Time: 1.5 Hours   Max. Marks: 40

GENERAL INSTRUCTIONS

– All questions are compulsory.

– The question paper consists of **five sections: A, B, C, D, and E**.

– Section A contains **8 Multiple Choice Questions (MCQs)** of **1 mark each**.

– Section B contains **4 Very Short Answer questions** of **2 marks each**.

– Section C contains **3 Short Answer questions** of **3 marks each**.

– Section D contains **2 Long Answer questions** of **5 marks each**.

– Section E contains **1 Case Study–based question** of **5 marks**.

– Use of calculators or any electronic devices is **not permitted**, unless stated otherwise.

– All necessary working steps must be clearly shown for full marks.

– The use of appropriate units and correct mathematical symbols is compulsory.

Section A (Multiple Choice Questions)

1. Which of the following is an irrational number?

   (a) $\sqrt{\frac{4}{9}}$

   (b) $\frac{\sqrt{12}}{\sqrt{3}}$

   (c) $\sqrt{7}$

   (d) 0.81

2. A rational number between $-2/3$ and $1/4$ is:

   (a) $-5/12$

   (b) $5/12$

   (c) $-3/4$

   (d) $1/2$

3. The product of any two irrational numbers is:

   (a) Always irrational

   (b) Always rational

   (c) Always an integer

   (d) Sometimes rational, sometimes irrational

4. The decimal expansion of the number $\sqrt{3}$ is:

   (a) A finite decimal

   (b) 1.732

   (c) Non-terminating recurring

   (d) Non-terminating non-recurring

5. $0.3\overline{2}$ in the form of p/q is:

   (a) 32/99

   (b) 29/90

   (c) 32/100

   (d) 29/99

6. Which of the following is not a real number?

   (a) $\sqrt{5}$

   (b) $-\sqrt{2}$

   (c) $\sqrt{-4}$

   (d) 0

7. Between two distinct rational numbers:

   (a) There is no rational number

   (b) There is exactly one rational number

   (c) There are infinitely many rational numbers

   (d) There are only irrational numbers

8. If $1/7 = 0.\overline{142857}$, then the value of $2/7$ is:

   (a) $0.\overline{285714}$

   (b) 0.285714

   (c) 0.1428572

   (d) $0.\overline{245817}$

Section B (Very Short Answer Questions)

1. Find the standard form of the rational number $\frac{105}{-168}$. (2)

2. Represent $\sqrt{3}$ on the number line. (Rough sketch with construction steps). (2)

3. State with reason whether $\sqrt{1.44}$ is rational or irrational. (2)

4. Express $2.1\overline{47}$ in the form p/q, where p and q are integers and $q \neq 0$. (2)

Section C (Short Answer Questions)

1. Prove that $\sqrt{2}$ is an irrational number using the method of contradiction. (3)

2. Find three different irrational numbers between the rational numbers 5/7 and 9/11. (3)

3. Using successive magnification, show the position of $5.3\overline{7}$ up to 4 decimal places on the number line. (3)

Section D (Long Answer Questions)

1. (i) Define Real Numbers. Explain the relationship between the sets of Natural numbers, Whole numbers, Integers, and Rational numbers using a Venn diagram description. (ii) Is every whole number a natural number? Justify your answer with an example. (5)

2. In a math lab activity, students are asked to construct a "Square Root Spiral." (i) Describe the steps to locate $\sqrt{10}$ on a number line using the spiral method or direct Pythagoras application. (ii) Explain why the diagonal of a unit square represents an irrational length. (5)

Section E (Case Study Based Question)

Case Study: The Coding Mystery

A software engineer, Ananya, is designing a new encryption algorithm based on decimal expansions of numbers. She discovers that rational numbers with terminating or recurring decimals create predictable codes, while irrational numbers provide a much higher level of security because their decimal expansions never repeat and never end. Ananya decides to use the first 50 digits of π as a primary key. However, for a specific sub-routine, she needs to convert some sensor data which is in the form of recurring decimals, specifically $0.\overline{54}$, into a fraction to perform precise modular arithmetic. She explains to her team that while computers approximate these values as finite decimals, the mathematical truth lies in their infinite nature. Understanding whether a number like $\sqrt{17}$ or 22/7 fits the criteria for "unpredictable expansions" is crucial for the success of her security protocol.

Based on the above information, answer the following questions:

1. Which number would Ananya consider "unpredictable" for her security protocol?

   (a) 22/7

   (b) 3.1414

   (c) $\sqrt{17}$

   (d) $0.\overline{54}$

2. The value $0.\overline{54}$ expressed as a fraction in simplest form is:

   (a) 54/100

   (b) 6/11

   (c) 27/50

   (d) 54/90

3. The decimal expansion of 22/7 is:

   (a) Terminating

   (b) Non-terminating non-recurring

   (c) Non-terminating recurring

   (d) Same as π

4. Ananya's use of π digits is based on the fact that π is:

(a) A rational number

(b) An irrational number

(c) An integer

(d) A terminating decimal

5. If Ananya encounters the number $\sqrt{6.25}$, she should classify it as:

(a) A predictable rational number

(b) An unpredictable irrational number

(c) A non-terminating repeating number

(d) An integer