

RRB JE Mathematics

Complete Notes with Formulas + 30 Practice Questions & Answers

For RRB JE CBT 1 & CBT 2 (Mathematics section) — Number System, Algebra, Geometry & Mensuration, Trigonometry, Statistics, Arithmetic (Time & Work, Time & Speed, SI/CI, Profit & Loss, Ratio & Percentage) and more.

Prepared by Entri App

Part A: Quick Revision Notes & Key Formulas

1. Number System

Natural numbers: 1,2,3,... Whole numbers: 0,1,2,3,... Integers: ..., -2, -1, 0, 1, 2, ...

Divisibility: by 2 (last digit even), by 3 (sum of digits divisible by 3), by 9 (sum of digits divisible by 9), by 11 (difference of sum of digits at odd & even places is 0 or a multiple of 11).

Sum of first n natural numbers = $n(n+1)/2$. Sum of squares = $n(n+1)(2n+1)/6$. Sum of cubes = $[n(n+1)/2]^2$.

2. HCF and LCM

HCF $\times$ LCM = Product of two numbers.

HCF of fractions = HCF of numerators / LCM of denominators.

LCM of fractions = LCM of numerators / HCF of denominators.

3. Ratio, Proportion & Percentage

$a : b = a/b$. If $a/b = c/d$, then a, b, c, d are in proportion ($ad = bc$).

$x\%$ of $y = (x \times y)/100$. To convert a fraction to percentage, multiply by 100.

If A is $x\%$ more than B , then B is less than A by $[x/(100+x)] \times 100\%$.

4. Profit, Loss & Discount

Profit % = $(\text{Profit}/\text{CP}) \times 100$. Loss % = $(\text{Loss}/\text{CP}) \times 100$.

SP = $\text{CP}(100+\text{P}\%)/100$ (profit) or $\text{CP}(100-\text{L}\%)/100$ (loss).

Marked Price and Discount: SP = $\text{MP}(100-\text{D}\%)/100$.

5. Simple & Compound Interest

SI = $(P \times R \times T)/100$.

CI (annual) = $P[(1 + R/100)^T - 1]$.

Amount (CI) = $P(1 + R/100)^T$.

6. Time, Speed & Distance / Time & Work

Speed = Distance/Time. 1 km/h = $5/18$ m/s; 1 m/s = $18/5$ km/h.

Average speed (equal distances, two speeds) = $2xy/(x+y)$.

If A does a work in n days, A 's one-day work = $1/n$. Combined rate = sum of individual rates.

7. Algebra (Key Identities)

$(a+b)^2 = a^2 + 2ab + b^2$ $(a-b)^2 = a^2 - 2ab + b^2$

$a^2 - b^2 = (a+b)(a-b)$

$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

Quadratic formula: $x = [-b \pm \sqrt{b^2 - 4ac}] / 2a$

8. Mensuration (2D)

Rectangle: Area = $l \times b$, Perimeter = $2(l+b)$.

Square: Area = a^2 , Perimeter = $4a$.

Triangle: Area = $\frac{1}{2} \times \text{base} \times \text{height}$. Equilateral triangle Area = $(\sqrt{3}/4)a^2$.

Circle: Area = πr^2 , Circumference = $2\pi r$.

Trapezium: Area = $\frac{1}{2}(a+b) \times h$.

9. Mensuration (3D)

Cube: Volume = a^3 , Surface area = $6a^2$.

Cuboid: Volume = $l \times b \times h$, Surface area = $2(lb + bh + hl)$.

Cylinder: Volume = $\pi r^2 h$, Curved SA = $2\pi rh$, Total SA = $2\pi r(r + h)$.

Cone: Volume = $(1/3)\pi r^2 h$, Curved SA = πrl (l = slant height).

Sphere: Volume = $(4/3)\pi r^3$, SA = $4\pi r^2$.

10. Trigonometry (Basic Ratios)

$\sin\theta$ = Opposite/Hypotenuse, $\cos\theta$ = Adjacent/Hypotenuse, $\tan\theta$ = Opposite/Adjacent.

$\sin^2\theta + \cos^2\theta = 1$. $1 + \tan^2\theta = \sec^2\theta$. $1 + \cot^2\theta = \operatorname{cosec}^2\theta$.

Standard values: $\sin 30^\circ = 1/2$, $\sin 45^\circ = 1/\sqrt{2}$, $\sin 60^\circ = \sqrt{3}/2$, $\sin 90^\circ = 1$.

11. Statistics

Mean = Sum of observations / Number of observations.

Median = middle value of data arranged in order (average of two middle values if n is even).

Mode = most frequently occurring value.

Part B: 30 Practice Questions with Answers

Each question is followed immediately by its answer and a short solution/explanation, so this section can double as both practice and a quick-revision set.

Q1. The HCF and LCM of two numbers are 12 and 240 respectively. If one number is 48, find the other.

Answer: 60

Solution: Product of numbers = HCF $\times$ LCM = $12 \times 240 = 2880$. Other number = $2880/48 = 60$.

Q2. Simplify: $15 - 3 \text{ of } (4 - 2) + 6 \div 3$

Answer: 11

Solution: BODMAS: 'of' first $\rightarrow 3 \text{ of } 2 = 6$. Then division: $6 \div 3 = 2$. So $15 - 6 + 2 = 11$.

Q3. A sum of Rs. 8,000 becomes Rs. 9,261 in 3 years at compound interest (compounded annually). Find the rate of interest.

Answer: 5%

Solution: $9261/8000 = (1+R/100)^3$. Since $(21/20)^3 = 9261/8000$, we get $1+R/100 = 21/20$, so $R = 5\%$.

Q4. The ratio of ages of A and B is 3:5. After 9 years, the ratio becomes 3:4. Find A's present age.

Answer: 9 years

Solution: Let ages be $3x$ and $5x$. $(3x+9)/(5x+9) = 3/4 \rightarrow 12x+36 = 15x+27 \rightarrow 3x = 9 \rightarrow x = 3$. A's age = $3x = 9$ years.

Q5. A shopkeeper marks an item 40% above cost price and gives a discount of 15%. Find his profit percentage.

Answer: 19%

Solution: Let CP = 100. MP = 140. SP = $140 \times 85/100 = 119$. Profit % = $(119-100)/100 \times 100 = 19\%$.

Q6. A can complete a work in 12 days and B in 18 days. Working together, in how many days will they finish it?

Answer: 7.2 days ($36/5$ days)

Solution: A's rate = $1/12$, B's rate = $1/18$. Combined rate = $1/12+1/18 = (3+2)/36 = 5/36$. Time = $36/5 = 7.2$ days.

Q7. A train 150 m long crosses a pole in 15 seconds. Find its speed in km/h.

Answer: 36 km/h

Solution: Speed = $150/15 = 10$ m/s. Convert: $10 \times 18/5 = 36$ km/h.

Q8. Find the value of x if $2x^2 - 5x - 3 = 0$.

Answer: $x = 3$ or $x = -1/2$

Solution: Using the quadratic formula: $x = [5 \pm \sqrt{25+24}]/4 = [5 \pm 7]/4$. So $x = 3$ or $x = -1/2$.

Q9. The perimeter of a rectangle is 60 cm and its length is twice its breadth. Find its area.

Answer: 200 cm²

Solution: Let breadth = b , length = $2b$. Perimeter: $2(2b+b) = 60 \rightarrow 6b = 60 \rightarrow b = 10$, $l = 20$. Area = $20 \times 10 = 200$ cm².

Q10. Find the curved surface area of a cone with radius 7 cm and slant height 10 cm. (Use $\pi = 22/7$)

Answer: 220 cm²

Solution: CSA = $\pi rl = (22/7) \times 7 \times 10 = 220$ cm².

Q11. If $\sin \theta = 3/5$, find $\cos \theta$ (θ acute).

Answer: 4/5

Solution: $\sin^2\theta + \cos^2\theta = 1 \rightarrow \cos^2\theta = 1 - 9/25 = 16/25 \rightarrow \cos\theta = 4/5$.

Q12. Find the mean of the first 10 natural numbers.

Answer: 5.5

Solution: Sum of first n natural numbers = $n(n+1)/2 = 10 \times 11/2 = 55$. Mean = $55/10 = 5.5$.

Q13. A number when divided by 5 leaves remainder 3, and when divided by 7 leaves remainder 4. Find the smallest such number.

Answer: 18

Solution: By checking multiples: numbers giving remainder 3 when divided by 5 are 3, 8, 13, 18, 23...
Checking each with 'remainder 4 when divided by 7': $18 \div 7 = 2$ remainder 4. So 18 is the smallest.

Q14. Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both are opened together, how long will the tank take to fill?

Answer: 12 minutes

Solution: Rate of A = $1/20$, Rate of B = $1/30$. Combined = $(3+2)/60 = 5/60 = 1/12$. Time = 12 minutes.

Q15. A sum becomes double itself in 8 years at simple interest. Find the rate of interest.

Answer: 12.5%

Solution: $SI = P$ (since amount doubles, $SI = P$). Using $SI = PRT/100$: $P = P \times R \times 8/100 \rightarrow R = 100/8 = 12.5\%$.

Q16. Find the value of $\sqrt{144} + \sqrt{196} - \sqrt{64}$.

Answer: 18

Solution: $\sqrt{144} = 12$, $\sqrt{196} = 14$, $\sqrt{64} = 8$. $12 + 14 - 8 = 18$.

Q17. The average of 5 consecutive odd numbers is 61. Find the largest number.

Answer: 65

Solution: For consecutive odd numbers, the average equals the middle (3rd) number = 61. Numbers: 57, 59, 61, 63, 65. Largest = 65.

Q18. A boat covers 32 km downstream in 4 hours and the same distance upstream in 8 hours. Find the speed of the boat in still water.

Answer: 6 km/h

Solution: Downstream speed = $32/4 = 8$ km/h. Upstream speed = $32/8 = 4$ km/h. Speed in still water = $(8+4)/2 = 6$ km/h.

Q19. Find the compound interest on Rs. 5,000 for 2 years at 10% per annum (compounded annually).

Answer: Rs. 1,050

Solution: Amount = $5000(1+10/100)^2 = 5000 \times 1.21 = 6050$. CI = $6050 - 5000 = \text{Rs. } 1,050$.

Q20. The volume of a cube is 343 cm^3 . Find the length of its edge.

Answer: 7 cm

Solution: Edge = cube root of 343 = 7 cm (since $7^3 = 343$).

Q21. What is the probability of getting a sum of 8 when two dice are thrown together?

Answer: 5/36

Solution: Total outcomes = 36. Pairs giving sum 8: (2,6), (3,5), (4,4), (5,3), (6,2) = 5 outcomes. Probability = $5/36$.

Q22. If $x + 1/x = 5$, find the value of $x^2 + 1/x^2$.

Answer: 23

Solution: $x^2 + 1/x^2 = (x + 1/x)^2 - 2 = 25 - 2 = 23$.

Q23. A boat's speed in still water is 9 km/h and the speed of the stream is 3 km/h. Find the time taken to cover 24 km downstream.

Answer: 2 hours

Solution: Downstream speed = $9 + 3 = 12$ km/h. Time = Distance/Speed = $24/12 = 2$ hours.

Q24. Find the area of a circle whose circumference is 44 cm. (Use $\pi = 22/7$)

Answer: 154 cm²

Solution: Circumference = $2\pi r = 44 \rightarrow r = 44 \times 7/(2 \times 22) = 7$ cm. Area = $\pi r^2 = 22/7 \times 49 = 154$ cm².

Q25. The sum of three consecutive integers is 72. Find the largest integer.

Answer: 25

Solution: Let integers be $n-1, n, n+1$. Sum = $3n = 72 \rightarrow n = 24$. Largest = $n+1 = 25$.

Q26. A alone can do a piece of work in 10 days, B alone in 15 days. They work together for 3 days, then A leaves. In how many more days will B finish the remaining work?

Answer: 6.5 days

Solution: Combined rate = $1/10 + 1/15 = 5/30 = 1/6$. Work done in 3 days = $3/6 = 1/2$. Remaining work = $1/2$. B's rate = $1/15$. Days needed = $(1/2)/(1/15) = 7.5$ days.

Q27. Find the value of $\tan 45^\circ + \sec 60^\circ - \operatorname{cosec} 30^\circ$.

Answer: 1

Solution: $\tan 45^\circ = 1, \sec 60^\circ = 2, \operatorname{cosec} 30^\circ = 2$. So $1 + 2 - 2 = 1$.

Q28. A sells an article to B at a profit of 20% and B sells it to C at a loss of 10%. If C pays Rs. 216, find A's cost price.

Answer: Rs. 200

Solution: Let CP for A = x . A sells at $1.2x$ (B's CP). B sells at $0.9 \times 1.2x = 1.08x = 216$. $x = 216/1.08 = 200$.

Q29. If the angle of elevation of the sun changes from 30° to 60° , the length of a tower's shadow decreases by 20 m. Find the height of the tower.

Answer: $10\sqrt{3}$ m

Solution: Let height = h . Shadow at $30^\circ = h/\sqrt{3}$, at $60^\circ = h/\sqrt{3}$. Difference: $h/\sqrt{3} - h/\sqrt{3} = 20 \rightarrow h(3-1)/\sqrt{3} = 20 \rightarrow h = 10\sqrt{3}$ m.

Q30. Find the median of the data: 12, 15, 9, 21, 18, 24, 6.

Answer: 15

Solution: Arrange in order: 6, 9, 12, 15, 18, 21, 24. Middle (4th of 7) value = 15.

Q31. A container has 40 litres of milk. 4 litres is replaced with water, and the process is repeated once more. Find the quantity of milk left.

Answer: 32.4 litres

Solution: Using the formula: Final quantity = $40(1 - 4/40)^2 = 40 \times (9/10)^2 = 40 \times 0.81 = 32.4$ litres.