

Must For All Maths Talent Search Exams & Olympiads

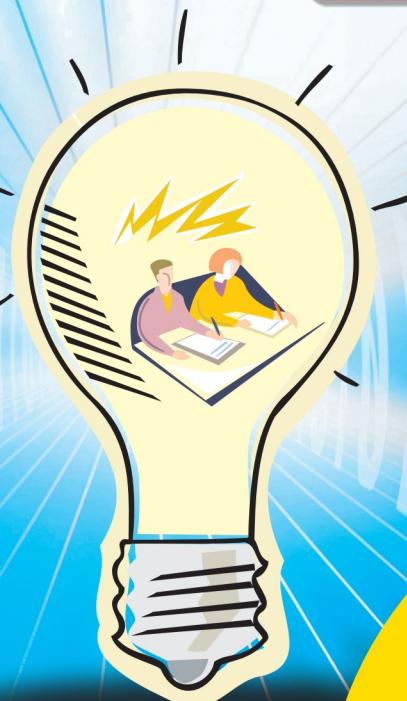
BMA'S

TALENT & OLYMPIAD EXAMS RESOURCE BOOK

MATHEMATICS

CLASS VIII

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Brain Mapping Academy

BMA's

TALENT & OLYMPIAD EXAMS RESOURCE BOOK

CLASS VIII

Mathematics



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Publisher's Note

Sometimes the understanding of fundamental concepts alone does not help the students to crack the competitive exams as most of them are objective in structure. Students need rigorous training to familiarize themselves to the style of the exams they are attempting. The board exams which are of qualifying, but not competitive, nature do not completely address the needs of students in testing them in objective type format.

To bridge this gap and to enable the students to face the reality of competitive exams, Brain Mapping Academy, brought out an all-objective questions reference book.

A crisp summary of the topics and useful equations were provided at the beginning of each chapter so that the students can memorize the important points.

Care has been taken to design thought-provoking questions. These should help students to attain a deeper understanding of principles. The questions have been reviewed to fill the gaps in problem coverage and to build the confidence in the students. They have also been expanded to impart reasoning/logical/analytical skills.

This book will cater all the requirements of the students who are approaching national/state level talent search examinations and all Olympiad exams. This book also complements the additional preparation needs of the students for the regular board exams.

We took utmost care to make this the best resource book available for the talent / olympiad exams aspirants. We welcome criticism from the students, teacher community and educators, especially concerning any errors and deficiencies which may have remained in this edition and the suggestions for improvement for the next edition.

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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Aim of this examination

The focus on fundamentals is so important that without a firm understanding of them, a child cannot be expected to face the reality of the competitive world once he/she finishes the formal education. Even while opting for higher studies the student has to go through a complete scan of what he/she knows. Exams like IIT-JEE, AIEEE, AIIMS, AFMC, CAT, SAT, GRE, GMAT, etc. are so designed to test the fundamental strength of a student. Hence the need of the hour is building the fundamental base as strong as possible.

A successful life emerges out from healthy and sound competition. Competition is the only way for the students to shake lethargy. It's the only way to get introduced for manly worthiness. Firm standards in education and competition are the tonic for a promising and talented future.

This exactly is the philosophy behind the Unified Council's NSTSE.

Organisation

National Science Talent Search Examination is conducted by Unified Council. Unified Council is India's first ISO 9001 certified organisation in the educational testing and assessment. Since its inception, Unified Council has put together the best brains in an endeavour to make the younger generation fundamentally stronger and nourish their brains for a bright and enterprising future.

Eligibility : Students of classes 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12 are eligible to participate in this examination.

Medium & Syllabus: This exam is conducted in only English medium and is suitable for all the students following CBSE/ICSE/State Board Syllabi.

Examination Pattern

There will be a separate question paper for each class. All questions are objective-type multiple choice with no negative marking for wrong answers.

Duration: 90 minutes

Date : Conducted every year on the last Sunday of January.

Test Centres : Spread across the country.

DIVISION OF MARKS	
FOR CLASS I	
Mathematics	: 25 marks
General Science	: 15 Marks
FOR CLASS II	
Mathematics	: 25 marks
General Science	: 25 Marks
FOR CLASS III	
Mathematics	: 40 marks
General Science	: 35 Marks
FOR CLASSES IV & V	
Mathematics	: 45 marks
General Science	: 45 Marks
General Questions	: 10 marks
FOR CLASSES VI TO X	
Mathematics	: 25 marks
Physics	: 25 marks
Chemistry	: 20 marks
Biology	: 20 marks
General Questions	: 10 marks
FOR CLASS XI & XII(PCM)	
Mathematics	: 40 marks
Physics	: 25 marks
Chemistry	: 25 marks
General Questions	: 10 marks
FOR CLASS XI & XII(PCB)	
Biology	: 40 marks
Physics	: 25 marks
Chemistry	: 25 marks
General Questions	: 10 marks

Infrastructure

The Council makes use of ultra-modern equipment such as **Optical Mark Recognition (OMR)** equipment to evaluate the answer papers to proficiently assess students' performance. The examination procedure is **completely computerised**.

Unique Service from Unified Council:

Unique analysis reports like Student's Performance Report for students, General School Report & Individual School Report for schools provided. These reports are very much helpful for students & schools to analyse their strengths and weaknesses.

General School Report (GSR) analyses the performance of students participating in the exam (subject-wise and class-wise). The report, in graphical format will have Ogive and Histogram Graphs, which are useful to schools that wish to improve their students' performance by benchmarking the areas of weaknesses and building upon them.

Individual School Report (ISR) analyses the performance of a particular school when compared to the rest of the students participating in this examination (subject-wise, class-wise and question-wise). This report acts as a tool for the schools to improve their students' performance in the future by benchmarking the areas of weaknesses and building upon them.

Awards & Scholarships:

Top 100 members in each class will be awarded with Awards & Medals etc.



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Rational Numbers

Synopsis

◆ **Natural numbers (N)**

1, 2, 3, 4, etc., are called natural numbers, denoted by N.

◆ **Whole numbers (W)**

All natural numbers together with zero are called whole numbers, denoted by W.

$$W = \{0, 1, 2, 3, 4, \dots\}$$

◆ **Integers (Z)**

All whole numbers together with negatives of natural numbers are called integers, denoted by Z.

$$Z = \{\dots, -4, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$$

(i) $-1, -2, -3, -4, \dots$ are called negative integers.

(ii) $1, 2, 3, 4, \dots$ are called positive integers.

Note : Zero is neither positive nor negative.

◆ The numbers of the form $\frac{a}{b}$, where 'a' and 'b' are natural numbers are called **fractions**.

e.g., $\frac{3}{5}, \frac{7}{11}, \frac{13}{213}, \dots$ etc.

◆ The numbers of the form $\frac{p}{q}$, where 'p' and 'q' are integers and ' $q \neq 0$ ' are called **rational numbers**, denoted by Q.

e.g., $\frac{-3}{5}, \frac{7}{-11}, \frac{-13}{-213}, \dots$ etc.

Properties of rational numbers

- ◆ **Closure property of addition:** The sum of two rational numbers is always a rational number.
- ◆ **Commutative law of addition:** For any two rational numbers 'a' and 'b', $a + b = b + a$.
- ◆ **Associative law of addition:** For any three rational numbers 'a', 'b' and 'c', $(a + b) + c = a + (b + c)$.
- ◆ **Existence of additive identity:** Zero is the additive identity.
For any rational number 'a', $a + 0 = 0 + a = a$

- ◆ **Existence of additive inverse:** For each rational number 'a', there exists a rational number ' $-a$ ' such that $a + (-a) = (-a) + a = 0$. So, $(-a)$ is the additive inverse of 'a'.
- ◆ **Closure property for multiplication:** The product of two rational numbers is a rational number.
- ◆ **Commutative law of multiplication:** For any two rational numbers 'a' and 'b', $ab = ba$.
- ◆ **Associative law of multiplication:** For any three rational numbers 'a', 'b' and 'c', $(ab)c = a(bc)$.
- ◆ **Existence of multiplicative identity:** 1 is called the multiplicative identity.
For any rational number 'a', $1.a = a.1 = a$.
- ◆ **Existence of multiplicative inverse:** Every non-zero rational number 'a' has its multiplicative inverse $\frac{1}{a}$.

Note: Zero is a rational number which has no multiplicative inverse.

- ◆ **Distributive law of multiplication over addition:**
For rational numbers 'a', 'b' and 'c', $a(b + c) = ab + ac$.
- ◆ Rational numbers can be represented on a number line.
- ◆ Between any two rational numbers, there exist infinitely many rational numbers.
- ◆ To find rational numbers between any two given rational numbers, we find their average or mean.

Multiple Choice Questions

A

B

C

D



- 1** Which of the following statements is true?

- (A) Every fraction is a rational number.
 (B) Every rational number is a fraction.
 (C) Every integer is a rational number.
 (D) Both (A) and (C).

- 2** Compare $\frac{-8}{9}$ and $\frac{4}{-5}$.

- (A) $\frac{-8}{9} > \frac{-4}{5}$ (B) $\frac{-4}{5} < \frac{-8}{9}$
 (C) $\frac{-8}{9} = \frac{-4}{5}$ (D) $\frac{-8}{9} < \frac{-4}{5}$

- 3** How is $\frac{-28}{84}$ expressed as a rational number with numerator 4?

- (A) $\frac{4}{7}$ (B) $-\frac{4}{12}$ (C) $\frac{4}{12}$ (D) $\frac{4}{-7}$

- 4** Which of the following sets of rational numbers is arranged in ascending order?

- (A) $-\frac{5}{14}, -\frac{25}{28}, -\frac{3}{7}, -\frac{1}{2}$
 (B) $-\frac{25}{28}, -\frac{5}{14}, -\frac{3}{7}, -\frac{1}{2}$
 (C) $-\frac{25}{28}, -\frac{1}{2}, -\frac{3}{7}, -\frac{5}{14}$
 (D) $-\frac{1}{2}, -\frac{3}{7}, -\frac{5}{14}, -\frac{25}{28}$

- 5** Which of the following statements is false?

- (A) $\frac{5}{7} < \frac{7}{9} < \frac{9}{11} < \frac{11}{13}$
 (B) $\frac{11}{13} < \frac{9}{11} < \frac{7}{9} < \frac{5}{7}$

(C) $\frac{5}{7} < \frac{11}{13} < \frac{7}{9} < \frac{9}{11}$

- (D) Both (B) & (C)

- 6** Which of the following is a rational number between $\frac{1}{4}$ and $\frac{1}{3}$?

- (A) $\frac{7}{24}$ (B) $\frac{8}{15}$
 (C) $\frac{13}{48}$ (D) Both (A) & (C)

- 7** Which of the following is the correct arrangement of $\frac{-11}{15}, \frac{-3}{10}, \frac{-1}{5}$ and $\frac{13}{20}$ in descending order?

- (A) $\frac{13}{20}, \frac{-1}{5}, \frac{-11}{15}, \frac{-3}{10}$
 (B) $\frac{13}{20}, \frac{-1}{5}, \frac{-3}{10}, \frac{-11}{15}$
 (C) $\frac{13}{20}, \frac{-11}{15}, \frac{-3}{10}, \frac{1}{5}$
 (D) $\frac{13}{20}, \frac{-3}{10}, \frac{-11}{15}, \frac{1}{5}$

- 8** Simplify $\frac{2}{5} + \frac{8}{3} + \frac{-11}{15} + \frac{4}{5} + \frac{-2}{3}$.

- (A) $\frac{37}{15}$ (B) $\frac{-37}{15}$ (C) $\frac{-36}{5}$ (D) $\frac{-38}{3}$

- 9** What is the sum of the additive inverse and multiplicative inverse of 2?

- (A) $\frac{3}{2}$ (B) $-\frac{3}{2}$ (C) $\frac{1}{2}$ (D) $-\frac{1}{2}$

- 10** Subtract $\frac{2}{3}$ from $\frac{7}{8}$.

- (A) $\frac{-5}{24}$ (B) $\frac{5}{24}$ (C) $\frac{7}{16}$ (D) $\frac{5}{16}$

- 11** Which among the following is a rational number equivalent to $\frac{-5}{-3}$?

(A) $\frac{-25}{15}$ (B) $\frac{25}{-15}$ (C) $\frac{25}{15}$ (D) $\frac{-25}{30}$

- 12** If $\frac{(-3)}{x} = \frac{x}{(-27)}$, what is the positive value of 'x'?

(A) -9 (B) 9 (C) -81 (D) 81

- 13** Which number is in the middle if $\frac{-1}{6}, \frac{4}{9}, \frac{6}{-7}, \frac{2}{5}$ and $\frac{-3}{4}$ are arranged in descending order?

(A) $\frac{2}{5}$ (B) $\frac{4}{9}$ (C) $\frac{-1}{6}$ (D) $\frac{-6}{7}$

- 14** What is the average of the two middle rational numbers when $\frac{4}{-9}, \frac{-6}{9}, \frac{5}{9}, \frac{-7}{9}, \frac{8}{9}$ and $\frac{1}{9}$ are arranged in ascending order?

(A) $\frac{1}{8}$ (B) $\frac{2}{7}$ (C) $\frac{-3}{7}$ (D) $\frac{-1}{6}$

- 15** Subtract $\frac{-5}{9}$ from $\frac{-3}{7}$.

(A) $\frac{62}{63}$ (B) $\frac{8}{63}$ (C) $\frac{-8}{63}$ (D) $\frac{-62}{63}$

- 16** What number should be added to $\frac{-4}{7}$ to get $\frac{5}{9}$?

(A) $\frac{-71}{63}$ (B) $\frac{71}{63}$ (C) $\frac{1}{63}$ (D) $\frac{-1}{63}$

- 17** What should be subtracted from $\frac{-7}{11}$ to get -2?

(A) $\frac{15}{11}$ (B) $\frac{-15}{11}$ (C) $\frac{29}{11}$ (D) $\frac{-29}{11}$

- 18** By what rational number should $\frac{-3}{5}$ be multiplied to obtain 21?

(A) $\frac{507}{4}$ (B) 35 (C) -35 (D) 507

- 19** The sum of two rational numbers is -3. If one of them is $\frac{-11}{5}$, find the other.

(A) $\frac{-4}{5}$ (B) $\frac{-8}{5}$ (C) $\frac{4}{5}$ (D) $\frac{8}{5}$

- 20** Which of the following is the resultant of $\frac{1}{12} + \frac{-1}{3} + \frac{-1}{6} + \frac{-5}{7} + \frac{3}{4} + \frac{10}{7}$?

(A) $1\frac{1}{21}$ (B) -1 (C) 0 (D) 1

- 21** Find four rational numbers between $\frac{1}{6}$ and $\frac{1}{3}$.

(A) $\frac{-1}{4}, \frac{7}{24}, \frac{13}{48}, \frac{-27}{96}$

(B) $\frac{1}{4}, \frac{-7}{24}, \frac{13}{48}, \frac{27}{96}$

(C) $\frac{1}{4}, \frac{7}{24}, \frac{-13}{48}, \frac{27}{96}$

(D) $\frac{1}{4}, \frac{7}{24}, \frac{13}{48}, \frac{27}{96}$

- 22** Which of the following numbers must be added to $\frac{-5}{16}$ to get $\frac{7}{24}$?

(A) $\frac{21}{28}$ (B) $\frac{-29}{48}$ (C) $\frac{15}{48}$ (D) $\frac{29}{48}$

- 23** Which of the following numbers must be subtracted from $\frac{7}{8}$ to get $\frac{-13}{12}$?

(A) $\frac{5}{24}$ (B) $\frac{9}{24}$ (C) $\frac{-7}{24}$ (D) $\frac{-5}{24}$

- 24** What is the resultant obtained when the additive inverse of $\frac{5}{6}$ is subtracted from the multiplicative inverse of $\frac{-5}{7} \times \frac{14}{15}$?
- (A) $\frac{3}{2}$ (B) $-\frac{2}{3}$ (C) $-\frac{3}{2}$ (D) $\frac{2}{3}$
- 25** Which of the following are three rational numbers between -2 and -1 ?
- (A) $\frac{-1}{2}, \frac{-1}{3}, \frac{-1}{5}$ (B) $\frac{-3}{2}, \frac{-7}{4}, \frac{-5}{4}$
 (C) $\frac{-12}{5}, \frac{-22}{5}, \frac{12}{5}$ (D) $\frac{3}{2}, \frac{7}{4}, \frac{5}{4}$
- 26** What is the simplified form of $\left(\frac{-9}{7} \times \frac{-1}{3}\right) + \left(\frac{15}{8} \times \frac{-4}{5}\right) - \left(\frac{27}{14} \times \frac{2}{9}\right)$?
- (A) $\frac{3}{2}$ (B) $-\frac{3}{7}$ (C) $-\frac{3}{2}$ (D) $\frac{3}{7}$
- 27** The product of two numbers is $\frac{5}{9}$. If one of the numbers is $\frac{-35}{24}$, find the other.
- (A) $\frac{8}{7}$ (B) $-\frac{8}{21}$ (C) $-\frac{3}{7}$ (D) $\frac{8}{21}$
- 28** The area of a rectangle is $45 \frac{5}{16}$ cm². If one edge is $6 \frac{1}{4}$ cm, find the other in cm.
- (A) $7\frac{1}{8}$ (B) $\frac{7}{4}$ (C) $7\frac{1}{4}$ (D) $4\frac{1}{7}$
- 29** Evaluate $\left(\frac{\frac{1}{6} - \frac{17}{18}}{\frac{5}{7}} \right)$.
- (A) $\frac{49}{45}$ (B) $-1\frac{4}{45}$ (C) $\frac{45}{49}$ (D) $1\frac{4}{45}$
- 30** What is the multiplicative inverse of 0 ?
- (A) $\frac{1}{0}$ (B) 0
 (C) Does not exist (D) $\frac{0}{0}$
- 31** Arrange $\frac{-4}{5}, \frac{9}{-15}$ and $-\frac{2}{3}$ in descending order.
- (A) $\frac{9}{-15}, \frac{-2}{3}, \frac{-4}{5}$ (B) $-\frac{2}{3}, \frac{-4}{5}, \frac{-9}{15}$
 (C) $\frac{9}{-15}, \frac{-4}{5}, \frac{-2}{3}$ (D) $-\frac{2}{3}, \frac{-9}{15}, \frac{-4}{5}$
- 32** Simplify $\frac{4}{7} + 0 + \frac{-8}{9} + \frac{-13}{7} + \frac{17}{21}$.
- (A) $-\frac{56}{63}$ (B) $-\frac{86}{63}$ (C) $\frac{86}{63}$ (D) $\frac{56}{63}$
- 33** What is the sum of the greatest and the least numbers of $\frac{5}{9}, \frac{1}{9}$ and $\frac{11}{9}$?
- (A) $\frac{2}{9}$ (B) $\frac{4}{9}$ (C) $\frac{4}{3}$ (D) $\frac{2}{3}$
- 34** Find the value of $\left(\frac{5}{9} \div \frac{15}{36} \right) \div \left(\frac{-5}{6} \right)$.
- (A) $-\frac{4}{3}$ (B) $\frac{3}{5}$ (C) $-\frac{8}{5}$ (D) $-\frac{3}{8}$
- 35** State which of the numbers given in the box are rational.
- (i) $\sqrt{2} \times \sqrt{8}$ (ii) $\frac{22}{7}$ (iii) $2\sqrt{3}$ (iv) π
- (A) (i) and (ii) only
 (B) (i) and (iii) only
 (C) (ii) and (iv) only
 (D) (iii) and (iv) only



Previous Contest Questions

- 1** Which of the following is not a rational number?
 (A) $\frac{3}{17}$ (B) $\frac{-4}{19}$ (C) $-\frac{0}{8}$ (D) $\frac{3}{0}$
- 2** Find the difference of $\left(\frac{3}{4} + \frac{1}{3} + \frac{2}{5}\right)$ and $\frac{59}{60}$.
 (A) $\frac{3}{4}$ (B) $\frac{1}{2}$ (C) $-\frac{4}{3}$ (D) $-\frac{1}{4}$
- 3** What is the product of $\frac{-55}{72}$ and $\frac{-90}{11}$?
 (A) $-6\frac{1}{4}$ (B) $6\frac{1}{4}$ (C) $4\frac{1}{6}$ (D) $-4\frac{1}{6}$
- 4** What is the number that is to be subtracted from $\frac{7}{8}$ to get $\frac{-13}{12}$?
 (A) $\frac{5}{12}$ (B) $\frac{5}{24}$ (C) $-\frac{5}{24}$ (D) $-\frac{5}{12}$
- 5** What is the simplified form of $\frac{1}{6} + \frac{-3}{5} + \frac{-8}{15} + \frac{2}{3}$?
 (A) $3\frac{1}{10}$ (B) $\frac{-3}{10}$ (C) $-3\frac{1}{10}$ (D) $\frac{3}{10}$
- 6** The product of two rational numbers is $\frac{15}{16}$. If one of the numbers is $\frac{5}{4}$, what is the other number?
 (A) $\frac{75}{64}$ (B) $\frac{25}{64}$ (C) $\frac{25}{4}$ (D) $\frac{3}{4}$

7

Find the number which when added to $\frac{1}{8}$ results in $\frac{5}{18}$.

- (A) $\frac{11}{72}$ (B) $\frac{2}{9}$ (C) $\frac{4}{7}$ (D) $\frac{5}{72}$

8

A recipe for French toast needs $\frac{3}{4}$ litres of milk. If you want to make only $\frac{2}{3}$ of the recipe, how much milk should you use?

- (A) $\frac{1}{7}l$ (B) $\frac{1}{5}l$ (C) $\frac{2}{3}l$ (D) $\frac{1}{2}l$

9

Which of the following is the correct descending order of $\frac{-3}{4}, \frac{-1}{2}, \frac{3}{8}$ and $\frac{5}{6}$?

- (A) $\frac{-3}{4}, \frac{-1}{2}, \frac{5}{6}, \frac{3}{8}$ (B) $\frac{-3}{4}, \frac{-1}{2}, \frac{3}{8}, \frac{5}{6}$
 (C) $\frac{5}{6}, \frac{3}{8}, \frac{-1}{2}, \frac{-3}{4}$ (D) $\frac{-1}{2}, \frac{-3}{4}, \frac{3}{8}, \frac{5}{6}$

10

The sum of two rational numbers is -5 . If one of the numbers is $\frac{-3}{5}$, what is the other number?

- (A) $-4\frac{2}{5}$ (B) $4\frac{8}{5}$ (C) $\frac{-6}{5}$ (D) $4\frac{6}{5}$



Synopsis

- ◆ **Equation:** An equation is a statement of equality of two algebraic expressions involving one or more unknown quantities (variables).
- ◆ **Linear equation in one variable:** If an equation involves only one variable and the highest index of power of that variable is 1, the equation is called a linear equation in one variable.

The general form of a linear equation in variable x is

$$ax + b = 0, a \neq 0 \text{ or } px = q, p \neq 0$$

◆ **Laws of Equality**

- (i) The same quantity may be added to or subtracted from both sides of an equation without changing the equality.

Thus, if $a = b$,

$$a + c = b + c$$

$$a - c = b - c$$

- (ii) If $a = b$ then $a - b = 0$ (or $b - a = 0$).

That is, given an equality any term from one side may be transferred to the other side by changing its sign. (Law of transposition)

- (iii) If $a = b$ then $ac = bc$ and $\frac{a}{c} = \frac{b}{c}, (c \neq 0)$.

That is, given an equality, both the sides can be multiplied by the same number or divided by the same nonzero number.

If $\frac{a}{b} = \frac{c}{d}$ then multiplying both sides by bd we have $ad = bc$.

(rule of crosswise multiplication)

- (iv) If $ac = bc$ $a = b$ provided $c \neq 0$. (Law of cancellation)

That is, both sides of an equality can be divided by the same nonzero number.

- ◆ The **solution of a linear equation** may be any rational number.
- ◆ The expressions forming equations have to be simplified before solving them. Some equations may not be linear but can be brought to a linear form by multiplying both its sides by a suitable expression.

Multiple Choice Questions

A B C D 

- 1** If $\frac{x-5}{2} - \frac{x-3}{5} = \frac{1}{2}$, what is the value of 'x'?

(A) 7 (B) 9 (C) 8 (D) 5

- 2** Which of the following values satisfies $\frac{2x+1}{3x-1} = \frac{3}{2}$?

(A) $x = 1$ (B) $x = -1$
 (C) $x = 2$ (D) $x = -3$

- 3** In an examination, a student was asked to find $\frac{3}{14}$ th of a certain number. By mistake, he found $\frac{3}{4}$ of it. His answer was 150 more than the correct answer. What was the number given to him ?

(A) 290 (B) 280 (C) 240 (D) 180

- 4** $\frac{2}{3}$ rd of a number when multiplied by $\frac{3}{4}$ of the same number gives 338. What is the number ?

(A) 18 (B) 24 (C) 36 (D) 26

- 5** If $3\frac{1}{x} \times 3\frac{3}{4} = 12\frac{1}{2}$, what is the value of 'x'?

(A) 1 (B) $\frac{1}{3}$ (C) 2 (D) 3

- 6** Four students Preeti, Qadir, Ravi and Sonam solved the equation $\frac{p-3}{p+4} = \frac{p+1}{p-2}$. Their answers are

$-\frac{1}{5}, \frac{1}{5}, \frac{2}{5}$ and $-\frac{2}{5}$ respectively. Whose answer is correct ?

(A) Ravi (B) Qadir
 (C) Sonam (D) Preeti

- 7** When 75% of a number is added to 75 the result is the number again. What is the number ?

(A) 150 (B) 300 (C) 100 (D) 450

- 8** A student has to secure 40% marks to pass. He got 30 marks and failed by 50 marks. What is the maximum number of marks?

(A) 160 (B) 180 (C) 200 (D) 320

- 9** If the sum of three consecutive even numbers is 234, which is smallest among them ?

(A) 76 (B) 78 (C) 80 (D) 68

- 10** The prices of a scooter and cycle are in the ratio 9 : 5. If the scooter costs ₹ 4,200 more than a cycle, what is the price of the cycle ?

(A) ₹ 5250 (B) ₹ 5200
 (C) ₹ 5000 (D) ₹ 4800

- 11** 351 is divided in the ratio 2 : 7. Find the product of the two numbers.

(A) 20294 (B) 21294
 (C) 25295 (D) 31294

- 12** A boat goes downstream and covers the distance between two ports in 4 hours while it covers the same distance upstream in 5 hours. If the speed of the stream is 2 kmph, what is the speed of the boat in still water ?

(A) 15 kmph (B) 20 kmph
 (C) 24 kmph (D) 18 kmph

- 13** If $\frac{2}{3}$ of a number is 20 less than the original number, what is the original number ?

(A) 60 (B) 40 (C) 80 (D) 120

- 14** If 10 is added to four times a certain number the result is 5 less than five times the number. What is the number ?

(A) 10 (B) 15 (C) 20 (D) 25

- 15** If a number increased by 8% of itself gives 135, what is the number ?
 (A) 112 (B) 100 (C) 125 (D) 75
- 16** By selling a bicycle for ₹ 1885, a man gains 16%. At what price did he buy the bicycle?
 (A) ₹ 1625 (B) ₹ 1825
 (C) ₹ 2000 (D) ₹ 1450
- 17** What is the solution of $(x + 4)^2 - (x - 5)^2 = 9$?
 (A) $x = 1$ (B) $x = 2$
 (C) $x = 3$ (D) $x = 4$
- 18** If the angles of a triangle are in the ratio $2 : 3 : 4$, what is the difference between the greatest and the smallest angles ?
 (A) 10° (B) 20° (C) 30° (D) 40°
- 19** Which of the following are the consecutive multiples of 3 whose sum is 51 ?
 (A) 24, 27 (B) 20, 31
 (C) 40, 11 (D) 25, 26
- 20** If $2 - \frac{x}{3} = 4$, what is the value of 'x'?
 (A) -6 (B) 6 (C) -4 (D) 4
- 21** Which of the following is the solution of $\frac{2x}{5} = \frac{10}{3}$?
 (A) $x = \frac{25}{3}$ (B) $x = \frac{35}{3}$
 (C) $x = \frac{45}{2}$ (D) $x = \frac{55}{2}$
- 22** If $9 - 7x = 5 - 3x$, what is the value of 'x'?
 (A) 0 (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) 1
- 23** The sum of two numbers is 35 and their difference is 13. What are the numbers ?
 (A) 10, 25 (B) 22, 13
 (C) 24, 11 (D) 20, 15
- 24** Solve : $1.32y + 0.02y = 1.19 + y$
 (A) $-\frac{7}{2}$ (B) $3\frac{1}{2}$ (C) $\frac{7}{4}$ (D) $-3\frac{1}{4}$
- 25** One number is 3 times another number. If 15 is added to both the numbers, one of the new numbers becomes twice that of the other new number. Find the numbers.
 (A) 15 and 60 (B) 30 and 45
 (C) 15 and 30 (D) 15 and 45
- 26** The width of Sudha's garden is $\frac{2}{3}$ of its length. If its perimeter is 40 m, find its dimensions.
 (A) length = 12 m and breadth = 8 m
 (B) length = 8 m and breadth = 12 m
 (C) length = 12 m and breadth = 6 m
 (D) length = 8 m and breadth = 4 m
- 27** A boy gets 3 marks for each correct sum and loses 2 marks for each incorrect sum. He does 24 sums and obtains 37 marks. What was the number of correct sums ?
 (A) 20 (B) 17 (C) 31 (D) 19
- 28** Arif, Ajay and Madhav secured $m + 20$, $2m - 17$ and $m - 5$ marks respectively in an English test. What is their average marks ?
 (A) $\frac{4m - 8}{3}$ (B) $\frac{4m - 2}{3}$
 (C) $\frac{4m + 8}{3}$ (D) $\frac{4m + 2}{3}$
- 29** There are 3 bags of flour. Bag B weighs thrice as much as bag A and bag C weighs 4 kg less than bag B. If bag A weighs 6 kg, how heavy is bag C ?
 (A) 52 kg (B) 18 kg
 (C) 22 kg (D) 14 kg
- 30** When 'p' is subtracted from 10 and the difference is divided by 2, the result is 3. What is the value of 'p'?
 (A) 4 (B) 3 (C) -4 (D) 6

31 Three numbers are such that the second is twice the first and the third is thrice the first. If their sum is 12, what is the value of the largest number?

- (A) 4 (B) 2 (C) 6 (D) 8

32 Subtracting 5 from thrice x results in 4. What is the value of 15 subtracted from nine times ' x '?

- (A) 15 (B) 3 (C) 27 (D) 12

33 The digits in the tens place and units place of a two digit number are t and u respectively. If 1 is placed between them, what is the value of the three digit number so formed?

- (A) $100u + t + 10$ (B) $100t + 10 + u$
 (C) $10t + u + 1$ (D) $100t + 10u + 1$

34 How much pure alcohol should be added to 400 ml of strength 15% to make its strength 32%?

- (A) 50 ml (B) 75 ml
 (C) 100 ml (D) 150 ml

35 X is a two-digit number. Y is the number obtained on reversing the digits of X. Which of the following is true?

- (A) $X + Y$ is divisible by 10.
 (B) $X - Y$ is divisible by 6.
 (C) $X - Y$ is divisible by 9.
 (D) $X + Y$ is divisible by 8.



Previous Contest Questions

1 Given that $\frac{-6p-9}{3} = \frac{2p+9}{5}$, find the value of ' p '.

- (A) -4 (B) -2 (C) 3 (D) 5

2 When a certain number ' m ', is divided by 5 and added to 8, the result is equal to $3m$ subtracted from 4. Find the value of ' m '.

- (A) 2 (B) $\frac{4}{3}$ (C) $-\frac{1}{3}$ (D) $-\frac{5}{4}$

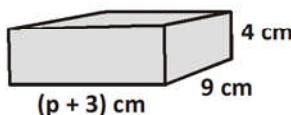
3 Kiran scored 80 marks in his science test which is $\frac{5}{6}$ of the total marks. What is the total marks for the test?

- (A) 96 (B) 100 (C) 104 (D) 108

4 If the total of four consecutive odd numbers is 40, what is the smallest number?

- (A) 7 (B) 9 (C) 11 (D) 13

5 The figure shows a cuboid with a volume of 180 cm^3 .



What is the value of ' p '?

- (A) 72 (B) 36 (C) 18 (D) 2

6 The sum of two numbers is 10. One of the numbers is equal to the sum of 6 and twice the other number. What is the difference of the numbers?

- (A) $5\frac{1}{4}$ (B) $8\frac{1}{2}$ (C) $7\frac{1}{3}$ (D) $6\frac{2}{3}$

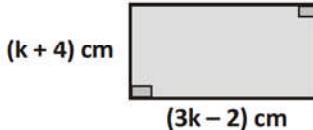
7 10 added to twice ' p ' is 16. What is 10 subtracted from twice ' p '?

- (A) 3 (B) -4 (C) -3 (D) 16

8 For what value of ' n ' is $5n - 4 = n - 1$?

- (A) $\frac{5}{4}$ (B) $-\frac{3}{4}$ (C) $\frac{3}{4}$ (D) $-\frac{5}{4}$

9 The figure shows a rectangle with a perimeter of 60 cm.



What is the value of ' k '?

- (A) 7 (B) 9 (C) 12 (D) 29

10 If $3a + 2b + c = 22$, $b + c = 8$ and $c = 6$, what is the value of $a + b + c$?

- (A) 12 (B) 6 (C) 2 (D) 4

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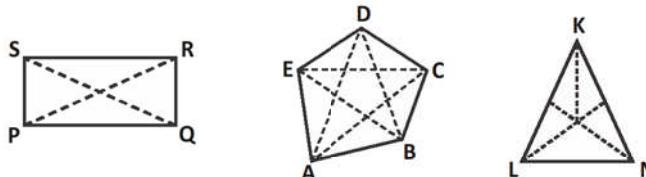
Understanding Quadrilaterals

Synopsis

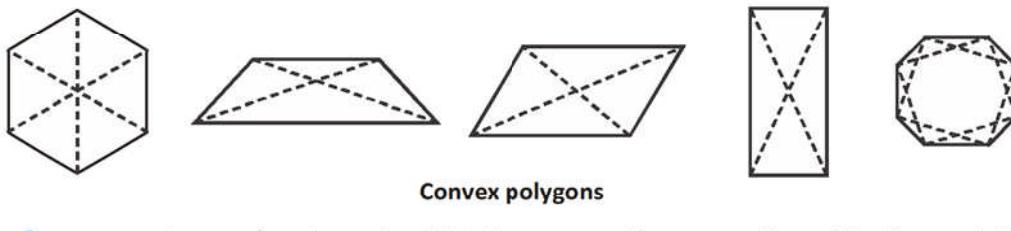
- ◆ **Quadrilateral:** A closed figure bounded by four line segments is called a quadrilateral. It has four angles and four sides.
- ◆ **Classification of polygons**

Sample Figure							
Number of sides, vertices, Diagonals, Name of the shape	3, 3, 0 Triangle	4, 4, 2 Quadrilateral	5, 5, 5 Pentagon	6, 6, 9 Hexagon	7, 7, 14 Heptagon	8, 8, 20 Octagon	

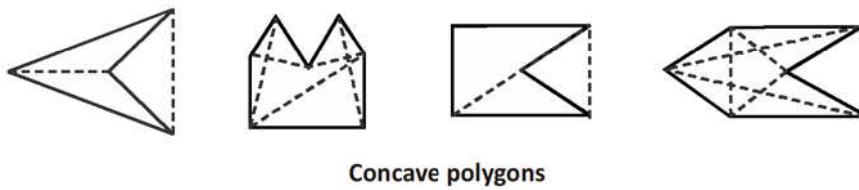
- ◆ **Diagonals:** A diagonal is a line segment connecting two non-consecutive vertices of a polygon.



- ◆ **Convex polygon:** A polygon is said to be convex if no portion of its diagonals lies in its exterior.

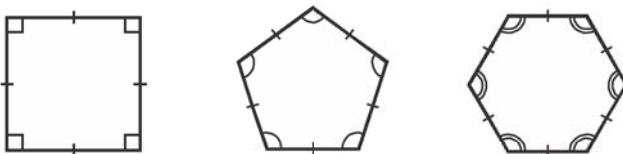


- ◆ **Concave polygon:** A polygon is said to be concave if some portion of its diagonals lies in its exterior.



- ◆ **Regular polygon:** A polygon that is both equilateral and equiangular is called a regular polygon.

e.g., A square (since all its sides are equal and all its angles are equal.)



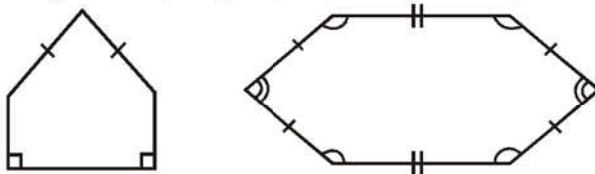
Regular polygons

The number of sides of a regular polygon whose each exterior angle has a measure x° is

$$\frac{360^\circ}{x^\circ}.$$

- ◆ **Irregular polygon:** A polygon that is either not equilateral or not equiangular or both is called an irregular polygon.

e.g., A rectangle (though it is equiangular, it is not equilateral.)



Irregular polygons

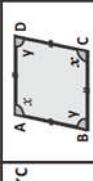
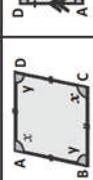
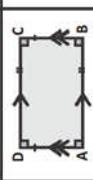
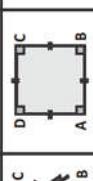
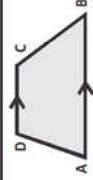
- ◆ **Angle sum property:** The sum of the measures of the four angles of a quadrilateral is 360° .
- ◆ **Sum of the interior angles of a regular polygon**

Figure				
Number of sides	3	4	5	6
Angle sum	180°	$2 \times 180^\circ = (4 - 2) \times 180^\circ$	$3 \times 180^\circ = (5 - 2) \times 180^\circ$	$4 \times 180^\circ = (6 - 2) \times 180^\circ$

Thus, in general, the sum of interior angles of a polygon of 'n' sides is given by $(n - 2) \times 180^\circ$ or $(n - 2) \times 2$ right angles or $2n - 4$ right angles.

- ◆ **Sum the exterior angles of a polygon:** The sum of the exterior angles of any polygon is 360° .

◆ **Types of quadrilaterals:**

Definitions →	A quadrilateral with each pair of opposite sides parallel is called a parallelogram.	A parallelogram having all sides equal is called a rhombus.	A parallelogram is a rectangle if each of its angles is a right angle.	A rectangle having all its sides equal is called a square.	A quadrilateral in which one pair of opposite sides is parallel is called a trapezium.	A kite is a quadrilateral formed by two isosceles triangles standing on the opposite sides of a common base.
						
S.No.	Property	Rhombus	Rectangle	Square	Trapezium	Kite
1.	The diagonals bisect each other.	Yes	Yes	Yes	Not always	Yes
2.	Each diagonal bisects each pair of opposite angles.	Not always	Not always	Not always	Not always	Not always
3.	The diagonals divide the quadrilateral into four congruent triangles.	Not always	Not always	Not always	Not always	Not always
4.	The diagonals are perpendicular to each other.	Not always	Yes	Not always	Yes	Yes
5.	The diagonals are equal.	Yes	Not always	Yes	Not always	Not always
6.	Diagonals are equal and right bisectors of each other.	Not always	Not always	Yes	Not always	Not always

Multiple Choice Questions

A

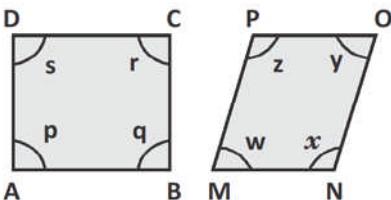
B

C

D



- 1 ABCD is a quadrilateral. If AC and BD bisect each other, what is ABCD ?
 (A) A square (B) A parallelogram
 (C) A rectangle (D) All the above
- 2 ABCD is a parallelogram. The angle bisectors of $\angle A$ and $\angle D$ meet at O. What is the measure of $\angle AOD$?
 (A) 45° (B) 90° (C) 75° (D) 180°
- 3 The diagonal of a rectangle is 10 cm and its breadth is 6 cm. What is its length ?
 (A) 6 cm (B) 5 cm (C) 8 cm (D) 4 cm
- 4 ABCD and MNOP are quadrilaterals as shown in the figure.

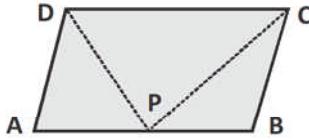


Which of the following is correct?

- (A) $p + q + r + s = w + x + y + z$
 (B) $p + q + r + s < w + x + y + z$
 (C) $p + q + r + s > w + x + y + z$
 (D) Either (B) or (C)

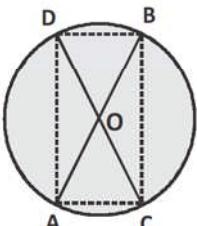
- 5 What do you call a parallelogram which has equal diagonals ?
 (A) A trapezium (B) A rectangle
 (C) A rhombus (D) A kite
- 6 In a square ABCD, the diagonals bisect at O. What type of a triangle is AOB ?
 (A) An equilateral triangle.
 (B) An isosceles but not a right angled triangle.
 (C) A right angled but not an isosceles triangle.
 (D) An isosceles right angled triangle.

- 7 The perimeter of a parallelogram is 180 cm. If one side exceeds the other by 10 cm, what are the sides of the parallelogram?
 (A) 40 cm, 50 cm (B) 45 cm each
 (C) 50 cm each (D) 45 cm, 50 cm
- 8 In the quadrilateral ABCD, the diagonals AC and BD are equal and perpendicular to each other. What type of a quadrilateral is ABCD ?
 (A) A square (B) A parallelogram
 (C) A rhombus (D) A trapezium
- 9 ABCD is a parallelogram as shown in the figure. If $AB = 2AD$ and P is the mid-point of AB, what is the measure of $\angle CPD$?



- (A) 90° (B) 60° (C) 45° (D) 135°
- 10 In a parallelogram ABCD, if $AB = 2x + 5$, $CD = y + 1$, $AD = y + 5$ and $BC = 3x - 4$, what is the ratio of AB and BC ?
 (A) 71:21 (B) 12:11
 (C) 31:35 (D) 4:7
- 11 If ABCD is an isosceles trapezium, what is the measure of $\angle C$?
 (A) $\angle B$ (B) $\angle A$ (C) $\angle D$ (D) 90°
- 12 A diagonal of a rectangle is inclined to one side of the rectangle at 25° . What is the measure of the acute angle between the diagonals ?
 (A) 25° (B) 40° (C) 50° (D) 55°
- 13 If angles P, Q, R and S of the quadrilateral PQRS, taken in order, are in the ratio 3 : 7 : 6 : 4, what is PQRS ?
 (A) A rhombus (B) A parallelogram
 (C) A trapezium (D) A kite

- 14** If AB and CD are diameters, what is ACBD?

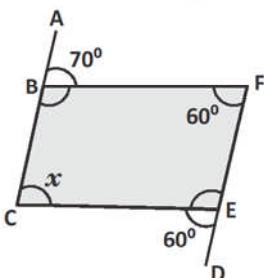


- (A) A square
(B) A trapezium
(C) An isosceles trapezium
(D) A rectangle

- 15** If two adjacent angles of a parallelogram are in the ratio 3 : 2, what are their measures ?

- (A) $108^\circ, 72^\circ$ (B) $72^\circ, 36^\circ$
(C) $100^\circ, 80^\circ$ (D) $144^\circ, 36^\circ$

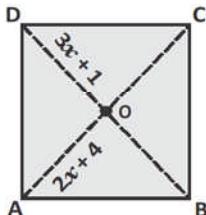
- 16** ABC and DEF are straight lines.



Find the value of 'x'.

- (A) 60° (B) 70°
(C) 80° (D) 85°

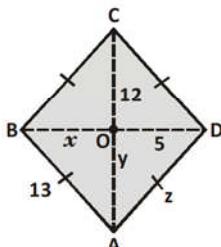
- 17** ABCD is a rectangle. Its diagonals meet at O.



Find 'x', if $OA = 2x + 4$ and $OD = 3x + 1$.

- (A) 2 (B) 3 (C) -3 (D) -2

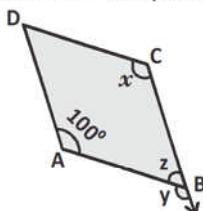
- 18** ABCD is a rhombus.



Find the respective values of 'x', 'y' and 'z'.

- (A) 12, 5, 13 (B) 5, 12, 13
(C) 5, 13, 5 (D) 12, 13, 5

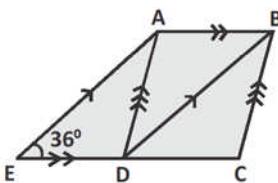
- 19** In the figure, ABCD is a parallelogram.



Find the respective values of x, y and z.

- (A) $100^\circ, 80^\circ, 100^\circ$ (B) $100^\circ, 100^\circ, 80^\circ$,
(C) $80^\circ, 100^\circ, 100^\circ$ (D) $80^\circ, 80^\circ, 100^\circ$

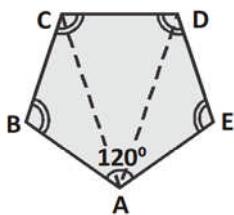
- 20** In the figure, ABCD is a rhombus and ABDE is a parallelogram.



Given that EDC is a straight line and $\angle AED = 36^\circ$, find $\angle BAD$.

- (A) 36° (B) 72° (C) 108° (D) 120°

- 21** Four of the angles of a pentagon are of equal size. The remaining angle is 120° .

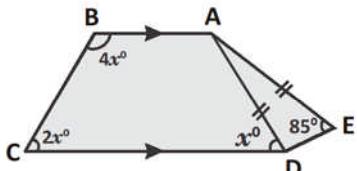


Find the value of each of the equal angles.

- (A) 210° (B) 110° (C) 540° (D) 105°

- 22 Each interior angle of a regular polygon is 150° . How many sides has the polygon ?
 (A) 8 (B) 12 (C) 9 (D) 10

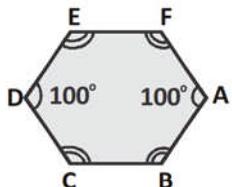
- 23 In the figure, ABCD is a trapezium and $AD = AE$.



Find the value of 'x'.

- (A) 30° (B) 40° (C) 60° (D) 50°

- 24 The figure shows a hexagon ABCDEF. $\angle A = \angle D = 100^\circ$. The other angles are of the same size.



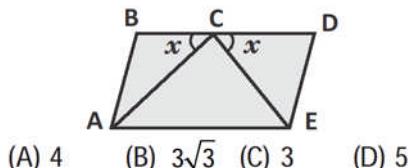
Find $\angle ABC$.

- (A) 100° (B) 110° (C) 130° (D) 120°

- 25 Each interior angle of a regular polygon is 162° . How many sides has the polygon ?
 (A) 12 (B) 20 (C) 16 (D) 10

- 26 ABCD is a quadrilateral such that $AB = BC$, $AD = \frac{1}{2} CD$ and $AD = \frac{1}{4} AB$. If $BC = 12\text{ cm}$, what is the measure of AD ?
 (A) 6 cm (B) 4 cm (C) 12 cm (D) 3 cm

- 27 In the figure given, $BD \parallel AE$. If $\overline{CE} = 3\text{ cm}$, what is the length of \overline{AC} ?



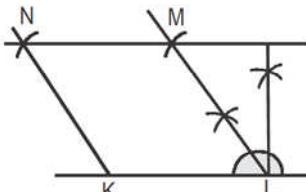
- (A) 4 (B) $3\sqrt{3}$ (C) 3 (D) 5
- 28 How many measurements are required to construct a quadrilateral ?
 (A) 5 (B) 4 (C) 3 (D) 2

- 29 How many unique measurements are needed to construct a parallelogram ?
 (A) 2 (B) 3 (C) 4 (D) 1

- 30 What is the minimum number of dimensions needed to construct a rectangle ?
 (A) 1 (B) 2 (C) 3 (D) 4

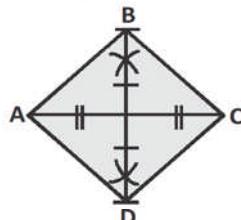
- 31 What is the minimum number of measurements needed to construct a square ?
 (A) 1 (B) 2 (C) 3 (D) 4

- 32 In the diagram, KLMN is a constructed parallelogram. What is the measure of $\angle KLM$?



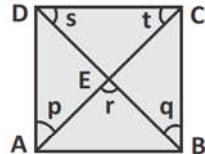
- (A) 15° (B) 30° (C) 45° (D) 60°

- 33 The construction of which figure is shown in the given figure ?



- (A) A trapezium (B) A rhombus
 (C) A rectangle (D) A kite

- 34 In the figure, ABCD is a rhombus. AEC and BED are straight lines.



What is the value of $p + q + r + s + t$?

- (A) 200° (B) 270° (C) 360° (D) 540°

- 35** In a trapezium ABCD, AB is parallel to CD and the diagonals intersect each other at O. What is the ratio of OA and OC ?

(A) $\frac{OB}{OD}$ (B) $\frac{BC}{CD}$ (C) $\frac{AD}{AB}$ (D) $\frac{AC}{BD}$



Previous Contest Questions

- 1** In $\triangle ABC$, P and Q are the midpoints of AB and AC. If PQ is produced to R such that $PQ = QR$, what is PRCB ?

(A) A rectangle (B) A square
(C) A rhombus (D) A parallelogram

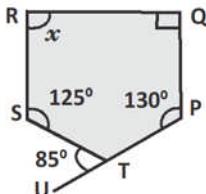
- 2** Three angles of a quadrilateral are equal and the measure of the fourth angle is 120° . Find the measure of each of these equal angles.

(A) 80° (B) 120° (C) 60° (D) 140°

- 3** A quadrilateral has three acute angles, each measuring 75° . Find the measure of the fourth angle.

(A) 65° (B) 135° (C) 140° (D) 225°

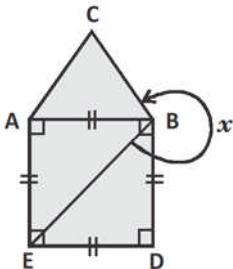
- 4** In the figure given, PTU is a straight line.



What is the value of 'x' ?

(A) 100° (B) 110° (C) 120° (D) 130°

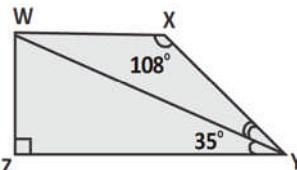
- 5** Equilateral $\triangle ABC$ is drawn on the side AB of square, ABDE.



Find the measure of 'x' shown in the figure.

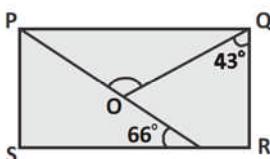
(A) 45° (B) 135° (C) 255° (D) 225°

- 6** What is the measure of $\angle XYW$ of the trapezium WXYZ given in the figure ?



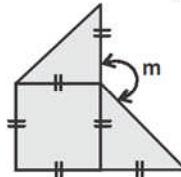
(A) 28° (B) 33° (C) 55° (D) 37°

- 7** In the given rectangle PQRS, find the measure of $\angle POQ$.



(A) 47° (B) 24° (C) 67° (D) 58°

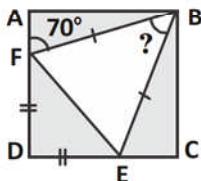
- 8** The figure given is made up of a square and two isosceles triangles.



What is the measure of the angle marked 'm' ?

(A) 105° (B) 95° (C) 135° (D) 85°

- 9** $\triangle BEF$ and $\triangle FED$ are two isosceles triangles in the square ABCD.



What is the measure of $\angle BFE$?

(A) 85° (B) 65° (C) 50° (D) 130°

Data Handling

Synopsis

- ◆ **Data:** The word data means information in the form of numerical figures or a set of given information.
- ◆ **Raw data:** Data obtained in the original form is called a raw data.
- ◆ **Array:** Arranging the numerical figures of a data in ascending or descending order is called an array.
- ◆ **Tabulation:** Arranging the data in a systematic tabular form is called tabulation or presentation of the data.
- ◆ **Observation:** Each numerical figure in a data is called an observation.
- ◆ **Frequency:** The number of times a particular observation occurs is called its frequency.
- ◆ **Range:** The difference between the highest and the lowest values of the observations in a given data is called its range.
- ◆ **Frequency distribution:** A table showing the frequencies of various observations of data is called a frequency distribution or simply a frequency table.
- ◆ **Tally marks**
 - (i) When the number of observations is large, we make use of tally marks to find the frequencies.
 - (ii) Tallies are usually marked in a bunch of five for the sake of easy counting.
- ◆ **Grouped data**
 - (i) When the list of observations is long, the data is usually organised into groups called class intervals and the data so obtained is called a grouped data.
 - (ii) The lower value of a class interval is called its lower limit and the upper value is called its upper limit.
 - (iii) The difference between the upper and lower class limits is called the width or the size of the class interval.
 - (iv) The mid-value of a class interval is called its class mark.
- ◆ **Graphical representation**
 - (i) **Histogram:** A histogram is a pictorial representation of the grouped data in which class intervals are taken along the horizontal axis and class frequencies along the vertical axis and for each class a rectangle is constructed with the class interval as the base and the class frequency as the height.
There is no gap between the bars in a histogram as there is no gap between the class intervals.

- (ii) **Bar graph:** In a bar graph, bars of uniform width are drawn with various heights. The height of a column represents the frequency of the corresponding observation.
- (iii) **Double bar graph:** A double bar graph shows two sets of data simultaneously. It is useful to compare data related to two variables.

◆ **Pie-chart:**

In a pie-chart, the values of different components are represented by the sectors of a circle. The total angle of 360° at the centre of a circle is divided according to the values of the components.

$$\text{Central angle for a component} = \frac{\text{Value of the component}}{\text{Total value}} \times 360^\circ$$

- ◆ **Experiment:** An experiment is a situation involving chance or probability that leads to results called outcomes.
- ◆ **Outcome:** An outcome is the result of a single trial of an experiment.
- ◆ **Event:** An event is one or more outcomes of an experiment.
- ◆ **Probability:** Probability is the measure of how likely an event is.

The probability of event A is the number of ways A can occur divided by the total number of possible outcomes.

$$P(A) = \frac{\text{The number of ways event A can occur}}{\text{The total number of possible outcomes}}, \text{ when the outcomes are equally likely.}$$

- ◆ **Random experiment:** A random experiment is one whose outcomes cannot be predicted exactly in advance.
- ◆ **Equally likely outcomes:** The outcomes of an event with the same probability of occurrence are known as equally likely outcomes.

Multiple Choice Questions

A B C D 

- 1 From the frequency table, the percentage of families with less than 3 children is $\frac{x}{40} \times 100\%$.

Number of children	0	1	2	3	4
Number of families	2	5	11	15	7

Find the value of 'x'.

- (A) 7 (B) 15
 (C) 11 (D) 18

- 2 A survey was carried out for the purpose of determining the number of children in each family. The results are shown in the table.

Number of children	0	1	2	3	4
No. of families	1	4	7	6	2

Calculate the percentage of families which have more than 2 children.

- (A) 35% (B) 40%
 (C) 60% (D) 75%

- 3 The scores obtained by a group of participants in a game are shown in the table. A participant who scores more than 3 points receives a hamper.

Score	2	3	4	5
Number of participants	104	16	y	34

If the number of participants who do not receive hampers is twice the number of those who do, find the value of 'y'.

- (A) 2 (B) 26
 (C) 32 (D) 68

- 4 The table shows the distribution of marks in an English test. Grade B is given to marks ranging from 40 to 54.

Marks	Frequency
30 - 34	2
35 - 39	8
40 - 44	13
45 - 49	8
50 - 54	5
55 - 59	4

Calculate the percentage of pupils who obtained grade B.

- (A) 26% (B) 52% (C) 65% (D) 75%

- 5 The table shows the type and number of cakes sold by a bakery. In a pictograph, one symbol represents 5 cakes.

Types of cakes	Number of cakes
P	50
Q	35
R	45

How many symbols are required to represent the number of the best-selling type of cake?

- (A) 5 (B) 9 (C) 10 (D) 15

- 6 The pictograph shows the number of pupils who cycle to school.

Class 1	
Class 2	
Class 3	

Key: Each  represents 30 pupils.

What is the total number of pupils who cycle to school?

- (A) 15 (B) 300 (C) 420 (D) 450

- 7 The pictogram shows the number of visitors to an exhibition in a particular week.

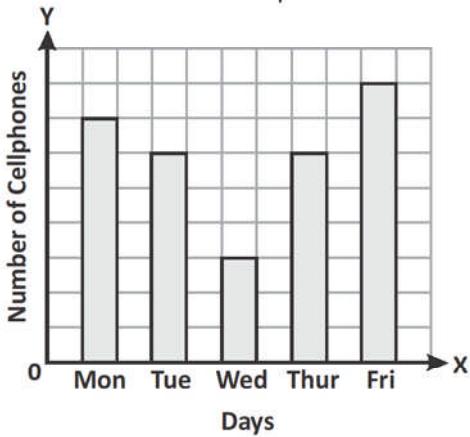
Monday	(Each smiley face represents 6 visitors)
Tuesday	
Wednesday	
Thursday	
Friday	

Key: Each represents 6 visitors.

What is the number of visitors recorded after Wednesday?

- (A) 10 (B) 18
 (C) 60 (D) 70

- 8 The bar chart shows the number of cellphones sold by a shop on 5 days of a certain week. The difference between the highest number and the lowest number of cellphones sold is 15.



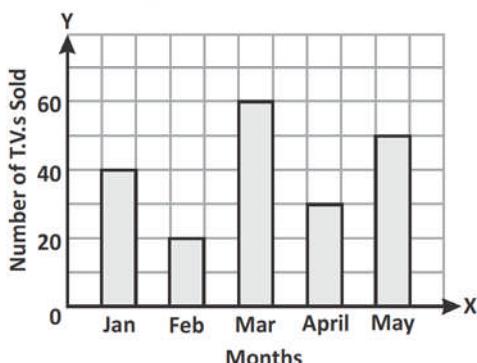
Find the number of cellphones sold on Thursday.

- (A) 6 (B) 12
 (C) 18 (D) 24

- 9 Which of the following experiments has equally likely outcomes?

- (A) Choose a number at random from 1 to 7.
 (B) Toss a coin.
 (C) Roll a die.
 (D) All the above.

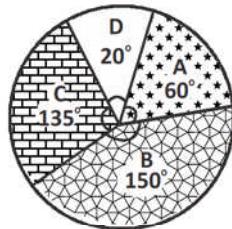
- 10 The bar chart shows the number of television sets sold by a shop in 5 months.



What is the sales in May, as a percentage of the total sales in the 5 months?

- (A) 25% (B) $33\frac{1}{3}\%$
 (C) 50% (D) $66\frac{2}{3}\%$

- 11 The table shows the frequency distribution of grades obtained by 120 students. The data is represented in the following pie chart.



Grade	A	B	C	D
Frequency	20	50	45	5

Which sector is labelled incorrectly?

- (A) A (B) B
 (C) C (D) D

- 12 Which of the following is an outcome?

- (A) Rolling a pair of dice.
 (B) A die landing on red.
 (C) Choosing 2 marbles from a jar.
 (D) Picking a card from a pack of 52 cards.

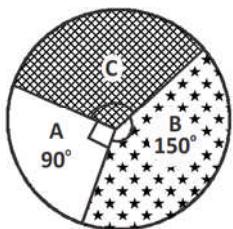
- 13** The table shows the number of cups of four different beverages sold by a coffee shop on a certain day.

Beverage	Number of cups
Coffee	60
Tea	75
Hot chocolate	25
Milk	40

What is the angle of sector in a pie chart representing tea ?

- (A) 40° (B) 135°
 (C) 108° (D) 72°

- 14** The pie chart shows the examination grades obtained by a group of students.



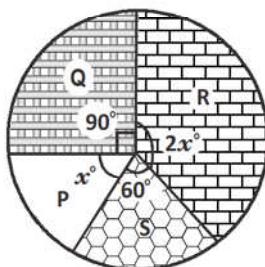
Which of the following statements about the pie chart is true ?

- (A) 15% of the students scored grade B.
 (B) 90% of the students scored grade A.
 (C) $\frac{1}{3}$ of the students scored grade C.
 (D) $\frac{1}{4}$ of the students scored grade B.

- 15** What is the probability of choosing a vowel from the alphabet ?

- (A) $\frac{21}{26}$ (B) $\frac{5}{26}$
 (C) $\frac{1}{21}$ (D) $\frac{5}{21}$

- 16** The pie chart shows the number of participants from four countries P, Q, R and S taking part in a tennis tournament.

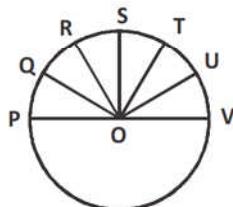


Given that there are 18 participants from country S, find the number of participants from country R.

- (A) 18 (B) 21
 (C) 27 (D) 42

- 17** The table shows the number of three different brands of laptops sold by a certain store. The data is represented by the pie chart which shows a semicircle divided into six equal sectors.

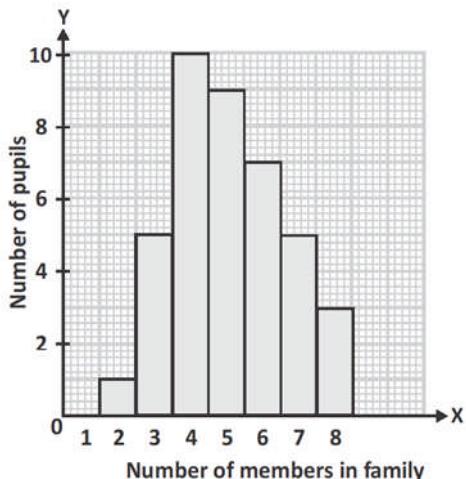
Brand	Number of laptops
Acer	60
Dell	40
Compaq	20



What is the angle of sector representing the number of Dell laptops sold ?

- (A) $\angle POR$ (B) $\angle ROV$
 (C) $\angle QOT$ (D) $\angle POU$

(18-21): The histogram shows the number of members in the families of the pupils of Class VIII.



Study the histogram and answer the following questions.

- 18** What is the enrolment of Class VIII?

(A) 40 (B) 50
 (C) 60 (D) 70

- 19** The maximum number of pupils have families with 'n' members. What is the value of 'n'?

(A) n = 1 (B) n = 4
 (C) n = 2 (D) n = 3

- 20** What is the total number of people in 5-member families ?

(A) 22 (B) 25
 (C) 45 (D) 50

- 21** What percentage of the pupils come from families with more than 5 members?

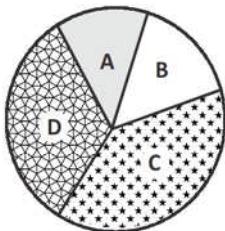
(A) 20.5% (B) 21.5%
 (C) 50% (D) 37.5%

- 22** What is the probability of getting an ace from a well shuffled deck of 52 playing cards?

(A) $\frac{1}{13}$ (B) $\frac{2}{13}$
 (C) $\frac{3}{13}$ (D) $\frac{4}{13}$

- 23** The pie chart shows the distribution of grades obtained by a group of students in a test. The number of students who

scored grade C is twice the number who scored grade B, and $\frac{3}{5}$ of the students scored grades B and C.



Find the angle of the sector which represents grade C.

- (A) 108° (B) 144°
 (C) 216° (D) 288°

- 24** Which of the following is an experiment ?

(A) Tossing a coin.
 (B) Rolling a single 6-sided die.
 (C) Choosing a marble from a jar.
 (D) All of the above.

- 25** A number from 1 to 11 is chosen at random. What is the probability of choosing an odd number ?

(A) $\frac{1}{11}$ (B) $\frac{5}{11}$
 (C) $\frac{6}{11}$ (D) $\frac{3}{26}$

- 26** The following frequency table shows the number of occupants in each flat in an apartment.

Number of occupants	Number of units (frequency)
1	2
2	5
3	8
4	14
5	12
6	9
7	4

Find the percentage of the flats with fewer than 4 occupants.

- (A) 25 % (B) 27.8 %
 (C) 42 % (D) 35 %

- 27** The table shows the grades obtained by a group of students in an examination.

Grade	Number of students
A	45
B	60
C	80
D	15

If the given information is illustrated using a pie chart, what is the angle of the sector that represents grade A ?

- (A) 45° (B) 81°
 (C) 65° (D) 100°

- (28-31): Numbers 1 to 10 are written on ten separate slips (one number on one slip), kept in a box and mixed well. One slip is chosen from the box without looking into it.**

- 28** What is the probability of getting the number 6 ?

- (A) $\frac{1}{10}$ (B) $\frac{2}{20}$
 (C) $\frac{1}{30}$ (D) $\frac{1}{15}$

- 29** What is the probability of getting a number less than 6 ?

- (A) $\frac{1}{3}$ (B) $\frac{1}{2}$
 (C) $\frac{2}{3}$ (D) $\frac{4}{3}$

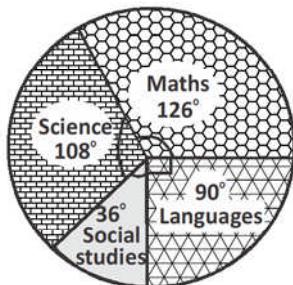
- 30** What is the probability of getting a number greater than 6 ?

- (A) $\frac{1}{5}$ (B) $\frac{3}{5}$
 (C) $\frac{2}{5}$ (D) $\frac{4}{5}$

- 31** What is the probability of getting a 1-digit number ?

- (A) $\frac{2}{10}$ (B) $\frac{3}{10}$
 (C) $\frac{4}{10}$ (D) $\frac{9}{10}$

- 32** A school has a strength of 2000 students. The following pie chart shows the interests of students in different subjects.

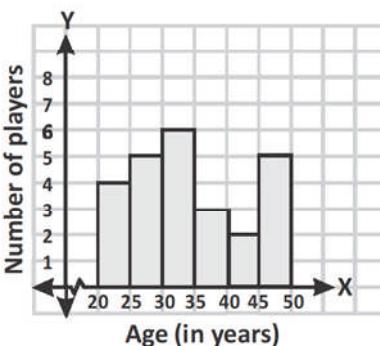


What is the number of students interested in Maths ?

- (A) 700 (B) 600
 (C) 200 (D) 500

Previous Contest Questions

- (1-3): The histogram shown gives the ages of 25 players of a sports club.**



- 1** How many players are of age 35 years and above but less than 40 years ?

- (A) 10 (B) 6
 (C) 5 (D) 3

- 2 How many players are aged below 30 years?

(A) 10 (B) 15
 (C) 9 (D) 4

- 3 How many players are aged 40 years and above?

(A) 8 (B) 2
 (C) 10 (D) 7

- 4 The frequency table shows the number of passengers in each of the 40 taxis that were inspected during a police roadblock.

Number of Passengers	0	1	2	3	4
Number of taxis	3	8	10	x	7

Find the value of 'x'.

(A) 2 (B) 3
 (C) 12 (D) 22

- 5 The table shows the number of children in each of the 35 families surveyed.

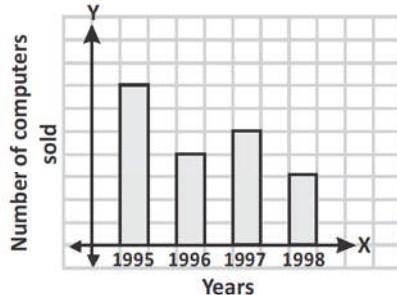
Number of Childrens	Tally
2	
3	
4	
5	
6	

Which of the following calculations used to find the percentage of families with more than 3 children, is correct ?

(A) $\frac{10}{35} \times 100\%$ (B) $\frac{21}{35} \times 100\%$
 (C) $\frac{14}{35} \times 100\%$ (D) $\frac{31}{35} \times 100\%$

- 6 The bar chart represents the data in the frequency table given.

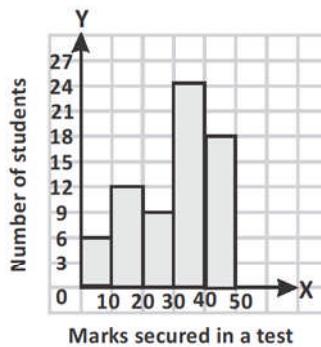
Year	Number of Computers sold
1995	
1996	
1997	
1998	



The bar for which year is incorrectly drawn?

(A) 1995 (B) 1996
 (C) 1997 (D) 1998

7-8: Study the histogram given and answer the questions that follow.



Marks secured in a test

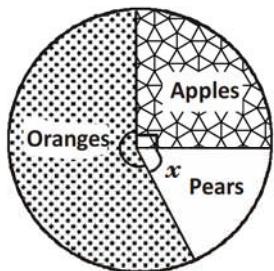
- 7 The pass mark in the test is 20. How many students failed in the test?

(A) 6 (B) 18
 (C) 12 (D) 10

- 8 How many students secured marks between 30 and 50?

(A) 42 (B) 24
 (C) 33 (D) 18

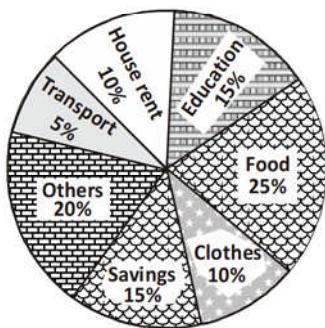
- 9** The pie chart shows the number of fruits sold in a store. The number of apples is 180 and the number of oranges is 400.



What is the angle of the sector representing the number of pears?

- (A) 60° (B) 70°
 (C) 160° (D) 200°

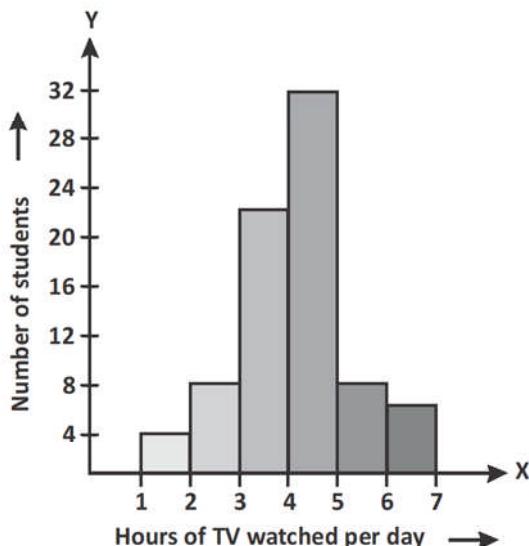
- 10** The pie chart gives the expenditure (in percentage) on various items and savings of a family during a month.



On which item was the expenditure the maximum?

- (A) Food
 (B) Clothes
 (C) Savings
 (D) Transport

- 11** The number of hours for which students of a particular class watched television during holidays is shown in the given graph.



How many students spent more than 5 hours watching TV?

- (A) 14 (B) 12
 (C) 08 (D) 10

- 12** Which of the following is an outcome?
 (A) Rolling a pair of dice.
 (B) A die landing on red.
 (C) Choosing 2 marbles from a jar.
 (D) Picking a card from a pack of 52 cards.

- 13** Which of the following experiments has equally likely outcomes?
 (A) Choose a number at random from 1 to 7.
 (B) Toss a coin.
 (C) Roll a die.
 (D) All the above.

- 14** What is the probability of choosing a vowel from the alphabet?

- (A) $\frac{21}{26}$ (B) $\frac{5}{26}$
 (C) $\frac{1}{21}$ (D) $\frac{5}{21}$

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Squares and Square roots

Synopsis

- ◆ **Square:** The square of a number is the product obtained when a number is multiplied by itself.
- ◆ **Perfect Square:** A perfect squares are the squares of whole numbers. Perfect squares are formed by multiplying a whole number by itself.
- ◆ **Properties of Squares**
 - (i) A number ending in 2, 3, 7 or 8 is never a perfect square. All square numbers end in 0, 1, 4, 5, 6 or 9.
 - (ii) A number ending in an odd number of zeroes is never a perfect square.
 - (iii) Square numbers have only even number of zeros at the end.
 - (iv) Squares of even numbers are even.
 - (v) Squares of odd numbers are odd.
 - (vi) For every natural number n , $(n + 1)^2 - n^2 = (n + 1) + n$.
e.g., $9^2 - 8^2 = 9 + 8 = 17$
 - (vii) A triplet (a, b, c) of three natural numbers 'a', 'b' and 'c' is called a Pythagorean triplet if $a^2 + b^2 = c^2$.
 - (viii) For any natural number $m > 1$, we have $(2m)^2 + (m^2 - 1)^2 = (m^2 + 1)^2$. So, $2m$, $(m^2 - 1)$ and $(m^2 + 1)$ form a Pythagorean triplet.
 - (ix) The square of a natural number 'n' is equal to the sum of the first 'n' odd numbers.
 - (x) If a natural number cannot be expressed as a sum of successive odd natural numbers starting with 1, then it is not a perfect square.
 - (xi) There are no natural numbers 'm' and 'n' for which $m^2 = 2n^2$.
 - (xii) There are $2n$ non-perfect square numbers between the squares of the numbers n and $(n + 1)$.
- ◆ **Square root:** Square root is the inverse operation of square.
 - (i) The square root of a number 'x' is a number which when multiplied by itself gives 'x' as the product. We denote the square root of 'x' by \sqrt{x} .
 - (ii) There are two integral square roots of a perfect square number. The positive square root of a number is denoted by the symbol $\sqrt{}$.

- (iii) If x and y are positive numbers, work out the square root of the numerator and denominator separately.

$$\sqrt{\frac{x}{y}} = \frac{\sqrt{x}}{\sqrt{y}}$$

- (vi) Square root of a number can be found using the following methods.
 (a) Repeated subtraction (b) Prime factorisation and (c) Division

◆ **Determining the square roots of positive numbers without using a calculator**

- (i) The square root of a fraction is determined by finding the square root of the numerator and denominator separately.
- (ii) Some fractions must be reduced to fractions with perfect squares as their numerators and denominators before their square roots can be calculated.
- (iii) To find the square root of a mixed number, first change the mixed number into an improper fraction.
- (iv) The square root certain decimals are obtained by first changing the decimals into fractions with perfect squares as their numerators and denominators.

◆ **Estimating the number of digits in the square root of a given number:** Place bars over every two digits from the right. The number of bars obtained is the number of digits in the square root of the number.

e.g., $\sqrt{9} = 3$; $\sqrt{25} = 5$; $\sqrt{100} = 10$; $\sqrt{169} = 13$; $\sqrt{144\ 00} = 120$

- ◆ Estimate the square root of a number by determining the range of the square root of that number.

$$\sqrt{193}$$

$169 < 193 < 196 \rightarrow$ Determine the range between two known perfect squares.

$\sqrt{169} < \sqrt{193} < \sqrt{196} \rightarrow$ Square root the range.

$13 < \sqrt{193} < 14 \rightarrow$ Estimated answer.

- (i) The square root of a number with one bar has one digit.
- (ii) The square root of a number with two bars has two digits. The square root of a number with three bars has three digits.
- ◆ To compute the square or square root of a mixed number, first convert it into an improper fraction.

Multiple Choice Questions

A

B

C

D



- 1** What is the least perfect square which is divisible by 2, 4 and 6 ?
 (A) 36 (B) 64
 (C) 16 (D) 18
- 2** What is the number of digits in the square root of 390625 ?
 (A) 4 (B) 6
 (C) 5 (D) 3
- 3** What is the least perfect square exactly divisible by each of the numbers 6, 9, 15 and 20 ?
 (A) 3600 (B) 900
 (C) 400 (D) 225
- 4** The sides of a rectangular field are 80 m and 18 m respectively. What is the length of its diagonal ?
 (A) 84 m (B) 98 m
 (C) 82 m (D) 86 m
- 5** What is the least number which must be subtracted from 2509 to make it a perfect square ?
 (A) 6 (B) 9
 (C) 12 (D) 14
- 6** What is the square root of $42\frac{583}{1369}$?
 (A) $6\frac{19}{37}$ (B) $4\frac{2}{11}$
 (C) $7\frac{2}{121}$ (D) $6\frac{12}{37}$
- 7** If $\sqrt{1+\frac{27}{169}} = 1 + \frac{x}{13}$, what is the value of 'x' ?
 (A) 1 (B) 14
 (C) 10 (D) 12
- 8** What is the value of $(501)^2 - (500)^2$?
 (A) 1 (B) 101
 (C) 1001 (D) 100
- 9** Which of the following is a Pythagorean triplet?
 (A) (6, 8, 10) (B) (3, 4, 7)
 (C) (5, 12, 18) (D) (2, 3, 6)
- 10** What is the value of $1 + 3 + 5 + 7 + 9 + \dots + 25$?
 (A) 196 (B) 625
 (C) 225 (D) 169
- 11** What is the smallest number by which 396 must be multiplied so that the product is a perfect square ?
 (A) 5 (B) 11
 (C) 3 (D) 2
- 12** Find the square root of $\frac{0.081}{0.0064} \times \frac{0.484}{6.25} \times \frac{2.5}{12.1}$.
 (A) 0.45 (B) 0.75
 (C) 0.95 (D) 0.99
- 13** Find the approximate value of $\frac{1+\sqrt{0.01}}{1-\sqrt{0.1}}$.
 (A) 0.6 (B) 1.1
 (C) 1.6 (D) 1.7
- 14** If $x * y = \sqrt{x^2 + y^2}$, find the value of $(1 * 2\sqrt{2})(1 * -2\sqrt{2})$.
 (A) -7 (B) 0 (C) 2 (D) 9
- 15** Evaluate $\sqrt{41 - \sqrt{21 + \sqrt{19 - \sqrt{9}}}}$.
 (A) 3 (B) 6 (C) 5 (D) 6.4

- 16** Which of the following is a four digit perfect square number whose first two digits and last two digits taken separately are also perfect squares ?
 (A) 1681 (B) 1636
 (C) 3664 (D) 6481
- 17** Find the number, which when subtracted from its square results in 12.
 (A) 6 (B) 5
 (C) 4 (D) 8
- 18** Which is the smallest natural number which when added to the difference of squares of 17 and 13 gives a perfect square ?
 (A) 1 (B) 5
 (C) 11 (D) 24
- 19** If $\sqrt{\frac{16}{49}} = \frac{x}{49}$, find the value of 'x'.
 (A) 4 (B) 7
 (C) 16 (D) 28
- 20** The area of a square field is $80\frac{244}{729}$ sq. m. What is the length of each side of the field?
 (A) 8.96 m (B) 10.26 m
 (C) 13.54 m (D) 9.86 m
- 21** If $\sqrt{2^n} = 64$, what is the value of 'n'?
 (A) 2 (B) 4
 (C) 6 (D) 12
- 22** Evaluate $\sqrt{\frac{36.1}{102.4}}$.
 (A) $\frac{29}{32}$ (B) $\frac{19}{72}$
 (C) $\frac{19}{32}$ (D) $\frac{29}{62}$
- 23** Given $\frac{x}{\sqrt{2.25}} = 550$, find the value of 'x'.
 (A) 825 (B) 82.5
 (C) 3666.66 (D) 2
- 24** If $\sqrt{24} = 4.899$, find the value of $\sqrt{\frac{8}{3}}$.
 (A) 0.544 (B) 2.666
 (C) 1.633 (D) 1.333
- 25** Evaluate $\sqrt{\frac{4}{3}} - \sqrt{\frac{3}{4}}$.
 (A) $\frac{1}{2\sqrt{3}}$ (B) $-\frac{1}{2\sqrt{3}}$
 (C) 1 (D) $\frac{5\sqrt{3}}{6}$
- 26** Find the value of the expression $\sqrt{0.0009} \div \sqrt{0.01}$.
 (A) 3 (B) 0.3
 (C) $\frac{1}{3}$ (D) 0.9
- 27** If $\sqrt{2401} = \sqrt{7^x}$, find the value of 'x'.
 (A) 3 (B) 4
 (C) 5 (D) 6
- 28** Find the value of $\sqrt{0.064}$.
 (A) 0.8 (B) 0.08
 (C) 0.008 (D) 0.253
- 29** Find the value of $\sqrt{\frac{0.16}{0.4}}$.
 (A) 0.2 (B) 0.02
 (C) 0.63 (D) $\frac{2\sqrt{5}}{5}$
- 30** Which of the following is the smallest number of 4 digits, which is not a perfect square ?
 (A) 1024 (B) 1089
 (C) 1000 (D) 1156

31 A gardener wants to plant 17956 trees and arranges them in such a way that there are as many rows as there are trees in a row. What is the number of trees in a row?

- (A) 144 (B) 136
(C) 154 (D) 134

32 A group of students decided to collect as many rupees from each member of the group as is the number of members. If the total collection amounts to ₹ 2209, what is the number of members in the group?

- (A) 37 (B) 47
(C) 107 (D) 43

33 A general wishes to draw up his 36562 soldiers in the form of a solid square. After arranging them, he found that some of them are left over. How many are left?

- (A) 36 (B) 65
(C) 81 (D) 97



Previous Contest Questions

1 Find the value $\sqrt{\frac{0.289}{0.00121}}$.

- (A) $\frac{1.7}{11}$ (B) $\frac{17}{11}$
(C) $\frac{170}{11}$ (D) $\frac{17}{110}$

2 If $\sqrt{75.24+x} = 8.71$, find the value of 'x'.

- (A) 0.6241 (B) 6.241
(C) 62.41 (D) 624.1

3 If $\sqrt{3} = 1.732$, find the approximate value of $\frac{1}{\sqrt{3}}$.

- (A) 0.617 (B) 0.313
(C) 0.577 (D) 0.173

4 If $\sqrt{0.04 \times 0.4 \times a} = 0.4 \times 0.04 \times \sqrt{b}$, what is the value of $\frac{a}{b}$?

- (A) 0.016 (B) 1.60
(C) 0.16 (D) 16

5 Find the value of $\sqrt{2\sqrt{2\sqrt{2\sqrt{2\sqrt{2}}}}}$.

- (A) 0 (B) 1
(C) 2 (D) $2^{31/32}$

6 Find the largest number of 5 digits, which is perfect square.

- (A) 99999 (B) 99764
(C) 99976 (D) 99856

7 Which smallest number must be added to 269 to make it a perfect square?

- (A) 31 (B) 16
(C) 20 (D) 7



Cubes and Cube roots

Synopsis

Cubes

- (i) The cube of a number is the product of the number multiplied by itself twice.
- (ii) Write the cube of a number using the cube symbol or notation.
- (iii) 8^3 is read as 'eight cubed' or 'the cube of eight', or 'eight to the power of three.'

Estimating the cubes of numbers

Estimate the cube of a number by determining the range in which its value lies.

e.g., Estimate the cube of 10.6 by determining the range in which its value lies.

Solution

$$\begin{aligned} 10 < 10.6 < 11 &\rightarrow \text{Determine the range} \\ 103 < (10.6)^3 < 113 &\rightarrow \text{Cube the range} \\ 1\,000 < (10.6)^3 < 1\,331 &\rightarrow \text{Estimated answer} \\ \therefore (10.6)^3 \text{ is between } 1\,000 \text{ and } 1\,331. \end{aligned}$$

Perfect cube

- (i) A natural number is said to be a perfect cube if it is the cube of some natural number.
- (ii) Cubes of all even natural numbers are even.
- (iii) Cubes of all odd natural numbers are odd.
- (iv) Cubes of negative integers are negative.

Cube roots of numbers

- (i) The cube root of a number is a number which, when multiplied by itself twice, equals the given number.
- (ii) The symbol used for cube root is $\sqrt[3]{}$.
- (iii) The cube root of a number ' x ' is that number whose cube gives ' x '. It is denoted as $\sqrt[3]{x}$.
- (iv) For any positive integer ' x ', $\sqrt[3]{-x} = -\sqrt[3]{x}$.
- (v) For any two integers 'a' and 'b',

$$(a) \sqrt[3]{ab} = \sqrt[3]{a} \times \sqrt[3]{b} \qquad (b) \sqrt[3]{\frac{a}{b}} = \frac{\sqrt[3]{a}}{\sqrt[3]{b}}$$

- (iv) Cube root of a number can be found by prime factorisation.

Determining the cube roots

- (i) To find the cube roots of fractions, reduce the fractions to numerators and denominators that are cubes of integers. Then, find the cube roots of those integers.
- (ii) To find the cube roots of decimals, convert the decimals to fractions so that the numerators and denominators are cubes of integers. Then, solve the cube roots of those integers.

Multiple Choice Questions



- 1** If $72K$ is a perfect cube, find the value of K .
 (A) 1 (B) 2 (C) 3 (D) 4
- 2** If ' a ', ' b ', ' c ' and ' d ' are consecutive natural numbers and $a^3 = b^3 + c^3 + d^3$, what is the least value of ' a '?
 (A) 6 (B) 9 (C) 3 (D) 12
- 3** Find the number which is not a perfect cube among the following.
 (A) 1331 (B) 216 (C) 243 (D) 512
- 4** What is the smallest number by which 2560 must be multiplied so that the product is a perfect cube?
 (A) 5 (B) 25 (C) 10 (D) 15
- 5** Find the smallest number by which 8788 must be divided so that the quotient is a perfect cube.
 (A) 4 (B) 12 (C) 16 (D) 32
- 6** What is the cube root of 1.331?
 (A) 0.11 (B) 0.011
 (C) 11 (D) 1.1
- 7** Find the value of $\sqrt[3]{343} \times \sqrt[3]{-64}$.
 (A) 28 (B) -28 (C) 18 (D) -18
- 8** The length of each side of a cubical box is 2.4 m. What is its volume?
 (A) 13.824 cu m (B) 13.824 cu cm
 (C) 13.824 m² (D) 13.824 cm²
- 9** The cube of a number is 8 times the cube of another number. If the sum of the cubes of numbers is 243, what is difference of the numbers?
 (A) 3 (B) 4 (C) 6 (D) -6
- 10** The difference of the cube and the square of a natural number is 48. Find the number.
 (A) 6 (B) 5 (C) 4 (D) 8
- 11** Which of the following numbers is a perfect cube?
 (A) 108 (B) 343 (C) 243 (D) 5324
- 12** Which of the following is the cube of an even natural number?
 (A) 729 (B) 3375
 (C) 1331 (D) 13824
- 13** Find the cube root of 0.001728.
 (A) 0.12 (B) 1.2
 (C) 12 (D) 2.6
- 14** Evaluate $\sqrt[3]{-2744} \div \sqrt[3]{0.008}$.
 (A) 70 (B) -70
 (C) 14 (D) -14
- 15** Identify the digit in the units place of $\sqrt[3]{21952}$.
 (A) 8 (B) 4 (C) 6 (D) 7
- 16** The quotient of the cube root of a number and 25 is 5. Identify the number.
 (A) 5^3 (B) 25^3
 (C) 125^2 (D) 125^3
- 17** The product $864 \times n$ is a perfect cube. What is the smallest possible value of ' n '?
 (A) 2 (B) 1 (C) 4 (D) 3
- 18** Find the units place in the cube of 126.
 (A) 4 (B) 6 (C) 8 (D) 1
- 19** Find the value of $\sqrt[3]{0.000216}$.
 (A) 0.006 (B) 0.6
 (C) 0.36 (D) 0.06
- 20** Find the value of $\sqrt[3]{0.000064}$.
 (A) 0.2 (B) 0.02
 (C) 0.002 (D) 0.04
- 21** If $P = \sqrt[3]{\sqrt[3]{a^9}}$, what is the value of P ?
 (A) $(a^3)^3$ (B) a^3 (C) a^9 (D) a
- 22** By which number should 5184 be divided to make it a perfect cube?
 (A) 2 (B) 4 (C) 3 (D) 6

- 23** The cube root of a number when divided by 7 results in 49. Identify the number.
 (A) 343^3 (B) 33^3 (C) 43^3 (D) 343^7

24 Evaluate $\sqrt[3]{\frac{343 \times 125}{0.064}}$.

- (A) 875 (B) 8.75 (C) 807.5 (D) 87.5

- 25** A metallic cuboid with dimensions $16\text{ cm} \times 8\text{ cm} \times 4\text{ cm}$ was melted and recast into a cube. What is the length of the edge of the cube ?
 (A) 8 cm (B) 2 cm (C) 4 cm (D) 16 cm

- 26** What is the volume of a cube of edge 15 cm ?
 (A) 15625 cm^3 (B) 3.375 cm^3
 (C) 3375 cm^3 (D) 225 cm^3

- 27** The volume of liquid in a measuring jar is 200 cm^3 . A cube of side 7 cm is immersed in the liquid. What is the reading on the measuring jar ?
 (A) 800 cm^3 (B) 543 cm^3
 (C) 643 cm^3 (D) 843 cm^3

- 28** The volume of material used to make a cube is 4913 cm^3 . What is the length of the edge of the cube ?
 (A) 16 cm (B) 27 cm
 (C) 18 cm (D) 17 cm

- 29** A tank holds 27000 litres of water. How many litres of water would a similar pond hold, if its dimensions were double the first one ?

- (A) 17286 litres (B) 216000 litres
 (C) 15625 litres (D) 432000 litres

- 30** A cubic wooden block has an edge of 0.21 m. What is its volume ?
 (A) 9261 cm^3 (B) 926.1 m^3
 (C) 92.61 cm^3 (D) 92.61 m^3

- 31** A cube is made of 24389 cm^3 of wood. What is the measure of its edge ?
 (A) 39 cm (B) 29 cm
 (C) 2.9 cm (D) 19 cm

- 32** A water tank holds 79507 cm^3 of water. What is the measure of its edge ?
 (A) 23 cm (B) 33 cm
 (C) 43 cm (D) 38 cm

- 33** A wooden cuboid is 24 cm by 30 cm by 36 cm. 8 cubes of equal sides are cut off from the 8 corners of the cuboid. The volume of the remaining block is 20088 cm^3 . What is the length of the edge of each cube ?
 (A) 6 cm (B) 9 cm (C) 1 cm (D) 7 cm

Previous Contest Questions

- 1** Find the value of $\sqrt[3]{0.125} + 3$.
 (A) 8 (B) 3.5 (C) 2 (D) 0.35

- 2** If $x = \sqrt[3]{-3\frac{3}{8}}$, find the value of 'x'.
 (A) $\frac{3}{2}$ (B) $\frac{3}{4}$ (C) $-\frac{3}{4}$ (D) $-\frac{3}{2}$

- 3** Find the value of $\sqrt[3]{\frac{-192}{81}}$.
 (A) $-\frac{5}{3}$ (B) $-\frac{4}{3}$ (C) $\frac{3}{2}$ (D) $\frac{13}{9}$

- 4** What is the value of $\sqrt[3]{216}$?
 (A) Less than 6.
 (B) Greater than 6.
 (C) Equal to 6.
 (D) Equal to 9.

- 5** Given that $512 = 8^3$ and $3.375 = 1.5^3$, find the value of $\sqrt[3]{512} \times \sqrt[3]{3.375}$.

- (A) 12 (B) 9.5 (C) 8 (D) 1.5

- 6** Given that $\sqrt[3]{x} = -6$, find the value of 'x'.
 (A) 216 (B) 18 (C) -18 (D) -216

- 7** The length of each edge of a cube is 9 m. Find the volume of the cube.
 (A) 27 m^3 (B) 81 m^3
 (C) 108 m^3 (D) 729 m^3

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Comparing Quantities

Synopsis

- ◆ **Compound interest:** Amount at compound interest is given by $A = P \left(1 + \frac{R}{100}\right)^n$, where,

A – Amount, P – Principal, R – Rate of interest, n – Time period.

(i) Compound interest = A – P

(ii) In case of depreciation (or) decay,

$$A = P \left(1 - \frac{R}{100}\right)^n$$

(iii) If the rates of increase in population P are p%, q% and r% during 1st, 2nd and 3rd years respectively, then the population after 3 years = $P \left(1 + \frac{p}{100}\right) \left(1 + \frac{q}{100}\right) \left(1 + \frac{r}{100}\right)$.

(iv) If principal = ₹ P, rate = R% per annum and time = n years, then

(a) Amount after 'n' years (compounded annually) is

$$A = P \left(1 + \frac{R}{100}\right)^n.$$

(b) Amount after 'n' years (compounded half-yearly) is

$$A = P \left(1 + \frac{R}{2 \times 100}\right)^{2n},$$

where $\frac{R}{2}$ is half-yearly rate and 2n is the number of half-years.

(c) Amount after 'n' years (compounded quarterly) is

$$A = P \left(1 + \frac{R}{4 \times 100}\right)^{4n},$$

where $\frac{R}{4}$ is the quarterly rate and 4n is the number of quarter years.

(v) When T = 2 years and n = 1, then

$$C.I. - S.I. = \frac{R \times S.I.}{2 \times 100} = P \left(\frac{R}{100}\right)^2$$

(vi) When $T = 3$ years and $n = 1$, then

$$\begin{aligned} \text{C.I.} - \text{S.I.} &= \frac{\text{S.I.}}{3} \left[\left(\frac{R}{100} \right)^2 + 3 \left(\frac{R}{100} \right) \right] \\ &= P \left[\left(\frac{R}{100} \right)^3 + 3 \left(\frac{R}{100} \right)^2 \right] \end{aligned}$$

(vii) If a certain amount becomes N times in T years, then it will be

N^2 times in $T \times 2$ years, N^3 times in $T \times 3$ years and N^x times in $T \times x$ years.

◆ **Profit and loss:**

- (i) **Cost price (C.P.):** The price at which an article is purchased is called its cost price.
- (ii) **Selling price (S.P.):** The price at which an article is sold is called its selling price.
 - (a) If $S.P. > C.P.$, then there is a gain and $\text{Gain} = S.P. - C.P.$
 - (b) If $S.P. < C.P.$, then there is a loss and $\text{Loss} = C.P. - S.P.$
- (iii) **Profit and loss percentage:**

$$(i) \text{ Profit \%} = \frac{\text{profit}}{\text{C.P.}} \times 100\% \quad (ii) \text{ Loss \%} = \frac{\text{loss}}{\text{C.P.}} \times 100\%$$

Note : Profit and loss percentage are reckoned on cost price.

(iv) **Important formulae:**

$$\begin{array}{ll} (a) \text{ S.P.} = \left(\frac{100 + \text{gain}\%}{100} \right) \times \text{C.P.} & (b) \text{ S.P.} = \left(\frac{100 - \text{loss}\%}{100} \right) \times \text{C.P.} \\ (c) \text{ C.P.} = \left(\frac{100}{100 + \text{gain}\%} \right) \times \text{S.P.} & (d) \text{ C.P.} = \left(\frac{100}{100 - \text{loss}\%} \right) \times \text{S.P.} \end{array}$$

(v) **Discount:** In order to give a boost to the sales of an item or to clear the old stock, articles are sold at reduced prices. This reduction is given on the Marked Price (M.P.) of the article and is known as discount.

- (a) $S.P. = M.P. - \text{Discount}$ (b) $\text{Discount} = M.P. - S.P.$
- (c) $\text{Discount \%} = \frac{M.P. - S.P.}{M.P.} \times 100\%$ (d) $\text{Discount \% of M.P.} = \text{Discount \%} \times M.P.$
- (e) Additional expenses made after buying an article are included in the cost price and are known as overhead expenses.
 $C.P. = \text{Buying price} + \text{Overhead expenses}$
- (f) Sales tax is charged on the sale of an item by the government and is added to the bill amount.
 $\text{Sales tax} = \text{Tax \% of bill amount}$

Multiple Choice Questions



- 1** A sum of money, at compound interest, yields ₹ 200 and ₹ 220 at the end of first and second years respectively. What is the rate percent ?
 (A) 20% (B) 15%
 (C) 10% (D) 5%
- 2** The sale price of a shirt is ₹ 176. If a discount of 20% is allowed on its marked price, what is the marked price of the shirt?
 (A) ₹ 160 (B) ₹ 180
 (C) ₹ 200 (D) ₹ 220
- 3** The difference in S.I. and C.I. on a certain sum of money in 2 years at 15% p.a. is ₹ 144. Find the sum.
 (A) ₹ 6000 (B) ₹ 6200
 (C) ₹ 6300 (D) ₹ 6400
- 4** In what time will a sum of ₹ 800 at 5% p.a. C.I. amount to ₹ 882 ?
 (A) 1 year (B) 5 years
 (C) 4 years (D) 2 years
- 5** What is the C.I. on ₹ 8000 for 1 year at 5% p.a. payable half-yearly ?
 (A) ₹ 800 (B) ₹ 810
 (C) ₹ 400 (D) ₹ 405
- 6** Raghu borrowed ₹ 25000 at 20% p.a. compounded half-yearly. What amount of money will clear his debt after $1\frac{1}{2}$ years ?
 (A) ₹ 28275 (B) ₹ 36275
 (C) ₹ 33275 (D) ₹ 38275
- 7** In what time will ₹ 1000 amount to ₹ 1331 at 10% p.a. compounded annually?
 (A) 4 years (B) 3 years
 (C) 2 years (D) 1 year
- 8** The present population of a town is 25000. It grows at 4%, 5% and 8% during first year, second year and third year respectively. Find the population after 3 years.
 (A) 29484 (B) 28696
 (C) 24576 (D) 30184
- 9** The value of an article which was purchased 2 years ago, depreciates at 12% per annum. If its present value is ₹ 9680, what is the price at which it was purchased?
 (A) ₹ 10000 (B) ₹ 12500
 (C) ₹ 14575 (D) ₹ 16250
- 10** The cost of a vehicle is ₹ 175000. If its value depreciates at the rate of 20% per annum, find the total depreciation after 3 years.
 (A) ₹ 86400 (B) ₹ 82500
 (C) ₹ 84500 (D) ₹ 85400
- 11** The C.I. on a certain sum for 2 years is ₹ 410 and S.I. is ₹ 400. What is the rate of interest per annum ?
 (A) 10% (B) 8%
 (C) 5% (D) 4%
- 12** The C.I. on a certain sum for 2 years at 10% per annum is ₹ 525. Calculate the S.I. on the same sum for double the time at half the rate percent per annum.
 (A) ₹ 400 (B) ₹ 500
 (C) ₹ 600 (D) ₹ 800
- 13** The S.I. on a sum of money for two years is ₹ 660, while C.I. is ₹ 696.30, the rate of interest being the same in both the cases. Find the rate of interest.
 (A) 10% (B) $10\frac{1}{2}\%$
 (C) 12% (D) 11%
- 14** A sum of money doubles itself in 3 years at C.I., when the interest is compounded annually. In how many years will it amount to 16 times of itself ?
 (A) 6 years (B) 8 years
 (C) 12 years (D) 16 years

- 15** The C.I. on a certain sum at 5% for 2 years is ₹ 328. Calculate the S.I. for the sum at the same rate and for the same period.
- (A) ₹ 320 (B) ₹ 322
 (C) ₹ 325 (D) ₹ 326
- 16** Find the amount on ₹ 12500 for 2 years compounded annually, the rate of interest being 15% for the first year and 16% for the second year.
- (A) ₹ 16500 (B) ₹ 16750
 (C) ₹ 16675 (D) ₹ 16275
- 17** Sugar is bought at ₹ 16.20 per kg and sold at ₹ 17.28 per kg. What is the gain percent?
- (A) $6\frac{2}{3}\%$ (B) $3\frac{1}{3}\%$ (C) 10% (D) $10\frac{2}{3}\%$
- 18** A woman bought two packs of toffees, with the same number of toffees in each pack. She bought the first pack at 25 paise per toffee and the second pack at 3 toffees for 65 paise. She mixed them together and sold at ₹ 3.50 a dozen. What is her gain percent?
- (A) 15% (B) 25% (C) $16\frac{2}{3}\%$ (D) 12%
- 19** A man bought 542 kg of sugar for ₹ 7560.90 and sold it so as to gain 20%. What is the selling price per kilogram of sugar?
- (A) ₹ 16.74 (B) ₹ 22.92
 (C) ₹ 31.46 (D) ₹ 12.24
- 20** A trader marks his goods 30% above the cost price but makes a reduction of $6\frac{1}{4}\%$ on the marked price for ready money. What is his gain percent?
- (A) 23.75% (B) 23.25%
 (C) 21.875% (D) 20%
- 21** If the discount is 10%, what is the M.P of an item bought for ₹ 9?
- (A) ₹ 11 (B) ₹ 10 (C) ₹ 8.10 (D) ₹ 12
- 22** A cask containing 425 litres of petrol lost 8% by leakage and evaporation. Find the number of litres of petrol left in the cask.
- (A) 34 l (B) 391 l (C) 459 l (D) 319 l
- 23** Waheeda bought an air cooler for ₹ 3300 including a tax of 10%. Find the price of the air cooler before VAT was added.
- (A) ₹ 3000 (B) ₹ 2000
 (C) ₹ 3100 (D) ₹ 2900
- 24** Ravi sold an article to Sudhir at a profit of 6% who in turn sold it to Gopal at a loss of 5%. If Gopal paid ₹ 2014 for the article, find the cost price of the article for Ravi.
- (A) ₹ 2020 (B) ₹ 2000
 (C) ₹ 1900 (D) ₹ 2011
- 25** If a merchant estimates his profit as 20% of the selling price, what is his real profit percent?
- (A) 25% (B) 20% (C) 22% (D) 30%
- 26** Karuna bought a car for a certain sum of money. She spent 10% of the cost on repairs and sold the car for a profit of ₹ 11000. How much did she spend on repairs, if she made a profit of 20%?
- (A) ₹ 4000 (B) ₹ 4400
 (C) ₹ 5500 (D) ₹ 5000
- 27** A shopkeeper fixes the M.P. of an item 35% above its C.P. What is the percentage of discount allowed to gain 8%?
- (A) 43% (B) 30% (C) 20% (D) 31%
- 28** If S.P. of an article is $\frac{4}{3}$ of its C.P. What is the profit percentage in the transaction?
- (A) $\frac{1}{3}\%$ (B) $20\frac{1}{2}\%$ (C) $33\frac{1}{3}\%$ (D) $25\frac{1}{2}\%$

29 If 5% more is gained by selling an article for ₹ 350 than by selling it for ₹ 340, what is the cost of the article?

- (A) ₹ 50 (B) ₹ 160 (C) ₹ 200 (D) ₹ 225

30 Garima purchased a briefcase with an additional 10% discount on the reduced price after deducting 20% on the labelled price. If the labelled price was ₹ 1400, at what price did she purchase the briefcase?

- (A) ₹ 980 (B) ₹ 1008
(C) ₹ 1056 (D) ₹ 1120

31 A pair of articles was bought for ₹ 37.40 at a discount of 15%. What was the marked price of each of the articles?

- (A) ₹ 11 (B) ₹ 22 (C) ₹ 33 (D) ₹ 44

32 What will be the list price of an article which is sold for ₹ y after giving a discount of $x\%$?

$$\begin{array}{ll} \text{(A)} \frac{100y}{100-x} & \text{(B)} \frac{100y}{1-x} \\ \text{(C)} \frac{100y}{1-(x/100)} & \text{(D)} \frac{100-x}{100-y} \end{array}$$

33 The selling price of 4 articles is the same as the C.P of 5 articles. What is the profit percent?

- (A) 25% (B) 20% (C) 18% (D) 15%

34 By selling 20 mangoes, a person recovers the price of 25 mangoes. What is the profit percentage?

- (A) 20% (B) 25% (C) 27.5% (D) 22.5%

35 The marked price of an article is ₹ x, and selling price is ₹ y. What is the discount percentage?

$$\begin{array}{ll} \text{(A)} \frac{(x-y)100}{x}\% & \text{(B)} \frac{(y-x)100}{x}\% \\ \text{(C)} \left(\frac{y-x}{y}\right)100\% & \text{(D)} \frac{x-y}{100}\% \end{array}$$

36 The selling price and cost price of an article differ by ₹ 240. If the profit percentage is 20, find the selling price.

- (A) ₹ 1440 (B) ₹ 1200
(C) ₹ 1420 (D) ₹ 1540

37 What is a single discount equivalent to a series discount of 20%, 10% and 5%?

- (A) 81% (B) 31.4% (C) 31.6% (D) 32%

Previous Contest Questions

1 Sam invested ₹ 15000 at the rate of 10% per annum for one year. If the interest is compounded half-yearly, what is the amount received by Sam at the end of the year?

- (A) ₹ 16500 (B) ₹ 16525.50
(C) ₹ 16537.50 (D) ₹ 18150

2 What will be the difference between simple and compound interests at the rate of 10% per annum on a sum of ₹ 1000 after 4 years?

- (A) ₹ 31 (B) ₹ 32.10
(C) ₹ 40.40 (D) ₹ 64.10

3 In how many years will a sum of ₹ 800 at 10% per annum compounded semi-annually become ₹ 926.10?

- (A) $1\frac{1}{3}$ (B) $1\frac{1}{2}$ (C) $2\frac{1}{3}$ (D) $2\frac{1}{2}$

4 A shopkeeper gives 12% additional discount on a radio after giving an initial discount of 20% on its labelled price. If the final selling price of the radio is ₹ 704, what is its labelled price?

- (A) ₹ 844.80 (B) ₹ 929.28
(C) ₹ 1000 (D) ₹ 1044.80

5 A book is marked at ₹ 880 and sold for ₹ 770, what is the discount percentage?

- (A) 20% (B) 25% (C) 12.5% (D) 15%

6 A shopkeeper allows a discount of 10% on the marked price. How much above the cost price must he mark his goods to gain 8%?

- (A) 20% (B) 100% (C) 80% (D) 25%

Algebraic Expressions and Identities

Synopsis

◆ Algebraic expression:

A combination of constants and variables connected by $+$, $-$, \times and \div is known as an algebraic expression.

e.g., $2 - 3x + 5x^{-2}y^{-1} + \frac{x}{3y^3}$

◆ Polynomial:

An algebraic expression in which the variables involved have only non-negative integral powers is called a polynomial.

e.g., $2 - 3x + 5x^2y - \frac{1}{3}xy^3$

- ◆ **Like terms:** Terms formed from the same variables whose powers are same are called like terms. The coefficients of like terms need not be the same.
- ◆ **Unlike terms:** Terms formed from different variables whose powers may be same or different are called unlike terms. The coefficients of unlike terms may or may not be the same.

In other words, terms with the same variables and which have the same exponent are called like or similar terms, otherwise they are called unlike (or) dissimilar terms.

e.g., (1) $3x^3, \frac{1}{2}x^3, -9x^3, \dots$ etc, are like terms.

(2) $x^2y, 3xy^2, -4x^3, \dots$ etc, are unlike terms.

◆ Degree of a polynomial:

In case of a polynomial in one variable, the highest power of the variable is called the degree of the polynomial.

e.g., $5x^3 - 7x + \frac{3}{2}$ is a polynomial in 'x' of degree 3.

In case of polynomial in more than one variable, the sum of the powers of the variables in each term is taken up and the highest sum so obtained is called the degree of the polynomial.

e.g., $5x^3 - 2x^2y^2 - 3x^2y + 9y$ is a polynomial of degree 4 in 'x' and 'y'.

◆ **Types of polynomials:**

- (i) **Monomial:** A polynomial containing 1 term is called a monomial.
- (ii) **Binomial:** A polynomial containing 2 terms is called a binomial.
- (iii) **Trinomial:** A polynomial containing 3 terms is called a trinomial.

◆ **Multiplication of polynomials:**

- (i) A monomial multiplied by a monomial always gives a monomial.
- (ii) While multiplying a polynomial by a monomial, we multiply every term in the polynomial by the monomial.
- (iii) In carrying out the multiplication of a polynomial by a binomial (or trinomial), we multiply term by term, i.e., every term of the polynomial is multiplied by every term in the binomial (or trinomial). Note that in such multiplication, we may get terms in the product which are like and have to be combined.

◆ **Identity:**

An identity is an equality, which is true for all values of the variables in the equality.

◆ **Some important identities:**

- (i) $(a + b)^2 = a^2 + 2ab + b^2$
- (ii) $(a - b)^2 = a^2 - 2ab + b^2$
- (iii) $(a + b)(a - b) = a^2 - b^2$
- (iv) $(x + a)(x + b) = x^2 + (a + b)x + ab$
- (v) These identities are useful in computing squares and products of algebraic expressions. They are alternative methods to calculate products of numbers too.

Multiple Choice Questions

A

B

C

D



- 1** Find the degree of the polynomial $5x^3 - 6x^3y + 4y^2 - 8$.
 (A) 3 (B) 4 (C) 2 (D) 6
- 2** What must be added to $x^3 + 3x - 8$ to get $3x^3 + x^2 + 6$?
 (A) $2x^3 + x^2 - 3x + 14$
 (B) $2x^2 + x^2 + 14$
 (C) $2x^3 + x^2 - 6x - 14$
 (D) $-2x^3 - x^2 + 6x - 14$
- 3** What must be subtracted from $x^3 - 3x^2 + 5x - 1$ to get $2x^3 + x^2 - 4x + 2$?
 (A) $-x^3 + 4x^2 - 9x + 3$
 (B) $x^3 + 4x^2 - 9x + 3$
 (C) $x^3 - 4x^2 + 9x - 3$
 (D) $-x^3 - 4x^2 + 9x - 3$
- 4** What is the measure of the third side of a triangle given that its two sides are $a^2 - 2a + 1$ and $3a^2 - 5a + 3$ and has a perimeter $6a^2 - 4a + 9$?
 (A) $2a^2 - 3a - 5$ (B) $2a^2 + 3a - 5$
 (C) $2a^2 + 3a + 5$ (D) $2a^2 - 3a + 5$
- 5** Two sides of a rectangle are $(3p + 5q)$ units and $(5p - 7q)$ units. What is its area in sq. units?
 (A) $15p^2 + 4pq - 35q^2$
 (B) $15p^2 - 4pq + 35q^2$
 (C) $15p^2 + 14pq + 35q^2$
 (D) $15p^2 - 4pq - 35q^2$
- 6** Find the product of $(x^2 + 3x + 5)$ and $(x^2 - 1)$.
 (A) $x^4 + 3x^3 - 4x^2 - 3x - 5$
 (B) $x^4 + 3x^3 + 4x^2 - 3x - 5$
 (C) $x^4 + 3x^3 + 4x^2 + 3x - 5$
 (D) $x^4 - 3x^3 - 4x^2 + 3x - 5$
- 7** The length of a rod is $4x + 5y - 3z$ cm and the length of another is $6x - 3y + z$ cm. By how much is the second rod longer than the first?
 (A) $2x + 8y + 4z$ (B) $2x - 8y - 4z$
 (C) $2x + 8y - 4z$ (D) $2x - 8y + 4z$
- 8** The sum of two expressions is $x^3 - x^2 + 3x - 2$. If one of them is $x^2 + 5x - 6$, what is the other?
 (A) $x^3 - 2x^2 - 2x - 4$
 (B) $x^3 + 3x^2 - 2x + 4$
 (C) $x^3 - 2x^2 - 2x + 4$
 (D) $-x^3 - 2x^2 + 2x - 4$
- 9** The difference of $x^4 + 2x^2 - 3x + 7$ and another polynomial is $x^3 + x^2 + x - 1$. What is the other polynomial?
 (A) $x^4 - x^3 + x^2 - 4x + 8$
 (B) $x^3 + x^2 - 4x + 8$
 (C) $x^4 - x^3 + x^2 + 4x - 8$
 (D) $x^4 - x^3 - x^2 + 4x - 8$
- 10** Find the side of a square field of area $\frac{9}{16}x^2 + \frac{25}{36}y^2 - \frac{5}{4}xy$ sq. units.
 (A) $\left(\frac{3}{4}x + \frac{5}{6}y\right)$ units (B) $\left(\frac{3}{5}x - \frac{5}{6}y\right)$ units
 (C) $\left(\frac{3}{5}x + \frac{5}{6}y\right)$ units (D) $\left(\frac{3}{4}x - \frac{5}{6}y\right)$ units
- 11** If $(3x - 4)(5x + 7) = 15x^2 - ax - 28$, what is the value of 'a'?
 (A) 1 (B) -1 (C) -2 (D) 2
- 12** What is the difference obtained when $x^3 - xy^2 + 5x^2y - y^3$ is subtracted from $-y^3 - 6x^2y - xy^2 + x^3$?
 (A) $2y^3 - 8x^2y + 3xy^2 - 2x^3$
 (B) $2x^3 - 2xy^2 - x^2y - 2y^3$
 (C) $-11x^2y$
 (D) $11x^2y$
- 13** Find the missing term in the following expression.

$$\left(\frac{3x}{4} - \frac{4y}{3}\right)^2 = \frac{9x^2}{16} + \underline{\hspace{1cm}} + \frac{16y^2}{9}$$

 (A) $2xy$ (B) $-2xy$ (C) $12xy$ (D) $-12xy$

- 14** What is the value of $\frac{7.83 \times 7.83 - 1.17 \times 1.17}{6.66}$?
 (A) 9 (B) 6.66 (C) 1.176 (D) -9
- 15** If $x - \frac{1}{x} = \sqrt{6}$, find the value of $x^2 + \frac{1}{x^2}$.
 (A) 2 (B) 4 (C) 6 (D) 8
- 16** If $x^2 + \frac{1}{x^2} = 79$, what is the value of $x + \frac{1}{x}$?
 (A) 7 (B) 9 (C) $\sqrt{79}$ (D) -9
- 17** If $3x - 7y = 10$ and $xy = -1$, find the value of $9x^2 + 49y^2$.
 (A) 58 (B) 142 (C) 104 (D) -104
- 18** Given that $x - \frac{1}{x} = 5$, find the value of $x^2 + \frac{1}{x^2}$.
 (A) -27 (B) 23 (C) 27 (D) -23
- 19** Evaluate the expression $81p^2 + 16q^2 - 72pq$ when $p = \frac{2}{3}$ and $q = \frac{3}{4}$.
 (A) -16 (B) 9 (C) -9 (D) 16
- 20** What is the product of $(4x - 3y)$ and $(16x^2 + 12xy + 9y^2)$?
 (A) $(4x - 3y)^3$
 (B) $(16x^2 + 12xy + 9y^2)^2$
 (C) $64x^3 - 27y^3$
 (D) $64x^3 + 27y^3$
- 21** Using the identity $(a - b)^2 = a^2 - 2ab + b^2$, find the value of 96^2 .
 (A) 9642 (B) 9461 (C) 9426 (D) 9216
- 22** Using the identity $a^2 - b^2 = (a + b)(a - b)$, evaluate 24.7×25.3 .
 (A) 624.91 (B) 642.91
 (C) 624.19 (D) 642.19
- 23** Given that $pq = 6$ and $p + q = 5$, find the value of $p^2 + q^2$.
 (A) 300 (B) 37 (C) 13 (D) 12
- 24** The side of a square is 17 cm and the side of another is 983 cm. What is the difference of their areas in sq. cm ?
 (A) 900660 (B) 966000
 (C) 960600 (D) 906600
- 25** What is the value of $\frac{(67.542)^2 - (32.458)^2}{75.458 - 40.374}$?
 (A) 1 (B) 10 (C) 100 (D) 1000
- 26** A room is of dimensions $6x$ feet in length and $4y$ feet in breadth. A table measuring $2x$ feet in length and y feet in breadth is in a corner of the room. Find the area of the room not occupied by the table.
 (A) $22xy$ sq feet (B) $24xy$ sq feet
 (C) $26xy$ sq feet (D) $20xy$ sq feet
- 27** Simplify $\frac{3(3x+4)}{2} + \frac{5(x-3)}{3} - \frac{3(2x-5)}{4}$.
 (A) $\frac{57x-56}{12}$ (B) $\frac{56x+57}{12}$
 (C) $\frac{57x+56}{12}$ (D) $\frac{56x-57}{12}$
- 28** If $x + y = 6$ and $3x - y = 4$ find the value of $x - y$.
 (A) -1 (B) 0 (C) 2 (D) 4
- 29** If the product of two numbers is 10 and their sum is 7, what is the larger of the two numbers ?
 (A) -2 (B) 2 (C) 5 (D) 4
- 30** Find the value of the product $\left(3 + \frac{5}{x}\right) \left(9 - \frac{15}{x} + \frac{25}{x^2}\right)$ at $x = 1$.
 (A) 150 (B) 148 (C) 152 (D) 146
- 31** The volume V , of a solid is given by the formula $V = \pi(R^2 - r^2)h$. Find the value of V , given that $R = 8$, $r = 5$, $h = 3\frac{1}{2}$ and $\pi = \frac{22}{7}$.
 (A) 393 (B) 429 (C) 492 (D) 294
- 32** The area A , of a solid is given by the formula $A = \pi r^2 + 2\pi rh + \pi rl$. Find the value of A given that $\pi = 3.142$, $r = 10$, $h = 3$ and $l = 4$.
 (A) 629 (B) 628.4 (C) 630 (D) 631

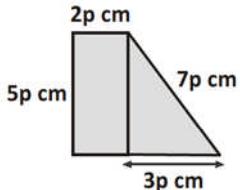
- 33** Mother bought some vegetables for ₹ x and some fruits for ₹ 3. If she gave ₹ 10, to the shopkeeper, how much change did she receive ?

(A) ₹ $(13 - x)$ (B) ₹ $(7 + x)$
 (C) ₹ $(13 + x)$ (D) ₹ $(7 - x)$

- 34** Ajit is 21 years younger than his father. What is their total age in 7 years time ?

(A) $(x + 28)$ years (B) $(x + 35)$ years
 (C) $(2x + 28)$ years (D) $(2x + 35)$ years

- 35** If the perimeter of the figure given is 57 cm, find the perimeter of the triangle in the figure.



(A) 30 cm (B) 45 cm (C) 39 cm (D) 3 cm



Previous Contest Questions

- 1** A concert hall with 1000 seats is completely filled with 'x' boys, 'y' girls and adults. Admission fee for an adult is ₹ 10 while a

child pays $\frac{1}{2}$ the price. Find in terms of 'x' and 'y', the total amount collected.

(A) ₹ $2(3000 + x + y)$
 (B) ₹ $(6000 - x - y)$
 (C) ₹ $(2000 - x - y)$
 (D) ₹ $5(2000 - x - y)$

- 2** A steel rod is cut into 3 pieces. The second piece is twice as long as the first piece while the third piece is 20 cm longer than the second piece. If the shortest piece is $2x$ cm, find the length of the rod in metres.

(A) $(x - 5)$ m (B) $(x + 5)$ m
 (C) $\left(\frac{x+2}{10}\right)$ m (D) $\left(x+\frac{1}{5}\right)$ m

- 3** Given that $T = \frac{2\pi l}{\sqrt{l^2 + g^2}}$, find the value of T if $\pi = 3.142$, $l = 7.89$ and $g = 9.81$. (Give your answer correct to 3 significant figures.)

(A) 3.94 (B) 394 (C) 39.4 (D) 4.39

- 4** If $2a - \frac{1}{2a} = 3$, evaluate $16a^4 + \frac{1}{16a^4}$.

(A) 123 (B) 119 (C) 117 (D) 121

- 5** A set of school uniform consists of a shirt and a pair of trousers for boys and a blouse and a skirt for girls. A shirt costs ₹ x and a pair of trousers costs ₹ 5 more. A blouse costs ₹ y and a skirt costs ₹ 3 more. A class has 40 pupils of which 25 are boys. Each pupil orders 2 sets of uniform. Find (in simplest form) in terms of x and y , the total amount in rupees paid by the pupils.

(A) $5x - 3y + 17$ (B) $5x + 3y + 17$
 (C) $5x + 3y - 17$ (D) $5x - 3y - 17$

- 6** If $\frac{17 - 3x}{5} - \frac{4x + 2}{3} = 5 - 6x + \frac{7x + 14}{3}$, find the value of 'x'.

(A) 2 (B) 4 (C) -4 (D) -2

- 7** Mohan has ₹ P . Naveen has 4 times as much money as Mohan. Also Naveen has ₹ 15 more than Mohan. How much money do they have altogether ?

(A) ₹ 20 (B) ₹ 5 (C) ₹ 15 (D) ₹ 25

- 8** If Sudhir will be 'x' years old in 3 years, how old was he 5 years ago ?

(A) $(x + 3)$ years (B) $(x - 8)$ years
 (C) $(x - 5)$ years (D) $(x - 3)$ years

- 9** 60 equally priced downloads cost ₹ x . How much do 9 downloads cost ?

(A) ₹ $\frac{20}{3x}$ (B) ₹ $\frac{9x}{20}$ (C) ₹ $\frac{20x}{3}$ (D) ₹ $\frac{3x}{20}$

- 10** If 'n' is a negative integer, which of the following must be a positive integer?

(A) $n + 2$ (B) $2n$
 (C) $n^2 - 5$ (D) $n^2 + 1$

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Visualising Solid Shapes

Synopsis

◆ **Geometrical shapes:**

Plane shapes have two measurements – length and breadth and therefore they are called two-dimensional shapes.

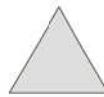
e.g.,



Square



Rectangle



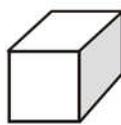
Triangle



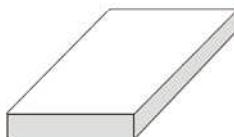
Circle

Solid objects have three measurements – length, breadth and height or depth. So, they are called three-dimensional shapes. Also, solids occupy some space.

e.g.,



Cube



Cuboid



Cone



Sphere



Rectangular prism



Square pyramid



Triangular prism

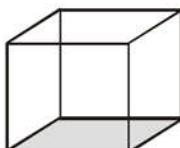
◆ **Description of solid shapes:**

S. No.	Solid Shape	Number of vertices	Number of edges	Number of faces
1.	Cube	8	12	6
2.	Cuboid	8	12	6
3.	Cone	1	1 curved edge	1 curved face, 1 flat face
4.	Cylinder	Nil	2 curved edges	2 flat faces, 1 curved face
5.	Sphere	Nil	Nil	1 curved face

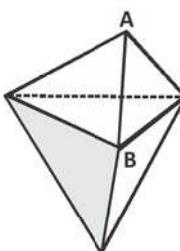
◆ **Polyhedron:**

- (i) A solid figure bounded by plane polygonal faces is called a polyhedron.
- (ii) The point at which three or more faces of a polyhedron intersect is called a vertex.
- (iii) A line along which two faces of a polyhedron intersect is called an edge.

◆ **Regular polyhedron:** A polyhedron with regular polygons as its faces is called a regular polyhedron. The same number of faces meet at each vertex.

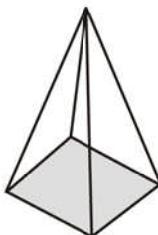


This polyhedron is regular. Its faces are congruent, regular polygons. Vertices are formed by the same number of faces.



This polyhedron is not regular. All the sides are congruent; but the vertices are not formed by the same number of faces. We see that three faces meet at A but four faces meet at B.

- ◆ **Convex polyhedron:** A polyhedron in which a line segment connecting any of its two vertices contains only points that are on a face or inside the polyhedron is called a convex polyhedron.
- ◆ **Prism:** A polyhedron with two parallel opposite faces, called bases, that are congruent polygons and the lateral faces are parallelograms is called a prism.
- ◆ **Pyramid:** A polyhedron whose base is a polygon and whose lateral faces are triangles with a common vertex is called a pyramid.

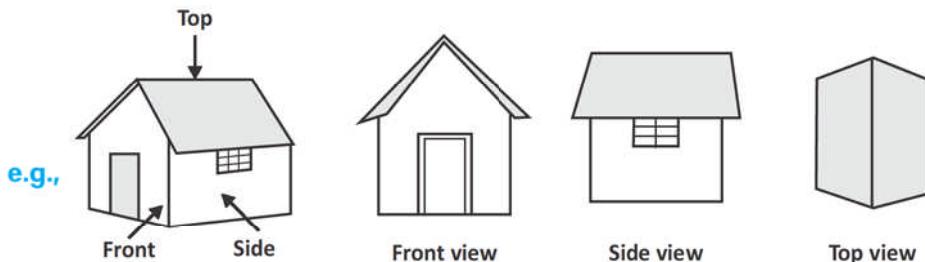


A prism or a pyramid is named after its base. If a prism has a hexagonal base, it is called a hexagonal prism. A pyramid with a triangular base is called a triangular pyramid.

- ◆ **Euler's formula for convex polyhedron:** For any convex polyhedron, the relation between its faces (F), vertices (V) and edges (E) is given by the following.

$$F + V = E + 2$$

- ◆ **Maps:** A map shows the location of a particular object/place in relation to other objects/places.
 - (i) We use symbols to depict different objects/places.
 - (ii) In a map, there is no reference or perspective.
 - (iii) Maps involve a scale that is fixed for a particular map.
- ◆ **Different views of 3-D objects:** 3-D objects appear differently from different positions so they can be drawn from different perspectives.



- ◆ **Net:** The 2-D figure of a 3-D shape or solid, which when folded gives the solid is called a net.

Multiple Choice Questions

A

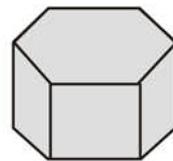
B

C

D



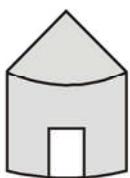
- 1** Which is the three-dimensional figure formed by rotating a triangle ?
 (A) Cone (B) Quadrilateral
 (C) Prism (D) Square
- 2** Which is/are three dimensional shapes?
 (A) Sphere (B) Cylinder
 (C) Cone (D) All of the above
- 3** What is the flat surface of a solid figure called ?
 (A) Vertex (B) Face
 (C) Edge (D) Solid
- 4** What is the number of flat surfaces of a cone ?
 (A) 1 (B) 2
 (C) 3 (D) 0
- 5** Of which shape are the faces of a cuboid ?
 (A) Square (B) Rectangle
 (C) Circle (D) Triangle
- 6** What is the the number of corners in a cone?
 (A) 1 (B) 2
 (C) 3 (D) 0
- 7** What is the number of corners in a cylinder ?
 (A) 1 (B) 2
 (C) 3 (D) 0
- 8** What do you call solid figures with line segments as their edges ?
 (A) Polygons (B) Squares
 (C) Cylinders (D) Polyhedrons
- 9** What is the difference between a rectangle and a cube ?
 (A) A rectangle is 3-dimensional and a cube is 2-dimensional.
 (B) A rectangle and a cube are both 2-dimensional.
 (C) A rectangle is 2-dimensional and a cube is 3-dimensional.
 (D) A rectangle and a cube are both 3-dimensional.
- 10** How many edges does a cuboid have ?
 (A) 6 (B) 12
 (C) 8 (D) 16
- 11** Of what shape are the bases of a cylinder?
 (A) Square (B) Rectangle
 (C) Circle (D) Triangle
- 12** Which of the following statements is false?
 (A) A sphere has one flat surface.
 (B) A cone has one flat face.
 (C) A cylinder has two circular faces.
 (D) A sphere has one curved face.
- 13** What does the following figure represent?



- (A) A polygon
 (B) A convex polyhedron
 (C) A cylinder
 (D) A pyramid

- 14** A rectangular photoframe is an example of which of the following ?
 (A) A rectangular path
 (B) A groove
 (C) A circular path
 (D) A cylindrical shell

15 What is the shape of the given tent ?



- (A) A cone surmounted on a cube.
- (B) A cylinder surmounted on a cube.
- (C) A cone surmounted on a cylinder.
- (D) A cylinder surmounted on a cone.

16 What is the shape of a sharpened pencil?



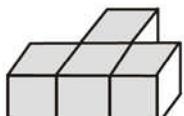
- (A) A cube surmounted on a cuboid.
- (B) A cone surmounted on a cylinder.
- (C) A triangle surmounted on a rectangle.
- (D) A triangle surmounted on a square.

17 Which of the following is the side view of a 5 kg weight given ?

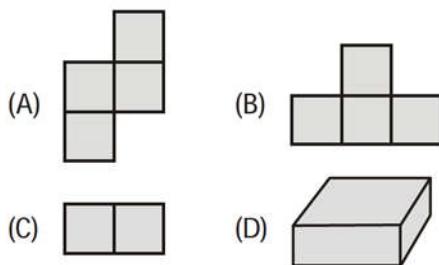


- (A)
- (B)
- (C)
- (D)

18 A solid is of the shape given.



Which is its top view ?



19 Which of the following objects has the given figure as the front view ?

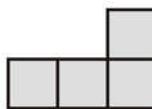


- (A) A T.V set
- (B) A car
- (C) A match box
- (D) An almirah

20 Observe the following solid.



The following box has a figure which is a view of the given solid.



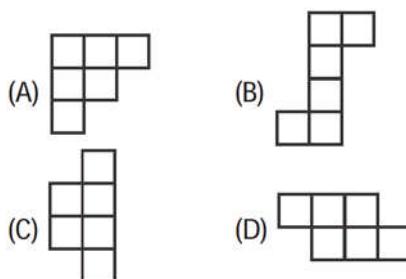
Which view of the solid is shown in the box?

- (A) Side view
- (B) Top view
- (C) Back view
- (D) Front view

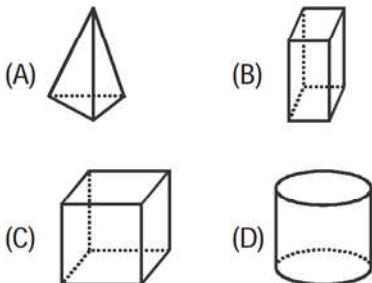
21 What is the shape of the top view of a die?

- (A) Cuboid
- (B) Square
- (C) Cube
- (D) Rectangle

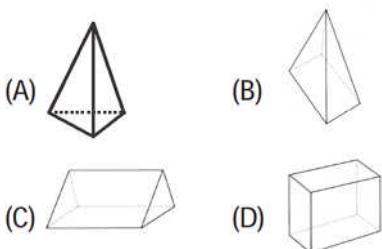
22 Which one of the following is the net of a cube ?



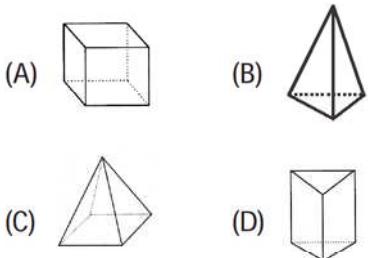
- 23** Which one of the following solids has a curved surface?



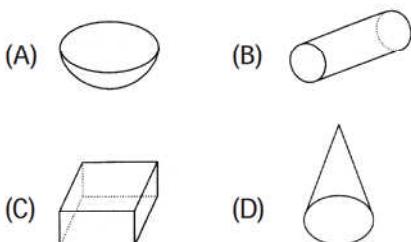
- 24** Which of the solids has the least number of faces?



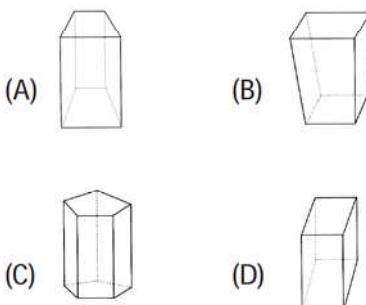
- 25** Identify the solid with no triangular faces.



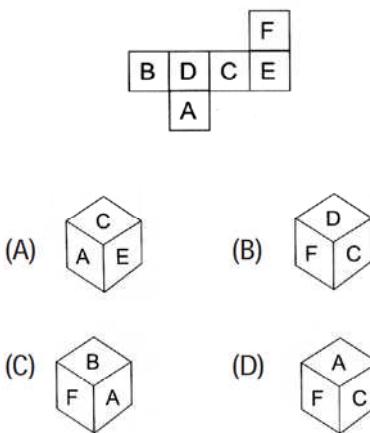
- 26** Which of these solids does not have any curved surface?



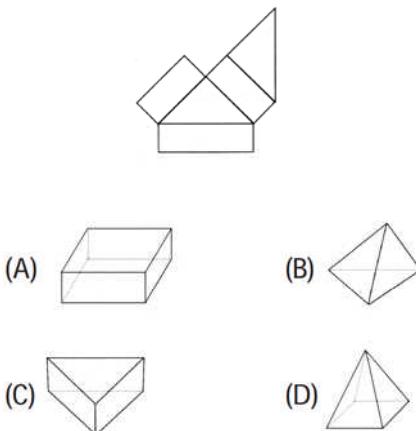
- 27** Which of the following has a base other than a quadrilateral?



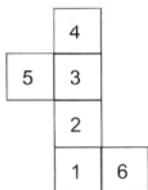
- 28** Which one of the following cubes can be formed by the net given?



- 29** Which one of the following solids can be formed by the net given?

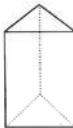


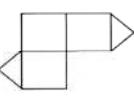
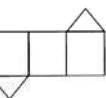
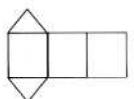
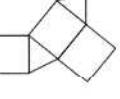
- 30** Which one of the following solids can be obtained by folding the net given ?



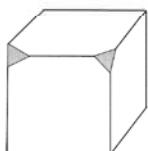
- (A)  (B) 
- (C)  (D) 

- 31** Which one of the following is not a net of the solid given ?



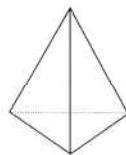
- (A)  (B) 
- (C)  (D) 

- 32** How many faces does the given solid have ?



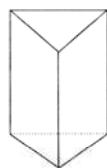
- (A) 6 (B) 4
(C) 8 (D) 12

- 33** Name the solid given in the figure.



- (A) Cuboid
(B) Square based prism
(C) Cube
(D) Triangular pyramid

- 34** Name the solid in the given figure.



- (A) Triangular prism (B) Cuboid
(C) Rectangular prism (D) Pyramid



Previous Contest Questions

- 1** Which of the following statements is true?
- (A) There is no difference between a cube and a cuboid.
(B) A cube has equal length, breadth and height whereas a cuboid has different measures for length, breadth and height.
(C) A cube has different measures for length, breadth and height and a cuboid has equal length, breadth and different height.
(D) A cube and a cuboid are both 2-dimensional figures.

- 2** Which of the given geometric solids has the maximum number of vertices ?
- (A) Cone (B) Cylinder
(C) Cuboid (D) Pyramid

3 If two cubes of dimensions $3\text{ cm} \times 3\text{ cm} \times 3\text{ cm}$ are placed side by side, what would the dimensions of the resulting cuboid be?

- (A) $6\text{ cm} \times 6\text{ cm} \times 6\text{ cm}$
- (B) $12\text{ cm} \times 12\text{ cm} \times 12\text{ cm}$
- (C) $9\text{ cm} \times 6\text{ cm} \times 3\text{ cm}$
- (D) $6\text{ cm} \times 3\text{ cm} \times 3\text{ cm}$

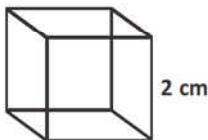
4 What solid do you get when you give a vertical cut to a brick of dimensions $5\text{ cm} \times 5\text{ cm} \times 10\text{ cm}$ along 10 cm side?

- (A) Cuboid
- (B) Cylinder
- (C) Cube
- (D) Triangle

5 What is a geometrical shape with no vertices and no flat surfaces called?

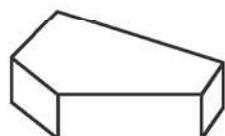
- (A) Sphere
- (B) Cone
- (C) Cylinder
- (D) Pyramid

6 What is the total length of edges of the following cube?

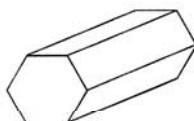


- (A) 24 cm
- (B) 30 cm
- (C) 32 cm
- (D) 36 cm

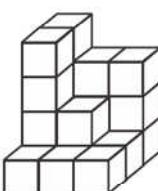
(7-9): Find the number of faces of solids shown in questions 7 to 9.



- (A) 4
- (B) 5
- (C) 6
- (D) 7

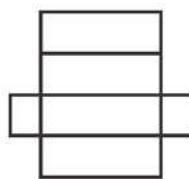
8

- (A) 8
- (B) 6
- (C) 6
- (D) 7

9

- (A) 12
- (B) 20
- (C) 13
- (D) 16

10 Name the solid that can be formed from the given net.



- (A) Cylinder
- (B) Cuboid
- (C) Cone
- (D) Cube

11 Name the solid that can be formed from the given net.



- (A) Square based pyramid
- (B) Cube
- (C) Cone
- (D) Triangular pyramid



Synopsis

- ◆ **Perimeter:** The length of the boundary of a plane figure is called its perimeter.
- ◆ **Area:** The amount of surface enclosed by a plane figure is called its area.
- ◆ **Rectangle:** Given a rectangle of length ' l ' units and breadth ' b ' units,
 - Perimeter of the rectangle = $2(l + b)$ units
 - Diagonal of the rectangle, $d = \sqrt{l^2 + b^2}$ units
 - Area of the rectangle = $(l \times b)$ sq. units
 - Length = $\left(\frac{\text{area}}{\text{breadth}} \right)$ units
 - Breadth = $\left(\frac{\text{area}}{\text{length}} \right)$ units
- ◆ **Area of four walls of room:** Let there be a room with length ' l ' units, breadth ' b ' units and height ' h ' units.
Then (i) Area of four walls = $2(l + b) \times h$ sq. units
(ii) Diagonal of room = $\sqrt{l^2 + b^2 + h^2}$ units
- ◆ **Perimeter and area of a square:** Let each side of a square be ' a ' units. Then
 - Perimeter of the square = $(4a)$ units
 - Diagonal of the square = $\sqrt{a^2 + a^2} = \sqrt{2a^2} = a\sqrt{2}$ units
 - Area of the square = a^2 sq. units
 - Area of the square = $\frac{1}{2} \times (\text{diagonal})^2$ sq. units
 - Side of the square = $\sqrt{\text{Area}}$ units
- ◆ **Perimeter and area of a triangle:**
 - Let ' a ', ' b ' and ' c ' be the lengths of sides of a triangle. Then, perimeter of the triangle is given by $(a + b + c)$ units.
$$s = \frac{1}{2} (a + b + c)$$
 is called semi-perimeter of the triangle.

(ii) Area of the triangle = $\sqrt{s(s-a)(s-b)(s-c)}$ sq. units

(iii) Let the base of a triangle be 'b' units and its corresponding height (or altitude) be 'h' units.

Then the area of the triangle = $\left(\frac{1}{2} \times b \times h\right)$ sq. units

Note: We may consider any side of the triangle as its base.

Then the corresponding height would be the length of the perpendicular to this side from the opposite vertex.

(iv) Area of an equilateral triangle with each side 'a' units = $\left(\frac{\sqrt{3}}{4} \times a^2\right)$ sq. units

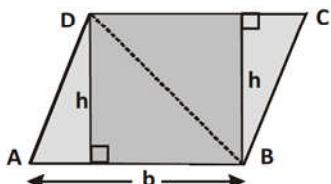
(v) Height of an equilateral triangle of side 'a' units = $\left(\frac{\sqrt{3}a}{2}\right)$ units

(vi) Area of a right triangle = $\frac{1}{2} \times (\text{product of legs})$ sq. units

Note: The sides containing the right angle are known as legs of a right triangle.

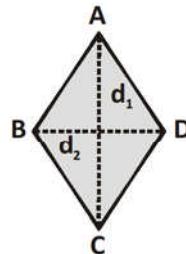
◆ **Area of a parallelogram:** Let ABCD be a parallelogram with base 'b' units and height 'h' units.

Then area of parallelogram = (base \times height) sq. units



◆ **Area of a rhombus:** Let ABCD be a rhombus in which diagonal AC = d_1 units and diagonal BD = d_2 units.

Then area of rhombus ABCD = $\left(\frac{1}{2} \times d_1 \times d_2\right)$ sq. units.

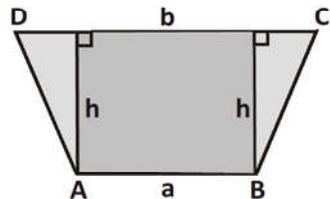


◆ **Area of a trapezium:** Let ABCD be a trapezium in which $AB \parallel DC$. Let AB be 'a' units and DC be 'b' units.

Then area of trapezium ABCD

$$= \frac{1}{2} \times (\text{sum of parallel sides}) \times \text{distance between them}$$

$$= \frac{1}{2} \times (a + b) \times h \text{ sq. units}$$



Note: Distance between the parallel sides = height

- ◆ **Circle:** A circle is a closed curve in a plane drawn in such a way that every point on this curve is at a constant distance (r units) from a fixed point O inside it.

The fixed point O is called the centre of the circle and the constant distance ' r ' is called the length of radius of the circle.

- ◆ **Circumference of a circle:** The perimeter of a circle is called its circumference. The length of the thread that goes around the circle exactly once gives the circumference of the circle.

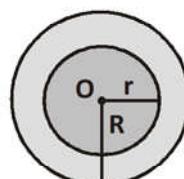
Circumference = $2\pi r = \pi d$, where r = radius and d = diameter

Here, π (Pi) is a constant.

Note: The approximate value of π is taken as $\frac{22}{7}$ or 3.14. However is not a rational number. It is an irrational number and is defined as the ratio of circumference of a circle to its diameter.

- ◆ **Area of a circle:** Area of a circle with radius ' r ' units is equal to πr^2 sq. units.
- ◆ **Area of a ring:** The region enclosed between two concentric circles of different radii is called a ring.

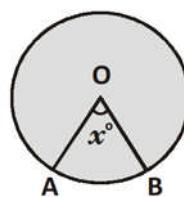
$$\text{Area of the ring} = (\pi R^2 - \pi r^2) \text{ sq. units} = \pi(R^2 - r^2) \text{ sq. units} \\ = \pi(R+r)(R-r) \text{ sq. units}$$



- ◆ **Length of arc of a circle:** Let A and B be any two points on a circle. The length of the thread that will wrap along this arc from A to B is the length of AB written as \widehat{AB} .

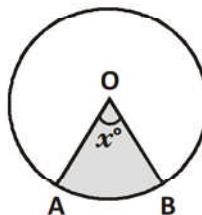
In a circle of radius ' r ', we have

$$\frac{l(\widehat{AB})}{\text{Circumference}} = \frac{x^\circ}{360^\circ} \text{ or } l(\widehat{AB}) = \frac{2\pi r x^\circ}{360^\circ}$$



- ◆ **Area of a sector:** A sector of a circle is the region enclosed by an arc of a circle and two radii to its end points.

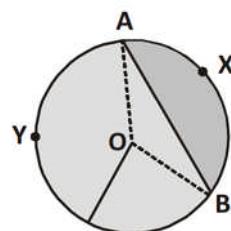
Area of sector = $\frac{x^\circ}{360^\circ} \times \pi r^2$ where ' x ' is sector angle and ' r ' is the radius of circle.



- ◆ **Segment of a circle:** A segment of a circle is the region enclosed by an arc of the circle and its chord.

Area of minor segment AXB = area of sector $OAXB$ - area of $\triangle OAB$

Area of major segment AYB = area of circle - area of minor segment AXB



- ◆ **Volume:** The space occupied by a solid body is called its volume.
The units of volume are cubic centimetres (cm^3) or cubic metres (m^3) etc.
- ◆ **Cuboid:** A solid bounded by six rectangular plane faces is called a cuboid.
For a cuboid of length ' l ' units, breadth ' b ' units and height ' h ' units,
 - Volume of the cuboid = $(l \times b \times h)$ cubic units
 - Diagonal of the cuboid = $\sqrt{l^2 + b^2 + h^2}$ units
 - Total surface area of the cuboid = $2(lb + bh + lh)$ sq. units
 - Lateral surface area of the cuboid = $[2(l + b) \times h]$ sq. units
 - Area of 4 walls of a room = $[2(l + b) \times h]$ sq. units
- ◆ **Cube:** A cuboid whose length, breadth and height are all equal is called a cube.
For a cube of edge ' a ' units,
 - Volume of the cube = a^3 cubic units
 - Diagonal of the cube = $a\sqrt{3}$ units
 - Total surface area of the cube = $(6a^2)$ sq. units
 - Lateral surface area of the cube = $(4a^2)$ sq. units

Relation between units	
Units of length	Units of Volume
$1 \text{ cm} = 10 \text{ mm}$	$1 \text{ cm}^3 = 1000 \text{ mm}^3$
$100 \text{ cm} = 1 \text{ m}$	$1 \text{ m}^3 = 1000000 \text{ cm}^3$
	$1 \text{ litre} = 1000 \text{ cm}^3$
	$1 \text{ kilolitre} = 1000 \text{ litres} = 1 \text{ m}^3$

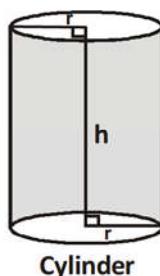
- ◆ **Cylinder:** A solid having a curved surface and a uniform circular cross-section is known as a cylinder.

Note: If the axis of the cylinder is perpendicular to each cross-section, the cylinder is called a right circular cylinder.

- ◆ **Volume of a cylinder:** For a cylinder whose height is ' h ' units and the radius of base is ' r ' units,
 - Volume of cylinder = $(\pi r^2 h)$ cubic units = (base area) \times height
 - Area of curved surface = $(2 \pi r h)$ sq. units
 - Total surface area = $(2 \pi r h + 2 \pi r^2)$ sq. units
 = $2 \pi r (h + r)$ sq. units

Volume and Capacity are similar words

- Volume is the amount of space occupied by an object.
- Capacity is the quantity that a container holds.



Multiple Choice Questions

A

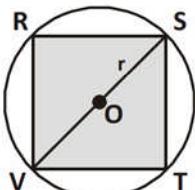
B

C

D



- 1** The area of a rhombus is 28 cm^2 and one of its diagonals is 4 cm. Find its perimeter.
 (A) $4\sqrt{53} \text{ cm}$ (B) 36 cm
 (C) $2\sqrt{53} \text{ cm}$ (D) 44 cm
- 2** The area of a trapezium is 28 cm^2 and one of its parallel sides is 6 cm. If its altitude is 4 cm, find its other parallel side.
 (A) 4 cm (B) 8 cm
 (C) 6 cm (D) 10 cm
- 3** The perimeter of a trapezium is 52 cm and its non-parallel sides are each equal to 10 cm. If its altitude is 8 cm, what is its area?
 (A) 128 cm^2 (B) 112 cm^2
 (C) 118 cm^2 (D) 124 cm^2
- 4** A man bought a rectangular field of length 144 m and width 64 m. In exchange for this field he wanted to buy a square field of the same area. What would the side of the square field be?
 (A) 104 m (B) 208 m
 (C) 96 m (D) 416 m
- 5** The area of a parallelogram is 120 cm^2 and its altitude is 10 cm. Find the length of the base.
 (A) 24 cm (B) 12 cm
 (C) 8 cm (D) 4 cm
- 6** What is the area of an isosceles triangle having base 'x' cm and one side 'y' cm?
 (A) $\frac{x}{2}\sqrt{y^2 + \frac{x^2}{4}} \text{ cm}^2$ (B) $\frac{x}{2}\sqrt{\frac{4y^2 - x^2}{4}} \text{ cm}^2$
 (C) $\frac{x^2 - y^2}{4} \text{ cm}^2$ (D) $\frac{x^2 + y^2}{4} \text{ cm}^2$
- 7** What is the length of the diagonal of a square whose area is 16900 m^2 ?
 (A) 130 m (B) $130\sqrt{2} \text{ m}$
 (C) 169 m (D) 144 m
- 8** The sides of a triangle are 3 cm, 5 cm and 4 cm. What is its area?
 (A) 6 cm^2 (B) 7.5 cm^2
 (C) $5\sqrt{2} \text{ cm}^2$ (D) 10 cm^2
- 9** The base of an isosceles right triangle is 30 cm. Find its area.
 (A) 225 cm^2 (B) $225\sqrt{3} \text{ cm}^2$
 (C) $5\sqrt{2} \text{ cm}^2$ (D) $6\sqrt{3} \text{ cm}^2$
- 10** The sides of a triangle are 16 cm, 30 cm and 34 cm. What is its area ?
 (A) 120 cm^2 (B) 260 cm^2
 (C) 240 cm^2 (D) 272 cm^2
- 11** The adjacent sides of a parallelogram are 8 cm and 9 cm. The diagonal joining the ends of these sides is 13 cm. Calculate the area of the parallelogram.
 (A) 72 cm^2 (B) $12\sqrt{35} \text{ cm}^2$
 (C) $24\sqrt{35} \text{ cm}^2$ (D) 150 cm^2
- 12** The sides of a triangle are 11 cm, 15 cm and 16 cm. What is the measure of the altitude to the largest side ?
 (A) $30\sqrt{7} \text{ cm}$ (B) 30 cm
 (C) $\frac{15\sqrt{7}}{4} \text{ cm}$ (D) $\frac{15\sqrt{7}}{2} \text{ cm}$
- 13** The perimeter of a triangular field is 144 m and the ratio of its sides is 3 : 4 : 5. What is the area of the field?
 (A) 864 m^2 (B) 468 m^2
 (C) 824 m^2 (D) 486 m^2
- 14** A rectangular field has its length and breadth in the ratio 5 : 3. Its area is 3.75 hectares. Find the cost of fencing it at ₹5 per metre.
 (A) ₹400 (B) ₹4000
 (C) ₹1000 (D) ₹500

- 15** What is the percentage change in the area of a rectangle obtained by decreasing its length and increasing its breadth by 5%?
 (A) 2.5% increase
 (B) 0.25% increase
 (C) 0.25% decrease
 (D) 2.5% decrease
- 16** Find the area of the sector of a circle, whose radius is 6 m when the angle at the centre is 42° .
 (A) 13.2 m^2 (B) 14.2 m^2
 (C) 13.4 m^2 (D) 14.4 m^2
- 17** If the radius of a circle is $\frac{7}{\sqrt{\pi}}$ cm, what is the area of the circle?
 (A) 154 cm^2 (B) $\frac{49}{\pi} \text{ cm}^2$
 (C) 22 cm^2 (D) 49 cm^2
- 18** Find the area of a segment of a circle of radius 21 cm if the arc of the segment has a measure of 60° . (Take $\sqrt{3} = 1.73$.)
 (A) 45.27 cm^2 (B) 40.8 cm^2
 (C) 40.27 cm^2 (D) 42.07 cm^2
- 19** An aquarium is in the form of a cuboid whose external measures are $80 \text{ cm} \times 30 \text{ cm} \times 40 \text{ cm}$. The base, side faces and back face are to be covered with a coloured paper. Find the area of the paper needed.
 (A) 2000 cm^2 (B) 8000 cm^2
 (C) 3000 cm^2 (D) 1000 cm^2
- 20** A rectangular piece of paper $11 \text{ cm} \times 4 \text{ cm}$ is folded without overlapping to make a cylinder of height 4 cm. Find the volume of the cylinder.
 (A) 38.5 cm^3 (B) 40.5 cm^3
 (C) 41.5 cm^3 (D) 42.5 cm^3
- 21** In a building, there are 24 cylindrical pillars. The radius of each pillar is 28 cm and height is 4 m. Find the total cost of painting the curved surface area of all pillars at the rate of ₹ 8 per m^2 .
 (A) ₹ 1352.68 (B) ₹ 1351.68
 (C) ₹ 1353.68 (D) ₹ 1340.68
- 22** A sector of 120° cut out from a circle has an area of $9\frac{3}{7} \text{ sq. cm}$. What is the radius of the circle?
 (A) 3 cm (B) 2.5 cm
 (C) 3.5 cm (D) 3.6 cm
- 23** Find the radius of the cylinder whose lateral surface area is 704 cm^2 and height is 8 cm.
 (A) 6 cm (B) 4 cm
 (C) 8 cm (D) 14 cm
- 24** In the figure given, RSTV is a square inscribed in a circle with centre O and radius 'r'. What is the total area of unshaded region?
- 
- (A) $r^2(\pi - 2) \text{ sq. units}$
 (B) $2r(2 - \pi) \text{ sq. units}$
 (C) $\pi(r^2 - 2) \text{ sq. units}$
 (D) $(\pi r^2 - 8r) \text{ sq. units}$
- 25** The dimensions of a hall are 40 m, 25 m and 20 m. If each person requires 200 cubic metres of space, how many persons can be accommodated in the hall?
 (A) 120 (B) 150
 (C) 140 (D) 100
- 26** Three cylinders each of height 16 cm and radius of base 4 cm are placed on a plane so that each cylinder touches the other two. What is the volume of the region enclosed between the three cylinders?
 (A) $98(4\sqrt{3} - \pi) \text{ cm}^3$
 (B) $98(2\sqrt{3} - \pi) \text{ cm}^3$
 (C) $98(\sqrt{3} - \pi) \text{ cm}^3$
 (D) $128(2\sqrt{3} - \pi) \text{ cm}^3$

- 27** From a cuboid measuring 7 cm by 8 cm by 9 cm, a cube of side 5 cm is cut. What is the volume of the remaining cuboid?

(A) 397 cm^3 (B) 389 cm^3
 (C) 398 cm^3 (D) 379 cm^3

- 28** A stone of volume 36 cm^3 is placed in a rectangular tank measuring 8 cm by 6 cm by 5 cm. A student wants to fill the tank with water to a height of 4 cm. What is the volume of water needed?

(A) 218 cm^3 (B) 156 cm^3
 (C) 228 cm^3 (D) 192 cm^3

- 29** An empty tank was $\frac{2}{5}$ full after 1.5 l of water was poured in it. The base area of the tank was 250 cm^2 . What was the height of the tank?

(A) 15 cm (B) 5 cm
 (C) 4 cm (D) 8 cm

- 30** A cuboid measuring 20 cm by 10 cm by 4 cm is constructed using 2 cm cubes. How many cubes were needed?

(A) 200 (B) 300
 (C) 100 (D) 150

- 31** What is the volume of a cylindrical container with base radius 5 cm and height 20 cm? (Take $\pi = 3.14$.)

(A) 157 l (B) 1.57 l
 (C) 1570 l (D) 15.7 l

- 32** What is the height of a cuboid of volume 216 cm^3 if its length and breadth measure 8 cm and 6 cm?

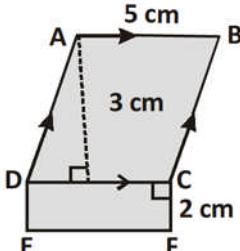
(A) 4.5 m (B) 6 m
 (C) 4.8 m (D) 9 m

- 33** A tank with a square base has a volume of 384 cm^3 . If its height is 6 cm, find the length of the side of the square base.

(A) 10 cm (B) 8 cm
 (C) 12 cm (D) 6 cm

Previous Contest Questions

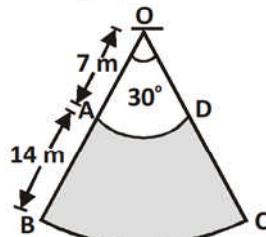
- 1** In the figure given, ABCD is a parallelogram and CDEF is a rectangle.



What is the total area of the figure?

(A) 35 cm^2 (B) 30 cm^2
 (C) 25 cm^2 (D) 20 cm^2

- 2** What is the area of the shaded region in the following figure?



(A) 51.33 cm^2 (B) 102.7 cm^2
 (C) 205.34 cm^2 (D) 108.6 cm^2

- 3** If the areas of three adjacent faces of a rectangular block are in the ratio of $2:3:4$ and its volume is 9000 cm^3 , what is the length of the shortest side?

(A) 10 cm (B) 15 cm
 (C) 20 cm (D) 30 cm

- 4** Two cylinders of equal volume have their heights in the ratio $2:1$. What is the ratio of their radii?

(A) $2:1$ (B) $1:2$
 (C) $\sqrt{2}:1$ (D) $1:\sqrt{2}$

- 5** A well is to be dug 20 m deep, 2.25 m inside diameter, with a brick lining of 0.35 m thickness. What is the amount of brick work done?

(A) 14.75 m^3 (B) 57.2 m^3
 (C) 136.75 m^3 (D) 572 m^3

- 6** A rectangular sheet of paper, $36\text{ cm} \times 22\text{ cm}$, is rolled along its length to form a cylinder. Find the volume of the cylinder so formed.
- (A) 2268 cm^3 (B) 226.8 cm^3
 (C) 226 cm^3 (D) 23.4 cm^3
- 7** A wooden box (open at the top) of thickness 0.5 cm , length 21 cm , width 11 cm and height 6 cm is painted on the inside. The expense for painting is ₹ 70. What is the rate of painting per square centimetre?
- (A) ₹ 0.7 (B) ₹ 0.5
 (C) ₹ 0.1 (D) ₹ 0.2
- 8** If each edge of a cube is increased by 25%, what is the percentage increase in its surface area?
- (A) 25% (B) 48.75%
 (C) 50% (D) 56.25%
- 9** How many cubes of side 4 cm can fill a rectangular box measuring $60\text{ cm} \times 40\text{ cm} \times 24\text{ cm}$?
- (A) 900 (B) 90
 (C) 3600 (D) 600
- 10** A pit 10 m long and 2 m wide is filled with 4.8 m^3 of sand. What is the depth of the pit?
- (A) 14 cm (B) 2.4 cm
 (C) 24 cm (D) 12 cm
- 11** The capacity of a cup is 300 mL . The capacity of a jug is twice that of a cup. What is the capacity of 3 cups and 3 jugs?
- (A) 2.7 L (B) 2700 L
 (C) 27 L (D) 270 L
- 12** The volume of a cube is 512 cm^3 . After a smaller cube is cut off from it, its volume is 448 cm^3 . What is the length of each side of the smaller cube?
- (A) 6 cm (B) 7 cm
 (C) 9 cm (D) 4 cm



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Exponents and Powers

Synopsis

- ◆ **Exponential equation:** An equation which has an unknown quantity as an exponent is called an exponential equation.

e.g., (i) $5^x = 625$

$$(ii) 3^{x-5} = 1$$

Note: If $ax = ay$, then $x = y$.

- ◆ **Standard form of numbers:** A number written in the form $(m \times 10^n)$ is said to be in standard form if 'm' is a decimal number between 1 and 9 and 'n' is either a positive or a negative integer.

Very large numbers and very small numbers are expressed in standard form.

- ◆ **Laws of exponents (Integers):** For any two non-zero integers 'a' and 'b', and any integers 'm' and 'n', the following laws hold good.

$$(i) a^m \times a^n = a^{m+n}$$

$$(v) (a^m)^n = a^{mn}$$

$$(ii) \frac{a^m}{a^n} = a^{m-n} \quad (m > n)$$

$$(vi) a^m \times b^m = (ab)^m$$

$$(iii) \frac{a^m}{a^n} = \frac{1}{a^{n-m}} \quad (m < n)$$

$$(vii) \frac{a^m}{b^m} = \left(\frac{a}{b}\right)^m$$

$$(iv) \frac{a^m}{a^n} = a^0 \quad (m = n)$$

$$(viii) a^0 = 1$$

- ◆ **Positive integral exponent of a rational number:** For any rational number $\frac{a}{b}$ and a positive integer 'n', $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$.

$$\text{positive integer 'n', } \left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}.$$

- ◆ **Negative integral exponent of a rational number:** For any rational number $\frac{a}{b}$ and a positive integer 'n', $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$.

$$\text{positive integer 'n', } \left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n.$$

- ◆ **Zero exponent of a rational number:** For any rational number $\frac{a}{b}$ and '0', $\left(\frac{a}{b}\right)^0 = 1$.

- ◆ **Special case of a^n :**

$a^n = 1$ only if $n = 0$ for any 'a' except $a = 1$ or $a = -1$.

For $a = 1$,

$1^1 = 1^2 = 1^3 = 1^{-2} = \dots = 1$ or $(1)^n = 1$ for infinitely many 'n'.

For $a = -1$,

$(-1)^0 = (-1)^2 = (-1)^4 = (-1)^{-2} = \dots = 1$ or $(-1)^p = 1$ for any even integer 'p', and $(-1)^q = (-1)$ for any odd integer 'q'.

- ◆ **Laws of exponents (Rational numbers):** Let $\frac{a}{b}$ and $\frac{c}{d}$ be any two rational numbers, and 'm' and 'n' be any integers. Then,

$$(i) \quad \left(\frac{a}{b}\right)^m \times \left(\frac{a}{b}\right)^n = \left(\frac{a}{b}\right)^{m+n} \quad (iv) \quad \left(\frac{a}{b} \times \frac{c}{d}\right)^n = \left(\frac{a}{b}\right)^n \times \left(\frac{c}{d}\right)^n \text{ and } \left\{\left(\frac{a}{b}\right)\right\}^n = \frac{(a/b)^n}{(c/d)^n}$$

$$(ii) \quad \left(\frac{a}{b}\right)^m \div \left(\frac{a}{b}\right)^n = \left(\frac{a}{b}\right)^{m-n} \quad (v) \quad \left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n, \text{ where 'n' is a positive integer.}$$

$$(iii) \quad \left\{\left(\frac{a}{b}\right)^m\right\}^n = \left(\frac{a}{b}\right)^{mn} \quad (vi) \quad \left(\frac{a}{b}\right)^0 = 1$$

Multiple Choice Questions

1 What is the value of $(3^0 - 4^0) \times 5^{-3}$?

- (A) 25 (B) 0
(C) -25 (D) -125

2 What is the solution of $3^{3x-5} = \frac{1}{9^x}$?

- (A) $\frac{5}{2}$ (B) 5 (C) 1 (D) $\frac{7}{3}$

3 Find the value of $\left[(-3)^{(-2)}\right]^{(-3)}$.

- (A) 729 (B) 32
(C) 64 (D) -729

4 Evaluate: $\left(\frac{16}{81}\right)^{\frac{3}{4}}$

- (A) $\frac{9}{2}$ (B) $\frac{2}{9}$ (C) $\frac{8}{27}$ (D) $\frac{27}{8}$

5 What is the value of $(512)^{-\frac{2}{9}}$?

- (A) $\frac{1}{2}$ (B) 2 (C) 4 (D) $\frac{1}{4}$

6 Simplify $(32)^{-\frac{2}{5}} \div (125)^{-\frac{2}{3}}$.

- (A) $\frac{4}{25}$ (B) $\frac{25}{4}$ (C) $\frac{2}{5}$ (D) $\frac{5}{2}$

7 If $x^y = y^x$, find the value of $\left(\frac{x}{y}\right)^{\frac{x}{y}}$.

- (A) x^y (B) x^{y-1}

- (C) x^x (D) x^{x-1}

8 Evaluate $\frac{(5)^{0.25} \times (125)^{0.25}}{(256)^{0.10} \times (256)^{0.15}}$.

- (A) $\frac{\sqrt{5}}{2}$ (B) $\frac{5}{4}$
(C) $\frac{25}{2}$ (D) $\frac{25}{16}$

9 What is the value of

$$\frac{(67.542)^2 - (32.458)^2}{75.458 - 40.374}?$$

- (A) 1 (B) 10
(C) 100 (D) -10

10 Which of the following values are equal?

- | | |
|------------|-----------|
| I. 1^4 | II. 4^0 |
| III. 0^4 | IV. 4^1 |

- (A) I and II (B) II and III
(C) I and III (D) I and IV

11 Find the sum of the powers of the prime factors in 108×192 .

- (A) 5 (B) 7
(C) 8 (D) 12

12 Find the value of $3\sqrt[3]{2} \times 7\sqrt[3]{6} \times 5\sqrt[3]{18}$.

- (A) 545 (B) 500
(C) 630 (D) 360

13 Find the value of

$$(-3)^0 - (-3)^3 - (-3)^{-1} + (-3)^4 - (-3)^{-2}.$$

- (A) $109\frac{2}{9}$ (B) $102\frac{2}{9}$

- (C) 109 (D) 110

14 Evaluate

$$\frac{(-1)^{13}}{2^3} + \frac{2^3 - 1^{10} + 3^2}{3^2 - 2^2} + \left(\frac{7}{11}\right)^3 \div \frac{98}{121}.$$

- (A) $3\frac{173}{440}$ (B) $3\frac{17}{44}$

- (C) $3\frac{137}{440}$ (D) $3\frac{21}{440}$

15 If $(25)^x = (125)^y$, find $x : y$.

- (A) 1 : 1 (B) 2 : 3
(C) 3 : 2 (D) 1 : 3

16 Compute $\frac{(64)^{-1/6} \times (216)^{-1/3} \times (81)^{1/4}}{(512)^{-1/3} \times (16)^{1/4} \times (9)^{-1/2}}$.

- (A) 3 (B) 6 (C) 1 (D) -6

17 What is the simplified form of

$$\left[\sqrt[3]{x^4y} \times \frac{1}{\sqrt[4]{x^2y^8}} \right]^6 ?$$

- (A) $x^5.y^{10}$ (B) $\frac{y^{10}}{x^5}$
 (C) $\frac{y^2}{x}$ (D) $\frac{x^5}{y^5}$

18 Find the value of $\frac{1}{1+x^{-m}} + \frac{1}{1+x^m}$.

- (A) 0 (B) x^m (C) 1 (D) x^{-m}

19 Give the simplified form of $\frac{3^a 4^{a-2} 25^{a+1}}{9^{a-1} 2^{a+1} 5^{a-2}}$.

- (A) $3^{a-2} \cdot 2^{a-5} \cdot 5^{a+4}$ (B) $2^{a-5} \cdot 3^{a+2} \cdot 5^{a+4}$
 (C) $2^{a+5} \cdot 3^{-a+2} \cdot 5^{a+4}$ (D) $2^{a-5} \cdot 3^{a-2} \cdot 5^{a+4}$

20 Which is greater of 2^{12} and 3^8 ?

- (A) 3^8 (B) 2^{12}
 (C) Both are equal.
 (D) Cannot be compared.

21 What is the simplified form of

$$\frac{(x^{a+b})^3 \cdot (x^{b+c})^3 \cdot (x^{c+a})^3}{(x^a \cdot x^b \cdot x^c)^6} ?$$

- (A) 0 (B) 1
 (C) x^{a+b+c} (D) x

22 If $3^n = 729$, find the value of $3^{3n} + 1$.

- (A) 3^{21} (B) 3^{10} (C) 3^{19} (D) 3^{15}

23 If $27^{x+1} = 9^{x+3} = 3^y$, find the respective values of 'x' and 'y'.

- (A) 3 and 12 (B) 12 and 3
 (C) 6 and 6 (D) 4 and 9

24 Find $(0.000064)^{5/4} \times (0.04)^{5/4}$.

- (A) $2^{10} \cdot 10^{10}$ (B) $2^{10} \cdot 10^{-10}$
 (C) $2^{-10} \cdot 10^{10}$ (D) $2^{-10} \cdot 10^{-10}$

25 By what number should we multiply 4^{-3} so that the product may be equal to 64?

- (A) 4^5 (B) 2^{12} (C) 2^6 (D) 1

26 What is the number to be multiplied by $(-7)^{-1}$ so as to get 10^{-1} as the product?

- (A) $\frac{-7}{10}$ (B) $\frac{7}{10}$ (C) $\frac{9}{10}$ (D) $\frac{-3}{10}$

27 What is the value of $(6^{-1} - 8^{-1}) + (2^{-1} - 3^{-1})^{-1}$?

- (A) 25 (B) 30 (C) 35 (D) 40

28 What is the standard form of 6020000000000000?

- (A) 6.02×10^{15} (B) 6.02×10^{13}
 (C) 602×10^{13} (D) 602×10^{-15}

29 What is the usual form of 1.0001×10^9 ?

- (A) 100010000
 (B) 1000100000
 (C) 10001000000000
 (D) 10001000000

30 The size of a plant cell is 0.00001275 m. Express this size in standard form.

- (A) 1.25×10^8 m
 (B) 1.275×10^5 m
 (C) 1.275×10^{-8} m
 (D) 1.275×10^{-5} m

31 Evaluate $\left\{ \left(\frac{3}{4} \right)^{-1} - \left(\frac{1}{4} \right)^{-1} \right\}^{-1}$.

- (A) $\frac{3}{16}$ (B) $\frac{-3}{8}$ (C) $\frac{16}{3}$ (D) $\frac{-8}{3}$

32 A box has 5 books, each 20 mm thick and 5 cards each 0.016 mm thick. What is the total thickness?

- (A) 1.0008×10^4 mm
 (B) 1.008×10^3 mm
 (C) 1.0008×10^2 mm
 (D) 1.0008×10^5 mm

- 33** The size of a red blood cell is 0.000007 m. The size of a plant cell is 0.00001275 m. Compare them.

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) $\frac{1}{5}$ (D) $-\frac{1}{5}$

- 34** By what number should $(-8)^{-1}$ be divided to get 10^{-1} ?

(A) $\frac{4}{5}$ (B) $-\frac{5}{4}$ (C) $-\frac{4}{5}$ (D) $\frac{5}{4}$



Previous Contest Questions

- 1** What is the value of $\left(\frac{-1}{216}\right)^{-2/3}$?

(A) 36 (B) -36
(C) $\frac{1}{36}$ (D) $-\frac{1}{36}$

- 2** Evaluate:

$$\frac{1}{(216)^{-2/3}} + \frac{1}{(256)^{-3/4}} + \frac{1}{(32)^{-1/5}}.$$

(A) 102 (B) 105
(C) 107 (D) 109

- 3** How much is $[10^{150} \div 10^{146}]$?

(A) 1000 (B) 10000
(C) 100000 (D) 10^6

- 4** Evaluate the product $5^{1/4} \times (125)^{0.25}$.

(A) $\sqrt{5}$ (B) 5 (C) $5\sqrt{5}$ (D) 25

- 5** How much is $(0.04)^{-1.5}$?

(A) 25 (B) 125
(C) 250 (D) 625

- 6** What is the value of $(8^{-25} - 8^{-26})$?

(A) 7×8^{-25} (B) 8×8^{-26}
(C) 7×8^{-26} (D) 8×8^{-25}

- 7** If $(25)^{7.5} \times (5)^{2.5} \div (125)^{1.5} = 5^x$, find 'x'.

(A) 8.5 (B) 13
(C) 16 (D) 17.5

- 8** What is the value of 'x' if $\frac{a^x}{a^y} = a^{10}$ and $(a^y)^3 = a^x$ for $a > 1$?

(A) 25 (B) 5 (C) 20 (D) 15

- 9** If $x > 0$, which of the following is equal to $\sqrt{x^3}$?

- (i) $x + x^{1/2}$
(ii) $(x^{1/2})^3$
(iii) $(x^2)(x)^{-1/2}$

(A) (ii) and (iii) only
(B) (i) and (ii) only
(C) (i) and (iii) only
(D) (i), (ii) and (iii)

- 10** If $x^2 = 16$ and $y^2 = 4$, what is the greatest possible value of $(x - y)^2$?

(A) 4 (B) -36
(C) -4 (D) 36

- 11** If $\sqrt{5} = x - 2$, what is the value of $(x - 2)^3$?

(A) $\sqrt{25}$ (B) $\sqrt{65}$
(C) $5\sqrt{5}$ (D) $2\sqrt{5}$



Synopsis**◆ Unitary method:**

A method in which the value of a quantity is first obtained to find the value of any required quantity is called unitary method.

◆ Direct proportion:

- Two quantities x and y are said to be in direct proportion if they increase (decrease) together in such a manner that the ratio of their corresponding values remains constant.
- That is, if $\frac{x}{y} = k$ [k is a positive number], then x and y are said to vary directly. In such a case if y_1 and y_2 are the values of y corresponding to the values x_1 and x_2 of x respectively then $\frac{x_1}{y_1} = \frac{x_2}{y_2}$.

Examples:

- As the number of articles increases, their cost increases. Cost is directly proportional to the number of articles.
- The more the number of men, the more work is done in a given time. Work done is directly proportional to the number of men working at it.

◆ Inverse proportion:

- Two quantities x and y are said to be in inverse proportion if an increase in x causes a proportional decrease in y (and vice-versa) in such a manner that the product of their corresponding values remains constant.
- That is, if $xy = k$, then x and y are said to vary inversely. In this case, if y_1 and y_2 are the values of y corresponding to the values x_1 and x_2 of x respectively then $x_1 y_1 = x_2 y_2$ or $\frac{x_1}{x_2} = \frac{y_2}{y_1}$.

Examples:

- The more men employed, the less time it takes to complete a given work. The time taken to finish a work is inversely proportional to the number of persons working at it.
- If speed of car is increased, time taken to cover a given distance decreases. The time taken by any vehicle in covering a certain distance is inversely proportional to the speed of the vehicle.

Multiple Choice Questions



- 1 Observe the given table.

x	4	6	8	10	12
y	8	12	16	20	24

What can be said about x and y ?

- (A) x and y are directly proportional.
 (B) x is inversely proportional to y .
 (C) y is inversely proportional to x .
 (D) There is no proportionality between x and y .

- 2 A van covers 432 km with 36 litres of diesel. How much distance would it cover with 25 litres of diesel?

- (A) 200 km (B) 300 km
 (C) 100 km (D) 350 km

- 3 A photograph of a type of bacteria enlarged 50000 times attains a length of 5 cm. What is the actual length of bacteria?

- (A) 1000 cm (B) 10^{-3} cm
 (C) 10^{-4} cm (D) 10^{-2} cm

- 4 If the cost of 27 bags of paddy is ₹ 9450, what is the cost of 36 bags of paddy?

- (A) ₹ 12000 (B) ₹ 12600
 (C) ₹ 16200 (D) ₹ 10620

- 5 The scale of a map is $1 : 3 \times 10^7$. Two cities are 5 cm apart on the map. Find the actual distance between them in kilometres.

- (A) 1500 km (B) 1000 km
 (C) 1100 km (D) 2000 km

- 6 A train is moving at a uniform speed of 75 km/hr. How far will it travel in 36 minutes?

- (A) 60 km (B) 40 km
 (C) 50 km (D) 45 km

- 7 If x and y are directly proportional, find the respective values of x_1 , x_2 and y_1 in the table given.

x	3	x_1	x_2	10
y	30	50	80	y_1

- (A) $x_1 = 8$; $x_2 = 2$; $y_1 = 100$
 (B) $x_1 = 5$; $x_2 = 8$; $y_1 = 100$
 (C) $x_1 = 2$; $x_2 = 8$; $y_1 = 100$
 (D) $x_1 = 5$; $x_2 = 8$; $y_1 = 120$

- 8 A car takes 3 hours to reach a destination by travelling at 60 km/h. How long will it take while travelling at 90 km/h?

- (A) 1 hour 30 minutes
 (B) 1 hour 40 minutes
 (C) 2 hours 40 minutes
 (D) 2 hours

- 9 If 24 workers can paint a wall in 45 hours, how many workers are required to do the same work in 20 hours?

- (A) 45 (B) 24 (C) 54 (D) 36

- 10 If the weight of 15 sheets of thick paper is 50 grams, how many sheets of the same paper would weigh $1\frac{1}{4}$ kilograms?

- (A) 300 (B) 250 (C) 200 (D) 375

- 11 If 32 horses consume 112 kg of gram in a certain period, how much gram will be consumed by 16 horses during the same period?

- (A) 56 kg (B) 48.5 kg
 (C) 31.5 kg (D) 50 kg

- 12 x varies inversely as square of y . Given that $y = 3$ for $x = 1$, find the value of x for $y = 4$.

- (A) 3 (B) 9 (C) $\frac{1}{3}$ (D) $\frac{9}{16}$

- 13 The price of 357 mangoes is ₹ 1517.25. What will be the approximate price of 49 dozens of such mangoes?

- (A) ₹ 3000 (B) ₹ 3500
 (C) ₹ 4000 (D) ₹ 2500

- 14 If the cost of " x " metres of wire is "d" rupees, what is the cost of " y " metres of wire at the same rate?

- (A) ₹ $\left(\frac{yd}{x}\right)$ (B) ₹ (xy)
 (C) ₹ (yd) (D) ₹ $\left(\frac{xy}{d}\right)$

- 15 A contractor can complete a certain piece of work in 9 days. He employed certain number of men, but 6 of them being absent from the very first day, the rest could finish the work in 15 days. How many men were originally employed?

- (A) 12 (B) 15 (C) 18 (D) 24

- 16** If 11.25 m of a uniform iron rod weighs 42.75 kg, what will be the weight of 6 m of the same rod ?
 (A) 22.8 kg (B) 25.6 kg
 (C) 28 kg (D) 26.5 kg
- 17** On a scale of a map, 0.6 cm represents 6.6 km. If the distance between the points on the map is 80.5 cm. What is the actual distance between these places ?
 (A) 9 km (B) 72.5 km
 (C) 190.75 km (D) 885.5 km
- 18** A flagstaff 17.5 m high casts a shadow of length 40.25 m. What is the height of the building which casts a shadow of length 28.75 m under similar conditions ?
 (A) 10 m (B) 12.5 m
 (C) 17.5 m (D) 21.25 m
- 19** 36 men can construct a bridge in 18 days. In how many days will 27 men complete the construction ?
 (A) 12 (B) 18 (C) 22 (D) 24
- 20** A rope makes 70 rounds of the circumference of a cylinder whose radius of the base is 14 cm. How many times can it go round a cylinder with radius 20 cm ?
 (A) 40 (B) 49 (C) 100 (D) 54
- 21** A certain number of men can finish a piece of work in 100 days. If, there were 10 men less, it would take 10 days more for the work to be finished. How many men were there originally ?
 (A) 75 (B) 82 (C) 100 (D) 110
- 22** In a camp, 95 men had provisions for 200 days. After 5 days, 30 men left the camp. For how many days will the remaining provisions last ?
 (A) 180 (B) 285
 (C) $139\frac{16}{19}$ (D) 200
- 23** A garrison of 500 men had provisions for 27 days. After 3 days, a reinforcement of 300 men arrived. For how many more days will the remaining provisions last ?
 (A) 15 (B) 16 (C) $17\frac{1}{2}$ (D) 18
- 24** If a quarter kg of green chillies cost 60 paise, how many paise will 200 g cost ?
 (A) 48 paise (B) 54 paise
 (C) 56 paise (D) 72 paise
- 25** A recipe for 20 rolls needs 5 tablespoons of butter. How many tablespoons of butter is needed for 30 rolls ?
 (A) 6 (B) 7 (C) 7.5 (D) 6.5
- 26** Food in a camp lasts for 8 men for 29 weeks. How long would the food last for 10 men ?
 (A) 22.3 weeks (B) 24 weeks
 (C) 32 weeks (D) 23.2 weeks
- 27** A wheel revolves 19500 times in 3 hours. How many times does it revolve in 7 hours ?
 (A) 54500 (B) 55400
 (C) 45500 (D) 50450
- 28** Suman drove 244 km in 4 hours. How long will he take to drive 366 km going at the same speed ?
 (A) 8 hours (B) 4 hours
 (C) 10 hours (D) 6 hours
- 29** A typist can finish typing 3 pages in 5 minutes. How many minutes does it take him to type 10 pages ?
 (A) 16.7 minutes (B) 17.6 minutes
 (C) 180 minutes (D) 160 minutes
- 30** 6 workers complete a job in 8 days. How many workers are needed to complete the job 2 days in advance ?
 (A) 4 (B) 8 (C) 10 (D) 6
- 31** A supply of food lasts for a week for 25 families. How long would it last if 5 more families are to be supplied ?
 (A) 5 days (B) 6 days
 (C) $\frac{5}{6}$ of a week (D) $1\frac{1}{5}$ weeks
- 32** 5 people can paint a wall in 5 hours. In how many hours can 3 people paint the same wall ?
 (A) $8\frac{2}{3}$ hours (B) $8\frac{1}{3}$ hours
 (C) $9\frac{1}{3}$ hours (D) 8 hours
- 33** A car needs 33 litres of petrol to cover a distance of 363 km. Petrol costs ₹ 78 per litre. How much would one spend on a journey of 407 km by that car ?
 (A) ₹ 2886 (B) ₹ 2780
 (C) ₹ 2618 (D) ₹ 2870

- 34** John bought 9 books for ₹ 36. How much should he pay for 5 such books ?
 (A) ₹ 18 (B) ₹ 12 (C) ₹ 72 (D) ₹ 20
- 35** A shirt costs ₹ 520 and a pair of trousers cost ₹ 145. How much does it cost for 2 such shirts and 3 pairs of such trousers ?
 (A) ₹ 1040 (B) ₹ 1475
 (C) ₹ 605 (D) ₹ 435
- 36** A van travels 210 km in 3 hours. How far can it travel in 5 hours ?
 (A) 350 km (B) 70 km
 (C) 35 km (D) 270 km
- 37** A tailor makes 16 dresses from a 40 m long material. How much material would be needed for 20 such dresses ?
 (A) 20 m (B) 60 m (C) 28 m (D) 50 m
- 38** A shopkeeper makes a profit of ₹ 15 from 36 tins of oil. How much profit does he make from 66 such tins ?
 (A) ₹ 32.50 (B) ₹ 22.50
 (C) ₹ 27.50 (D) ₹ 18.50
- 39** Three people paint a house in 20 days. How many days do 30 people take to do the same ?
 (A) 3 days (B) 2 days
 (C) 60 days (D) 12 days
- 40** A car takes one hour to cover a certain distance at 60 km/h. How long will the same journey take at 80 km/h ?
 (A) 45 minutes (B) 2 hours
 (C) 90 minutes (D) 3 hours

**Previous Contest Questions**

- 1** If 45 students can consume a stock of food in 2 months, for how many days does the same stock of food last for 27 students ?
 (A) 100 (B) 144
 (C) 160 (D) 180
- 2** A man working 8 hours a day takes 5 days to complete a project. How many hours a day must he work to complete it in 4 days ?
 (A) 10 (B) 11 (C) 12 (D) 14
- 3** A rope makes 260 rounds of a cylinder with base radius 20 cm. How many times can it go round a cylinder with base radius 26 cm ?
 (A) 130 (B) 300 (C) 200 (D) 150
- 4** In a camp, there is a meal for 120 men or 200 children. If 150 children have taken the meal, how many men will be catered to with the remaining meal ?
 (A) 20 (B) 30 (C) 40 (D) 50
- 5** A wheel that has 6 cogs is meshed with a larger wheel of 14 cogs. When the smaller wheel has made 21 revolutions, what is the number of revolutions made by the larger wheel ?
 (A) 4 (B) 9 (C) 12 (D) 49
- 6** A fort had provision of food for 150 men for 45 days. After 10 days, 25 men left the fort. For how many days does the remaining food last ?
 (A) $29\frac{1}{5}$ (B) $37\frac{1}{4}$ (C) 42 (D) 54
- 7** A man completes $\frac{5}{8}$ of a job in 10 days. At this rate, how many more days will it take him to finish the job ?
 (A) 5 (B) 6 (C) 7 (D) $7\frac{1}{2}$
- 8** 5 women can clear a piece of land in 4 days. How many more women will be required to clear it in one day ?
 (A) 10 (B) 20 (C) 25 (D) 15
- 9** Satish takes 24 minutes to reach his school, travelling at 15 km/h. At what speed must he go to reach his school in 18 minutes ?
 (A) 20 km/h (B) 30 km/h
 (C) 24 km/h (D) 18 km/h
- 10** 8 bags of cattle feed are needed to feed 4 cows for 2 months. How long will the same feed last to feed 6 cows ?
 (A) 4 months (B) $1\frac{1}{3}$ months
 (C) 1 months (D) 3 months

Factorisation

Synopsis

◆ **Factorisation:**

- (i) The process of writing an algebraic expression as the product of two or more algebraic expressions is called factorisation.
- (ii) When we factorise an expression, we write it as a product of factors. These factors may be numbers, algebraic variables or algebraic expressions.
- (iii) An irreducible factor is that which cannot be expressed further as a product of factors.
- (iv) A systematic way of factorising an expression is the **common factor method**.
It consists of three steps:
 - (a) Write each term of the expression as a product of irreducible factors.
 - (b) Look for and separate the common factors and
 - (c) Combine the remaining factors in each term in accordance with the distributive law.
- (v) Sometimes, all the terms in a given expression do not have a common factor; but the terms can be grouped in such a way that all the terms in each group have a common factor. When we do this, there emerges a common factor across all the groups leading to the required factorisation of the expression. This is the method of regrouping.

◆ **Some important identities:**

A number of expressions to be factorised are of the form or can be put into the form : $a^2 + 2ab + b^2$, $a^2 - 2ab + b^2$, $a^2 - b^2$ and $x^2 + (a + b) + ab$. These expressions can be easily factorised using identities I, II, III and IV.

- I. $(a + b)^2 \equiv a^2 + 2ab + b^2$
- II. $(a - b)^2 \equiv a^2 - 2ab + b^2$
- III. $(a + b)(a - b) \equiv a^2 - b^2$
- IV. $(x + a)(x - b) \equiv x^2 + (a + b)x - ab$

- ◆ In expressions which have factors of the type $(x + a)(x + b)$, remember that the numerical term gives ab . Its factors, a and b , should be so chosen that their sum, with signs taken care of, is the coefficient of x .
- ◆ We know that in the case of numbers, division is the inverse of multiplication. This idea is applicable also to the division of algebraic expressions.

Multiple Choice Questions



- 1** What are the factors of $ax + by + bx + az + ay + bz$?
- $(bx + ay), (ax + by)$
 - $(a + b), (2x + 2y + 2z)$
 - $(x + y + z), (a + b)$
 - $(x + y - z), (a - b)$
- 2** Which of the following is one of the factors of $x^4 + 4$?
- $x^2 + 2$
 - $x^2 - 2x + 2$
 - $x^2 - 2$
 - $x^2 + 2x - 2$
- 3** What are the factors of $x^4 + 2x^2 + 9$?
- $(x^2 + 2x + 3), (x^2 - 2x + 3)$
 - $(x^2 + 3), (x^2 - 3)$
 - $(x^2 + 2x + 3), (x^2 + 2x + 3)$
 - $(x^2 + 3), (x^2 + 3)$
- 4** For $x^2 + 2x + 5$ to be a factor of $x^4 + px^2 + q$, what must the respective values of p and q be?
- 2 and 5
 - 5 and 25
 - 10 and 20
 - 6 and 25
- 5** What are the factors of $x^2 + xy - 2xz - 2yz$?
- $(x - y)$ and $(x + 2z)$
 - $(x + y)$ and $(x - 2z)$
 - $(x - y)$ and $(x - 2z)$
 - $(x + y)$ and $(x + 2z)$
- 6** Amrit and Pankaj expanded $(x - 5)^2$. Amrit's answer is $x^2 - 25$ and Pankaj's answer is $x^2 - 10x + 25$. Which of the following statements is correct?
- Amrit's answer is correct.
 - Pankaj's answer is wrong.
 - Both got correct answer.
 - Pankaj's answer is correct.
- 7** Find the quotient when $5a^2b^2c^2$ is divided by $15abc$.
- $\frac{abc}{3}$
 - $3abc$
 - $3a^2b^2c^2$
 - $5a^2b^2c^2$
- 8** Which of the following statements is correct?
- $(a - 4)(a - 2) = a^2 + 8 - 6a$
 - $(2p + 3q)(p - q) = 2p^2 - 3q^2$
 - $\frac{3p^2}{3p^2} = 0$
 - $4(m - 5) = 4m - 5$
- 9** What are the factors of $x^4 + y^4 + x^2y^2$?
- $(x^2 + y^2)$ and $(x^2 + y^2 - xy)$
 - $(x^2 + y^2)$ and $(x^2 - y^2)$
 - $(x^2 + y^2 + xy)$ and $(x^2 + y^2 - xy)$
 - Factorisation is not possible.
- 10** Choose the factors of $15x^2 - 26x + 8$ from the following.
- $(3x - 4), (5x + 2)$
 - $(3x - 4), (5x - 2)$
 - $(3x + 4), (5x - 2)$
 - $(3x + 4), (5x + 2)$
- 11** How many factors does $(x^9 - x)$ have?
- 5
 - 4
 - 2
 - 9
- 12** Which of the following are the factors of $\frac{x^2}{4} - \frac{y^2}{9}$?
- $\left(\frac{x}{4} + \frac{y}{9}\right)$ and $\left(\frac{x}{4} - \frac{y}{9}\right)$
 - $\left(\frac{x}{2} + \frac{y}{9}\right)$ and $\left(\frac{x}{2} - \frac{y}{9}\right)$
 - $\left(\frac{x}{2} + \frac{y}{3}\right)$ and $\left(\frac{x}{2} - \frac{y}{3}\right)$
 - $\left(\frac{x}{2} - \frac{y}{3}\right)$ and $\left(\frac{x}{4} - \frac{y}{9}\right)$
- 13** What is the coefficient of 'a' when $9a^2 + 18a$ is divided by $(a + 2)$?
- 18
 - 9
 - $\frac{1}{2}$
 - 2

- 14** From the following, which are the factors of $a^2 + b - ab - a$?
 (A) $(a - 1)$ and $(a - b)$
 (B) $(a + b)$ and $(a - 1)$
 (C) $(a + 1)$ and $(a - b)$
 (D) $(a + b)$ and $(a + 1)$
- 15** The expression $(p^2 + 7p + 10)$ is factorised and then divided by $(p + 5)$. What is the quotient ?
 (A) $p - 5$ (B) $p - 2$
 (C) $p + 2$ (D) $p + 5$
- 16** Which is the correct statement in the following ?
 (A) $(3m + 4)^2 = 3m^2 + 6m + 16$
 (B) $n(3n + 2) = 3n^2 + 2n$
 (C) $(x - 2)(x - 8) = x^2 - 16$
 (D) $(p + 2)(p + 4) = p^2 + 8$
- 17** If $(x^2 + 3x + 5)(x^2 - 3x + 5) = m^2 - n^2$, what is the value of m ?
 (A) $x^2 - 3x$ (B) $3x$
 (C) $x^2 + 5$ (D) $x^2 + 3x$
- 18** Divide $6p^5 + 18p^4 - 3p^2$ by $3p^2$.
 (A) $2p^3 - 6p^2 + 1$ (B) $2p^3 - 6p^2 - 1$
 (C) $2p^3 + 6p^2 - 1$ (D) $2p^3 + 6p^2 + 1$
- 19** Find the factors of $b^2 - 7b + 12$.
 (A) $(b - 4), (b - 8)$ (B) $(b - 3), (b - 4)$
 (C) $(b - 10), (b - 1)$ (D) $(b - 7), (b - 9)$
- 20** Find the factors of $6mn - 4n + 6 - 9m$.
 (A) $(2m - 1)$ and $(2n - 4)$
 (B) $(4m - 1)$ and $(n - 3)$
 (C) $(3m - 2)$ and $(2n - 3)$
 (D) $(4m - 4)$ and $(n - 1)$
- 21** Which of the following is the exponential form of factors of $a^2 + 4a + 4$?
 (A) $(a + 2)^2$ (B) $(a + 1)^2$
 (C) $(a - 2)^2$ (D) $(a - 1)^2$
- 22** What is the result when $x^3 + 6x^2 + 9x$ is factorised ?
 (A) $x^2(x + 2)^2$ (B) $x(x + 3)^2$
 (C) $x(x + 3)$ (D) $x^2(x + 3)$
- 23** What are the factors of $(2x + 3y)^2 + 2(2x + 3y)(x + y) + (x + y)^2$?
 (A) $(3x + 4y)$ and $(3x - 4y)$
 (B) $(3x + 4y)$ and $(3x + 4y)$
 (C) $(3x + 2y)$ and $(2x - 3y)$
 (D) $(3x - 4y)$ and $(3x + 2y)$
- 24** What are the factors of $a^2b^2 + c^2d^2 - a^2c^2 - b^2d^2$?
 (A) $(a + d), (a - d), (b + c)$ and $(b - c)$
 (B) $(a^2 - b^2)$
 (C) $(a^2 - d^2)$ and $(b^2 + c^2)$
 (D) $(a^2 + d^2)$ and $(b^2 - c^2)$
- 25** Divide $-15a^3bc^3$ by $-5abc^2$.
 (A) $3a^1c$ (B) $3a^2c$
 (C) $3a^3c$ (D) $4a^2c$
- 26** Simplify $\frac{-3a^2b \times 15cab^2}{-10cab}$.
 (A) $\frac{3}{2}a^2b^2$ (B) $\frac{9}{2}a^2b^2$
 (C) $\frac{3}{2}a^3b^3$ (D) $\frac{7}{2}a^2b^2$
- 27** Find the quotient of the algebraic terms $\frac{36x^3y^2z}{-9x^2y^2z}$.
 (A) $4x$ (B) $4xy^2z$
 (C) $-4x$ (D) $4x^3y^2z$
- 28** Divide: $4p^5 - 14p^4 + 6p^3 - 2p^2$ by $2p^2$.
 (A) $2p^3 + 7p^2 + 3p + 1$
 (B) $2p^3 - 7p^2 + 3p - 1$
 (C) $2p^3 - 7p^2 - 3p - 1$
 (D) $2p^3 + 7p^2 - 3p - 1$
- 29** Simplify

$$\frac{3(4 + 2m^2 - m) - 6(3m^2 + m + 2)}{2(2m - 3) + 3(m + 2)}$$

 (A) $\frac{3(3m + 4)}{7}$ (B) $\frac{3(4m + 3)}{7}$
 (C) $3\left(\frac{3m - 4}{7}\right)$ (D) $\frac{-3(4m + 3)}{7}$

30 What is the factorisation of $3xz - 4yz - 6xp + 8yp$?

- (A) $(3x + 4y)(z + 2p)$
- (B) $(3x + 4y)(z - 2p)$
- (C) $(3x - 4y)(z + 2p)$
- (D) $(3x - 4y)(z - 2p)$

31 Give the factor form of

$$3(2p - q + 4r) + 2p + 15q - 16r.$$

- (A) $4(2p + 3q + r)$
- (B) $4(2p + 3q - r)$
- (C) $4(2p - 3q + r)$
- (D) $4(2p - 3q - r)$

32 Simplify $\frac{3lm}{8n^2} \times \frac{32ln^3}{m^2} \div \frac{9ln^2}{m}$.

- | | |
|---------------------|----------------------|
| (A) $\frac{4l}{3n}$ | (B) $-\frac{4l}{3n}$ |
| (C) $\frac{4n}{3l}$ | (D) $-\frac{4n}{3l}$ |

33 Divide $q(5q^2 - 80)$ by $5q(q + 4)$.

- (A) $5q(q-16)$
- (B) $(q-4)$
- (C) $5q(q^2+16)$
- (D) $(q + 16)$

34 Give the factor form of

$$6m^2n + 9mn^2l + 12mnl.$$

- (A) $3mn(2m + 3nl + 4l)$
- (B) $4mn(4m + 4nl + 2l)$
- (C) $5mn(2m + 2nl + l)$
- (D) $3mn(m + 2nl + 2l)$

35 Divide $44(m^4 - 5m^3 - 24m^2)$ by $11m(m - 8)$.

- (A) $4m^2(m - 3)$
- (B) $4m(m - 3)$
- (C) $4m^2(m + 3)$
- (D) $4m(m + 3)$

36 Factorise $49x^2 - 36$.

- (A) $(7x - 6)(7x + 6)$
- (B) $(7x + 36)7$
- (C) $(7x + 6)6$
- (D) $(7x + 6)(7x + 36)$

37 Find the factors of $3z^2 + 9z + 6$.

- (A) $3(z + 1)(z + 2)$
- (B) $4(z + 2)(z + 3)$
- (C) $2(z + 3)(z + 1)$
- (D) $3(z + 5)(z + 5)$

38 The area of a square is $(x^2 + 8x + 16)$ cm². Find the length of its side.

- (A) $(x - 8)$ cm
- (B) $(x - 4)$ cm
- (C) $(x + 4)$ cm
- (D) $(x + 2)$ cm

39 Which of the following is the correct factorisation?

- (A) $64 - x^2 = (64 - x)(64 + x)$
- (B) $27x^2 - 48 = 3(3x + 4)(3x - 4)$
- (C) $y^2 - 81 = (y + 9)(y + 9)$
- (D) $36 - p^2 = (p - 6)(p + 6)$

40 Which of the following factorisations is incorrect?

- (A) $200y^2 - 2 = 2(10y + 1)(10y - 1)$
- (B) $49x^2 - 36 = (7x + 6)(7x - 6)$
- (C) $200y^2 - 2 = 2(10y + 1)(10y + 1)$
- (D) $36 - 100k^2 = (6 + 10k)(6 - 10k)$



Previous Contest Questions

1 Choose the factors of $x^4 - 13x^2y^2 + 36y^4$ from the following.

- (A) $(x + 4y), (x - 4y), (x + 2y)$ and $(x - 2y)$
- (B) $(x^2 + 2x - 8)$ and $(x^2 + 2x - 3)$
- (C) $(x + 3y), (x - 3y), (x + 2y)$ and $(x - 2y)$
- (D) $(x^2 - 2x - 8)$ and $(x^2 + 2x + 3)$

2 What is the factor form of $9x^4 - 40x^2 + 16$?

- (A) $(x + 1)(x - 1)(2x + 1)(2x - 1)$
- (B) $(2x - 1)(4x^2 + 2x + 1)$
- (C) $(x + 2)(2x - 3)(x - 1)(2x + 3)$
- (D) $(x + 2)(x - 2)(3x + 2)(3x - 2)$

3 What is the perfect square form of $9a^2 - \frac{12}{5}a + \frac{4}{25}$?

- (A) $\left(a - \frac{2}{5}\right)^2$
- (B) $\left(3a - \frac{2}{5}\right)^2$
- (C) $\left(2a - \frac{2}{5}\right)^2$
- (D) $\left(3a + \frac{2}{5}\right)^2$

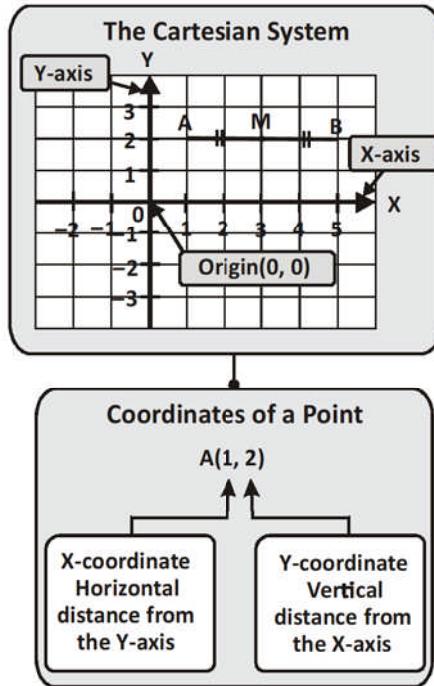
- 4** Choose the factors of $a(x-y)^2 - by + bx + 3x - 3y$.
- (A) $(x-y)$ and $[a(x-y) + b + 3]$
 (B) $(a-b)$ and $(3x-3y)$
 (C) $(x-y)$ and $(x^2 + a + 1)$ and $(y^2 + b + 1)$
 (D) $(ax-y)$ and $[a(x-y) + b + 3]$
- 5** Find the factors of $x^2 + \frac{a^2 - 1}{a} x - 1$ from the following.
- (A) $\left(x - \frac{1}{a}\right)$ and $(x+a)$
 (B) $\left(x - \frac{1}{a^2}\right)$ and $(x+a)$
 (C) $\left(x - \frac{1}{a^2}\right)$ and $(x-a)$
 (D) $\left(x + \frac{1}{a^2}\right)$ and $(x+a)$
- 6** What is the factor form of $(p^2 + q^2 - r^2)^2 - 4p^2q^2$?
- (A) $(p+q+r)(p+q-r)$
 $(p-q+r)(p-q-r)$
 (B) $(p-q-r)(p^2 - q^2 - r^2)$
 (C) $(p-q-r)(2p - 2q - 2r)$
 (D) $(p+q-r)(p^2 - q^2 - r^2)$
- 7** What is the quotient when $12ab(9a^2 - 16b)^2$ is divided by $4ab(3a + 4b)$?
- (A) $4(3a + 4b)$ (B) $3(3a - 4b)$
 (C) $3(3a + 4b)$ (D) $4(3a - 4b)$
- 8** Identify the factors of $18 - 32p^2$.
- (A) $2(4p + 3)(4p - 3)$
 (B) $2(3 + 4p)(3 - 4p)$
 (C) $4(3 + 4p)(3 - 4p)$
 (D) $4(3 + 2p)(3 - 2p)$
- 9** Which of the following factorisations is incorrect?
- (A) $27k - 5k^2 = k(27 - 5k)$
 (B) $6y^2 - 12y = 6y(y - 2)$
 (C) $16x - 4x^2 = 4x(4 - x^2)$
 (D) $121n^2 - 22n = 11n(11n - 2)$
- 10** Which of the following factorisations is correct?
- (A) $2 - 32x^2 = 2(1 - 4x)^2$
 (B) $4x^2 - 49 = (7 - 2x)(7 + 2x)$
 (C) $-18x^2 + 27x = 9x(2x - 3)$
 (D) $-25 - 150p^2 = (-25)(1 + 6p^2)$



Introduction to Graphs

Synopsis

- ◆ **Bar graph:** A bar graph is used to show comparison among categories.
- ◆ **Pie graph:** A pie graph is used to compare parts of whole.
- ◆ **Histogram:** Representation that shows data in intervals.
- ◆ **Line graph:** It shows data that changes continuously over periods of time.
- ◆ **Linear graph:** A straight line graph is called a linear graph.
- ◆ **The Cartesian system:**
 - (i) A plane is divided into 4 quarters (called quadrants) by two perpendicular lines intersecting at O (called origin). The horizontal line is called the X-axis and the vertical line is called the Y-axis.
 - (ii) A point is represented by the horizontal distance from the origin called the x-coordinate and by the vertical distance from the origin called the y-coordinate.
 - (iii) A point is represented by an ordered pair (x, y) where x is the x-coordinate and y is the y-coordinate.



- A graph shows the relation between two variables, one of which is an independent variable (or control variable) and the other a dependent variable.
- Advantages and disadvantages of various graphs:**

Representation of data	Advantages	Disadvantages												
<p>Pictogram</p> <p>Sales of Fruits</p> <table border="1"> <tr> <td>Stall A</td> <td>2 apples</td> </tr> <tr> <td>Stall B</td> <td>3 apples</td> </tr> <tr> <td>Stall C</td> <td>2 apples</td> </tr> </table> <p>Key : 1 Represents 50 apples</p>	Stall A	2 apples	Stall B	3 apples	Stall C	2 apples	Data is represented in an attractive manner.	Not accurate. Difficult and time consuming to draw the figures for large data involving fractions.						
Stall A	2 apples													
Stall B	3 apples													
Stall C	2 apples													
<p>Bar Chart</p> <p>Number of students enrolled in three years</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Boys (Grey)</th> <th>Girls (White)</th> </tr> </thead> <tbody> <tr> <td>Year 1</td> <td>~600</td> <td>~400</td> </tr> <tr> <td>Year 2</td> <td>~400</td> <td>~750</td> </tr> <tr> <td>Year 3</td> <td>~600</td> <td>~150</td> </tr> </tbody> </table>	Category	Boys (Grey)	Girls (White)	Year 1	~600	~400	Year 2	~400	~750	Year 3	~600	~150	Easy to construct. Shows the exact quantities of each data category. Two or more types of data can be displayed simultaneously.	Does not show comparisons between the categories of data.
Category	Boys (Grey)	Girls (White)												
Year 1	~600	~400												
Year 2	~400	~750												
Year 3	~600	~150												
<p>Pie Chart</p> <p>Nationality of tourists</p> <table border="1"> <thead> <tr> <th>Nationality</th> <th>Approximate Proportion</th> </tr> </thead> <tbody> <tr> <td>Europe</td> <td>~45%</td> </tr> <tr> <td>Asia</td> <td>~25%</td> </tr> <tr> <td>China</td> <td>~15%</td> </tr> <tr> <td>Japan</td> <td>~15%</td> </tr> </tbody> </table>	Nationality	Approximate Proportion	Europe	~45%	Asia	~25%	China	~15%	Japan	~15%	Shows clearly the difference in magnitude between the categories.	Long calculations are needed. Not suitable if too many categories of data are involved. Actual quantities are not displayed.		
Nationality	Approximate Proportion													
Europe	~45%													
Asia	~25%													
China	~15%													
Japan	~15%													

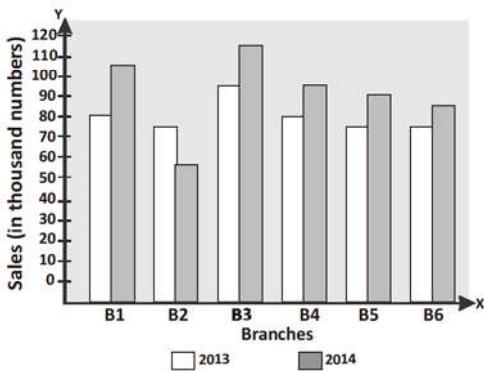
Multiple Choice Questions

A B C D

- 1** Which of the following statements is true ?
 (A) The X-axis is a vertical line.
 (B) The Y-axis is a horizontal line.
 (C) The scale on both the axes must be the same in a Cartesian plane.
 (D) The point of intersection between the X-axis and Y-axis is called the origin.
- 2** Which of the points given is a point on the X-axis ?
 (A) (5, 0) (B) (0, 5) (C) (5, 3) (D) (3, 5)

(3-7): The bar-graph provided gives the sales of books (in thousand numbers) by six branches of a publishing company during two consecutive years 2013 and 2014.

Sales of books (in thousand numbers) in different branches



Answer the questions 5-9 based on this bar-graph.

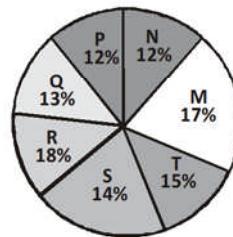
- 3** What is the total sales of branches B₁, B₃ and B₅ together for both the years (in thousand numbers) ?
 (A) 250 (B) 310 (C) 435 (D) 565
- 4** What percent of the total sales of branch B₃ for both the years is the total sales of branch B₆ for both the years ?
 (A) 68.54% (B) 71.11%
 (C) 76.19% (D) 75.55%
- 5** What is the average sale of all the branches (in thousand numbers) for the year 2013 ?
 (A) 73 (B) 81 (C) 83 (D) 88

- 6** What is the ratio of the total sales of branch B₂ for both years to the total sales of branch B₄ for both the years ?
 (A) 2 : 3 (B) 3 : 5 (C) 4 : 5 (D) 13 : 18
- 7** What percent of the average sales of branches B₁, B₂ and B₃ in 2014 is the average sales of branches B₁, B₃ and B₆ in 2013 ?
 (A) 75% (B) 77.5% (C) 91% (D) 87.5%

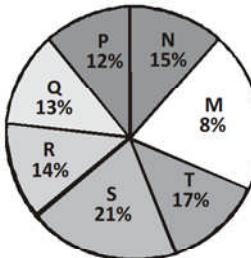
(8-12): The following pie charts show the distribution of students of graduate and post-graduate levels in seven different institutes M, N, P, Q, R, S and T in a town.

Distribution of students at graduate and post-graduate levels in seven institutes M, N, P, Q, R, S, and T.

Total number of students of graduate level = 27300



Total number of students of post-graduate level = 24700



Note : Pie charts are not drawn to scale.

- 8** How many students of institutes M and S are studying at graduate level ?
 (A) 7516 (B) 8463 (C) 9127 (D) 9409
- 9** What is the total number of students studying at post-graduate level from institutes N and P ?
 (A) 5601 (B) 5944
 (C) 6669 (D) 7004

10 What is the total number of graduate and post-graduate level students in the institute R ?

- (A) 8320 (B) 7916
(C) 9116 (D) 8372

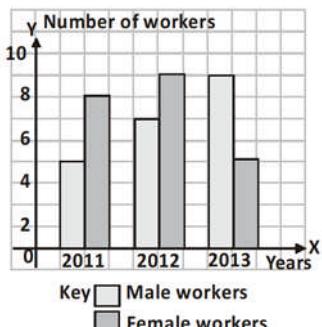
11 What is the ratio of the number of students studying at post-graduate and graduate levels respectively in institute S ?

- (A) 14 : 19 (B) 19 : 14
(C) 17 : 21 (D) 19 : 21

12 What is the ratio of the number of students at post-graduate level in institute S and the number of students studying at graduate level in institute Q ?

- (A) 13 : 19 (B) 21 : 13
(C) 13 : 8 (D) 19 : 13

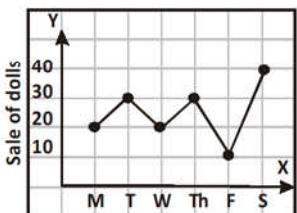
13 The bar chart shows the number of workers employed by a trading company in three years.



Calculate the difference between the total number of male and female workers employed over those three years.

- (A) 1 (B) 2 (C) 4 (D) 6

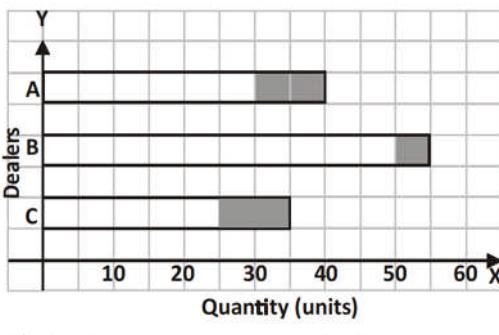
14 The line graph shows the sale of dolls by Suhas from Monday to Saturday in a particular week.



Given that the cost of one doll is ₹ 35, how much did Suhas receive from the sale of dolls on Saturday ?

- (A) ₹ 200 (B) ₹ 700
(C) ₹ 1050 (D) ₹ 1400

15 The bar chart shows the number of 'Maruti' and 'Benz' cars sold by three dealers, A, B and C.

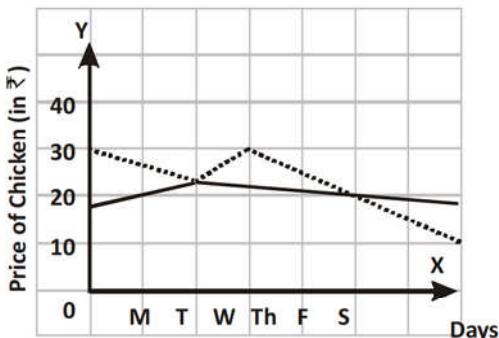


- Maruti cars** **Benz cars**

Which of the following statements is true?

- (A) Dealer A sold 40 Maruti cars less than dealer B.
(B) Dealer B sold 50 Maruti cars more than dealer C.
(C) Dealer B sold the most number of Benz cars.
(D) The total number of Benz cars by dealers B and C is 15.

16 The line graph shows the price of chicken in towns M and N.

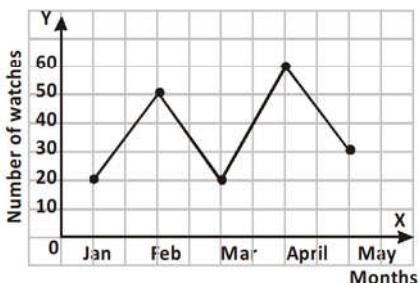


- Key:** Town M —— Town N

On which days are the price of chicken the same in both the towns ?

- (A) Tuesday and Friday only
(B) Friday only
(C) Wednesday and Friday only
(D) Tuesday only

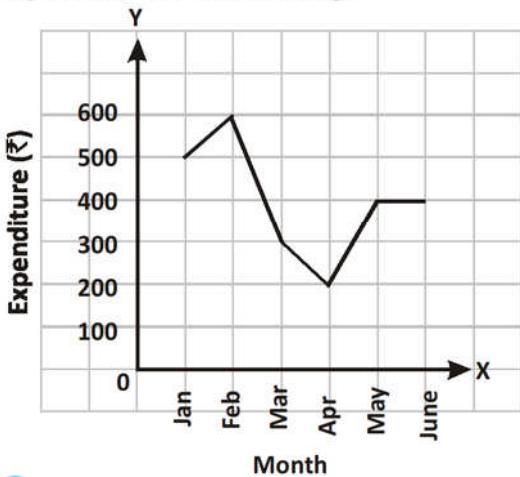
- 17** The line graph shows the sale of watches in a company.



How many watches were sold in all 5 months?

- (A) 160 (B) 180 (C) 175 (D) 170

- (18-19): The line graph shows the monthly expenditure of Vasu's family.**



- 18** What is the total expenditure over the first 3 months?

- (A) ₹ 1400 (B) ₹ 600
(C) ₹ 1100 (D) ₹ 1320

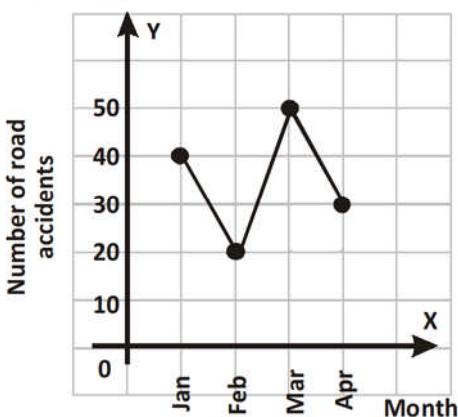
- 19** Find the difference between their highest and lowest monthly expenditures.

- (A) ₹ 100 (B) ₹ 400
(C) ₹ 300 (D) ₹ 200

- 20** Which of the following statements is correct?

- (A) The coordinates of the origin are (0, 1).
(B) The point (5, 0) lies on the Y-axis.
(C) The point (0, 7) lies on the Y-axis.
(D) The point (3, 2) lies on the X-axis.

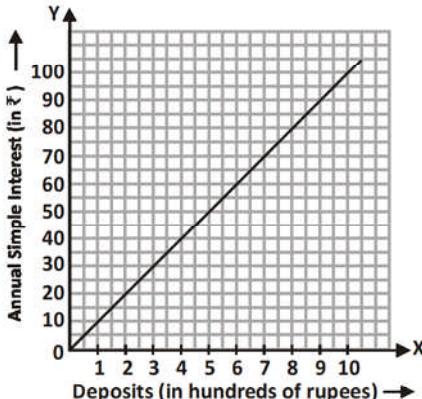
- 21** The line graph shows the number of road accidents over the first four months of a certain year.



Which of the following statements is false?

- (A) The number of accidents is the highest in March.
(B) The number of accidents fell by 50% in February compared to the number in January.
(C) The total number of accidents over the four months is 140.
(D) The number of accidents increased by 3 times in March as compared to the number in February.

- (22-23): The graph given shows the simple interest given on deposits in a bank.**



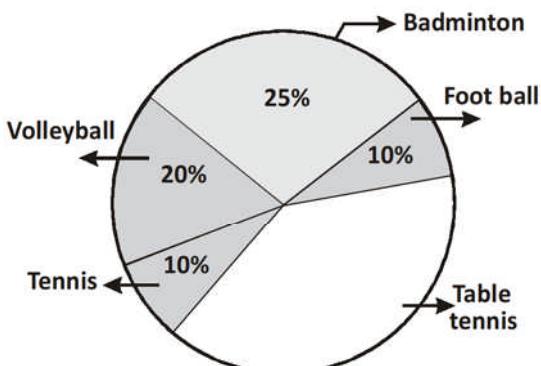
- 22** Find the amount to be deposited to earn an interest of ₹ 45.

- (A) ₹ 250 (B) ₹ 450
(C) ₹ 400 (D) ₹ 550

- 23** How much interest is paid on a deposit of ₹ 750 ?

(A) ₹ 75 (B) ₹ 65
(C) ₹ 70 (D) ₹ 80

(24-28): 1200 students were asked to choose a game for their CCA. The pie chart given represents their choices.



- 24** What percentage of the pupils chose table tennis ?

(A) 30 % (B) 40%
(C) 35% (D) 45%

- 25** How many more pupils chose table tennis than foot ball ?

(A) 120 (B) 30
(C) 250 (D) 300

- 26** The table-tennis group and the volleyball group should have the same number of pupils. How many pupils should be transferred from the table tennis group to the volleyball group?

(A) 50 (B) 27 (C) 90 (D) 112

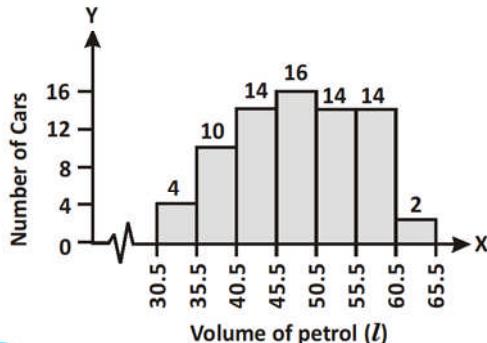
- 27** What is the ratio of the number of pupils who chose tennis and table tennis to the number of pupils who chose the other games ?

(A) 7 : 13 (B) 9 : 11 (C) 11 : 9 (D) 9 : 13

- 28** Which of the following is correct ?

	Game	No. of pupils
(A)	Badminton	300
(B)	Volley ball	300
(C)	Tennis	240
(D)	Soccer	360

- (29-33): The histogram shows the petrol consumption per week of a number of cars in a city.**



- 29** What is the total number of cars ?

(A) 70 (B) 68 (C) 74 (D) 76

- 30** What is the frequency of the modal class ?

(A) 16 (B) 14 (C) 4 (D) 10

- 31** How many cars consume less than 40.5 l of petrol per week ?

(A) 4 (B) 14 (C) 10 (D) 6

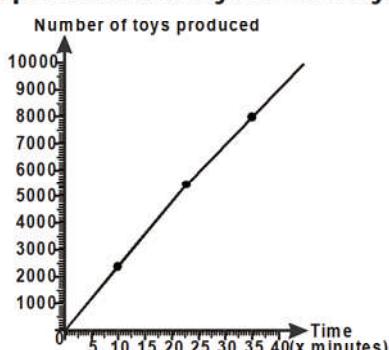
- 32** How many cars consume more than 50.5 l of petrol ?

(A) 28 (B) 14 (C) 16 (D) 30

- 33** How many litres of petrol do 10 cars consume ?

(A) 45.5 – 50.5 (B) 30.5 – 35.5
(C) 40.5 – 45.5 (D) 35.5 – 40.5

- (34-36): The line graph given shows the rate of the production of toys in a factory.**

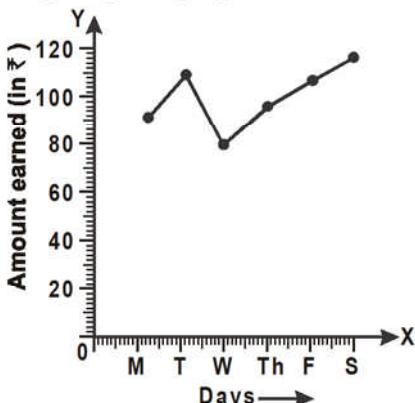


- 34** How many toys were produced in 10 minutes ?

(A) 2100 (B) 2300
(C) 2200 (D) 2000

- 35** Find the time taken to produce 5400 toys.
 (A) 35 minutes (B) 30 minutes
 (C) 23.5 minutes (D) 20 minutes
- 36** Find the expected time to complete producing 8000 toys if the production starts at 3.45 p.m.
 (A) 3 : 50 p.m (B) 4 : 20 p.m
 (C) 4 : 15 p.m (D) 4 : 35 p.m

(37-38): The line graph shows the earning of a daily wage employee in a small firm.

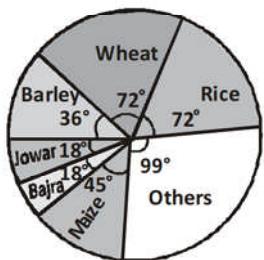


- 37** By how much did his income fall on Wednesday from that on Monday ?
 (A) ₹ 20 (B) ₹ 15 (C) ₹ 10 (D) ₹ 40
- 38** Between which two days was the increase in the income of the person the same as that between Monday and Tuesday ?
 (A) Wednesday and Thursday
 (B) Wednesday and Friday
 (C) Tuesday and Wednesday
 (D) Friday and Saturday



Previous Contest Questions

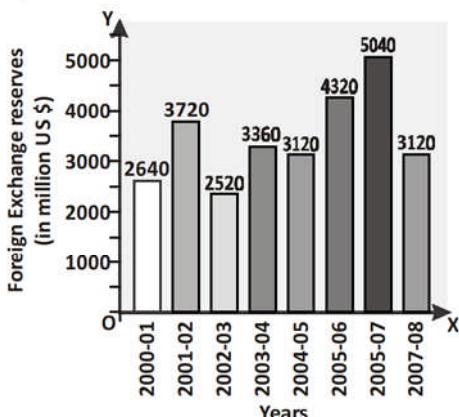
(1-2): The pie-chart gives the distribution of land (in a village) under various food crops.



Study the pie chart and answer the following questions.

- 1** Which combination of three crops contribute to 50% of the total area under the food crops ?
 (A) Wheat, Barley and Jowar
 (B) Rice, Wheat and Jowar
 (C) Rice, Wheat and Barley
 (D) Bajra, Maize and Rice
- 2** If the total area under jowar was 1.5 million acres, what was the area (in millions acres) under rice ?
 (A) 6 (B) 7.5
 (C) 9 (D) 4.5

(3-5): The bar graph shows the foreign exchange reserves of a country (in million US \$) from 2000 - 01 to 2007 - 08.

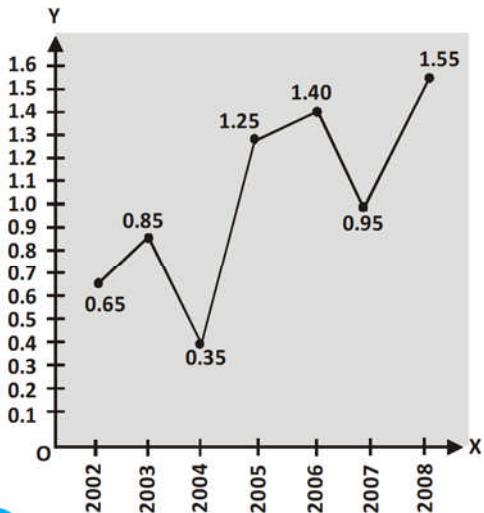


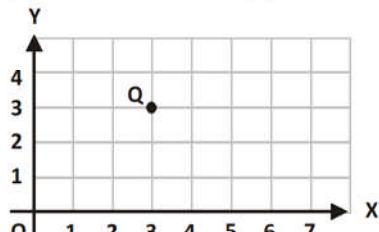
Answer the questions based on the graph.

- 3** The foreign exchange reserves in 2006-2007 was how many times that in 2003-2004 ?
 (A) 0.7 (B) 1.2
 (C) 1.4 (D) 1.5
- 4** What was the percentage increase in the foreign exchange reserves in 2006-2007 over 2002-2003 ?
 (A) 100 % (B) 150 %
 (C) 200 % (D) 620 %
- 5** What is the ratio of the number of years, in which the foreign exchange reserves are above the average reserves, to those in which the reserves are below the average reserves ?
 (A) 2 : 6 (B) 3 : 4
 (C) 3 : 5 (D) 5 : 3

(6-8): The following line graph gives the ratio of the amount of imports by a company to the amount of exports from that company over the period from 2002 to 2008.

Ratio of value of imports to exports by a company over the years.



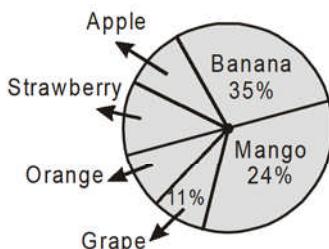


What are the coordinates of O?

- (A) (6, 6) (B) (3, 3)
 (C) (10, 6) (D) (12, 9)

- 10** Which of the points given is a point on the Y-axis ?
(A) (7, 0) (B) (6, 5)
(C) (5, 3) (D) (0, 5)

(11-15): The pie chart shows the number of different flavours of milk shakes sold at an ice-cream parlour in a day. Same number of apple, strawberry and orange flavours were sold.



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Playing with Numbers

Synopsis

- ◆ **General form of a number:** The general form of a number abc is $abc = a \times 100 + b \times 10 + c$.

- ◆ **Divisibility Rules:**

Divisibility factor	Conditions	Example	
2	The last digit is 0 or an even number.	9340 3456	0 (Last digit 0) 6 (Last digit is an even number) \therefore 9340 & 3456 are divisible by 2.
3	The sum of all the digits of the number is divisible by 3.	4746	$(4 + 7 + 4 + 6) \div 3$ $= 21 \div 3 = 7$ \therefore 4746 is divisible by 3.
4	The number formed by last two digits of the number is divisible by 4 or are 00.	616 8900	$16 \div 4 = 4$ 00 (Last two digits are 00) \therefore 616 and 8900 are divisible by 4.
5	The last digit of the number is 0 or 5.	60415 76290	5 (Last digit is 5) 0 (Last digit is 0) \therefore 60 415 and 76 290 are divisible by 5.
6	The last digit is 0 or an even number, and the sum of all the digits of the number is divisible by 3.	7596	$(7 + 5 + 9 + 6) \div 3$ $= 27 \div 3 = 9$ \therefore 7 596 is divisible by 6.
7	The difference between the number formed by the digit/digits in front and the doubled value of the last digit is 0 (or) is divisible by 7.	406 8722 815	406 is divisible by 7 because $40 - (6 \times 2) = 28$ 28 is divisible by 7. \therefore 406 is divisible by 7. 8722 is divisible by 7 because $872 - (2 \times 2) = 868$ 868 is divisible by 7. \therefore 8722 is divisible by 7. 815 is not divisible by 7 because $81 - (5 \times 2) = 71$ 71 is not divisible by 7. \therefore 815 is not divisible by 7.
8	The number formed by the last three digits of the number is divisible by 8.	3568	$568 \div 8 = 71$ \therefore 3 568 is divisible by 8.

Divisibility factor	Conditions	Example	
9	The sum of all the digits of the number is divisible by 9.	6048 $(6 + 0 + 4 + 8) \div 9 = 18 \div 9 = 2$ $\therefore 6048$ is divisible by 9.	
10	The last digit is 0.	931 <u>0</u> 0 (Last digit is 0) $\therefore 9310$ is divisible by 10.	
11	The difference of the sum of the digits in even places and the sum of the digits in odd places is 0 or is divisible by 11.	1364 $((3 + 4) - (1 + 6)) = 0$ 3729 $((7 + 9) - (3 + 2)) = 11$ $\therefore 1364$ and 3729 are divisible by 11. 25176 $((5 + 7) - (2 + 1 + 6)) = 3$ $\therefore 25176$ is not divisible by 11.	
12	The number is divisible by both 3 and 4.	648 $(6 + 4 + 8 = 18 \text{ and also } 48 \div 4 = 12)$ $\therefore 648$ is divisible by 12. 916 $(9 + 1 + 6 = 16 \text{ and } 16 \div 4 = 4)$ $\therefore 916$ is not divisible by 12 as it is not divisible by 3.	

Multiple Choice Questions

A

B

C

D



- 1** By which of these numbers is the number 3116365 divisible?
 (A) 5 (B) 7
 (C) Both 5 and 7 (D) 6
- 2** Which of the following statements is false?
 (A) If a number is divisible by 8, it must be divisible by 4.
 (B) If a number is divisible by both 9 and 10, it is divisible by 90.
 (C) The sum of two consecutive odd numbers is always divisible by 4.
 (D) If a number is not divisible by both 3 and 4, it is divisible by 12.
- 3** What value should be given to * so that the number 653*47 is divisible by 11?
 (A) 1 (B) 6 (C) 2 (D) 9
- 4** Which is the least number of 4 digits that is exactly divisible by 13?
 (A) 1052 (B) 1039
 (C) 1032 (D) 1001
- 5** When is a number always divisible by 90?
 (A) If it is divisible by both 2 and 45.
 (B) If it is not divisible by both 5 and 18.
 (C) If it is not divisible by both 9 and 10.
 (D) If it is divisible by 3 and 20.
- 6** By which of the following numbers is 477 not divisible?
 (A) 3 (B) 7 (C) 53 (D) 9
- 7** If a number is divisible by 9, it is also divisible by which number?
 (A) 3 (B) 6 (C) 2 (D) 4
- 8** Which number is divisible by 6?
 (A) 213 (B) 468 (C) 621 (D) 573
- 9** $32 + m$ is a prime number. What is the least value of 'm'?
 (A) 3 (B) 5 (C) 6 (D) 4
- 10** Which of the following is not prime?
 (A) 107 (B) 127
 (C) 153 (D) 197
- 11** Which of the given numbers is composite?
 (A) 137 (B) 147
 (C) 157 (D) 167
- 12** A prime number is greater than 30 and lesser than 60. What is the greatest possible such number?
 (A) 37 (B) 53 (C) 43 (D) 59
- 13** Which of the following statements is true?
 (A) A number is divisible by 4 if it is divisible by 2.
 (B) A number is divisible by 9 if it is divisible by 3.
 (C) A number is divisible by 11 if the number formed by its last two digits is divisible by 11.
 (D) A number is divisible by 8 if the number formed by its last three digits is divisible by 8.
- 14** N is a 5-digit number divisible by 5. If N is bigger than 10000 and smaller than 10010, what is the value of N?
 (A) 10000 (B) 10010
 (C) 10005 (D) 10001
- 15** Identify the multiple of 8.
 (A) 487718 (B) 505672
 (C) 216428 (D) 763121
- 16** Which of the following is divisible by 12?
 (A) 284382 (B) 624876
 (C) 926248 (D) 746174
- 17** X is the least composite number between 85 and 100. What is the value of X?
 (A) 85 (B) 99 (C) 100 (D) 86

- 18** Z is a three digit even number less than 200, and more than 190 that is divisible by 7. Find Z.
 (A) 196 (B) 193 (C) 199 (D) 197
- 19** Identify the even prime number.
 (A) 132 (B) 102
 (C) 284 (D) 2
- 20** How many prime numbers are there between 100 and 200?
 (A) 25 (B) 19 (C) 21 (D) 20
- 21** Identify a factor of 261111.
 (A) 8 (B) 3 (C) 4 (D) 2
- 22** 30 is expressed in terms of prime numbers. Which of the expressions is incorrect?
 (A) $30 = 12 + 18$ (B) $30 = 11 + 19$
 (C) $30 = 13 + 17$ (D) $30 = 2 \times 3 \times 5$
- 23** Identify the incorrect statement.
 (A) The sum of two odd numbers is always odd.
 (B) The product of two odd numbers is always odd.
 (C) The sum of two even numbers is always even.
 (D) The product of two even numbers is always even.
- 24** $x^2 + x + 11$ is a prime number. Which of the following is not a value of 'x'?
 (A) 1 (B) 3 (C) 4 (D) 2
- 25** If $a - b$ is a multiple of 7, which of the following is also a multiple of 7?
 (A) $b - a$ (B) ab
 (C) $a + b$ (D) $\frac{a+b}{2}$
- 26** The units digit of a two digit number is 3 times the tens digit. If the digits are reversed, the resulting number is 36 more than the original number. What is the original number?
 (A) 26 (B) 36 (C) 93 (D) 39
- 27** If 'r' and 's' are both odd integers, which of the following must be an even integer?
 (A) $\frac{r+s}{2}$ (B) $2rs$ (C) $\frac{rs}{2}$ (D) $3rs$
- 28** When 'n' is divided by 5, the remainder is 4. When 'n' is divided by 4, the remainder is 3. If $0 < n < 100$, what is a possible value of 'n'?
 (A) 9 (B) 14 (C) 19 (D) 24
- 29** If 'n' is an even integer, which of the following must be an odd integer?
 (A) $3n - 2$ (B) $n - 2$
 (C) $3(n + 1)$ (D) $\frac{n}{3}$
- 30** If $a = 4b + 26$, and 'b' is a positive integer, which of the following does not divide 'a'?
 (A) 2 (B) 5 (C) 4 (D) 6
- 31** If a, b, c and d are consecutive multiples of 5 and $a < b < c < d$, what is the value of $(a - c)(d - b)$?
 (A) 100 (B) -100
 (C) 25 (D) -25
- 32** The remainder when 'x' is divided by 5 equals the remainder when 'x' is divided by 4. Which of the following could not be a value of 'x'?
 (A) 20 (B) 24 (C) 21 (D) 22
- 33** If 'q' is an integer between 50 and 70 which can be expressed as $7j + 3$, for some integer j what is a possible value of 'q'?
 (A) 59 (B) 53 (C) 64 (D) 68
- 34** What is the remainder when the sum of three consecutive even integers is divided by 6?
 (A) 4 (B) 1 (C) 0 (D) 3
- 35** How many numbers between 1 and 200 are multiples of 5 and are divisible by 3?
 (A) 100 (B) 50 (C) 95 (D) 93

- 36** Find the value of P, Q, R and S respectively.

$$\begin{array}{r}
 \text{P Q R S} \\
 \times 9 \\
 \hline
 \text{S R Q P}
 \end{array}$$

- (A) 1, 0, 8, 9 (B) 8, 1, 0, 9
 (C) 1, 0, 9, 8 (D) 1, 9, 0, 8

- 37** Find the value of P, Q, R and S respectively.

$$\begin{array}{r}
 \text{R S} \\
 \text{Q R S} \\
 + \text{Q P R S} \\
 \hline
 1 9 8 9
 \end{array}$$

- (A) 6, 1, 7, 3 (B) 1, 7, 3, 6
 (C) 7, 1, 6, 3 (D) 1, 6, 3, 7

- 38** Find D + E + F from the following.

$$\text{D E F} \times \text{D} = 10 \text{ DF}$$

- (A) 12 (B) 4 (C) 3 (D) 5



Previous Contest Questions

- 1** X is the sum of the digits of a 3 digit number subtracted from the number. Which of the following is true ?
 (A) X is divisible by 5.
 (B) X is not divisible by 6.
 (C) X is divisible by 9.
 (D) X is not divisible by 9.
- 2** If $X + X + X = YX$, find the respective values of X and Y.
 (A) 6, 1 (B) 5, 1 (C) 1, 5 (D) 1, 6
- 3** Which of the following is the usual form of $100 \times 8 + 10 \times 5 + 9$?
 (A) 985 (B) 895 (C) 809 (D) 859
- 4** Which of the following integers has the most divisors?
 (A) 88 (B) 91 (C) 99 (D) 101
- 5** Which of the following numbers is exactly divisible by 99?
 (A) 114345 (B) 135792
 (C) 3572404 (D) 913464

- 6** Which is the expanded form of 407?

- (A) $4 \times 100 + 7 \times 10$
 (B) $4 \times 100 + 0 \times 10 + 7 \times 1$
 (C) $4 \times 10 + 7$
 (D) $4 \times 10 + 0 \times 10 + 7 \times 1$

- 7** In the product $BA \times B3 = 57A$, what are the respective positional values of B and A?

- (A) 6, 7 (B) 5, 2 (C) 7, 4 (D) 2, 5

- 8** In which of the following pairs of numbers is it true that their sum is 11 times their product?

- (A) $1, 1/11$ (B) $1, 1/10$
 (C) $1, 1/12$ (D) $1, 10$

- 9** X is a prime number greater than 50 but less than 70. What is the greatest possible value of X?

- (A) 53 (B) 61 (C) 67 (D) 59

- 10** M is a composite number between 70 and 90. Which of the following is the greatest possible value of M?

- (A) 70 (B) 88 (C) 72 (D) 90

- 11** Which of the following is true?

- (A) 7 is the least composite number.

- (B) 53 is the only prime number between 50 and 60.

- (C) 97 is the only prime number between 90 and 100.

- (D) 1 is the least prime number.

- 12** Which of the given statements is false?

- (A) 47 is the largest prime between the numbers 1 and 50.

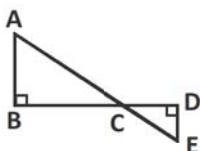
- (B) 89 is the only prime between 85 and 95.

- (C) 99 is the largest composite number less than 100.

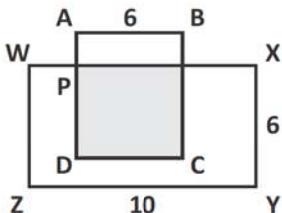
- (D) There are 10 prime numbers between 1 and 20.

Questions@stimulating-minds

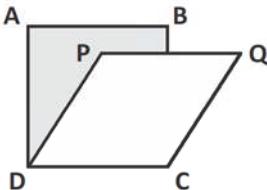
1. A pool has a volume of 4000 l. Sheela starts filling the empty pool with water at a rate of 20 L/min. The pool springs a leak after 20 minutes and water leaks out at 2 l/min. Beginning from the time when Sheela starts filling the empty pool, how long does it take until the pool is completely full?
2. March 3, 2009 or 3/3/09 was called a "square root day" because the day and the month are both the square root of the last two digits of the year. Find the number of square root days between January 1, 2012 and December 31, 2099.
3. In the given figure, AE and BD are straight lines that intersect at C. If $BD = 16$, $AB = 9$, $CE = 5$, and $DE = 3$, what is the length of AC?



4. In the given figure, ABCD is a square with side length 6, and WXYZ is a rectangle with $ZY = 10$ and $XY = 6$. Also, AD and WX are perpendicular. If the shaded area is equal to half of the area of WXYZ, what is the length of AP?



5. Krish and Purab go on a 30 km run. They both usually run at 10 km/h. If Krish runs at $\frac{1}{2}$ his usual running speed, and Purab runs at $1\frac{1}{2}$ times his usual speed, how many more hours does it take Krish to complete the run than it takes Purab to complete the run?
6. In the given figure, ABCD is a square with area 25 cm^2 . If PQCD is a rhombus with area 20 cm^2 , find the area of the shaded region, (in cm^2).



7. In the following equations, the letters a, b and c represent different numbers.

$$1^3 = 1; \quad a^3 = 1 + 7; \quad 3^3 = 1 + 7 + b; \quad 4^3 = 1 + 7 + c$$

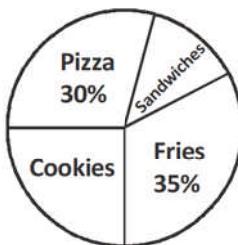
Find the numerical value of $a + b + c$.

8. When $5^{35} - 6^{21}$ is evaluated, what is the units (ones) digit?

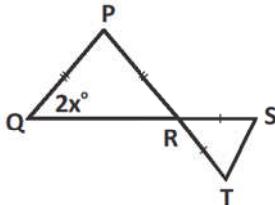
9. Jack and Jill exercise along the same route. Jill jogs the first half of the route at 6 km/h, runs the remainder of the route at 12 km/h and takes a total time of x hours. Jack walks the first third of the route at 5 km/h, runs the remainder at 15 km/h and takes a total time of y hours. Find the value of

$$\frac{x}{y}$$

10. The circle graph shown illustrates the results of a survey taken by the H.S. Student Council to determine the favourite cafeteria food. How many of the 200 students surveyed said that their favourite food was sandwiches?



11. In the given figure R is the point of intersection of PT and QS, PQ = PR, and RS = RT. If $\angle PQR = 2x^\circ$, what is the measure of $\angle RST$, (in degrees)?



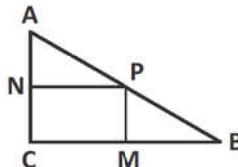
12. On Monday, Harsh drove to work at an average speed 70 km/h and arrived 1 minute late. On Tuesday, he left at the same time and took the same route. This time he drove at an average speed of 75 km/h and arrived 1 minute early. How long is his route to work?

13. If x and y are two-digit positive integers with $xy = 555$, what is $x + y$?

14. Suppose $N = 1 + 11 + 101 + 1001 + 10001 + \dots + \underbrace{1000\dots00001}_{50 \text{ zeroes}}$.

When N is calculated and written as a single integer, what is the sum of its digits?

15. In the diagram, $\triangle ABC$ is right-angled at C. Also, points M, N and P are the midpoints of sides BC, AC and AB, respectively. If the area of $\triangle APN$ is 2 cm^2 , find the area of $\triangle ABC$.



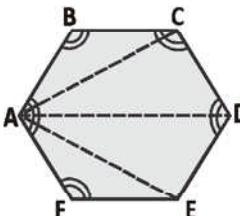
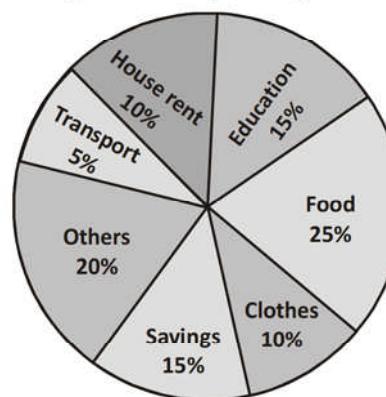
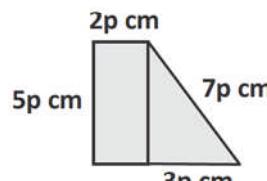


Model Test Paper

Score

25

- 1** If 50 men can do a piece of work in 49 days, in how many days will 35 men do it?
 (A) 60 (B) 76 (C) 70 (D) 84
- 2** Compute the perimeter of the figure to one decimal place.
-
- (A) 56.0 m (B) 56.6 m
 (C) 57.2 m (D) 57.9 m
- 3** X is a two-digit number. Y is the number obtained on reversing the digits of X. Which of the following is true ?
 (A) X + Y is divisible by 10.
 (B) X - Y is divisible by 6.
 (C) X - Y is divisible by 9.
 (D) X + Y is divisible by 8.
- 4** If $\frac{x}{y} = \frac{6}{5}$, what is the value of $\frac{x^2 + y^2}{x^2 - y^2}$?
 (A) $\frac{36}{25}$ (B) $\frac{25}{36}$ (C) $\frac{61}{11}$ (D) $\frac{11}{61}$
- 5** The adjacent sides of a rectangle are $5a^2 - 3b^2$ and $a^2 + 2ab$. What is its perimeter?
 (A) $12a^2 - 6b^2 + 4ab$
 (B) $-12a^2 + 6b^2 + 4ab$
 (C) $12a^2 + 6b^2 - 4ab$
 (D) $12a^2 - 6b^2 - 4ab$
- 6** If ABCD is a parallelogram, what is the difference of $\angle A$ and $\angle C$?
 (A) 180° (B) 0° (C) 360° (D) 90°
- 7** Which is the correct net for the solid with a top opening as given in figure?
-
- (A)
- (B)
- (C)
- (D)
- 8** What is the sum of the greatest and the least numbers of $\frac{5}{9}, \frac{1}{9}$ and $\frac{11}{9}$?
 (A) $\frac{2}{9}$ (B) $\frac{4}{9}$ (C) $\frac{4}{3}$ (D) $\frac{2}{3}$
- 9** When 23 is divided by 3, the remainder is 'x'. What is the remainder when 23 is divided by $2x$?
 (A) 2 (B) 5 (C) 3 (D) 4
- 10** A group of 20 participants entered a quiz competition. Their scores are given in the table.
- | Score | 0 | 1 | 2 | 3 | 4 |
|------------------------|---|---|---|---|---|
| Number of participants | 3 | 5 | 7 | 4 | 1 |
- Calculate the percentage of the participants who scored more than 2 points.
 (A) 5% (B) 15% (C) 25% (D) 60%

- 11** Which of the points given is a point on the Y-axis?
- (A) (5, 0) (B) (6, 5)
 (C) (3, 12) (D) (0, 11)
- 12** Instead of walking along two adjacent sides of a rectangular field, a boy took a short cut along the diagonal and saved a distance equal to half the longer side. What is the ratio of the shorter side to the longer side?
- (A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{1}{4}$ (D) $\frac{3}{4}$
- 13** If the difference between S.I. and C.I. on a certain sum of money for 3 years at 10% p.a. is ₹ 15.50, Find the sum.
- (A) ₹ 1000 (B) ₹ 500
 (C) ₹ 1500 (D) ₹ 2000
- 14** A recipe for French toast needs $\frac{3}{4}$ litres of milk. If you want to make only $\frac{2}{3}$ of the recipe, how much milk should you use?
- (A) $\frac{1}{7} l$ (B) $\frac{1}{5} l$ (C) $\frac{2}{3} l$ (D) $\frac{1}{2} l$
- 15** Find the size of each angle of a regular hexagon.
- 
- (A) 720° (B) 540°
 (C) 120° (D) 60°
- 16** A cycle is sold for ₹ 880 at a loss of 20%. For how much should it be sold to gain 10%?
- (A) ₹ 1400 (B) ₹ 1210
 (C) ₹ 1100 (D) ₹ 1000
- 17** Alice types 150 words in 5 minutes. How long will it take her to type 3500 words?
- (A) 100 min (B) 116.7 min
 (C) 150 min (D) 130 min
- 18** How many 1 cm cubes can fill an empty cube of volume 1 m^3 ?
- (A) 100 (B) 1000
 (C) 1000000 (D) 10000
- 19** The pie chart gives the expenditure (in percentage) on various items and savings of a family during a month.
- 
- | Item | Percentage |
|------------|------------|
| House rent | 10% |
| Transport | 5% |
| Education | 15% |
| Food | 25% |
| Clothes | 10% |
| Savings | 15% |
| Others | 20% |
- On which item was, the expenditure the maximum?
- (A) Food (B) Clothes
 (C) Savings (D) Transport
- 20** Find $\sqrt[3]{x^2 - y^2}$ when $x = 76$ and $y = 49$.
- (A) 125 (B) 27 (C) 15 (D) 25
- 21** If the perimeter of the figure given is 57 cm, find the perimeter of the triangle in the figure.
- 
- (A) 30 cm (B) 45 cm
 (C) 39 cm (D) 3 cm

- 22** In the following, what are the respective values of P, Q and R?

$$\begin{array}{r}
 \begin{array}{rrr} P & Q & R \\ \times P & & \\ \hline 2 & R & 9 & 0 \end{array}
 \end{array}$$

- (A) P = 7, Q = 7, R = 5
 (B) P = 5, Q = 7, R = 5
 (C) P = 5, Q = 8, R = 7
 (D) P = 8, Q = 5, R = 5

- 23** The measures of the angles of a quadrilateral ABCD are respectively in the ratio 1 : 2 : 3 : 4. Which of the following is true?

- (A) AC = BC (B) AB || DC
 (C) AD || BC (D) AB = CD

- 24** A producer blends two qualities of rice, one costing ₹ 12.50 per kg and the other costing ₹ 14 per kg in the ratio 4 : 5. Find his profit percent if he sells the mixture at the rate of ₹ 16 per kg.

- (A) 25% (B) 15% (C) 20% (D) 10%

- 25** If $3a + 2b + c = 22$, $b + c = 8$ and $c = 6$, what is the value of $a + b + c$?

- (A) 12 (B) 6 (C) 2 (D) 4

Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C	B	B	C	A	B	D	C	C	C	D	D	B	D	C	B	B	C	A	C
21	22	23	24	25															
B	B	B	C	A															

Explanatory Answers

1. Rational Numbers

Multiple Choice Questions

1. (D) Every rational number is not a fraction. In rational numbers, we use integers and in fractions, we use only natural numbers.

2. (D) Expressing in standard form, we get $\frac{-8}{9} = \frac{-8}{9}$ and $\frac{4}{-5} = \frac{-4}{5}$

Express each rational number with L.C.M as denominator.

L.C.M of 9 and 5 is $9 \times 5 = 45$.

$$\therefore \frac{-8}{9} = \frac{-8 \times 5}{9 \times 5} = \frac{-40}{45},$$

$$\frac{-4}{5} = \frac{-4 \times 9}{5 \times 9} = \frac{-36}{45}$$

Comparing the numerators, we have $-40 < -36$.

$$\therefore \frac{-40}{45} < \frac{-36}{45} \Rightarrow \frac{-8}{9} < \frac{-4}{5}$$

3. (B) The H.C.F of 28 and 84 such that the numerator is 4 is 7.

So, simplify $\frac{28}{84}$ by dividing its numerator and denominator by 7, to get $\frac{-4}{12}$.

4. (C) Convert the given fractions into equivalent fractions and compare.

$$\frac{-25}{28} < \frac{-1}{2} < \frac{-3}{7} < \frac{-5}{14}$$

5. (D) $\frac{5}{7} = 0.71$; $\frac{7}{9} = 0.77$

$$\frac{9}{11} = 0.81; \frac{11}{13} = 0.84$$

$$\text{So, } \frac{5}{7} < \frac{7}{9} < \frac{9}{11} < \frac{11}{13}.$$

Hence, both (B) and (C) are false.

6. (D) $\frac{1}{4} = 0.25$; $\frac{1}{3} = 0.33$; $\frac{8}{15} = 0.53$

$\frac{7}{24} = 0.29$; $\frac{13}{48} = 0.27$

So, $\frac{7}{24}$ and $\frac{13}{48}$ lie between $\frac{1}{4}$ & $\frac{1}{3}$.

7. (B) 8. (A) 9. (B) 10. (B) 11. (C)

12. (B) $\frac{(-3)}{x} = \frac{x}{(-27)} \Rightarrow x^2 = 81 \Rightarrow x = 9$

13. (C) The descending order is

$$\frac{4}{9}, \frac{2}{5}, \frac{-1}{6}, \frac{-3}{4}, \frac{-6}{7}.$$

\therefore The middle number is $\frac{-1}{6}$.

14. (D) Arranging the given rational numbers in ascending order, we get $\frac{-7}{9}, \frac{-6}{9}, \frac{-4}{9}, \frac{1}{9}, \frac{5}{9}, \frac{8}{9}$.

The two middle rational numbers are $\frac{-4}{9}$ and $\frac{1}{9}$.

Their average is

$$\frac{\frac{-4}{9} + \frac{1}{9}}{2} = \frac{-3}{9} \times \frac{1}{2} = \frac{-1}{6}.$$

15. (B) 16. (B) 17. (A) 18. (C) 19. (A)

20. (A) $\frac{1}{12} + \frac{-1}{3} + \frac{-1}{6} + \frac{-5}{7} + \frac{3}{4} + \frac{10}{7}$

$$= \left(\frac{1}{12} - \frac{1}{3} - \frac{1}{6} + \frac{3}{4} \right) + \left(\frac{10}{7} - \frac{5}{7} \right)$$

$$= \left(\frac{1-4-2+9}{12} \right) + \frac{5}{7} = \frac{1}{3} + \frac{5}{7}$$

$$= \frac{22}{21} = 1\frac{1}{21}$$

21. (D) 22. (D) 23. (A) 24. (B)

25. (B) A rational number between any two rational numbers is obtained by taking their average or mean.

∴ A rational number between -2 and -1 is $\frac{(-2)+(-1)}{2} = \frac{-3}{2}$.

A rational number between -2 and $-\frac{3}{2}$ is $\frac{(-2)+\left(-\frac{3}{2}\right)}{2} = \frac{-7}{4}$.

And a rational number between $-\frac{3}{2}$ and -1 is $\frac{\left(\frac{-3}{2}\right)+(-1)}{2} = \frac{-5}{4}$.

26. (C)
$$\left(\frac{-9}{7} \times \frac{-1}{3}\right) + \left(\frac{15}{8} \times \frac{-4}{5}\right) - \left(\frac{27}{14} \times \frac{2}{9}\right)$$

 $= \frac{3}{7} - \frac{3}{2} - \frac{3}{7} = \frac{-3}{2}$

27. (B) Product $= \frac{5}{9}$
Given number $= -\frac{35}{24}$

∴ The other number
 $= \frac{5}{9} \div \left(\frac{-35}{24}\right)$
 $= \frac{5}{9} \times \frac{24}{35} = \frac{1 \times 8}{3 \times 7} = \frac{8}{-21}$

28. (C) Area of the rectangle
 $= 45 \frac{5}{16} \text{ cm}^2 = \frac{725}{16} \text{ cm}^2$

One edge $= 6 \frac{1}{4} \text{ cm} = \frac{25}{4} \text{ cm}$

The other edge $= \left(\frac{725}{16} \div \frac{25}{4}\right) = 7 \frac{1}{4} \text{ cm}$

29. (B)
$$\frac{\frac{1}{6} - \frac{17}{18}}{\frac{5}{7}} = \left(\frac{1}{6} - \frac{17}{18}\right) \frac{7}{5} = \left(-1 \frac{4}{45}\right)$$

30. (C) Does not exist since division by zero is not defined.

31. (A) Writing each rational number with a positive denominator, we have
 $\frac{-4}{5}, \frac{-9}{15}$ and $\frac{-2}{3}$.

L.C.M of $5, 15$ and 3 is 15 .

$$\therefore \frac{-4}{5} = \frac{(-4) \times 3}{5 \times 3} = \frac{-12}{15}$$

$$\frac{-2}{3} = \frac{(-2) \times 5}{3 \times 5} = \frac{-10}{15}$$

Since $-12 < -10 < -9$, we have

$$\frac{-12}{15} < \frac{-10}{15} < \frac{-9}{15} \Rightarrow \frac{-4}{5} < \frac{-2}{3} < \frac{-9}{15}$$

$$\Rightarrow \frac{-9}{15} > \frac{-2}{3} > \frac{-4}{5}$$

32. (B)
$$\frac{4}{7} + 0 + \frac{-8}{9} + \frac{-13}{7} + \frac{17}{21}$$

 $= \left(\frac{4}{7} + 0\right) + \frac{-8}{9} + \frac{-13}{7} + \frac{17}{21}$

L.C.M of $7, 9$ and $21 = 7 \times 3 \times 3$
 $= 63$

$$\begin{aligned} &= \frac{4}{7} + \frac{-8}{9} + \frac{-13}{7} + \frac{17}{21} \\ &= \left(\frac{4}{7} + \frac{-13}{7}\right) + \frac{-8}{9} + \frac{17}{21} \\ &= \frac{-9}{7} + \frac{-8}{9} + \frac{17}{21} \\ &= \frac{-9 \times 9 + (-8) \times 7 + 17 \times 3}{63} \\ &= \frac{-81 - 56 + 51}{63} \\ &= \frac{-137 + 51}{63} = \frac{-86}{63} \end{aligned}$$

33. (C) The ascending order of given numbers is $\frac{1}{9}, \frac{5}{9}, \frac{11}{9}$.
∴ The required sum

$$= \frac{11}{9} + \frac{1}{9} = \frac{12}{9} = \frac{4}{3}$$

34. (C) Simplify within brackets first and then simplify the resultant.

$$\begin{aligned} & \left(\frac{5}{9} + \frac{15}{36} \right) \div \left(\frac{-5}{6} \right) \\ &= \left(\frac{5}{9} \times \frac{36}{15} \right) \times \left(\frac{6}{-5} \right) = \frac{4}{3} \times \frac{6}{-5} \\ &= \frac{8}{-5} = \frac{-8}{5} \end{aligned}$$

35. (A) $\sqrt{2} \times \sqrt{8} = \sqrt{2 \times 8} = \sqrt{16} = 4$ is a rational number. $\frac{22}{7}$ is in the form of $\frac{p}{q}$ where p and q are integers and $q \neq 0$.

Therefore $\sqrt{2} \times \sqrt{8}$ and $\frac{22}{7}$ are rational numbers.

Previous Contest Questions

1. (D) 2. (B) 3. (B) 4. (B) 5. (B)
6. (D) Let 'x' be the required number.

$$\text{Then, } x \times \frac{5}{4} = \frac{15}{16}$$

$$\Rightarrow x = \frac{15}{16} \div \frac{5}{4} = \frac{15}{16} \times \frac{4}{5} = \frac{3}{4}$$

7. (A) Let the number to be added be x.
According to the problem,

$$\frac{1}{8} + x = \frac{5}{18}$$

$$\Rightarrow x = \frac{5}{18} - \frac{1}{8} = \frac{11}{72}$$

8. (D) Quantity of milk required for a recipe = $\frac{3}{4} l$.

The amount of milk required for $\frac{2}{3}$

$$\text{of recipe} = \left(\frac{2}{3} \times \frac{3}{4} \right) l = \frac{1}{2} l$$

9. (C) Express $\frac{-3}{4}, \frac{-1}{2}, \frac{3}{8}$ and $\frac{5}{6}$ with a common denominator and compare them.

10. (A) Let x be the required number.

$$\text{So, } x + \left(\frac{-3}{5} \right) = -5$$

$$x = -5 + \frac{3}{5} = \frac{-25 + 3}{5} = \frac{-22}{5} = -4\frac{2}{5}$$

2. Linear Equations in one Variable

Multiple Choice Questions

1. (C) $\frac{x-5}{2} - \frac{x-3}{5} = \frac{1}{2}$
 $\Rightarrow \frac{5x-25-2x+6}{10} = \frac{1}{2}$
 $\Rightarrow x = 8$
2. (A) $\frac{2x+1}{3x-1} = \frac{3}{2}$
 $\Rightarrow x = 1$
3. (B) Let the required number be 'x'.
 Then, $\frac{3x}{4} - \frac{3x}{14} = 150$
 $\Rightarrow x = \frac{150 \times 28}{15} = 280$

4. (D) Let the number be x.
 $\frac{2x}{3} \times \frac{3x}{4} = 338 \quad \Rightarrow x^2 = 676$

$$\Rightarrow x = \sqrt{676} = 26$$

5. (D) $3\frac{1}{x} \times 3\frac{3}{4} = 12\frac{1}{2}$
 $\Rightarrow \left(\frac{3x+1}{x} \right) \times \frac{15}{4} = \frac{25}{2}$
 $\Rightarrow x = 3$

6. (B) Given equation is $\frac{p-3}{p+4} = \frac{p+1}{p-2}$.
 On cross multiplication, we get
 $(p-3)(p-2) = (p+1)(p+4)$
 $\Rightarrow p^2 - 5p + 6 = p^2 + 5p + 4$
 $\Rightarrow p^2 - 5p + 6 - p^2 - 5p - 4 = 0$
 $\Rightarrow -10p + 2 = 0$
 $\Rightarrow p = \frac{-2}{-10} = \frac{1}{5}$.
 So, Qadir's answer was correct.

7. (B) Let the number be 'x'. We have,

$$\frac{75x}{100} + 75 = x \Rightarrow \frac{25x}{100} = 75 \\ \Rightarrow x = 300$$

8. (C) Let the maximum number of marks be 'x'.

$$\text{We have, } \frac{40x}{100} = 30 + 50 \\ \Rightarrow x = 200$$

9. (A) Let the three consecutive even numbers be $2x - 2$, $2x$ and $2x + 2$. We have,

$$(2x - 2) + 2x + (2x + 2) = 234$$

$$\Rightarrow 6x = 234 \Rightarrow x = 39$$

$$\therefore \text{The least even number} \\ = 2x - 2 = 2(39) - 2 = 76$$

10. (A) Let the cost of the scooter be ₹ $9x$ and the cost of the cycle be ₹ $5x$.

$$\text{We have, } 9x - 5x = 4200 \quad x = 1050$$

$$\text{Cost of the cycle} = 5 \times 1050 = ₹ 5250$$

11. (B) Let the numbers be $2x$ and $7x$.

$$2x + 7x = 351 \Rightarrow x = 39$$

$$\text{Product} = 2x \times 7x = 14 \times (39)^2$$

$$= 21294$$

12. (D) Let the speed of the boat in still water be 'x' kmph.

The speed downstream = $(x + 2)$ kmph

The speed upstream = $(x - 2)$ kmph

$$\text{We have, } 4(x + 2) = 5(x - 2)$$

$$\Rightarrow 4x + 8 = 5x - 10$$

$$\Rightarrow x = 10 + 8 \text{ kmph}$$

$$\Rightarrow x = 18 \text{ kmph}$$

13. (A) Let the number be 'x'.

$$\frac{2}{3}x = x - 20 \Rightarrow x - \frac{2}{3}x = 20 \\ \Rightarrow x = 60$$

14. (B) Let the number be 'x'.

According to the given problem,

$$4x + 10 = 5x - 5$$

$$\Rightarrow x = 15$$

15. (C) $x + 8\% \text{ of } 'x' = 135$

$$\Rightarrow \frac{108x}{100} = 135$$

$$\Rightarrow x = 135 \times \frac{100}{108} = 125$$

16. (A) 17. (A) 18. (D) 19. (A) 20. (A)

$$21. (A) \frac{2x}{5} = \frac{10}{3}$$

On cross multiplying, we get
 $6x = 50$

$$\therefore x = \frac{50}{6} = \frac{25}{3}$$

$$22. (D) 9 - 7x = 5 - 3x \\ \Rightarrow -7x + 3x = 5 - 9 \\ \Rightarrow -4x = -4$$

$$\Rightarrow x = \frac{-4}{-4} = 1$$

23. (C) Let the two numbers be x and y . Then, $x + y = 35$ (1)

$$x - y = 13 \quad \dots \dots \quad (2)$$

Adding equations (1) and (2), we get $2x = 48 \Rightarrow x = 24$

Subtracting equation (2) from (1), we get $2y = 22 \Rightarrow y = 11$

Hence, the two numbers are 24 and 11.

$$24. (B) 1.32y + 0.02y = 1.19 + y$$

$$\Rightarrow 1.34y = 1.19 + y$$

$$\Rightarrow 1.34 - y = 1.19$$

$$\Rightarrow 0.34y = 1.19$$

$$\Rightarrow y = \frac{1.19}{0.34} = \frac{119}{34} = \frac{7}{2}$$

$$\therefore y = 3\frac{1}{2}$$

25. (D) Let one of the numbers be 'x'.

Then the second number = $3x$

By the given condition,
 one number + 15 =

$$2(\text{second number} + 15)$$

$$\text{i.e., } 3x + 15 = 2(x + 15)$$

$$\Rightarrow x = -3$$

Hence, if one number is 15 the other number is $3 \times 15 = 45$. (or)

if one number is -3 , the second number is $3 \times (-3) = -9$.

\therefore Of the given options 15 and 45 are the required numbers.

26. (A) Let the length of the garden be 'x' m.

$$\text{Then, breadth} = \frac{2}{3} x \text{ m}$$

$$\text{Perimeter} = 2(\text{length} + \text{breadth})$$

$$= 2\left(x + \frac{2}{3}x\right)$$

$$\therefore 2x + 2\left(\frac{2x}{3}\right) = 40$$

$$\Rightarrow 2x + \frac{4x}{3} = 40$$

(Given : Perimeter is 40 m.)

$$\Rightarrow 6x + 4x = 120 \Rightarrow 10x = 120$$

$$\therefore x = \frac{120}{10} = 12$$

\therefore Length is 12 m and breadth is

$$\frac{2}{3} \times 12 = 8 \text{ m}$$

27. (B) Let the number of correct answers be 'x'. Then the number of incorrect answers is $24 - x$.

The boy gets 3 marks for correct answers and loses 2 marks for wrong answers.

\therefore Total marks

$$= 3x - 2(24 - x) = 37 \text{ (Given)}$$

$$\Rightarrow 3x - 48 + 2x = 37$$

$$\Rightarrow 5x = 37 + 48$$

$$\Rightarrow x = 17$$

\therefore The number of correct sums is 17.

28. (B) 29. (D) 30. (A) 31. (C) 32. (D)

33. (B) The two digit number is as given in the following box.

Tens	Units
t	u

If 1 is placed between the digits, the three digit number formed is as shown.

Hundreds	Tens	Units
t	1	u

\therefore Its value is $100t + 10 + u$.

34. (C) $\frac{15}{100} \times 400 = 60$

$$\frac{60+x}{400+x} \times 100 = 32$$

$$\Rightarrow \frac{60+x}{400+x} = \frac{32}{100} = \frac{8}{25}$$

$$\Rightarrow x = 100 \text{ ml}$$

35. (C) Let us consider an example.

Consider the two-digit number 25. The number obtained on reversing the digits is 52.

$$\text{Their difference} = 52 - 25 = 27$$

27 is divisible by 9.

Previous Contest Questions

1. (B) $\frac{-6p - 9}{3} = \frac{2p + 9}{5}$

On cross multiplying, we get

$$5(-6p - 9) = 3(2p + 9)$$

$$\Rightarrow p = -\frac{72}{36} = -2$$

$$\Rightarrow p = -2$$

2. (D) According to the problem,

$$8 + \frac{m}{5} = 4 - 3m$$

$$\Rightarrow m = -\frac{5}{4}$$

3. (A) Let the total marks be 'x'. According to the problem,

$$\frac{5}{6}x = 80 \Rightarrow x = 80 \times \frac{6}{5} = 96$$

4. (A) Let the four consecutive odd numbers be $x, x+2, x+4$ and $x+6$.

$$\text{Their sum} = 40$$

$$\Rightarrow x + x + 2 + x + 4 + x + 6 = 40$$

$$\Rightarrow x = 7$$

5. (D) Volume of the cuboid = 180 cm^3
 From the figure, volume is
 $(p + 3)(9)(4)$
 $\Rightarrow 36(p + 3) = 180$
 $\Rightarrow p + 3 = 5$
 $\Rightarrow p = 2$

6. (C) Let the numbers be 'x' and 'y'.
 Then $x + y = 10$ and $x = 6 + 2y$.

$$\begin{aligned}\Rightarrow 6 + 2y + y &= 10 \\ \Rightarrow 3y &= 10 - 6 \\ \Rightarrow y &= \frac{4}{3}\end{aligned}$$

$$\therefore x = 6 + 2\left(\frac{4}{3}\right) = 6 + \frac{8}{3} = \frac{26}{3}$$

Therefore, the required difference

$$= \frac{26}{3} - \frac{4}{3} = \frac{22}{3} = 7\frac{1}{3}$$

7. (B) According to the problem,
 $2p + 10 = 16$

$$\Rightarrow 2p = 6 \Rightarrow p = 3$$

$$\therefore 2p - 10 = 2(3) - 10 = -4$$

8. (C) $5n - 4 = n - 1$

$$\Rightarrow 4n = 3 \Rightarrow n = \frac{3}{4}$$

9. (A) Perimeter of the rectangle = 60 cm
 From the figure, length is $(3k - 2)$ cm and breadth is $(k + 4)$ cm

$$\therefore 2[(3k - 2) + (k + 4)] = 60$$

$$\Rightarrow 2[4k + 2] = 60$$

$$\Rightarrow 4k + 2 = 30$$

$$\Rightarrow 4k = 28$$

$$k = \frac{28}{4} = 7$$

10. (A) Given $3a + 2b + c = 22$

$$b + c = 8 \text{ and } c = 6$$

$$\text{Therefore, } b = 8 - c = 8 - 6 = 2$$

$$\text{and } a = \frac{22 - c - 2b}{3}$$

$$= \frac{22 - 10}{3} = \frac{12}{3} = 4$$

$$\begin{aligned}\text{Hence } a + b + c &= 4 + 2 + 6 = 12 \\ &= ₹ 5306.04\end{aligned}$$

3. Understanding Quadrilaterals

Multiple Choice Questions

1. (D) 2. (B) 3. (C) 4. (A) 5. (B)
 6. (D) Since diagonals of a square are equal and bisect at right angles, triangle AOB is an isosceles right angled triangle.

7. (A) Let one side of the parallelogram be 'x' cm. Then adjacent side is $(x + 10)$ cm.
 \therefore Perimeter
 $= x + (x + 10) + x + (x + 10) = 180$
 (Given)

$$\Rightarrow 4x + 20 = 180$$

$$\text{or } x = 40 \text{ cm}$$

$$\therefore x + 10 = 50 \text{ cm}$$

8. (A) A quadrilateral in which the diagonals are equal and perpendicular is called a square.

9. (A) As shown in the figure, since P is the midpoint of AB and $AB = 2AD$, we have $AB = 2AP = 2AD$
 or $AP = AD$.

i.e., triangle ADP is an isosceles triangle. If $\angle ADP = x^\circ$ and $\angle APD = x^\circ$, then $\angle A = 180^\circ - 2x^\circ$.

Since $\angle B$ is adjacent to $\angle A$, in ABCD

$$\angle B = 180^\circ - (180^\circ - 2x) = 2x.$$

In $\triangle CBP$, $x^\circ + x^\circ + 2x^\circ = 180^\circ$
 (Angle sum property)

$$\Rightarrow 4x^\circ = 180^\circ \Rightarrow x^\circ = 45^\circ$$

$$\begin{aligned}\therefore \angle CPD &= 180^\circ - 2x^\circ \\ &= 180^\circ - 2 \times 45^\circ = 90^\circ\end{aligned}$$

10. (C) We know that in a parallelogram opposite sides are equal.

$$\therefore AB = CD \text{ or } 2x + 5 = y + 1$$

$$\text{and } AD = BC \text{ or } y + 5 = 3x - 4$$

$$2x - y = -4 \dots \text{(i)}$$

$$y - 3x = -9 \dots \text{(ii)}$$

Adding (i) and (ii), we get

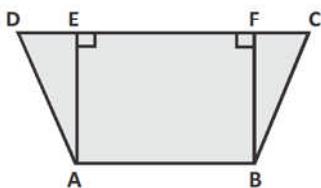
$$-x = -13 \text{ or } x = 13 \text{ and } y = 30.$$

Substituting, we have

$$AB = 31 \text{ cm and } BC = 35 \text{ cm}$$

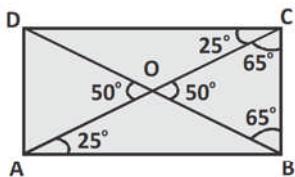
$$\therefore \text{The required ratio} = 31 : 35$$

11. (C)



From definition, we know that in an isosceles trapezium the non-parallel sides are equal or $AD = BC$ in the figure. Drop perpendiculars AE and BF to CD . Triangles AED and BFC are congruent by R.H.S congruency. Hence, $\angle D = \angle C$.

12. (C)



Since $\angle CAB = 25^\circ$ $\angle OCB = 65^\circ$.

Let diagonals meet at O. $\triangle OCB$ is an isosceles triangle.

$$\therefore \angle OBC = 65^\circ \Rightarrow \angle BOC = 50^\circ$$

13. (C) Let the angles be $3x, 7x, 6x$ and $4x$.

$$\therefore 3x + 7x + 6x + 4x = 360^\circ$$

$20x = 360^\circ$ or $x = 18^\circ$. The angles are $54^\circ, 126^\circ, 108^\circ$ and 72° . We see that adjacent angles are supplementary but opposite angles are not equal. Clearly, it is a trapezium.

14. (D) Since the angle in a semicircle is a right angle, clearly

$$\angle A = \angle C = \angle B = \angle D = 90^\circ.$$

The diagonals (diameters) are equal but they are not intersecting (bisecting) at right angles. Hence, it is not a square and can be only a rectangle.

15. (A) Let the angles be $3x$ and $2x$.

$$\text{We have, } 3x + 2x = 180^\circ$$

$$\Rightarrow 5x = 180^\circ$$

$$\Rightarrow x = 36^\circ$$

$$\therefore \text{The angles are } 36^\circ \times 3 \text{ and } 36^\circ \times 2 = 108^\circ \text{ and } 72^\circ.$$

16. (B) In the given figure,

$$\angle ABF + \angle FBC = 180^\circ$$

$$70^\circ + \angle FBC = 180^\circ$$

$$\Rightarrow \angle FBC = 180^\circ - 70^\circ = 110^\circ$$

$$\text{Now, } \angle DEC + \angle CEF = 180^\circ$$

$$\angle CEF = 180^\circ - 60^\circ = 120^\circ$$

$$\text{Now, } \angle FBC + \angle BCE + \angle CEF + \angle BFE = 360^\circ$$

$$290^\circ + x = 360^\circ \Rightarrow x = 70^\circ$$

17. (B) \overline{OD} is half of the diagonal \overline{BD} .

\overline{OA} is half of the diagonal \overline{AC} .

Diagonals are equal.

So, their halves are also equal.

$$\text{Therefore, } 3x + 1 = 2x + 4$$

$$\Rightarrow x = 3.$$

18. (B) $x = OB = OD$ (Diagonals bisect) = 5

$$y = OA = OC$$
 (Diagonals bisect) = 12

$$z = \text{side of the rhombus} = 13$$

(All sides are equal).

19. (B) C is opposite to A.

So, $x = 100^\circ$ (Opposite angles property.)

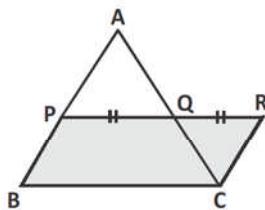
$y = 100^\circ$ (Measure of angle corresponding to $\angle x$.)

$z = 80^\circ$ (Since $\angle y, \angle z$ is a linear pair)

20. (C) $BDC = AED = 36^\circ$
 (Corresponding s, AE BD.)
 $ABD = BDC = 36^\circ$
 (Alternate s, AB DC)
 $ADB = ABD = 36^\circ$
 (Base angles of isosceles , since AB = DC)
 $BAD = 180^\circ - ABD - ADB$
 (Angle sum of a triangle.)
 $= 180^\circ - 36^\circ - 36^\circ$
 $= 108^\circ$
21. (D) The pentagon can be divided into 3 triangles by joining the vertex A to C and D (See the figure).
 Angle sum of 1 triangle = 180°
 Angle sum of 3 triangles
 $= 3 \times 180^\circ = 540^\circ$
 Sum of the four equal angles
 $= 540^\circ - 120^\circ = 420^\circ$
 Each equal angle
 $= 420^\circ \div 4 = 105^\circ$
22. (B) Let the polygon have 'n' sides.
 Sum of the interior angles
 $= (n - 2) \times 180^\circ$
 $\therefore n \times 150^\circ = (n - 2) \times 180^\circ$
 $\Rightarrow 150n = 180n - 360^\circ$
 $\Rightarrow n = 12$
23. (A) 24. (C) 25. (B) 26. (C) 27. (D)
28. (A) Five independent measurements determine a quadrilateral uniquely.
29. (B) 30. (B) 31. (A) 32. (C)
33. (B) 34. (B) 35. (A)

☛ Previous Contest Questions

1. (D) Since P and Q are mid points of AB and AC, $PQ = \frac{1}{2} BC$ and $PQ \parallel BC$.



So, $BC = 2PQ = PR$
 Hence, $PRCB$ is a parallelogram.

2. (A) Let the three equal angles of the quadrilateral be x° each.
 The sum of all angles is 360° .
 Given that fourth angle is 120° .
 $\therefore x^\circ + x^\circ + x^\circ + 120^\circ = 360^\circ$
 $\Rightarrow 3x^\circ = 360^\circ - 120^\circ = 240^\circ$
 $\Rightarrow x = 80^\circ$
3. (B) Each of the three acute angles is 75° .
 Let the fourth angle be x° .
 Then $3 \times 75^\circ + x^\circ = 360^\circ$ (Sum of angles of a quadrilateral.)
 $\Rightarrow 225^\circ + x^\circ = 360^\circ$
 $\Rightarrow x^\circ = 360^\circ - 225^\circ$
 $\Rightarrow x^\circ = 135^\circ$
4. (A) $\angle STP = 180^\circ - 85^\circ = 95^\circ$
 Sum of all interior angles of 'n' sided polygon
 $= (n - 2) \times 180^\circ$
 $= (5 - 2) \times 180^\circ = 3 \times 180^\circ = 540^\circ$
 $\Rightarrow x + 90^\circ + 125^\circ + 130^\circ + 95^\circ = 540^\circ$
 $\Rightarrow x + 440^\circ = 540^\circ$
 $\Rightarrow x = 540^\circ - 440^\circ = 100^\circ$
5. (C) Since $\triangle ABC$ is equilateral,
 $\angle CBA = 60^\circ$.
 BE is the diagonal of square ABDE
 $\Rightarrow \angle ABE = \frac{90^\circ}{2} = 45^\circ$
 Therefore, the angle marked x in the figure is $360^\circ - (60^\circ + 45^\circ)$
 $= 360^\circ - 105^\circ = 255^\circ$
6. (D) 7. (C) 8. (C) 9. (C)

4. Data Handling

Multiple Choice Questions

1. (D) 'x' is the number of families with less than 3 children, i.e., the number of families with no children, (= 0 children), 1 child and 2 children.

$$\therefore x = 2 + 5 + 11 = 18$$
2. (B) No. of families which have more than 2 children = $6 + 2 = 8$
 Total number of families
 $= 1 + 4 + 7 + 6 + 2 = 20$
 \therefore The required percentage
 $= \frac{8}{20} \times 100\% = 40\%$
3. (B) 4. (C) 5. (C) 6. (D) 7. (C)
8. (C) The difference between the highest number and the lowest number of cell phones sold = $15 = (8 - 3)$ units
 $\therefore 1$ unit = 3 cell phones.
 \therefore No. of cell phones sold on Thursday = $6 \times 3 = 18$
9. (D) The outcomes of an event with the same probability of occurrence are called equally likely outcomes.
10. (A) No. of T.V sets sold in May = 50
 Total number of T.V. sets sold
 $= 40 + 20 + 60 + 30 + 50 = 200$
 \therefore The required percentage
 $= \frac{50}{200} \times 100\% = 25\%$
11. (D) 12. (B) 13. (B) 14. (C) 15. (B)
16. (D) $x^\circ + 90^\circ + 2x^\circ + 60^\circ = 360^\circ$
 $\Rightarrow x = 70^\circ$
 $R = 2x^\circ = 140^\circ$
 $60^\circ \rightarrow 18$ participants
 $140^\circ \rightarrow ?$
 $\Rightarrow \frac{140^\circ \times 18}{60^\circ} = 42$ participants
17. (B) The semicircular region is divided into 6 equal parts (sectors).

Therefore, each sector has a central angle of 30° . Angle of sector representing Dell laptops sold

$$= \frac{40}{120} \times 360^\circ = 120^\circ = 4 \times 30^\circ$$

In the pie chart $\angle ROV = 4 \times 30^\circ$

So, $\angle ROV$ gives the angle of the sector representing the number of Dell laptops sold.

18. (A) Enrolment of Class VIII = $1 + 5 + 10 + 9 + 7 + 5 + 3 = 40$
19. (B) The maximum number of pupils have families with 4 members.
 Hence, $n = 4$.
20. (C) Number of pupils with 5-member families = 9
 Total number of people in 5-member families = $9 \times 5 = 45$
21. (D) 22. (A) 23. (B) 24. (D) 25. (C)
26. (B) Flats with fewer than 4 occupants are those with 1, 2 or 3 occupants.
 Number of flats with fewer than 4 occupants = $2 + 5 + 8 = 15$
 Total number of flats = $2 + 5 + 8 + 14 + 12 + 9 + 4 = 54$
 Percentage of flats with fewer than 4 occupants
 $= \frac{15}{54} \times 100\% = 27.8\%$ (3 significant figures)
27. (B) Total number of students = $45 + 60 + 80 + 15 = 200$
 Angle of sector for grade A
 $= \frac{\text{Number of students with grade A}}{\text{Total number of students}} \times 360^\circ$
 $= \frac{45}{200} \times 360^\circ = 81^\circ$
28. (A) 29. (B) 30. (C) 31. (D) 32. (A)

Previous Contest Questions

1. (D) 2. (C) 3. (D) 4. (C) 5. (B)
6. (A) From the given bar chart, it is clear that each square represents 2 units since the 6 computers sold in 1998 is represented by a bar extending 3 squares.

So, the length (or height) of the bar for the year 1995 must be $\frac{18}{2} = 9$ squares.

But the bar is drawn to a height of 7 squares.

7. (B) No. of students who secured less than 20 marks = $6 + 12 = 18$.
18 students failed in the test.

8. (A) No. of students who secured marks between 30 and 50 = $24 + 18 = 42$.

9. (B) $90 — 180$
? — 400
 $\Rightarrow 400 \times \frac{90^\circ}{180} = 200^\circ$

Angle of sector showing oranges = 200°

$$\therefore 90^\circ + 200^\circ + x^\circ = 360^\circ$$

$$\Rightarrow x = 360^\circ - 290^\circ = 70^\circ$$

10. (A) 11. (A) 12. (B) 13. (D) 14. (B)

5. Squares and Square roots

Multiple Choice Questions

1. (A) 2. (D) 3. (B) 4. (C) 5. (B) 6. (A)

7. (A) $\sqrt{1 + \frac{27}{169}} = \sqrt{\frac{196}{169}} = \frac{14}{13}$
 $= 1\frac{1}{13} = 1 + \frac{1}{13} \Rightarrow x = 1$

8. (C) We have, $(n+1)^2 - n^2 = (n+1) + n$.
So, $(501)^2 - (500)^2 = 501 + 500 = 1001$

9. (A) General form of Pythagorean triplet is $(2m, m^2 - 1, m^2 + 1)$.

Let $m = 3$.

Then $2m = 6$, $m^2 - 1 = 3^2 - 1 = 8$ and $m^2 + 1 = 3^2 + 1 = 10$.

$\therefore (6, 8, 10)$ is a Pythagorean triplet.

10. (D) The given expression is the sum of 13 odd numbers.

So, the required value is $13^2 = 169$.

11. (B) 12. (A) 13. (C) 14. (D) 15. (B)

16. (A) By checking the given options only (A) has a number that satisfies the given conditions as $1681 = 41^2$.

17. (C) Let 'x' be the required number. Then $x^2 - x = 12$

$$\Rightarrow x(x-1) = 12$$

By inspection, we have

$$4(4-1) = 12$$

$$\Rightarrow 4 \times 3 = 12$$

$$\Rightarrow x = 4$$

18. (A) $17^2 - 13^2 = 289 - 169 = 120$
 $120 + 1 = 121 = 11^2$
 \therefore The required number is 1.

19. (D) $\sqrt{\frac{16}{49}} = \frac{4}{7} = \frac{x}{49}$
 $\Rightarrow x = 28$

20. (A) Length of each side of the square field

$$= \sqrt{80 \frac{244}{729}} = \sqrt{\frac{58564}{729}} = \frac{242}{27} = 8.96 \text{ m}$$

21. (D) $\sqrt{2^n} = 64 = 2^6 \Rightarrow 2^{\frac{n}{2}} = 2^6$

So, $\frac{n}{2} = 6$ or $n = 12$.

22. (C) $\sqrt{\frac{36.1}{102.4}} = \sqrt{\frac{361}{1024}} = \frac{19}{32}$

23. (A) Given $\frac{x}{\sqrt{2.25}} = 550$.

Then, $\frac{x}{1.5} = 550$.

$$\therefore x = 550 \times 1.5 = \left(\frac{550 \times 15}{10} \right) = 825$$

24. (C) $\sqrt{\frac{8}{3}} = \frac{\sqrt{8}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{24}}{3} = \frac{4.899}{3} = 1.633$

25. (A) $\frac{\sqrt{4}}{\sqrt{3}} - \frac{\sqrt{3}}{\sqrt{4}} = \frac{2}{\sqrt{3}} - \frac{\sqrt{3}}{2}$
 $= \frac{4-3}{2\sqrt{3}} = \frac{1}{2\sqrt{3}}$

26. (B) Given expression

$$\begin{aligned} &= \frac{\sqrt{0.0009}}{\sqrt{0.01}} = \frac{\sqrt{0.0009}}{\sqrt{0.0100}} \\ &= \sqrt{\frac{9}{100}} = \frac{\sqrt{9}}{\sqrt{100}} = \frac{3}{10} = 0.3 \end{aligned}$$

27. (B) $\sqrt{2401} = \sqrt{7^x} \Rightarrow 7^x = 2401 \Rightarrow x = 4$
 28. (D) 29. (C) 30. (C) 31. (D) 32. (B)
 33. (C)

☛ Previous Contest Questions

1. (C) $\sqrt{\frac{0.289}{0.00121}} = \sqrt{\frac{0.28900}{0.00121}} = \sqrt{\frac{28900}{121}}$
 $= \frac{\sqrt{28900}}{\sqrt{121}} = \frac{170}{11}$

2. (A) $75.24 + x = 8.71 \times 8.71$
 $\Rightarrow x = 0.6241$

3. (C) $\frac{1}{\sqrt{3}} = \frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$
 $= \frac{1.732}{3} = 0.577$

4. (A) 5. (D) 6. (D) 7. (C)

6. Cubes and Cube roots

☛ Multiple Choice Questions

1. (C) $72 = 2 \times 2 \times 2 \times 3 \times 3$

If $K = 3$,

$72K = 72 \times 3 = 216 = 6^3$ is a perfect cube.

2. (A) $a = 6$ as $6^3 = 3^3 + 4^3 + 5^3$

3. (C) $1331 = 11^3$, $216 = 6^3$ and $512 = 8^3$.

But, 243 is not a perfect cube.

4. (B) $2560 = 2 \times 2 \times 2 \times 4 \times 4 \times 4 \times 5$

Clearly, on multiplication by $5 \times 5 = 25$, it becomes a perfect cube.

5. (A) $8788 = 4 \times 13 \times 13 \times 13$

On division by 4 it becomes a perfect cube.

6. (D) $\sqrt[3]{1.331} = \sqrt[3]{(1.1)^3} = 1.1$

7. (B) $\sqrt[3]{343} \times \sqrt[3]{-64} = \sqrt[3]{343 \times -64}$
 $= -\sqrt[3]{7 \times 7 \times 7 \times 4 \times 4 \times 4}$
 $= -7 \times 4 = -28$

8. (A) 9. (A) 10. (C) 11. (B) 12. (D)

13. (A) $\sqrt[3]{0.001728} = \sqrt[3]{(0.12)^3} = 0.12$

14. (B) $\sqrt[3]{-2744} \div \sqrt[3]{0.008} = (-14) \div 0.2$
 $= -70$

15. (A) $21952 = 2^3 \times 2^3 \times 7^3$

$$\therefore \sqrt[3]{21952} = \sqrt[3]{2^3 \times 2^3 \times 7^3}$$

 $= 2 \times 2 \times 7 = 28$

\therefore The required units digit is 8.

16. (D) According to the problem if 'x' is the number, then $\sqrt[3]{x+25}$ is 5
 $\Rightarrow \sqrt[3]{x} = 125 \Rightarrow x = 125^3$

17. (A) $864 \times 2 = 1728 = 12^3$ which is a perfect cube. Hence, the smallest possible value of 'n' is 2.

18. (B) 126 ends in 6. So its cube also ends in 6.

19. (D) 20. (A) 21. (D) 22. (C) 23. (A)

24. (D) $\sqrt[3]{\frac{343 \times 125}{0.064}} = \sqrt[3]{\frac{7^3 \times 5^3}{(0.4)^3}}$

$$= \frac{7 \times 5}{0.4} = \frac{7 \times 5 \times 10^5}{4^2} = \frac{175}{2} = 87.5$$

25. (A) Volume of the metallic cuboid
 $= 16 \times 8 \times 4 \text{ cm}^3 = 512 \text{ cm}^3$

$$\therefore \text{The edge of the cube} = \sqrt[3]{512} = 8 \text{ cm.}$$

26. (C) Edge of the cube = 15 cm
 \Rightarrow Its volume = $15^3 \text{ cm}^3 = 3375 \text{ cm}^3$

27. (B) Volume of the liquid in the jar = 200 cm^3 .

Side of the immersed cube = 7 cm
 \Rightarrow Its volume = $7^3 \text{ cm}^3 = 343 \text{ cm}^3$

Therefore, the reading on the measuring jar is $200 + 343 \text{ cm}^3 = 543 \text{ cm}^3$

28. (D) Volume of the material used
 $= \text{volume of the cube} = 4913 \text{ cm}^3$
 $\therefore \text{The length of its edge}$
 $= \sqrt[3]{4913} = 17 \text{ cm}$

29. (B) 30. (A) 31. (B) 32. (C) 33. (B)

☛ Previous Contest Questions

1. (B) $\sqrt[3]{0.125} + 3 = 0.5 + 3 = 3.5$

2. (D) $\sqrt[3]{-3\frac{3}{8}} = \sqrt[3]{-\frac{27}{8}} = \sqrt[3]{-\frac{3^3}{2^3}} = \frac{-3}{2}$

3. (B) $\sqrt[3]{\frac{-192}{81}}$
 $= \sqrt[3]{\frac{(-2) \times (-2) \times (-2) \times 2 \times 2 \times 2 \times 3}{3 \times 3 \times 3 \times 3}}$
 $= \frac{-2 \times 2}{3} = \frac{-4}{3}$

4. (C) $\sqrt[3]{216} = 2 \times 3 = 6$

5. (A) $\sqrt[3]{512} \times \sqrt[3]{3.375} = 8 \times 1.5 = 12$

6. (D) $\sqrt[3]{x} = -6$
 $\Rightarrow x = (-6)^3 = (-6) \times (-6) \times (-6)$
 $= -216$

7. (D) Volume of cube $= 9 \times 9 \times 9 \text{ m}^3$
 $= 729 \text{ m}^3$

7. Comparing Quantities

- ☛ Multiple Choice Questions
1. (C) 2. (D) 3. (D) 4. (D) 5. (D)

6. (C) $A = ₹ 25000 \left(1 + \frac{20}{200}\right)^3$
 $= ₹ 25000 \times \left(\frac{11}{10}\right)^3 = ₹ 33275$

7. (B) $₹ 1331 = ₹ 1000 \left(1 + \frac{10}{100}\right)^n$
 $\Rightarrow \frac{1331}{1000} = \left(\frac{11}{10}\right)^n$
 $\Rightarrow \left(\frac{11}{10}\right)^3 = \left(\frac{11}{10}\right)^n \Rightarrow n = 3 \text{ years}$

8. (A) Population after 3 years
 $= P \left(1 + \frac{p}{100}\right) \left(1 + \frac{q}{100}\right) \left(1 + \frac{r}{100}\right)$

$$= 25000 \times \left(1 + \frac{4}{100}\right) \times \left(1 + \frac{5}{100}\right) \times \left(1 + \frac{8}{100}\right)$$

$$= 25000 \times \frac{26}{25} \times \frac{21}{20} \times \frac{27}{25} = 29484$$

9. (B) $A = P \left(1 - \frac{R}{100}\right)^n$
 $\Rightarrow ₹ 9680 = P \left(1 - \frac{12}{100}\right)^3$
 $\Rightarrow P = ₹ 9680 \times \frac{25}{22} \times \frac{25}{22}$
 $= ₹ 12500$

10. (D) Value of the vehicle after 3 years
 $= ₹ 175000 \times \left(1 - \frac{20}{100}\right)^3$
 $= ₹ 175000 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5}$
 $= ₹ 89600$
 $\therefore \text{Total depreciation}$
 $= ₹ (175000 - 89600)$
 $= ₹ 85400$

11. (C) 12. (B) 13. (D) 14. (C) 15. (A)

16. (C) $A = P \left(1 + \frac{p}{100}\right) \left(1 + \frac{q}{100}\right)$
 $A = ₹ 12500 \times \left(1 + \frac{15}{100}\right) \times \left(1 + \frac{16}{100}\right)$
 $= ₹ 12500 \times \frac{115}{100} \times \frac{116}{100}$
 $= ₹ 16675$

17. (A) Profit % $= \frac{\text{S.P.} - \text{C.P.}}{\text{C.P.}} \times 100\%$
 $= \frac{17.28 - 16.20}{16.20} \times 100\% = 6\frac{2}{3}\%$

18. (B) A woman bought 3 toffees at 25 paise each. So she spent 75 paise and 3 for 65 paise, then totally for 6 toffees she spent ₹ 1.40 or for a dozen she spent ₹ 2.80 and sold the dozen at ₹ 3.50.

$$\therefore \text{Gain\%} = \frac{0.70}{2.80} \times 100\% = 25\%$$

19. (A) The cost of sugar per kilogram

$$= ₹ \frac{7560.90}{542} = ₹ 13.95$$

$$\text{S.P.} = \text{C.P.}(1 + \text{gain\%})$$

S.P. at 20% profit

$$= ₹ 13.95 \times 1.2 = ₹ 16.74$$

20. (C) 21. (B) 22. (B) 23. (A) 24. (B)

25. (A) Suppose S.P. = ₹ 100

$$\text{Profit} = ₹ 20$$

$$\text{C.P.} = ₹ (100 - 20) = ₹ 80$$

$$\text{Profit \%} = \frac{\text{profit}}{\text{C.P.}} \times 100\%$$

$$= \frac{20}{80} \times 100\% = 25\%$$

26. (D) 27. (C) 28. (C) 29. (C)

30. (B) C.P. = 90% of 80% of ₹ 1400

$$= ₹ \left(\frac{90}{100} \times \frac{80}{100} \times 1400 \right) = ₹ 1008$$

31. (B) S.P. of each article = ₹ $\left(\frac{37.40}{2} \right)$

$$= ₹ 18.70$$

Let M.P. be ₹ x .

Then, 85% of x = ₹ 18.70

$$\Rightarrow x = ₹ \left(\frac{18.70 \times 100}{85} \right) = ₹ 22$$

32. (A) Let the list price be ₹ z .

$$\therefore (100 - x)\% \text{ of } z = y$$

$$\Rightarrow \left(\frac{100 - x}{100} \right) \times z = y$$

$$\Rightarrow z = \left(\frac{100 y}{100 - x} \right)$$

33. (A) 34. (B) 35. (A) 36. (A) 37. (C)

Previous Contest Questions

1. (C) $P = ₹ 15000; R = 10\% \text{ p.a} = 5\% \text{ per half-year}; T = 1 \text{ year} = 2 \text{ half-years}$.

$$\begin{aligned}\therefore \text{Amount} &= \left[15000 \times \left(1 + \frac{5}{100} \right)^2 \right] \\ &= ₹ \left(15000 \times \frac{21}{20} \times \frac{21}{20} \right) \\ &= ₹ 16537.50\end{aligned}$$

2. (D) $S.I. = ₹ \left(\frac{1000 \times 10 \times 4}{100} \right) = ₹ 400$

$$\begin{aligned}C.I. &= ₹ \left[1000 \times \left(1 + \frac{10}{100} \right)^4 - 1000 \right] \\ &= ₹ 464.10\end{aligned}$$

$$\therefore \text{Difference} = ₹ (464.10 - 400) \\ = ₹ 64.10$$

3. (B) Let the time be 'n' years. Then,

$$800 \times \left(1 + \frac{5}{100} \right)^{2n} = 926.10$$

$$\Rightarrow \left(\frac{21}{20} \right)^{2n} = \left(\frac{21}{20} \right)^3$$

$$\Rightarrow 2n = 3 \Rightarrow n = \frac{3}{2}$$

$$\therefore n = 1\frac{1}{2} \text{ years}$$

4. (C) Let the labelled price of the radio be ₹ x .

88% of 80% of x = ₹ 704

$$\Rightarrow x = \left(\frac{704 \times 100 \times 100}{80 \times 88} \right) = ₹ 1000$$

5. (C) Given M.P. = ₹ 880

S.P. = ₹ 770

Discount = M.P. - S.P.

$$= ₹ (880 - 770)$$

$$= ₹ 110$$

$$\text{Discount\%} = \frac{\text{Discount}}{\text{M.P.}} \times 100\%$$

$$= \frac{110}{880} \times 100\% = 12.5\%$$

6. (A) Let the C.P. be ₹ 100 \Rightarrow S.P. is ₹ 108. Let the M.P. of the goods be ₹ x .

Since discount of 10% is allowed on M.P. and sold at 8% gain,
90% of x = ₹ 108

$$\Rightarrow x = 108 \times \frac{100}{90} = ₹ 120$$

\therefore The goods must be marked at 20% above the C.P.

8. Algebraic Expressions and Identities

Multiple Choice Questions

1. (B) The highest power of the variables is $3 + 1 = 4$.

2. (A)

$$\begin{array}{r} 3x^3 + x^2 + 0x + 6 \\ + x^3 + 0x^2 + 3x - 8 \\ \hline 2x^3 + x^2 - 3x + 14 \end{array}$$

3. (D)

$$\begin{array}{r} x^3 - 3x^2 + 5x - 1 \\ + 2x^3 + x^2 - 4x + 2 \\ \hline -x^3 - 4x^2 + 9x - 3 \end{array}$$

4. (C) 5. (A) 6. (B) 7. (D)

8. (C)

$$\begin{array}{r} x^3 - x^2 + 3x - 2 \\ (-) \quad x^2 + 5x - 6 \\ \hline x^3 - 2x^2 - 2x + 4 \end{array}$$

9. (A)

$$\begin{array}{r} x^4 + 0 + 2x^2 - 3x + 7 \\ (-) \quad x^3 + x^2 + x - 1 \\ \hline x^4 - x^3 + x^2 - 4x + 8 \end{array}$$

10. (D)

11. (B) $(3x - 4)(5x + 7) = 15x^2 - ax - 28$
 $\Rightarrow 15x^2 + x - 28 = 15x^2 - ax - 28$
Comparing the coefficients of like terms, we get $a = -1$.

12. (C)

$$\begin{array}{r} x^3 - 6x^2y - xy^2 - y^3 \\ (-) \quad x^3 + 5x^2y - xy^2 - y^3 \\ \hline -11x^2y \end{array}$$

13. (B) 14. (A) 15. (D) 16. (B) 17. (A)

18. (C) $x - \frac{1}{x} = 5 \Rightarrow \left(x - \frac{1}{x}\right)^2 = 5^2$
 $\Rightarrow x^2 + \frac{1}{x^2} - 2 = 25 \Rightarrow x^2 + \frac{1}{x^2} = 27$

19. (B) Given $p = \frac{2}{3}$ and $q = \frac{3}{4}$

$$\begin{aligned} 81p^2 + 16q^2 - 72pq \\ = 81\left(\frac{2}{3}\right)^2 + 16\left(\frac{3}{4}\right)^2 - 72\left(\frac{2}{3}\right)\left(\frac{3}{4}\right) \\ = 81 \times \frac{4}{9} + 16 \times \frac{9}{16} - \frac{72}{2} \\ = 36 + 9 - 36 = 9 \end{aligned}$$

20. (C) $(4x - 3y)(16x^2 + 12xy + 9y^2)$
 $= (4x)(16x^2 + 12xy + 9y^2)$
 $+ (-3y)(16x^2 + 12xy + 9y^2)$

$$\begin{aligned} &= 64x^3 + 48x^2y + 36xy^2 \\ &\quad - 48x^2y - 36xy^2 - 27y^3 \\ &= 64x^3 - 27y^3 \end{aligned}$$

21. (D) $96^2 = (100 - 4)^2$
 $= 100^2 - 2(100)(4) + (4)^2 = 9216$

22. (A) $24.7 \times 25.3 = (25 - 0.3)(25 + 0.3)$
 $= 25^2 - (0.3)^2$
 $= 625 - 0.09 = 624.91$

23. (C) $p^2 + q^2 = (p+q)^2 - 2pq$
 $= 5^2 - 2(6) = 25 - 12 = 13$

24. (B) Area of bigger square = 983^2 sq. cm
Area of smaller square = 17^2 sq.cm
The difference of their areas

$$\begin{aligned} &= 983^2 - 17^2 \text{ sq.cm} \\ &= (983 + 17)(983 - 17) \text{ sq. cm} \\ &= 966000 \text{ sq. cm} \end{aligned}$$

25. (C) 26. (A) 27. (B) 28. (A) 29. (C)

30. (C) At $x = 1$, $\left(3 + \frac{5}{x}\right)\left(9 - \frac{15}{x} + \frac{25}{x^2}\right)$
 $= \left(3 + \frac{5}{1}\right)\left(9 - \frac{15}{1} + \frac{25}{1}\right)$
 $= (3 + 5)(9 - 15 + 25)$
 $= 8 \times 19 = 152$

31. (B) $V = \pi(R^2 - r^2)h$
 $= \frac{22}{7}(8^2 - 5^2)\left(3\frac{1}{2}\right)$
 $= \frac{22}{7}(64 - 25)\left(\frac{7}{2}\right)$
 $= \frac{22}{7} \times 39 \times \frac{7}{2}$
 $= 11 \times 39 = 429$

32. (B) When $\pi = 3.142$, $r = 10$, $h = 3$ and $l = 4$,
 $A = 3.142(10)(10 + 2 \times 3 + 4)$
 $= 31.42(20) = 628.4$

33. (D) 34. (D) 35. (B)

☛ Previous Contest Questions

1. (D) 2. (C) 3. (A) 4. (B) 5. (B)
6. (B) Multiplying both sides by 15, (i.e., L.C.M of 5 and 3, we get
 $3(17 - 3x) - 5(4x + 2)$
 $= 15(5 - 6x) + 5(7x + 14)$
 $\Rightarrow 51 - 9x - 20x - 10$
 $= 75 - 90x + 35x + 70$
 $\Rightarrow 41 - 29x = 145 - 55x$
 $\Rightarrow -29x + 55x = 145 - 41$
 $\Rightarrow 26x = 104 \Rightarrow x = \frac{104}{26}$
 $\Rightarrow x = 4$
7. (D) According to the problem, Mohan has ₹ P.
 Naveen has ₹ 4P
 Also amount Naveen has = ₹ (P + 15)
 $\therefore 4P = P + 15$
 $\Rightarrow 3P = 15 \Rightarrow P = 5$

∴ Amount with Mohan = ₹ 5

Amount with Naveen = ₹ 20

∴ Total amount = ₹ 25

8. (B) Age of Sudhir after 3 years is 'x' years.

⇒ His present age = $(x - 3)$ years.

Therefore, Sudhir's age 5 years ago

$= (x - 3 - 5)$ years

$= (x - 8)$ years

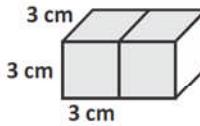
9. (D) 10. (D)

9. Visualising Solid Shapes

☛ Multiple Choice Questions

1. (A) 2. (D) 3. (B) 4. (A) 5. (B)
6. (A) 7. (D) 8. (D) 9. (C) 10. (B)
11. (C) 12. (A) 13. (B) 14. (A) 15. (C)
16. (B) 17. (C) 18. (B) 19. (B) 20. (D)
21. (B) 22. (B) 23. (D) 24. (A) 25. (A)
26. (C) 27. (C) 28. (A) 29. (C) 30. (B)
31. (A) 32. (C) 33. (D) 34. (A)

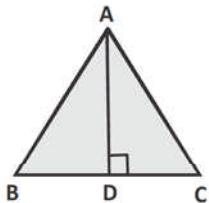
☛ Previous Contest Questions

1. (B) All the sides of a cube have equal measure but the sides of a cuboid have different measures.
2. (C) A cuboid has the maximum number of vertices.
3. (D) 
4. (A) The vertical cut of a brick of the given dimensions results in a cuboid.
5. (A) A sphere has no vertices and no flat surfaces.
6. (A) The number of edges of a cube is 12. So, their total length is $12 \times 2 \text{ cm} = 24 \text{ cm}$.
7. (D) 8. (A) 9. (C) 10. (B) 11. (A)

10. Mensuration**Multiple Choice Questions**

1. (A) 2. (B) 3. (A) 4. (C) 5.
(B)

6. (B) Consider the isosceles triangle as shown in the figure. Drop a perpendicular AD to base BC.



It bisects the base. $\therefore BD = \frac{x}{2}$

Now, by Pythagoras' theorem, we have $AD^2 = AB^2 - BD^2$

$$\Rightarrow y^2 - \frac{x^2}{4} = \frac{4y^2 - x^2}{4}$$

$$\Rightarrow AD = \sqrt{\frac{4y^2 - x^2}{4}}$$

Area of triangle

$$= \frac{1}{2} \times \text{base} \times \text{height}$$

\therefore Area of $\triangle ABC$

$$= \frac{1}{2} \times x \times \sqrt{\frac{4y^2 - x^2}{4}} \text{ cm}^2$$

7. (B) 8. (A) 9. (A) 10. (C) 11. (B)

12. (C) By Heron's formula, we have area of triangle

$$= \sqrt{s(s-a)(s-b)(s-c)}.$$

Here,

$$s = \frac{11+15+16}{2} = \frac{42}{2} = 21 \text{ cm}$$

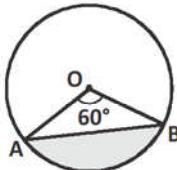
$$\therefore \text{Area} = \sqrt{21(10)(6)(5)}$$

$$= 30\sqrt{7} \text{ sq. cm}$$

$$\therefore \text{Height} = \frac{2 \times \text{area}}{\text{base}} = \frac{2 \times 30\sqrt{7}}{16} = \frac{15\sqrt{7}}{4} \text{ cm}$$

13. (A) 14. (B) 15. (C) 16. (A) 17. (D)

18. (C)



$$\text{Area of sector OAB} = \frac{x^\circ}{360^\circ} \times \pi r^2$$

$$= \frac{60^\circ}{360^\circ} \times \frac{22}{7} \times 21 \times 21 \text{ cm}^2 \\ = 231 \text{ cm}^2$$

$$\text{Area of } \triangle OAB = \frac{\sqrt{3}}{4} r^2$$

$$= \frac{\sqrt{3}}{4} \times 21 \times 21 \text{ cm}^2 \\ = 190.73 \text{ cm}^2$$

$$\therefore \text{Area of shaded region} = \text{Area of sector OAB} - \text{Area of } \triangle OAB \\ = (231 - 190.73) \text{ cm}^2 \\ = 40.27 \text{ cm}^2$$

19. (B) 20. (A) 21. (B) 22. (A)
23. (D) Lateral surface area of a cylinder
 $= 2\pi rh = 704 \text{ cm}^2$

$$\therefore r = \frac{704}{2\pi h} = \frac{704}{2 \times \frac{22}{7} \times 8} = 14 \text{ cm}$$

24. (A) Clearly, area of unshaded region
 $= \text{Area of circle} - \text{Area of square RSTV}$

$$\text{But, diameter of circle} \\ = \text{diagonal of square}$$

$$\text{or } 2r = \sqrt{2} l \text{ or } r = \frac{1}{\sqrt{2}} \text{ or } l = r\sqrt{2}$$

Area of unshaded region

$$= \pi r^2 - l^2 = \pi r^2 - (r\sqrt{2})^2$$

$$= \pi r^2 - 2r^2 = r^2(\pi - 2) \text{ sq. units}$$

25. (D) 26. (D) 27. (D)
 28. (B) Volume of water needed to fill the tank to a height of 4 cm
 $= (8 \times 6 \times 4) \text{ cm}^3 = 192 \text{ cm}^3$
 Volume of the stone = 36 cm³
 \therefore Volume of water needed
 $= 192 - 36 = 156 \text{ cm}^3$
 29. (A) 30. (C) 31. (B)
 32. (A) Volume of a cuboid
 $= l \times b \times h \text{ cu. units}$
 $\Rightarrow 216 = 8 \times 6 \times h$
 $\Rightarrow h = \frac{216}{8 \times 6} = 4.5 \text{ m}$
 33. (B) Volume = Area of square base \times Height
 So, 384 = Area \times h
 \Rightarrow Area of the base
 $= \frac{384}{6} = 64 \text{ cm}^2$
 \Rightarrow Length of the side of the square base = 8 cm.

Previous Contest Questions

1. (C) Total area of the given figure = Area of parallelogram ABCD + Area of rectangle CDEF
 $= (5 \times 3) + (5 \times 2) = 25 \text{ cm}^2$
2. (B) Area of sector OBCO
 $= \frac{30^\circ}{360^\circ} \times \pi \times 21 \times 21$
 $= \frac{22}{7} \times \frac{7}{4} \times 21$
 $= \frac{231}{2} = 115.5 \text{ cm}^2$
- Area of sector OADO
 $= \frac{30^\circ}{360^\circ} \times \pi \times 7 \times 7$
 $= \frac{1}{12} \times \frac{22}{7} \times 7 \times 7$

$$= \frac{77}{6} = 12.8 \text{ cm}^2$$

So, area of shaded region

$$= 115.5 - 12.8 = 102.7 \text{ cm}^2$$

3. (B) 4. (D) 5. (B) 6. (A) 7. (C)
 8. (D) Let the original edge of the cube be 'a' units.
 Surface area = $6a^2$ sq. units
 Increase in edge = 25%

$$\text{New edge} = \frac{125}{100}a = \frac{5a}{4} \text{ units}$$

New surface area

$$= 6 \times \left(\frac{5a}{4} \right)^2 = \frac{75a^2}{8} \quad \text{Increase in surface area}$$

$$= \left(\frac{75a^2}{8} - 6a^2 \right) = \frac{27a^2}{8}$$

\therefore Percentage increase in surface area

$$= \left(\frac{27a^2}{8} \times \frac{1}{6a^2} \times 100 \right)\% = 56.25\%$$

9. (A) 10. (C) 11. (A) 12. (D)

11. Exponents and Powers

Multiple Choice Questions

1. (B) Since $a^0 = 1$ for any 'a',
 $(3^0 - 4^0) \times 5^{-3} = (1 - 1) \times 5^{-3} = 0$
2. (C) $3^{3x-5} = \frac{1}{9^x}$
 $\Rightarrow 3^{3x-5} = 3^{-2x}$
 $\Rightarrow 3x - 5 = -2x$
 [When bases are equal, powers can be equated.]
 $\Rightarrow 5x = 5$
 $\Rightarrow x = 1$

3. (A) $\left[(-3)^{(-2)}\right]^{(-3)} = (-3)^6 = 729$

$$\left[\because (a^m)^n = a^{mn}\right]$$

4. (C) $\left(\frac{16}{81}\right)^{\frac{3}{4}} = \left[\left(\frac{2}{3}\right)^4\right]^{\frac{3}{4}} = \frac{8}{27}$

[Since $(a^m)^n = a^{mn}$.]

5. (D) $(512)^{\frac{-2}{9}} = (2^9)^{\frac{-2}{9}} = 2^{-2} = \frac{1}{4}$

[Since $(a^m)^n = a^{mn}$.]

6. (B) $\frac{(32)^{\frac{-2}{5}}}{(125)^{\frac{-2}{3}}} = \frac{\frac{1}{4}}{\frac{1}{25}} = \frac{25}{4}$

7. (B) 8. (B) 9. (C) 10. (A) 11. (D)

12. (C) $3\sqrt[3]{2} \times 7\sqrt[3]{6} \times 5\sqrt[3]{18}$

$$= (3 \times 7 \times 5) \times (\sqrt[3]{2 \times 6 \times 18})$$

$$= 105 \times \sqrt[3]{216}$$

$$= 105 \times 6 = 630$$

13. (A) 14. (A) 15. (C) 16. (A) 17. (B)

18. (C) $\frac{1}{1+\frac{1}{x^m}} + \frac{1}{1+x^m}$ (Since $a^{-m} = \frac{1}{a^m}$.)

$$= \frac{1}{\frac{x^m+1}{x^m}} + \frac{1}{1+x^m}$$

$$= \frac{x^m}{x^m+1} + \frac{1}{x^m+1}$$

$$= \frac{x^m+1}{x^m+1} = 1$$

19. (B) $\frac{3^a \cdot (2^2)^{a-2} \cdot (5^2)^{a+1}}{(3^2)^{a-1} \cdot 2^{a+1} \cdot 5^{a-2}}$

$$= \frac{3^a \cdot 2^{2a-4} \cdot 5^{2a+2}}{3^{2a-2} \cdot 2^{a+1} \cdot 5^{a-2}}$$

[Since $(a^m)^n = a^{mn}$.]

$$= 3^{a-2a+2} \cdot 2^{2a-4-a-1} \cdot 5^{2a+2-a+2}$$

$$\text{Since } \left[\frac{a^m}{b^n} = a^{m-n}\right]$$

$$= 3^{-a+2} \cdot 2^{a-5} \cdot 5^{a+4}$$

$$= 2^{a-5} \cdot 3^{-a+2} \cdot 5^{a+4}$$

20. (A) $2^{12} = 2^{3 \times 4} = (2^3)^4 = 8^4$

$$3^8 = 3^{2 \times 4} = (3^2)^4 = 9^4$$

Since the powers of 8^4 and 9^4 are the same, 9^4 is greater than $8^4 \Rightarrow 3^8 > 2^{12}$.

21. (B) The given expression

$$= \frac{x^{3a+3b} \cdot x^{3b+3c} \cdot x^{3c+3a}}{x^{6a+6b+6c}}$$

$$= \frac{x^{3a+3b+3b+3c+3e+3a}}{x^{6a+6b+6c}} = \frac{x^{6a+6b+6c}}{x^{6a+6b+6c}}$$

$$= x^{6a+6b+6c-6a-6b-6c} = x^0 = 1$$

22. (C) $3^n = 729 \Rightarrow 3^n = 3^6 \Rightarrow n = 6$

$$\therefore 3^{3n+1} = 3^{3(6)+1} = 3^{18+1} = 3^{19}$$

23. (A) $27^{x+1} = 9^{x+3}$

$$\Rightarrow (3^3)^{x+1} = (3^2)^{x+3}$$

$$\Rightarrow 3^{3x+3} = 3^{2x+6}$$

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

$$\Rightarrow 3x-2x = 6-3 \Rightarrow x = 3$$

Consider $9^{x+3} = 3^y \Rightarrow (3^2)^{x+3} = 3^y$

$$\Rightarrow 3^{2x+6} = 3^y$$

$$\Rightarrow 2x+6 = y$$

$$\therefore 2(3) + 6 = y$$

$$\Rightarrow y = 12$$

24. (B) 25. (B) 26. (A) 27. (B)

28. (A) The standard form of the given number is 6.02×10^{15} . [Standard form of a number N is $m \times 10^n$ where 'm' is a decimal between 1 and 9.]
29. (B) The usual form of the given number is 1000100000.
30. (D) The standard form of the size of a plant cell which is 0.00001275 m is 1.275×10^{-5} m.
31. (B) 32. (C) 33. (A) 34. (B)

Previous Contest Questions

$$\begin{aligned} 1. \quad (\text{A}) \quad \left(\frac{-1}{216}\right)^{\frac{-2}{3}} &= \left[\left(\frac{-1}{6}\right)^3\right]^{\frac{-2}{3}} \\ &= \left(\frac{-1}{6}\right)^{3 \times \frac{-2}{3}} = \left(\frac{-1}{6}\right)^{-2} \\ &= \frac{1}{(-1/6)^2} = \frac{1}{(1/36)} = 36 \end{aligned}$$

2. (A) 3. (B) 4. (B) 5. (B) 6. (C)
7. (B) 8. (D) 9. (A) 10. (D) 11. (C)

12. Direct and Inverse Proportion

Multiple Choice Questions

1. (A) Clearly,
- $$\frac{x}{y} = \frac{4}{8} = \frac{6}{12} = \frac{8}{16} = \frac{10}{20} = \frac{12}{24} = \frac{1}{2}$$
- $\therefore x$ and y are directly proportional
as $\frac{x}{y}$ is a constant.
2. (B) 3. (C) 4. (B) 5. (A) 6. (D) 7. (B)
8. (D) Speed of the car = 60 km/h.
Time taken = 3 h
Speed is increased to 90 km/h.
Time taken is inversely proportional to speed.
Let the time taken to cover the distance travelling at 90 km/h be x h.
- Then, $x = \frac{60}{90} \times 3 = 2$ hours.

9. (C) 10. (D) 11. (A) 12. (D)
13. (A) 14. (D) 15. (B)
16. (A) Let the required weight be x kg.
The length and weight are in direct proportion.
 $\therefore 11.25 : 6 :: 42.75 : x$
 $\Rightarrow 11.25 \times x = 6 \times 42.75$
 $\Rightarrow x = \frac{6 \times 42.75}{11.25} \Rightarrow x = 22.8$

17. (D) 18. (B) 19. (D) 20. (B)
21. (D) Originally, let there be x men.
Less men \Rightarrow more days.
 $\therefore (x-10) : x :: 100 : 110$
 $\Rightarrow (x-10) \times 110 = x \times 100$
 $\Rightarrow 10x = 1100 \Rightarrow x = 110$
22. (B) Let the remaining food last for x days.
95 men had provisions for 195 days. 65 men had provisions for x days.
Less men \Rightarrow more days.

$$\begin{aligned} \therefore 65 : 95 :: 195 : x \\ \Rightarrow (65 \times x) = (95 \times 195) \\ \Rightarrow x = \frac{95 \times 195}{65} = 285 \end{aligned}$$

23. (A)
24. (A) Let the required cost be x paise.
Cost and weight are in direct proportion.
 $\therefore 250 : 200 :: 60 : x$
 $\Rightarrow 250 \times x = 200 \times 60$
 $\Rightarrow x = \frac{200 \times 60}{250} = 48$ paise

25. (C) 26. (D) 28. (D)

29. (A) The number of pages typed is directly proportional to the number of hours.

$$\therefore 3 : 10 :: 5 : x$$

$$\Rightarrow x = \frac{10 \times 5}{3} = \frac{50}{3} = 16.66$$

≈ 16.7 minutes

30. (B) The job needs to be completed 2 days in advance, i.e., in $8 - 2 = 6$ days.

The number of men and the number of days are inversely proportional.

$$\therefore 6 : x :: 6 : 8$$

$$\Rightarrow x = \frac{6 \times 8}{6} = 8$$

\therefore 8 workers are needed to complete the job in 6 days.

31. (C) The number of weeks the food lasts is inversely proportional to the number of families.

$$\therefore 25 : 30 :: x : 1$$

$$\Rightarrow x = \frac{25 \times 1}{30} = \frac{5}{6} \text{ of a week.}$$

32. (B) The number of people and the amount of work done by them are inversely proportional.

$$\therefore 5 : 3 = x : 5$$

$$\Rightarrow x = \frac{5 \times 5}{3} = 8\frac{1}{3} \text{ hours}$$

33. (A)

34. (D) The number of books and their cost are directly proportional.

$$\therefore 9 : 5 :: 36 : x$$

$$\Rightarrow x = \frac{5 \times 36}{9} = 20$$

\therefore Cost of 5 books = ₹ 20

35. (B)

36. (A) The distance travelled is directly proportional to the time taken.

$$\therefore 210 : x :: 3 : 5$$

$$\Rightarrow x = \frac{210 \times 5}{3} = 350 \text{ km}$$

37. (D) 38. (C) 39. (B)

40. (A) A car takes one hour to cover a certain distance at 60 km/h.

\Rightarrow Distance covered = 60 km

Let the required time be x h.

Speed of the car and the time taken to travel a distance are inversely proportional.

$$\therefore 60 : 80 :: x : 1$$

$$\Rightarrow x = \frac{60}{80} = \frac{3}{4} \text{ hour}$$

$= 45$ minutes

Previous Contest Questions

1. (A) The less the number of students, the more the number of days the food lasts.

Students	Days
45	60
1	60×45
27	$\frac{60 \times 45}{27} = 100$

2. (A) The less the number of days the more the number of hours.

Days	Hours
5	8
1	5×8
4	$\frac{5 \times 8}{4} = 10$

3. (C) The more the radius, the less the number of rounds.

Radius (cm)	Rounds
20	260
1	260×20
26	$\frac{260 \times 20}{26} = 200$

4. (B) There is a meal for 200 children. 150 children have taken the meal. Remaining meal is to be catered to 50 children. To find the number of men the remaining food is catered to, we must find the number of men equal to 50 children.

Children	Men
200	120
1	$\frac{120}{200}$
50	$\frac{120}{200} \times 50 = 30$

5. (B) The more the number of cogs the less the number of revolutions.

Cogs	Revolutions
6	21
1	6×21
14	$\frac{6 \times 21}{14} = 9$

6. (C) 7. (B)

8. (D) Let the number of women needed to clear the land in 1 day be 'x'.

Number of women and number of days are inversely proportional.

$$\therefore 5 : x :: 1 : 4$$

$$\Rightarrow x = 4 \times 5 = 20$$

$$\therefore \text{Number of more women required} = 20 - 5 = 15.$$

9. (A) Let the required speed be 'x' km/h. Speed is inversely proportional to the time taken.

$$\therefore 24 : 18 :: x : 15$$

$$\Rightarrow x = \frac{24 \times 15}{18} = 20$$

\therefore Satish must go at a speed of 20 km/h to reach his school in 18 minutes.

10. (B) Let the number of months be 'x'. Number of cows and number of months the cattle feed last are inversely proportional.

$$\therefore 4 : 6 :: x : 2$$

$$\Rightarrow x = \frac{4 \times 2}{6} = 1\frac{1}{3} \text{ months}$$

\therefore The 8 bags of cattle feed last $1\frac{1}{3}$ months to feed 6 cows.

13. Factorisation

Multiple Choice Questions

1. (C) 2. (B) 3. (A)

4. (D) Let the other factor be $x^2 + ax + b$. We have

$$(x^2 + 2x + 5)(x^2 + ax + b)$$

$$= x^4 + px^2 + q$$

$$x^4 + (2 + a)x^3 + (2a + b + 5)x^2 + (5a + 2b)x + 5b = x^4 + px^2 + q$$

Comparing the coefficients of corresponding terms, we get

$$2a + b + 5 = p \quad \dots\dots(1)$$

$$5b = q \quad \dots\dots(2)$$

$$2 + a = 0 \Rightarrow a = -2$$

$$5a + 2b = 0 \Rightarrow b = 5$$

$$\therefore p = 2a + b + 5 = 2(-2) + 5 + 5 = 6$$

$$q = 5b = 5(5) = 25$$

5. (B)

6. (D) $(x - 5)^2 = x^2 - 10x + 25$
using $(a - b)^2 = a^2 - 2ab + b^2$.
So, Pankaj's answer is correct.

7. (A)

8. (A) $(a - 4)(a - 2) = a^2 - 4a - 2a + 8 = a^2 - 6a + 8$

So, the statement in option (A) is correct.

9. (C) $x^4 + y^4 + x^2y^2$

$$= (x^4 + y^4 + 2x^2y^2) - x^2y^2$$

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

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

10. (B) $15x^2 - 26x + 8$

$$\begin{aligned} &= 15x^2 - 20x - 6x + 8 \\ &= 5x(3x - 4) - 2(3x - 4) \\ &= (3x - 4)(5x - 2) \end{aligned}$$

11. (A) 12. (C) 13. (B) 14. (A) 15. (C)

16. (B) $n(3n + 2) = 3n^2 + 2n$

17. (C) $(x^2 + 3x + 5)(x^2 - 3x + 5)$
 $= (x^2 + 5 + 3x)(x^2 + 5 - 3x)$
 $= (x^2 + 5)^2 - (3x)^2 = m^2 - n^2$

$$\therefore m = x^2 + 5$$

18. (C) 19. (B) 20. (C) 21. (A) 22. (B)

23. (B) 24. (A) 25. (B) 26. (B)

27. (C) $\frac{36x^3y^2z}{-9x^2y^2z} = \frac{36}{-9} \left(\frac{x^3}{x^2}\right) \left(\frac{y^2}{y^2}\right) \left(\frac{z}{z}\right) = -4x$

28. (B) We have

$$\begin{aligned} &(4p^5 - 14p^4 + 6p^3 - 2p^2) \div 2p^2 \\ &= \frac{4p^5}{2p^2} - \frac{14p^4}{2p^2} + \frac{6p^3}{2p^2} - \frac{2p^2}{2p^2} \\ &= 2p^3 - 7p^2 + 3p - 1 \end{aligned}$$

29. (D)

30. (D) $\underbrace{3xz - 4yz}_{= z(3x - 4y)} - \underbrace{6xp + 8yp}_{= (3x - 4y)(z - 2p)}$
 $= z(3x - 4y) - 2p(3x - 4y)$
 $= (3x - 4y)(z - 2p)$

31. (B) 32. (A) 33. (B) 34. (A) 35. (D)

36. (A) $49x^2 - 36 = (7x)^2 - (6)^2$
 $= (7x - 6)(7x + 6)$

37. (A) $3z^2 + 9z + 6 = 3(z^2 + 3z + 2)$
 $z^2 + 3z + 2 = z^2 + z + 2z + 2$
 $= z(z + 1) + 2(z + 1)$
 $= (z + 1)(z + 2)$
 $\therefore 3z^2 + 9z + 6 = 3(z + 1)(z + 2)$

38. (C) Area of a square is side \times side.

$$\begin{aligned} x^2 + 8x + 16 &= (x^2) + 2(x)(4) + (4)^2 \\ &= (x + 4)^2 \\ &= (x + 4)(x + 4) \end{aligned}$$

\therefore The length of the side of a square is $(x + 4)$ cm.

39. (B) $27x^2 - 48 = 3[9x^2 - 16]$

$$\begin{aligned} &= 3[(3x)^2 - (4)^2] \\ &= 3(3x + 4)(3x - 4) \end{aligned}$$

40. (C) $200y^2 - 2 = 2(100y^2 - 1)$

$$\begin{aligned} &= 2[(10y)^2 - 1^2] \\ &= 2[(10y + 1)(10y - 1)] \end{aligned}$$

Previous Contest Questions

1. (C) 2. (D) 3. (B) 4. (A)

5. (A) $x^2 + \frac{a^2 - 1}{a}x - 1 = x^2 + \left(\frac{a^2}{a} - \frac{1}{a}\right)x - 1$

$$= x^2 + ax - \frac{x}{a} - 1$$

$$= \left(x^2 - \frac{x}{a}\right) + (ax - 1)$$

$$= x\left(x - \frac{1}{a}\right) + a\left(x - \frac{1}{a}\right)$$

$$= \left(x - \frac{1}{a}\right)(x + a)$$

6. (A) 7. (B) 8. (B) 9. (C)

10. (D) $-25 - 150 p^2 = (-25)(1 + 6p^2)$

14. Introduction to Graphs

Multiple Choice Questions

1. (D) Origin is the point of intersection of the X and Y axes.

2. (A) A point on the X-axis has its y-coordinate zero 0.

3. (D) Total sales of branches B_1, B_3 , and B_5 together for both the years (in thousand numbers)

$$\begin{aligned} &= (80 + 105) + (95 + 115) + (75 + 95) \\ &= 565 \end{aligned}$$

4. (C) The required percentage

$$= \left[\frac{(75+85)}{(95+115)} \times 100 \right] \%$$

$$= \left(\frac{160}{210} \times 100 \right) \% = 76.19\%.$$

5. (B) The average sales of all the six branches (in thousand numbers) for the year 2013

$$= \frac{1}{6} \times [80 + 75 + 95 + 85 + 75 + 75] \\ = 80.8 \approx 81$$

6. (D) The required ratio

$$= \frac{(75+55)}{(85+95)} = \frac{130}{180} \\ = \frac{13}{18} = 13 : 18$$

7. (C)

8. (B) Students of institute M at graduate level = 17% of 27300
= 4641

Students of institute S at graduate level = 14 % of 27300 = 3822

∴ Total number of students at graduate level in institutes M and S = 4641 + 3822 = 8463

(or) 31% of 27300 = 8463

9. (C) 10. (D) 11. (B) 12. (D)

13. (A) The total number of male workers employed = 5 + 7 + 9 = 21

The total number of female workers employed = 8 + 9 + 5 = 22

∴ The required difference

$$= 22 - 21 = 1$$

14. (D) Sale of dolls on Saturday = 40

Cost of each doll = ₹ 35

∴ Amount earned = ₹ 35 × 40
= ₹ 1400

15. (C) The number of Benz cars sold by dealer B is the maximum.

16. (A) The price of chicken is the same in both the towns

⇒ their graphs intersect at a point.

This happens to be on Tuesday and Friday.

17. (B) 18. (A) 19. (B) 20. (C) 21. (D)

22. (B) From ₹ 45 on Y-axis, draw a line onto the graph. From this point, drop a perpendicular onto the X-axis. The point where this line meets the X-axis is the required value which is ₹ 450.

23. (A) From 750 on the X-axis, draw a line onto the graph. From this point, drop a perpendicular onto the Y-axis.

The point where this line meets the Y-axis is the required value which is ₹ 75.

24. (C) The required percentage

$$= [100 - (10 + 25 + 20 + 10)]\% \\ = (100 - 65)\% = 35\%$$

25. (D) 26. (C) 27. (B) 28. (A)

29. (C) The total number of cars

$$= 4 + 10 + 14 + 16 + 14 + 14 + 2 \\ = 74$$

30. (A) The class with the highest frequency is called the modal class.

∴ The required frequency = 16 cars

31. (B) The number of cars that consume less than 40.5 l of petrol per week = 4 + 10 = 14.

32. (D) The number of cars that consume more than 50.5 l of petrol = 14 + 14 + 2 = 30

33. (D) 10 cars consume 35.5 to 40.5 litres of petrol.

34. (B) 35. (C) 36. (B) 37. (A) 38. (A)

Previous Contest Questions

1. (C) The total of the central angles corresponding to the three crops which cover 50% of the total area, should be 180° . Now, the total of the central angles for the given combinations are:
- (A) Wheat, Barley and Jowar
 $= (72^\circ + 36^\circ + 18^\circ) = 126^\circ$
 - (B) Rice, Wheat and Jowar
 $= (72^\circ + 72^\circ + 18^\circ) = 162^\circ$
 - (C) Rice, Wheat and Barley
 $= (72^\circ + 72^\circ + 36^\circ) = 180^\circ$
 - (D) Bajra, Maize and Barley
 $= (18^\circ + 45^\circ + 72^\circ) = 135^\circ$
- Clearly, (C) is the required combination.
2. (A) The area under any of the food crops is proportional to the central angle corresponding to that crop. Let, the area under rice production be x million acres.
- Then, $18 : 72 = 1.5 : x$
- $$\Rightarrow x = \left(\frac{72 \times 1.5}{18} \right) = 6$$
3. (D) The required ratio $= 5040/3360 = 1.5$
4. (A) Foreign exchange reserves in 2006 – 2007 $= 5040$ millions
 Foreign exchange reserves in 2002 – 2003 $= 2520$ millions
 \therefore Increase $= (5040 - 2520)$
 $= 2520$ millions
 \therefore Percentage increase
 $= \left(\frac{2520}{2520} \times 100 \right)\% = 100\%$
5. (C) The average foreign exchange reserves over the given period $= 3480$ millions.
 The country had reserves above 3480 millions during the years

2001-2002, 2005-2006, 2006-2007 i.e., for 3 years and below 3480 millions during the years 2000-2001, 2002-2003, 2003-2004, 2004-2005 and 2007-2008 i.e., for 5 years.

Hence, the required ratio $= 3 : 5$

6. (D) 7. (B) 8. (C) 9. (B)
 10. (D) A point on the Y-axis has 0 as its X-coordinate. So, $(0, 5)$ is a point on the Y-axis.
 11. (A) Grape flavoured milk shake
 $= 11\% = 66$ (Given)
 $\Rightarrow 100\% = \frac{66}{11} \times 100 = 600$
 12. (B) 13. (A) 14. (B) 15. (C)

15. Playing with Numbers

Multiple Choice Questions

1. (C) The last digit is 5, the number is divisible by 5.
 Since $311636 - 10 = 311626 \div 7 = 44568$, the number is divisible by 7 also.
2. (D) A number divisible by 3 and 4 is divisible by 12.
3. (A) Adding the digits at odd places of the given number $653 * 47$, we get 13. Now if the number is divisible by 11, the sum of digits at even places should also be 13, so that $13 - 13 = 0$ is divisible by 11.
 We have $7 + * + 5 = 13$.
 $\therefore *$ $= 13 - 12 = 1$ is the required value.
4. (D) 1001 is divisible by 13, as $1001 = 13 \times 77$.
5. (A) 6. (B) 7. (A) 8. (A)
 9. (B) The prime number after 32 is 37 which is got by adding 5 to 32.
10. (C) $153 = 3 \times 51$. So, 153 is not prime.

11. (B) $147 = 7 \times 21$ is a composite number.
12. (D) The prime numbers between 30 and 60 are 31, 37, 41, 43, 47, 53 and 59. The greatest of these is 59.
13. (D) The statement in option (D) is true according to the test of divisibility by 8.
14. (C) According to the problem, a five-digit number between 10000 and 10010 divisible by 5 is 10005.
15. (B) $672 \div 8 = 84$
 $\therefore 505672$ is a multiple of 8.
16. (B) 17. (D) 18. (A) 19. (D)
20. (C) The prime numbers between 100 and 200 are 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 191, 193, 197 and 199 which are 21 in number.
21. (B) 22. (A) 23. (A)
24. (B) For $x = 3$, $x^2 + x + 11 = 9 + 3 + 11 = 33$ is not a prime number.
25. (A) 26. (A) 27. (B) 28. (C)
29. (C) Consider $n = 10$ (Even)
 $\Rightarrow 3(n+1) = 3(11) = 33 \rightarrow$ Odd
30. (C) $a = 4b + 26$
 Consider $b = 1$. Then $a = 4(1) + 26 = 30$, which is divisible by 2, 5 and 6, but not 4.
 Hence option (C) is the answer.
31. (B) 32. (B) 33. (A) 34. (C) 35. (D)
36. (A) Consider $P = 1$ and $S = 9$.
 Then
$$\begin{array}{r} 1 Q R 9 \\ \times 9 \\ \hline 9 R Q 1 \end{array}$$

 $Q = 0$ (else there will be regrouping in the thousands place) and $R = 8$.
- $$\begin{array}{r} 1 Q R 9 \\ \times 9 \\ \hline 9 R Q 1 \end{array}$$

 So, $\underline{\underline{9 R Q 1}}$ is correct.
37. (C) 38. (A)

Previous Contest Questions

1. (C) Consider an example 452
 $4 + 5 + 2 = 11$ is the sum of the digits.
 $X = 452 - 11 = 441$
 $4 + 4 + 1 = 9$ is divisible by 9.
 So, option (C) is correct.
2. (B) $X + X + X = YX$
 Consider 5, 1 for the respective values of X and Y.
 Then $5 + 5 + 5 = 15$ is correct.
3. (D) $100 \times 8 + 10 \times 5 + 9 = 859$
4. (A) 57. (D) 6. (B) 7. (D) 8. (B)
9. (C) The prime numbers that lie between 50 and 70 are 53, 59, 61 & 67.
 Therefore, the greatest possible value of X is 67.
10. (B) The composite numbers between 70 and 90 are 72, 74, 75, 76, 77, 78, 80, 81, 82, 84, 85, 86, 87 and 88.
 Thus, M = 88.
11. (C) The only prime number between 90 and 100 is 97.
12. (D)

Questions@stimulating-minds

1. In the first 20 minutes, Sheila fills the pool at a rate of 20 l/min and thus adds $20 \times 20 = 400$ l of water to the pool.
 At this time, the pool needs $4000 - 400 = 3600$ l of water to be full.
 After filling for 20 minutes, water begins to leak out of the pool at a rate of 2 l per min.
 Since water is still entering the pool at a rate of 20 l per min, then the net result is that the pool is filling at a rate of $20 - 2 = 18$ l per min.
 Since the pool needs 3600 l of water to be full and is filling at a rate of 18 l/min, then it will take an additional $3600 \div 18 = 200$ minutes before the pool is full of water.

Thus, the total time needed to fill the pool is $20 + 200 = 220$ minutes or 3 hours and 40 minutes.

2. First recognize that the day and the month must be equal.

Next, since $3^2 = 9$ and $10^2 = 100$, both the day and the month must be larger than 3 but less than 10 so that the year lies between 2012 and 2099.

We list all possible square root days in the table below.

Day and Month	Last Two Digits of the Year	Date
4	$4^2 = 16$	4/4/2016
5	$5^2 = 25$	5/5/2025
6	$6^2 = 36$	6/6/2036
7	$7^2 = 49$	7/7/2049
8	$8^2 = 64$	8/8/2064
9	$9^2 = 81$	9/9/2081

Since these are all actual dates between January 1, 2012 and December 31, 2099, then the number of square root days is 6.

3. In $\triangle CDE$, $CE = 5$, $DE = 3$, and $\angle CDE = 90^\circ$.

$$CE^2 = CD^2 + DE^2$$

$$\Rightarrow CD^2 = CE^2 - DE^2$$

$$= 5^2 - 3^2 = 16$$

$$\therefore CD = 4$$

In $\triangle ABC$, $AB = 9$, $BC = BD - CD$

$$= 16 - 4 = 12$$
, and $\angle ABC = 90^\circ$.

$$AC^2 = AB^2 + BC^2$$

$$\Rightarrow AC^2 = 9^2 + 12^2 = 81 + 144 = 225$$

$$\therefore AC = 15 \text{ (since } AC > 0)$$

4. The area of rectangle WXYZ
 $= 10 \times 6 = 60$.

Since the shaded area is half of the total

$$\text{area of WXYZ, its area is } \frac{1}{2} \times 60 = 30.$$

Since AD and WX are perpendicular, then the shaded area has four right angles, so is a rectangle.

Since square ABCD has a side length of 6, then DC = 6.

Since the shaded area is 30, then $PD \times DC = 30$ or $PD \times 6 = 30$ or $PD = 5$.

Since $AD = 6$ and $PD = 5$, then $AP = 1$.

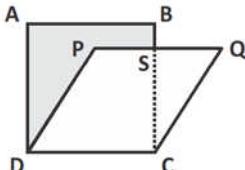
5. Since Krish runs $\frac{1}{2}$ as fast as his usual running speed, he runs at 5 km/h, and so will take 6 hours to complete the 30 km run.

Since Purab runs at $1\frac{1}{2}$ her usual

running speed, she runs at 15 km/h, and so will take 2 hours to complete the 30 km run.

Thus, it takes Krish 4 hours longer to complete the run than it takes Purab.

- 6.



$$\text{Area of ABCD} = 25$$

$$\text{Side of ABCD} = \sqrt{25} = 5\text{cm}$$

$$\text{Side of rhombus} = 5\text{cm}$$

$$\text{Area of rhombus} = 20$$

$$5 \times h = 20$$

$$\Rightarrow h = 4 \text{ cm}$$

$$\text{In } \triangle CSQ, CQ = 5, SC = 4,$$

$$\Rightarrow SQ = \sqrt{25 - 16} = \sqrt{9} = 3$$

Area of PSCD,

$$= \frac{1}{2} [5 + (5 - 3)] \times 4$$

$$= \frac{1}{2} \times 7 \times 4$$

$$= 14 \text{ cm}$$

$$\text{Shaded Area} = 25 - 14 = 11 \text{ cm}^2$$

7. Since $2^3 = 8 = 1 + 7$ then $a = 2$.

$$\text{Since } 3^3 = 27, \text{ then } 27 = 8 + b \text{ or } b = 19.$$

$$\text{Since } 4^3 = 64, \text{ then } 64 = 8 + c \text{ or } c = 56.$$

$$\text{Thus, } a + b + c = 2 + 19 + 56 = 77.$$

8. First, we note that $5^{35} - 6^{21}$ is a positive integer, since $5^{35} - 6^{21} = (5^5)^7 - (6^3)^7 = 3125^7 - 216^7$ and $3125 > 216$.

Second, we note that any positive integer power of 5 has a units digit of 5. Since, $5 \times 5 = 25$ and this product has a units digit of 5, then the units digit of 53 is obtained by multiplying 5 by the units digit 5 of 25. Thus, the units digit of (5^3) is 5. Similarly, each successive power of 5 has a units digit of 5.

Similarly, each power of 6 has a units digit of 6.

Therefore, 5^{35} has a units digit of 5 and 6^{21} has a units digit of 6. When a positive integer with units digit 6 is subtracted from a larger positive integer whose units digit is 5, the difference has a units digit of 9.

Therefore, $5^{35} - 6^{21}$ has a units digit of 9.

9. Suppose that the length of the route is d km.

Then Jill jogs $\frac{d}{2}$ km at 6 km/h and runs $\frac{d}{2}$ km at 12 km/h.

Note that time equals distance divided by speed.

Since her total time was x hours, then

$$x = \frac{d/2}{6} + \frac{d/2}{12} = \frac{d}{12} + \frac{d}{24} = \frac{2d}{24} + \frac{d}{24} = \frac{3d}{24} = \frac{d}{8}.$$

Also, Jack walks $\frac{d}{3}$ km at 5 km/h and

runs $\frac{2d}{3}$ km at 15 km/h.

Since his total time is y hours, then $y =$

$$\frac{d/3}{5} + \frac{2d/3}{15} = \frac{d}{15} + \frac{2d}{45} = \frac{3d}{45} + \frac{2d}{45} = \frac{5d}{45} = \frac{d}{9}.$$

Finally, $\frac{x}{y} = \frac{d/8}{d/9} = \frac{9}{8}$.

10. Since the angle in the sector representing cookies is 90° , then this sector represents $\frac{1}{4}$ of the total circle.

Therefore, 25% of the students chose cookies as their favourite food.

Thus, the percentage of students who chose sandwiches was $100\% - 30\% - 25\% - 35\% = 10\%$.

Since there are 200 students in total,

then $200 \times \frac{10}{100} = 20$ students said that their favourite food was sandwiches.

11. Since $\triangle PQR$ is isosceles, then $\angle PRQ = \angle PQR = 2x^\circ$.

Since $\angle PRQ$ and $\angle SRT$ are opposite angles, then $\angle SRT = \angle PRQ = 2x^\circ$.

Since $\triangle RST$ is isosceles with $RS = RT$, then

$$\angle RST = \frac{1}{2}(180^\circ - \angle SRT) = \frac{1}{2}(180^\circ - 2x^\circ) = 90^\circ - x^\circ = (90 - x)^\circ$$

12. Let the length of his route be d km.

Since he arrives 1 minute early when travelling at 75 km/h and 1 minute late when travelling at 70 km/h, then the difference between these times is 2

minutes, or $\frac{1}{30}$ of an hour.

The time that his trip takes while travelling at 75 km/h is $\frac{d}{75}$ hours, and

at 70 km/h is $\frac{d}{70}$ hours.

Therefore,

$$\frac{d}{70} - \frac{d}{75} = \frac{1}{30}$$

$$75d - 70d = \frac{75(70)}{30}$$

$$5d = 25(7)$$

$$d = 35$$

Therefore, the route is 35 km long.

13. First, we find the prime factors of 555. Since 555 ends with a 5, it is divisible by 5, with $555 = 5 \times 111$.

Since the sum of the digits of 111 is 3, then 111 is divisible by 3, with $111 = 3 \times 37$.

Therefore, $555 = 3 \times 5 \times 37$, and each of 3, 5, and 37 is a prime number.

The possible ways to write 555 as the product of two integers are 1×555 , 3×185 , 5×111 , and 15×37 . (In each of these products, two or more of the prime factors have been combined to give a composite divisor).

The only pair where both members are two-digit positive integers is 37 and 15, so $x + y$ is $37 + 15 = 52$.

14. There are 52 terms in the sum: the number 1, the number 11, and the 50 numbers starting with a 1, ending with a 1 and with 1 to 50 zeroes in between. The longest of these terms thus has 52 digits (50 zeroes and 2 ones).

When the units digits of all 52 terms are added up, their sum is 52, so the units digit of N is 2, and a 5 carried to the tens digit.

In the tens digit, there is only 1 non-zero digit: the 1 in the number 11. Therefore, using the carry, the tens digit of N is $1 + 5 = 6$.

In each of positions 3 to 52 from the right-hand end, there is only one non-zero digit, which is a 1.

Therefore, the digit in each of these positions in N is also a 1. (There is no carrying to worry about).

Therefore, $N = 11 \times 1162$, where N has $52 - 2 = 50$ digits equal to 1.

This tells us that the sum of the digits of N is $50(1) + 6 + 2 = 58$.

15. Since the ratio $AN : AC$ equals the ratio $AP : PB$ (each is $1 : 2$) and $\angle A$ is common in $\triangle APN$ and $\triangle ABC$, then $\triangle APN$ is similar to $\triangle ABC$.

Since the ratio of side lengths between these two triangles is $1 : 2$, then the ratio of areas is $1 : 2^2 = 1 : 4$.

Thus, the area of $\triangle ABC$ is $4 \times 2 = 8 \text{ cm}^2$.



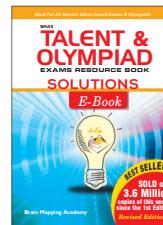
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