

Class 10 Maths: High-Weightage Chapters

Study Notes & Practice Questions

Based on the Latest Exam Pattern and Syllabus

Introduction

Scoring high in Class 10 Mathematics requires a strategic approach, focusing heavily on chapters that carry the maximum weightage in the board exams. Based on recent syllabus trends, the most critical units include **Algebra**, **Trigonometry**, **Geometry (Triangles)**, and **Statistics**.

This comprehensive study guide compiles essential formulas, key concepts, and important practice questions for these high-weightage chapters to help you streamline your preparation.

1 Chapter 1: Quadratic Equations

1.1 Key Concepts & Formulas

A quadratic equation in the variable x is an equation of the form $ax^2 + bx + c = 0$, where a, b, c are real numbers and $a \neq 0$.

- **Roots of the Equation:** The values of x that satisfy the equation are called its roots. A quadratic equation has at most two roots.
- **Quadratic Formula:** The roots of $ax^2 + bx + c = 0$ are given by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- **Discriminant (D):** $D = b^2 - 4ac$. The discriminant determines the nature of the roots:
 - If $D > 0$: Two distinct real roots.
 - If $D = 0$: Two equal real roots.
 - If $D < 0$: No real roots (imaginary roots).

1.2 Important Practice Questions

Question 1: Find the roots of the quadratic equation $2x^2 - 5x + 3 = 0$ using the quadratic formula.

Solution: Given equation: $2x^2 - 5x + 3 = 0$. Comparing with $ax^2 + bx + c = 0$, we get $a = 2, b = -5, c = 3$.

Step 1: Calculate the discriminant (D).

$$D = b^2 - 4ac = (-5)^2 - 4(2)(3) = 25 - 24 = 1$$

Since $D > 0$, the roots are real and distinct.

Step 2: Apply the quadratic formula.

$$x = \frac{-b \pm \sqrt{D}}{2a} = \frac{-(-5) \pm \sqrt{1}}{2(2)} = \frac{5 \pm 1}{4}$$

$$x_1 = \frac{5+1}{4} = \frac{6}{4} = \frac{3}{2}$$
$$x_2 = \frac{5-1}{4} = \frac{4}{4} = 1$$

Answer: The roots are $\frac{3}{2}$ and 1.

Question 2: Find the value of k for which the quadratic equation $kx(x-2) + 6 = 0$ has two equal roots.

Solution: Simplify the equation: $kx^2 - 2kx + 6 = 0$. Here, $a = k, b = -2k, c = 6$. For equal roots, $D = 0$.

$$b^2 - 4ac = 0 \implies (-2k)^2 - 4(k)(6) = 0$$

$$4k^2 - 24k = 0 \implies 4k(k-6) = 0$$

Since $k \neq 0$ (otherwise it's not a quadratic equation), we have $k-6 = 0 \implies k = 6$.

2 Chapter 2: Introduction to Trigonometry

2.1 Key Concepts & Formulas

Trigonometry deals with the relationship between the angles and sides of a right-angled triangle. Let θ be an acute angle in a right triangle.

- **Trigonometric Ratios:**

$$\sin \theta = \frac{\text{Perpendicular}}{\text{Hypotenuse}}, \quad \cos \theta = \frac{\text{Base}}{\text{Hypotenuse}}, \quad \tan \theta = \frac{\text{Perpendicular}}{\text{Base}}$$

$$\operatorname{cosec} \theta = \frac{1}{\sin \theta}, \quad \sec \theta = \frac{1}{\cos \theta}, \quad \cot \theta = \frac{1}{\tan \theta}$$

- **Trigonometric Identities:**

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$$

2.2 Important Practice Questions

Question 3: Prove that $\frac{\cos A}{1+\sin A} + \frac{1+\sin A}{\cos A} = 2 \sec A$.

Solution: Take the Left Hand Side (LHS):

$$\text{LHS} = \frac{\cos A}{1 + \sin A} + \frac{1 + \sin A}{\cos A}$$

Take the common denominator:

$$\text{LHS} = \frac{\cos^2 A + (1 + \sin A)^2}{\cos A(1 + \sin A)}$$

Expand $(1 + \sin A)^2$:

$$\text{LHS} = \frac{\cos^2 A + 1 + \sin^2 A + 2 \sin A}{\cos A(1 + \sin A)}$$

Using the identity $\sin^2 A + \cos^2 A = 1$:

$$\text{LHS} = \frac{1 + 1 + 2 \sin A}{\cos A(1 + \sin A)} = \frac{2 + 2 \sin A}{\cos A(1 + \sin A)}$$

Factor out 2 from the numerator:

$$\text{LHS} = \frac{2(1 + \sin A)}{\cos A(1 + \sin A)}$$

Cancel the common term $(1 + \sin A)$:

$$\text{LHS} = \frac{2}{\cos A} = 2 \sec A = \text{RHS}$$

Hence Proved.

Question 4: If $3 \cot A = 4$, check whether $\frac{1 - \tan^2 A}{1 + \tan^2 A} = \cos^2 A - \sin^2 A$ or not.

Solution: Given $3 \cot A = 4 \implies \cot A = \frac{4}{3}$. Therefore, $\tan A = \frac{1}{\cot A} = \frac{3}{4}$.

Let the base be $4x$ and perpendicular be $3x$. Hypotenuse = $\sqrt{(4x)^2 + (3x)^2} = \sqrt{16x^2 + 9x^2} = \sqrt{25x^2} = 5x$.

Now, find $\sin A$ and $\cos A$: $\sin A = \frac{\text{Perp}}{\text{Hyp}} = \frac{3x}{5x} = \frac{3}{5}$ $\cos A = \frac{\text{Base}}{\text{Hyp}} = \frac{4x}{5x} = \frac{4}{5}$

Evaluate LHS:

$$\text{LHS} = \frac{1 - \tan^2 A}{1 + \tan^2 A} = \frac{1 - (3/4)^2}{1 + (3/4)^2} = \frac{1 - 9/16}{1 + 9/16} = \frac{7/16}{25/16} = \frac{7}{25}$$

Evaluate RHS:

$$\text{RHS} = \cos^2 A - \sin^2 A = \left(\frac{4}{5}\right)^2 - \left(\frac{3}{5}\right)^2 = \frac{16}{25} - \frac{9}{25} = \frac{7}{25}$$

Since LHS = RHS, the given statement is **True**.

3 Chapter 3: Triangles

3.1 Key Concepts & Formulas

- **Basic Proportionality Theorem (BPT / Thales Theorem):** If a line is drawn parallel to one side of a triangle intersecting the other two sides, then it divides the two sides in the same ratio.
- **Criteria for Similarity of Triangles:**
 - **AAA / AA:** If corresponding angles are equal.
 - **SSS:** If corresponding sides are proportional.
 - **SAS:** If one angle of a triangle is equal to one angle of the other triangle and the sides including these angles are proportional.

3.2 Important Practice Questions

Question 5: In a $\triangle ABC$, $DE \parallel BC$. If $AD = 1.5$ cm, $DB = 3$ cm, and $AE = 1$ cm, find EC .

Solution: By the Basic Proportionality Theorem (BPT), since $DE \parallel BC$, we have:

$$\frac{AD}{DB} = \frac{AE}{EC}$$

Substitute the given values:

$$\frac{1.5}{3} = \frac{1}{EC}$$

$$\frac{1}{2} = \frac{1}{EC} \implies EC = 2 \text{ cm}$$

4 Chapter 4: Statistics

4.1 Key Concepts & Formulas

- **Mean ($\bar{x}$):**
 - Direct Method: $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$
 - Assumed Mean Method: $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$, where $d_i = x_i - a$
- **Mode:** The value among the observations which occurs most frequently.

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where l = lower limit of modal class, h = class size, f_1 = frequency of modal class, f_0 = frequency of class preceding modal class, f_2 = frequency of class succeeding modal class.

- **Median:**

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

Where l = lower limit of median class, n = number of observations, cf = cumulative frequency of class preceding the median class, f = frequency of median class, h = class size.

- **Empirical Relationship:** $3 \times \text{Median} = \text{Mode} + 2 \times \text{Mean}$

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