MARKING SCHEME — APPLIED MATHEMATICS CLASS XI

SET A

SECTION A (Q.1 – Q.20 : 1 mark each)

Q.1 (A) 10 $[120 - (78 + 54 - 22) = 10]$ **1**

Q.2 (A) $\{12, 24\}$ [multiples of LCM $= 12$] **1**

Q.3 (B) 63 $[2^6 - 1]$ **1**

Q.4 (C) 20 $[n(A \cap B) = 32 + 25 - 45 = 12\,;\, n(A - B) = 32 - 12]$ **1**

Q.5 (B) 12 $[n(A \times B) = 4 \times 3]$ **1**

Q.6 (B) $2^{12} - 1$ **1**

Q.7 (A) domain has at most 5 elements **1**

Q.8 (B) $\{(1,4),(2,3),(3,2),(4,1)\}$ **1**

Q.9 (A) ₹ 130 $[C(26) - C(25) = 130]$ **1**

Q.10 (B) $(-3, 3)$ **1**

Q.11 (B) $10 + 20x$ $[30 + 20(x - 1)]$ **1**

Q.12 (B) $(-\infty, 7]$ **1**

Q.13 (A) ₹ 16,250 $[8000 + 11 \times 750]$ **1**

Q.14 (B) a GP with common ratio 0.8 **1**

Q.15 (A) 1650 $[S_{25} = \frac{25}{2}[12 + 24 \times 5]]$ **1**

Q.16 (A) 60 $[\,{}^4P_2 \times 5 = 12 \times 5]$ **1**

Q.17 (A) 360 $[\,{}^6P_4]$ **1**

Q.18 (C) 180 $[\frac{6!}{2! \times 2!}$, as A and N each repeat twice] **1**

Q.19 (A) Both true, (R) correctly explains (A) $[5d = 20]$ **1**

Q.20 (A) Both true, (R) correctly explains (A) **1**

SECTION B (Q.21 – Q.25 : 2 marks each)

Q.21 $n(M \cup B) = 55 + 48 - 21 = 82$ 1 **2**
Employees using exactly one mode $= 82 - 21 = 61$ 1

OR

$n(C \times B) = 5 \times 4 = 20$ 1
Each element of $C \times B$ is an ordered pair (car model, bike model), i.e. one possible car–bike combination the showroom can display 1

Q.22 $R = \{(2,4),(2,6),(2,10),(3,6),(3,9),(5,10)\}$ 1½ **2**
Range of $R = \{4, 6, 9, 10\}$ ..... ½

Q.23 $a = 240000$, $d = 18000$, $n = 15$ ..... ½ **2**

$a_{15} = 240000 + 14 \times 18000$ 1
$= ₹\,4{,}92{,}000$ ..... ½

Q.24 The first place can be filled by an odd digit (1, 3, 5, 7) in 4 ways 1 **2**
The remaining three places can be filled in ${}^{6}P_{3} = 120$ ways ; total $= 4 \times 120 = 480$ 1

Q.25 $LOGISTICS$ has 9 letters with S repeating thrice and I twice 1 **2**
Number of arrangements $= \frac{9!}{3! \times 2!} = 30240$ 1

OR

Total arrangements $= 6! = 720$; arrangements with the two delegates together $= 2 \times 5! = 240$ 1
Required number $= 720 - 240 = 480$ 1

SECTION C (Q.26 – Q.31 : 3 marks each)

Q.26 Correct Venn diagram with the three overlapping regions marked 1 **3**
$n(C \cup T \cup J) = 25 + 26 + 26 - 9 - 11 - 8 + 3 = 52$ 1½
Customers ordering none of the three $= 60 - 52 = 8$ ..... ½

Q.27 (a) $R = \{(1,1),(1,2),(1,3),(1,4),(1,6),(2,2),(2,4),(2,6),(3,3),(3,6),(4,4),(6,6)\}$ 1½ **3**
(b) Domain $= \{1,2,3,4,6\}$, Range $= \{1,2,3,4,6\}$ 1
(c) $n(A \times A) = 25$, so the number of relations from A to A is 2^{25} ..... ½

OR

(a) $R = \{(1,2),(2,4),(3,6),(4,8)\}$; Domain $= \{1,2,3,4\}$, Range $= \{2,4,6,8\}$ 1½
(b) Yes ; every element of A has exactly one image in B under the rule $b = 2a$ 1
(c) $n(A \times B) = 16$, so the number of relations from A to B is 2^{16} ..... ½

Q.28 (a) $f(x) = 60 + 22(x - 1)$, i.e. $f(x) = 38 + 22x$, $x \in N$ 1 **3**
(b) $f(9) = 38 + 198 = ₹\,236$ 1
(c) $38 + 22x = 258 \Rightarrow x = 10$; the parcel weighed 10 kg 1

Q.29 $ar^4 = 81$ and $ar = 3 \Rightarrow r^3 = 27 \Rightarrow r = 3$ 1½ **3**
$a = 1$, so the GP is $1, 3, 9, 27, \ldots$ ..... ½
$S_6 = \frac{3^6 - 1}{3 - 1} = \frac{728}{2} = 364$ 1

Q.30 $ARTICLE$ has 7 letters ; treating the vowels A, I, E as one unit gives 5 units 1 **3**
Arrangements $= 5! \times 3! = 120 \times 6 = 720$ 1
Those beginning with a consonant : the first place can be filled in 4 ways, the remaining 4 units in $4! \times 3! = 144$ ways $\Rightarrow 4 \times 144 = 576$ 1

Q.31 ${}^{n}P_{4} = 20 \times {}^{n}P_{2} \Rightarrow n(n-1)(n-2)(n-3) = 20\,n(n-1)$ 1 **3**
$(n-2)(n-3) = 20 \Rightarrow n^2 - 5n - 14 = 0 \Rightarrow (n-7)(n+2) = 0$ 1½
$n = 7$ (rejecting $n = -2$) ..... ½

OR

Total 5-digit numbers $= 5 \times 5 \times 4 \times 3 \times 2 = 600$ 1½
Ending in 0 : $5 \times 4 \times 3 \times 2 = 120$; ending in 5 : $4 \times 4 \times 3 \times 2 = 96$ 1
Divisible by 5 $= 120 + 96 = 216$ ..... ½

SECTION D (Q.32 – Q.35 : 5 marks each)

Q.32 (a) Correct Venn diagram with all seven regions marked 1 **5**
(b) $n(F \cup C \cup B) = 120 + 95 + 70 - 45 - 30 - 35 + 15 = 190$ 1½
(c) Only food court $= 120 - 45 - 35 + 15 = 55$ 1½
(d) None of the three $= 200 - 190 = 10$; these 10 shoppers came to the mall but used none of the three facilities, so the management may target them with offers 1

Q.33 (a) $S = \{4,8,12,16,20\}$, $G = \{6,12,18\}$ 1 **5**
(b) $S \cap G = \{12\}$ — the slot shared by both batches ; $S \cup G = \{4,6,8,12,16,18,20\}$ — all slots used for training 1½

(c) $S - G = \{4, 8, 16, 20\}$; $G' = U - G$, i.e. all slots except 6, 12 and 18 ..... 1½
(d) $(S \cap G)' = U - \{12\}$ and $S' \cup G' = U - \{12\}$; hence verified 1

Q.34 (a) $f(x) = 120 + 5x$ for $0 \le x \le 100$ and $f(x) = 620 + 8(x - 100)$ for $x > 100$ 1½ **5**
(b) $f(80) = 120 + 400 = ₹\,520$ 1
(c) $f(250) = 620 + 8(150) = ₹\,1{,}820$ 1
(d) $1340 > 620$, so $620 + 8(x - 100) = 1340 \Rightarrow x = 190$ units 1
(e) $f(0) = 120$ and $f(400) = 620 + 2400 = 3020$, so range $= [120, 3020]$ ..... ½

Q.35 The instalments $1000, 1100, 1200, \ldots$ form an AP with $a = 1000$, $d = 100$ 1 **5**
(a) $a_{30} = 1000 + 29 \times 100 = ₹\,3{,}900$ 1
(b) $S_{30} = \frac{30}{2}[2000 + 29 \times 100] = 15 \times 4900 = ₹\,73{,}500$ 1½
(c) Since $73500 < 118000$, the loan is not cleared ; amount still due $= 118000 - 73500 = ₹\,44{,}500$ 1½

OR

(a) Each year the value is 0.85 times the previous value, so the values form a GP with $a = 8{,}00{,}000 \times 0.85 = ₹\,6{,}80{,}000$ and $r = 0.85$ 2
(b) Value after 3 years $= 800000 \times (0.85)^3 = ₹\,4{,}91{,}300$ 1½
(c) After 4 years the value $= 800000 \times (0.85)^4 = ₹\,4{,}17{,}605$, which is more than ₹ 4,00,000 ; hence the value does not fall below half the purchase price by the end of the 4th year 1½

SECTION E (Q.36 – Q.38 : case study, 4 marks each)

Q.36 (i) $f(x) = 60 + 14x$ and $g(x) = 20x$ 1 **4**
(ii) $f(8) = ₹\,172$ and $g(8) = ₹\,160$ 1
(iii) $60 + 14x = 20x \Rightarrow x = 10$ km 1
For 15 km : $f(15) = ₹\,270$ and $g(15) = ₹\,300$, so Plan I is cheaper 1

OR

(iii) $60 + 14x \le 300 \Rightarrow x \le \frac{240}{14} = 17.1$, so the greatest whole number of km is 17 1
$f(0) = 60$ and $f(20) = 340$, so the range for $0 \le x \le 20$ is $[60, 340]$ 1

Q.37 (i) Members joining form an AP with $a = 40$, $d = 6$; $a_{10} = 40 + 54 = 94$ 1 **4**
(ii) $S_{10} = \frac{10}{2}[80 + 9 \times 6] = 5 \times 134 = 670$ members 1
(iii) Fees form a GP with $a = 1000$, $r = 1.1$; fee in the 4th month $= 1000(1.1)^3 = ₹\,1{,}331$ 1
It is a GP because each fee is a constant multiple (1.1) of the previous one, not a constant addition 1

OR

(iii) $40 + (n - 1)6 > 100 \Rightarrow 6n > 66 \Rightarrow n > 11$ 1
Hence the number first exceeds 100 in the 12th month 1

Q.38 (i) QUIZTEAM has 8 distinct letters ; number of arrangements of 3 letters $= {}^8P_3 = 336$ 1 **4**
(ii) Two distinct digits from 1 to 6 can be arranged in ${}^6P_2 = 30$ ways ; total codes $= 336 \times 30 = 10080$ 1
(iii) Treating the two finalists as one unit : $4! \times 2! = 24 \times 2 = 48$ arrangements 2

OR

(iii) $ASSESS$ has 6 letters with S repeated 4 times ; arrangements $= \frac{6!}{4!} = 30$ 1
It is smaller than $6! = 720$ because interchanging identical S's does not create a new arrangement 1

Note : Competency-based / application questions (Q.1, 4, 5, 7, 9, 11, 13, 14, 16, 19, 20, 21, 23, 24, 26, 28, 30, 32, 34, 35, 36–38) ≈ 52 marks (65%), well above the CBSE requirement of at least 50% competency-focused assessment.