Chapter: Rational Numbers **Lesson Module**
Name of Teacher: **Class: 8**

Lesson Objectives	Curricular Goals	Competency Codes and Descriptions
1. Define a rational number 2. Convert a rational number to its standard form 3. Check whether two rational numbers are equal or not 4. Find equivalent rational numbers of a given rational number 5. Compare two given rational numbers and arrange rational numbers in ascending and descending orders 6. Find the absolute value of a rational number 7. Define and check the closure, commutative, associative and distributive properties of rational numbers for all four mathematical operations 8. find additive and multiplicative identity of a rational number 9. find additive and multiplicative inverse of a rational number 10. Represent rational numbers on a number line	CG-1: Understands numbers and sets of numbers (whole numbers, fractions, integers, rational numbers, and real numbers), looks for patterns, and appreciates relationships between numbers CG-7: Engages with puzzles and mathematical problems and develops own creative methods and strategies to solve them	C-1.4: Explores and understands sets of numbers, such as whole numbers, fractions, integers, rational numbers, and real numbers, and their properties, and visualises them on the number line C-7.1: Demonstrates creativity in discovering one's own solutions to puzzles and other problems, and appreciates the work of others in finding their own, possibly different, solutions
11. Find rational numbers between any two given rational numbers	CG-1; CG-7 CG-9: Knows and appreciates the development of mathematical ideas over a period of time and the contributions of past and modern mathematicians from India and across the world	C-1.4; C-7.1 C-9.2 Knows and appreciates the contributions of specific Indian mathematicians, such as, Baudhayana, Pingala, Aryabhata, Brahmagupta, Virahanka, Bhaskara, and Ramanujan.

12. Solve word problems on rational numbers	CG-1; CG-7 CG-10: Knows about and appreciates the interaction of Mathematics with each of their other school subjects	C-1.4; C-7.1 C-10.1: Recognises interaction of Mathematics with multiple subjects across Science, Social Science, Visual Arts, Music, Vocational Education, and Sports

NCF/NEP FEATURES	Resources
21C Skills *21C: Critical Thinking, Collaboration* **Sustainable Development Goals** *SDG: Quality Education, Climate Action, Affordable and Clean Energy; Good Health and Well-being; Gender Equality; Decent Work and Economic Growth;* **Integration:** *IL: Language, Real-life* **Financial Literacy** **Game-based Learning** **Assessments** Assessment for Learning Assessment as Learning Assessment of Learning	• Coursebook • Smartbook (https://teachers.orientblackswandigital.com/) **Scope** • Pre-requisite Knowledge • Differentiated Learning for Mixed Ability Classes • In-situ Learning Reminders • Interactive Activity, Animation, Photo Gallery, PowerPoint Presentations • Assessments (AFL; AAL; AOL)

Prerequisite Knowledge

Before starting this chapter, students should ideally be able to:

- understand natural numbers, whole numbers, and integers.
- perform basic operations of arithmetic with fractions and integers.
- understand the concept of a number line.
- convert fractions to decimals and percentages, and vice versa.
- find HCF and LCM of numbers.

Session Plans (9 sessions)

Session 1: Introduction to Rational Numbers and Standard Form **LO-1, LO-2**

NCF/NEP Features: IL: Real-life; IL: India Knowledge; IL: Language; 21C: Communication, Collaboration; SDG: Quality Education

Key Concepts: Definition of rational numbers ($\frac{a}{b}$ form, $b \neq 0$, where a and b are integers), positive and negative rational numbers, standard form, HCF.

Teaching Methodology:

- Begin with the 'Gyan Sagar' magazine introduction from the coursebook, focusing on the highlighted numbers and asking 'What is common to all? They are all rational numbers.'
- Encourage students to work collaboratively by sharing their magazine or souvenir contributions with the class, discussing ideas, and appreciating each other's creativity.
- Define rational numbers, including how integers, whole numbers, and natural numbers are rational. Explain positive and negative rational numbers. Discuss the Fact Corner on the word 'rational' and the rationale behind bagless day in school.
- Introduce the standard form of a rational number and the process of reducing it using HCF.

Example	Example 1
Skill Focus	Practice 1—sum 1
Assessment (Formative)	Oral questions, short practice problems on standard form.
Differentiated Learning for Mixed Ability Classes	*Challenge level 1*: Provide a checklist for standard form steps. Review HCF calculation.
	Challenge level 2: Ask students to express large numbers in standard form.
In-situ Learning Reminder	Encourage students to look at product labels (like snack wrappers, water bottles, or medicine strips) to spot percentages, measurements, prices, and dates. Ask them to write these as fractions ($\frac{a}{b}$ form).
Bloom's Taxonomy	Remembering, Understanding, Applying
Activity	Give students cards with various numbers and ask them to sort them into 'Rational' and 'Not Rational' piles.
Digital	IA – Standard form of Rational Number
End-of-session test	1. Is 5 a rational number? Why or why not? 2. Write $\frac{-18}{24}$ in its standard form. Answers: 1. Yes, 5 can be expressed as $\frac{5}{1}$. 2. $\frac{-3}{4}$

Session 2: Equivalent and Equal Rational Numbers; Comparison of Rational Numbers

LO-3, LO-4, LO-5

Key Concepts: Equivalent rational numbers, equality of rational numbers (cross-multiplication), comparison method (LCM of denominators)

Teaching Methodology

- Explain how equivalent rational numbers are obtained by multiplying or dividing both the numerator and the denominator by the same non-zero integer.
- Introduce equality of rational numbers using cross-multiplication.

• Start the concept of comparing rational numbers by referring to the article 'Don't Compare Yourself with Others' in Gyan Sagar to show that while we should not compare people, comparing numbers—especially rational numbers—is important in real life. • Teach the method of comparing rational numbers by finding a common denominator (LCM).	
Example	Example 2
Skill Focus	Practice 1—sums 2, 3, 4
Assessment (Formative)	Give examples for equal and equivalent rational numbers. Ask: Are equal rational numbers equivalent and vice versa?
Differentiated Learning for Mixed Ability Classes	*Challenge level 1*: Provide pre-calculated LCMs for comparison problems. Focus on comparing positive rational numbers first. *Challenge level 2*: Ask students to justify why cross-multiplication works for checking equality. Ask students to compare more than two rational numbers.
In-situ Learning Reminder	Ask students to take prices or discounts from shop boards, online shopping apps, or restaurant menus (for example, ₹$\frac{75}{100}$ g, $\frac{2}{3}$ kg, $\frac{5}{8}$ litre). Have them reduce these to equivalent rational numbers, and then compare which is cheaper or larger in quantity.
Bloom's Taxonomy	Applying, Analysing
Activity	Form groups. Each group writes five rational numbers on chits between two consecutive integers from –5 to 5. Collect and shuffle all chits. Give five random chits to each group. Groups plot these numbers on a number line from –5 to 5.
Digital	Animation − Equivalent rational numbers; IA − Comparison of rational numbers
End-of-session test	1. Write 3 equivalent rational numbers for $\frac{2}{5}$. 2. Compare $\frac{-5}{6}$ and $\frac{-7}{8}$ using $<$, $>$, or $=$. 3. Arrange in ascending order: $\frac{-1}{2}, \frac{3}{4}, \frac{-2}{3}$. Answer: 1. $\frac{4}{10}, \frac{6}{15}, \frac{10}{25}$ 2. $>$ 3. $\frac{-2}{3}, \frac{-1}{2}, \frac{3}{4}$

Session 3: Ordering Rational Numbers and Absolute Value **LO-5, LO-6**

Key Concepts: Ascending and descending order of rational numbers, definition of absolute value, properties of absolute value
Teaching Methodology • Demonstrate arranging rational numbers in ascending and descending order using the common denominator method. • Define absolute value as the distance from zero on the number line; it is always positive. • Discuss properties of absolute value (for example, $\lvert -x \rvert = \lvert x \rvert$).

Example	Examples 3, 4
Skill Focus	Practice 1—sums 5, 6, 7
Assessment (Formative)	Quick Drill
Differentiated Learning for Mixed Ability Classes	*Challenge level 1*: Provide number lines for visualising ordering. Focus on ordering three to four numbers initially. *Challenge level 2*: Order a larger set of rational numbers, including mixed numbers and decimals. Find absolute values of expressions involving operations.
In-situ Learning Reminder	Ask students to record the daily temperatures of your city from a newspaper or weather app (for example, −3°C, +5°C, −7°C, 0°C). Then, let them calculate the absolute values of these temperatures to understand how far they are from zero, ignoring whether they are above (positive) or below (negative) zero.
Bloom's Taxonomy	Applying, Analysing
Activity	Create cards with rational numbers and their absolute values for students to match.
End-of-session test	1. Find the absolute value of: a) $\left\lvert\frac{-7}{11}\right\rvert$ b) $\left\lvert\frac{15}{-20}\right\rvert$ c) $\lvert -3.5 \rvert$. 2. Which is smaller: $\left\lvert\frac{-1}{4}\right\rvert$ or $\left\lvert\frac{-1}{3}\right\rvert$? Answers: 1. a) $\frac{7}{11}$ b) $\frac{3}{4}$ c) 3.5 2. $\left\lvert\frac{-1}{4}\right\rvert$

Session 4: Properties of Rational Numbers – Closure and Commutative **LO-7**

NCF/NEP Features: 21C: Critical Thinking *Key Concepts*: Closure property, commutative property, operations (addition, subtraction, multiplication, division).
Teaching Methodology • Introduce properties of rational numbers. • Explain and verify the closure property for addition, subtraction, and multiplication. Discuss why it does not hold for division (division by zero). • Explain and verify the commutative property for addition and multiplication. Discuss why it does not hold for subtraction and division.

Example	Example 5, 6
Skill Focus	Practice 2—sums 1, 2, 3

Assessment (Formative)	Thinking Cap! Encourage students to reason out and compare the two quantities ($\frac{1}{4}$ cup and $2 \times \frac{1}{16}$ cup) step by step, instead of just calculating, so they develop critical thinking in connecting fractions to real-life cooking measurements.
Differentiated Learning for Mixed Ability Classes	*Challenge level 1:* Provide a table for students to fill in for each property and operation. *Challenge level 2:* Ask students to create their own examples to verify or disprove the properties.
Bloom's Taxonomy	Understanding, Applying, Analysing
Activity	Teams use index cards to verify properties by solving and matching examples with the correct property.
End-of-session test	1. Is the sum of $\frac{1}{3}$ and $\frac{2}{5}$ a rational number? Which property does this illustrate? 2. Verify if $\frac{3}{-2} \times \frac{5}{7} = \frac{5}{7} \times \frac{3}{-2}$ Answers: 1. $\frac{1}{3} + \frac{2}{5} = \frac{11}{15}$; Closure property 2. Equal

Session 5: Properties of Rational Numbers – Associative and Distributive **LO-7**

NCF/NEP Features: Game-based Learning *Key Concepts*: Associative property, distributive property (multiplication over addition/subtraction).	
Teaching Methodology • Explain and verify the associative property for addition and multiplication. Discuss why it does not hold for subtraction and division. • Explain and verify the distributive property of multiplication over addition and subtraction.	
Example	Example 7
Skill Focus	Practice 3—sums 1, 2, 3
Assessment (Formative)	Quick Drill
Differentiated Learning for Mixed Ability Classes	*Challenge level 1:* Provide templates for verifying associative property with parentheses. *Challenge level 2:* Ask students to prove the distributive property using algebraic expressions.
Bloom's Taxonomy	Applying, analysing

Activity	'Property Relay': Teams verify properties using index cards. Explore! *NEP Compliance: This relay game encourages collaboration and teamwork through game-based learning, while helping students discover properties of rational numbers in an engaging, hands-on way.*
End-of-session test	1. Verify if $\left[\frac{1}{2}+\frac{1}{3}\right]+\frac{1}{4}=\frac{1}{2}+\left[\frac{1}{3}+\frac{1}{4}\right]$. Which property is this? 2. Simplify using the distributive property: $\frac{4}{5}\times\left[\frac{1}{2}-\frac{3}{4}\right]$ 3. State whether division of rational numbers is associative. Answers: 1. Yes. Associative property 2. $\frac{-1}{5}$ 3. No

Session 6: Identity and Inverse Properties; Representation on Number Line **LO-8, LO-9, LO-10**

Key Concepts: Additive identity (0), multiplicative identity (1), additive inverse, multiplicative inverse (reciprocal), representation on number line.	
Teaching Methodology • Explain additive identity (0) and multiplicative identity (1). • Define additive inverse (sum is 0) and multiplicative inverse/reciprocal (product is 1). Discuss why 0 has no reciprocal. • Demonstrate representing rational numbers on a number line.	
Skill Focus	Practice 3—sums 4, 5; Practice 4—sum 1
Assessment (Formative)	Quick Drill
Differentiated Learning for Mixed Ability Classes	*Challenge level 1:* Simplify language and symbols: Use terms like 'opposite' for additive inverse and 'flip' for multiplicative inverse to help students relate better. *Challenge level 2:* Ask students to find the additive/multiplicative inverse of complex rational expressions.
In-situ Learning Reminder	Ask students to take three measurements from any recipe and use them to verify the closure, commutative, associative, and distributive properties of rational numbers.
Bloom's Taxonomy	Remembering, Understanding, Applying
Activity	Create cards with rational numbers and their additive/multiplicative inverses for matching.
Digital	IA – Properties of rational numbers, Representing rational numbers on number line

End-of-session test	1. What is the additive and multiplicative inverse of $\frac{-5}{9}$? 2. Represent $\frac{3}{5}$ on a number line. Answers: 1. additive inverse: $\frac{5}{9}$; multiplicative inverse: $\frac{-9}{5}$ 2. 

Session 7: Rational Numbers Between Two Rational Numbers **LO-11**

NCF/NEP Features: IL: India Knowledge; 21C: Critical Thinking *Key Concepts*: Density property of rational numbers, equivalent fractions method, arithmetic mean method.	
Teaching Methodology • Introduce the concept of density of rational numbers (infinite numbers between any two rational numbers.). Discuss the fact corner on the film 'The Man Who Knew Infinity' on Srinivasa Ramanujan. Ask students to gather information about him and create an album. • Explain the method of finding rational numbers using equivalent fractions. • Explain the arithmetic mean method.	
Example	Example 8, 9
Skill Focus	Practice 4—sum 2, 3, 4, 5
Assessment (Formative)	Choose any two rational numbers and find at least five rational numbers between them. Thinking Cap!
Differentiated Learning for Mixed Ability Classes	*Challenge level 1:* Focus on finding a few rational numbers using the equivalent fractions.
	Challenge level 2: Find a specific number of rational numbers (for example, 10) between two given rational numbers.
In-situ Learning Reminder	Take a metre tape or measuring tape and mark two points on it. Gradually reduce the distance between these points and challenge students to find at least two rational numbers that lie between them.
Bloom's Taxonomy	Understanding, Applying
Activity	Students work in pairs to find as many rational numbers as possible between two given numbers within a time limit. Explore!
Digital	Animation − Rational numbers between any two rational numbers

End-of-session test	1. Find one rational number between $\frac{-2}{5}$ and $\frac{-1}{5}$ using the arithmetic mean method. 2. Which property states that there are infinite rational numbers between any two rational numbers? Answers: 1. $\frac{-3}{10}$ 2. Density Property

Sessions 8 and 9: Real-Life Applications and Review **LO-12**

NCF/NEP Features: IL: Real-life connect, India Knowledge; Financial Literacy; 21C: Critical Thinking; SDG: Climate Action, Affordable and Clean Energy, Good Health and Well-Being, Gender Equality, Decent Work and Economic Growth *Key Concepts*: Review of operations and properties, choosing the correct operation for word problems.	
Teaching Methodology • Focus heavily on varied word problems under real-life applications. • Encourage discussion on problem-solving strategies and error analysis. • Discuss the Money Matters section on the quarterly magazine published for the financial year by the government. Ask students to analyse quarterly financial data to understand budgeting, fund allocation, and the importance of monitoring income and expenses in real-life financial planning. • Use the real-life problems of solar energy generation and waste recycling to teach students how to apply fractions and division in calculations, while linking them to sustainable development goals like climate action and affordable and clean energy. • Use the millet cultivation case study to guide students in applying mathematics to calculate land allocation, flour usage, and nutritional values, while highlighting how women-led initiatives promote good health, well-being, and gender equality.	
Example	Example 10, 11
Skill Focus	Practice 5
Assessment (Formative)	Discuss 'Thinking Cap!' problems (Ask students to critically analyse Pulakesh's reasoning, determine the actual order of the fractions on a number line, and justify why a positive number is always greater than a negative number. Also, encourage students to carefully analyze each clue, perform the calculations step by step, and justify their reasoning to locate the treasure accurately.), Case Studies, Worksheet 1 and Worksheet 2 *Pen and Paper FA*
Differentiated Learning for Mixed Ability Classes	*Challenge level 1:* Provide a checklist of steps for solving word problems. *Challenge level 2:* Create complex multi-step problems.
Bloom's Taxonomy	Analysing, Creating, Evaluating
Digital	PPT – Rational Numbers

QUESTION BANK

A. Choose the correct answer.

1. Which of the following is a rational number?

   a) $\frac{8}{0}$ b) π c) $\frac{3}{5}$ d) None of these

2. The standard form of $\frac{-72}{40}$ is:

   a) $\frac{-18}{10}$ b) $\frac{-9}{5}$ c) $\frac{-36}{20}$ d) $\frac{9}{5}$

3. Which number is its own additive inverse?

   a) 1 b) 0 c) –1 d) 2

4. Which of the following represents the reciprocal of $\frac{-3}{4}$?

   a) $\frac{-4}{3}$ b) $\frac{4}{3}$ c) $\frac{-3}{4}$ d) $\frac{3}{4}$

5. The value of $\left(\frac{-2}{5}\right)\times\left(\frac{5}{3}\right)$ is:

   a) $\frac{-10}{15}$ b) $\frac{-2}{3}$ c) $\frac{-1}{3}$ d) –10

B. Mark these rational numbers on the number line.

1. $\frac{-3}{2}$ 2. $\frac{-1}{4}$ 3. 0 4. $\frac{1}{2}$ 5. $\frac{5}{3}$

C. Write the standard form of the rational numbers.

1. $\frac{-18}{24}$ 2. $\frac{30}{-45}$ 3. $\frac{-54}{-81}$ 4. $\frac{40}{100}$ 5. $\frac{-63}{90}$

D. Compare the following rational numbers.

1. $\frac{-1}{2}$ ___ $\frac{1}{3}$ 2. $\frac{5}{6}$ ___ $\frac{4}{5}$ 3. $\frac{-7}{8}$ ___ $\frac{-3}{4}$ 4. $\frac{2}{3}$ ___ $\frac{2}{3}$

E. Arrange in ascending order.

1. $\frac{-2}{3}, 0, \frac{1}{4}, \frac{-1}{2}$ 2. $\frac{3}{5}, \frac{-1}{3}, \frac{2}{3}, \frac{-2}{5}$ 3. $\frac{-3}{4}, \frac{-1}{4}, \frac{-1}{2}, 0$

F. Arrange in descending order.

1. $\frac{3}{5}, \frac{1}{2}, \frac{4}{7}$ 2. $\frac{-3}{4}, \frac{-1}{2}, \frac{-2}{3}, \frac{-1}{4}$ 3. $\frac{7}{8}, \frac{3}{4}, \frac{2}{5}, \frac{1}{10}$

G. Find the absolute value of the following.

1. $|4|$ 2. $|-7|$ 3. $\left|\frac{-11}{26}\right|$ 4. $\left|\frac{25}{36}\right|$ 5. $\left|\frac{-10}{11}\right|$

6. $\left|\frac{3}{4}-6\right|$ 7. $\left|\frac{3}{4}+\frac{4}{3}\right|$ 8. $\left|-7\times\frac{6}{14}\right|$ 9. $\left|\frac{-2}{3}\div\frac{8}{9}\right|$ 10. $\left|\frac{-2}{3}-\frac{5}{6}\right|$

H. Write the equivalent fractions for the following.

1. $\frac{4}{9}$ 2. $\frac{15}{21}$ 3. $\frac{-6}{10}$ 4. $\frac{50}{80}$ 5. $\frac{-21}{35}$

I. Answer the following on the properties of rational numbers.

1. Verify the closure and commutative property for addition using $\frac{2}{3}$ and $\frac{-1}{4}$.
2. Is subtraction and division commutative for rational numbers? Give a counter-example for each.
3. Verify the associative property for multiplication using $\frac{2}{5}, \frac{-3}{7}, \frac{1}{2}$.
4. Does the associative property hold for subtraction and division of rational numbers? Justify your answer.
5. Simplify using the distributive property: $\frac{-2}{7} \times \left[\frac{14}{15} - \frac{7}{15}\right]$.
6. Find the additive and multiplicative inverse of: a) $\frac{7}{12}$ b) $\frac{-15}{23}$ c) 0
7. What is the sum of a rational number and its additive inverse?

J. Answer the following.

1. Find three rational numbers between $\frac{1}{3}$ and $\frac{2}{3}$.
2. A cyclist covers $15\frac{1}{2}$ km in $2\frac{1}{4}$ hours. What is the cyclist's average speed?
3. A water tank is $\frac{5}{6}$ full. If $\frac{1}{4}$ of the water is used, what fraction of the tank is still full?
4. Find the perimeter of a rectangular garden with length $15\frac{1}{4}$ metres and width $8\frac{1}{2}$ metres.
5. Design a word problem that requires multiplying a negative rational number by a positive rational number in a real-life context.

K. For each question, two statement are given, one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the options 1), 2), 3) and 4) given below. Choose the correct option:

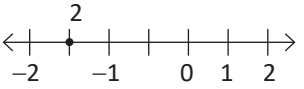
1) Both A and R are true and R is the correct explanation of A.
2) Both A and reason R are true and R is not the correct explanation of A.
3) A is true but reason R is false.
4) A is false but reason R is true.

a) A: Every integer is a rational number.
R: Rational numbers include numbers that can be expressed as fractions with non-zero denominators.

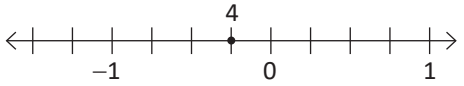
b) A: The difference between two rational numbers is always a rational number.
R: Rational numbers are not closed under subtraction.

Answer Key to the Question Bank

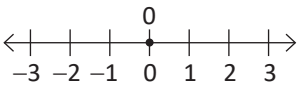
A. 1. c 2. b 3. b 4. a 5. b **B.** 1. $-\frac{3}{2}$



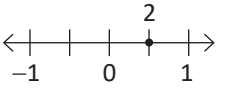
2. $-\frac{1}{4}$



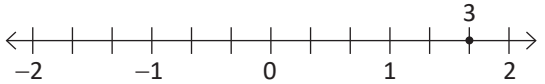
3. 0



4. $\frac{1}{2}$



5. $\frac{5}{3}$



C. 1. $\frac{-3}{4}$ 2. $\frac{-2}{3}$ 3. $\frac{2}{3}$ 4. $\frac{2}{5}$ 5. $\frac{-7}{10}$

D. 1. < 2. > 3. < 4. = **E.** 1. $\frac{-2}{3}, \frac{-1}{2}, 0, \frac{1}{4}$ 2. $\frac{-2}{5}, \frac{-1}{3}, \frac{3}{5}, \frac{2}{3}$ 3. $\frac{-3}{4}, \frac{-1}{2}, \frac{-1}{4}, 0$

F. 1. $\frac{3}{5}, \frac{4}{7}, \frac{1}{2}$ 2. $\frac{-1}{4}, \frac{-1}{2}, \frac{-2}{3}, \frac{-3}{4}$ 3. $\frac{7}{8}, \frac{3}{4}, \frac{2}{5}, \frac{1}{10}$ **G.** 1. 4 2. 7 3. $\frac{11}{26}$ 4. $\frac{25}{36}$

5. $\frac{10}{11}$ 6. $\frac{21}{4}$ 7. $\frac{25}{12}$ 8. 3 9. $\frac{3}{4}$ 10. $\frac{3}{2}$ **H.** open-ended answers

I. 1. Yes, rational numbers are closed and commutative under addition.

2. Subtraction and Division not commutative: for example, $\frac{1}{2}-\frac{1}{3} \neq \frac{1}{3}-\frac{1}{2}$ 3. yes; $\frac{-3}{35}$

4. Associative Property does not hold for subtraction/division: $(5-2)-1 \neq 5-(2-1)$, since $(5-2)-1 =$ $3-1=2$ and $5-(2-1)=5-1=4$ 5. $\frac{-2}{15}$ 6. a) $\frac{-7}{12}, \frac{12}{7}$ b) $\frac{15}{23}, \frac{-23}{15}$

c) 0, No multiplicative inverse 7. 0

J. 1. open-ended answer 2. $\frac{62}{9}$ km/hr 3. $\frac{5}{8}$ 4. $\frac{95}{2}$ 5. open-ended answer

K. a) 1 b) 3