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ENGINEERING APTITUDE

(QUANTITATIVE APTITUDE & ANALYTICAL ABILITY)

Revised and Updated

AS PER ENGINEERING SERVICE EXAM NEW PATTERN

1270+ Objective Questions

ENGINEERING APTITUDE

QUANTITATIVE APTITUDE & ANALYTICAL ABILITY

New Pattern

for

UPSC ESE Exam

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PREFACE

Engineering Aptitude, as a subject, has been growing in significance across competitive examinations in India. Now, Union Public Service Commission (UPSC) has introduced this topic in Engineering Service Examination (ESE). We have immense pleasure in introducing this book **"Engineering Aptitude** covering **Quantitative Aptitude and Analytical ability"** for the aspirants of various competitive examinations, mainly Civil Services, ESE and GATE aspirants.

In writing this book, under the guidance of **Mr. Kanchan Kumar Thakur (Ex. IES)**, we have had in mind the needs and interests of students appearing for Competitive Examinations like UPSC exams and GATE exam.

The discussion points focus on points of topical interest or on particular concept. Questions typical of those asked in the examinations have been included for practice and to discover the extent of knowledge of the aspirants. Keywords are printed in bold type to assist the student further in assimilating the information.

IES Master Publication is thankful to **Mr. Satendra Dubey** for his extensive contribution in generating, shaping, editing and production of this work. We also thanks the staff of IES Master and all those who have assisted with information and advice in the production of this book.

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CONTENTS

Preface *(iii)*

PART-A

1. Basics of Arithmetic **01–56**

1.1 Introduction … 01
1.2 Real Numbers … 01
1.2.1 Real Numbers
1.2.1 Rational Numbers … 02
1.2.2 Irrational Numbers … 04
1.3 Divisibility Rules … 05
1.4 Remainder Problems … 08
1.4.1 Remainder Theorem … 08
1.5 Factorial … 08
1.5.1 Largest Power of a Number in a Factorial (n!) … 09
1.6 LCM and HCF … 09
1.6.1 Methods of Finding LCM … 09
1.6.2 Methos of Finding HCF … 11
1.6.3 Types of Problems … 11
1.7 Indices or Powers … 14
1.7.1 Last Digit Problems … 15
1.8 Surds … 16
1.8.1 Types of Problems … 16
1.9 Logarithms … 17
1.9.1 Properties of Logarithms … 18
1.10 Simplification … 19
1.10.1 Hierarchy of Arithmetic Operations … 19
Exercise Level - I … 21
Exercise Level - II … 23

2. Sequences and Series **34 – 60**

2.1 Introduction … 34
2.1.1 Sequence … 34
2.1.2 Series … 35
2.2 Arithmetic Progression (AP) … 35
2.2.1 Representation of AP … 35
2.2.2 Standard Terms and Their Relations … 35
2.3 Geometric Progression (GP) … 38
2.3.1 Representation of GP … 39
2.3.2 Standard Terms and Their Relations … 39
2.4 Harmonic Progression (HP) … 41

2.4.1 Harmonic Mean (HM) ... *41*

2.5 Sum of General Series ... 42

2.6 Hidden Sequences ... 42

2.6.1 Types of Problems ... *42*

Exercise Level - I ... ***45***

Exercise Level - II ... ***48***

3. Simple and Compound Interest **61 – 78**

3.1 Introduction ... 61

3.2 Percentage ... 61

3.2.1 Percentage Change ... *62*

3.2.2 Successive Percentage Change ... *62*

3.3 Profit, Loss and Discount ... 63

3.3.1 Cost Price ... *63*

3.3.2 Selling Price ... *63*

3.3.3 Market Price ... *64*

3.3.4 Profit or Gain ... *64*

3.3.5 Loss ... *64*

3.3.6 Discount ... *64*

3.4 Interest ... 64

3.4.1 Simple Interest ... *65*

3.4.2 Compound Interest ... *65*

Exercise Level - I ... ***67***

Exercise Level - II ... ***70***

4. Ratio and Proportion **79 – 98**

4.1 Introduction ... 79

4.2 Ratio ... 79

4.2.1 Properties of Ratio ... *79*

4.2.2 Comparison of Ratios ... *80*

4.3 Proportion ... 80

4.3.1 Operations on Proportions ... *81*

4.3.2 Business Partnership Problems ...*82*

4.4 Average ... 82

4.4.1 Weighted Average ... *83*

4.5 Mixture ... 84

4.6 Alligation ... 85

4.6.1 Rule of Alligation ... *85*

4.7 Problems on Ages ... 87

Exercise Level - I ... ***88***

Exercise Level - II ... ***91***

5. Polynomials **99 – 119**

5.1 Introduction ... 99

5.2 Factors of a Polynomial ... 99

5.3 Graph of Elementary Functions ... 100
5.4 Quadratic Equations ... 101
5.4.1 Roots of Quadratic Equation ... 101
5.5 Roots of a Polynomial ... 103
5.5.1 Common Roots of Two Polynomials ... 104
5.5.2 Maximum and Minimum Values of a Polynomial ... 104
5.6 Inequalities ... 104
5.6.1 Properties and Results ... 104
5.6.2 Interval Notations ... 105
5.7 Modulus ... 106
5.7.1 Properties of Modulus ... 106
Exercise Level - I ... 107
Exercise Level - II ... 109

6. Speed-Time and Work-Time 120 – 152

6.1 Introduction ... 120
6.2 Speed ... 120
6.2.1 Analysis of Speed, Distance and Time Relationship ... 121
6.2.2 Average Speed ... 123
6.2.3 Relative Speed ... 125
6.3 Boats and Streams ... 126
6.4 Linear and Circular Races ... 127
6.4.1 Linear Races ... 127
6.4.2 Circular Races ... 128
6.5 Work-Time ... 129
6.6 Pipes and Cisterns ... 130
Exercise Level - I ... 132
Exercise Level - II ... 137

7. Clocks and Calendars 153 – 164

7.1 Introduction ... 153
7.2 Clocks ... 153
7.3 Types of Problems ... 154
7.3.1 Angle Between Two Hands (when time is given) ... 154
7.3.2 Time (when angle between two hands is given) ... 154
7.3.3 Slow and Fast Clocks ... 155
7.3.4 Overall Gain or Loss of Time ... 155
7.3.5 Mirror Based Problems ... 155
7.4 Calendar ... 156
7.4.1 Basic Terminology ... 156
Exercise Level - I ... 157

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Exercise Level - II ... ***159***

8. Geometry and Mensuration **165 – 199**

8.1 Introduction ... 165

8.2 Point, Line and Plane ... 165

8.2.1 Types of Points ... *166*

8.2.2 Midpoint and Bisector ... *166*

8.2.3 Types of Lines and Planes ... *166*

8.3 Angle ... 166

8.3.1 Classification of Angles ... *167*

8.3.2 Complementary and Supplementary Angles ... *167*

8.3.3 Alternate Interior and Exterior Angles ... *168*

8.3.4 Corresponding Angles ... *168*

8.4 Polygon ... 169

8.4.1 Basic Terms ... *169*

8.4.2 Types of Polygons ... *170*

8.5 Triangle ... 171

8.5.1 Triangle Classification ... *172*

8.5.2 Altitude and Median of a Triangle ... *173*

8.5.3 Types of Centres in Triangles ... *173*

8.5.4 Congruent Triangles ... *173*

8.5.5 Similar Triangles ... *174*

8.5.6 Perimeter and Area of Triangles ... *175*

8.6 Quadrilaterals ... 176

8.6.1 Trapezoid (Trapezium) ... *176*

8.6.2 Parallelogram ... *176*

8.6.3 Perimeter and Areas of Quadrilaterals ... *177*

8.7 Hexagon ... 178

8.8 Circle ... 179

8.8.1 Terminology Used in Circles ... *179*

8.8.2 Properties of Circle ... *179*

8.8.3 Perimeter and Area ... *180*

8.9 Pyramid ... 183

Exercise Level - I ... ***186***

Exercise Level - II ... ***190***

9. Probability **200 – 232**

9.1 Introduction ... 200

9.2 Set ... 200

9.2.1 Types of Set ... *200*

9.2.2 Venn Diagrams of Different Sets ... *201*

9.3 Fundamental Principle of Counting ... 203

9.4 Permutation ... 203

9.4.1 Concept of ${}^nP_r$ ... 203

9.5 Combination ... 204

9.5.1 Concept of ${}^nC_r$ ... 204

9.5.2 Difference between Permutation and Combination ... 204

9.6 Problems on Permutation and Combination ... 205

9.6.1 Total Number of Combinations ... 205

9.6.2 Permutation of things when Some are Identical ... 205

9.6.3 Dividing given Items into Groups ... 205

9.6.4 Circular Permutation ... 206

9.6.5 Sum of all Numbers formed from given Digits ... 205

9.6.6 Number of Integral Solution of the equation $x_1 + x_2 + ... + x_n = p$ ... 206

9.6.7 Rank of a Word ... 207

9.7 Probability ... 208

9.7.1 Terms Related to Probability ... 209

9.7.2 Event ... 209

9.7.3 Algebra of Events ... 210

9.7.4 Mutually Exclusive Events ... 210

9.7.5 Independent Events ... 211

9.7.6 Exhaustive Events ... 211

9.7.7 Conditional Probability ... 213

Exercise Level - I ... 215

Exercise Level - II ... 220

10. Dice and Cubes 233 – 248

10.1 Introduction ... 233

10.2 Cubes ... 233

10.3 Types of Problems ... 233

Exercise Level - I ... 239

Exercise Level - II ... 240

Exercise Level - III ... 241

11. Direction Sense 249 – 260

11.1 Introduction ... 249

11.2 Problem Solving ... 249

Exercise Level - II ... 252

Exercise Level - III ... 253

12. Blood Relation 261– 271

12.1 Introduction ... 261

12.2 Symbols Used in Family Diagram ... 262

12.3 Types of Problems ... 262

12.3.1 Single Person Blood Relationship ... 262

12.3.2 Mixed Blood Relationship ... 263

12.3.3 Coded Blood Relationship ... 264

Exercise Level - II ... 265

Exercise Level - III ... 266

13.	**Sitting Arrangements**	**472 – 285**
13.1	Introduction	... 272
13.2	Solving Procedure	... 272
13.3	Types of Problems	... 272
	13.3.1 Linear Arragement	*... 273*
	13.3.2 Circular Arragement	*... 274*
	Exercise Level - I	***... 276***
	Exercise Level - II	**... 277**
	Exercise Level - III	***... 278***
14.	**Data Interpretation**	**286 – 323**
14.1	Introduction	... 286
14.2	Tables	... 286
14.3	Graphs	... 288
	14.3.1 Line Graph	*... 288*
	14.3.2 Bar Graph	*... 288*
	14.3.3 Cumulative Bar Graph	*... 289*
14.4	Pie Charts	... 290
14.5	Combination of Graphs	... 291
	Exercise Level - I	***... 293***
	Exercise Level - II	***... 296***
	Exercise Level - III	***... 302***
15.	**Puzzles**	**324 – 352**
15.1	Introduction	... 324
15.2	Problems of Categorisation	... 324
	15.2.1 Problem Solving Steps	*... 324*
15.3	Blood Relationship and Professions Problems	... 326
15.4	Sequencing Problems	... 326
15.5	Comparision Problems	... 327
15.6	Conditional Selection Problems	... 328
15.7	Problems of Pattern	... 328
15.8	Miscellaneous	... 330
	Exercise Level - I	***... 333***
	Exercise Level - II	***... 339***
	Exercise Level - III	***... 343***

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PART-B

16. Basic Concept of Syllogism **353 – 398**

16.1 Introduction ... 353

16.2 Basic syllogism terminology ... 353

16.2.1 Proposition ... 353

16.2.2 Parts of Proposition ... 354

16.3 Venn diagrams ... 354

16.4 Classification of Propositions ... 354

16.4.1 Universal Affirmative Proposition ... 354

16.4.2 Particular Affirmative Proposition ... 355

16.4.3 Universal Non-Affirmative Proposition ... 356

16.4.4 Particular Non-Affirmative Proposition ... 356

16.5 Ellimination Techniques ... 357

16.6 Adjectives in Syllogism ... 357

16.6.1 'Few' and 'A Few' ... 357

16.6.2 'Little' and 'A Little' ... 357

16.6.3 'Most' and 'Many' ... 357

16.6.4 'Only' ... 358

16.7 Conclusions From Multiple Statements ... 358

16.8 Definite Conclusions ... 359

16.9 Derivations ... 361

16.9.1 Derivation 1 ... 361

16.9.2 Derivation 2 ... 362

16.9.3 Derivation 3 ... 365

16.9.4 Derivation 4 ... 366

16.9.5 Exceptions ... 366

16.10 Steps to Solve Question of Syllogism ... 368

16.11 "Either ... or ..." case in syllogism ... 370

Exercise Level - I ***... 375***

Exercise Level - II ***... 378***

Exercise Level - III ***... 379***

17. Causative Syllogism **399– 411**

17.1 Introduction ... 399

17.2 Cause and Effect ... 399

17.3 Cause-Effect relationships ... 399

17.3.1 If Cause then Effect / Effect When Cause ... 400

17.3.2 Only If Cause then Effect ... 400

17.3.3 If Cause then not Effect / If not Cause then Effect ... 400
17.3.4 If and Only If Cause then Effect ... 401
17.3.5 If not Cause then Effect ... 402
17.4 Examples for sufficient and Necessary Cause ... 402
Exercise Level - I ... 404
Exercise Level - III ... 405

18. Critical Reasoning 734 – 463

18.1 Introduction ... 412
18.2 Critical Reasoning Terminology ... 412
18.2.1 Premise ... 412
18.2.2 Assumption ... 412
18.2.3 Inference ... 412
18.3 Steps followed in Critical Reasoning ... 413
18.4 Types of Questions ... 413
Exercise Level - I ... 418
Exercise Level - II ... 423
Exercise Level - III ... 425

EXERCISE (LEVEL-I)

Previous Year Questions from UPSC, CDS, CAPF and NDA

E1.1: A person has to completely put each of three liquids: 403 litres of petrol, 465 litres of diesel and 496 litres of mobil oil in bottles of equal size without mixing any of the above three types of liquids such that each bottle is completely filled. What is the least possible number of bottles required?

(a) 34 (b) 44
(c) 46 (d) None of the above

(UPSC 2007)

E1.2: Three bells toll at intervals of 9, 12 and 15 minutes respectively. All the three begin to toll at 8am. At what time will they first toll together again?

(a) 08:45 am (b) 10:30 am
(c) 11:00 am (d) 01:30 pm

(UPSC 2013)

E1.3: There are five hobby clubs in a college viz, photography, yachting, chess, electronics and gardening. The gardening group meets every second day, the electronics group meets every third day, the chess group meets every fourth day, the yachting group meets every fifth day and the photography group meets every sixth day. How many times do all the five groups meet on the same day within 180 days?

(a) 3 (b) 5
(c) 10 (d) 18 **(UPSC 2013)**

E1.4: A gardener has 1000 plants. He wants to plan them in such a way that the number of rows and the number of columns remains the same. What is the minimum number of plants that he needs more for this purpose?

(a) 14 (b) 24
(c) 32 (d) 34 **(UPSC 2013)**

E1.5: Five persons fire bullets at a target at an interval of 6, 7, 8, 9 and 12 sec. respectively. The number of times they would fire the bullets together at the target in an hour is.

(a) 6 (b) 7
(c) 8 (d) 9 **(UPSC 2014)**

E1.6: A bell rings every 18 min. A second bell rings every 24 min. A third bell rings every 32 min. If all the three bells ring at the same time at 8 O'clock in the morning, at what other time will they all ring together?

(a) 12:40 hrs. (b) 12:48 hrs.
(c) 12:56 hrs. (d) 13:04 hrs.

(UPSC–2014)

E1.7: For what value of k is $(x + 1)$ a factor of $x^3 + kx^2 – x + 2$?

(a) 4 (b) 3
(c) 1 (d) –2 **(CDS–2016)**

E1.8: The largest natural number which divides every natural number of the form $(n^3 – n)(n – 2)$, where n is a natural number greater than 2, is

(a) 6 (b) 12
(c) 24 (d) 48 **(CDS–2015)**

E1.9: What is the sum of digits of the least multiple of 13, which when divided by 6, 8 and 12 leaves 5, 7 and 11, respectively, as the remainders?

(a) 5 (b) 6
(c) 7 (d) 8 **(CDS–2015)**

E1.10: The number of pairs (x, y), where x, y are integers satisfying the equation $21x + 48y = 5$, is

(a) Zero (b) One
(c) Two (d) Infinity

(CDS–2015)

E1.11: A number when divided by 7 leaves a remainder 3 and the resulting quotient, when divided by 11 leaves a remainder 6. If the same number when divided by 11 leaves a remainder m and the resulting quotient when divided by 7 leaves a remainder n. What are the values of m and n, respectively?

(a) 1 and 4 (b) 4 and 1
(c) 3 and 6 (d) 6 and 3

(CDS–2015)

EXERCISE (LEVEL-II)

Previous Year Questions from GATE, CAT and ESE

E1.23: If $q^{-a} = \frac{1}{r}$ and $r^{-b} = \frac{1}{s}$ and $s^{-c} = \frac{1}{q}$, the value of abc is..... .

(a) $(rqs)^{-1}$ (b) 0

(c) 1 (d) r + q + s

(GATE–2016)

E1.24: If $(1.001)^{1259} = 3.52$, $(1.001)^{2062} = 7.85$, then $(1.001)^{3321}$

(a) 2.23 (b) 4.33

(c) 11.37 (d) 27.64

(GATE–2012)

E1.25: The numeral in the units position of

$211^{870} + 146^{127} \times 3^{424}$ is _____.

(GATE–2016)

E1.26: The binary operation □ is defined as $a \square b = ab + (a + b)$, where a and b are any two real numbers. The value of the identity element of this operation, defined as the number x such that $a \square x = a$, for any a, is _____.

(a) 0 (b) 1

(c) 2 (d) 10

(GATE–2016)

E1.27: If Log (P) = (1/2) Log (Q) = (1/3) Log (R), then which of the following option is TRUE?

(a) $P^2 = Q^3R^2$

(b) $Q^2 = PR$

(c) $Q^2 = R^3P$

(d) $R = P^2Q^2$

(GATE–2011)

E1.28: Given $(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$, which one of the following statements is TRUE?

(a) 3 inches = 0.5 yards

(b) 9 inches = 1.5 yards

(c) 9 inches = 0.25 yards

(d) 81 inches = 0.0625 yards

(GATE–2016)

E1.29: Operators □, ◇ and → are defined by;

$a \square b = \frac{a-b}{a+b}$; $a \diamond b = \frac{a+b}{a-b}$; $a \rightarrow b = ab$,

Find the value of $(66 \square 6) \rightarrow (66 \diamond 6)$.

(a) –2 (b) –1

(c) 1 (d) 2

(GATE–2015)

E1.30: Consider the equation : $(7526)_8 - (Y)_8 = (4364)_8$, where $(X)_N$ stands for X to the base N. Find Y.

(a) 1634 (b) 1737

(c) 3142 (d) 3162

(GATE–2014)

E1.31: If 137 + 276 = 435 how much is 731 + 672?

(a) 534 (b) 1408

(c) 1623 (d) 1513

(GATE–2010)

E1.32: A number is as much greater than 75 as it is smaller than 117. The number is:

(a) 91 (b) 93

(c) 89 (d) 96

(GATE–2013)

E1.33: If x = –0.5, then which of the following has the smallest value?

(a) $2^{\frac{1}{x}}$ (b) $\frac{1}{x}$

(c) 2^x (d) $\frac{1}{\sqrt{-x}}$

(CAT–2006)

E1.34: If $\frac{a}{b} = \frac{1}{3}, \frac{b}{c} = 2, \frac{c}{d} = \frac{1}{2}, \frac{d}{e} = 3$ and $\frac{e}{f} = \frac{1}{4}$, then what is the value of $\frac{abc}{def}$?

(a) 3/8 (b) 27/8

(c) 3/4 (d) 27/4

(CAT–2006)

PRACTICE PROBLEMS KEY

P1.1 (d)	P1.4 (a)	P1.7 (c)	P1.10 (a)	P1.13 (b)
P1.2 (a)	P1.5 (a)	P1.8 (b)	P1.11 (b)	P1.14 (d)
P1.3 (b)	P1.6 (d)	P1.9 (a)	P1.12 (a)	

EXERCISE (LEVEL-I) KEY

E1.1 (b)	E1.6 (b)	E1.11 (a)	E1.16 (c)	E1.21 (a)
E1.2 (c)	E1.7 (d)	E1.12 (d)	E1.17 (b)	E1.22 (d)
E1.3 (a)	E1.8 (c)	E1.13 (a)	E1.18 (c)	
E1.4 (b)	E1.9 (a)	E1.14 (a)	E1.19 (b)	
E1.5 (b)	E1.10 (a)	E1.15 (c)	E1.20 (d)	

EXERCISE (LEVEL-II) KEY

E1.23 (c)	E1.29 (c)	E1.35 (d)	E1.41 (a)	E1.47 (b)
E1.24 (d)	E1.30 (c)	E1.36 (b)	E1.42 (d)	E1.48 (b)
E1.25 (7)	E1.31 (c)	E1.37 (d)	E1.43 (a)	
E1.26 (a)	E1.32 (d)	E1.38 (b)	E1.44 (d)	
E1.27 (b)	E1.33 (b)	E1.39 (d)	E1.45 (d)	
E1.28 (c)	E1.34 (a)	E1.40 (c)	E1.46 (b)	

EXERCISE EXPLANATIONS (LEVEL-I)

E1.1: **(b)**

The size of bottle required to be filled

= HCF of (403, 465 and 1496 litres)

= 31 litres

The minimum possible number of bottles required

$$= \frac{403}{31}+\frac{465}{31}+\frac{496}{31}$$

= 13 + 15 + 16 = 44

E1.2: **(c)**

The time direction after which each bell toll

= LCM of (9, 12 and 15 min.)

= 180 min.

= 3 hrs

$\therefore$ If all the three begin to toll at 8:00 AM then the next toll together again

= 8 + 3 = 11:00 AM

E1.3: **(a)**

The number of days after which all the five groups meet same day

= LCM of (2, 3, 4, 5 and 6 days)

= 60 days

$\therefore$ The number of times all the groups meet on the same day within 180 days

$$= \frac{180}{60} = 3 \text{ times}$$

E1.4: **(b)**

As the number of columns and rows are same so, the number of plants will be a perfect square (i.e. n^2).

The perfect square just greater than 1000 is 1024

so, the number of plants needed

= 1024 – 1000

= 24 plants

E1.5: **(b)**

The time after which the persons firing the bullet together = LCM of (6, 7, 8, 9 and 12 sec.)

$$\begin{aligned} 6 &= 2 \times 3 \\ 7 &= 1 \times 7 \\ 8 &= 2 \times 2 \times 2 \\ 9 &= 3 \times 3 \\ 12 &= 2 \times 2 \times 3 \end{aligned}$$

$\therefore$ LCM = $2 \times 3 \times 7 \times 2 \times 2 \times 3$

= 36×14 sec.

So, the number of times they firing bullets together in a hour

$$= \frac{3600}{36\times14} = \frac{50}{7} = 7\frac{1}{7}$$

Hence, it will be 7.

E1.6: **(b)**

The time after which all the bell rings at the same time

= LCM of (18, 24 and 32 min.)

= 288 min.

= 4 hrs 48 min.

$\therefore$ The required time

= 08:00 hrs + 04:48 hrs

= 12:40 hrs

E1.7: **(d)**

As (x + 1) is a factor of $f(x) = x^3 + kx^2 – x + 2$ so, f(–1) will result of zero remainder.

$\therefore$ $f(-1) = 0 = (-3)^3 + k(-1)^2 – (-1) + 2$

or $–1 + k + 1 + 2 = 0$

or $k = –2$

E1.8: **(c)**

Let $f(n) = (n^3 – n)(n – 2)$ for n > 2; where n is natural number.

$f(3) = (3^3 – 3)(3 – 2) = 24 = 1 \times 24$

$f(4) = (4^4 – 4)(4 – 2) = 120 = 5 \times 24$

$f(5) = (5^4 – 5)(5 – 2) = 360 = 15 \times 24$

As we see the pattern above, all the natural numbers are divisible by 24 (largest).

E1.9: **(a)**

This is a LCM based type-3 problem.

EXERCISE EXPLANATIONS (LEVEL-II)

E1.23: (c)

Given, $q^{-a} = \frac{1}{r}, r^{-b} = \frac{1}{s}, s^{-c} = \frac{1}{q}$

By using the Rules of indices, the above equations can be written as

$q^a = r, \quad r^b = s, \quad s^c = q$

Now, $q^{abc} = (q^a)^{bc} = (r)^{bc} = (r^b)^c = (s)^c = q$

$\therefore \quad q^{abc} = q \Rightarrow abc = 1$

E1.24: (d)

$(1.001)^{1259} = 3.52, (1.001)^{2062 = 7.85}$

Multiplying both the equations

$(1.001)^{1259} \times (1.001)^{2069} = 3.52 \times 7.85$

As $1259 + 2062 = 3321$

$\therefore \quad (1.001)^{3321} = 27.632$

E1.25: (7)

The number $(211)^{870}$ can be written as

$(210 + 1)^{870}$

As the cyclicity of number 11 is 1 so,

Numeral at the unit position in $(211)^{870} = 1$

Similarly, the number $(146)^{127}$ can be written as $(140 + 6)^{127}$.

As the cyclicity of number 6 is 1 so, the last numberal of $(146)^{127}$ will be 6.

Similarly, 3^{424} can be written as

$(9)^{212} = (10 - 1)^{212}$.

So, at unit place it will be 1.

Hence, the numeral at the unit position of

$211^{870} + 146^{127} \times 3^{424} = 1 + 6 \times 7 = 7$.

E1.26: (a)

Given, $a \square b = ab + a + b$

The equation, $a \square x = a$ or $ax + a + x = a$

or $(a + 1)x = 0 \Rightarrow x = 0$

E1.27: (b)

Let $\log P = \frac{1}{2}\log Q = \frac{1}{3}\log R = k$

$P = 10^k, \; Q = 10^{2k}$ and $R = 10^{3k}$

$$\frac{Q}{P} = \frac{10^{2k}}{10^k} = 10^k \qquad \text{... (i)}$$

and $$\frac{R}{Q} = \frac{10^{3k}}{10^{2k}} = 10^k \qquad \text{... (ii)}$$

$\therefore$ From equation (i) and (ii),

$Q^2 = PR$

E1.28: (c)

Given, $(9 \text{ inches})^{1/2} = (0.25 \text{ yards})^{1/2}$

By squaring both the sides of above equation

9 inches = 0.25 yards

E1.29: (c)

From the given data :

$$(66 \square 6) = \frac{66 - 6}{66 + 6} = \frac{60}{72}$$

and $$(66 \diamond 6) = \frac{66 + 6}{66 - 6} = \frac{72}{60}$$

then, $$(66 \square 6) \to (66 \diamond 6) = \frac{60}{72} \times \frac{72}{60} = 1$$

E1.30: (c)

$(7526)_8 - (Y)_8 = (4364)_8$

or $(Y)_8 = (7526 - 4364)_8 = (3142)_8$

E1.31: (c)

The given addition is an octal addition as,

$137 + 276 = 435$

$7 + 6 = 8 + 5$

$3 + 7 = 8 + 2$

$1 + 2 = 0 + 3$

$\therefore \quad (731)_8 + (672)_8 = (1623)_8$

E1.32: (d)

Let the number, say N, is x greater than 75 and it is x less than 117 then,

$N = 75 + x = 117 - x$

$\Rightarrow \quad 2x = 117 - 75 = 42$

$\Rightarrow \quad x = 21$

$\therefore \quad N = 75 + 21 = 96$

E1.33: (b)

In the given options, for negative value of x, all are positive except $\frac{1}{x}$ which will be negative. Hence, $\frac{1}{x}$ is smallest among all options for x = –0.5.

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