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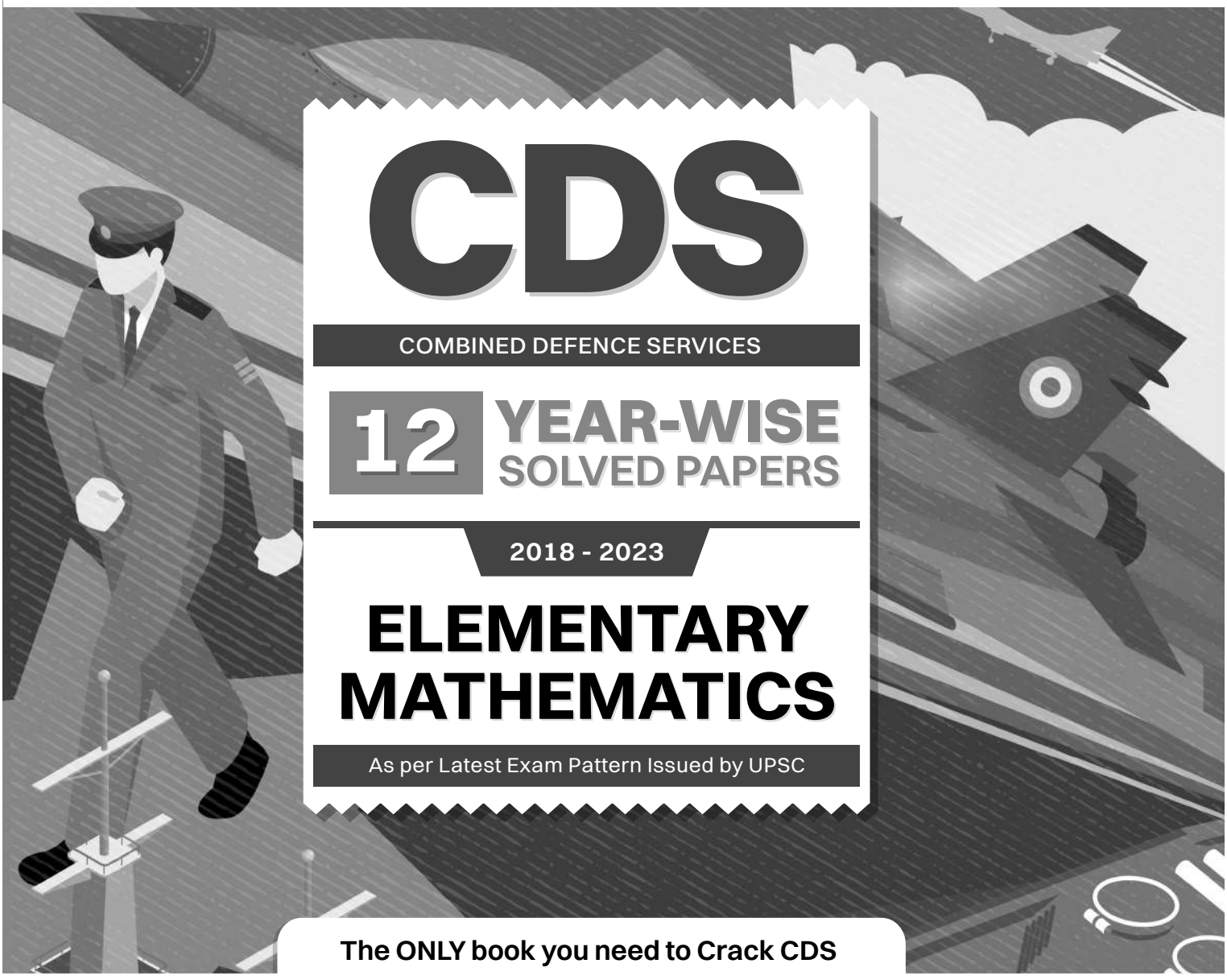

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1/11, Sahitya Kunj, M.G. Road,
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1010, Cambourne Business Centre
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0562-2857671

contact@oswaalbooks.com

www.OswaalBooks.com

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PREFACE

"Some goals are so worthy, it's glorious even to fail"

— Capt. Manoj Kumar Pandey

Union Public Service Commission (UPSC) every year conducts a CDS exam twice a year for candidates who wish to make their career in the defence forces-Army, Navy and Air Force. The Combined Defence Services Examination is conducted for admission to the Indian Military Academy (IMA), Indian Naval Academy (INA), Air Force Academy (AFA), and Officers Training Academy (OTA).

The CDS selection process comprises two stages-written exams and SSB interviews. The final selection of candidates is done based on the performance in both stages. After completing training at IMA, INA, AFA, and OTA, candidates are selected for the post of Lieutenant.

In 2023, Approx. 4.5 Lacs students applied for the CDS examination, the opportunity you get from the Indian Armed Forces is just limitless, which helps in enhancing your personality traits. For a youngster who is aspiring to get a job full of challenges and excitement, then there is no better job than the defence.

This book aims to make aspirants exam-ready, boost their confidence and help them achieve better results in CDS. By making learning Simple, we are also making better careers and a better life for every student. Every day we are moving ahead pursuing our noble cause of spreading knowledge.

This set of solved question papers is designed to enrich students with ample and exam-oriented practice so that they can clear CDS Examination with extraordinary results. Not one or two but 12 Previous Year Solved Question Paper [2018 to 2023] focussed on polishing every topic. Thorough studying of this book will boost my confidence and familiarise me with exam patterns.

Some benefits of studying from Oswaal CDS 12 Previous year solved questions papers:

1. **100% updated** with Fully Solved Paper of April and September 2023.
2. **Concept Clarity** with detailed explanations of 2018 to 2023 Papers.
3. **Extensive Practice** with 1500+ Questions and Two Sample Question Papers.
4. **Crisp Revision** with Mind Maps.
5. **Expert Tips** helps you get expert knowledge master & crack CDS in first attempt.
6. **Exam insights** with 5 Year-wise (2023-2019) Trend Analysis, empowering students to be 100% exam ready.

Our Heartfelt Gratitude

Finally, we would like to thank our authors, editors, and reviewers. Special thanks to our students who send us suggestions and constantly help improve our books. To stay true to our motto of 'Learning Made Simple', we constantly strive to present information in ways that are easy to understand as well as remember.

Wish you all Happy Learning!

All the Best!!
TEAM OSWAAL

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 12 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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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

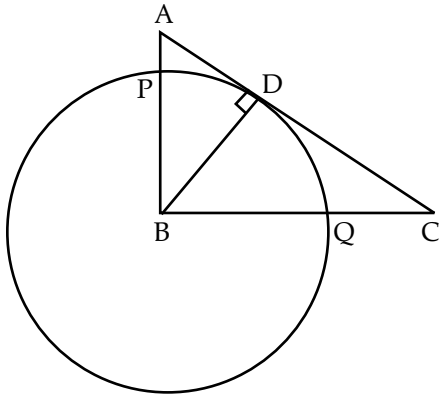
88. The perimeter and the area of a right-angled triangle are 36 cm and 54 square cm respectively. What is the length of the hypotenuse ?
(a) 12 cm **(b)** 14 cm
(c) 15 cm **(d)** 16 cm

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.



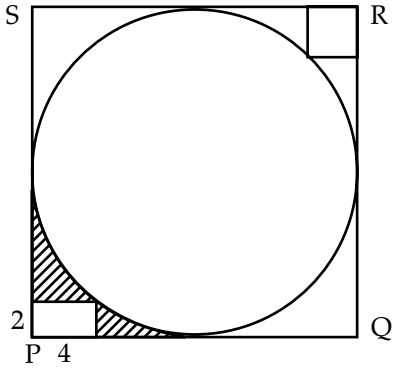
91. What is the length of QC ?
(a) 4.4 cm **(b)** 4.2 cm
(c) 3.6 cm **(d)** 3.2 cm

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 ?

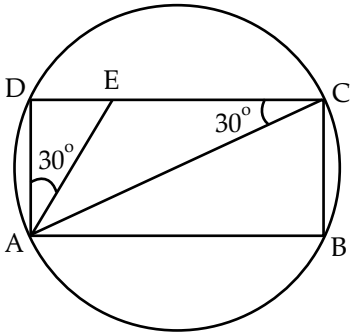
(a) 50 $(3 - \sqrt{2})$ square cm
(b) 25 $(3 - 2\sqrt{2})$ square cm
(c) 25 $(3 + 2\sqrt{2})$ square cm
(d) 50 $(3 - 2\sqrt{2})$ square cm

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 ?

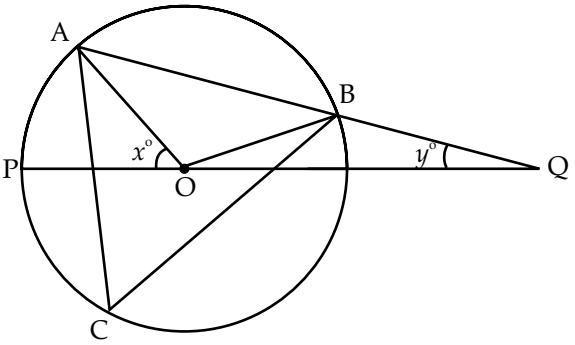
(a) $\frac{\pi}{\sqrt{2}}$ **(b)** $\frac{\pi}{\sqrt{3}}$
(c) $\frac{2\pi}{\sqrt{3}}$ **(d)** $\frac{3\pi}{\sqrt{2}}$

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

C.D.S.
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)
$2^{91} - 1$
$= (2^7)^{13} - 1$
$= (128)^{13} - 1$
$= (128 - 1)(128^{12} + 128^{11} + \ldots + 128 + 1)$
$= (127)$ (Integer)
So, both numbers are divisible by 127.

2. Option (c) is correct.

Let $P = 1 \times 2 \times 3 \times \ldots \times 28 \times 29$
$\Rightarrow P = 29!$
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.

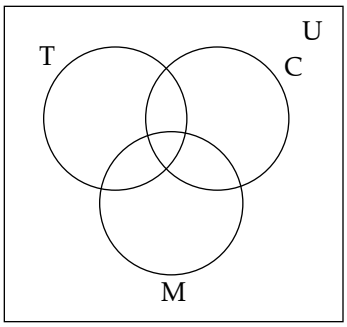
3. Option (d) is correct.

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

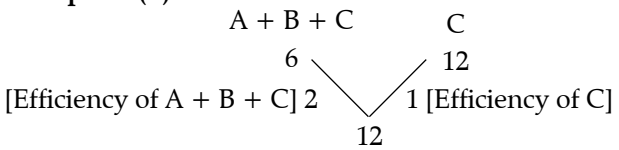
(17w + 24m) × 5 = (12w + 23m) × 6

$\Rightarrow$ 85w + 120m = 72w + 138m

$\Rightarrow$ 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

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

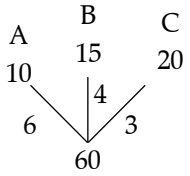
$\Rightarrow 2t + 8 = 12$

$\Rightarrow 2t = 4$

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