\cot x + \text{cosec}\, x$ **(b)** $\cot^2 x$

(c) $\cot x$ **(d)** $\text{cosec}\, x$

(ix) In which one of the following intervals is the function $f(x) = x^3 - 12x$ increasing? **[1]**

(a) $(-2, 2)$ **(b)** $(-\infty, -2) \cup (2, \infty)$

(c) $(-2, \infty)$ **(d)** $(-\infty, 2)$

(x) If A and B are symmetric matrices of the same order, then AB – BA is: **[1]**

(a) Skew-symmetric matrix

(b) Symmetric matrix

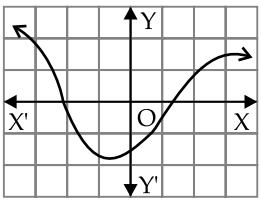
(c) Diagonal matrix

(d) Identity matrix

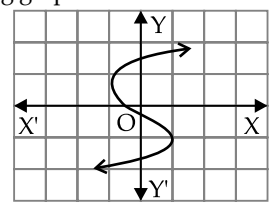
(xi) Find the derivative of $y = \log x + \dfrac{1}{x}$ with respect to x. **[1]**

(xii) Teena is practising for an upcoming Rifle Shooting tournament. The probability of her shooting the target in the 1st, 2nd, 3rd and 4th shots are 0.4, 0.3, 0.2 and 0.1 respectively. Find the probability of at least one shot of Teena hitting the target. **[1]**

(xiii) Which one of the following graphs is a function of x?



Graph A



Graph B

[1]

(xiv) Evaluate: $\int_0^6 |x+3|\,dx$ **[1]**

(xv) Given that $\dfrac{1}{y} + \dfrac{1}{x} = \dfrac{1}{12}$ and y decreases at a rate of 1 cms^{-1}, find the rate of change of x when $x = 5$ cm and $y = 1$ cm

Question 2 **[2]**

(i) Let $f : \text{R} - \left\{\dfrac{-1}{3}\right\} \to \text{R} - \{0\}$ be defined as $f(x) = \dfrac{5}{3x+1}$ is invertible. Find $f^{-1}(x)$

OR

(ii) If $f : R \to R$ is defined by $f(x) = \dfrac{2x-7}{4}$, show that $f(x)$ is one - one and onto.

Question 3 **[2]**

Find the value of the determinant given below, without expanding it at any stage.

$$\begin{vmatrix} \beta\gamma & 1 & \alpha(\beta+\gamma) \\ \gamma\alpha & 1 & \beta(\gamma+\alpha) \\ \alpha\beta & 1 & \gamma(\alpha+\beta) \end{vmatrix}$$

Question 4 **[2]**

(i) Determine the value of k for which the following function is continuous at $x = 3$.

$$f(x) = \begin{cases} \dfrac{(x+3)^2 - 36}{x-3} & ; \quad x \neq 3 \\ k & ; \quad x = 3 \end{cases}$$

OR

(ii) Find a point on the curve $y = (x-2)^2$ at which the tangent is parallel to the line joining the chord through the points (2, 0) and (4, 4).

Question 5 **[2]**

Evaluate: $\int_0^{2\pi} \dfrac{1}{1+e^{\sin x}}\,dx$

Question 6 **[2]**

Evaluate: $P(A \cup B)$ if $2P(A) = P(B) = \dfrac{5}{13}$ and $P(A|B) = \dfrac{2}{5}$

Question 7 **[4]**

If $y = 3\cos(\log x) + 4\sin(\log x)$, show that

$$x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$$

Question 8 **[4]**

(i) Solve for x : $\sin^{-1}\left(\dfrac{x}{2}\right) + \cos^{-1} x = \dfrac{\pi}{6}$

OR

(ii) If $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = \pi$, show that $x^2 - y^2 - z^2 + 2yz\sqrt{1-x^2} = 0$

Question 9 **[4]**

(i) Evaluate: $\int x^2 \cos x\, dx$

OR

(ii) Evaluate: $\int \dfrac{x+7}{x^2+4x+7}\,dx$

Question 10 **[4]**

A jewellery seller has precious gems in white and red colour which he has put in three boxes. The distribution of these gems is shown in the table given below:

Box	Number of Gems	
	White	Red
I	1	2
II	2	3
III	3	1

He wants to gift two gems to his mother. So, he asks her to select one box at random and pick out any two gems one after the other without replacement from the selected box. The mother selects one white and one red gem.

Calculate the probability that the gems drawn are from Box II.

Question 11 **[6]**

A furniture factory uses three types of wood namely, teakwood, rosewood and satinwood for

manufacturing three types of furniture, that are, table, chair and cot. The wood requirements (in tonnes) for each type of furniture are given below:

	Table	Chair	Cot
Teakwood	2	3	4
Rosewood	1	1	2
Satinwood	3	2	1

It is found that 29 tonnes of teakwood, 13 tonnes of rosewood and 16 tonnes of satinwood are available to make all three types of furniture.

Using the above information, answer the following questions:

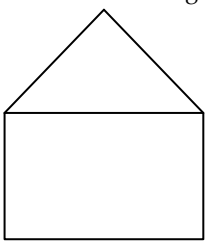
(i) Express the data given in the table above in the form of a set of simultaneous equations.

(ii) Solve the set of simultaneous equations formed in subpart (i) by matrix method.

(iii) Hence, find the number of table(s), chair(s) and cot(s) produced.

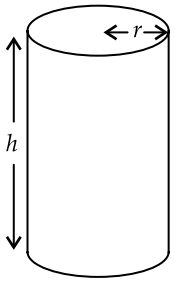
Question 12 **[6]**

(i) Mrs. Roy designs a window in her son's study room so that the room gets maximum sunlight. She designs the window in the shape of a rectangle surmounted by an equilateral triangle. If the perimeter of the window is 12 m, find the dimensions of the window that will admit maximum sunlight into the room.



OR

(ii) Sumit has bought a closed cylindrical dustbin. The radius of the dustbin is 'r'cm and height is 'h' cm. It has a volume of 20π cm^3.



(a) Express 'h' in terms of 'r', using the given volume.

(b) Prove that the total surface area of the dustbin is $2\pi r^2 + \frac{40\pi}{r}$

(c) Sumit wants to paint the dustbin. The cost of painting the base and top of the dustbin is ₹ 2 per cm^2 and the cost of painting the curved side is ₹ 25 per cm^2. Find the total cost in terms of 'r', for painting the outer surface of the dustbin including the base and top.

(d) Calculate the minimum cost for painting the dustbin.

Question 13 **[6]**

(i) Solve the following differential equation:

$2ye^{x/y}\,dx + \left(y - 2xe^{x/y}\right)dy = 0$, given $x = 0$ and $y = 1$

OR

(ii) Solve the following differential equation:

$x(x^2 - 1)\frac{dy}{dx} = 1$, $y = 0$, given $x = 2$

Question 14 **[6]**

A primary school teacher wants to teach the concept of 'larger number' to the students of Class II.

To teach this concept, he conducts an activity in his class. He asks the children to select two numbers from a set of numbers given as 2, 3, 4, 5 one after the other without replacement. All the outcomes of this activity are tabulated in the form of ordered pairs given below:

	2	**3**	**4**	**5**
2	(2, 2)	(2, 3)	(2, 4)	
3	(3, 2)	(3, 3)		(3, 5)
4	(4, 2)		(4, 4)	(4, 5)
5		(5, 3)	(5, 4)	(5, 5)

(i) Complete the table given above.

(ii) Find the total number of ordered pairs having one larger number.

(iii) Let the random variable X denote the larger of two numbers in the ordered pair. Now, complete the probability distribution table for X given below.

X	3	4	5
$P(X = x)$			

(iv) Find the value of $P(X < 5)$

(v) Calculate the expected value of the probability distribution.

SECTION B - 15 MARKS

Question 15 **[5]**

In subparts (i) and (ii) choose the correct options and in subparts (iii) to (v), answer the questions as instructed.

(i) If $\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} - 4\hat{j} - 3\hat{k}$ then the value of $|\vec{a} - 2\vec{b}|$ will be:

(a) $\sqrt{85}$ **(b)** $\sqrt{86}$

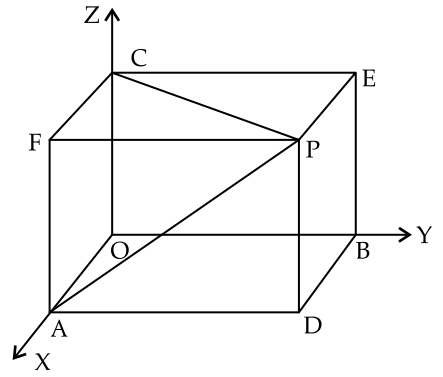
(c) $\sqrt{87}$ **(d)** $\sqrt{88}$

(ii) If a line makes an angle α, β and γ with positive direction of the coordinate axes, then the value of $\sin^2\alpha + \sin^2\beta + \sin^2\gamma$ will be:

(a) 1 **(b)** 3

(c) -2 **(d)** 2

(iii) In the figure. given below, if the coordinates of the point P are (a, b, c), then what are the perpendicular distances of P from XY, YZ and ZX planes respectively?



(iv) If $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = 5\hat{i} - 3\hat{j} + \hat{k}$, find the projection of $\vec{b}$ on $\vec{a}$

(v) Find a vector of magnitude 20 units parallel to the vector $2\hat{i} + 5\hat{j} + 4\hat{k}$.

Question 16 **[2]**

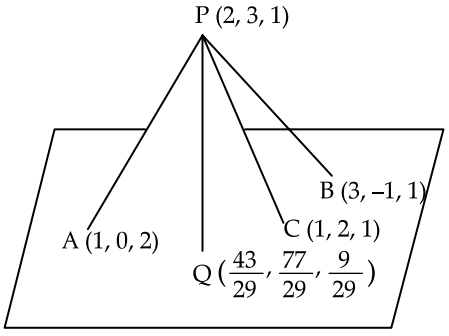
(i) If $\vec{a} \times \vec{b} = \vec{a} \times \vec{c}$ where $\vec{a}, \vec{b}$ and $\vec{c}$ are non-zero vectors, then prove that either $\vec{b} = \vec{c}$ or $\vec{a}$ and $(\vec{b} - \vec{c})$ are parallel.

OR

(ii) If $\vec{a}$ and $\vec{b}$ are two non-zero vectors such that $|\vec{a} \times \vec{b}| = \vec{a}.\vec{b}$, find the angle between $\vec{a}$ and $\vec{b}$.

Question 17 **[4]**

A mobile tower is situated at the top of a hill. Consider the surface on which the tower stands as a plane having points A(1, 0, 2), B(3, –1, 1) and C(1, 2, 1) on it. The mobile tower is tied with three cables from the points A, B and C such that it stands vertically on the ground. The top of the tower is at point P(2, 3, 1) as shown in the figure below. The foot of the perpendicular from the point P on the plane is at the point $Q\left(\frac{43}{29}, \frac{77}{29}, \frac{9}{29}\right)$



Answer the following questions.

(i) Find the equation of the plane containing the points A, B and C.

(ii) Find the equation of the line PQ.

(iii) Calculate the height of the tower.

Question 18 **[4]**

(i) Using integration, find the area bounded by the curve $y^2 = 4ax$ and the line $x = a$

OR

(ii) Using integration, find the area of the region bounded by the curve $y^2 = 4x$ and $x^2 = 4y$

SECTION C - 15 MARKS

Question 19 **[5]**

In subparts (i) and (ii) choose the correct options and in subparts (iii) to (v), answer the questions as instructed.

(i) A company sells hand towels at ₹ 100 per unit. The fixed cost for the company to manufacture hand towels is ₹ 35,000 and variable cost is estimated to be 30% of total revenue. What will be the total cost function for manufacturing hand towels?

(a) $35000 + 3x$ **(b)** $35000 + 30x$

(c) $35000 + 100x$ **(d)** $35000 + 10x$

(ii) If the correlation coefficient of two sets of variables (X, Y) is $\frac{-3}{4}$, which one of the following statements is true for the same set of variables?

(a) Only one of the two regression lines has a negative coefficient.

(b) Both regression coefficients are positive.

(c) Both regression coefficients are negative.

(d) One of the lines of regression is parallel to the x-axis.

(iii) If the total cost function is given by $C = x + 2x^3 - \frac{7}{2}x^2$, find the Marginal Average Cost function (MAC).

(iv) The equations of two lines of regression are $4x + 3y + 7 = 0$ and $3x + 4y + 8 = 0$. Find the mean value of x and y.

(v) The manufacturer of a pen fixes its selling price at ₹ 45, and the cost function is $C(x) = 30x + 240$. The manufacturer will begin to earn profit if he sells more than 16 pens. Why? Give one reason.

Question 20 **[2]**

(i) The Average Cost function associated with producing and marketing x units of an item is given by $AC = x + 5 + \frac{36}{x}$

(a) Find the Total Cost function.

(b) Find the range of values of x for which Average Cost is increasing.

OR

(ii) A monopolist's demand function is $x = 60 - \frac{p}{5}$. At what level of output will marginal revenue be zero?

Question 21 **[4]**

(i) XYZ company plans to advertise some vacancies. The Manager is asked to suggest the monthly salary for these vacancies based on the years of experience. To do so, the Manager studies the years of service and the monthly salary drawn by the existing employees in the company.

Following is the data that the Manager refers to:

Years of service (X)	11	7	9	5	8	6	10
Monthly salary (in ₹ 1000) (Y)	10	8	6	5	9	7	11

(a) Find the regression equation of monthly salary on the years of service.

(b) If a person with 13 years of experience applies for a job in this company, what monthly salary will be suggested by the Manager?

OR

The line of regression of marks in Statistics (X) and marks in Accountancy (Y) for a class of 50 students is $3y - 5x + 180 = 0$. The average score in Accountancy is 44 and the variance of marks in Statistics is $\left(\frac{9}{16}\right)^{th}$ of variance of marks in Accountancy.

(a) Find the average score in Statistics.

(b) Find the coefficient of correlation between marks in Statistics and marks in Accountancy.

Question 22 **[4]**

Aman has ₹ 1500 to purchase rice and wheat for his grocery shop. Each sack of rice and wheat costs ₹ 180 and ₹ 120 respectively. He can store a maximum number of 10 bags in his shop. He will earn a profit of ₹ 11 per bag of rice and ₹ 9 per bag of wheat.

(i) Formulate a Linear Programming Problem to maximise Aman's profit.

(ii) Calculate the maximum profit.

■■

SOLUTIONS

SECTION A

1. (i) Option (c) is correct.

***Explanation*:** $L_1 \perp L_2$, $L_2 \perp L_3$ then $L_1 \parallel L_3$

$\therefore$ relation is not transitive

$L_1 \perp L_2$ then $L_2 \perp L_1$

$\therefore$ relation is symmetric.

(ii) Option (d) is correct.

***Explanation*:** Highest derivative of D.E. is $\left(\frac{d^2y}{dx^2}\right)^1$

Hence, order and degree are 2 and 1 respectively.

(iii) Option (c) is correct.

***Explanation*:** Every identity relation on a non empty set A is a reflexive relation but not conversely.

(iv) Option (a) is correct.

***Explanation*:** Function is not differentiable.

at $x = 0$, $x = 2$ and $x = 4$

(v) Option (b) is correct.

***Explanation*:** $\text{cosec}\left(\sin^{-1}\left(-\frac{1}{2}\right)\right) - \sec\left(\cos^{-1}\left(-\frac{1}{2}\right)\right)$

$= \text{cosec}\left(\sin^{-1}\left(-\sin\frac{\pi}{6}\right)\right) - \sec\left(\cos^{-1}\left(\cos\frac{2\pi}{3}\right)\right)$

$= \text{cosec}\left(-\frac{\pi}{6}\right) - \sec\left(\frac{2\pi}{3}\right)$

$= -\text{cosec}\frac{\pi}{6} + \sec\frac{\pi}{3}$

$= -2 + 2 = 0$

(vi) Option (d) is correct.

***Explanation*:** $\int_1^{\sqrt{3}} \frac{dx}{1+x^2}$

$= \left[\tan^{-1}x\right]_1^{\sqrt{3}}$

$= \tan^{-1}\sqrt{3} - \tan^{-1}1$

$= \frac{\pi}{3} - \frac{\pi}{4} = \frac{\pi}{12}$

(vii) Option (a) is correct.

***Explanation*:** $AB = \begin{bmatrix} -3 & 2 \\ -5 & 4 \end{bmatrix}\begin{bmatrix} 4 & -2 \\ 5 & -3 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$

$BA = \begin{bmatrix} 4 & -2 \\ 5 & -3 \end{bmatrix}\begin{bmatrix} -3 & 2 \\ -5 & 4 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -2 \end{bmatrix}$

Reason, $AB = BA$

$A.A.B = A.B.A$

$\{\because$ Both side multiply by A$\}$

$A^2B = B.A.A \qquad \{AB = BA\}$

$A^2B = BA^2$

So, $A^nB = BA^n$

Hence, Reason is true and correct explanation of Assertion

(viii) Option (c) is correct.

***Explanation*:** $\int(\cot x - \text{cosec}^2 x)e^x dx$

$f(x) = \cot x$ then $f'(x) = -\text{cosec}^2 x$

$\int e^x f(x) + f'(x)dx = e^x f(x) + c$

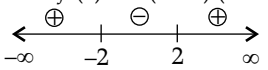
$\therefore \quad f(x) = \cot x$

(ix) Option (b) is correct.

***Explanation*:** $f(x) = x^3 - 12x$

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

$f'(x) = 3(x-2)(x+2)$



Increasing function $(-\infty, -2) \cup (2, \infty)$

(x) Option (a) is correct.

***Explanation*:** Let A and B be symmetric matrices then $A = A^t$ and $B = B^t$

$(AB - BA)^t = (AB)^t - (BA)^t$

$= (B^tA^t) - (A^tB^t)$

$= BA - AB$

$= -(AB - BA)$

Hence it is skew-symmetric.

(xi) $y = \log x + \frac{1}{x}$

$\frac{dy}{dx} = \frac{d}{dx}\log x + \frac{d}{dx}\frac{1}{x}$

$\frac{dy}{dx} = \frac{1}{x} - \frac{1}{x^2} = \frac{x-1}{x^2}$

(xii) Probability of at least one hitting the target

$= 0.4 \times 0.3 \times 0.2 \times 0.1$

$= 0.0024$

Probability of not hitting the target is

$= (1 - 0.4)(1 - 0.3)(1 - 0.2)(1 - 0.1)$

$= 0.6 \times 0.7 \times 0.8 \times 0.9$

$= 0.336 \times 0.9$

$= 0.3024$

Probability of at least one shot hitting the target is

$1 - 0.3024 = 0.6976$

(xiii) A relation is a function if each input x is associated with exactly one output. This means that for each value of x, there must be only one corresponding value of y. so Graph A is a function but Graph B is not a function because at $x = 0$ then we get three value of y.

(xiv) $\int_0^6 |x+3|$

$f(x) = |x + 3|$

$f(x) = x + 3, \quad x > -3$

$\therefore \quad \int_0^6 |x+3|\,dx = \int_0^6 (x+3)dx = \left[\frac{x^2}{2} + 3x\right]_0^6$

$= 18 + 18 - 0 - 0$

$= 36$

(xv) $\frac{1}{y}+\frac{1}{x} = \frac{1}{12}$

$\frac{d}{dt}\frac{1}{y}+\frac{d}{dt}\frac{1}{x} = \frac{d}{dt}\frac{1}{12}$

$-\frac{1}{y^2}\frac{dy}{dt}-\frac{1}{x^2}\frac{dx}{dt} = 0$

$\frac{1}{x^2}\frac{dx}{dt} = -\frac{1}{y^2}\frac{dy}{dt}$

$\frac{dx}{dt} = -\frac{x^2}{y^2}\frac{dy}{dt}$

$\frac{dx}{dt} = -\frac{25}{1}(-1) = 25$ cm/s

2. (i) $f(x) = \frac{5}{3x+1}$

$y = \frac{5}{3x+1}$

$3xy + y = 5$

$x = \frac{5-y}{3y}$

$f^{-1}(x) = \frac{5-x}{3x}$

OR

(ii) $f(x_1) = f(x_2)$

$\frac{2x_1-7}{4} = \frac{2x_2-7}{4}$

$2x_1-7 = 2x_2-7$

$x_1 = x_2$

$\therefore f(x)$ is one-one

onto $f(x) = y$

$\frac{2x-7}{4} = y$

$2x-7 = 4y$

$x = 2y-\frac{7}{2}$

For any value of y co-domain, we can find the domain x.

3. $A = \begin{vmatrix} \beta\gamma & 1 & \alpha(\beta+\gamma) \\ \gamma\alpha & 1 & \beta(\gamma+\alpha) \\ \alpha\beta & 1 & \gamma(\alpha+\beta) \end{vmatrix}$

$C_1 : C_1 + C_3$

$A = \begin{vmatrix} \beta\gamma+\alpha\beta+\alpha\gamma & 1 & \alpha(\beta+\gamma) \\ \gamma\alpha+\beta\gamma+\beta\alpha & 1 & \beta(\gamma+\alpha) \\ \alpha\beta+\gamma\alpha+\gamma\beta & 1 & \gamma(\alpha+\beta) \end{vmatrix}$

$A = (\alpha\beta+\beta\gamma+\gamma\alpha)\begin{vmatrix} 1 & 1 & \alpha(\beta+\gamma) \\ 1 & 1 & \beta(\gamma+\alpha) \\ 1 & 1 & \gamma(\alpha+\beta) \end{vmatrix}$

$A = (\alpha\beta+\beta\gamma+\gamma\alpha)\times 0 = 0 \quad (C_1 = C_2)$

4. (i) $f(x) = \frac{(x+3)^2-36}{x-3}$

$\lim\limits_{x\to 3} f(x) = \lim\limits_{x\to 3}\frac{(x+3)^2-36}{x-3}$

$= \lim\limits_{x\to 3}\frac{(x+3+6)(x+3-6)}{(x-3)}$

$= \lim\limits_{x\to 3}(x+9) \qquad (x\neq 3)$

$= 12$

$f(x)$ is continuous at $x = 3$

$\therefore \quad k = 12$

OR

(ii) $y = (x-2)^2$

$\frac{dy}{dx} = 2(x-2)$

$\left(\frac{dy}{dx}\right)_{(x_1,y_1)} = 2(x_1-2)$

Slope of chord $= \frac{y_2-y_1}{x_2-x_1} = \frac{4-0}{4-2} = 2$

Slope of tangent = slope of chord

$2(x_1-2) = 2$

$\therefore \quad x_1 = 3$

Required point (3, 1)

5. $I = \int_0^{2\pi}\frac{1}{1+e^{\sin x}}dx$ ...(i)

$I = \int_0^{2\pi}\frac{1}{1+e^{\sin(2\pi-x)}}dx$

$I = \int_0^{2\pi}\frac{1}{1+e^{-\sin x}}dx$

$I = \int_0^{2\pi}\frac{e^{\sin x}}{1+e^{\sin x}}dx$ ...(ii)

From (i) & (ii)

$2I = \int_0^{2\pi}\frac{1+e^{\sin x}}{1+e^{\sin x}}dx$

$= \int_0^{2n}dx = [x]_0^{2\pi}$

$2I = 2\pi - 0$

$I = \pi$

6. $P(A|B) = \frac{P(A\cap B)}{P(B)}$

$\frac{2}{5} = \frac{P(A\cap B)}{\frac{5}{13}}$

$\frac{2}{5}\times\frac{5}{13} = \frac{2}{13} = P(A\cap B)$

$P(A\cup B) = P(A) + P(B) - P(A\cap B)$

$= \frac{5}{26}+\frac{5}{13}-\frac{2}{13}$

$= \frac{5}{26}+\frac{3}{13}$

$= \frac{5+6}{26} = \frac{11}{26}$

7.
$$y = 3\cos(\log x) + 4\sin(\log x)$$
$$\frac{dy}{dx} = -3\sin(\log x)\ \frac{d}{dx}\log x + 4\cos(\log x)\ \frac{d}{dx}\log x$$
$$\frac{dy}{dx} = \frac{-3\sin(\log x)}{x} + \frac{4\cos(\log x)}{x}$$
$$\frac{xdy}{dx} = -3\sin(\log x) + 4\cos(\log x)$$
$$\frac{xd^2y}{dx^2} + \frac{dy}{dx} = -\frac{\cos(\log x)}{x} - \frac{4\sin(\log x)}{x}$$
$$\frac{x^2d^2y}{dx^2} + \frac{xdy}{dx} = -(3\cos(\log x) + 4\sin(\log x)$$
$$\frac{x^2d^2y}{dx^2} + \frac{xdy}{dx} + y = 0$$ **Hence Proved**

8.
$$\cos^{-1}x + \sin^{-1}\frac{x}{2} = \frac{\pi}{6}$$
$$\frac{\pi}{2} - \sin^{-1}x + \sin^{-1}\frac{x}{2} = \frac{\pi}{6}$$
$$-\sin^{-1}x + \sin^{-1}\frac{x}{2} = \frac{\pi}{6} - \frac{\pi}{2}$$
$$\sin^{-1}\frac{x}{2} = -\frac{\pi}{3} + \sin^{-1}x$$
$$\frac{x}{2} = \sin\left(\sin^{-1}x - \frac{\pi}{3}\right)$$
$$\frac{x}{2} = \sin\sin^{-1}x\cos\frac{\pi}{3} - \cos\sin^{-1}x\sin\frac{\pi}{3}$$
$$\frac{x}{2} = x\times\frac{1}{2} - \sqrt{1-x^2}\,\frac{\sqrt{3}}{2}$$
$$x = x - \sqrt{3}\sqrt{1-x^2}$$
$$\sqrt{3}\sqrt{1-x^2} = 0$$
$$3(1-x^2) = 0$$
$$x^2 = 1$$
$$\Rightarrow \quad x = \pm 1$$

$x = -1$ is not satisfied the equation

$$\therefore \quad x = 1$$

OR

$$\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \pi$$
$$\sin^{-1}x + \sin^{-1}y = \pi - \sin^{-1}z$$
$$\sin^{-1}(x\sqrt{1-y^2} + y(\sqrt{1-x^2}) = \pi - \sin^{-1}z$$
$$x\sqrt{1-y^2} + y\sqrt{1-x^2} = \sin(\pi - \sin^{-1}z)$$
$$x\sqrt{1-y^2} + y\sqrt{1-x^2} = \sin\pi\cos\sin^{-1}z - \cos\pi\sin\sin^{-1}z$$
$$x\sqrt{1-y^2} + y\sqrt{1-x^2} = z$$
$$x\sqrt{1-y^2} = z - y\sqrt{1-x^2}$$

Squaring both sides

$$x^2(1-y^2) = z^2 + y^2(1-x^2) - 2yz\sqrt{1-x^2}$$
$$x^2 - x^2y^2 = z^2 + y^2 - x^2y^2 - 2yz\sqrt{1-x^2}$$
$$x^2 - y^2 - z^2 + 2yz\sqrt{1-x^2} = 0$$ **Hence Proved**

9. $\int x^2\cos x\,dx$
$$= x^2\int\cos x\,dx - \int\left[\frac{d}{dx}x^2\int\cos x\,dx\right]dx$$
$$= x^2\sin x - \int 2x\sin x dx$$
$$= x^2\sin x - 2\left[-x\cos x - \int 1(-\cos x)dx\right]$$
$$= x^2\sin x + 2x\cos x - \sin x + c$$

OR

$$\int\frac{x+7}{x^2+4x+7}dx$$
$$= \int\frac{\frac{1}{2}(2x+4)+5}{x^2+4x+7}dx$$
$$= \frac{1}{2}\int\frac{2x+4}{x^2+4x+7}dx + \int\frac{5}{x^2+4x+7}dx$$
$$= \frac{1}{2}\log|x^2+4x+7| + \int\frac{5}{(x+2)^2+3}$$
$$\left[\int\frac{f'(x)}{f(x)}dx = \log|f(x)|\right]$$
$$= \frac{1}{2}\log|x^2+4x+7| + \frac{5}{\sqrt{3}}\tan^{-1}\left|\frac{x+2}{\sqrt{3}}\right| + C$$

10. Let E_1, E_2, E_3 and A the events of selecting the box I, II, III and 1 white and 1 red gem.

$$P(E_1) = P(E_2) = P(E_3) = \frac{1}{3}$$
$$P\left(\frac{A}{E_1}\right) = \frac{{}^1C_1\times{}^2C_1}{{}^3C_2} = \frac{1\times 2}{3} = \frac{2}{3}$$
$$P\left(\frac{A}{E_2}\right) = \frac{{}^2C_1\times{}^3C_1}{{}^5C_2} = \frac{2\times 3}{\frac{5\times 4}{2}} = \frac{3}{5}$$
$$P\left(\frac{A}{E_3}\right) = \frac{{}^3C_1\times{}^1C_1}{{}^4C_2} = \frac{3\times 1}{\frac{4\times 3}{2}} = \frac{1}{2}$$
$$P\left(\frac{E_2}{A}\right) = \frac{P(E_2)\times P\left(\frac{A}{E_2}\right)}{P(E_1)\times P\left(\frac{A}{E_1}\right) + P(E_2)\times P\left(\frac{A}{E_2}\right) + P(E_3)\times P\left(\frac{A}{E_3}\right)}$$
$$= \frac{\frac{1}{3}\times\frac{3}{5}}{\frac{1}{3}\times\frac{2}{3} + \frac{1}{3}\times\frac{3}{5} + \frac{1}{3}\times\frac{1}{2}}$$

$$= \frac{\frac{3}{5}}{\frac{2}{3}+\frac{3}{5}+\frac{1}{2}}$$

$$= \frac{\frac{3}{5}}{\frac{20+18+15}{30}} = \frac{3}{5}\times\frac{30}{53}$$

Required probability $= \frac{18}{53}$

11. **(i)** Let the number of table, chair and cot be x, y and z respectively

$$2x + 3y + 4z = 29$$
$$x + y + 2z = 13$$
$$3x + 2y + z = 16$$

(ii) Equations can be rearranged in matrix form

$$\begin{bmatrix}2 & 3 & 4\\ 1 & 1 & 2\\ 3 & 2 & 1\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}29\\ 13\\ 16\end{bmatrix}$$

$AX = B$ Where $A = \begin{bmatrix}2 & 3 & 4\\ 1 & 1 & 2\\ 3 & 2 & 1\end{bmatrix}$

$A^{-1}AX = A^{-1}B$ $\quad X = \begin{bmatrix}x\\ y\\ z\end{bmatrix}$ and $B = \begin{bmatrix}29\\ 13\\ 16\end{bmatrix}$

$$|A| = \begin{vmatrix}2 & 3 & 4\\ 1 & 1 & 2\\ 3 & 2 & 1\end{vmatrix}$$

$$= 2\begin{vmatrix}1 & 2\\ 2 & 1\end{vmatrix} - 3\begin{vmatrix}1 & 2\\ 3 & 1\end{vmatrix} + 4\begin{vmatrix}1 & 1\\ 3 & 2\end{vmatrix}$$

$$= -6 + 15 - 4 = 5$$

$C_{11} = (1-4) = -3$ | $C_{21} = -(3-8) = 5$

$C_{12} = -(1-6) = 5$ | $C_{22} = (2-12) = -10$

$C_{13} = (2-3) = -1$ | $C_{23} = -(4-9) = 5$

$C_{31} = (6-4) = 2$, $C_{32} = -(4-4) = 0$, $C_{33} = 2-3 = -1$

$$\text{Adj } A = \begin{bmatrix}-3 & 5 & -1\\ 5 & -10 & 5\\ 2 & 0 & -1\end{bmatrix}^t$$

$$= \begin{bmatrix}-3 & 5 & 2\\ 5 & -10 & 0\\ -1 & 5 & -1\end{bmatrix}$$

$$A^{-1} = \frac{\text{Adj } A}{|A|} = \frac{1}{5}\begin{bmatrix}-3 & 5 & 2\\ 5 & -10 & 0\\ -1 & 5 & -1\end{bmatrix}$$

$$X = A^{-1}B$$

$$\begin{bmatrix}x\\ y\\ z\end{bmatrix} = \frac{1}{5}\begin{bmatrix}-3 & 5 & 2\\ 5 & -10 & 0\\ -1 & 5 & -1\end{bmatrix}\begin{bmatrix}29\\ 13\\ 16\end{bmatrix}$$

$$= \frac{1}{5}\begin{bmatrix}10\\ 15\\ 20\end{bmatrix} = \begin{bmatrix}2\\ 3\\ 4\end{bmatrix}$$

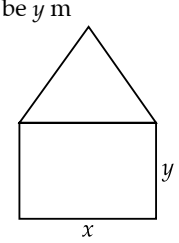
$x = 2$, $y = 3$, $z = 4$

(iii) No. of chairs = 2

No of tables = 3

No, of Cots = 4

12. Let the length of window be x m and breadth of rectangle part be y m



Perimeter = 12 m

$$3x + 2y = 12$$

$$y = 6 - \frac{3x}{2} \quad \text{...(i)}$$

Area of window

$$A = xy + \frac{\sqrt{3}}{4}x^2$$

$$A = x\left(6 - \frac{3x}{2}\right) + \frac{\sqrt{3}}{4}x^2$$

$$A = 6x - \frac{3x^2}{2} + \frac{\sqrt{3}}{4}x^2$$

$$\frac{dA}{dx} = 6 + \left(\frac{-3}{2} + \frac{\sqrt{3}}{4}\right)2x$$

for maxima/min. $\frac{dA}{dx} = 0$

$$6 + \left(\frac{\sqrt{3}}{4} - \frac{3}{2}\right)2x = 0$$

$$\left(\frac{\sqrt{3}-6}{4}\right)x = -3$$

$$x = \frac{12}{6-\sqrt{3}} = \frac{12(6+\sqrt{3})}{36-3}$$

$$= \frac{4}{11}(6+\sqrt{3})$$

$$\frac{d^2A}{dx^2} = 0 + 2\left(\frac{\sqrt{3}}{4} - \frac{3}{2}\right) < 0$$

Hence Area is maximum at $x = \frac{4}{11}(6+\sqrt{3})$

$$y = 6 - \frac{3x}{2}$$

$$y = 6 - \frac{12}{22}(6+\sqrt{3})$$

$$y = \frac{66-36-6\sqrt{3}}{11} = \frac{30-6\sqrt{3}}{11}$$

$$y = \frac{6(5-\sqrt{3})}{11}$$

Hence dimension of window be $\frac{4}{11}(6+\sqrt{3})$ m and $\frac{6}{11}(5-\sqrt{3})$ m

OR

(ii) (a) Volume of cylinder $= 20\pi$

$$\pi r^2 h = 20\pi$$

$$h = \frac{20}{r^2}$$

(b) $$\text{T.S.A} = 2\pi r^2 + 2\pi rh$$

$$= 2\pi r^2 + \frac{40\pi}{r}$$

(c) $$\text{Cost of Painting} = 2 \times 2\pi r^2 + 25 \times \frac{40\pi}{r}$$

$$= 4\pi r^2 + \frac{1000\pi}{r}$$

$$C(r) = 4\pi r^2 + \frac{1000\pi}{r}$$

$$\frac{dC}{dr} = 8\pi r - \frac{1000\pi}{r^2}$$

For max/min $\frac{dC}{dr} = 0$

$$8\pi r - \frac{1000\pi}{r} = 0$$

$$r^3 = \frac{1000}{8}$$

$$r = \frac{10}{2} = 5 \text{ cm}$$

$$\frac{d^2C}{dr^2} = 8\pi + \frac{2000\pi}{r^3}$$

$$\left(\frac{d^2C}{dr^2}\right)_{r=5} = 8\pi + \frac{2000\pi}{125} > 0$$

Hence cost is minimum at $r = 5$cm

(d) Minimum cost $C(r) = 4\pi(5)^2 + \frac{1000\pi}{5}$

$$= ₹\, 300\pi$$

$$= ₹\, \frac{300 \times 22}{7}$$

$$= ₹\, 942.85 \quad \text{(Approx)}$$

13. $2ye^{x/y}\,dx + (y - 2xe^{x/y})\,dy = 0$

$$\frac{dx}{dy} = -\left(\frac{y - 2xe^{x/y}}{2ye^{x/y}}\right)$$

Let, $x = Vy$

$$\frac{dx}{dy} = V + y\frac{dV}{dy}$$

$$V + y\frac{dV}{dy} = -\left(\frac{y - 2Vye^V}{2ye^V}\right)$$

$$y\frac{dV}{dy} = -\left(\frac{1 - 2Ve^V}{2e^V}\right) - V$$

$$y\frac{dV}{dy} = \frac{-1 + 2Ve^V - 2Ve^V}{2e^V}$$

$$y\frac{dV}{dy} = -\frac{1}{2e^V}$$

$$e^V dV = -\frac{1}{2}\frac{dy}{y}$$

$$\int e^V dV = -\frac{1}{2}\int\frac{dy}{y}$$

$$e^V = -\frac{1}{2}\log y + C$$

$$e^{x/y} = -\frac{1}{2}\log y + C$$

$$x = 0, y = 1$$

$$e^\circ = -\frac{1}{2}\log 1 + C$$

$$C = 1$$

$\therefore$ $$e^{x/y} = -\frac{1}{2}\log y + 1$$

$$2e^{x/y} + \log y = 2$$

$$\log y = 2\,(1 - e^{x/y})$$

OR

$$x\,(x^2 - 1)\,\frac{dy}{dx} = 1$$

$$dy = \frac{dx}{x(x^2-1)}$$

$$dy = \frac{dx}{x(x-1)(x+1)}$$

$$\frac{1}{x(x-1)(x+1)} = \frac{A}{x} + \frac{B}{x-1} + \frac{C}{x+1}$$

$$1 = A(x^2 - 1) + Bx(x+1) + Cx(x-1)$$

$x = 0, \quad -1 = A, \quad x = 1 \quad 1 = 2B \Rightarrow B = \frac{1}{2}$

At $x = -1$,

$$1 = 2C \Rightarrow C = \frac{1}{2}$$

$$\int dy = \int\frac{dx}{x(x^2-1)}$$

$$y = \int\left(\frac{-1}{x} + \frac{1}{2(x+1)} + \frac{1}{2(x-1)}\right)dx$$

$$y = -\log x + \frac{1}{2}\log(x+1) + \frac{1}{2}\log(x-1) + \log C$$

$$y = \log\frac{\sqrt{(x^2-1)}C}{x}$$

$$0 = \log\frac{\sqrt{3}}{2}C$$

$$\log 1 = \log\frac{\sqrt{3}}{2}C$$

$$\frac{\sqrt{3}}{2}C = 1 \Rightarrow C = \frac{2}{\sqrt{3}}$$

$$\therefore \quad y = \log\frac{\frac{2}{\sqrt{3}}\sqrt{x^2-1}}{x}$$

$$e^y = \frac{2}{\sqrt{3}}\frac{\sqrt{x^2-1}}{x}$$

14. (i)

	2	3	4	5
2	(2, 2)	(2, 3)	(2, 4)	(2, 5)
3	(3, 2)	(3, 3)	(3, 4)	(3, 5)
4	(4, 2)	(4, 3)	(4, 4)	(4, 5)
5	(5, 2)	(5, 3)	(5, 4)	(5, 5)

(ii) Total no. of order of pairs having one larger number are

$$16 - 4 = 12$$

(iii)

X	3	4	5
P ($X = x$)	2/12	4/12	6/12

(iv) $$P(x < 5) = \frac{2}{12} + \frac{4}{12} = \frac{6}{12} = \frac{1}{2}$$

(v) Expected value $(\bar{X}) = 3\times\frac{1}{6} + 4\times\frac{1}{3} + 5\times\frac{1}{2}$

$$= \frac{1}{2} + \frac{4}{3} + \frac{5}{2}$$

$$= \frac{3+8+15}{6}$$

$$= \frac{26}{6} = \frac{13}{3}$$

$\therefore$ Required answer $= \frac{13}{3}$

SECTION B

15. (i) Option (b) is correct.

***Explanation*:** $\vec{a} - 2\vec{b} = 3\hat{i} - 2\hat{j} + \hat{k} - 2(2\hat{i} - 4\hat{j} - 3\hat{k})$

$$= 3\hat{i} - 2\hat{j} + \hat{k} - 4\hat{i} + 8\hat{j} + 6\hat{k}$$

$$= -\hat{i} + 6\hat{j} + 7\hat{k}$$

$$|\vec{a} - 2\vec{b}| = |\sqrt{1^2 + 6^2 + 7^2}| = \sqrt{86} \text{ unit}$$

(ii) Option (d) is correct.

***Explanation*:** $\sin^2\alpha + \sin^2\beta + \sin^2\alpha$

$1 - \cos^2\alpha + 1 - \cos^2\beta + 1 - \cos^2\gamma$

$3 - (\cos^2\alpha + \cos^2\beta + \cos^2\gamma)$

$3 - 1 = 2$

(iii) Distance from XY plane c unit

YX plane a unit

ZX plane b unit

(iv) Projection b on $a = \frac{\vec{a}.\vec{b}}{|\vec{a}|}$

$$= \frac{(2\hat{i} + \hat{j} + 2\hat{k}).(5\hat{i} - 3\hat{j} + \hat{k})}{\sqrt{2^2 + 1^2 + 2^2}}$$

$$= \frac{10 - 3 + 2}{3}$$

$= 3$ units

(v) $$\vec{a} = 2\hat{i} + 5\hat{j} + 4\hat{k}$$

$$\vec{a} = \frac{2\hat{i} + 5\hat{j} + 4\hat{k}}{\sqrt{2^2 + 5^2 + 4^2}}$$

$$\vec{a} = \frac{2\hat{i} + 5\hat{j} + 4\hat{k}}{3\sqrt{5}}$$

20 units magnitude vector parallel to $\vec{a}$ is

$$\frac{20\times(2\hat{i} + 5\hat{j} + 4\hat{k})}{3\sqrt{5}}$$

$$\frac{4\sqrt{5}}{3}(2\hat{i} + 5\hat{j} + 4\hat{k})$$

$$\frac{8\sqrt{5}}{3}\hat{i} + \frac{20\sqrt{5}}{3}\hat{j} + \frac{16\sqrt{5}}{3}\hat{k}$$

16. (i) $$\vec{a}\times\vec{b} = \vec{a}\times\vec{c}$$

$$\vec{a}\times\vec{b} - \vec{a}\times\vec{c} = 0$$

$$\vec{a}\times(\vec{b} - \vec{c}) = 0$$

Either $\vec{a}$ and $\vec{b} - \vec{c}$ is parallel vectors

or $$\vec{b} - \vec{c} = 0$$

$$\vec{b} = \vec{c}$$

OR

(ii) $$|\vec{a}\times\vec{b}| = \vec{a}.\vec{b}$$

$$|\vec{a}||\vec{b}|\sin\theta = |\vec{a}||\vec{b}|\cos\theta$$

$$\tan\theta = 1$$

$$\theta = \frac{\pi}{4} \text{ or } 45°$$

17. (i) $A(1, 0, 2)$ $B(3, -1, 1)$ $C(1, 2, 1)$

Equation of the plane passing through the three points is

$$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_2-x_1 & y_2-y_1 & z_2-z_1 \\ x_3-x_1 & y_3-y_1 & z_3-z_1 \end{vmatrix} = 0$$

$$\begin{vmatrix} x-1 & y-0 & z-2 \\ 2 & -1 & -1 \\ 0 & 2 & -1 \end{vmatrix} = 0$$

$$(x-1)\begin{vmatrix} -1 & -1 \\ 2 & -1 \end{vmatrix} + y\begin{vmatrix} -1 & 2 \\ -1 & 0 \end{vmatrix} + (z-2)\begin{vmatrix} 2 & -1 \\ 0 & 2 \end{vmatrix} = 0$$

$$3(x-1) + 2y + (z-2)(4) = 0$$

$$3x + 2y + 4z - 11 = 0$$

(ii) Equation of line PQ

P(2, 3, 1) Q $\left(\frac{43}{29}, \frac{77}{29}, \frac{9}{29}\right)$

$$\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} = \frac{z-z_1}{z_2-z_1}$$

$$\frac{x-2}{\frac{43}{29}-2} = \frac{y-3}{\frac{77}{29}-3} = \frac{z-3}{\frac{9}{29}-1}$$

$$\frac{x-2}{-\frac{15}{29}} = \frac{y-3}{-\frac{10}{29}} = \frac{z-3}{-\frac{20}{29}}$$

$$\frac{x-2}{15} = \frac{y-3}{10} = \frac{z-1}{20}$$

$$\frac{x-2}{3} = \frac{y-3}{2} = \frac{z-1}{4}$$

(iii) Height of tower (PQ)

$$\left|\sqrt{(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2}\right|$$

$$\left|\sqrt{\left(\frac{-15}{29}\right)^2+\left(\frac{-10}{29}\right)^2+\left(\frac{-20}{29}\right)^2}\right|$$

$$\frac{1}{29}\left|\sqrt{225+100+400}\right|$$

$$\frac{5\sqrt{29}}{29} \text{ units}$$

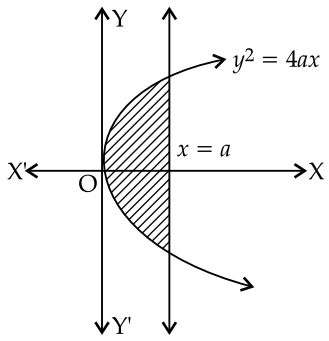
18. (i) Required area $= 2\int_0^a y\,dx$

$$= 2\int_0^a 2\sqrt{a}\sqrt{x}\,dx$$

$$= 2.2.\sqrt{a}\left(\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\right)_0^a$$

$$= \frac{8\sqrt{a}}{3}(a^{3/2}-0)$$

$$= \frac{8a^2}{3} \text{ units}^2$$



OR

$y^2 = 4x$

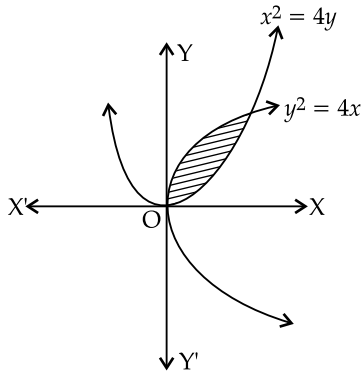
$x^2 = 4y$

the curve (0, 0) and (4, 4)

Required area $= \int_0^4 (y_2 - y_1)dx$

$$= \int_0^4 \left(2\sqrt{x} - \frac{x^2}{4}\right)dx$$

$$= \left(\frac{2x^{3/2}}{\frac{3}{2}} - \frac{x^3}{12}\right)_0^4$$



Required Area $= \left[\frac{4}{3}x^{3/2} - \frac{x^3}{12}\right]_0^4$

$$= \left[\frac{4}{3}\times 8 - \frac{64}{12} - 0\right]$$

$$= \frac{32}{3} - \frac{16}{3}$$

$$= \frac{16}{3} \text{ units}^2$$

SECTION - C

19. (i) Option (b) is correct

Explanation: Let no of travels sold be x

$\therefore$ Revenue $= ₹\,100x$

Variable cost $= \frac{30}{100}\times 100x = 30x$

$\therefore$ Total cost $= 35000 + 30x$

(ii) Option (c) is correct.

Explanation: The correlation coefficient ranges from –1 to 1, where–1 indicates a perfect negative correlation, 0 indicates no correlation, and 1 indicates a perfect positive correlation. A coefficient greater than 0 indicates a positive relationship, meaning as one variable increases, the other tends to increase as well. Conversely, a coefficient less than 0 indicates a negative relationship, meaning as one variable increases, the other tends to decrease. Therefore, a correlation coefficient of –3/4 indicates a negative relationship between the variables X and Y.

(iii) $$C = x + 2x^3 - \frac{7}{2}x^2$$

$$\text{Arg cost} = \frac{C}{x} = 1 + 2x^2 - \frac{7}{2}x$$

$$\text{M.A.C} = \frac{d}{dx}\left(1 + 2x^2 - \frac{7}{2}x\right) = 4x - \frac{7}{2}$$

(iv) $4x + 3y + 7 = 0$ ...(i)

$3x + 4y + 8 = 0$ ...(ii)

from (i) & (ii) $7x + 7y + 15 = 0$

by adding $x + y + \frac{15}{7} = 0$ ...(iii)

by subtracting $x - y - 1 = 0$ ....(iv)

from (iii) & (iv) $2x + \frac{8}{7} = 0$

$$x = -\frac{4}{7}$$

from (iii) $y = -\frac{11}{7}$

mean value of x and y is $-\frac{4}{7}$ and $-\frac{11}{7}$

(v) $R(x) = p \times x = 45x$

$C(x) = 30x + 240$

$P(x) = R(x) - C(x)$

$= 45x - 30x - 240$

$= 15x - 240$

To get profit $p(x) > 0$

$15x - 240 > 0$

$$x > \frac{240}{15}$$

$$x > 16$$

20. $$\text{A.C} = x + 5 + \frac{36}{x}$$

(a) Total cost function $= x \times \text{A.C} = x^2 + 5x + 36$

(b) $$AC = x + 5 + \frac{36}{x}$$

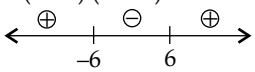
$$\frac{d(AC)}{dx} = 1 + 0 - \frac{36}{x^2}$$

for increasing $\frac{d(AC)}{dx} > 0$

$$1 - \frac{36}{x^2} > 0$$

$$x^2 - 36 > 0$$

$$(x - 6)(x + 6) > 0$$



Range of increasing average cost is $x > 6$

OR

$$x = 60 - \frac{p}{5}$$

$\Rightarrow$ $300 - 5x = p$

$R(x) = p \times x = (300 - 5x)$

$$\text{M.R.} = \frac{d}{dx}(300x - 5x^2) = 300 - 10x$$

$\text{M.R} = 0$

$300 - 10x = 0$

$\therefore$ $x = 30$

21.

Year of Series (X)	Monthly salary in (₹ 1000) (Y)	x^2	y^2	xy
11	10	121	100	110
7	8	49	64	56
9	6	81	36	54
5	5	25	25	25
8	9	64	81	72
6	7	36	49	42
10	11	100	121	110
56	**56**	**476**	**476**	**469**

$n = 7$

$$b_{yx} = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2}$$

$$b_{yx} = \frac{7 \times 469 - 56 \times 56}{7 \times 476 - (56)^2}$$

$$= \frac{3283 - 3136}{3332 - 3136}$$

$$b_{yx} = \frac{147}{196} = 0.75$$

$$\bar{x} = \frac{\sum x}{7} = \frac{56}{7} = 8, \ \bar{y} = \frac{\sum y}{n} = \frac{56}{7} = 8$$

Regression line y on x

$y - \bar{y} = b_{yx}(x - \bar{x})$

$y - 8 = 0.75(x - 8)$

$$y - 8 = \frac{3}{4}(x - 8)$$

$$y = \frac{3x}{4} - 6 + 8$$

$$y = \frac{3}{4}x + 2$$

(b) If 13 years of service i.e., $x = 13$

$$y = \frac{(3/4) \times 13 + 2}{4}$$

$y = 9.75 + 2 = 11.75$

$y = 11.75 \times 1000 = ₹\,11750$

OR

(ii) $3y - 5x + 180 = 0$

$\bar{y} = 44, n = 50$

Variance of X $= \frac{9}{16}$ Variance of Y

Regression equation X on Y is

$5x = 3y + 180$

$x = \frac{3}{5}y + \frac{180}{5} = \frac{3}{5}y + 36$

$\therefore \quad b_{xy} = \frac{3}{5} = 0.6$

(a) $a = \bar{x} - b_{xy}\,\bar{y}$

$\bar{x} = a + b_{xy}\,\bar{y} = 36 + 0.6 \times 44$

$\bar{x} = 36 + 26.4 = 62.4$

(b) $\sigma_x^2 = \frac{9}{16}\sigma_y^2$

$\therefore \quad \frac{\sigma_x}{\sigma_y} = \frac{3}{4}$

$b_{xy} = r \times \frac{\sigma_x}{\sigma_y}$

$\frac{3}{5} = r \times \frac{3}{4}$

$\therefore \quad r = \frac{4}{5} = 0.8$

22. $Z = 11x + 9y$

$x + y \le 10$

$180x + 120y \le 1500$

$18x + 12y \le 150$

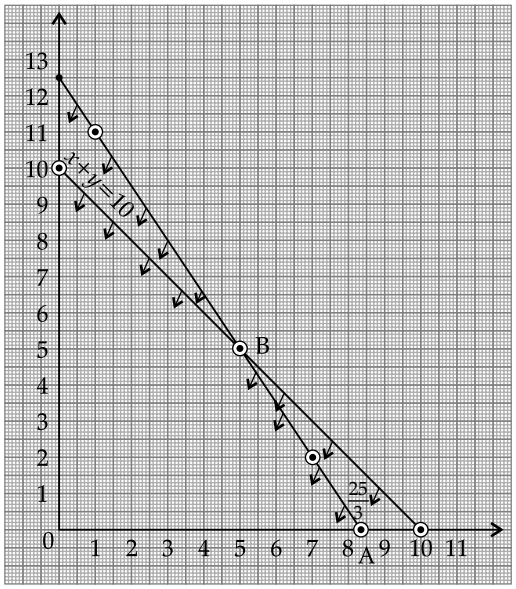
$3x + 2y \le 25$

$x + y = 10$

x	0	10	5
y	10	0	5

$3x + 2y = 25$

x	1	5	7
y	11	5	2



Feasible region is OABCO

$Z = 11x + 9y$

At (0, 0) $Z = 11 \times 0 + 9 \times 0 = 0$

At $A(25/3, 0)$ $Z = 11 \times \frac{25}{3} + 9 \times 0 = \frac{275}{3} = 91.66$

At $B(5, 5)$ $Z = 11 \times 5 + 9 \times 5 = 55 + 45 = 100$

At $C(0, 10)$ $Z = 11 \times 0 + 9 \times 10 = 0 + 90 = 90$

Maximum profit at (5, 5) is ₹ 100

■■