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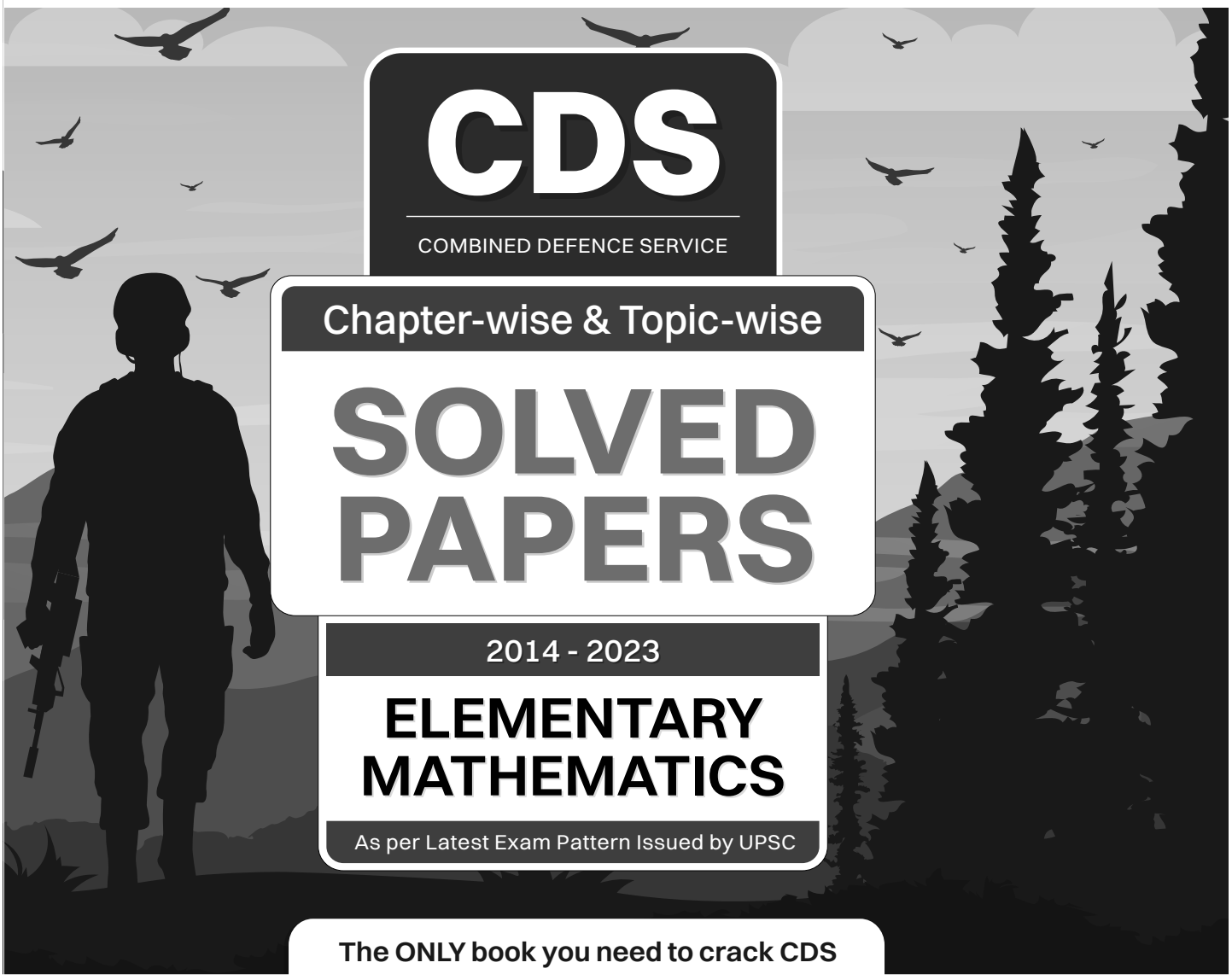

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SYLLABUS COVERED

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PREFACE

Welcome to the world of Combined Defence Services (CDS) entrance examination. The CDS exam is one of the most sought-after competitive exams in India, as it paves the way for candidates to join the prestigious Indian Army, Navy, and Air Force as officers.

This book, "CDS Chapter-wise & Topic-wise Solved Papers - Mathematics," aims to facilitate your exam preparation by providing you with a wide range of solved papers from previous years, giving you a clear understanding of the exam's complexity and scope. Each Chapter is accompanied by Concept Revision Notes & detailed explanations to help you grasp the concepts and techniques required to solve the questions effectively.

Some benefits of studying from Oswaal CDS Solved papers are:

- **100% updated** with Fully Solved Paper of April & September 2023.
- **Concept Clarity** with detailed explanations of 2014 to 2023 Papers.
- **Extensive Practice** with 1200+ Questions and Two Sample Question Papers.
- **Crisp Revision** with Concept Based Revision Notes, Mind Maps & Mnemonics.
- **Expert Tips** helps you get expert knowledge master & crack CDS in first attempt.
- **Exam insights** with 4 Year-wise (2020-2023) Trend Analysis, empowering students to be 100% exam ready.

This book has been developed with the highest editorial standards, keeping in mind the rigor and meticulousness required of an exam resource catering to CDS. The features of the book make it a must-have for anyone preparing for CDS 2023-24. We hope it will help students to supplement their CDS preparation strategy and secure a high rank.

We wish the readers great success ahead!

All the Best!

Tips to Crack Combined Defence Services (CDS) in the First Attempt

The CDS Exam is conducted by the Union Public Service Commission or UPSC for recruitment of commissioned officers in the Indian Military Academy, Officers Training Academy, Indian Naval Academy & Indian Airforce Academy. CDS is recognised as one of the reputed National level Examinations in India. Cracking the CDS Exam in the very first attempt, given the difficulty level, can be a laborious task but is quite attainable if done diligently as well as smartly. Here are some tips that you must follow by heart to crack the exam in the very first attempt:

1 Think Right

Calming yourself and thinking positive is the first and the best course of action that one is required to take. Think and believe that the exam goal is achievable if worked upon smartly.

2 Start studying from the beginning

All the aspirants are aware of how vast, comprehensive and detailed the syllabus of the CDS exam is. To crack the exam in the first attempt you have to start preparing for the exam from the beginning of your 12th class. It is only then that you will be able to complete the entire syllabus. Following this approach will also allow you plenty of time to revise.

3 Respect the syllabus and arrange the materials accordingly

While preparing for the CDS exam nothing can be labelled as less important. Questions can come from the most unexpected topics too. Laying down your whole syllabus in front of you will help you to decide on the study material you require.

4 Get the right tools and study material

Gathering and preparing from the appropriate study material is something you cannot be ignorant towards. You can refer to Oswaal Books CDS Year-Wise Solved Papers along with Question Banks to enhance your preparation. Both the reference books are on the lines of the current syllabus and can be entrusted upon before the examination.

5 Schedule total time for each subject

Creating a schedule which gives due time to all the subjects is a must. Giving proper time to all the subjects daily will help you cover the syllabus on time, giving you enough time for revision.

6 Understand the concepts

No one can crack the CDS exam just by mugging up all the concepts and topics. The syllabus of the exam is in-depth such that you need to understand every concept.

7 Practice a lot of Sample Papers

Year-wise Solved Papers will not only help you in understanding the examination pattern, but they will also help you in figuring out the questions that come up every year and this might give you an edge over other students. You can refer to Oswaal CDS Question Bank, as they include all the typologies of Questions asked in the Examination, Previous Years Papers with solutions, Mind Maps, etc. Referring to various sample papers might also help you in comprehending the areas which require more work.

8 Revise whenever you get time

Make sure you revise as much as possible. The revision will help you in keeping the concepts fresh in your mind.

9 Analysing your performance

While you are solving papers, make sure you keep a track of time i.e. how much time does it take to solve one section or one question? Make a report of the sections and type of questions which take minimum and maximum time.

Contents

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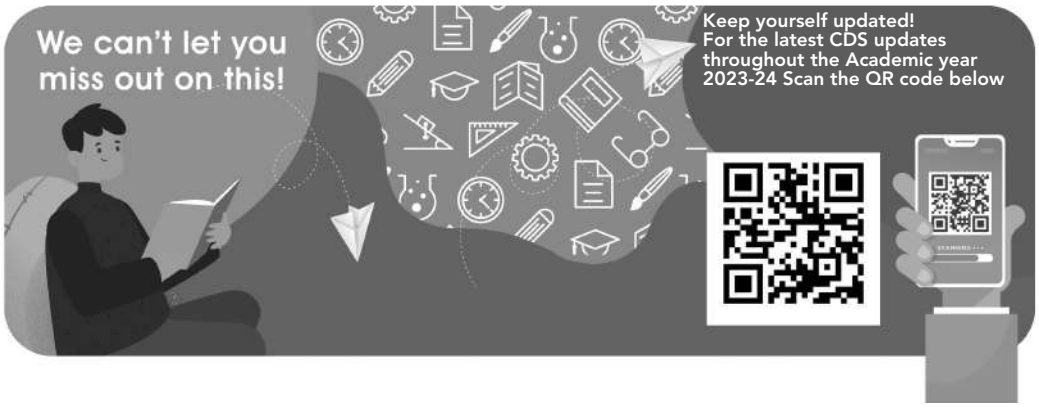

Syllabus

PAPER-I
ELEMENTARY MATHEMATICS

(Code No. 03)

Number System-Natural numbers, Integers, Rational and Real numbers. Fundamental operations, addition, substraction, multiplication, division, Square roots, Decimal fractions. Unitary method, time and distance, time and work, percentages, applications to simple and compound interest, profit and loss, ratio and proportion, variation.

Elementary Number Theory—Division algorithm. Prime and composite numbers. Tests of divisibility by 2, 3, 4, 5, 9 and 11. Multiples and factors. Factorisation Theorem. H.C.F. and L.C.M. Euclidean algorithm. Logarithms to base 10, laws of logarithms, use of logarithmic tables.

ALGEBRA Basic Operations, simple factors, Remainder Theorem, H.C.F., L.C.M., Theory of polynomials, solutions of quadratic equations, relation between its roots and coefficients (Only real roots to be considered). Simultaneous linear equations in two unknowns—analytical and graphical solutions. Simultaneous linear inequations in two variables and their solutions. Practical problems leading to two simultaneous linear equations or inequations in two variables or quadratic equations in one variable & their solutions. Set language and set notation, Rational expressions and conditional identities, Laws of indices.

TRIGONOMETRY sine x, cosine x, tangent x when $0° < x < 90°$ Values of sin x, cos x and tan x, for $x = 0°$, 30°, 45°, 60° and 90° Simple trigonometric identities. Use of trigonometric tables. Simple cases of heights and distances.

GEOMETRY Lines and angles, Plane and plane figures, Theorems on (i) Properties of angles at a point, (ii) Parallel lines, (iii) Sides and angles of a triangle, (iv) Congruency of triangles, (v) Similar triangles, (vi) Concurrence of medians and altitudes, (vii) Properties of angles, sides and diagonals of a parallelogram, rectangle and square, (viii) Circles and its properties including tangents and normals, (ix) Loci.

MENSURATION Areas of squares, rectangles, parallelograms, triangle and circle. Areas of figures which can be split up into these figures (Field Book), Surface area and volume of cuboids, lateral surface and volume of right circular cones and cylinders, surface area and volume of spheres.

STATISTICS Collection and tabulation of statistical data, Graphical representation frequency polygons, histograms, bar charts, pie charts etc. Measures of central tendency.

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NDA vs CDS: Know All the Similarities & Differences

The National Defence Academy (NDA) and the Combined Defence Services (CDS) Exams are gateways to the Indian Armed Forces. Though both the exams are conducted by the Union Public Service Commission, i.e. UPSC, there are many similarities and differences in the recruitment, training, salary, perks and promotion opportunities, etc.

For those who are planning to join Indian Army, Navy or Air Force, it is essential to know the differences and similarities in NDA and CDS. The similarities are given below:

Parameter	NDA	CDS
Age	16.5-19.5 Years	19-25 Years
Eligibility	Men only	Men & Women
Educational Qualification	10+2	Degree
Scheme of Examination	Written + SSB	Written + SSB
Frequency of the Exam	Twice/Year	Twice/Year
Duration of Training	4-4.5 Years 3 Yrs. at NDA and 1 Yr. at IMA (For Army cadets) 3 Yrs. at NDA and 1 Yr. at Naval Academy (For Naval cadets)/ 3 Yrs. at NDA and 1 & 1/2 Yrs. at AFA Hyderabad (For AF cadets)	18 months for IMA Cadets 37-40 months for Navy Officers 74 months for Air Force Officers
Training Centres	National Defence Academy, Khadakwasla, Pune Indian Military Academy, Dehradun Indian Naval Academy, Ezhimala Indian Air Force Academy, Hyderabad	Indian Military Academy (IMA), Dehradun for Army Cadets Indian Naval Academy, Ezhimala for Navy Cadets Indian Air Force Academy, Hyderabad for Air Force Officers Officers Training Academy (OTA), Chennai
Degrees awarded	Army Cadets - B.Sc./B.Sc. (Computer)/BA /B.Tech. degree Naval Cadets - B.Tech. degree Air Force Cadets - B.Tech. degree	Army Cadets in IMA - PG Diploma in 'Military and Defence Management OTA Chennai – Post Graduate Diploma in Defence Management and Strategic Studies
Rank assigned after training	Lieutenant	Lieutenant
Stipend during training	Rs. 21,000/- p.m. (fixed)	Rs. 21,000/- p.m. (fixed)

Promotional Avenues

Rank	Min. Commissioned Service for Promotion	
	NDA Officer	CDS Officer
Lieutenant	On Commission	On Commission
Captain	02 Years	02 Years
Major	06 years	06 years
Lieutenant Colonel	13 years	13 years
Colonel(Selection)	15 years	15 years
Colonel (Time Scale)	26 years	26 years
Brigadier	On Selection	23 years
Major General	On Selection	25 years
Lieutenant General	On Selection	28 years
General	On Selection	No restrictions

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APPENDIX-I

A. SCHEME OF EXAMINATION

1. The Competitive examination comprises:

(a) Written examination as shown in para 2 below.

(b) Interview for intelligence and personality test (vide Part 'B' of this Appendix) of such candidates as may be called for interview at one of the Services Selection Centres.

2. The subjects of the written examination, the time allowed and the maximum marks allotted to each subject will be as follows:

(a) For Admission to Indian Military Academy, Indian Naval Academy and Air Force Academy:—

Subject	Duration	Maximum Marks
1. English	2 Hours	100
2. General Knowledge	2 Hours	100
3. Elementary Mathematics	2 Hours	100

(b) For Admission to Officers' Training Academy :—

Subject	Duration	Maximum Marks
1. English	2 Hours	100
2. General Knowledge	2 Hours	100

The maximum marks allotted to the written examination and to the interviews will be equal for each course i.e. the maximum marks allotted to the written examination and to the interviews will be 300, 300, 300 and 200 each for admission to the Indian Military Academy, Indian Naval Academy, Air Force Academy and Officers' Training Academy respectively.

3. The papers in all the subjects will consist of objective type questions only. The question papers (Test Booklets) of General Knowledge and Elementary Mathematics will be set bilingually in Hindi as well as English.

4. In the question papers, wherever necessary, questions involving the metric system of Weights and Measures only will be set.

5. Candidates must write the papers in their own hand. In no circumstances will they be allowed the help of a scribe to write answers for them.

6. The Commission have discretion to fix qualifying marks in any or all the subjects of the examination.

7. The candidates are not permitted to use calculator for answering objective type papers (Test Booklets). They should not therefore, bring the same inside the Examination Hall.

Height requirement varies as per the stream of entry. Weight should be proportionate to height as per the chart given below:-

Age (yrs)	Minimum weight for all ages	Age: 17 to 20 yrs	Age: 20 + 01 day - 30 yrs	Age : 30 + 01 Day - 40 yrs	Age: Above 40 yrs
Height (cm)	Weight (Kg)	Weight (Kg)	Weight (Kg)	Weight (Kg)	Weight (Kg)
140	35.3	43.1	45.1	47.0	49.0
141	35.8	43.7	45.7	47.7	49.7
142	36.3	44.4	46.4	48.4	50.4
143	36.8	45.0	47.0	49.1	51.1
144	37.3	45.6	47.7	49.8	51.8
145	37.8	46.3	48.4	50.5	52.6
146	38.4	46.9	49.0	51.2	53.3
147	38.9	47.5	49.7	51.9	54.0
148	39.4	48.2	50.4	52.6	54.8
149	40.0	48.8	51.1	53.3	55.5
150	40.5	49.5	51.8	54.0	56.3
151	41.0	50.2	52.4	54.7	57.0
152	41.6	50.8	53.1	55.4	57.8
153	42.1	51.5	53.8	56.2	58.5
154	42.7	52.2	54.5	56.9	59.3
155	43.2	52.9	55.3	57.7	60.1
156	43.8	53.5	56.0	58.4	60.8
157	44.4	54.2	56.7	59.2	61.6
158	44.9	54.9	57.4	59.9	62.4
159	45.5	55.6	58.1	60.7	63.2
160	46.1	56.3	58.9	61.4	64.0
161	46.7	57.0	59.6	62.2	64.8
162	47.2	57.7	60.4	63.0	65.6
163	47.8	58.5	61.1	63.8	66.4
164	48.4	59.2	61.9	64.6	67.2
165	49.0	59.9	62.6	65.3	68.1
166	49.6	60.6	63.4	66.1	68.9
167	50.2	61.4	64.1	66.9	69.7
168	50.8	62.1	64.9	67.7	70.6
169	51.4	62.8	65.7	68.5	71.4
170	52.0	63.6	66.5	69.4	72.3
171	52.6	64.3	67.3	70.2	73.1
172	53.3	65.1	68.0	71.0	74.0
173	53.9	65.8	68.8	71.8	74.8
174	54.5	66.6	69.6	72.7	75.7
175	55.1	67.4	70.4	73.5	76.6
176	55.8	68.1	71.2	74.3	77.4
177	56.4	68.9	72.1	75.2	78.3
178	57.0	69.7	72.9	76.0	79.2
179	57.7	70.5	73.7	76.9	80.1

Age (yrs)	Minimum weight for all ages	Age: 17 to 20 yrs	Age: 20 + 01 day - 30 yrs	Age : 30 + 01 Day - 40 yrs	Age: Above 40 yrs
Height (cm)	Weight (Kg)	Weight (Kg)	Weight (Kg)	Weight (Kg)	Weight (Kg)
180	58.3	71.3	74.5	77.8	81.0
181	59.0	72.1	75.4	78.6	81.9
182	59.6	72.9	76.2	79.5	82.8
183	60.3	73.7	77.0	80.4	83.7
184	60.9	74.5	77.9	81.3	84.6
185	61.6	75.3	78.7	82.1	85.6
186	62.3	76.1	79.6	83.0	86.5
187	62.9	76.9	80.4	83.9	87.4
188	63.6	77.8	81.3	84.8	88.4
189	64.3	78.6	82.2	85.7	89.3
190	65.0	79.4	83.0	86.6	90.3
191	65.7	80.3	83.9	87.6	91.2
192	66.4	81.1	84.8	88.5	92.2
193	67.0	81.9	85.7	89.4	93.1
194	67.7	82.8	86.6	90.3	94.1
195	68.4	83.7	87.5	91.3	95.1
196	69.1	84.5	88.4	92.2	96.0
197	69.9	85.4	89.3	93.1	97.0
198	70.6	86.2	90.2	94.1	98.0
199	71.3	87.1	91.1	95.0	99.0
200	72.0	88.0	92.0	96.0	100.0
201	72.7	88.9	92.9	97.0	101.0
202	73.4	89.8	93.8	97.9	102.0
203	74.2	90.7	94.8	98.9	103.0
204	74.9	91.6	95.7	99.9	104.0
205	75.6	92.5	96.7	100.9	105.1
206	76.4	93.4	97.6	101.8	106.1
207	77.1	94.3	98.6	102.8	107.1
208	77.9	95.2	99.5	103.8	108.2
209	78.6	96.1	100.5	104.8	109.2
210	79.4	97.0	101.4	105.8	110.3

(a) Weight for height charts given above is for all categories of personnel. This chart is prepared based on the BMI. The chart specifies the minimum acceptable weight that candidates of a particular height must have. Weights below the minimum specified will not be acceptable in any case. The maximum acceptable weight of height has been specified in age wise categories. Weights higher than the acceptable limit will be acceptable only in the case of candidates with documented evidence of body building, wrestling, and boxing at the National level. In such cases the following criteria will have to be met.

(i) Body Mass Index should be below 25.

(ii) Waist Circumference should be less than 90 cm for males and 80 cm for females.

(iii) All biochemical metabolic parameters should be within normal limits. Note:The height and weight for candidates below 17 yrs will be followed as per guidelines by 'Indian Academy of Paediatrics growth charts for height, weight and BMI for 05 yrs to 16 yrs old children'.

(b) The minimum height required for male candidates for entry into the Armed Forces is 157 cm or as decided by the respective recruiting agency. Gorkhas and candidates belonging to Hills of North Eastern region of India, Garhwal and Kumaon, will be accepted with a minimum height of 152 cm.

(c) The minimum height required for female candidates for entry into the Armed Forces is 152 cm. Gorkhas and candidates belonging to Hills of North Eastern region of India, Garhwal and Kumaon will be accepted with a minimum height of 148 cm. Note:An allowance for growth of 02 cm will be made for both male and female candidates below 18 years of age at the time of examination. The minimum height requirement for the Flying Branch is 163 cm. Anthropometric standards like sitting height, leg length and thigh length are also required by the flying Branch.

8. Following investigations will be carried out for all officer entries and for pre-commission training academies. However examining medical officer/ medical board may ask for any other investigation deemed fit.

(a) Complete haemogram
(b) Urine RE
(c) Chest X-ray
(d) USG abdomen and Pelvis.

9. Certain standards vary depending on age and type entry viz stds for vision as follows:-

Parameter	Standards : 10+2 entries, NDA(Army), TES and equivalent	Graduate & equivalent entries: CDSE, IMA, OTA, UES, NCC,TGC & equivalent	Post graduate & equivalent entries: JAG, AEC, APS, RVC,TA, AMC, ADC, SL & equivalent
Uncorrected vision (max allowed)	6/36 & 6/36	6/60 &6/60	3/60 & 3/60
BCVA	Rt 6/6 & Lt 6/6	Rt 6/6 & Lt 6/6	Rt 6/6 & Lt 6/6
Myopia	< -2.5 D Sph (including max astigmatism ≤ +/- 2.0 D Cyl)	< -3.50 D Sph (including max astigmatism ≤ +/- 2.0 D Cyl)	< -5.50 D Sph (including max astigmatism ≤ +/- 2.0 D Cyl)
Hypermetropia	<+2.5 D Sph, (including max astigmatism ≤ +/- 2.0 D Cyl)	<+3.50 DSph (including max astigmatism ≤ +/- 2.0 D Cyl)	<+3.50 D Sph (including max astigmatism ≤ +/- 2.0 D Cyl)
Lasik/equivalent surgery	Not permitted	Permitted*	Permitted*
Colour perception	CP-II	CP-II	CP-II

***LASIK or Equivalent kerato-refractive procedure**

(a) Any candidate who has undergone any kerato-refractive procedure will have a certificate from the centre where he/she has undergone the procedure, specifying the date and type of surgery.
(b) In order to be made FIT, the following criteria will have to be met:
(i) Age more than 20 yrs at the time of surgery
(ii) Minimum 12 months post LASIK
(iii) Central corneal thickness equal to or more than 450 μ
(iv) Axial length by IOL Master equal to or less than 26 mm
(v) Residual refraction of less than or equal to +/- 1.0 D incl cylinder, (provided acceptable in the category applied for).
(vi) Normal healthy retina.
(vii) Corneal topography and ectasia markers can also be included as addl criteria.

Trend Analysis from (2023-2019)

Chapter Name	Number of Question (s) in								
	2023	2022	2022	2021		2020		2019	
	I	I	II	I	II	I	II	I	II
Arithmetic	35	21	19	30	27	35	39	38	41
Algebra	15	23	25	15	21	10	12	17	10
Trigonometry	11	14	17	15	13	15	12	11	4
Mensuration	29	17	15	13	14	14	12	13	16
Geometry	5	17	15	17	17	21	19	14	19
Statistics	5	8	9	10	8	5	6	7	2
Data Interpretation	–	–	–	–	–	–	–	–	8
Total	100	100	100	100	100	100	100	100	100

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	Bhaiya Book Centre, 9424081874, Seva Suppliers, 9826451052
JABALPUR	Vinay Pustak Sadan, 8962362667, Anand Books and Stationers, 9425323508
SAGAR	Princi Book Depot, Sagar, 9977277011
KATNI	Shri Mahavir Agency, 9425363412
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NANDED	Abhang Pustakalaya, 9823470756/9175940756
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C.D.S.
Combined Defence Services

EXAM I 2023

Elementary Mathematics

Time Allowed : 2 Hours **Total Marks : 100**

Instructions

1. *This Test Booklet contains **100** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.*
2. *You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.*
3. ***All** items carry equal marks.*
4. ***Penalty for wrong answers :***
   THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
   (i). *There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** (0.33) of the marks assigned to that question will be deducted as penalty.*
   (ii). *If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.*
   (iii). *If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.*

1. What is the largest number which divides both $2^{35} - 1$ and $2^{91} - 1$?
(a) 34 **(b)** 90
(c) 127 **(d)** 129

2. What is the largest power of 10 that divides the product $29 \times 28 \times 27 \times ... 2 \times 1$?
(a) 4 **(b)** 5
(c) 6 **(d)** 7

3. What is the remainder when 65^{99} is divided by 11?
(a) 0 **(b)** 5
(c) 9 **(d)** 10

4. If the roots of the equation $x^2 - bx + c = 5$ differ by 5, then which one of the following is correct ?
(a) $b^2 = 4c + 5$ **(b)** $c^2 = 4b - 5$
(c) $b^2 + c^2 = 5$ **(d)** $b^2 - c^2 = 5$

5. In a party of 150 persons, 75 persons take tea, 60 persons take coffee and 50 persons take milk. 15 of them take both tea and coffee, but no one taking milk takes tea. If each person in the party takes at least one drink, then what is the number of persons taking milk only ?
(a) 50 **(b)** 40
(c) 30 **(d)** 20

6. A, B, C, D and E enter into a business. They invest money in the ratio 2 : 3 : 4 : 5 : 6. However, the time invested by them is in the ratio 6 : 5 : 4 : 3 : 2. If the profit distributed is directly proportional to time and money invested, then who receives the highest amount of profit ?
(a) C
(b) Both B and D
(c) Both C and D
(d) All get equal profit

7. Consider the following numbers :
1. 437
2. 797
3. 1073
How many of the above numbers are prime ?
(a) Only one **(b)** Only two
(c) All three **(d)** None

8. A can do a certain work at twice the speed of B. Further, B can do the same work at 1.5 times the speed of C. All of them together can finish the work in 12 days. In how many days can C alone finish the work ?
(a) 36 days **(b)** 45 days
(c) 60 days **(d)** 66 days

9. The sum of digits of a 2-digit number is 12. When the digits are reversed, the number becomes greater by eighteen. What is the difference between the digits in the number ?
(a) 1 **(b)** 2
(c) 3 **(d)** 4

10. The time taken by a train to cross a man travelling in another train is 10 seconds, when the other train is travelling in the opposite direction. However, it takes 20 seconds, if both the trains are travelling in the same direction. The length of the first train is 200 m and that of the second train is 150 m. What is the speed of the first train ?

(a) 60 km/hr **(b)** 56 km/hr
(c) 54 km/hr **(d)** 52 km/hr

11. If a, b, c, d, e and f satisfy $2a = 3b = 6c = 9d = 12e = 18f$, then what is the value of $(a + b)/(c + d + e + f)$?

(a) 4/7 **(b)** 2
(c) 5/2 **(d)** 9/2

12. If a, b, c are non-zero real numbers such that $a + b + c = 0$, then what are the roots of the quadratic equation $ax^2 + bx + c = 0$?

(a) $2, 1 + \left(\frac{c}{a}\right)$ **(b)** $1, \frac{a}{c}$

(c) $1, \frac{c}{a}$ **(d)** $2, \left(\frac{c}{a}\right) - 1$

13. Twelve percent of bananas bought by a fruit vendor got lost during transportation. On selling the remaining bananas, the vendor's overall profit turned out to be 4%. If the vendor had not lost any bananas and had sold them at the price of the remaining bananas, what would have been his profit percentage ?

(a) $8\frac{1}{9}\%$ **(b)** $9\frac{1}{11}\%$

(c) $18\frac{2}{11}\%$ **(d)** None of the above

14. If the positive square root of $(5 + 3\sqrt{2})(5 - 3\sqrt{2})$ is α, then what is the positive square root of $8 + 2\alpha$?

(a) $2 + \sqrt{3}$ **(b)** $3 - \sqrt{2}$
(c) $\sqrt{7} - 1$ **(d)** $\sqrt{7} + 1$

15. When every even power of every odd integer (greater than 1) is divided by 8, what is the remainder ?

(a) 3
(b) 2
(c) 1
(d) The remainder is not necessarily 1

16. Consider the following statements :

1. If n is a natural number, then the number $\frac{n(n^2+2)}{3}$ is also a natural number.
2. If m is an odd integer, then the number $\frac{m^4+4m^2+11}{16}$ is an integer.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

17. It is given that 5 does not divide $n - 1$, n and $n + 1$, where n is a positive integer. Which one of the following is correct ?

(a) 5 divides $(n^2 + 1)$
(b) 5 divides $(n^2 - 1)$
(c) 5 divides $(n + n)$
(d) 5 divides $(n^2 - n)$

18. What is the largest 5-digit number, which leaves remainder 7, when divided by 18 as well as by 11 ?

(a) 99981 **(b)** 99988
(c) 99997 **(d)** 99999

19. In a business dealing, A owes B ₹ 20,000 payable after 5 years, whereas B owes A ₹ 12,000 payable after 4 years. They want to settle it now at the rate of 5% simple interest. Who gives how much money in this settlement?

(a) Both are at par
(b) B gives ₹ 6,000 to A
(c) A gives ₹ 6,000 to B
(d) A gives ₹ 4,000 to B

20. Average marks in Mathematics of Section A comprising 30 students is 65 and that of Section B comprising 35 students is 70. What are the average marks (approximately) of both the sections if it was detected later that an entry of 47 marks was wrongly made as 74 ?

(a) 67.28 **(b)** 67.58
(c) 68.11 **(d)** 68.63

21. If α and P are the roots of the equation $x^2 - 7x + 1 = 0$, then what is the value of $\alpha^4 + \beta^4$?

(a) 2207 **(b)** 2247
(c) 2317 **(d)** 2337

22. Consider the following statements in respect of all factors of 360 :

1. The number of factors is 24.
2. The sum of all factors is 1170.

Which of the above statements is/are correct ?

(a) 1 only **(b)** 2 only
(c) Both 1 and 2 **(d)** Neither 1 nor 2

23. Consider a 6-digit number of the form XYXYXY. The number is divisible by :
(a) 3 and 7 only
(b) 7 and 13 only
(c) 3, 13 and 37 only
(d) 3, 7, 13 and 37

24. What is the HCF of $3^{29} - 9$ and $3^{38} - 9$?
(a) $3^1 - 1$ **(b)** $3^{11} - 1$
(c) $3^{11} - 3$ **(d)** $3^{11} - 9$

25. If $x = \sqrt{4\sqrt{4\sqrt{4\sqrt{4\ldots}}}}$, then what is the value of x ?
(a) 2 **(b)** 4
(c) 8 **(d)** 16

26. Let m and n be natural numbers. What is the minimum value of $(m + n)$ such that $33m + 22n$ is divisible by 121 ?
(a) 3 **(b)** 4
(c) 5 **(d)** 10

27. The product of two numbers is 2160 and their HCF is 12. If the sum of the squares of the two numbers is 4896, then what is the mean of the two numbers ?
(a) 24 **(b)** 36
(c) 48 **(d)** 96

28. The age of Q exceeds the age of P by 3 years. The age of R is twice the age of P and the age of Q is twice the age of S. Further, the age difference of R and S is 30 years. What is the sum of the ages of P and Q ?
(a) 35 years **(b)** 38 years
(c) 39 years **(d)** 45 years

29. If a, b and c are the sides of a triangle ABC, then $\sqrt{a} + \sqrt{b} - \sqrt{c}$ is always :
(a) Negative **(b)** Positive
(c) Non-negative **(d)** Non-positive

30. There are four bells which ring at an interval of 15 minutes, 25 minutes, 35 minutes and 45 minutes respectively. If all of them ring at 9 A.M., how many more times will they ring together in the next 72 hours ?
(a) 0 **(b)** 1
(c) 2 **(d)** 3

31. Let a, b, c and d be four positive integers such that $a + b + c + d = 200$. If $S = (-1)^a + (-1)^b + (-1)^c + (-1)^d$, then what is the number of possible values of S ?
(a) One **(b)** Two
(c) Three **(d)** Four

32. The number $97^{30} - 14^{30}$ is divisible by :
(a) 37 but not 83
(b) 83 but not 37
(c) Both 37 and 83
(d) Neither 37 nor 83

33. Consider the following statements :
1. $\log_{10} 50$ is a rational number.
2. $\log_{100} 10$ is an irrational number.
Which of the statements given above is/are correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

34. If 17 women and 24 men can do a piece of work in 5 days and 12 women and 23 men can do it in 6 days, then which one of the following is correct ?
(a) Efficiency of 13 women = Efficiency of 18 men
(b) Efficiency of 11 women = Efficiency of 16 men
(c) Efficiency of 13 women = Efficiency of 17 men
(d) Efficiency of 11 women = Efficiency of 15 men

35. Three taps A, B and C together can fill a tank in 6 hours. Tap C alone can fill the tank in 12 hours. To fill the tank, when it is empty, all the three taps are started together. After working t hours, tap C is closed and the tank is filled in 8 more hours. What is t equal to ?
(a) 1 **(b)** 2
(c) 4 **(d)** 6

36. A, B and C can complete a work in x, $1.5x$ and $2x$ days respectively. If they complete the work together, in what ratio should they be paid ?
(a) 2:3:4 **(b)** 6:4:3
(c) 3:2:1 **(d)** 4:3:2

37. Consider the following statements :
1. $n^3 - n$ is divisible by 6.
2. $n^5 - n$ is divisible by 5.
3. $n^5 - 5n^3 + 4n$ is divisible by 120.
Which of the statements given above are correct ?
(a) 1 and 2 only **(b)** 2 and 3 only
(c) 1 and 3 only **(d)** 1, 2 and 3

38. What is the last digit of the sum $S = 9^{27} + 27^9$?
(a) 3 **(b)** 6
(c) 7 **(d)** 9

39. If $x = \frac{\sqrt{3}+1}{\sqrt{3}-1}$ and $y = \frac{\sqrt{3}-1}{\sqrt{3}+1}$, then what is the value of $x^3 - y^3$?

(a) 60 **(b)** $45\sqrt{3}$

(c) $30\sqrt{3}$ **(d)** 90

40. The speed of a boat in still water is 15 km/hr. If it can travel 42 km downstream and 28 km upstream in the same time, then what is the speed of the stream ?

(a) 2.5 km/hr **(b)** 3 km/hr

(c) 4.5 km/hr **(d)** 6 km/hr

41. What is the difference between simple interest and compound interest on ₹ 10,000 for two years at 20% per annum compounded half-yearly ?

(a) ₹ 842 **(b)** ₹ 756

(c) ₹ 641 **(d)** ₹ 542

42. Consider the following statements in respect of the polynomial $a(b-c)(x-b)(x-c) + b(c-a)(x-c)(x-a) + c(a-b)(x-a)(x-b)$:

1. The coefficient of x^2 is 0.

2. The coefficient of x is $(a-b)(b-c)(c-a)$.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

43. Consider the following statements in respect of the polynomial $1 - x - x^n + x^{n+1}$, where n is a natural number:

1. It is divisible by $1 - 2x + x^2$.

2. It is divisible by $1 - x^n$.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

44. For what values of m, is $mx^2 + mx + 8x + 9$ a perfect square ?

(a) 1, 4 **(b)** 4, 9

(c) 9, 16 **(d)** 4, 16

45. If $x = a + b + \frac{(a-b)^2}{4a+4b}$ and $y = \frac{a+b}{4} + \frac{ab}{a+b}$ then what is the value of $(x-a)^2 - (y-b)^2$?

(a) a^2 **(b)** b^2

(c) ab **(d)** a^2b^2

46. Consider the following :

1. $\cos^4\theta - \sin^4\theta = \frac{2\tan\theta}{1-\tan^2\theta}, 0 < \theta < \frac{\pi}{2}$

2. $\operatorname{cosec}\theta + \cot\theta = \frac{1}{\operatorname{cosec}\theta - \cot\theta}, 0 < \theta < \frac{\pi}{2}$

3. $\cos^2\theta - \sin^2\theta = \frac{1-\tan^2\theta}{1-\tan^2\theta}, 0 < \theta < \frac{\pi}{2}$

Which of the above equations are identities ?

(a) 1 and 2 only **(b)** 2 and 3 only

(c) 1 and 3 only **(d)** 1, 2 and 3

47. If $\sin\theta = \frac{12}{13}$, then what is the value of $(\tan\theta + \sec\theta)^2 (\operatorname{cosec}\theta - \cot\theta)^{-2}$, $0 < \theta < \frac{\pi}{2}$

(a) $\frac{121}{4}$ **(b)** $\frac{169}{9}$

(c) $\frac{196}{9}$ **(d)** $\frac{225}{4}$

48. If $\tan^8\theta + \cot^8\theta = m$, then what is the value of $\tan\theta + \cot\theta$?

(a) $\sqrt{\sqrt{m+2}+2}$

(b) $\sqrt{\sqrt{\sqrt{m+4}+2}}$

(c) $\sqrt{\sqrt{\sqrt{m+2}+2}+2}$

(d) $\sqrt{\sqrt{\sqrt{m+4}+2}+2}$

49. What is the minimum value of $6 - 4\sin\theta$, $0 \le \theta \le \frac{\pi}{2}$?

(a) 1 **(b)** 2

(c) 4 **(d)** 6

50. What is the value of x that satisfies $4\cos^2 30° + 2x\sin 30° - \cot^2 30° - 6\tan 15°\tan 75° = 0$?

(a) 1 **(b)** 2

(c) 3 (d) 6

51. What is the value of $\frac{\cos^2 32° + \cos^2 58°}{\sec^2 50° - \cot^2 40°} + 4\tan 13°\tan 37°\tan 53°\tan 77°$?

(a) 2 **(b)** 3

(c) 4 **(d)** 5

52. What is the value of $(1 + \cot^2 \theta)(1 + \cos \theta)(1 - \cos \theta) - (1 + \tan^2 \theta)(1 + \sin \theta)(1 - \sin \theta)$?

(a) -1 **(b)** 0
(c) 1 **(d)** 2

53. If $2\cos^2 \theta + \sin \theta - 2 = 0$, $0 < \theta \leq \frac{\pi}{2}$, then what is the value of θ ?

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{2}$

54. A person on the top of a vertical tower observes a car moving at a uniform speed coming directly towards it. If it takes 6 minutes for the angle of depression to change from 30° to 45°, and further t minutes to reach the tower, which one of the following is correct ?

(a) $7.7 < t < 8$ **(b)** $8 < t < 8.3$
(c) $8.3 < t < 8.6$ **(d)** $8.6 < t < 8.9$

55. A woman is standing on the deck of a ship, which is h (in metres) above water level. She observes the angle of elevation of the top of a tower as 60° and the angle of depression of the base of the tower as 30°. What is the height of the tower ?

(a) $2h$ **(b)** $3h$
(c) $4h$ **(d)** $5h$

56. Let ABC be a right-angled triangle with sides 5 cm, 12 cm and 13 cm. If p is the length of the perpendicular drawn from vertex A on the hypotenuse BC, then what is the value of $13p$?

(a) 24 **(b)** 48
(c) 60 **(d)** 90

57. OABC is a rhombus whose three vertices lie on a circle with centre at O. If the area of the rhombus is $32\sqrt{3}$ square cm, then what is the radius of the circle ?

(a) 4 cm **(b)** 6 cm
(c) 8 cm **(d)** 16 cm

58. The surface area of a cube is increased by 25%. If p is the percentage increase in its length, then which one of the following is correct ?

(a) $16 < p < 18$ **(b)** $14 < p < 16$
(c) $12 < p < 14$ **(d)** $10 < p < 12$

59. A solid cube is cut into two cuboids of equal volume. What is the ratio of total surface area of the given cube to that of one of the cuboids ?

(a) 2 : 1 **(b)** 3 : 2
(c) 4 : 3 **(d)** 5 : 3

60. The length of a diagonal of a cuboid is 11 cm. The surface area is 240 square cm. What is the sum of its length, breadth and height ?

(a) 16 cm **(b)** 17 cm
(c) 18 cm **(d)** 19 cm

61. What is the area of the circle (approximately) inscribed in a triangle with side lengths 12 cm, 16 cm and 20 cm ?

(a) 48 square cm **(b)** 50 square cm
(c) 52 square cm **(d)** 54 square cm

62. Two times the total surface area of a solid right circular cylinder is three times its curved surface area. If h is the height and r is the radius of the base of the cylinder, then which one of the following is correct ?

(a) $h = r$ **(b)** $h = 2r$
(c) $2h = 3r$ **(d)** $3h = 4r$

63. A floor of a big hall has dimensions 30 m 60 cm and 23 m 40 cm. It is to be paved with square tiles of same size. What is the minimum number of tiles required ?

(a) 30 **(b)** 36
(c) 169 **(d)** 221

64. How long will a man take to walk around the boundary of a square field of area 25 hectares at the rate of 5 km/hr ?

(a) 36 minutes **(b)** 30 minutes
(c) 24 minutes **(d)** 18 minutes

65. Let x be the area of a square inscribed in a circle of radius r and y be the area of an equilateral triangle inscribed in the same circle. Which one of the following is correct ?

(a) $9x^2 = 16y^2$ **(b)** $27x^2 = 64y^2$
(c) $36x^2 = 49y^2$ **(d)** $16x^2 = 21y^2$

66. If the length of a rectangle is increased by $66\frac{2}{3}\%$, then by what percent should the width of the rectangle be decreased in order to maintain the same area ?

(a) 50% **(b)** 45%
(c) 40% **(d)** 35%

67. What is the maximum area that can be covered by three non-intersecting circles drawn inside a rectangle of sides 8 cm and 12 cm ?

(a) 16π square cm **(b)** 18π square cm
(c) 20π square cm **(d)** 24π square cm

68. ABCD is a square field with AB = x. A vertical pole OP of height $2x$ stands at the centre O of the square field. If $\angle APO = \theta$, then what is $\cot \theta$ equal to ?

(a) $\sqrt{2}$ **(b)** 2

(c) $2\sqrt{2}$ **(d)** $3\sqrt{2}$

69. A solid iron ball is melted and 64 smaller solid balls of equal size are made using the entire volume of iron. What is the ratio of the surface area of the larger ball to the sum of the surface areas of all the smaller balls ?

(a) 0.25 **(b)** 0.5

(c) 0.75 **(d)** 1

70. A triangle ABC has been divided into four smaller triangles P, Q, R, S whose perimeters are 16 cm, 12 cm, 4 cm and 12 cm respectively. P, R and S contain the vertices A, B and C respectively. What is the perimeter of the triangle ABC ?

(a) 18 cm **(b)** 20 cm

(c) 22 cm **(d)** 24 cm

*For the next **ten (10)** items that follow :*

Each item contains a Question followed by two Statements. Answer each item using the following instructions :

(a) Choose this option if the Question can be answered by one of the Statements alone but not by the other.

(b) Choose this option if the Question can be answered by either Statement alone.

(c) Choose this option if the Question can be answered by using both the Statements together, but cannot be answered by using either Statement alone.

(d) Choose this option if the Question cannot be answered even by using both Statements together.

71. A number 277XY5 (where X, Y are digits) is divisible by 25.

Question: What is the value of X ?

Statement I: The given number is divisible by 9.

Statement II: X > 5.

72. Question: What are the unique values of a, b and c if 2 is a root of the 2 equation $ax^2 + bx + c = 0$?

Statement I: Ratio of c to a is 1.

Statement II: Ratio of b to a is (– 5/2).

73. Question: Is $m > n$, where m, n are non-zero numbers ?

Statement I: $\frac{m}{n} > 1$.

Statement II: $m > 2n$.

74. Question: Can a circle be drawn through the points A, B and C ?

Statement I: AB = 5 cm, BC = 5 cm, CA = 6 cm.

Statement II: AB = 3 cm, BC = 4 cm, CA = 7 cm.

75. x and y are consecutive odd integers.

Question: Can the value of $(x + y)$ be determined uniquely ?

Statement I: $(x + y)^4 = 256$.

Statement II: $(x + y)^3 < 16$.

76. Question: Is $p^2 + q^2 + q$ odd, where p, q are positive integers ?

Statement I: $2p + q$ is odd.

Statement II: $q - 2p$ is odd.

77. Question: What is the area of the circle C ?

Statement I: An arc of length 7 cm subtends an angle 30° at the centre of C.

Statement II: A chord of length 10 cm subtends an angle 90° at the centre of C.

78. Question: Is triangle A right angled ?

Statement I: The length of the line segment joining the mid-points of two sides of A is half of the third side of A.

Statement II: The angles of A are in the ratio 1 : 2 : 3.

79. The lengths of two longer sides of the triangle are 25 cm and 24 cm.

Question: What is the length of the shortest side ?

Statement I: The angles of A are in the ratio 1 : 2 : 3.

Statement II: The length of the perpendicular drawn on the longest side of Δ from its opposite vertex is 6.72 cm.

80. A chord PQ of the circle C divides it into two segments such that 3 times the area of the major segment is 4 times the area of the minor segment.

Question: What is the radius of C ?

Statement I: Area of the minor segment is 66 square cm.

Statement II: Area of the major segment is 88 square cm.

*Consider the following data for the next **two (02)** items that follow :*

Class	0 – 30	30 – 60	60 – 90	90 – 120
Frequency	4	5	7	4

81. What is the mode of the distribution ?
(a) 60 **(b)** 72
(c) 75 **(d)** 80

82. If the median (P) and mode (Q) satisfy the relation 7(Q – P) = 9R, then what is the value of R?
(a) 6 **(b)** 5
(c) 3 **(d)** 1

*Consider the following data for the next **two (02)** items that follow :*

Class	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	4	3	1	2

83. What is the mean of the distribution ?
(a) 51 **(b)** 52
(c) 54 **(d)** 56

84. If M is the median, then what is the value of 3M?
(a) $53\frac{1}{3}$ **(b)** 60
(c) 160 **(d)** 180

85. The plinth of a house has an area of 200 square metres. It is rectangular in shape and its length and breadth are in the ratio 2 : 1. The owner of the house extends the terrace by 1 m on each side. What is the percentage of area that has increased in the terrace relative to the plinth ?
(a) 40% **(b)** 32%
(c) 20% **(d)** 15.5%

86. A square sheet of side length 44 cm is rolled along one of its sides to form a cylinder by making opposite edges just to touch each other. What is the volume of the cylinder ?
(Take $\pi = \frac{22}{3}$)
(a) 6776 cubic cm **(b)** 6248 cubic cm
(c) 5896 cubic cm **(d)** 5680 cubic cm

87. The volume of a cuboid is 3600 cubic cm. The areas of two adjacent faces are 225 square cm and 144 square cm. What is the area of the other adjacent face ?
(a) 400 square cm **(b)** 360 square cm
(c) 320 square cm **(d)** 300 square cm

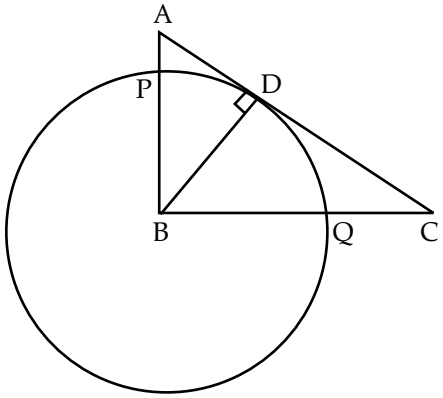
88. The perimeter and the area of a right-angled triangle are 36 cm and 54 square cm respectively. What is the length of the hypotenuse ?
(a) 12 cm **(b)** 14 cm
(c) 15 cm **(d)** 16 cm

89. Let
X={$x \mid x = 2 + 4k$, where $k = 0, 1, 2, 3, \ldots 24$}. Let S be a subset of X such that the sum of no two elements of S is 100. What is the maximum possible number of elements in S ?
(a) 10 **(b)** 11
(c) 12 **(d)** 13

90. The perimeter of a sector of a circle of radius 5.2 cm is 16.4 cm. What is the area of the sector?
(a) 15.6 square cm **(b)** 15 square cm
(c) 14.4 square cm **(d)** 14.1 square cm

*Consider the following for the next **three (03)** items that follow :*

In the triangle ABC, AB = 6 cm, BC = 8 cm and AC = 10 cm. The perpendicular dropped from B meets the side AC at D. A circle of radius BD (with centre B) cuts AB and BC at P and Q respectively as shown in the figure.



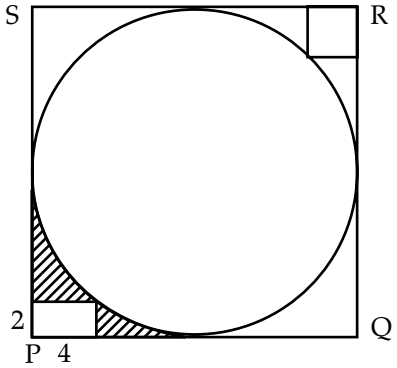
91. What is the length of QC ?
(a) 4.4 cm **(b)** 4.2 cm
(c) 3.6 cm **(d)** 3.2 cm

92. If $\angle ABD = \theta$, then what is $\sin\theta$ equal to ?
(a) 0.4 **(b)** 0.5
(c) 0.6 **(d)** 0.8

93. What is the radius of the circle ?
(a) 5 cm **(b)** 4.8 cm
(c) 4.4 cm **(d)** 4 cm

*Consider the following for the next **three (03)** items that follow :*

In the figure given below, a circle is inscribed in a square PQRS. A rectangle at the comer P that measures 4 cm × 2 cm and a square at the comer R.



94. What is the area of the circle ?

(a) 100π square cm
(b) 96π square cm
(c) 50π square cm
(d) 48π square cm

95. What is the area of the smaller square ?

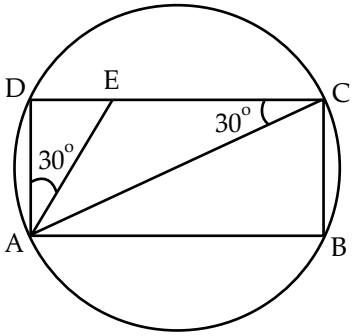
(a) 50 $(3 - \sqrt{2})$ square cm
(b) 25 $(3 - 2\sqrt{2})$ square cm
(c) 25 $(3 + 2\sqrt{2})$ square cm
(d) 50 $(3 - 2\sqrt{2})$ square cm

96. What is the area of the shaded region ?

(a) (96 – 25π) square cm
(b) (92 – 25π) square cm
(c) (96 – 16π) square cm
(d) (92 – 16π) square cm

*Consider the following for the next **two (02)** items that follow :*

In the following figure, a rectangle ABCD is inscribed in a circle of radius r. Given ∠ DAE = 30° and ∠ ACD = 30°.



97. What is the ratio of the area of the circle to the area of the rectangle ?

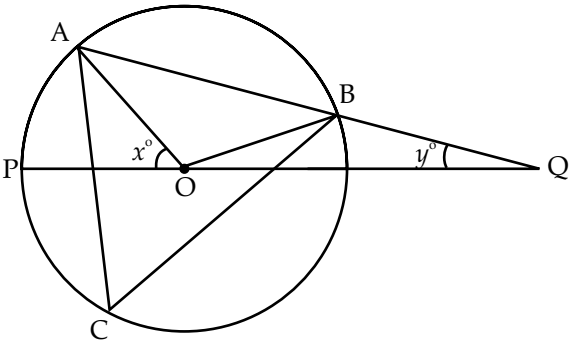
(a) $\frac{\pi}{\sqrt{2}}$ **(b)** $\frac{\pi}{\sqrt{3}}$
(c) $\frac{2\pi}{\sqrt{3}}$ **(d)** $\frac{3\pi}{\sqrt{2}}$

98. What is the area of Δ AEC ?

(a) $\frac{r^2}{\sqrt{3}}$ **(b)** $\frac{r^2}{2\sqrt{3}}$
(c) $\frac{r^2}{3\sqrt{3}}$ **(d)** $\frac{2r^2}{\sqrt{3}}$

*Consider the following for the next **two (02)** items that follow :*

In the following figure, a triangle ABC is inscribed in a circle with centre at O. Let ∠POA = $x°$ and ∠ OQB = $y°$. Further, OB = BQ



99. What is the relation between x and y ?

(a) $x = y$ **(b)** $2x = 3y$
(c) $x = 3y$ **(d)** $3x = 4y$

100. If $y = 15$, then what is ∠ACB equal to ?

(a) 30° **(b)** 40°
(c) 45° **(d)** 60°

Answer Key

Q.No.	Answer Key	Topic's Name	Chapter's Name
1	**c**	Divisibility	Number System
2	**c**	Divisibility	Number System
3	**d**	Remainder	Number System
4	**a**	Quadratic Equation	Equations
5	**c**	Venn Diagram	Set Theory
6	**a**	Ratio	Ratio and Proportion
7	**a**	Prime and Composite numbers	Number System
8	**d**	Time & Work	Time & Work
9	**b**	Numbers	Number System
10	**c**	Time & Distance	Time & Distance
11	**b**	Ratio	Ratio and Proportion
12	**c**	Quadratic Equation	Equations
13	**c**	Profit percentage	Profit loss
14	**d**	Numbers	Number System
15	**c**	Remainder	Number System
16	**c**	Numbers	Number System
17	**a**	Divisibility	Number System
18	**c**	Divisibility	Number System
19	**c**	SI & CI	SI & CI
20	**a**	Average	Statistics
21	**a**	Quadratic Equation	Equations
22	**c**	Factors	Number System
23	**d**	Divisibility	Number System
24	**d**	Divisibility	Number System
25	**b**	Numbers	Number System
26	**b**	Divisibility	Number system
27	**c**	HCF	HCF and LCM
28	**d**	Ages	Ratio-Proportion
29	**b**	Triangles	Mensuration
30	**c**	LCM	HCF and LCM
31	**c**	Integers	Number system
32	**c**	Divisibility Rule	Number system
33	**a**	Logarithm	Logarithm
34	**a**	Concept of Efficiency	Time and work
35	**b**	Pipe and Cistern	Time and work
36	**b**	Time and Work	Time and work
37	**d**	Divisibility	Number system
38	**b**	Surds and Indices	Number system
39	**c**	Algebraic Identities	Algebra
40	**b**	Boats and Stream	Speed, time and distance

41	**c**	CI And SI	Compound interest
42	**a**	Polynomial	Algebra
43	**c**	Polynomial	Algebra
44	**d**	Quadratic Equations	Algebra
45	**b**	Algebraic Identities	Algebra
46	**b**	Trigonometric Functions	Trigonometry
47	**d**	Trigonometric Ratios	Trigonometry
48	**c**	Trigonometric Functions	Trigonometry
49	**b**	Trigonometric Functions	Trigonometry
50	**d**	Trigonometric Functions	Trigonometry
51	**d**	Complementary angle	Trigonometry
52	**b**	Trigonometric Identity	Trigonometry
53	**a**	Trigonometric Identity	Trigonometry
54	**b**	Height and Distance	Trigonometry
55	**c**	Height and Distance	Trigonometry
56	**c**	Similarity	Trigonometry
57	**c**	Area of circle	Mensuration
58	**d**	Area of cube	Mensuration
59	**b**	Area of cube and cuboid	Mensuration
60	**d**	Area of cuboid	Mensuration
61	**b**	Area of triangle and circle	Mensuration
62	**b**	Cylinder	Mensuration
63	**d**	Area of floor	Mensuration
64	**c**	Area of square	Mensuration
65	**b**	Circle	Mensuration
66	**c**	Area of rectangle	Mensuration
67	**d**	Circle	Mensuration
68	**c**	Height and Distance	Mensuration
69	**a**	Sphere	Mensuration
70	**b**	Perimeter of triangle	Mensuration
71	**d**	Divisibility	Algebra
72	**b**	Quadratic equation	Algebra
73	**b**	Inequality	Algebra
74	**b**	Circumcircle	Mensuration
75	**c**	Integer	Algebra
76	**d**	Integer	Algebra
77	**b**	Area related to circle	Mensuration
78	**a**	Triangle	Geometry
79	**b**	Sine Rule	Properties of triangle
80	**b**	Area related to circle	Mensuration
81	**b**	Mode	Statistics
82	**a**	Median	Statistics

83	**d**	Mean	Statistics
84	**c**	Median	Statistics
85	**b**	Rectangle	Mensuration
86	**a**	Cylinder	Mensuration
87	**a**	Cuboid	Mensuration
88	**c**	Area of triangle	Mensuration
89	**d**	Sets	Algebra
90	**a**	Area related to circle	Mensuration
91	**d**	Similar Triangle	Geometry
92	**c**	Similar Triangle	Geometry
93	**b**	Area related to circle	Mensuration
94	**a**	Area related to circle	Mensuration
95	**d**	Area related to circle	Mensuration
96	**b**	Area related to circle	Mensuration
97	**b**	Area related to circle	Mensuration
98	**a**	Area related to circle	Mensuration
99	**c**	Circle	Geometry
100	**d**	Circle	Geometry

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Combined Defence Services

EXAM
I
2023

Mathematics

ANSWERS WITH EXPLANATION

1. Option (c) is correct.

$2^{35} - 1$
$= (2^7)^5 - 1$
$= (128)^5 - 1$
$= (128-1)(128^4 + 128^3 + 128^2 + 128 + 1)$
$= (127)$ (Integer)
$2^{91} - 1$
$= (2^7)^{13} - 1$
$= (128)^{13} - 1$
$= (128 - 1)(128^{12} + 128^{11} + \ ..... + 128 + 1)$
$= (127)$ (Integer)
So, both numbers are divisible by 127.

2. Option (c) is correct.

Let $P = 1 \times 2 \times 3 \times ..... \times 28 \times 29$
$\Rightarrow P = 29!$
Also, $10 = 2 \times 5$
Exponent of 2 in P

$$= \left[\frac{29}{2}\right] + \left[\frac{29}{2^2}\right] + \left[\frac{29}{2^3}\right] + \left[\frac{29}{2^4}\right] + \left[\frac{29}{2^5}\right]$$

where [.] = GIF
$= 14 + 7 + 3 + 1 + 0 = 25$
Exponent of 5 in P

$$= \left[\frac{29}{5}\right] + \left[\frac{29}{5^2}\right] + \left[\frac{29}{5^3}\right]$$

$= 5 + 1 + 0 = 6$
So, largest power of 10 that divides P is 6.

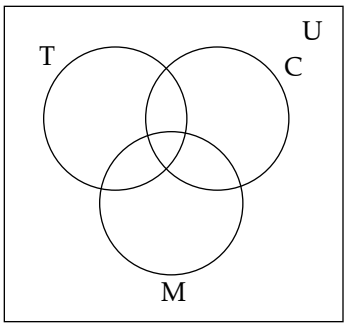
3. Option (d) is correct.

Let $P = 65^{99}$
$\Rightarrow P = (66 - 1)^{99}$
$\Rightarrow P = {}^{99}C_0 (66)^{99} - {}^{99}C_1 (66)^{98} + {}^{99}C_2 (66)^{97} - {}^{99}C_3 (66)^{96} + \ldots - {}^{99}C_{99}$
$\Rightarrow P =$ (Multiple of 11) $- 1$
$\Rightarrow P =$ (Multiple of 11) $+ 11 - 1$
$\Rightarrow P =$ (Multiple of 11) $+ 10$
So, remainder will be 10, when 65^{99} is divided by 11.

4. Option (a) is correct.

Let the roots of equation $x^2 - bx + c = 5$ be α & β.
Given, $|\alpha - \beta| = 5$
$\Rightarrow (\alpha - \beta)^2 = 25$
$\Rightarrow (\alpha^2 + \beta^2) - 2\alpha\beta = 25$
$\Rightarrow (\alpha^2 + \beta^2 + 2\alpha\beta) - 4\alpha\beta = 25$
$\Rightarrow (\alpha + \beta)^2 - 4\alpha\beta = 25$ ($\because$ Sum of roots $= b$ and Product of roots $= c - 5$)
$\Rightarrow (b)^2 - 4(c - 5) = 25$
$\Rightarrow b^2 - 4c + 20 = 25$
$\Rightarrow b^2 = 4c + 5$

5. Option (c) is correct.



T – Tea
C – Coffee
M – Milk
$n(U) = 150$
$n(T) = 75$
$n(C) = 60$
$n(M) = 50$
$n(T \cap C) = 15$, $n(T \cap M) = 0$, $n(T \cap M \cap C) = 0$
Also, $n(U) = n(T) + n(M) + n(C) - n(M \cap T) - n(C \cap T) - n(C \cap M) + n(T \cap M \cap C)$
$\Rightarrow 150 = 75 + 60 + 50 - 0 - 15 - n(C \cap M) + 0$
$\Rightarrow n(C \cap M) = 20$
So, people having milk only
$= n(M) - [n(M \cap T) + n(C \cap M) - n(C \cap M \cap T)$
$= 50 - [0 + 20 - 0] = 30$

6. Option (a) is correct.

Let A, B, C, D, E are investing ₹ 200, 300, 400, 500 & 600 respectively for months as 6, 5, 4, 3 & 2 respectively.

A's Capital	1200
B's Capital	1500
C's Capital	1600
D's Capital	1500
E's Capital	1200

$\Rightarrow$ Profit of C will be highest because C's Capital is highest.

7. Option (a) is correct.

Let A = 437

$\Rightarrow$ A = 19 × 23

So, A is not prime:

B = 797

$\Rightarrow$ B = 797 × 1

C = 1073

$\Rightarrow$ C = 29 × 37

So, C is not prime.

8. Option (d) is correct.

Let speed of C be x.

So, speed of B will be $3x/2$.

And, speed of A will be $2(3x/2) = 3x$

So, work with effeciency of (A+B+C) i.e $11x/2$ is done in 12 days.

Now, C who is having efficiency /speed as "x" will complete the work in $= 12 \times \frac{11}{2} = 66$ days

9. Option (b) is correct.

Let the number be xy.

Sum of digits = $x + y = 12$ (1)

Reversed digits, yx

Now, $(10y + x) - (10x + y) = 18$

$\Rightarrow 9(y - x) = 18$

$\Rightarrow y - x = 2$

$\Rightarrow y = x + 2$ (2)

From eq. (1) ,

$x + x + 2 = 12$

$\Rightarrow x = 5$

So, $y = 7$

Difference of digits = 7 – 5 = 2

10. Option (c) is correrct.

Let speed of trains be v_1 and v_2 respectively.

When trains are travelling in opposite direction,

$$10 = \frac{200}{v_1 + v_2}$$

$\Rightarrow v_1 + v_2 = 20$ (1)

When trains are travelling in same direction,

$$20 = \frac{200}{v_1 - v_2}$$

$\Rightarrow v_1 - v_2 = 10$ (2)

By eq. (1) + (2),

$2v_1 = 30$

$v_1 = 15$ m/sec

$v_1 = (15 \times 18/5)$ km/hr = 54 km/hr

11. Option (b) is correct.

Given, $2a = 3b = 6c = 9d = 12e = 18f = k$(let)

Now, $\frac{(a+b)}{(c+d+e+f)}$

$$= \frac{\frac{k}{2}+\frac{k}{3}}{\frac{k}{6}+\frac{k}{9}+\frac{k}{12}+\frac{k}{18}} = \frac{\left(\frac{3+2}{6}\right)}{\left(\frac{6+4+3+2}{36}\right)}$$

$$= \left(\frac{5}{6}\right)\left(\frac{36}{15}\right) = 2$$

12. Option (c) is correct.

Given equation : $ax^2 + bx + c = 0$

Put $x = 1$, $a + b + c = 0$

So, $x = 1$ is a root of $ax^2 + bx + c = 0$

Product of roots $= \frac{c}{a}$

$\Rightarrow$ (1) (α) $= \frac{c}{a}$, where α be the other root

$\Rightarrow \alpha = \frac{c}{a}$

So, roots are 1 & $\frac{c}{a}$.

13. Option (c) is correct.

Solution:

Let total number of banana = 100

and cost price of one banana = ₹ 1.

$\because$ On selling 88% of banana, vendor's overall profit turned out to be 4%.

$\therefore$ 88 × (SP of one banana) = 104

$\Rightarrow$ SP of one banana $= \frac{104}{88}$

If, vendor had not just any banana, then selling price of all banana $= \frac{104}{88} \times 100$

So, profit percentage $= \frac{SP - CP}{CP} \times 100\%$

$$= \frac{\frac{104}{88} \times 100 - 100}{100} \times 100\%$$

$$=\left(\frac{104}{88}-1\right)\times 100\%$$

$$=\frac{200}{11}\%=18\frac{2}{11}\%$$

14. Option (d) is correct.

Let $p=\left(5+3\sqrt{2}\right)\left(5-3\sqrt{2}\right)$

$\Rightarrow p=(5)^2-(3\sqrt{2})^2$

$\Rightarrow p=25-18$

$\Rightarrow p=7$

So, $\alpha=\sqrt{7}$

Now, $\sqrt{8+2\alpha}=\sqrt{8+2\sqrt{7}}$

$$=\sqrt{\left(\sqrt{7}\right)^2+(1)^2+2(1)\left(\sqrt{7}\right)}$$

$=\sqrt{7}+1$

15. Option (c) is correct.

Here, we are dividing by 8, so whenever an odd number is divided, the remainder is 1, 3, 5, 7.

i. $(8k+1)^{2n}\rightarrow$ Remainder = 1

ii. $(8k+3)^{2n}=$ (Multiple of 8) + 3^{2n}

$3^{2n}=9^n=(8+1)^n=$ (Multiple of 8) + 1

So, remainder = 1

iii. $(8k+5)^{2n}=$ (Multiple of 8) + 5^{2n}

$5^{2n}=(25)^n=(24+1)^n=$ (Multiple of 8) + 1

So, remainder = 1

iv. $(8k+7)^{2n}=(8k-1)^{2n}=$ (Multiple of 8) + 1

So, remainder = 1

16. Option (c) is correct.

Statement 1: If n is natural number.

Then, let n = 1, 2, 3, ... etc.

Case1: When $n=1$, then $\frac{n(n^2+2)}{3}=\frac{1(1^2+2)}{3}=1$

Case 2: When n = 2, $\frac{2(2^2+2)}{3}=\frac{2\times 6}{3}=4$

Case 3: When n = 3, $\frac{3(3^2+2)}{3}=\frac{3\times 11}{3}=11$

Means in each case, the result is a natural number. So, statement (1) is true.

Statement 2: If m is odd integer. Let m = 1

Then $\frac{m^4+4m^2+11}{16}=\frac{1^2+4\times 1^2+11}{16}=1$

For m = 3,

$$\frac{m^4+4m^2+11}{16}=\frac{3^4+4\times 3^2+11}{16}$$

$$=\frac{81+36+11}{16}=8$$

So, statement (2) is also true.

Hence, option (c) is correct.

17. Option (a) is correct.

(i) Let n = 2

$n+1=3, n-1=1$

$n^2+1=5, n^2-1=3, n^2+n=6, n^2-n=2$

(ii) Let n = 3

$n+1=4, n-1=2$

$n^2+1=10, n^2-1=8,$

$n^2+n=12, n^2-n=6$

So, we can say that (n^2+1) is divisible by 5.

18. Option (c) is correct.

99981 = 5554(18) + 9

99988 = 5554(18) + 16

99997 = 5555(18) + 7

= 9090(11) + 7

So, required number = 99997

19. Option (c) is correct.

Present worth of A

$$=\frac{100\times\text{Amount}}{100+(\text{Rate}\times\text{Time})}=\frac{100\times 20000}{100+(5\times 5)}$$

= ₹ 16,000

Present worth of B

$$=\frac{100\times\text{Amount}}{100+(\text{Rate}\times\text{Time})}=\frac{100\times 12000}{100+(5\times 4)}$$

= ₹ 10,000

So, A gives ₹ 6,000 to B.

20. Option (a) is correct.

Average marks of section A students = 65

Total marks of section A students

= 30 × 65 = 1950

Average marks of section B students = 70

Total marks of section B students

= 70 × 35 = 2450

Total students = 30 + 35 = 65

Total marks = 1950 + 2450 = 4400

Corrected marks = 4400 + 47 – 74 = 4373

Average marks = 4373/65 = 67.28

21. Option (a) is correct.

The roots $x^2-7x+1=0$, are α & β.

Then, $\alpha+\beta=7$,

$\alpha\beta=1$

Now, $(\alpha+\beta)^2=(7)^2$

$\Rightarrow \alpha^2+\beta^2+2\alpha\beta=49$

$\Rightarrow \alpha^2+\beta^2=49+2(-1)$

$\Rightarrow \alpha^2+\beta^2=47$

Again, $(\alpha^2+\beta^2)^2=(47)^2$

$\Rightarrow \alpha^4+\beta^4+2\alpha^2\beta^2=2209$

$\Rightarrow \alpha^4+\beta^4=2209-2(1)^2$

$\Rightarrow \alpha^4+\beta^4=2207$

22. Option (c) is correct.

$360 = 36 \times 10$

$= 2^2 \times 3^2 \times 2^1 \times 5^1$

$= 2^3 \times 3^2 \times 5^1$

Number of factors $= (3 + 1)(2 + 1)(1 + 1) = 24$

Sum of all factors

$= (2^0 + 2^1 + 2^2 + 2^3)(3^0 + 3^1 + 3^2)(5^0 + 5^1)$

$= (1 + 2 + 4 + 8)(1 + 3 + 9)(1 + 5)$

$= 15 \times 13 \times 6 = 1170$

23. Option (d) is correct.

Let P = X

$\Rightarrow$ P = X$(10^5 + 10^3 + 10^1) + y(10^4 + 10^2 + 10^0)$

$\Rightarrow$ P = 101010X + 10101Y

$\Rightarrow$ P = 10101(10X + Y)

$\Rightarrow$ P = (10101)(10X + Y)

10101 = (37)(273)

= (13)(777)

= (7)(1443)

= (3)(3367)

So, the given number is divisible by all numbers 3, 7, 13 and 37.

24. Option (d) is correct.

Solution:

$3^{29} - 9 = 3^2 [3^{27} - 1]$

$= 3^2 [(3^9)^3 - 1^3]$

As we know, $a^n - b^n$ is divisible by $a - b$.

So, $3^{29} - 9$ is divisible by $3^2 [3^9 - 1]$

Now, $3^{38} - 9 = 3^2 [3^{36} - 1]$

$= 3^2 [(3^9)^4 - 1^4]$

So, $3^{38} - 9$ is divisible by $3^2[3^9 - 1]$

$\therefore$ HCF of $3^{29} - 9$ and $3^{38} - 9$ is $3^2[3^9 - 1]$

$= 3^{11} - 9$

25. Option (b) is correct.

$x = \sqrt{4\sqrt{4\sqrt{4.....}}}$

$\Rightarrow x = \sqrt{4x}$

$\Rightarrow x^2 = 4x$

$\Rightarrow x^2 - 4x = 0$

$\Rightarrow x(x - 4) = 0$

$\Rightarrow x = 0$ (not possible), 4

So, $x = 4$

26. Option (b) is correct.

$$\frac{33m + 22n}{121} = \frac{11(3m + 2n)}{11 \times 11} = \frac{3m + 2n}{11}$$

So, if $3m + 2n$ will divisible by 11 then $33m + 22n$ will also divisible by 121.

Using hit and trial method,

Verifying option (a) i.e $3 = 2 + 1$

Let $m = 2$, $n = 1$

$3 \times 2 + 2 \times 1 = 8$, which is not divisible by 11

Now take $m = 1$, $n = 2$

$3 \times 1 + 2 \times 2 = 7$, which is also not divisible by 11

Verifying option (b) i.e $4 = 3 + 1$

Let $m = 3$, $n = 1$

$3 \times 3 + 2 \times 1 = 9 + 2 = 11$, which is divisible by 11 and minimum value among other options.

Hence, $m + n = 3 + 1 = 4$

27. Option (c) is correct.

Explanation: Let one number is a and other number be b.

According to question

$a \times b = 2160$ (1)

Their HCF is 12. So, $a = 12x$ (2)

$b = 12y$ (3)

Putting value of a and b in (1),

$12x \times 12y = 2160$

$xy = 15$, i.e., $5 \times 3 = 15$

Using value of x, y in (2) and (3)

$a = 12 \times 5 = 60$

$b = 12 \times 3 = 36$

Hence, mean of these two numbers $\frac{(60 + 36)}{2} = 48$.

28. Option (d) is correct.

Assuming ages of Q, P, R and S is Q, P, R and S respectively.

According to question

Q – P = 3, R = 2P and Q = 2S

R – S = 30

So, 2P – S = 30 (1)

2S – P = 3 (2)

Multiplying (2) by 2

(2S – P = 3) $\times$ 2 $\Rightarrow$ 4S – 2P = 6 or –2P + 4S = 6 (3)

Solving (1) and (3),

$$\begin{array}{r} 2P - S = 30 \\ -2P + 4S = 6 \\ \hline 3S = 36 \\ S = 12 \end{array}$$

So, Q = 2 $\times$ 12 = 24

and 24 – P = 3

So, P = 21

Hence, P + Q = 21 + 24 = 45 years

29. Option (b) is correct.

We know that sum of two sides of triangle is always greater than third side

i.e. $a + b > c$

So, $\sqrt{a} + \sqrt{b} > \sqrt{c}$

Hence, $\sqrt{a} + \sqrt{b} - \sqrt{c} > 0$

30. Option (c) is correct.

LCM of 15, 25, 35, 45 = 1575

So, four bells will ring together after every 1575 minutes.

72 hours = 72 × 60 = 4320 minutes

Number of times they will ring together

= 4320 ÷ 1575 = 2.7429

So, bell will ring 2 times in 72 hours.

31. Option (c) is correct.

Given, $a + b + c + d = 200$

Here 200 is a even number we know that if we add 4 even numbers or 4 odd numbers or 2 even and 2 odd numbers then sum is positive. So here is only three possibility of S.

32. Option (c) is correct.

$x^n - y^n$ is divisible by both $(x - y)$ and $(x + y)$

If n is an even number.

So, $97^{30} - 14^{30}$ is divisible by $(97 - 14) = 83$

and $(97 + 14) = 111$, which is a multiple of 37

Hence, $97^{30} - 14^{30}$ is divisible by 83 and 37 both.

33. Option (a) is correct.

1. $\log_{10}50 = \log50/\log10 = \log5 + \log10 = \log5$, which is rational.
   So, the statement is correct
2. $\log_{100}10 = \log10/2\log10 = 1/2$ which is rational.
   So, given statement is incorrect
   Hence only 1 is correct.

34. Option (a) is correct.

Assuming efficiency of 1 woman = w and efficiency of 1 men = m

According to question

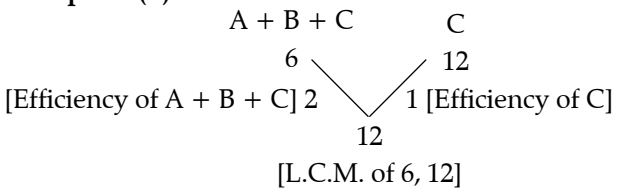
(17w + 24m) × 5 = (12w + 23m) × 6

⇒ 85w + 120m = 72w + 138m

⇒ 13w = 18m

Hence, efficiency of 13 women = efficiency of 18 men

35. Option (b) is correct.



So efficiency of A + B = 2 – 1 = 1

Now according to question

$(A + B + C)t + (A + B)8 = 12$

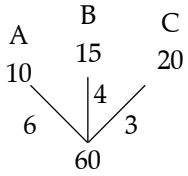
$\Rightarrow 2t + 8 = 12$

$\Rightarrow 2t = 4$

Hence, $t = 2$

36. Option (b) is correct.

Assuming $x = 10$



Then, efficiency of A : B : C is 6 : 4 : 3. So, they will be paid in the same ratio i.e 6 : 4 : 3.

37. Option (d) is correct.

Assuming value of $n = 2$

1. $2^3 - 2 = 6$ (which is divisible by 6)
2. $2^5 - 2 = 30$ (which is divisible by 5)
3. $2^5 - 5 \times 2^3 + 4 \times 2$
   $= 32 - 40 + 8$
   $= 0$ which is divisble by 120

Hence, all three statements are correct.

38. Option (b) is correct.

We know that if power of 9 is even then its units digit will be 1 and if power of 9 is odd then unit digit will be 9.

Unit digit of 27^9 = Unit digit of 71 (as Cyclicity of powers of 7 is 4).

So, in $9^{27} + 27^9$

unit digit of 9^{27} is 9 and unit digit of 27^9 is 7. So, 9 + 7 = 16

Hence, unit digit is 6.

39. Option (c) is correct.

$$x = \frac{\left(\sqrt{3}+1\right)\times\left(\sqrt{3}+1\right)}{\left(\sqrt{3}-1\right)\times\left(\sqrt{3}+1\right)} = \frac{\left(\sqrt{3}+1\right)^2}{3-1} = \frac{4+2\sqrt{3}}{2}$$

$$= 2+\sqrt{3}$$

$$y = \frac{\left(\sqrt{3}-1\right)\times\left(\sqrt{3}-1\right)}{\left(\sqrt{3}+1\right)\times\left(\sqrt{3}-1\right)} = \frac{\left(\sqrt{3}-1\right)^2}{3-1}$$

$$= \frac{4-2\sqrt{3}}{2} = 2-\sqrt{3}$$

$x = 2+\sqrt{3}$

$y = 2-\sqrt{3}$

$\Rightarrow x - y = 2\sqrt{3}$ and $xy = 4 - 1 = 3$

Using, $x^3 - y^3 = (x - y)(x^2 + y^2 + xy)$

$= 2\sqrt{3}\,[(x - y)^2 + 3xy]$

$= 2\sqrt{3}\,[(2\sqrt{3})^2 + 3]$

$= 30\sqrt{3}$

40. Option (b) is correct.

Assuming speed of boat is still water = a

Speed of current = b

Downstream speed = $a + b$
Upstream speed = $a - b$
According to question

$$\frac{42}{(a+b)} = \frac{28}{(a-b)}$$

$\Rightarrow 3a - 3b = 2a + 2b$
$\Rightarrow a = 5b$
Putting value of $a = 15$

$$b = \frac{15}{5} = 3 \text{ km/hr}$$

41. Option (c) is correct.
For half yearly, rate of interest

$$= \frac{R}{2} = \frac{20}{2} = 10\%$$

Time period = $2T = 2 \times 2 = 4$

$$\text{Compound interest} = P\left(1+\frac{R}{100}\right)^T - P$$

$$= 10000\left(1+\frac{10}{100}\right)^4 - 10000$$

$$= \left(10000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10}\right) - 10000$$

= ₹ 4,641

$$\text{Simple interest} = \frac{10000 \times 20 \times 2}{100}$$

$$\left[\text{Using, } SI = \frac{PRT}{100}\right]$$

= ₹ 4,000
Hence, required difference = 4641 – 4000
= ₹ 641

42. Option (a) is correct.
Assuming $a = 3, b = 2$ and $c = 1$

$$a(b-c)(x-b)(x-c) + b(c-a)(x-c)(x-a) + c(a-b)(x-a)(x-b)$$
$$= 3(2-1)(x-2)(x-1) + 2(1-3)(x-1)(x-3) + 1(3-2)(x-3)(x-2)$$
$$= 3(x-2)(x-1) + (-4)(x-1)(x-3) + (x-3)(x-2)$$
$$= (x-1)[3(x-2) + (-4)(x-3)] + x^2 - 2x - 3x + 6$$
$$= (x-1)[3x - 6 - 4x + 12] + x^2 - 2x - 3x + 6$$
$$= (x-1)(6-x) + x^2 - 5x + 6$$
$$= -x^2 + 7x - 6 + x^2 - 5x + 6$$
$$= 2x$$

Coeffcient of $x^2 = 0$
and coefficient of $x = 2 = -(a-b)(b-c)(c-a)$
Hence, only statement (1) is true

43. Option (c) is correct.
Assuming value of $n = 2$

$$1 - x - x^2 + x^{2+1}$$
$$= 1 - x - x^2(1-x)$$
$$= (1-x)(1-x^2)$$
$$= (1-x)(1-x)(1+x)$$

1. $1 - 2x + x^2 = (x-1)^2$
Here, $(1-x)^2(1+x)$ is divisible by $(x-1)^2$
So, statement 1 is correct.
2. $1 - x^n = 1 - x^2 = (1-x)(1+x)$
Yes, it can also divide $(1-x)(1-x)(1+x)$
Hence, both statements are true.

44. Option (d) is correct.
$mx^2 + x(m+8) + 9$
For perfect square, D = 0
$\Rightarrow (m+8)^2 - 4m \times 9 = 0$
$\Rightarrow m^2 + 64 + 16m - 36m = 0$
$\Rightarrow m^2 - 20m + 64 = 0$
$\Rightarrow (m-4)(m-16) = 0$
$\Rightarrow m = 4, m = 16$

45. Option (b) is correct.
Given,

$$x = a + b + \frac{(a-b)^2}{4a+4b}$$

$$y = \frac{a+b}{4} + \frac{ab}{a+b}$$

Putting $a = 2, b = 1$

$$x = 2 + 1 + \frac{(2-1)}{4\times2+4\times1} = 3 + \frac{1}{12} = \frac{37}{12}$$

$$y = \frac{2+1}{4} + \frac{2\times1}{2+1} = \frac{3}{4} + \frac{2}{3} = \frac{17}{12}$$

So, $(x-a)^2 - (y-b)^2$

$$= \left(\frac{37}{12} - 2\right)^2 - \left(\frac{17}{12} - 1\right)^2$$

$$= \frac{13}{12} \times \frac{13}{12} - \frac{5}{12} \times \frac{5}{12}$$

$$= \frac{1}{12\times12}[13\times13 - 5\times5]$$

$$= \frac{144}{144} = 1 = b^2$$

46. Option (b) is correct.
1. $\cos^4\theta - \sin^4\theta = 2\tan\theta/(1 - \tan2\theta)$
$\Rightarrow (\cos^2\theta + \sin^2\theta)(\cos^2\theta - \sin^2\theta)$
$= 2\tan\theta/(1 - \tan2\theta)$
$\Rightarrow (\cos^2\theta - \sin^2\theta) = 2\tan\theta/(1 - \tan2\theta)$

$$\Rightarrow 1 \times \cos2\theta \neq \frac{2\tan\theta}{1-\tan^2\theta}$$

2. $\text{cosec}\theta + \cot\theta = \dfrac{1}{\text{cosec}\theta - \cot\theta}$, given

$$\frac{1}{\operatorname{cosec}\theta-\cot\theta}\times\frac{\operatorname{cosec}\theta+\cot\theta}{\operatorname{cosec}\theta+\cot\theta}$$

$$=\frac{\operatorname{cosec}\theta+\cot\theta}{\operatorname{cosec}^2\theta-\cot^2\theta}=\operatorname{cosec}\theta+\cot\theta$$

So, statement 2 is correct.

3. $\cos^2\theta-\sin^2\theta=\cos 2\theta$

$$\frac{1-\tan^2\theta}{1-\tan^2\theta}=\cos 2\theta$$

$$\text{So, } \cos^2\theta-\sin^2\theta=\frac{1-\tan^2\theta}{1+\tan^2\theta}$$

So, statement 3 is correct.

47. Option (d) is correct.

$$\sin\theta=\frac{P}{H}=\frac{12}{13}$$

We know that 12, 13 and 5 forms a triplet of Pythagoras. So, base = 5

Now, $(\tan\theta+\sec\theta)^2(\operatorname{cosec}\theta-\cot\theta)^{-2}$

$$=\left(\frac{P}{B}+\frac{H}{B}\right)^2\left(\frac{H}{P}-\frac{B}{P}\right)^{-2}$$

$$=\left(\frac{12}{5}+\frac{13}{5}\right)^2\left(\frac{13}{12}-\frac{5}{12}\right)^{-2}$$

$$=25\times\left(\frac{2}{3}\right)^{-2}=25\times\frac{9}{4}=\frac{225}{4}$$

48. Option (c) is correct.

$\tan^2\theta+\cot^2\theta=m$

We have, $(a+b)^2=a^2+b^2+2ab$

$a^2+b^2=(a+b)^2-2ab$ (1)

but here power is 8, so we keep to use (1) those time which give three times faster and addition of 2, three time. So, correct option is

$$\sqrt{\sqrt{\sqrt{m+2}+2}+2}$$

49. Option (b) is correct.

Maximum value of $\sin\theta = 1$

So, minimum value of $6-4\sin\theta$

$= 6-4\times1=2$

50. Option (d) is correct.

$4\cos^2 30°+2x\sin 30°-\cot^2 30°-6\tan 15°\tan 75°=0$

$$\Rightarrow 4\left(\frac{\sqrt{3}}{2}\right)^2+2x\times\frac{1}{2}-\left(\sqrt{3}\right)^2-6\ \tan 15\frac{1}{\tan 15}=0$$

$$\Rightarrow 4\times\frac{3}{4}+x-3-6=0$$

$$\Rightarrow 3+x-9=0$$

$$\Rightarrow x-6=0$$

Hence, $x = 6$

51. Option (d) is correct.

$$\frac{\cos^2 32°+\cos^2 58°}{\sec^2 50°-\cot^2 40°}+4\tan 13°\cdot\tan 37°\cdot\tan 53°\cdot\tan 77°$$

$$=\frac{\sin^2(90°-32°)+\cos^2 58°}{\operatorname{cosec}^2(90°-50°)-\cot^2 40°}+4\cot(90°-13°)$$

$$\tan(90°-37°)\cdot\tan 53°\cdot\tan 77°$$

$$=\frac{\sin^2 58°+\cos^2 58°}{\operatorname{cosec}^2 40°-\cot^2 40°}+4\cot 77°\cdot\cot 53°\cdot\tan 53°\cdot\tan 77°$$

$= 1 + 4 = 5$

52. Option (b) is correct.

$(1+\cot^2\theta)(1+\cos\theta)(1-\cos\theta)$

$$-(1+\tan^2\theta)(1+\sin\theta)\times(1-\sin\theta)$$

$=\operatorname{cosec}^2\theta(1-\cos^2\theta)-\sec^2\theta(1-\sin^2\theta)$

$$=\frac{1}{\sin^2\theta}\times\sin^2\theta-\frac{1}{\cos^2\theta}\times\cos^2\theta$$

$= 1-1=0$

53. Option (a) is correct.

$2\cos^2\theta+\sin\theta-2=0$

$\Rightarrow 2(1-\sin^2\theta)+\sin\theta-2=0$

$\Rightarrow 2-2\sin^2\theta+\sin\theta-2=0$

$\Rightarrow \sin\theta-2\sin^2\theta=0$

$\Rightarrow \sin(1-2\sin\theta)=0$

$\Rightarrow \sin\theta\neq 0$ $(\because\ \theta\in(0,\pi/2])$

$1-2\sin\theta=0\Rightarrow\sin\theta=1/2$

So, $\theta=\pi/6$

Shortcut method

Put $x = \pi/6, \pi/4, \pi/3$ and $\pi/6$ in given equation.

$2\cos^2(\pi/6)=\sin\pi/6-2=0$

$$2\times\frac{3}{4}+\frac{1}{2}-2=0$$

Satisfy the given equation.

54. Option (b) is correct.

Let speed of can be x m/min.

CD = $6x$ m and BD = tx m

In ΔABD,

$\tan 45° = AB/BD$

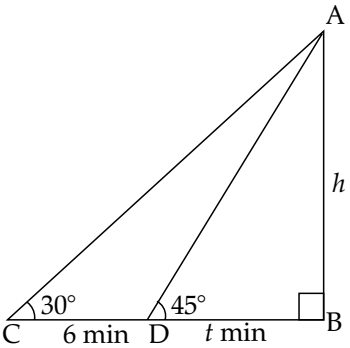
$$1=\frac{h}{tx}$$

$\Rightarrow h = tx$ (1)

In ΔABC,

$\tan 30° = AB/BC$

$$\Rightarrow\frac{1}{\sqrt{3}}=\frac{h}{6x+tx}$$



$\Rightarrow 6x+tx=\sqrt{3}\,tx$

$\Rightarrow 6+t=\sqrt{3}\,t$

$\Rightarrow 6=t(\sqrt{3}-1)$

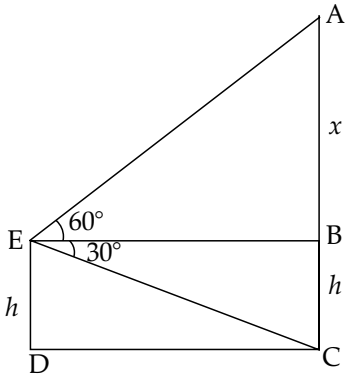
$$t = \frac{6}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1} = \frac{6(\sqrt{3}+1)}{3-1}$$

$$= 3(\sqrt{3}+1) = 3(1 \cdot 732 + 1) = 8 \cdot 196$$

$\therefore 8 < t < 8.3$

55. Option (c) is correct.

In ΔBCE,



$$\tan 30° = \frac{h}{BE}$$

$$\Rightarrow BE = \sqrt{3}h$$

In ΔABE

$$\tan 60° = \frac{x}{BE}$$

$$\Rightarrow \sqrt{3} = \frac{x}{\sqrt{3}h}$$

$$\Rightarrow x = 3h$$

Height of tower $= x + h = 3h + h = 4h$

56. Option (c) is correct.

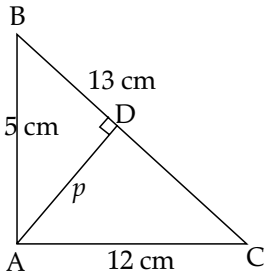
In ΔABC and ΔABD

$\angle BAC = \angle ADB = 90°$

$\angle B = \angle B$ (common)

$\angle BAC = \angle A$

$\therefore \Delta ABC = \Delta DBA$



$$\Rightarrow \frac{BC}{BA} = \frac{AC}{DA}$$

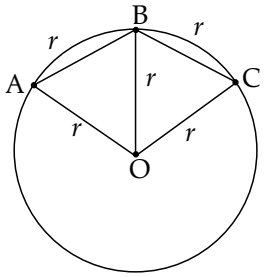
$$\Rightarrow \frac{13}{5} = \frac{12}{DA}$$

$$\Rightarrow AD = p = \frac{5 \times 12}{13} = \frac{60}{13}$$

$$\therefore 13p = 13 \times \frac{60}{13} = 60$$

57. Option (c) is correct.

Since, ΔOAB and ΔOBC are equilateral triangles with side r.



$$\therefore \text{Area of rhombus} = 2 \times \frac{\sqrt{3}}{4} r^2 = 32\sqrt{3}$$

$\Rightarrow r^2 = 64$ or $r = 8$ cm

58. Option (d) is correct.

Let length of side be x unit

$\therefore$ Surface area of cube $= 6x^2$

New length of side $= x\left(1 + \frac{p}{100}\right)$

New surface area $= 6x^2\left(1 + \frac{25}{100}\right)$

$$\Rightarrow \quad 6x^2\left(1 + \frac{p}{100}\right)^2 = 6x^2\left(1 + \frac{25}{100}\right)$$

$$\Rightarrow \quad \left(1 + \frac{p}{100}\right)^2 = \frac{125}{100}$$

$$\Rightarrow \quad 1 + \frac{p}{100} = \frac{5\sqrt{5}}{10}$$

$$\Rightarrow \quad \frac{p}{100} = \frac{5\sqrt{5} - 10}{10}$$

$$\Rightarrow \quad p = 50\sqrt{5} - 100 = 11.80$$

$\therefore 10 < p < 12$

59. Option (b) is correct.

Let side of cube be x unit

Then length of cuboids be $x/2$ unit

Breadth $= x$ unit and height $= x$ unit

$$\text{So, } \frac{\text{surface area of cube}}{\text{surface area of cuboids}} = \frac{6x^2}{2\left(\frac{x^2}{2} + x^2 + \frac{x^2}{2}\right)}$$

$$= \frac{6x^2}{x^2 + 2x^2 + x^2} = \frac{6x^2}{4x^2} = \frac{3}{2} = 3:2$$

60. Option (d) is correct.

Diagonal of cuboid $= \sqrt{l^2 + b^2 + h^2} = 11$

$\Rightarrow l^2 + b^2 + h^2 = 121$ (i)

Surface area $= 2(lb + bh + hl) = 240$

$\Rightarrow lb + bh + hl = 120$ (ii)

We know that

$(l + b + h)^2 = l^2 + b^2 + h^2 + 2(lb + bh + hl)$

$= 121 + 2(120)$

$= 121 + 240 = 361$

$$\Rightarrow \quad l + b + h = \sqrt{361} = 19 \text{ cm}$$

61. Option (b) is correct.

$$S = \frac{a+b+c}{2} = \frac{12+16+20}{2} = \frac{48}{2} = 24 \text{ cm}$$

Δ = area of triangle $= \sqrt{s(s-a)(s-b)(s-c)}$

$$= \sqrt{24(24-12)(24-16)(24-20)}$$

$$= \sqrt{24 \times 12 \times 8 \times 4} = \sqrt{12 \times 2 \times 12 \times 4 \times 2 \times 4}$$

$= 12 \times 2 \times 4 = 96 \text{ cm}^2$

Inradius (r) $= \frac{\Delta}{S} = \frac{96}{24} = 4$ cm

Area of circle $= \pi r^2 = 3.14 \times (4)^2$

$= 3.14 \times 16 = 50.24 \approx 50 \text{ cm}^2$

62. Option (b) is correct.

According to question,

$2 \times$ T.S.A. of cylinder $= 3 \times$ C.S.A. of cylinder

$2 \times 2\pi r\,(r + h) = 3 \times 2\pi rh$

$2r + 2h = 3h$

$\Rightarrow \quad 2r = h$

63. Option (d) is correct.

l = Length of floor = 30 m 60 cm = 3060 cm

b = Breadth of floor = 23 m 40 cm = 2340 cm

HCF of (3060, 2340) = side of square tiles

= 180 cm

$$\text{Number of tiles} = \frac{\text{Area of floor}}{\text{Area of each tile}}$$

$$= \frac{3060 \times 2340}{180 \times 180} = 17 \times 13$$

$$= 221$$

64. Option (c) is correct.

Area of square $= a^2 = 25$ hectares

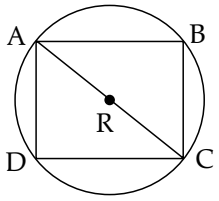
$\Rightarrow a^2 = 2{,}50{,}000 \text{ m}^2 \Rightarrow a = 500$ m

Length of boundary $= 4a = 2000$ m $= 2$ km

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{2}{5}\text{h} = \left(\frac{2}{5} \times 60\right) \text{min}.$$

= 24 minutes

65. Option (b) is correct.



Area of square $= x$

$\Rightarrow \quad (\text{Side})^2 = x$

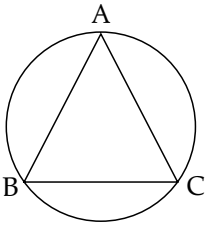
$\Rightarrow \quad \text{Side} = \sqrt{x}$

In right angle triangle ADC,

$$(2R)^2 = (\sqrt{x})^2 + (\sqrt{x})^2$$

$$\Rightarrow \quad 2R^2 = x \Rightarrow R^2 = \frac{x}{2} \qquad \text{(i)}$$

Area of equivaleteral triangle $= y$



$$\therefore \quad y = \frac{\sqrt{3}}{4}(\text{Side})^2$$

$$\Rightarrow \quad (\text{Side})^2 = \frac{4y}{\sqrt{3}} \qquad \text{(ii)}$$

We know that

Radius of circumcircle

$$= \frac{\text{Side of equilateral triangle}}{\sqrt{3}}$$

$$\text{R} = \frac{\text{side}}{\sqrt{3}} \Rightarrow \text{side} = \sqrt{3}\text{R} \qquad \text{[from (ii)]}$$

$$\Rightarrow 3\text{R}^2 = \frac{4y}{\sqrt{3}} \Rightarrow \text{R}^2 = \frac{4y}{3\sqrt{3}}$$

$$\Rightarrow \frac{x}{2} = \frac{4y}{3\sqrt{3}} \qquad \text{[from (i)]}$$

$$\Rightarrow 3\sqrt{3}x = 8y$$

Squaring both sides

$$27x^2 = 64y^2$$

66. Option (c) is correct.

$$\text{New length} = l\left(1 + \frac{200}{300}\right) = \frac{5l}{3}$$

Let new width $= b'$

According to question,

$$\frac{5l}{3} \times b' = lb$$

$$\Rightarrow \quad b' = \frac{3b}{5}$$

$\therefore$ Percentage decreased in width

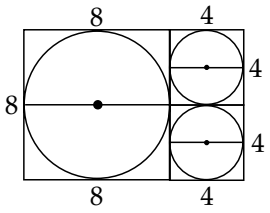
$$= \frac{b - \frac{3b}{5}}{b} \times 100 = \frac{2}{5} \times 100 = 40\%$$

67. Option (d) is correct.

$r_1 = 8/2 = 4$ cm

$r_2 = 4/2 = 2$ cm

$r_3 = 4/2 = 2$ cm



Area covered by these three circles

$= \pi {r_1}^2 + \pi {r_2}^2 + \pi {r_3}^2$

$= \pi(4)^2 + \pi(2)^2 + \pi(2)^2$

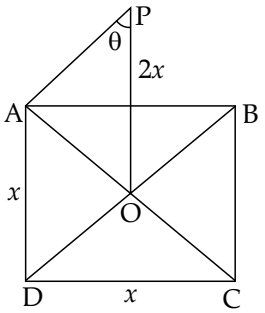
$= 16\pi + 4\pi + 4\pi = 24\pi \text{ cm}^2$

68. Option (c) is correct.

Given that side of square be x

$\therefore \quad \text{AC} = \sqrt{2}x$

$$\Rightarrow \quad \text{OA} = \frac{1}{2}\text{AC} = \frac{\sqrt{2}x}{2}$$



In ΔAOP,

$$\cot\theta = \frac{OP}{OA} = \frac{2x}{\frac{\sqrt{2}x}{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2}$$

69. Option (a) is correct.

Let radius of larger and smaller balls be r_1 and r_2 respectively.

$$\text{Number of balls} = \frac{\text{Volume of larger ball}}{\text{Volume of smaller ball}}$$

$$\Rightarrow \qquad 64 = \frac{\frac{4}{3}\pi r_1^3}{\frac{4}{3}\pi r_2^3} = \frac{r_1^3}{r_2^3}$$

$$\Rightarrow \qquad \frac{r_1}{r_2} = 4$$

$$\text{So, } \frac{\text{Surface are of larger ball}}{\text{Sum of the surface area of smaller balls}}$$

$$= \frac{4\pi r_1^2}{64 \times 4\pi r_2^2} = \frac{1}{64} \times \left(\frac{r_1}{r_2}\right)^2$$

$$= \frac{1}{64} \times 16 = \frac{1}{4} = 0.25$$

70. Option (b) is correct.

Perimeter of P:

$AF + FE + AE = 16$ (1)

Perimeter of Q:

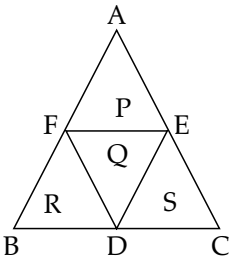
$FE + FD + ED = 12$ (ii)

Perimeter of R:

$BF + FD + BD = 4$ (iii)

Perimeter of S:

$CD + ED + EC = 12$ (iv)



Adding equation (i), (iii) and (iv), we get

$\Rightarrow$ $AB + BC + AC + EF + FD + ED$
$= 16 + 4 + 12$

$\Rightarrow$ $AB + BC + AC + 12 = 32$ [Using (ii)]

$\Rightarrow$ $AB + BC + AC = 32 - 12 = 20$

So, perimeter of $\Delta ABC = 20$ cm

71. Option (d) is correct.

A number 277XY5 is divisible by 25.

If Y5 is divisible by 25.

$\therefore$ Y = 2

Statement 1, since given number D.

Divisible by 9, so sum of digit is divisible by 9.

$2 + 7 + 7 + X + 2 + 5 = 23 + X$ is divisible by 9.

So, possible value of X is 4 which is not satisfy the statement II.

Hence, cannot be answered by using both statement together.

72. Option (b) is correct.

Since 2 is root of the given equation

$\therefore$ $4a + 2b + c = 0$ (i)

Statement I: $c/a = 1$ (ii)

Statement II: $b/a = -5/2$ (iii)

Hence, unique value of a, b, c can be obtained by using both statement I and statement II.

73. Option (b) is correct.

Statement I: $\frac{m}{n} > 1$ (i)

Statement II: $m > 2n \Rightarrow \frac{m}{n} > 2$ (ii)

From (i) or (ii) we get,

$$m > n$$

Hence, the question can be answered by either statement alone.

74. Option (b) is correct.

We can draw a circum circle if all sides of triangle are given.

75. Option (c) is correct.

Let consecutive odd integer x and y are k and $k + 2$ respectively.

From statement-I:

$(x + y)^4 = 256$

$\Rightarrow$ $x + y = 4$

$\therefore$ $(x, y) = (1, 3); (-1, -3)$

From statement-II:

$(x + y)^3 < 16$

$(x + y) < (16)^{1/3}$

$(x + y) < 2(2)^{1/3}$

76. Option (d) is correct.

Let, $p = 2$ and $q = 5$, then

Statement I: $2p + q = 4 + 5 = 9$ is odd

Statement II: $q - 2p = 5 - 4 = 1$ is odd

But

$p^2 + q^2 + q = 4 + 25 + 5 = 34$ is even

So, question cannot be answered even by using both statement together.

77. Option (b) is correct.

Statement I:

$l = 7$ cm

$\theta = 30° = \pi/6$

We have, $l = r\theta$

$$7 = r \times \frac{\pi}{6} \Rightarrow r = 7 \times \frac{6}{\pi}$$

$\Rightarrow \quad r = \dfrac{7\times6\times7}{22}$

Area of circle $= \dfrac{22}{7}\times\dfrac{7\times7\times6}{22}\times\dfrac{7\times6\times7}{22}$

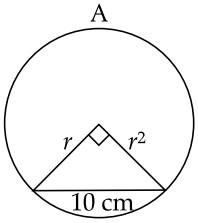
$= \dfrac{7\times6\times7\times6\times7}{22}$

Statement II:

$r^2 + r^2 = 100$

$\Rightarrow \quad r = 5\sqrt{2}$

Area of circle $= \dfrac{22}{7}\times 25 \times 2$



So, question can be answered by either statement alone.

78. Option (a) is correct.

Statement I is true for all the triangle. So, it may be right triangle.

Statement II

$x + 2x + 3x = 180°$

$\Rightarrow 6x = 180° \Rightarrow x = 30°$

So, $3x = 3 \times 30° = 90°$

So, triangle is right triangle.

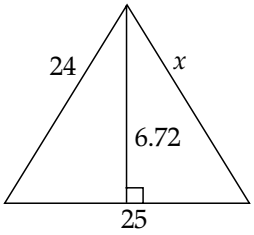
Hence, question can be answered by one of the statement alone but not by the other.

79. Option (b) is correct.

Statement-I:

$x + 2x + 3x = 180° \Rightarrow 6x = 180°$

$\Rightarrow x = 30°$



So, angles are 30°, 60°, 90°

$\dfrac{a}{\sin 30°} = \dfrac{24}{\sin 60°} = \dfrac{25}{\sin 90°}$

$a = \dfrac{25}{\sin 90°}\times \sin 30° = 25\times\dfrac{1}{2}$

Shortest side = 12.5 cm

Statement-II: We can find the value of x by Pythagoras theorem which is different from Statement I.

So, question can be answered by either statement alone.

80. Option (b) is correct.

Given that,

3X area of major segment

= 4 × area of minor segment

Area of major segment

= 4/3 × area of minor segment

Area of minor segment

= 3/4 × area of major segment

$\because$ Area of minor segment + Major segment

$= \pi r^2$

Area of major segment = $4/7\ \pi r^2$

So, we can find the radius of circle if either area of minor or major segment given.

81. Option (b) is correct.

Class	f_i	C.F
0-30	4	4
30-60	5	9
60-90	7	16
90-120	4	20

Mode $= l + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\times h$

$= 60 + \dfrac{7-5}{14-5-4}\times 30$

$= 60 + 2/5 \times 30$

$= 60 + 12 = 72$

82. Option (a) is correct.

Mode (Q) = 72

Median (P) $= l + \dfrac{\frac{N}{2} - C.F}{f}\times h$

$= 60 + \dfrac{10-9}{7}\times 30$

$= 60 + \dfrac{30}{7} = 30\left(2 + \dfrac{1}{7}\right)$

$= 30\times\dfrac{15}{7} = \dfrac{450}{7}$

Now, 7(Q–P) = 9R

$\Rightarrow 7\left(72 - \dfrac{450}{7}\right) = 9R$

$\Rightarrow 7\left(\dfrac{504-450}{7}\right) = 9R$

54 = 9R

R = 6

83. Option (d) is correct.

Class	Frequency (f_i)	Class mark (x_i)	$f_i x_i$
40–50	4	45	180
50–60	3	55	165
60–70	1	65	65
70–80	2	75	150
Total	10		560

$$\text{Mean} = \frac{\sum x_i f_i}{\sum f_i} = \frac{560}{10} = 56$$

84. Option (c) is correct.

Class	Frequency (f_i)	C.F	
40-50	4	4	
50-60	3	7	→ Median class
60-70	1	8	
70-80	2	10	

Here, $\frac{N}{2} = \frac{10}{2} = 5$

$$\text{Median (M)} = l + \frac{\frac{N}{2} - \text{C.F}}{f} \times h$$

$$= 50 + \frac{5-4}{3} \times 10$$

$$= 50 + \frac{10}{3} = \frac{160}{3}$$

So, $3M = 3 \times \frac{160}{3} = 160$

85. Option (b) is correct.

Let length be $2x$ and breadth be x

Area = $2x \times x = 200$

$2x^2 = 200 \Rightarrow x = 10$ m

Length = 20 m

Breadth = 10 m

New length = 20 + 2 = 22 m

New breadth = 10 + 2 = 12 m

New area = $22 \times 12 = 264$ m^2

Increased area percentage

$$= \frac{264 - 200}{200} \times 100 = 32\%$$

86. Option (a) is correct.

Circumference = 44 cm

$2\pi r = 44 \Rightarrow r = 44 \times 7/2 \times 22$

$r = 7$ cm

Height (h) = 44 cm

Volume = $\pi r^2 h$

$$= \frac{22}{7} \times 7 \times 7 \times 44$$

$$= 6776 \text{ cm}^3$$

87. Option (a) is correct.

Given that,

$lbh = 3600$ cm^3 (i)

$lb = x$ cm^2 (ii)

$bh = 225$ cm^2 (iii)

$lh = 144$ cm^2 (iv)

Multiply (ii), (iii) and (iv), we get

$l^2b^2h^2 = 225 \times 144 \times x$

$$\Rightarrow \quad x = \frac{3600 \times 3600}{225 \times 144} = 400 \text{ cm}^2$$

88. Option (c) is correct.

Given that,

$1/2 \times p \times b = 54 \Rightarrow pb = 108$

$p + b + h = 36$

$p + b = 36 - h$

Squaring both sides

$(p+b)^2 = (36 - h)^2$

$\Rightarrow p^2 + b^2 + 2pb = (36 - h)^2$

$\Rightarrow h^2 + 2 \times 108 = (36 - h)^2$

$\Rightarrow (36 - h)^2 - h^2 = 216$

$\Rightarrow (36 - h + h)(36 - h - h) = 216$

$\Rightarrow 36(36 - 2h) = 216$

$\Rightarrow 36 - 2h = 6 \Rightarrow h = 15$ cm

89. Option (d) is correct.

$x = \{2, 6, 10, 14, ..., 98\}$

Sum of two numbers is 100 = (2, 98), (6, 94), (10, 90), (14, 86), (18, 82), (22, 78), (26, 74)(30, 70) (34,66)(38,62), (42, 58), (46, 54), (50, 50)

S = {2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50} and {50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 98}

Required numbers = 13

90. Option (a) is correct.

Perimeter of a sector of a circle

= $2r$ + Length of arc

16.4 = 2(5.2) + Length of arc

Length of arc = 16.4 – 10.4 = 6

$$\Rightarrow \frac{\theta}{360^\circ} \times 2\pi r = 6$$

$$\Rightarrow \theta = \frac{6 \times 360}{2\pi \times 5.2} = \frac{6 \times 360 \times 7}{2 \times 22 \times 5.2}$$

So, area of sector $= \frac{\theta}{360^\circ} \times \pi r^2$

$$= \frac{1}{360^\circ} \times \frac{6 \times 360 \times 7}{2 \times 22 \times 5.2} \times \frac{22}{7} \times (5.2)^2 = 15.6 \text{ cm}^2$$

91. Option (d) is correct.

$10^2 = 6^2 + 8^2$

$\therefore \angle ABC = 90^\circ$

$\therefore \Delta ABC \sim \Delta BDC$

$$\Rightarrow \frac{AB}{BD} = \frac{AC}{BC}$$

$$\Rightarrow \frac{6}{BD} = \frac{10}{8}$$

$$\Rightarrow BD = \frac{6 \times 8}{10} = 4.8 \text{ cm} = BQ$$

So, CQ = BC – BQ = 8 – 4.8 = 3.2 cm

92. Option (c) is correct.

$\because \Delta ABC \sim \Delta ADB$

$\therefore \frac{AB}{AD} = \frac{AC}{AB} \Rightarrow \frac{6}{AD} = \frac{10}{6}$

$\Rightarrow AD = \frac{36}{10} = 3.6$ cm

Given that $\angle ABD = \theta$

$\sin\theta = \frac{AD}{AB} = \frac{3.6}{6} = 0.6$

93. Option (b) is correct.

$\because \Delta ABC \sim \Delta BDC$

$\therefore \frac{AB}{BD} = \frac{AC}{BC}$

$\frac{6}{BD} = \frac{10}{8}$

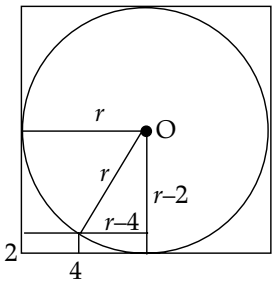
$\Rightarrow BD = \frac{6\times 8}{10} = 4.8$ cm

$\because$ Radius = 4.8 cm

94. Option (a) is correct

$r^2 = (r-4)^2 + (r-2)^2$

$r^2 = r^2 - 8r + 16 + r^2 - 4r + 4$



$r^2 - 12r + 20 = 0$

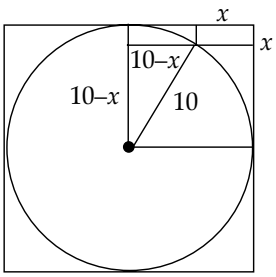
$r = 10$ ($r = 2$ is not possible)

$\therefore$ Area of circle $= \pi r^2 = \pi(10)^2 = 100\pi$ cm^2

95. Option (d) is correct.

$(10-x)^2 + (10-x)^2 = 10^2$

$\Rightarrow 2(10-x)^2 = 10^2$



$\Rightarrow \sqrt{2}\,(10-x) = 10$

$\Rightarrow 10 - x = 10/\sqrt{2} = 5\sqrt{2}$

$\Rightarrow x = 10 - 5\sqrt{2} = 5(2-\sqrt{2})$

Area of smaller square

$= [5(2-\sqrt{2}\,]^2 = 25\,[4 + 2 - 4\sqrt{2}\,]$

$= 50\,[3 - 2\sqrt{2}\,]$ cm^2

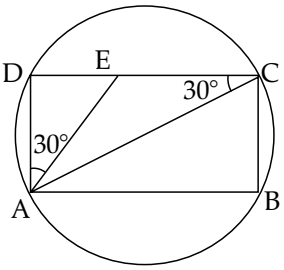
96. Option (b) is correct.

Area of the shaded region

$= (10)^2 - \frac{1}{4}\pi(10)^2 - 2\times 4$

$= 100 - 25\pi - 8 = (92 - 25\pi)$ cm^2

97. Option (b) is correct.



$AC = 2r$

In ΔACD

$\sin 30° = AD/AC$

$\Rightarrow AD = 1/2\ AC$

$= 1/2 \times 2r = r$

$\cos 30° = CD/AC$

$\Rightarrow \frac{\sqrt{3}}{2} = \frac{CD}{AC}$

$\Rightarrow CD = \frac{\sqrt{3}}{2}\times AC = \frac{\sqrt{3}}{2}\times 2r = \sqrt{3}r$

So, $\frac{\text{Area of circle}}{\text{Area of rectangle}} = \frac{\pi r^2}{(r)\times(\sqrt{3})} = \frac{\pi}{\sqrt{3}}$

98. Option (a) is correct.

In ADE,

$\tan 30° = \frac{DE}{AD}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{DE}{r} \Rightarrow DE = \frac{r}{\sqrt{3}}$

Area of ΔAEC = Area of ΔADC – Area of ΔADE

$= \frac{1}{2}\times r \times \sqrt{3}r - \frac{1}{2}\times r \times \frac{r}{\sqrt{3}}$

$= \frac{r^2}{2}\left(\sqrt{3} - \frac{1}{3}\right) = \frac{r^2}{2}\times\frac{2}{\sqrt{3}} = \frac{r^2}{\sqrt{3}}$

99. Option (c) is correct.

$\because OB = BQ$

$\therefore \angle BOQ = \angle BQO = y°$

$\Rightarrow \angle ABO = y° + y = 2y$ (exterior angle)

$\Rightarrow \angle OAB = \angle ABO = 2y$ (OA = OB)

In ΔAOB,

$\angle AOB = 180° - 4y°$

By angle sum property of a triangle,

$\angle POA + \angle AOB + \angle BOQ = 180°$

$\Rightarrow x° + 180° - 4y° + y° = 180°$

$\Rightarrow x° - 3y° = 0$

$\Rightarrow x° = 3y°$

100. Option (d) is correct.

$\therefore \angle AOB = 180° - 4y°$

$= 180° - 4 \times 15 = 120°$

$\angle ACB = 1/2\ \angle AOB$

$= 1/2 \times 120° = 60°$

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C.D.S.
Combined Defence Services

EXAM

II

2023

Elementary Mathematics

Time Allowed : 2 Hours **M.M. : 100**

Important Instructions :

1. *This Test Booklet contains **100** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each item.*
2. *You have to mark all your responses ONLY on the separate Answer Sheet provided. See directions in the Answer Sheet.*
3. ***All** items carry equal marks.*
4. ***Penalty for wrong answers :***
   THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
   (i) *There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.*
   (ii) *If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.*
   (iii) *If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.*

1. If $a^2 - bc = \alpha$, $b^2 - ac = \beta$, $c^2 - ab = \gamma$, then what is $\frac{a\alpha + b\beta + c\gamma}{(a+b+c)(\alpha+\beta+\gamma)}$ equal to?
   (a) $a + b - c$ (b) $a - b + c$
   (c) $-a + b + c$ (d) 1
2. If $(x-1)^3$ is a factor of $x^4 + \alpha x^3 + \beta x^2 + \gamma x - 1$, then the other factor will be:
   (a) $x + 1$ (b) $x - 3$
   (c) $x + 2$ (d) x
3. A 2-digit number is such that the sum of the number and the number obtained by reversing the order of the digits of the number is 55. Further, the difference of the given number and the number obtained by reversing the order of the digits of the number is 45. What is the product of the digits?
   (a) 5 (b) 2
   (c) 1 (d) 0
4. If A and B can finish a work in 10 days, B and C can finish the same work in 12 days, C and A can finish the same work in 15 days; then in how many days can A, B and C together finish half of the work?
   (a) 8 days (b) 5 days
   (c) 4 days (d) 3 days
5. A person borrowed ₹10,000 at 12% rate of interest per annum compounded quarterly for a period of 9 months. What is the interest paid by him to settle his account after 9 months?
   (a) ₹927.27 (b) ₹947.47
   (c) ₹967.67 (d) ₹987.87
6. For what relation between a and b is the equation $\sin\theta = \frac{a+b}{2\sqrt{ab}}$ possible?
   (a) $a = b$ (b) $a \le b$
   (c) $a \ge b$ (d) $a > b$
7. Three persons A, B and C together can do a piece of work in 36 days. A and B together can do five times as much work as C alone; B and C together can do as much work as A alone. If A and C together can do n times as much work as B alone, then what is the value of n?
   (a) 1.5 (b) 2
   (c) 2.5 (d) 3
8. If $\frac{2a}{3} = \frac{4b}{5} = \frac{3c}{4}$, then what is the value of $\frac{18}{a}\sqrt{a^2 + c^2 - b^2}$?
   (a) $3\sqrt{5}$ (b) $\sqrt{355}$
   (c) $\sqrt{375}$ (d) $3\sqrt{15}$
9. The sum of deviations of n numbers from 10 and 20 are a, b respectively. If $\frac{b}{a} = -4$, then what is the mean of these n numbers?
   (a) 12 (b) 14

(c) 16 (d) 18

10. If the median of observations 12, 1, 8, 54, 61, 28, 45, 35, 21, 17 is M, then what is the value of 2M + 5?
(a) 12 (b) 28
(c) 52 (d) 54

11. How many real roots does the equation $\sqrt{x+9} = x-3$ have?
(a) Only one (b) Only two
(c) Only three (d) None

12. If $x = 97 + 56\sqrt{3}$, then what is the value of $\sqrt[4]{x} + \frac{1}{\sqrt[4]{x}}$?
(a) 7 (b) 6
(c) 5 (d) 4

13. Let L be the LCM and H be the HCF of two given numbers. L and H are in the ratio 3 : 2. If the sum of the two numbers is 45, then what is the product of the numbers?
(a) 243 (b) 486
(c) 504 (d) Cannot be determined due to insufficient data

14. A man walks at an average speed of 3 km/h from his home and reaches office 40 minutes early. If he walks at an average speed of 2 km/h, he would reach office 40 minutes late. What is the distance between his home and office?
(a) 6 km (b) 8 km
(c) 10 km (d) 12 km

15. If $3^{x-1} + 3^{3-x} = 6$, then what is $2^{x-1} + 2^{3-x}$ equal to?
(a) 4 (b) 3
(c) 2 (d) 1

16. If $x\left(a-b+\frac{ab}{a-b}\right) = y\left(a+b-\frac{ab}{a+b}\right)$ and $x + y = 2a^3$, then what is $x - y$ equal to?
(a) $-2b^3$ (b) $-2ab^3$
(c) $2b^3$ (d) $2ab^3$

17. Which one of the following is a factor of $3\sqrt{3}x^3 + 2\sqrt{2}y^3 - 18xy + 6\sqrt{6}$?
(a) $\sqrt{3}x + \sqrt{2}y - \sqrt{3}$
(b) $\sqrt{3}x + \sqrt{2}y - \sqrt{6}$
(c) $3x^2 + 2y^2 - \sqrt{18}x - \sqrt{12}y - \sqrt{6}xy + 6$
(d) $3x^2 + 2y^2 + \sqrt{18}x + \sqrt{12}y - \sqrt{6}xy + 6$

18. What is the number of digits in the expansion of 125^{100}? (Given $\log_{10} 2 = 0.301$)
(a) 69 (b) 70
(c) 209 (d) 210

19. What is the HCF of $acx^3 + bcx^2 + adx^2 + acdx + bdx + bcd$ and $adx^3 + acx^2 + bdx^2 + bcx + acdx + bcd$ if HCF $(c, d) = 1$, $c \neq d$?
(a) $bx + c$ (b) $cx + x$
(c) $ax + d$ (d) $ax + b$

20. If $x^n - py^n + qz^n$ is divisible by $x^2 + abyz - bzx - axy$, then what is $\frac{p}{a^n} - \frac{q}{b^n}$ equal to?
(a) –1 (b) 0
(c) 1 (d) 2

21. Consider the following statements:
1. If $(a + b)$ is directly proportional to $(a - b)$, then $(a^2 + b^2)$ is directly proportional to ab.
2. If a is directly proportional to b, then $(a^2 - b^2)$ is directly proportional to ab.
Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

22. If $(3a + 6b + c + 2d) \times (3a - 6b - c + 2d) = (3a - 6b + c - 2d) \times (3a + 6b - c - 2d)$, then which one of the following is correct?
(a) $ab = cd$ (b) $ac = bd$
(c) $ad = bc$ (d) $ad + bc = 0$

23. If $3\sin\theta + 5\cos\theta = 5$, then what is the value of $5\sin\theta - 3\cos\theta$ equal to?
(a) 5 (b) –3
(c) –2 (d) 0

24. The combined age of a man and his wife is 6 times the combined age of their children. Two years ago their combined age was 10 times the combined age of their children; and six years later their combined age will be 3 times the combined age of their children. How many children do they have if each child is at least 2 years old?
(a) 2 (b) 3
(c) 4 (d) 5

25. What is $3(\sin x - \cos x)^4 + 6(\sin x + \cos x)^2 + 4(\sin x)^6 + 4(\cos x)^6$ equal to?
(a) 9 (b) 11
(c) 13 (d) 15

26. What is the value of $\sin\theta + \cos\theta$, if satisfies the equation $\cot^2\theta - (\sqrt{3}+1)\cot\theta + \sqrt{3} = 0$; $0 < \theta < \frac{\pi}{4}$?
(a) $\sqrt{2}$ (b) 2
(c) $\frac{\sqrt{3}+1}{2}$ (d) $\frac{\sqrt{3}-1}{2}$

27. Which one of the following is a value of θ, if θ satisfies the equation $\tan 2\theta \tan 4\theta - 1 = 0$; $0 < \theta < \frac{\pi}{2}$?
(a) $\frac{\pi}{12}$ (b) $\frac{\pi}{15}$
(c) $\frac{\pi}{6}$ (d) $\frac{\pi}{5}$

28. If $\tan x = \frac{\sin\theta + \cos\theta}{\sin\theta - \cos\theta}$, $\frac{\pi}{4} < \theta < \frac{\pi}{2}$, then what is $\sqrt{2}\sin x$ equal to?
(a) $\sin\theta + \cos\theta$ (b) $\sin\theta - \cos\theta$
(c) $\frac{\sin\theta + \cos\theta}{2}$ (d) $\frac{\sin\theta - \cos\theta}{2}$

29. How many values of θ will satisfy the equation $(\sin^2\theta - 4\sin\theta + 3)(4 - \cos^2\theta + 4\sin\theta) = 0$, where $0 < \theta < \frac{\pi}{2}$?
(a) None (b) Only one
(c) Only two (d) Only three

30. If $x\sin^3\theta + y\cos^3\theta = \sin\theta\cos\theta$ and $x\sin\theta - y\cos\theta = 0$, for every $\theta \in \left(0, \frac{\pi}{2}\right)$, then what is $x^2 + y^2$ equal to?
(a) 0 (b) 1
(c) 2 (d) 3

Consider the following for the next two (02) items that follow:

A flagstaff stands on the top of a vertical tower. The angle of elevation of the top of the flagstaff from a certain place on the same horizontal level with the base of the tower is found to be α. Advancing a distance *d* towards the tower in the same horizontal plane, the angle of elevation of the top of the flagstaff is observed to be β and that of the top of the tower is observed to be γ. Let H be the height of the top of the flagstaff from the base of the tower and h be the height of the tower.

31. Which one of the following is correct?
(a) $H\tan\gamma - h\tan\beta = 0$
(b) $h\tan\gamma - H\tan\beta = 0$
(c) $H\tan\gamma - h\tan\alpha = 0$
(d) $h\tan\gamma - H\tan\alpha = 0$

32. Which one of the following is correct?
(a) $d = \frac{H(\cot\alpha - \cot\beta)}{2}$ (b) $d = \frac{H(\tan\alpha - \tan\beta)}{2}$
(c) $d = H(\cot\alpha - \cot\beta)$ (d) $d = H(\tan\alpha - \tan\beta)$

Consider the following for the next two (02) items that follow:

AB is a straight road leading to the foot P of a tower of height *h*. Q is at distance *x* from P and R is at a distance *y* from Q (R is farther from P than Q; R, Q are on the same side). The angle of elevation of the top of the tower at Q is twice of that at R. (Use the formula $\tan 2\theta = \frac{2\tan\theta}{1 - \tan^2\theta}$).

33. Which one of the following is correct?
(a) $x = y$
(b) $x < y$
(c) $x > y$
(d) Cannot be concluded due to insufficient data.

34. Which one of the following is correct?
(a) $h^2 = x^2 - y^2$ (b) $h^2 = x^2 + y^2$
(c) $h^2 = 2(y^2 - x^2)$ (d) $h^2 = y^2 - x^2$

Consider the following for the next two (02) items that follow:

Two parallel chords AB and CD of a circle are of lengths 60 cm and 80 cm respectively. They are on the same side of the centre O and 10 cm apart.

35. What is the diameter of the circle?
(a) 120 cm (b) 110 cm
(c) 100 cm (d) 90 cm

36. If the chord AB subtends an angle α and chord CD subtends an angle β at the centre O, then what is the value of $\tan\left(\frac{\beta}{2}\right) - \tan\left(\frac{\alpha}{2}\right)$?
(a) $\frac{3}{4}$ (b) $\frac{5}{12}$
(c) $\frac{1}{2}$ (d) $\frac{7}{12}$

Consider the following for the next two (02) items that follow:

Let $p = x^4 - y^2z^2$, $q = y^4 - z^2x^2$, $r = z^4 - x^2y^2$.

37. What is $px^2 + qy^2 + rz^2$ equal to?
(a) $(x^2 + y^2 + z^2)(p + q + r)$
(b) $-(x^2 + y^2 + z^2)(p + q + r)$
(c) $(y^2 + z^2 - x^2)(r - q - p)$
(d) $(x^2 + y^2 - z^2)(p - q - r)$

38. What is $x^2(px^2 + qy^2 + rz^2) + qr - p^2$ equal to?
(a) 0 (b) 1
(c) $p + q + r$ (d) $x^2 + y^2 + z^2$

Consider the following for the next two (02) items that follow:

A right conical cap just covers two spheres placed one above the other on a table such that it touches both the spheres. Let *r* be the radius of the smaller sphere and R be the radius of the bigger sphere. Let 2θ be the vertical angle of the cone.

39. What is the height of the cone?
(a) $\frac{2r^2}{R - r}$ (b) $\frac{2R^2}{R - r}$
(c) $\frac{2(r^2 + R^2)}{R - r}$ (d) $\frac{r^2 + R^2}{R - r}$

40. What is the radius of the base of the cone?
(a) $\frac{2r^2\tan\theta}{R - r}$ (b) $\frac{2R^2\tan\theta}{R - r}$
(c) $\frac{2(r^2 + R^2)\tan\theta}{R - r}$ (d) $\frac{(r^2 + R^2)\tan\theta}{R - r}$

Consider the following for the next two (02) items that follow:

A line segment AB is bisected at C and semi-circles S_1, S_2 and S_3 are drawn respectively on AB, AC and CB as diameters such that they all lie on same side of AB. A circle S is drawn touching internally S_1 and externally S_2 and S_3.

41. If *r* is the radius of S and R is the radius of S_2, then which one of the following is correct?

(a) R = 3*r* (b) R = 2*r*
(c) 3R = 4*r* (d) 2R = 3*r*

42. If *m* is the area of the circle S and *n* is the area of semi-circle S_1, then which one of the following is correct?
(a) $9m = 2n$ (b) $9m = 4n$
(c) $3m = 2n$ (d) $7m = 3n$

Consider the following for the next two (02) items that follow:

Let $\frac{(x-a)(x-b)}{(x-ma)(x-mb)} = \frac{(x+a)(x+b)}{(x+ma)(x+mb)}$; $m, a, b > 0$.

43. What is $\frac{x^2+ab}{x^2+m^2ab}$ equal to?
(a) $-\frac{1}{m^2}$ (b) $\frac{1}{m^2}$
(c) $\frac{2}{m}$ (d) $\frac{1}{m}$

44. What is x equal to?
(a) $\pm\sqrt{mab}$ (b) $\pm\sqrt{ab}$
(c) $\pm\sqrt{2mab}$ (d) $\pm\sqrt{2ab}$

Consider the following for the next two (02) items that follow:

The total monthly electricity bill for a house consists of the sum of two parts, one part is proportional to number of rooms and the other part is proportional to number of units consumed. ₹400 is the monthly electricity bill for a house with 8 rooms and consuming 240 units and ₹320 is the monthly electricity bill for a house with 6 rooms and consuming 200 units.

45. What is the monthly electricity bill for a house with *m* rooms and consuming *n* units?
(a) ₹$(40m + n)$ (b) ₹$(20m + n)$
(c) ₹$\frac{(40m+n)}{2}$ (d) ₹$\frac{(30m+n)}{2}$

46. What is the monthly electricity bill for a house with 7 rooms consuming 300 units?
(a) ₹500 (b) ₹440
(c) ₹340 (d) ₹300

Consider the following for the next two (02) items that follow:

A grouped frequency distribution is given below :

Weekly wages in Rupees (₹)	Numbers of workers
2050–2550	5
2550–3050	10
3050–3550	*k*
3550–4050	8
4050–4550	2
4550–5050	10

47. If average weekly wages earned by a worker is ₹3,520, then what is the value of k?
(a) 10 (b) 12
(c) 15 (d) 20

48. What is the median (approximate value) of the distribution?
(a) ₹ 3,263 (b) ₹3,383
(c) ₹3,413 (d) ₹3,483

Consider the following for the next two (02) items that follow:

A quadratic equation is given by $(a + b + c)x^2 - (2a + 2b)x + (a + b - c) = 0$. Where *a*, *b* and *c* are real and distinct.

49. What are the roots of the equation?
(a) $1, \frac{(a+b-c)}{(a+b+c)}$ (b) $1, \frac{(a-b+c)}{(a+b+c)}$
(c) $-1, \frac{(-a-b+c)}{(a+b+c)}$ (d) $-1, \frac{(a+b-c)}{(a+b+c)}$

50. Consider the following statements:
1. One of the roots of the equation is always less than 1 if *a*, *b* and *c* are all positive.
2. One of the roots of the equation is always negative if *a*, *b* and *c* are all negative.

Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

51. What is the radius of the sphere passing through the corners of the cuboid with edges 8 cm, 12 cm and 24 cm?
(a) 10.5 cm (b) 14 cm
(c) 21 cm (d) 28 cm

52. A lamp shade is in the shape of a part of a cone and its top and bottom ends are circles whose circumferences are respectively 30 cm and 40 cm. The perpendicular distance between the ends is 6 cm. If the cone were to be completed, then how far would its vertex be from the top end?
(a) 20 cm (b) 18 cm
(c) 12 cm (d) 9 cm

53. A sum of money at 20% rate of compound interest per annum becomes more than 100 times in *n* years. What is the least value of n? (Use $\log_{10} 2 = 0.301$, $\log_{10} 3 = 0.477$).
(a) 23 (b) 24
(c) 25 (d) 26

54. The corners of an equilateral triangular plate were cut in such a manner that it forms a regular hexagonal plate. What is the ratio of the area of the triangular plate to the area of the hexagonal plate?
(a) 2: 1 (b) 3: 2
(c) 4: 3 (d) 5: 3

55. Two equal arcs of different circles C_1 and C_2 subtend angles of 60° and 75° respectively, at the centres. What is the ratio of the radius of C_1 to the radius of C_2?
(a) 4 : 5 (b) 5 : 4
(c) 1 : 1 (d) 3 : 2

56. ABC is a triangle with sides AB = 41 cm, BC = 28 cm and CA = 15 cm. IF D, E and F are the mid-point of AB, BC and CA respectively, then what is the area of the triangle DEF?
(a) 63 square cm (b) 45 square cm
(c) 31.5 square cm (d) 22.5 square cm

57. A triangle has sides 13 cm, 14 cm and 15 cm long. What is the length of the smallest altitude of the triangle?
(a) 11 cm (b) 11.2 cm
(c) 12 cm (d) 12.2 cm

58. The circumference of a circle exceeds the diameter by 16.8 cm. What is the diameter of the circle? (Take $\pi = \frac{22}{7}$)
(a) 6.24 cm (b) 6.42 cm
(c) 7.64 cm (d) 7.84 cm

59. The hypotenuse AC of a right-angled ABC is $3\sqrt{5}$ cm. If AB is doubled and BC is tripled such that ABC remains a right-angled triangle, the hypotenuse becomes 15 cm. What is AB + BC equal to?
(a) 10 cm (b) 9 cm
(c) $2\sqrt{5}$ cm (d) 8 cm

60. What is the area of the region between two concentric circles if the chord of the outer circle of length 14 cm is a tangent of the inner circle? (Take $\pi = \frac{22}{7}$)
(a) 125 square cm (b) 132 square cm
(c) 144 square cm (d) 154 square cm

61. A pendulum swings through an angle of 9° and its end describes an arc of length 14.3 cm. What is the length of the pendulum? (Take $\pi = \frac{22}{7}$)
(a) 88 cm (b) 91 cm
(c) 95 cm (d) 98 cm

62. The arch of a bridge is in the form of an arc of a circle. If the span of the bridge is 40 m and height in the middle is 8 m, then what is the radius of curvature of the bridge?
(a) 25 m (b) 27 m
(c) 29 m (d) 31 m

63. If a, b and c are the sides of a right-angled triangle, where $a > b > c$, then what is the value of the expression
$(a + b + c)(a + b - c)(a - b + c)(a - b - c)$?
(a) $4b^2c^2$ (b) $-4b^2c^2$
(c) $-2a^2b^2$ (d) $-4a^2b^2$

64. The cube root of x varies inversely as the square root of y. $x = 8$ when $y = 3$. What is the value of x when $y = \sqrt[3]{3}$?
(a) 18 (b) 21
(c) 24 (d) 27

65. Three solid lead spheres of diameters 6 cm, 8 cm and 10 cm are melted together and recast as a solid sphere. What is the percentage diminution of the surface area as compared to the sum of the surface areas of the three spheres?
(a) 25% (b) 26%
(c) 27% (d) 28%

66. A solid sphere of radius 3 cm is melted to form a hollow cylinder of height 4 cm and external diameter 10 cm. What is the thickness of the cylinder?
(a) 0.42 cm (b) 0.46 cm
(c) 0.50 cm (d) 1.00 cm

67. Three glasses P, Q and R have capacities in the ratio 1 : 2 : 3. All these glasses are completely filled with mixtures of milk and water. The ratio of milk to water in P is 1 : 2, in Q it is 2 : 3 and in R it is 3 : 1. If the content of all three glasses are put into a bigger container, what will be the ratio of milk to water in the container?
(a) 203 : 117 (b) 203 : 157
(c) 172 : 91 (d) 165 : 88

68. What is the LCM of $x^4 + x^2y^2 + y^4$, $x^3 + y^3$, $x^3 - y^3$?
(a) $(x^2 - y^2)(x^4 + x^2y^2 + y^4)^2$
(b) $(x^2 - y^2)(x^4 + 2x^2y^2 + y^4)$
(c) $(x^6 - y^6)$
(d) $(x^6 + y^6)$

69. What is $\frac{x^2 - y^2 - z^2 - 2yz}{x^2 + y^2 - z^2 + 2xy} + \frac{x^2 - y^2 - z^2 - 2yz}{x^2 - y^2 + z^2 - 2xz}$ equal to?
(a) $\frac{x}{x + y - z}$ (b) $\frac{y + z}{x + y - z}$
(c) $\frac{2x}{x + y - z}$ (d) $\frac{2y + 2z}{x + y - z}$

70. If tan A + cot A = 2, where $0 < A < 90°$, then what is the value of $\tan^2A + \tan^3A + \tan^4A + \ldots + \tan^nA$?
(a) 1 (b) $n - 2$
(c) $n - 1$ (d) n

71. Which of the following is/are identity/identities?
1. $\frac{\sin^3\theta + \cos^3\theta}{\sin\theta + \cos\theta} + \sin\theta\cos\theta = 1;\ 0 < \theta < \frac{\pi}{2}$
2. $1 - \sin^6\theta = \cos^2\theta(\cos^4\theta + 3\sin^2\theta)$
Select the correct answer using the code given below:
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

72. If $7\sin^4\theta + 9\cos^4\theta + 42\sin^2\theta = 16,\ 0 < \theta < \frac{\pi}{2}$, then what is the tan θ equal to?
(a) 1 (b) $\sqrt{2}$
(c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$

73. An isosceles triangle has its base length $2a$ and its height is h. On each side of the triangle a square is drawn external to the triangle. What is the area of the figure thus formed?

(a) $6a^2 + 2h^2 + 2ah$ (b) $6a^2 + 2h^2 + ah$
(c) $4a^2 + 2h^2 + ah$ (d) $6a^2 + h^2 + ah$

74. If $p = \frac{a^2}{(b-a)(c-a)}$, $q = \frac{b^2}{(c-b)(a-b)}$, $r = \frac{c^2}{(a-c)(b-c)}$, then what is $(p + q + r)^2$ equal to?
(a) 9 (b) 4
(c) 1 (d) 0

75. Which one of the following is a factor of $a^2 - b^2 - c^2 + 2bc + a + b - c$?
(a) $a + b + c + 1$ (b) $a - b - c + 1$
(c) $a + b + c - 1$ (d) $a - b + c + 1$

76. Let α and β be the roots of the equation $\frac{1}{x+a+b} = \frac{1}{x} + \frac{1}{a} + \frac{1}{b}$; $a \neq 0, b \neq 0, x \neq 0$. Which one of the following is a quadratic equation whose roots are α^2 and β^2?
(a) $x^2 + (a^2 + b^2)x + a^2b^2 = 0$
(b) $x^2 - (a^2 + b^2)x + a^2b^2 = 0$
(c) $x^2 - (a^2 + b^2)x - a^2b^2 = 0$
(d) $x^2 + (a^2 + b^2)x - a^2b^2 = 0$

77. If $x = \frac{6}{7 - \frac{6}{7 - \frac{6}{7 - \frac{6}{7-x}}}}$; $x > 1$, then what is the value of $x^2 - 3x + 2$ equal to?
(a) 0 (b) 1
(c) 18 (d) 20

78. A train completely overtakes two persons, walking in the same direction with speeds 3 km/h and 4 km/h in 9 seconds and $\frac{75}{8}$ seconds respectively. What is the length of the train?
(a) 60 m (b) 62.5 m
(c) 55 m (d) 67.5 m

79. A person bought an article and sold it at a profit of 20%. Had he bought it at 20% less, what would have been the profit percentage if the selling price had been the same?
(a) 25% (b) 40%
(c) 50% (d) 60%

80. If $2s = a + b + c$, then what is $s^2 + (s-a)(s-b) + (s-b)(s-c) + (s-c)(s-a)$ equal to?
(a) $(a + b + c)^2$ (b) $ab + bc + ca$
(c) $2(ab + bc + ca)$ (d) $3(ab + bc + ca)$

81. A sphere of radius 5 cm is dropped in a right circular cylindrical vessel partly filled with water. The radius of the cylindrical vessel is 10 cm. If the sphere is completely submerged in water, by how much will the level of water rise in the cylindrical vessel?
(a) $\frac{5}{3}$ cm (b) $\frac{5}{2}$ cm
(c) 1 cm (d) $\frac{5}{6}$ cm

82. Consider the following statements :
1. The angle in a sector greater than a semi-circle is less than a right angle.
2. If two sides of a pair of opposite sides of a cyclic quadrilateral are equal, then its diagonals are also equal.
Which of the statements given above is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

83. If a, b, c, x, y, z are real numbers such that $(a + b + c)^2 - 3(ab + bc + ca) + 3(x^2 + y^2 + z^2) = 0$, then which one of the following is correct?
(a) $a = b = c, x = y = z \neq 0$
(b) $a = b = c = 0, x = y = z = 1$
(c) $a = b = c, x = y = z = 0$
(d) $a \neq b \neq c, x = y = z = 0$

84. In a triangle ABC, angle B = 90° and p is the length of the perpendicular from B to AC. If BC = 10 cm and AC = 12 cm, then what is the value of p?
(a) $\frac{5\sqrt{11}}{3}$ (b) $\frac{10\sqrt{11}}{3}$
(c) $\frac{40}{\sqrt{61}}$ (d) $\frac{12}{25}$

85. The mean of p, q, r, s and t is 280. If the mean of p, r and t is 240, what is the mean of q and s?
(a) 310 (b) 320
(c) 330 (d) 340

Consider the following for the next (05) items that follow:

A, B, C, D, E, F and G are cousins. D is thrice as old as A. Further, C is as many years younger to B, as G to E and E to D. The average age of D and G is 16 years; the average age of A and E is 11 years; the average age of B and C is also 11 years. B and C have equal weight. A's weight is 10 kg less than that of B; D is 4 kg heavier than E; E is 4 kg heavier than F; F is 4 kg heavier than G. Further, D has age-weight ratio of 9 : 20, where age is in years and weight in kg; A has age-weight ratio of 2 : 5. Moreover, none of them is more than 40 kg.

86. What is D's age (in years)?
(a) 15 (b) 16
(c) 17 (d) 18

87. What is the average age (in years) of B, C, D, E and G?
(a) 12 (b) 13
(c) 14 (d) 15

88. What is the difference between the weights (in kg) of G and C?
(a) 4 (b) 3
(c) 2 (d) 1

89. What is the average weight (in kg) of A, B, C, D, E, F and G?
(a) $\frac{201}{7}$ (b) $\frac{197}{7}$
(c) 30 (d) 32

90. Consider the following statements:
1. The age of F cannot be determined due to insufficient data.
2. The average weight of D and F is equal to weight of E.
3. The weight difference is maximum for D and A.
Which of the statements given above are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Consider the following for the next ten (10) items that follow:

Mark option (a) if the question can be answered by using one of the statements alone, but cannot be answered using the other statement alone.

Mark option (b) if the question can be answered by using either statement alone.

Mark option (c) if the question can be answered by using both the statements together, but cannot be answered using either statement alone.

Mark option (d) if the question cannot be answered even by using both the statements together.

91. Question: Is $m > n$ if m, n are real numbers?
Statement I: $m = (1 - p)(p^2 + p + 1)$ and $n = (p + 1)(p^2 - p + 1)$
Statement II:
$m = pn$

92. Question: What is the other root of the quadratic equation with real coefficients if one of the roots is $\frac{-4-\sqrt{10}}{2}$?
Statement I: The product of the roots is $-\frac{3}{2}\left(3+\sqrt{10}\right)$.
Statement II: The sum of roots of quadratic equation is –1.

93. Question : What is the 3-digit number which is divisible by 10?
Statement I: If the digits in hundred's place and ten's place of the number are interchanged, the resulting number is diminished by 180.
Statement II : If the digit in hundred's place is halved and digit in ten's place and unit place of the number are interchanged, the resulting number is diminished by 336.

94. Question: Are x, y, z equal, where x, y, z are real numbers?
Statement I: $x^2 + y^2 + z^2 - xy - yz - zx = 0$
Statement II: $x^3 + y^3 + z^3 - 3xyz = 0$

95. Question: What is the ratio $x : y : z$ equal to if x, y, $z \neq 0$?
Statement I: $\frac{x+z}{y} = \frac{z}{x}$
Statement II: $\frac{z-y}{x} = \frac{x}{z}$

96. Question: What is the sum of two natural numbers?
Statement I: LCM of the two numbers is 144.
Statement II: One of the numbers is 72.

97. Question: Is average of the largest and the smallest of 4 given numbers greater than the average of the 4 numbers?
Statement I: The difference between the largest and the second largest numbers is less than the difference between the second smallest and the smallest of the numbers.
Statement II: The difference between the largest and the smallest numbers is greater than the difference between the second largest and the second smallest of the numbers.

98. Question: Is $(a - b + c) > (a + b - c)$, where a, b and c are real numbers?
Statement I: b is negative.
Statement II: c is negative.

99. Question: What is the cost of 15 pens, 21 pencils and 18 note books?
Statement I: The cost of 7 pens, 6 pencils and 5 note books is ₹200.
Statement II: The cost of 3 pens, 8 pencils and 7 note books is ₹210.

100. Question: What is the area of the triangle inscribed in a semi-circle with the diameter as the base?
Statement I: The diameter of semi-circle is 20 cm.
Statement II: Two shorter sides of the triangle are 12 cm and 16 cm.

Answers			
Q No	**Answer Key**	**Topic Name**	**Chapter Name**
1	(d)	Factorisaton	Polynomials
2	(a)	Factorisaton	Polynomials
3	(d)	Practical Problems	Linear Equations in Two Variables
4	(c)	Work Related Problem	Linear Equations in Two Variables
5	(a)	Compound Interest	Interest
6	(a)	Trigonometric Ratio	Trigonometry
7	(b)	Wrok Related Problem	Linear Equations in Two Variables
8	(b)	Ratio	Ratio and Proportion
9	(a)	Mean	Statistics
10	(d)	Median	Statistics
11	(b)	Roots of Equation	Quadratic Equation
12	(d)	Simplification	Polynomials
13	(b)	LCM & HCF	Number System
14	(b)	Practical Problems	Linear Equations in Two Variables
15	(a)	Solution	Polynomials
16	(a)	Solution	Linear Equations in Two Variables
17	(c)	Factorisaton	Polynomials
18	(d)	Application	Logarithm
19	(d)	HCF	Polynomials
20	(c)	Factor Theorem	Polynomials
21	(a)	Proportion	Ratio and Proportion
22	(c)	Simplification	Algebraic Expression
23	(b)	Trigonometric Ratio	Trigonometry
24	(b)	Age Related Problem	Linear Equations in Two Variables
25	(c)	Trigonometric Identities	Trigonometry
26	(c)	Trigonometric Equation	Trigonometry
27	(a)	Trigonometric Equation	Trigonometry
28	(a)	Trigonometric Ratio	Trigonometry
29	(a)	Trigonometric Equation	Trigonometry
30	(b)	Trigonometric Equation	Trigonometry
31	(a)	Height and Distance	Trigonometry
32	(c)	Height and Distance	Trigonometry
33	(b)	Height and Distance	Trigonometry
34	(d)	Height and Distance	Trigonometry
35	(c)	Chord	Circle
36	(d)	Chord	Circle
37	(a)	Factorisaton	Polynomials
38	(a)	Factorisaton	Polynomials
39	(b)	Application	Trigonometry
40	(b)	Application	Trigonometry

41	(d)	Circle	Circle
42	(a)	Circle	Circle
43	(d)	Ratio	Ratio and Proportion
44	(a)	Ratio	Ratio and Proportion
45	(b)	Practical Problems	Linear Equations in Two Variables
46	(b)	Practical Problems	Linear Equations in Two Variables
47	(c)	Mean	Statistics
48	(b)	Median	Statistics
49	(a)	Roots of Euqation	Quadratic Equation
50	(a)	Nature of Roots	Quadratic Equation
51	(b)	Sphere	Mensuration
52	(b)	Cone	Mensuration
53	(d)	Compound Interest	Interest
54	(b)	Area	Mensuration
55	(b)	Area Related To Circle	Circle
56	(c)	Herons Formula	Mensuration
57	(b)	Area of Triangle	Mensuration
58	(d)	Circle	Circle
59	(b)	Pythagoras Theorem	Triangle
60	(d)	Area Related To Circle	Circle
61	(b)	Arc Length	Circle
62	(c)	Radius of Curvature	Circle
63	(b)	Triangle Inequality	Properties of Triangle
64	(c)	Proportion	Ratio and Proportion
65	(d)	Sphere	Mensuration
66	(d)	Sphere and Cylinder	Mensuration
67	(b)	Capacity	Mensuration
68	(c)	LCM & HCF	Polynomials
69	(c)	Simplification	Polynomials
70	(c)	Trigonometric Ratio	Trigonometry
71	(c)	Trigonometric Identities	Trigonometry
72	(d)	Trigonometric Equation	Trigonometry
73	(b)	Area of Triangle	Coordinate Geometry
74	(c)	Ratio	Ratio and Proportion
75	(d)	Factor Theorem	Polynomials
76	(b)	Quadratic Equation	Quadratic Equation
77	(d)	Solution	Quadratic Equation
78	(b)	Speed and Time	Linear Equations in Two Variables
79	(c)	Profit and Loss	Linear Equations in Two Variables
80	(b)	Herons Formula	Mensuraton
81	(a)	Sphere	Mensuration

82	(b)	Sector and Segment	Circle
83	(c)	Factorisaton	Polynomials
84	(a)	Area of Triangle	Triangle
85	(d)	Mean	Statistics
86	(d)	Practical Problems	Linear Equations in Two Variables
87	(c)	Practical Problems	Linear Equations in Two Variables
88	(b)	Practical Problems	Linear Equations in Two Variables
89	(a)	Practical Problems	Linear Equations in Two Variables
90	(d)	Practical Problems	Linear Equations in Two Variables
91	(d)	Divisibility	Number System
92	(b)	Roots of Equation	Quadratic Equation
93	(c)	Practical Problems	Linear Equations in Two Variables
94	(b)	Factorisaton	Polynomials
95	(d)	Ratio	Ratio and Proportion
96	(d)	HCF and LCM	Number System
97	(a)	Mean	Statistics
98	(d)	Linear Inequality	Linear Inequality
99	(c)	Practical Problems	Linear Equations in Variables
100	(a)	Area	Circle

C.D.S.
Combined Defence Services

EXAM II 2023

Elementary Mathematics

Answers with Explanation

1. Option (d) is correct.

$a^2 - bc = \alpha \Rightarrow \alpha a = a^3 - abc$

$b^2 - ac = \beta \Rightarrow \beta b = b^3 - abc$

$c^2 - ab = \gamma \Rightarrow c\gamma = c^3 - abc$

Now

$$\frac{a\alpha + b\beta + c\gamma}{(a+b+c)(\alpha+\beta+\gamma)} = \frac{a^3 + b^3 + c^3 - 3abc}{(a+b+c)(\alpha+\beta+\gamma)}$$

$$= \frac{(a+b+c)\left(a^2 + b^2 + c^2 - ab - bc - ca\right)}{(a+b+c)(\alpha+\beta+\gamma)}$$

$$= \frac{(a+b+c)(\alpha+\beta+\gamma)}{(a+b+c)(\alpha+\beta+\gamma)}$$

$= 1$

2. Option (a) is correct.

$\because$ $(x-1)^3$ is a factor of $x^4 + \alpha x^3 + \beta x^2 + \gamma x - 1$.

$\therefore$ $x^4 + \alpha x^3 + \beta x^2 + \gamma x - 1 = (x + a)(x - 1)^3$.

Put $x = 0$

$-1 = a(0 - 1)^3 \Rightarrow a = 1$

$\therefore$ $(x + 1)$ is other factor.

3. Option (d) is correct.

Let the unit digit and tens place digit of number be x and y.

$\Rightarrow$ Number $= 10y + x$.

$\therefore$ According to the question

$10y + x + 10x + y = 55$

$\Rightarrow$ $x + y = 5$ ...(1)

Difference $= 45$

$10y + x - (10x + y) = 45$

$\Rightarrow$ $9y - 9x = 45$

$\Rightarrow$ $y - x = 5$ ...(2)

Solving (1) & (2)

$2y = 10 \Rightarrow y = 5$ & $x = 0$

$\therefore$ Required number is 50.

$\therefore$ Product of digits $= 0$

4. Option (c) is correct.

$\therefore$ Let A finishes the work in x days

Let B finishes the work in y days

Let C finishes the work in z days

Now according to question

$$\frac{1}{x} + \frac{1}{y} = \frac{1}{10} \quad ...(1)$$

$$\frac{1}{y} + \frac{1}{z} = \frac{1}{12} \quad ...(2)$$

and $$\frac{1}{z} + \frac{1}{x} = \frac{1}{15} \quad ...(3)$$

Add (1) (2) (&) (3) we get

$$2\left(\frac{1}{x} + \frac{1}{y} + \frac{1}{z}\right) = \frac{1}{10} + \frac{1}{12} + \frac{1}{15}$$

$$= \frac{6 + 5 + 4}{60} = \frac{15}{60} = \frac{1}{4}$$

$$\therefore \quad \frac{1}{x} + \frac{1}{y} + \frac{1}{z} = \frac{1}{8} \quad ...(4)$$

$\therefore$ They can complete the whole work completely together in 8 days.

$\therefore$ Half of work can be finished in 4 days.

5. Option (a) is correct.

P = ₹10,000; R = 12% per annum

Rat per quarter $= \frac{12}{4} = 3\%$

Time = 9 months = 3 quarters $\Rightarrow n = 3$

$$\text{Amount} = P\left(1 + \frac{R}{100}\right)^n$$

$$= 10{,}000\left(1 + \frac{3}{100}\right)^3$$

$$= 10{,}000\left(\frac{103}{100}\right)^3$$

$$= 10{,}000 \times \frac{103}{100} \times \frac{103}{100} \times \frac{103}{100}$$

$= 10927.27$

So, CI = 10927.97 – 10000 = ₹927.27

6. Option (a) is correct.

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

$$\frac{a+b}{2\sqrt{ab}} \le 1$$

$$a + b \le 2\sqrt{ab}$$

$$a + b - 2\sqrt{ab} \le 0$$