No. of Printed Pages:15

CLASS XI
ANNUAL EXAM (2024 – 25)
APPLIED MATHEMATICS (241)
SET B MARKING SCHEME

Time Allowed:3 hrs. **Max Marks:80**

General Instructions:

1. This Question paper contains - **five sections** A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2**. Section A** has 18 **MCQ's** and 02 Assertion-Reason based questions of 1 mark each.
3. **Section B** has 5 **Very Short Answer (VSA)**-type questions of 2 marks each.
4. **Section C** has 6 **Short Answer (SA)**-type questions of 3 marks each.
5. **Section D** has 4 **Long Answer (LA)**-type questions of 5 marks each.
6. **Section E** has 3 **source based/case based/passage based/integrated units of assessment** (4 marks each) with sub parts.

Section A
(One Mark for each correct answer)

1. Value of $(256)^{0.16}$ X $(256)^{0.09}$ is
(a) 4 (b) 16 (c) 64 (d) 256.25 (a)

2. A metallic sphere shell of internal and external diameters 4 cm and 8 cm, respectively is melted and recast into the form of a cone of base diameter 8 cm. The height of the cone is
(a) 12 cm (b) 14 cm (c) 15 cm (d) 18 cm (b)

3. Two trains running in opposite directions at the speed of 36km/h and 54km/h cross each other in 8 sec.If the length of the first train is 80m, then the length of second train is
(a) 90m (b)100m (c) 110m (d) 120m (d)

4. If BLEPIN is coded as 987416, MATPIN is coded as 123416, then TABLE is coded as?
(a) 32987 (b) 32897 (c) 38987 (d) 21987 (a)

5.In a certain language if 'MATHEMATICS' is coded as 'PDWKHPDWLFV' then 'STATISTICS' is coded as
(a)VWDWLVWLFV (b)VVDVLUWKFU
(c)VWCWLVWLFV (d)VWEWLVWLFV (a)

6. Two statements followed by two conclusions are given. Read the given statements and conclusions carefully and answer the question by choosing one of the options given below.
Statement I: All pens are pencils.
Statement II: Some books are pens.
Conclusion I: Some pencils are books.
Conclusion II: Some pencils are pens.

(a) Only conclusion I is true
(b) Only conclusion II is true.
(c) Neither conclusion I nor conclusion II is true.
(d) Both the conclusions I and II are true. (d)

7. Pointing to a picture the man said, "The lady in the picture is my nephew's maternal grandmother." The lady in the picture related to the man's sister who has no other sister is her

(a) Cousin (b) Sister- in – law (c) Mother - in law (d) Mother (d)

8. In a certain language, 321 means 'Glass of Tea', 426 means 'Tea is Brown' and 796 means 'Trunks are brown', which of the following represent 'is' in that language?

(a) 6 (b) 7 (c) 4 (d) 2 (c)

9.Find the odd one out: ACE, FHJ, LNP, QSU, UWX

(a) FHJ (b) QSU (c) LNP (d) UWX (d)

10. The range of the function $f(x) = \frac{x}{|x|},\ x \neq 0$ is

(a) $\{-1,1\}$ (b) $[-1,1]$ (c) $(-1,1)$ (d) $R - \{0\}$ (a)

11. Values of a & b if $(2a + b,\ a - b) = (-22, 10)$

(a) $a = 4, b = 14$ (b) $a = -4, b = 1$

(c) $a = -4, b = -14$ (d) $a = 4, b = 1$ (c)

12.Two coins are tossed .The probability of coming up two heads if it is known that atleast one head comes up is

(a) $\frac{3}{4}$ (b)$\frac{1}{4}$ (c) $\frac{1}{3}$ (d) 0 (c)

13.The variance of 10 observations is 16 and their mean is 12. If each observation is multiplied by 4, the new mean is

(a) 12 (b) 16 (c) 24 (d) 48 (d)

14.The score of a MCQ test of 10 students are given below:
37,48,35,49,29,46,49,40,33,50 The percentile rank of score 49 is

(a) 75 (b) 80 (c) 85 (d) 90 (b)

15.The time in which a sum of money double itself at 5% simple interest is

(a)2 years (b)5 years (c)20 years (d)10 years (c)

16. A manufacturer sells a refrigerator to a dealer for Rs.45000. The dealer sells it to a customer at a profit of Rs.4600. If the sales are intra-state and the rate of GST is 12%, the amount of GST paid to the state by manufacturer is

(a)Rs 2700 (b)Rs. 5400 (c)Rs 54000 (d)50400 (a)

17. The amount of a regular annuity of Rs 1000 payable at the end of each year for 3 years at 10% per annum compounded annually is

(a)Rs.3310 (b)Rs 3300 (c)Rs3410 (d)Rs3515 (a)

18. Equation of the line through the point $(-4,5)$ and the point of intersection of the lines $4x - 3y + 7 = 0$ and $2x + 3y + 5 = 0$ is

(a) $3x - 8y + 17 = 0$ (b) $8x + 3y + 17 = 0$

(c)$8x - 3y + 17 = 0$ (d) $3x + 8y - 17 = 0$ (b)

(ASSERTION AND REASON QUESTIONS) For questions 19 and 20 two statements are given – one labelled **Assertion (A)** and the other labelled **Reason (R).** Select the correct answer to the question from the codes (i), (ii), (iii) and (iv) as given below:

(i) Both A and R are true and R is the correct explanation of the assertion
(ii) Both A and R are true but R is not the correct explanation of the assertion
(iii) A is true, but R is false
(iv) A is false, but R is true

19. **Assertion (A):** The distance between the lines $2x - y = 4$ and $6x - 3y = 5$ is $\frac{17}{\sqrt{45}}$ units.
Reason (R): The distance between the lines $Ax + By = C_1$ and $Ax + By = C_2$ is given by $\left|\frac{C_1 - C_2}{\sqrt{A^2 + B^2}}\right|$.
Soln. (iv)

20. **Assertion (A):** A bag contains 4 white and 2 black balls.Another bag contains 3 white and 5 black balls.If one ball is drawn from each bag, the probability that both are white is $\frac{1}{4}$
Reason (R): Drawing a white ball from the first bag and drawing a white ball from the second bag are independent events.
Soln.(i)

Section B

21. Solve for x: $x = \frac{log 125}{log \frac{1}{5}}$
Soln.: $x = \frac{log 125}{log \frac{1}{5}} = \frac{\log 5^3}{\log 5^{-1}} = \frac{3log 5}{(-1)\log 5} = -3$ (1+0.5+0.5)

22.(a) If 4-digit numbers greater than 5000 are randomly formed from the digits 0, 1, 3, 5 and 7, what is the probability of forming a number divisible by 5 when the digits may be repeated?
Soln.: If the number formed has to be greater than 5000, then the thousands place can be filled by either $5\ or\ 7$ i. e in 2 different ways.
If the digits are allowed to be repeated then the number of such numbers will be $(2 \times 5 \times 5 \times 5) - 1(5000) = 249$ (0.5)
Now for the numbers greater than 5000 divisible by 5
The number of such numbers$= (2 \times 5 \times 5 \times 2) - 1(5000)$ { for the number to be divisible by 5 , the unit place can be occupied by either $0\ or\ 5$}
$= 99$ (0.5)
Thus the required probability$= \frac{99}{249} = \frac{33}{83}$ (1)

OR

22.(b) A and B are two events such that P(A) = 0.54, P(B) = 0.69 and $P(A \cap B) = 0.35$. Find (i) $P(A \cup B)$ (ii) $P(A' \cap B')$

Soln.: (i)$P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.54 + 0.69 - 0.35 = 0.88$
(ii)$P(A' \cap B') = P(A \cup B)' = 1 - P(A \cup B) = 1 - 0.88 = 0.12$
(1+1)

23(a). The lower and upper quartiles for a certain frequency distribution are 7 and 15 respectively. If the Bowley's coefficient of skewness is 0.25, find the median of the distribution.

Soln.: $S_{KB} = 0.25 \quad , Q_1 = 7 \quad , Q_3 = 15$

$S_{KB} = \frac{Q_3+Q_1-2Q_2}{Q_3-Q_1}$ (1)

$0.25 = \frac{7+15-2Q_2}{15-7}$

Hence, $Median\ (Q_2) = 10$ (1)

OR

23(b) Find Cov(X,Y) for the following data:

X	3	4	5	6	7
Y	8	7	6	5	4

Soln.: Here N=5

						Total
X	3	4	5	6	7	25
Y	8	7	6	5	4	30
xy	24	28	30	30	28	140

$Cov(X,Y) = \frac{1}{N}\left[\sum xy - \frac{1}{N}\sum x \sum y\right] = \frac{1}{5}\left[140 - \frac{1}{5}(25)(30)\right] = -2$ (1+1)

24. Determine the rate of interest per annum for a sum that becomes $\frac{216}{125}$ times of itself in $1\frac{1}{2}\ years$, compounded semi-annually.

Soln.: $A = \frac{216}{125}P$

$\frac{216}{125}P = P\left(1+\frac{r}{100}\right)^3$ (1)

$\left(1+\frac{r}{100}\right)^3 = \left(\frac{6}{5}\right)^3$

$\Rightarrow r = 20$

Hence, Rate of interest per annum = 40% (1)

25. Kiran purchases an article for Rs. 5310 which includes 10% rebate on the marked price and 18% tax (under GST) on the remaining price. Find the marked price of the article.

Soln.:Rate of GST=18%

Rebate =10% on Marked Price P

C.P.=M.P. − Discount

=P−10%P=0.9P (0.5)

Amount of GST on CP of article=18% of 0.9P

Amount paid by Kiran =CP+GST=5310

0.9P+(18% of 0.9P)=5310 (0.5)

P=Rs.5000 (1)

Section C

26(a). Given U={1,2,3,4,5,6,7,8,9,10,11}, A={1,2,3,4,5,6,7,8} and B= {2,4}
Verify $(A \cup B)' = (A' \cap B')$ and $(A \cap B)' = (A' \cup B')$

Soln.: Verification of law $(A \cup B)' = (A' \cap B') = \{9,10,11\}$
$(A \cap B)' = (A' \cup B') = \{1,3,5,6,7,8,9,10,11\}$ (1.5+1.5)

OR

26(b).Out of 100 students, 15 passed in English, 12 passed in Mathematics, 8 in Science, 6 in English and Mathematics, 7 in Mathematics and Science; 4 in English and Science; 4 in all the three. Find how many passed:

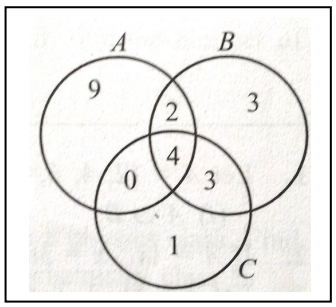
(i) In English and Mathematics but not in Science
(ii) In Mathematics only

Soln: Let A be the set of students passed in English, B be the set of students passed in Mathematics, C be the set of students passed in Science.

Then $n(A) = 15, n(B) = 12, n(C) = 8$

$n(A \cap B) = 6, n(B \cap C) = 7, n(A \cap C) = 4, n(A \cap B \cap C) = 4$

From Venn diagram:



(i) Number of students passed in English and Mathematics but not in Science
$= n(A \cap B) - n(A \cap B \cap C) = 6 - 4 = 2$

(ii) Number of students passed in Mathematics only
$= n(B) - n(A \cap B) - n(B \cap C) + n(A \cap B \cap C)$
$= 12 - 6 - 7 + 4 = 3$

(1.5+1.5)

27. Let R be a relation from N to N defined by $R = \{(a,b): a,b \in N \text{ and } a = b^2\}$. Are the following true?

(i) $(a,b) \in R$, implies $(b,a) \in R$ (ii) $(a,b) \in R$, $(b,c) \in R$ implies $(a,c) \in R$

Justify your answer in each case.

Soln.: (i) Let $(4,2) \in R \quad \Rightarrow 4 = 2^2$ But, $2 \neq 4^2 \quad \Rightarrow (2,4) \notin R$.

$\Rightarrow$ (i) is false.

(i) Let $(16,4) \in R$ & $(4,2) \in R \quad \Rightarrow 16 = 4^2$ & $4 = 2^2$ But $16 \neq 2^2$

$\Rightarrow (16,2) \notin R$. Hence, (ii) is false. (1+2)

28(a). Evaluate the following limits:

$$\lim_{x \to 0} \frac{\sqrt{1+2x} - \sqrt{1-2x}}{\sin x}$$

Soln.

$$\lim_{x \to 0} \frac{\sqrt{1+2x} - \sqrt{1-2x}}{\sin x}$$

$$= \lim_{x \to 0} \frac{\sqrt{1+2x} - \sqrt{1-2x}}{\sin x} \times \frac{\sqrt{1+2x} + \sqrt{1-2x}}{\sqrt{1+2x} + \sqrt{1+2x}}$$

$$= \lim_{x \to 0} \frac{(1+2x)-(1-2x)}{\sin x\,(\sqrt{1+2x} + \sqrt{1-2x})} = \lim_{x \to 0} \frac{4x}{\sin x\,(\sqrt{1+2x} + \sqrt{1-2x})}$$

$$= \frac{4}{\lim\limits_{x\to 0} \frac{\sin x}{x} \cdot \lim\limits_{x\to 0} (\sqrt{1+2x}+\sqrt{1-2x})} = \frac{4}{1.(\sqrt{1+0}+\sqrt{1-0})}$$

$= \frac{4}{1+1} = \frac{4}{2} = 2.$ (0.5 marks for each step)

OR

28(b).Find the derivative of $f(x) = \frac{x^2-1}{x}; x \neq 0\ w.r.t.\ x$ from first principle.

Soln. Given $f(x) = \frac{x^2-1}{x} = x - \frac{1}{x}$

$$f'(x) = \lim_{h\to 0}\left(\frac{f(x+h)-f(x)}{h}\right) = \lim_{h\to 0}\left(\frac{\left((x+h)-\frac{1}{x+h}\right)-\left(x-\frac{1}{x}\right)}{h}\right)$$

$$f'(x) = \lim_{h\to 0}\left(\frac{h-\left(\frac{1}{x+h}-\frac{1}{x}\right)}{h}\right) = \lim_{h\to 0}\left[\frac{h}{h}-\frac{1}{h}\left(\frac{x-x-h}{x(x+h)}\right)\right] = \lim_{h\to 0}\left(1-\frac{-h}{hx(x+h)}\right)$$

$f'(x) = 1 + \frac{1}{x^2}$ (0.5 marks for each step)

29. Find the mean deviation about the mean for the following data

x_i	10	30	50	70	90
f_i	4	24	28	16	8

Soln.: To calculate mean, we require $f_i x_i$ values; then to find deviation, we will require $|x_i - \bar{x}|$ and $f_i|x_i - \bar{x}|$ values, Hence, we make the following table

x_i	f_i	$f_i x_i$	$\lvert x_i - \bar{x}\rvert$	$f_i\lvert x_i - \bar{x}\rvert$
10	4	40	40	160
30	24	720	20	480
50	28	1400	0	0
70	16	1120	20	320
90	8	720	40	320
Total	80	4000		1280

Here $n = \Sigma f_i = 80$ and $\Sigma f_i x_i = 4000$

$\therefore \bar{x} = \frac{\Sigma f_i x_i}{n} = \frac{400}{80} = 50$

Mean deviation about the mean,

M.D. $(\bar{x}) = \frac{\sum f_i|x_i-\bar{x}|}{n} = \frac{1280}{80} = 16$ (Table 1.5+M.D.1.5)

30. Mr Pandey lives in Lucknow, Uttar Pradesh. The reading of electric meter of his house is found to be 5678 units. If the previous month's reading was 4803 units and connection load is 4 kW, calculate his electricity bill for that month.

Tariff plan is given below:

Energy charges

Number of units	$0-150$	$151-300$	$301-500$	>500
Price per unit (in ₹)	₹5.5	₹6	₹6.5	₹7

Fixed charges ₹ 110 per kW/month

Energy tax is 5% of tariff rates

Surcharge is ₹0.26 per unit

Soln.:Given current month's reading $= 5678$ units

Previous month's reading $= 4803$ units

$\therefore$ Number of units consumed $= 5678 - 4803 = 875$

Energy charges

Units	Price	Amount
$0-150$	₹5.5	₹825
$151-300$	₹ 6	₹900
$301-500$	₹ 6.5	₹ 1300
$501-875$	₹ 7	₹ 2625
	Total	₹ 5650

Fixed charges $= ₹(110 \times 4) = ₹440$
Surcharge $= ₹(0.26 \times 875) = ₹227.50$
Energy tax $= 5\%$ of $(₹5650 + ₹440)$
$= 5\%$ of ₹6090
$= ₹304.50$
Electricity bill $= ₹5650 + ₹440 + ₹227.50 + ₹304.50$
$= ₹6622$ (0.5+0.5+1+1)

31(a). The cable of a uniformly loaded suspension bridge hangs in the form of a parabola. The roadway which is horizontal and 100 m long is supported by vertical wires attached to the cable, the longest being 30m and the shortest being 6m.

Find the length of the supporting wire attached to the roadway 18m from the middle.

Soln.: The bridge is hung by supporting wires in a parabolic arc with vertex at the lower point and the axis vertical. Choose the co-ordinate axes as shown in the figure.

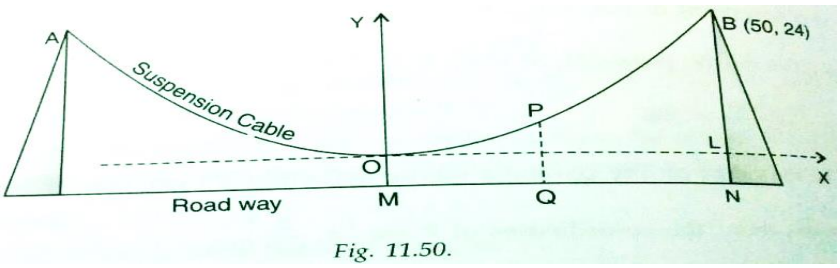


Fig. 11.50.

The equation of the parabola can be taken as $x^2 = 4$ ay.

Shortest supporting vertical wire = OM = 6m,

Longest supporting vertical wire = NB = 30 m.

∴LB = 30 m – 6 m = 24 m ,$OL = \frac{1}{2} \times 100\ m = 50\ m.$

The point B is (50, 24).

AS B (50, 24) lies on the parabola, we get

$(50)^2 = 4a \times 24 \Rightarrow a = \frac{2500}{96}$ (1)

Let PQ be the vertical supporting wire at a distance of 18 m from middle.

If PQ = k meters, then the point P is (18, k – 6)

As P lies on parabola, we get

$18^2 = 4 \times \frac{2500}{96}(k-6) \Rightarrow \frac{324 \times 24}{2500} = k - 6$ (1)

$k = \frac{324 \times 24}{2500} = 6 = 9.11\ metres\ (approx)$ (0.5)

Hence, the length of the required wire = 9.11 metres (approx.) (0.5)

OR

31(b).Find the equation of the circle passing through $(2, 3)$& $(-1, 1)$ and having centre is on the line $x - 3y - 11 = 0$.

Soln.: The equation of the circle can be taken as $(x-h)^2 + (y-k)^2 = a^2$. It is passing through $(2, 3)$, therefore, $(2-h)^2 + (3-k)^2 = a^2$ ... ... (i).
The circle is also passing through $(-1, 1)$, therefore,
$(-1-h)^2 + (1-k)^2 = a^2$ ... ... (ii). From (i) & (ii) we get,
$4 - 4h + 9 - 6k = 1 + 2h + 1 - 2k \ \therefore 6h + 4k = 11$ .... (iii).
Further the centre of the circle lies on the line $x - 3y - 11 = 0$, therefore,
$h - 3k = 11$ ... ... (iv).
From (iii) & (iv) we get, $6h + 4k = h - 3k$
$\therefore 5h = -7k \Longrightarrow h = \frac{-7}{5}k$ Putting this value of h in equation(iv)
we get, $\frac{-7}{5}k - 3k = 11 \implies \frac{-22k}{5} = 11 \therefore k = \frac{-5}{2}$.
Putting this value of k in equation(iv) $h + \frac{15}{2} = 11 \Longrightarrow h = \frac{7}{2}$. (2)
Putting the value of h & k in equation(i) we get $a^2 = \frac{9}{4} + \frac{121}{4} = \frac{65}{2}$
The equation of the circle is $\left(x - \frac{7}{2}\right)^2 + \left(y + \frac{5}{2}\right)^2 = \frac{65}{2}$
$i.e. x^2 + y^2 - 7x + 5y - 14 = 0.$ (1)

Section D

32. The AM of two positive numbers a and b is twice their GM.

Prove that $a : b = 2 + \sqrt{3} : 2 - \sqrt{3}$

Soln: AM = 2 GM

$\Rightarrow \frac{a+b}{2} = 2\sqrt{ab}$

$\Rightarrow a + b = 4\sqrt{ab}$

$\Rightarrow \frac{a+b}{2\sqrt{ab}} = 2$

$\Rightarrow \frac{a+b+2\sqrt{ab}}{a+b-2\sqrt{ab}} = \frac{2+1}{2-1}$

$\Rightarrow \frac{(\sqrt{a}+\sqrt{b})^2}{(\sqrt{a}-\sqrt{b})^2} = 3$

$\Rightarrow \frac{\sqrt{a}+\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \frac{\sqrt{3}}{1}$

$\Rightarrow \frac{2\sqrt{a}}{2\sqrt{b}} = \frac{\sqrt{3}+1}{\sqrt{3}-1}$

Squaring, we get

$\frac{a}{b} = \frac{3+1+2\sqrt{3}}{3+1-2\sqrt{3}}$

$\Rightarrow \frac{a}{b} = \frac{2+\sqrt{3}}{2-\sqrt{3}}$ (0.5 for each step)

33. If $y = \left(x + \sqrt{x^2 + a^2}\right)^n$, prove that $\frac{dy}{dx} = \frac{ny}{\sqrt{x^2+a^2}}$.

Soln.**:** Given $y = \left(x + \sqrt{x^2 + a^2}\right)^n$

Differentiating wrt x, we get

$\frac{dy}{dx} = n\left(x + \sqrt{x^2 + a^2}\right)^{n-1} . \frac{d}{dx}(x + \sqrt{x^2 + a^2})$ (1)

$= n\left(x + \sqrt{x^2 + a^2}\right)^{n-1} . \left[1 + \frac{1}{2}(x^2 + a^2)^{-1/2} . 2x\right]$ (1)

$= n\left(x + \sqrt{x^2 + a^2}\right)^{n-1} \left(1 + \frac{x}{\sqrt{x^2+a^2}}\right)$ (1)

$= n\left(x + \sqrt{x^2 + a^2}\right)^{n-1} \frac{\sqrt{x^2+a^2}+x}{\sqrt{x^2+a^2}}$ (1)

$= n . \left(\frac{x+\sqrt{x^2+a^2}}{\sqrt{x^2+a^2}}\right)^n = \frac{ny}{\sqrt{x^2+a^2}}$ (1)

34(a). The mean and the variance of eight observations are 9 & 9.25 respectively. If six of them are $6, 7, 10, 12, 12$ & 13. Find the other two observations.

Soln.: The mean of the given eight observations is 9. Therefore, $\sum x_i = 72$___(i)

Variance$= 9.25, \therefore \sum \frac{x_i^2}{8} - \ (mean)^2 = 9.25 \implies \sum \frac{x_i^2}{8} = 9.25 + (mean)^2 \ = 9.25 + \ (9)^2 =$ 90.25_____(ii) Let x & y be the two missing observations. Then, $6 + \ 7 + \ 10 + \ 12 +$ $12 + \ 13 + x + y = 72 \implies x + y = 12$____$(i)'$ & $6^2 + \ 7^2 + \ (10)^2 + \ (12)^2 + \ (12)^2 +$ $(13)^2 + \ x^2 + \ y^2 = 8 \times 90.25 = 722 \implies \ x^2 + \ y^2 = 722 - 642 = 80$_____$(ii)'$. Using $(i)'$ in $(ii)'$we get, $x^2 + \ (12 - x)^2 = 80 \implies x^2 - 12x + 32 = 0 \implies x = 4, 8.$ accordingly, the other number is $8, 4$ i. e. the numbers are $8, 4$.

(2+3)

OR

34(b).Calculate Karl Pearson's coefficient of skewness for the following data:

x_i	4	6	8	10	12
f_i	4	8	14	11	3

Soln.:

x_i	f_i	$f_i x_i$	$(x_i)^2$	$f_i(x_i)^2$
4	4	16	16	64
6	8	48	36	288
8	14	112	64	896
10	11	110	100	1100
12	3	36	144	432
Total	40	322		2780

Mean$=\frac{\sum f_i x_i}{n}=\frac{322}{40}$ $=8.05$

S.D. $= \frac{1}{n}\sqrt{n \sum f_i x_i^2 - (\sum f_i x_i)^2}$

$= \frac{1}{40}\sqrt{40 \times 2780 - (322)^2}$

$= \frac{1}{40}\sqrt{111200 - 103684}$

$= \frac{1}{40}\sqrt{7516}$

$= \frac{86.69}{40}$

$= 2.17$

Since the frequency of 8 is greatest, so mode is 8

$S_{k_p} = \frac{\text{mean - mode}}{\text{standard deviation}}$

$= \frac{8.05-8}{2.17}$

$= \frac{0.05}{2.17}$

$= 0.023$ So, the data is fairly symmetrical. (2+1+1+1)

35(a). Manufacturer A sells a washing machine to a dealer B for ₹ 12500. The dealer B sells it to a consumer at a profit of ₹ 1500. If the sales are intra-state and the rate of GST is 12%, find

(i) the amount of tax (under GST) paid by the dealer B to the Central Government.

(ii) the amount of tax (under GST) received by the State Government.

(iii) the amount that the consumer pays for the machine.

Soln.: As the sales are intra-state and the rate of GST is 12%, so GST comprises of 6% as CGST and 6% as SGST. Manufacturer A sells the washing machine to dealer B for ₹12500, amount of GST collected by manufacturer *A* from dealer *B* (or paid by dealer *B* to *A*):

CGST $= 6\%$ of ₹$12500 =$ ₹$\left(\frac{6}{100} \times 12500\right) =$ ₹750,

SGST $= 6\%$ of ₹$12500 =$ ₹$\left(\frac{6}{100} \times 12500\right) =$ ₹750.

∴ Amount of input GST of dealer B:

input CGST = ₹ 750, input SGST $=$ ₹750.

Manufacturer A will pay ₹ 750 as CGST and ₹750 as SGST.

Since the dealer B sells the washing machine to a consumer at a profit of ₹1500, the selling price of machine by dealer *B* (or cost price of machine to the consumer)

$=$ ₹$12500 +$ ₹$1500 =$ ₹14000

The amount of GST collected by dealer B (or paid by consumer):

CGST $= 6\%$ of ₹$14000 =$ ₹$\left(\frac{6}{100} \times 14000\right) =$ ₹840

SGST $= 6\%$ of ₹$14000 =$ ₹$\left(\frac{6}{100} \times 14000\right) =$ ₹840

∴ Amount of output GST of dealer B:

output CGST $=$ ₹840, output SGST $=$ ₹840.

(i) Amount of tax (under GST) paid by dealer B to the Central Government

$=$ CGST paid by dealer *B* to the Central Government

$=$ Output CGST $-$ input CGST

$=$ ₹$840 -$ ₹$750 =$ ₹90

(ii) Amount of SGST paid by dealer B = Output SGST − input SGST

= ₹840 − ₹750 = ₹90

Amount of tax (under GST) received by the State Government

= SGST paid by A + SGST paid by B

= ₹750 + ₹90 = ₹840.

(iii) The amount which the consumer pays for the machine

= Cost price of machine to consumer + GST paid by consumer

= ₹14000 + CGST paid by consumer + SGST paid by consumer

= ₹14000 + ₹840 + ₹840 = ₹15680 (2+2+1)

OR

35(b).In financial year 2019-20, the gross salary of Sanjay (age 29 years) was ₹8,50,000 (exclusive of HRA). He deposited ₹9,200 per month in G.P.F. and paid ₹43,000 as life insurance premium. He donated ₹25,000 in Prime Minister's National Relief Fund. He took a home loan of ₹24,00,000 from the State Bank of India and paid ₹76,000 as interest on home loan and ₹20,000 as principal of home loan. Calculate his income tax at the end of the financial year.

Income Tax Slab for FY 2019-20 (A.Y. 2020-21)
(For individual tax payers below the age of 60 years)

Taxable Income	Income tax
Upto ₹2,50,000	NIL
₹2,50,001 to ₹5,00,000	5% of taxable income exceeding ₹ 2,50,000
₹5,00,001 to ₹10,00,000	₹12,500 + 20% of taxable income exceeding ₹5,00,000
Above ₹10,00,000	₹1,12,500 + 30% of taxable income exceeding ₹10,00,000

At present 4% health and education cess is levied by the govt. on the income tax.

Soln.:

Gross income = ₹8,50,000

Less Standard deduction = −₹50,000

Balance = ₹8,00,000

Deductions under section 80G

Prime Minister's National Relief Fund = −₹25,000

Balance = ₹7,75,000

Deduction under section 24

Interest on Home Loan	$= -₹76,000$
Balance	$= ₹6,99,000$

Deductions under section 80C

Deposited in G.P.F. $₹(12 \times 9200)$	$= ₹1,10,400$
LIC Premium	$= ₹43,000$
Principal of Home Loan	$= ₹20,000$
Total	$= ₹1,73,400$

But deduction under section 80 C is allowed upto $₹1,50,000$

Less deductions under section 80C	$= -₹1,50,000$
Taxable income	$= ₹5,49,000$

Since taxable income is $₹5,49,000$, so from the income tax slab

Income tax $= ₹12500 + 20\%$ of $₹49000$

$= ₹12500 + ₹9800 = ₹22300$

Since taxable income is more than $₹5,00,000$. So Sanjay is not eligible for tax rebate under section 87 A.

∴ Income tax	$= ₹22300$
Health and Education cess 4% on $₹22300$	$= ₹892$
Total income tax	$= ₹23,192$

(1+1+1+1+1)

Section E

36**(CASE STUDY 1).**A well is an excavation or structure created in the ground, by digging, driving or drilling to access liquid resources usually water.The oldest and most common kind of well is a water well. A well of diameter 4m and depth 14m is dugged out.
Using the information given above, answer the following :
(i)How many cubic metres of earth will be dugged out?
(ii)Find the cost of cementing inner curved surface of the well at the rate of Rs 12 per sq.m.
(iii)(a) If the earth taken out is spread evenly all around the well in the shape of a circular ring of width 4 m to form an embankment, what will be the height of the embankment?

OR

(iii)(a) If the earth taken out is used to build a rectangular platform 11m long and 8m wide, what will be the height of the platform?

Soln.:(i)56π
(ii)Rs.2112
(iii)(a)1.75m
OR
(iii)(b)2m (1+1+2)

37**(CASE STUDY 2).** Adit and Amber were playing cards during their winter vacations. While playing they got inquisitive over some facts which were related to their course.

Using the information given above, answer the following :
(i)What is the number of ways of choosing 4 cards of the same suit from a pack of 52 playing cards?
(ii)In how many ways can 4 face cards be chosen ?
Soln.: (i)The required number of ways of choosing 4 cards of the same suit from a pack of 52 playing cards?
$= {}^{13}C_4 + {}^{13}C_4 + {}^{13}C_4 + {}^{13}C_4 = 2860$
(ii) The required number of ways of choosing 4 face cards $= {}^{12}C_4 = 495$
(2+2)

38**(CASE STUDY 3).** The insurance company insured 2000 cyclists, 4000 scooter drivers and 6000 car drivers. The probability of an accident involving a cyclist, scooter driver and a car driver are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident.

Using the information given above, answer the following :

(i)Find the probability of choosing a scooter driver.

(ii)What is the probability of an accident by a car driver?

(iii) (a) What is the probability that the insured person meets with an accident?

OR

(iii) (b) Given that an insured person meets with an accident,what is the probability that he is a scooter driver?

Soln.

Let the events are defined as E_1 : Person chosen is a cyclist,
E_2 : Person chosen is a scooter driver,
E_3 : Person chosen is a car driver and,
A : Person meets with an Accident.

Then, $P(E_1) = \frac{2000}{12000} = \frac{2}{12}$, $P(E_2) = \frac{4000}{12000} = \frac{4}{12}$, $P(E_3) = \frac{6000}{12000} = \frac{6}{12}$.

Also $P(A \mid E_1) = 0.01 = \frac{1}{100}$, $P(A \mid E_2) = 0.03 = \frac{3}{100}$, $P(A \mid E_3) = 0.15 = \frac{15}{100}$.

(i) $P(E_2) = \frac{4000}{12000} = \frac{4}{12}$

(ii) $P(A \mid E_3) = 0.15 = \frac{15}{100}$

(iii)(a) Probability that the insured person meets with an accident:

$\therefore \quad P(A) = P(A|E_1)P(E_1) + P(A|E_2)P(E_2) + P(A|E_3)P(E_3)$

$$\Rightarrow P(A) = \frac{1}{100} \times \frac{2}{12} + \frac{3}{100} \times \frac{4}{12} + \frac{15}{100} \times \frac{6}{12}$$

$$\Rightarrow P(A) = \frac{104}{1200} \text{ or, } \frac{13}{150}$$

OR

(iii)(b) Probability that he is a scooter driver :

$$P(E_2|A) = \frac{P(A|E_2)P(E_2)}{P(A|E_1)P(E_1) + P(A|E_2)P(E_2) + P(A|E_3)P(E_3)}$$

$$\Rightarrow P(E_2 \mid A) = \frac{\frac{3}{100} \times \frac{1}{3}}{\frac{1}{100} \times \frac{1}{6} + \frac{3}{100} \times \frac{1}{3} + \frac{15}{100} \times \frac{1}{2}}$$

$\therefore \quad P(E_2|A) = \frac{3}{26}$ (1+1+2)