MT

2014 ___ ___ 1100 **Seat No.** | | | | | | | |

MT - MATHEMATICS (71) ALGEBRA - PRELIM II - PAPER - 2 (E)

Time : 2 Hours **(Pages 3)** **Max. Marks : 40**

Note :

(i) All questions are compulsory.

(ii) Use of calculator is not allowed.

Q.1. Solve ANY Five of the following : **5**

(i) Write the first five terms of the following Arithmetic Progressions where, the common difference 'd' and the first term 'a' is given :
$a = 10, d = -3$

(ii) Determine whether the given values of 'x' is a roots of given quadratic equation.
$x^2 + 2x + 1 = 0, x = -1$

(iii) Find the value of discriminant of the following equation.
$2x^2 + x + 1 = 0$

(iv) If $D_x = -18$ and $D = 3$ are the values of the determinants for certain simultaneous equations in x and y, find x.

(v) If $A = 55$, $\bar{d} = -3.25$ and $h = 10$, then, find mean.

(vi) For a pie diagram, $\theta = 75°$, Total = 54000, find the data.

Q.2. Solve ANY FOUR of the following : **8**

(i) Find the twenty fifth term of the A. P. : 12, 16, 20, 24, ...

(ii) Form the quadratic equation if its roots are :
3 and – 11

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(iii) If $12x + 13y = 29$ and $13x + 12y = 21$, Find $x + y$.

(iv) In a each of the following experiments write the sample space S, number of sample points n (S), events P, Q, R using set and n (P), n (Q) and n (R). Find the events among the events defined above which are : complementary events, mutually exclusive events and exhaustive events.
A die is thrown :
(a) P is the event of getting an odd number.
(b) Q is the event of getting an even number.
(c) R is the event of getting a prime number.

(v) Which term of an A.P. is 55, if a = 3 and d = 1.3.

(vi) Two coins are tossed. Find the probability of the events.
(i) head appears on both the coins.
(ii) head does not appear.

Q.3. Solve ANY THREE of the following : 9

(i) The taxi fare is Rs. 14 for the first kilometer and Rs. 2 for each additional kilometer. What will be fare for 10 kilometers ?

(ii) Solve the given quadratic equations by completing square.
$z^2 + 6z - 8 = 0$

(iii) A card is drawn at random from a well shuffled pack of 52 cards. Find the probability that the card drawn is
(a) bears a number between 4 and 7 both inclusive.
(b) bears a number between 3 and 8 both inclusive.

(iv) What is the probability that an ordinary year has 53 Sundays ?

(v) Area under different crops in a certain village is given below. Represent it by pie diagram

Crop	Jowar	Wheat	Sugarcane	Vegetables
Area in hectare	8000	6000	2000	2000

Q.4. Solve ANY TWO of the following : 8

(i) Solve the given simultaneous equations using graphical method :
$4x = y - 5; y = 2x + 1$

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(ii) Represent the following data using frequency curve :

Electricity bill in a month (in Rs.)	200 - 400	400-600	600 - 800	800 - 1000
No. of families	362	490	185	63

Draw histogram and hence draw frequency curve.

(iii) Find the sum of all numbers from 1 to 140 which are divisible by 4.

Q.5. Solve ANY TWO of the following : 10

(i) The sum of the squares of five consecutive natural numbers is 1455. Find the numbers.

(ii) For the data given, find median calories consumed daily by a boy.
Number of calories (in' 00) consumed daily by a sample of 15 years old boys are given below.

Calories	1000 – 1500	1500 – 2000	2000 – 2500	2500 – 3000	3000 – 3500	3500 – 4000	4000 – 4500
No. of boys	5	13	16	18	27	10	4

(iii) A bus covers a certain distance with uniform speed. If the speed of the bus would have been increased by 15 km/h, it would have taken two hours less to cover the same distance and if the speed of the bus would have been decreased by 5 km/h, it would have taken one hour more to cover the same distance. Find the distance covered by the bus.

Best Of Luck 👍

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Time : 2 Hours **Preliminary Model Answer Paper** **Max. Marks : 40**

A.1. Attempt ANY FIVE of the following :

(i) a = 10, d = – 3

Here, $t_1 = a = 10$

$t_2 = t_1 + d = 10 + (-3) = 10 - 3 = 7$

$t_3 = t_2 + d = 7 + (-3) = 7 - 3 = 4$

$t_4 = t_3 + d = 4 + (-3) = 4 - 3 = 1$

$t_5 = t_4 + d = 1 + (-3) = 1 - 3 = -2$

∴ The first five terms of the A.P. are 10, 7, 4, 1 and – 2. **1**

(ii) $x^2 + 2x + 1 = 0$, x = – 1

Putting x = – 1 in L.H.S. we get,

L.H.S. $= (-1)^2 + 2(-1) + 1$

$= 1 - 2 + 1$

$= 2 - 2$

$= 0$

= R.H.S.

∴ L.H.S. = R.H.S.

Thus equation is satisfied.

So – 1 is the root of the given quadratic equation. **1**

(iii) $2x^2 + x + 1 = 0$

Comparing with $ax^2 + bx + c = 0$ we have a = 2, b = 1, c = 1

$\Delta = b^2 - 4ac$

$= (1)^2 - 4(2)(1)$

$= 1 - 8$

$= -7$

∴ $\Delta = -7$ **1**

(iv) $D_x = -18$ and D = 3

By Cramer's rule,

$$x = \frac{D_x}{D}$$

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	$\therefore \quad x = \frac{-18}{3}$	
	$\therefore \quad \boxed{x = -6}$	1
(v)	Mean $(\bar{x}) = A + \bar{d}$	
	$= 55 + (-3.25)$	
	$= 55 - 3.25$	
	$= 51.75$	
	$\therefore$ Mean is 51.75 units.	1
(vi)	$\theta = \frac{\text{Data}}{\text{Total}} \times 360$	
	$\therefore \quad 50 = \frac{\text{Data}}{54000} \times 360$	
	$\therefore \quad \text{Data} = \frac{50 \times 54000}{360}$	
	$\therefore \quad \boxed{\text{Data} = 7500}$	1
A.2.	**Solve ANY Four of the following :**	
(i)	For the given A.P. 12, 16, 20, 24, ...	
	Here, $a = t_1 = 12$	
	$d = t_2 - t_1 = 16 - 12 = 4$	
	We know,	
	$t_n = a + (n - 1)\ d$	1
	$\therefore \quad t_{25} = a + (25 - 1)\ d$	
	$\therefore \quad t_{25} = 12 + 24\ (4)$	
	$\therefore \quad t_{25} = 12 + 96$	
	$\therefore \quad t_{25} = 108$	
	$\therefore$ The twenty fifth term of A.P. is 108.	1
(ii)	The roots of the quadratic equation are -3 and -11.	
	Let $\alpha = -3$ and $\beta = -11$	
	$\therefore \quad \alpha + \beta = -3 + (-11) = -3 - 11 = -14$	1
	and $\alpha.\beta = -3 \times -11 = 33$	
	We know that,	
	$x^2 - (\alpha + \beta)x + \alpha.\beta = 0$	
	$\therefore \quad x^2 - (-14)x + 33 = 0$	
	$\therefore \quad x^2 + 14x + 33 = 0$	
	$\therefore$ The required quadratic equation is $x^2 + 14x + 33 = 0$	1

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(iii)	$12x + 13y = 29$ ......(i) $13x + 12y = 21$ .....(ii) Adding (i) and (ii), $12x + 13y = 29$ $13x + 12y = 21$ $25x + 25y = 50$	1
	Dividing throughout by 25 we get, $x + y = \frac{50}{25}$ $\therefore$ $\boxed{x + y = 2}$	1
(iv)	When a die is thrown S = { 1, 2, 3, 4, 5, 6 } n (S) = 6 P is the event of getting an odd number P = { 1, 3, 5 } $\therefore$ n (P) = 3 Q is the event of getting an even number Q = { 2, 4, 6 }	1
	$\therefore$ n (Q) = 3 R is the event of getting a prime number R = { 2, 3, 5 } $\therefore$ n (R) = 3 Here $P \cap Q = \phi$ and $P \cup Q = S$ $\therefore$ P and Q are complementary events.	1
(v)	For an A.P. a = 3, d = 1.3, $t_n = 55$ $\therefore$ $t_n = a + (n - 1)d$ $\therefore$ $55 = 3 + (n-1)(1.3)$	1
	$\therefore$ $55 - 3 = 1.3n - 1.3$ $\therefore$ $52 + 1.3 = 1.3n$ $\therefore$ $53 - 3 = 1.3n$ $\therefore$ $n = 41$ 41^{st} term of an A.P. is 55	1
(vi)	Two coins are tossed S = { HH, HT, TH, TT } n (S) = 4	

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(a) head appears on both the coins.
Let A be the event that head appears on both the coins

A = { HH }

n (A) = 1

$$P(A) = \frac{n(A)}{n(S)}$$

$$\therefore \boxed{P(A) = \frac{1}{4}}$$ **1**

(b) head does not appear.
Let B be the event that head does not appear

B = { TT }

n (B) = 1

$$P(B) = \frac{n(B)}{n(S)}$$

$$\therefore \boxed{P(B) = \frac{1}{4}}$$ **1**

A.3. Solve ANY THREE of the following :

(i) Since the taxi fare increases by Rs. 2 every kilometer after the first, the successive taxi fares form an A.P.
The taxi fare for first kilometer (a) = Rs. 14
Increase in taxi fare in every kilometer after first kilometer (d) = 2 **1**
No. of kilometers covered by taxi (n) = 10
Taxi fare for 10 kilometers = t_{10} = ?

$t_n = a + (n + 1)\ d$

$\therefore t_{10} = a + (10 - 1)\ d$ **1**

$\therefore t_{10} = 14 + 9\ (2)$

$\therefore t_{10} = 14 + 18$

$\therefore t_{10} = 32$

∴ Taxi fare for ten kilometers is Rs. 32. **1**

(ii) $z^2 + 6z - 8 = 0$

$\therefore z^2 + 6z = 8$ .... (i)

$$\text{Third term} = \left(\frac{1}{2} \times \text{coefficient of } z\right)^2$$

$$= \left(\frac{1}{2} \times 6\right)^2$$ **1**

$$= (3)^2$$

$$= 9$$

Adding 9 to both sides of (i), we get,

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	$z^2 + 6z + 9 = 8 + 9$ $\therefore (z+3)^2 = 17$ Taking square root on both the sides we get, $z + 3 = \pm\sqrt{17}$ $\therefore z = -3 \pm \sqrt{17}$ $\therefore z = -3 + \sqrt{17}$ or $z = -3 - \sqrt{17}$ $\therefore$ $-3 + \sqrt{17}$ and $-3 - \sqrt{17}$ are the roots of the given quadratic equations.	1 1
(iii)	There are 52 cards in a pack of cards $\therefore$ n (S) = 52 (i) Let A be the event that card drawn bears a number between 4 and 7 both inclusive $\because$ There are 4 numbers from 4 to 7 inclusive of both and there are 4 types of cards $\therefore$ Total no. of cards bearing numbers from 4 to 7 both inclusive in the pack of cards are $4 \times 4 = 16$ n (A) = 16 $P(A) = \frac{n(A)}{n(S)}$ $\therefore P(A) = \frac{16}{52}$ $\therefore P(A) = \frac{4}{13}$ (ii) Let B be the event that card drawn bears a number between 3 and 8 both inclusive. $\because$ There are 6 numbers from 3 to 8 both inclusive and there are 4 types of cards $\therefore$ Total no. of cards bearing numbers from 3 to 8 both inclusive in the pack of cards is $6 \times 4 = 24$ n (B) = 24 $\therefore P(B) = \frac{n(B)}{n(S)}$ $\therefore P(B) = \frac{24}{52}$ $\therefore P(B) = \frac{6}{13}$	½ 1 ½ 1
(iv)	An ordinary year has 365 days 52 weeks and 1 extra day 52 weeks will have 52 Sundays The sample space for one extra day is	

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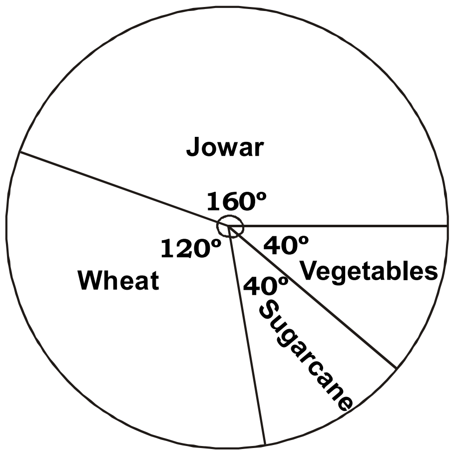
	S = { Monday, Tuesday, Wednesday, Thusday,Friday, Saturday, Sunday } n (S) = 7 Let A be the event that the extra day is a Sunday ∴ A = { Sunday } P (A) = 1 P (A) = $\frac{n(A)}{n(S)}$ ∴ $P(A) = \frac{1}{7}$	1 1 1

(v)

Crop	Area in hectare	Measure of central angle
Jowar	8000	$\frac{8000}{18000} \times 360^\circ = 160^\circ$
Wheat	6000	$\frac{6000}{18000} \times 360^\circ = 120^\circ$
Sugarcane	2000	$\frac{2000}{18000} \times 360^\circ = 40^\circ$
Vegetables	2000	$\frac{2000}{18000} \times 360^\circ = 40^\circ$
Total	**18000**	**360°**

1



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A.4. **Solve ANY TWO of the following :**

(i)

$4x = y - 5$

∴ $4x + 5 = y$

∴ $y = 4x + 5$

x	0	–1	–2
y	5	1	–3
(x, y)	(0, 5)	(–1, 1)	(–2, –3)

$y = 2x + 1$

x	0	1	2
y	1	3	5
(x, y)	(0, 1)	(1, 3)	(2, 5)

1

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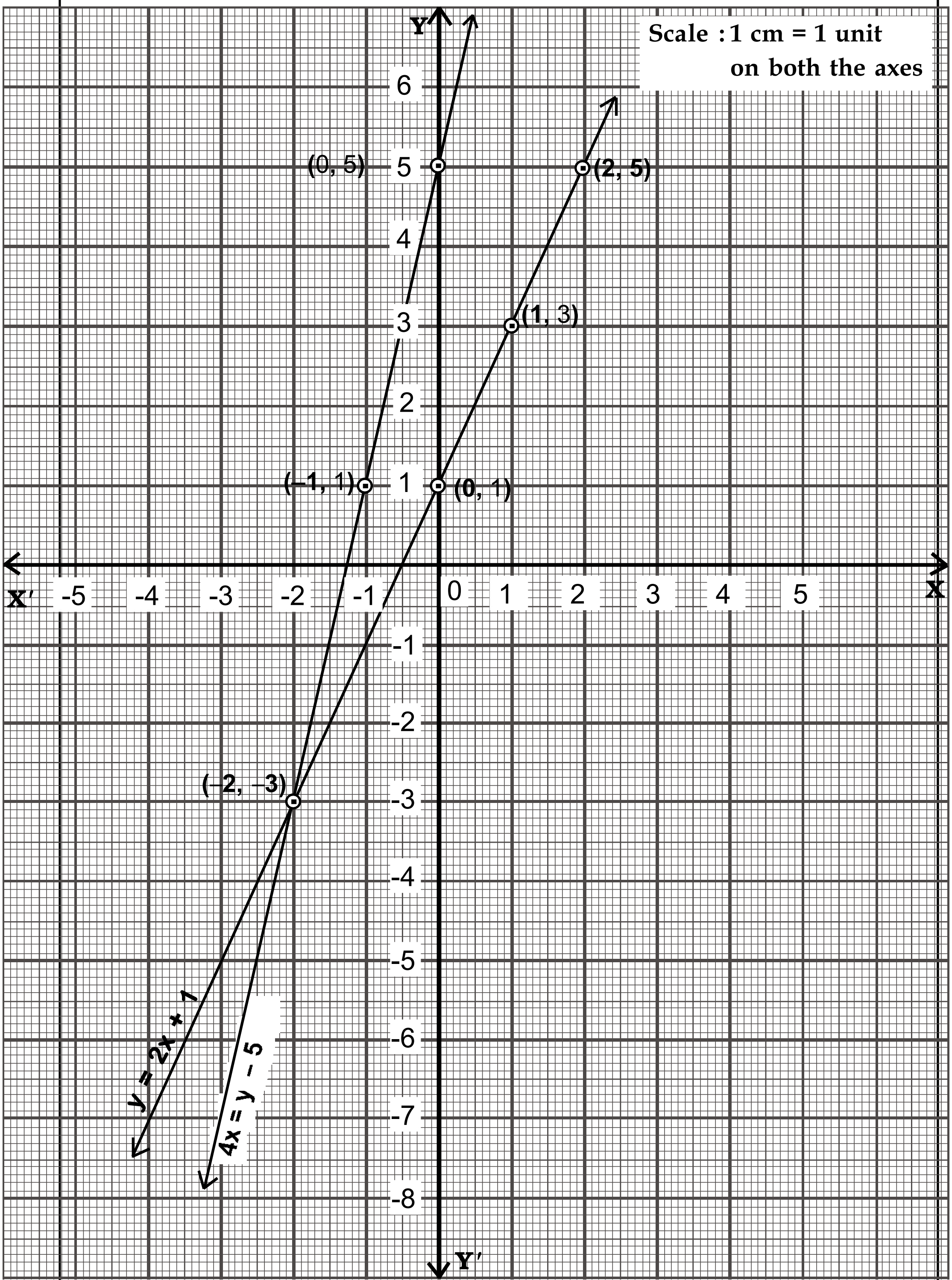

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∴ x = – 2 and y = -3 is the solution of given simultaneous equations. 1

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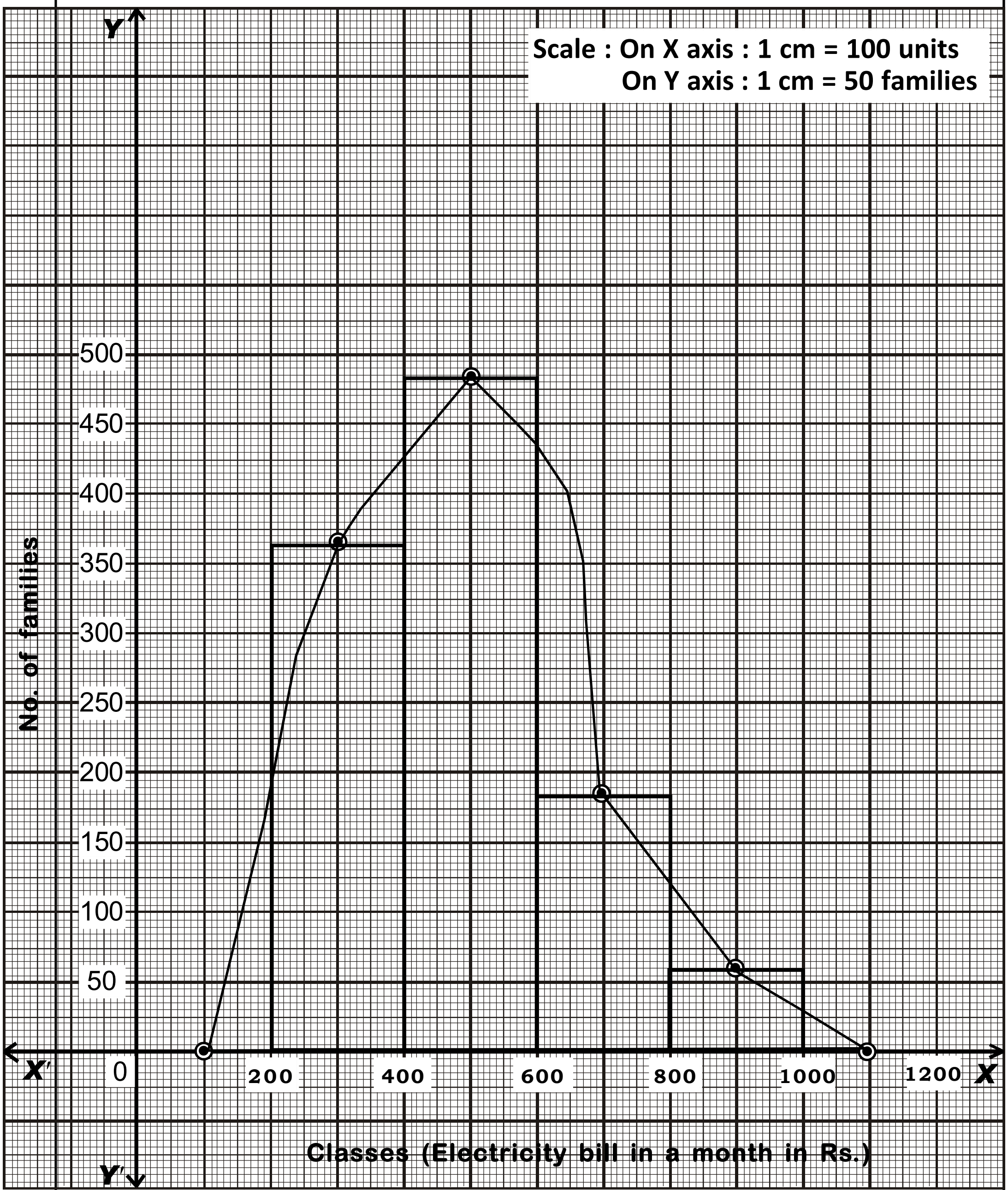
(ii)

Electricity bill in a month in Rs.	Class mark	No. of families
200 - 400	300	362
400 - 600	500	490
600 - 800	700	185
800 - 1000	900	63

1



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(iii) The natural numbers from 1 to 140 that are divisible by 4 are as follows : 4, 8, 12, 16, ..., 140

These numbers from an A.P. with $a = 4$, $d = t_2 - t_1 = 8 - 4 = 4$ **1**

Let, 140 be the n^{th} term of A.P.

$t_n = 140$

$t_n = a + (n - 1)\,d$

$\therefore\ 140 = 4 + (n - 1)\,4$

$\therefore\ 140 = 4 + 4n - 4$

$\therefore\ 140 = 4n$

$\therefore\ n = \dfrac{140}{4}$

$\therefore\ n = 35$ **1**

$\therefore$ 140 is 35 term of A.P.

$\therefore$ We have to find sum of 35 terms i.e. S_{35},

$S_n = \dfrac{n}{2}\,[2a + (n - 1)d]$

$\therefore\ S_{35} = \dfrac{35}{2}\,[2\,(4) + (35 - 1)\,4]$ **1**

$\therefore\ S_{35} = \dfrac{35}{2}\,[8 + 34\,(4)]$

$\therefore\ S_{35} = \dfrac{35}{2}\,[8 + 136)$

$\therefore\ S_{35} = \dfrac{35}{2}\,[144]$

$\therefore\ S_{35} = 2520$

$\therefore$ Sum of natural numbers from 1 to 140 that are divisible by 4 is 2520. **1**

A.5. Solve ANY TWO of the following :

(i) Let the five consecutive natural numbers be x, $x + 1$, $x + 2$, $x + 3$ and $x + 4$ respectively. **1**

As per the given condition,

$x^2 + (x + 1)^2 + (x + 2)^2 + (x + 3)^2 + (x + 4)^2 = 1455$

$\therefore\ x^2 + x^2 + 2x + 1 + x^2 + 4x + 4 + x^2 + 6x + 9 + x^2 + 8x + 16 - 1455 = 0$

$\therefore\ 5x^2 + 20x + 30 - 1455 = 0$ **1**

$\therefore\ 5x^2 + 20x - 1425 = 0$

Dividing throughout by 5 we get,

$x^2 + 4x - 285 = 0$

$\therefore\ x^2 - 15x + 19x - 285 = 0$

$\therefore\ x\,(x - 15) + 19\,(x - 15) = 0$

$\therefore\ (x - 15)\,(x + 19) = 0$

$\therefore\ x - 15 = 0$ or $x + 19 = 0$ **1**

$\therefore\ x = 15$ or $x = -19$

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∵ x is a natural number $x \neq -19$ **1**
Hence x = 15
∴ x + 1 = 15 + 1 = 16 ∴ x + 2 = 15 + 2 = 17
∴ x + 3 = 15 + 3 = 18 ∴ x + 4 = 15 + 4 = 19
∴ The required five consecutive natural numbers are 15, 16, 17, 18 and 19 respectively. **1**

(ii)

Calories	**Frequency (f_i) (No. of boys)**	**Cumulative frequency less than type**
1000 - 1500	5	5
1500 - 2000	13	18
2000 - 2500	16	34 → *c.f.*
2500 - 3000	18 → *f*	52
3000 - 3500	27	79
3500 - 4000	10	89
4000 - 4500	4	93
Total	**93 → N**	

1

Here total frequency = Σf_i = N = 93

∴ $\frac{N}{2} = \frac{93}{2} = 46.5$ **1**

Cumulative frequency (less than type) which is just greater than 46.5 is 52. Therefore corresponding class 2500 - 3000 is median class.

L = 2500, N = 93, *c.f.* = 34, f = 18, h = 500 **1**

$$\text{Median} = L + \left(\frac{N}{2} - c.f.\right)\frac{h}{f}$$

$$= 2500 + \left(\frac{93}{2} - 34\right)\frac{500}{18}$$

$$= 2500 + (46.5 - 34)\frac{500}{18}$$ **1**

$$= 2500 + (12.5)\frac{500}{18}$$

$$= 2500 + \frac{6250}{18}$$

$$= 2500 + 347.22$$

$$= 2847.22$$

∴ Median of calories consumed by boys is 2847.22 calories. **1**

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(iii) Let the speed of bus be x km/hr. and time taken be y hrs.

$$\text{Distance} = \text{Speed} \times \text{Time}$$

$\therefore$ Distance = xy km

According to the first condition,

$$(x + 15)(y - 2) = xy$$

$\therefore$ $x(y - 2) + 15(y - 2) = xy$

$\therefore$ $xy - 2x + 15y - 30 = xy$

$\therefore$ $-2x + 15y = 30$ ......(i) **1**

According to the second condition,

$$(x - 5)(y + 1) = xy$$

$\therefore$ $x(y + 1) - 5(y + 1) = xy$

$\therefore$ $xy + x - 5y - 5 = xy$

$\therefore$ $x - 5y = 5$ ......(ii)

Multiplying (ii) by 3 we get,

$$3x - 15y = 15 \quad ......(iii)$$ **1**

Adding (i) and (iii) we get,

$$-2x + 15y = 30$$
$$3x - 15y = 15$$
$$x = 45$$ **1**

Substituting x = 45 in (ii),

$\therefore$ $45 - 5y = 5$

$\therefore$ $-5y = 5 - 45$

$\therefore$ $-5y = -40$

$\therefore$ $y = \dfrac{-40}{-5}$ **1**

$\therefore$ $y = 8$

$\therefore$ Distance = xy

= 45×8

= 360

$\therefore$ **Distance covered by bus is 360 km.** **1**

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