HAWASSA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

GRADUATE ADMISSION TEST (GAT) TUTORIAL HAND BOOK FOR QUANTITATIVE REASONINIG

July 2024

Ratios, rates and percentages

Ratio: is a relatioship between two numbers, expressed as a quotient with the same unit in the denominator and the numerator.

The ratio of a and b is denoted by: a to b or $a : b$ or $\frac{a}{b}$

How to divide a quantity by a ratio:

(a) Add the parts of the ratio together.

(b) Divide the quantity by the sum of the parts.

(c) Multiply the share value by each parts in the ratio.

Rate: is a ratio of two quantities with different units.

Example: $\frac{2teachers}{50students}; \frac{200birr}{504hours}; \frac{50km}{2hrs}.$

Percentage: is one part per hundred.

i.e., $Percent = \frac{Part}{Whole}100\%$

Percent increase or decrease

- Percent increase $= \frac{\text{New value - Orginal value}}{\text{Orginal value}}100\%$
- Percent increase $= \frac{\text{Orginal value- New value}}{\text{Orginal value}}100\%$

Fraction Rule: Let a, b, c and d are integers and b and d are non-negative integers. Then

(a) Sum rule : $\frac{a}{b} + \frac{c}{d} = \frac{ad+bc}{bd}$.

(b) Difference rule: $\frac{a}{b} - \frac{c}{d} = \frac{ad-bc}{bd}$.

(c) Product rule: $\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$.

(d) Quotient rule: $\frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc}$ where $c \neq 0$.

(e) Proportion: $\frac{a}{b} = \frac{c}{d}$ if and only if $ad = bc$.

(f) Comparison: $\frac{a}{b} \geq \frac{c}{d}$ if and only if $ad \geq bc$.

Powers, Exponents, Roots

Product rule : $a^n \times a^m = a^{m+n}$.	Power of quotient rule: $(\frac{a}{b})^n = \frac{a^n}{b^n}$.
Quotient rule: $a^n \div a^m = a^{n-m}$.	Zero Exponent rule: $a^0 = 1$.
Power of power rule: $(a^n)^m = a^{nm}$.	Negative exponent rule: $a^{-n} = \frac{1}{a^n}$.
Power of product rule: $(a \times b)^n = a^n \times b^m$.	Fraction exponent rule: $a^{\frac{n}{m}} = \sqrt[n]{a^m}$.

Factoring:

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

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

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

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

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

Quadratic formula: The equation $ax^2 + bx + c = 0$ with $a \neq 0$ is called quadratic equation.

- If $b^2 - 4ac > 0$ then the quadratic equation has two real solutions.
- If $b^2 - 4ac = 0$ then the quadratic equation has one real solution.
- If $b^2 - 4ac < 0$ then the quadratic equation has no real solutions.

If the quadratic equation has real solution, then the solution is given by:

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

Discrete Quantitative Questions:

Directions: For each of the questions, select the best answer from the four alternatives.

Qn 1. A bus is carrying 28 passengers, of which 18 are male. What is the ratio of female to male passengers?

(A) $\frac{5}{14}$ (B) $\frac{9}{14}$ (C) $\frac{5}{9}$ (D) $\frac{9}{5}$

Qn 2. If 60 % of members of a club is men, what is the ratio of men to women in the club?

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

Qn 3. A father wants to divide birr 390 to his two children A and B in the ratio 5 : 8. How much money child A and child B get, respectively?

(A) 150 and 240 (B) 120 and 270 (C) 130 and 260 (D) 100 and 290

Qn 4. A person wants to divide birr 4,600 for his three children in the ratio of $\frac{1}{2} : \frac{2}{3} : \frac{3}{4}$. What are the shares in birr of each child from the smallest to the largest amount?

(A) 1200, 1400 and 2000 (B) 1200, 1600 and 1800 (C) 800,1600 and 2200

(D) 1000, 1600 and 2000

Qn 5. The daily sales of a shop is birr 2400.If the shop owner pays 4.5% sales tax, how rnuch does he pay from his daily sales?

(A) 234 (B) 180 (C) 108 (D) 216

Qn 6. A school is planning to increase the number of students from 40 to 50 per class. How much is the percentage increase?

(A) 40% (B) 25% (C) 20% (D) 10%

Qn 7. A retail store buys a shoe for 80 birr and sells at 75 % profit. What is the selling price of the shoe?

(A) 100 birr (B) 120 birr (C) 130 birr (D) 140 birr

Qn 8. A shop keeper bought 5 dozen pens at 85 cents per pen and planned to sell each for 1 Birr. However, 10% of the pens were damaged and thrown away. How much did profit?

(A) 15 birr (B) 9 birr (C) 5 birr (D) 3 birr

Qn 9. A person crossed a 600 meters long street in 4 minutes. What was his speed in km per hour?

(A) 8 km/hr (B) 7 km/hr (C) 6 km/hr (D) 9 km/hr

Qn 10. In a company, a regular work time is 40 hours per week and the rate of pyment for over time work is $1\frac{1}{2}$ times the regular rate (per hour). How much is the payment for an employe who worked 52 hours in a week if his hourly regular payment rate is birr 30?

(A) Birr 2340 (B) Birr 2560 (C) Birr 1740 (D) Birr 1560

Qn 11. 20 friends went to a movie theatre. The average cost of the movie ticket for 19 friends was 120 birr. But one of the friends paid 38birr more than the average cost for all the

19 friends. What was the total amount paid by all of them together?

(A) 2,438 (B) 2440 (C) 2204 (D) 2104

Qn 12. A retailer purchases shirts from a distributor at the rate of birr 300 per shirt and puts the label of birr 450 on each shirt. If the retailer allows some discount and still make a profit of 23%, then what is the discount percentage offered by the shopkeeper?

(A) 16% (B) 17% (C) 18% (D) 19%

Qn 13. The speeds of two trains are in the ratio 6 : 7. If the second train runs 364 km in 4 hours, then the speed of the first train is _____

(A) $60km/hr$ (B) $72km/hr$ (C) $78kr/hr$ (D) $84km/hr$

Qn 14. Average of five numbers is 20. If each number is multiplied by 2, what will be the new average?

(A) 30 (B) 40 (C) 50 (D) 60

Qn 15. A group consists of two male, two female and three children. The average age of the male is 67 years, that of the female is 35 years, and that of the children is six years. What is the average age of the group?

(A) 30.71 (B) 31.71 (C) 28.71 (D) 35.45

Qn 16. The average weight of a group of 5 boys is 26. If we replace a boy of weight 25 in the group with another boy so that new average increases by 3, find the weight of the new body.

(A) 56 (B) 34 (C) 40 (D) 33

Qn 17. If the price of petrol increases first by 10% and then by 15% in a particular month, then what is the total percentage increase in the price of petrol in that month?

(A) 26 (B) 26.5 (C) 27 (D) 27.5

Qn 18. In an election between 2 contestants, 20% of the total votes were declared invalid and one of the contestants got 35% of the total valid votes. If the total number of votes in that election is 4,850 then what is the total number of valid votes that the other contestant got?

(A) $2,522$ (B) $2,512$ (C) $2,502$ (D) $2,436$

Qn 19. Thahir spends 32% of his total income to maintain his family, 23% on his personal expenses and 70% of the remaining on children's education and saves the remaining.

What percent of his income is his savings?

(A) 13.8 (B) 13.7 (C) 13.6 (D) 13.5

Qn 20. If $A : B = 6 : 13$ and $B : C = 2 : 7$, then what is the value of $A : B : C$?

(A) 12 : 91 : 26 (B) 12 : 26 : 91 (C) 78 : 26 : 91 (D) 12 : 26 : 42

Qn 21. The total share of A,B and C is 669 in such a way that the ratio of the shares of A and B is 17:27 and that of B and C is 2:5. What is the share of C?

(A) 405 (B) 135 (C) 270 (D) 223

Qn 22. The ratio of boys to girls in a certain classroom was 2 : 3. If boys represented five more than one-third of the class, how many people were in the classroom?

(A) 30 (B) 45 (C) 75 (D) 60

Qn 23. Which of the following fractions given in the options is the smallest?

(A) $\frac{19}{23}$ (B) $\frac{29}{47}$ (C) $\frac{4}{7}$ (D) $\frac{17}{9}$

Qn 24. When $\sqrt{98} - \sqrt{50}$ Is simplified and it is equal to _____

(A) $4\sqrt{3}$ (B) $2\sqrt{2}$ (C) $4\sqrt{2}$ (D) $2\sqrt{3}$

Qn 25. If $x + 2y = 8$ and $-2x + 3y = 5$, then $x =$ _____

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

Qn 26. At a certain fruit shop, one mango is being sold for Birr 10 and one one banana is being sold for birr 5. If 30 fruits of mangos and bananas were purchased from the fruit shop for birr 200, how many of the fruits were bananas?

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

Qn 27. Suppose x and y are two quantities related by the equation $y = -\frac{1}{2}x + 2$ what happens to y if the vale of x is increases by 1?

(A) y decreases by $\frac{1}{2}$ (B) y increases by 2 (C) y decreases by 2

(D) y increases by $\frac{1}{2}$

Qn 28. A boy was asked to multiply a number by 25 but by mistake he multiplied by 45 and the answer was 200 more than the correct answer. What was the number?

(A) 7 (B) 8 (C) 10 (D) 12

Qn 29. If $a + 2b = x$ and $a - 2b = y$, which of the following expression is equal to ab?

(A) $\frac{x^2 - y^2}{8}$ (B) $\frac{x^2 + y^2}{8}$ (C) $x^2 - y^2$ (D) $x^2 + y^2$

Qn 30. If $a^2 = 17$, then $(a+1)(a-1) = ?$

(A) 15 (B) 12 (C) 16 (D) 9

Qn 31. Abebe, Bletu and Hussien combined their money to purchase a laptop. Together, they paid a total of 4900 birr for the laptop, including vat. Abebe paid 500 birr more than Beletu paid and Beletu paid twice as much as Hussien paid. How much did Abebe pay?

(A) 1080 birr (B) 1760 birr (C) 2260 birr (D) 2950 birr

Qn 32. Team members can complete a job in 20 days but with the help of their team leader, they can complete it in 15 days. In how many days can the team leader alone complete the job?

(A) 20 days (B) 40 days (C) 60 days (D) 80 days

Qn 33. There are two examinations rooms A and B. If 10 students are sent from A to B, then the number of students in each room is the same. If 20 candidates are sent from B to A, then the number of students in A is double the number of students in B. The number of students in room A is:

(A) 20 (B) 100 (C) 60 (D) 80

Qn 34. The price of 10 chairs is equal to that of 4 tables. The price of 15 chairs and 2 tables together is Birr 4000. The total price of 12 chairs and 3 tables is:

(A) 3500 (B) 3900 (C) 3700 (D) 3840

Qn 35. $(1-\frac{1}{2})(1-\frac{1}{3})(1-\frac{1}{3})\cdots(1-\frac{1}{x}) =$ _____

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

Qn 36. The sum of ages of 5 children born at the intervals of 3 years each is 50 years. What is the age of the youngest child?

(A) 16 (B) 12 (C) 4 (D) 7

Qn 37. Value of $(256)^{0.16}x(256)^{0.09}$ is _____

(A) 64 (B) 8 (C) 4 (D) 16

Qn 38. The ratio of birr 200, birr 50 and birr 5 notes in a purse is 5 : 19 : 8. If the total money in the bag is birr 39,800 then what is the amout of money in the form of birr 50 notes?

(A) $9,500$ (B) $27,500$ (C) $19,000$ (D) $15,400$

Qn 39. The average of five consequetive integer is 8. Then the largest of these number is _____

(A) 6 (B) 8 (C) 9 (D) 10

Qn 40. Let m and n are integers, $m - n$ is even. Which of the following is even integer?

(A) $mn + n$ (B) $mn + 2n$ (C) $m - 2n$ (D) $m + 2n$

Qn 41. What is the sum of the biggest and the smallest fraction among the given fractions $\frac{2}{3}, \frac{3}{4}, \frac{4}{5}$ and $\frac{5}{6}$?

(A) $\frac{1}{6}$ (B) $\frac{2}{5}$ (C) $1\frac{1}{2}$ (D) $\frac{2}{3}$.

Qn 42. Let $m + n = 30$ and $\frac{1}{n} + \frac{1}{m} = \frac{5}{6}$. Then mn=_____

(A) 32 (B) 36 (C) 42 (D) 48

Qn 43. Let $(-y + 2)2 = y(2 - y)$. Then $y =$ _____

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

Qn 44. If 3 peoples can wash a car in 8hr, the number of cars 6 peoples can wash in 12 hr is _____

(A) 24 (B) 48 (C) 60 (D) 72

Line: Let $P(x_1, y_1)$ and $Q(x_2, y_2)$ be distinct points in the coordinate plane.

(a) The distance between the points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is: $|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

(b) The midpoint of P and Q is given by $(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$

(c) The slope m of a non-vertical line that passes through the points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is $m = \frac{y_2 - y_1}{x_2 - x_1}$ (The slope of a vertical line is not defined and the slope of horizontal line is 0.)

(d) Equation of a line that passes through $P(x_1, y_1)$ and slope m is: $y = m(x - x_1) + y_1$

(e) Equation of a line that passes through $P(x_1, y_1)$ and $Q(x_2, y_2)$ is: $y = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) + y_1$

(f) Equation of a vertical line that passes through $P(x_1, 0)$ is $x = x_1$

(g) Equation of a horizontal line that passes through $P(0, y_1)$ is $y = y_1$

Qn 45. The distance between $P(1, 2)$ and $Q(4, 6)$ is _____

(A) 3 (B) 4 (C) 5 (D) 6

Qn 46. Let $P(-3, 3)$ and $Q(7, 9)$, then the mid point of PQ is _____

(A) $(2, 2)$ (B) $(2, 0)$ (C) $(2, 6)$ (D) $(-2, 3)$

Qn 47. What is the point of intersection of the line $2x + 3y = 6$ and the x -axis?

(A) $(0, 2)$ (B) $(2, 0)$ (C) $(3, 0)$ (D) $(0, 3)$

Qn 48. If (a, b) is the midpoint of the line segment joining the points $A(10, -6)$ and $B(k, 4)$ and $a - 2b = 18$. then what is the value of k ?

(A) 22 (B) 32 (C) 26 (D) 16

Qn 49. Which of the following lines passes through point $P(3, -1)$ in the $x - y$ coordinate plane?

(A) $y = -2x + 5$ (B) $y = 2x - 5$ (C) $y = -3x + 1$ (D) $y = 3x - 1$

Qn 50. Equation of the line passes through the points $(1, 2)$ and $(4, -2)$ is _____

(A) $-4x + 3y = 10$ (B) $4x + 3y = 10$ (C) $4x - 3y = 10$

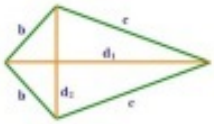
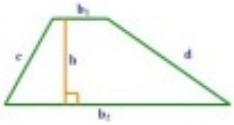
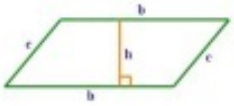
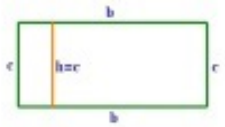
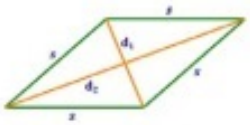
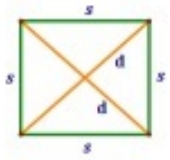
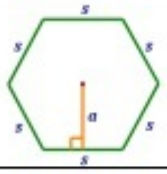
(D) $-4x - 3y = 10$

Qn 51. A point of the form $(a, -a)$ always lies on which of the foilowing line?

(A) $x = a$ (B) $y = -a$ (C) $y - x = 0$ (D) $x + y = 0$

Geometry

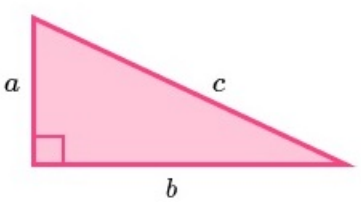
Summary of Perimeter and Area Formulas – 2D Shapes

Shape	Figure	Perimeter	Area
Kite		$P = 2b + 2c$ b, c = *sides*	$A = \frac{1}{2}(d_1 d_2)$ d_1, d_2 = *diagonals*
Trapezoid		$P = b_1 + b_2 + c + d$ b_1, b_2 = *bases* c, d = *sides*	$A = \frac{1}{2}(b_1 + b_2)h$ b_1, b_2 = bases h = height
Parallelogram		$P = 2b + 2c$ b, c = *sides*	$A = bh$ b = *base* h = *height*
Rectangle		$P = 2b + 2c$ b, c = *sides*	$A = bh$ b = *base* h = *height*
Rhombus		$P = 4s$ s = *side*	$A = bh = \frac{1}{2}(d_1 d_2)$ d_1, d_2 = *diagonals*
Square		$P = 4s$ s = *side*	$A = s^2 = \frac{1}{2}(d_1 d_2)$ d_1, d_2 = *diagonals*
Regular Polygon		$P = ns$ n = *number of sides* s = *side*	$A = \frac{1}{2}\, a \cdot P$ a = *apothem* P = *perimeter*
Circle		$C = 2\pi r = \pi d$ r = *radius* d = *diameter*	$A = \pi r^2$ r = *radius*

Pythagoras' Theorem states that the square of the longest side of a right angled triangle (called the hypotenuse) is equal to the sum of the squares of the other two sides.

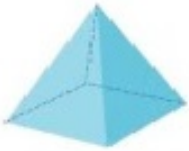
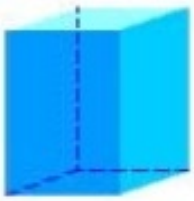
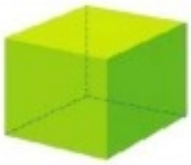
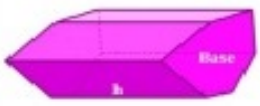
Pythagoras' Theorem is:

$$a^2 + b^2 = c^2$$



Geometry

Summary of Surface Area and Volume Formulas – 3D Shapes

Shape	Figure	Surface Area	Volume
Sphere		$SA = 4\pi r^2$ r = radius	$V = \frac{4}{3}\pi r^3$ r = radius
Right Cylinder		$SA = 2\pi rh + 2\pi r^2$ h = height r = radius of base	$V = \pi r^2 h$ h = height r = radius of base
Cone		$SA = \pi rl + \pi r^2$ l = slant height r = radius of base	$V = \frac{1}{3}\pi r^2 h$ h = height r = radius of base
Square Pyramid		$SA = 2sl + s^2$ s = base side length l = slant height	$V = \frac{1}{3}s^2 h$ s = base side length h = height
Rectangular Prism		$SA = 2 \cdot (lw + lh + wh)$ l = length w = width h = height	$V = lwh$ l = length w = width h = height
Cube		$SA = 6s^2$ s = side length (all sides)	$V = s^3$ s = side length (all sides)
General Right Prism		$SA = Ph + 2B$ P = Perimeter of Base h = height (or length) B = area of Base	$V = Bh$ B = area of Base h = height

Postulates and Theorems

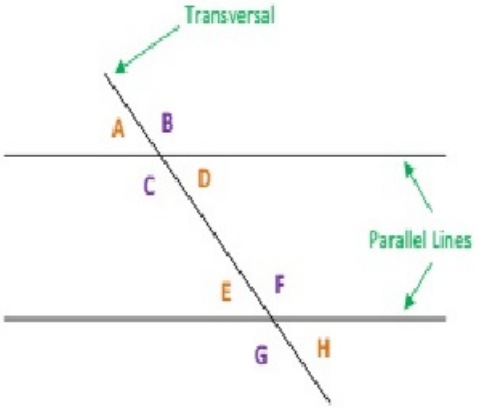
(a) **Same Side Interior Angles Postulate:** If a transversal intersects two parallel lines, then the sum the same side. interior angles is 180°.

(b) **Alternate Interior Angles Theorem:**If a transversal intersects two parallel lines, then alternate interior angles are congruent (have the same degree).

(c) **Corresponding Angles Theorem:** If a transversal intersects two parallel lines, the corresponding angles are congruent.

(d) **Alternate Exterior Angles Theorem:** If a transversal intersects two parallel lines, then alternate exterior angles are congruent.

(e) If two angles form a straight line, then the sum of their angle is 180°.



Alternate: refers to angles that are on opposite sides of the transversal.

Consecutive: refers to angles that are on the same side of the transversal.

Interior: refers to angles that are between the parallel lines.

Exterior: refers to angles that are outside the parallel lines.

(i) Angles A and E (top left) are Corresponding Angles. So are angle pairs B and F (top right), C and G (bottom left), and D and H (bottom right). Corresponding angles are congruent

(ii) Angles D and E are Alternate Interior Angles. Angles C and F are also alternate interior angles. Alternate interior angles are congruent.

(iii) Angles A and H are Alternate Exterior Angles. Angles B and G are also alternate exterior angles. Alternate exterior angles are congruent.

(iv) Angles C and E are Consecutive Interior Angles. Angles D and F are also consecutive interior angles. Consecutive interior angles are supplementary

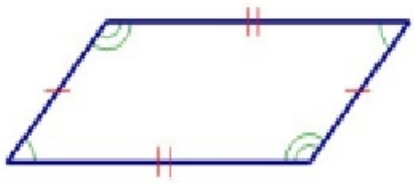
Note that angles A, D, E, and H are congruent, and angles B, C, F, and G are congruent. In addition, each of the angles in the first group are supplementary to each of the angles in the second group.

(a) **Triangle angle sum theorem:** The sum of the measures of the angles of a triangle is 180.

(b) **Triangle exterior angle theorem:** The measure of each exterior angle of a triangle equals the sum of the measures of its two remote interior angles.

(c) **Polygon angle sum theorem** The sum of the measures of an n-gon is: $(n-2) \times 180$.

Parallelograms: A parallelogram is a quadrilateral (four sided plane figure) in which the opposite sides are parallel and equal.



(i) If a quadrilateral is a parallelogram, then the sum of its consecutive angles is 180°.

(ii) If a quadrilateral is a parallelogram, then its opposite angles are congruent.

(iii) If a parallelogram is a rhombus, then its diagonals are perpendicular.

Perimeters of similar polygons: If two polygons are similar, then the ratio of their perimeters is equal to the ratios of their corresponding side lengths.
Areas of similar polygons: If two polygons are similar, then the ratio of their areas is equal to the squares of the ratios of their corresponding side lengths.

Qn 52. The angles of a triangle are in the ratio 8:3:4. What is the measure of the smallest angle?

(A) 12° (B) 24° (C) 32° (D) 72°

Qn 53. Corresponding sides of two similar triangles are in the ratio 2:3, If the area of the smaller triangle is 16 sq. cm, what is the area of the larger triangle?

(A) 24 sq.cm. (B) 36 sq.cm. (C) 48 sq.cm. (D) 64 sq.cm.

Qn 54. What is the area of a circle whose radius is the diagonal of a square whose area is 9?

(A) 8π (B) 18π (C) 3π (D) 36π

Qn 55. If an equilateral triangle and a square have the same perimeter, what is the ratio of the lengths of the sides of the equilateral triangle to the lengths of the sides of the square?

(A) 3 : 4 (B) 4 : 3 (C) 1 : 2 (D) 1 : 3

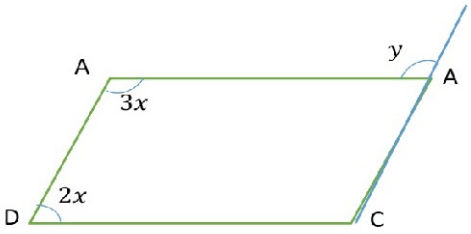
Qn 56. The circumference of a circle is $x\pi$ units, and the area of the circle is $y\pi$ square units. If $x = y$, then radius of the circle is:

(A) 1 (B) 2 (C) 3π (D) 2π

Qn 57. What is the volume of a cube whose surface area is 294?

(A) 125 (B) 216 (C) 294 (D) 343

Qn 58. Let ABCD is a parallelogram. Then the value of x is _____

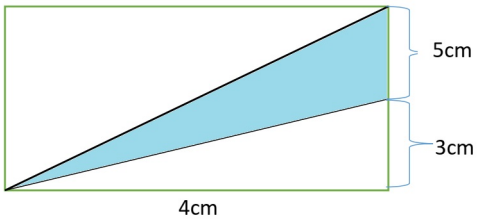


(A) 30° (B) 36° (C) 60° (D) 108°

Qn 59. From the parallelogram given above, the value of y is _____

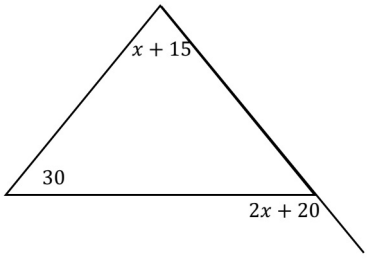
(A) 30° (B) 36° (C) 60° (D) 72°

Qn 60. In the figure below, what is the area of the shaded region?

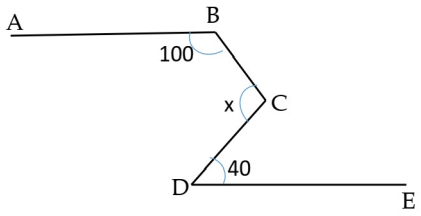


(A) 16sq.cm (B) 6sq.cm. (C) 10sq.cm (D) 4sq.cm.

Qn 61. The value of x given in the figure below is _____



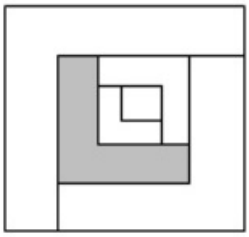
(A) 25° (B) 30° (C) 35° (D) 50°



Qn 62. In the figure given above, if $AB//DE$ then, then $x =$ _____

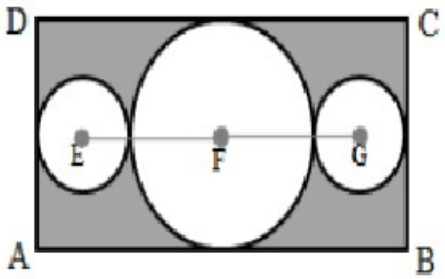
(A) 100° (B) 120° (C) 140° (D) 160°

Qn 63. In the figure below, each quadrilateral is square. The perimetere of each square is two third of the perimetere of the square containing it. If the area of the smaller squre is 8 cm.sq. What is the area of the shaded region in sq.cm



(A) $\frac{405}{16}$ (B) $\frac{405}{8}$ (C) $\frac{243}{8}$ (D) $\frac{243}{4}$

Qn 64. in the figure given below, $ABCD$ is a rectangle containing three circles whose centers are on line segment parallel to $\bar{AB}$ ate E, F and G. The two smaller circles has equal radius which is half of the radius of the larger circle. If the area of each smaller circle is πcm^2, what is the area of the shaded region in πcm^2.



(A) $32 - 4\pi$ (B) $32 - 6\pi$ (C) $24 - 4\pi$ (D) $24 - 6\pi$

Data Interpretation

Mean, Median, Mode, Range, Standard Deviation and Variance

(a) Arithmetic Mean (Average): If any data set consisting of the values $b_1, b_2, b_3 \cdots, b_n$ then the arithmetic mean B is defined as:

$$B = \frac{\text{Sum of all observations}}{\text{Total number of observation}} = \frac{b_1 + b_2 + b_3 \cdots + b_n}{n}$$

If these n observations $b_1, b_2, b_3 \cdots, b_n$ have corresponding frequencies $f_1, f_2, f_3 \cdots, f_n$ respectively, then the arithmetic mean (called weighted arthimetic mean) is computed using the formula:

$$B = \frac{b_1 f_1 + b_2 f_2 + b_3 f_3 \cdots + b_n f_n}{n}$$

(b) Median (the middle number): is a number that splits the data set in half.
How to find median?

Step 1 Arrange data in increasing order

Step 2 Determine how many numbers are in the data set = n

Step 3 If n is odd: Median is the middle number (i.e., median=$(\frac{n+1}{2})^{th}$ term)
If n is even: Median is the average of two middle numbers
(i.e., median = $\frac{(\frac{n}{2})^{th}term + (\frac{n}{2}+1)^{th}term}{2}$

(c) Mode: is the most frequent number in the data set.

(d) Arithmetic Range: is the difference between the largest and the smallest value of data.

(e) Variance: is average of the squared deviations from its mean(average) $\bar{x}$. Measures how far the values of the data set are from the mean, on average. The variance is denoted by δ^2 and calculated by:

$$\delta^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$$

(f) Standard deviation square root of the variance and denoted by δ and calculated by:

$$\delta = \sqrt{\delta^2} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

Properties of mean:

(a) If each observations is increased by k, then the mean is increased by k.

(b) If each observations is decreased by k, then the mean is decreased by k.

(c) If each observations is multiplied by a non-zero k, then the mean is multiplied by k.

(d) If each observations is divided by a non-zero k, then the mean is divided by k.

For Questions 65–67 refer to the following data:

1, 2, 3, 5, 2, 2, 6, 3

Qn 65. What is the mean of the data?

(A) 1 (B) 2 (C) 3 (D) 1.5

Qn 66. What is the median of the data?

(A) 3.5 (B) 2 (C) 3 (D) 2.5

Qn 67. What is the standard deviation of the data?

(A) $\sqrt{2.5}$ (B) $\sqrt{2}$ (C) $\sqrt{1.5}$ (D) $\sqrt{3}$

For Questions 68 – 71, refer to the following data given in the table:

x	10	20	30	40	50	60
f	4	5	2	4	3	1

Qn 68. The mean of given distribution:

(A) 30 (B) 40 (C) 50 (D) 60

Qn 69. The mode of given distribution:

(A) 20 (B) 30 (C) 40 (D) 50

Qn 70. The range of given distribution:

(A) 30 (B) 40 (C) 50 (D) 60

Qn 71. The standard deviation of given distribution:

(A) 15 (B) 15.56 (C) 17.4 (D) 18

Qn 72. A group of 100 items have a mean of 54. If the mean of 60 of these items is 58, what is the mean of the remaining items?

(A) 46 (B) 50 (C) 52 (D) 48

Qn 73. The average age of 6 friends that include 2 twins is 14. How old are the twins if the average age of the remaining 4 is 14.5 years?

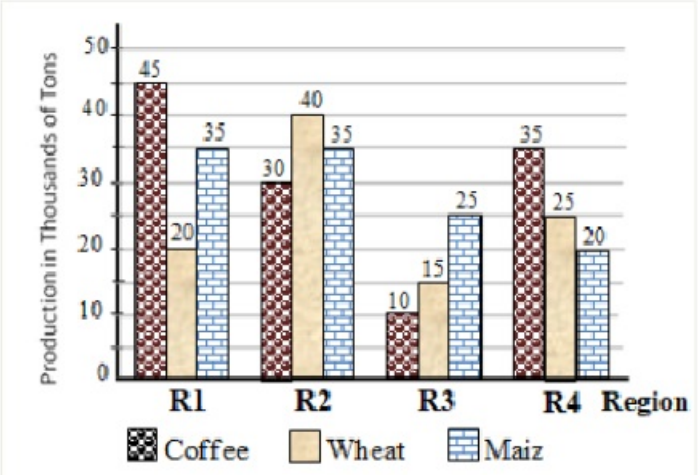
(A) 12 (B) 13 (C) 14 (D) 15

Qn 74. In an office with 30 trainee and a team lead, the average age of the whole team decreases by 1 year when team lead is excluded. If the average age of the whole team is 27 years, then what is the age of the team lead?

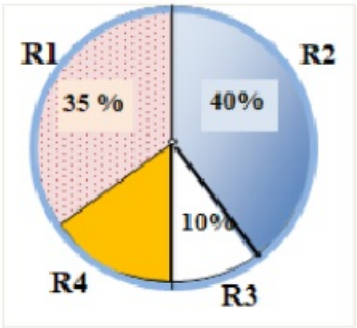
(A) 54 (B) 55 (C) 56 (D) 57

For questions 75 - 80 refer to the following bar diagrams and pie chart

I. PRODUCTION OF COFFEE, WHEAT & MAIZE IN FOUR REGIONS R1, R2, R3 & R4



II. PERCENTAGE OF AGRICULTURAL LAND IN THE FOUR REGIONS.



Qn 75. Which regions production is the maximum?

(A) R1 (B) R2 (C) R3 (D) R4

Note: $Productivity = \dfrac{Total production}{Area of agricultural land}$

Qn 76. What is the angle of the sector in the pie chart representing R4?

(A) 32° (B) 42° (C) 72° (D) 54°

Qn 77. What is the ratio of agricultural land in R3 to the agricultural land in R2? (A) 1 : 4

(B) 3 : 4 (C) 1 : 3 (D) 2 : 3

Qn 78. In what percent, the production of Coffee in R1 is more than the production of Coffee in R3?

(A) 350% (B) 45% (C) 450% (D) 35%

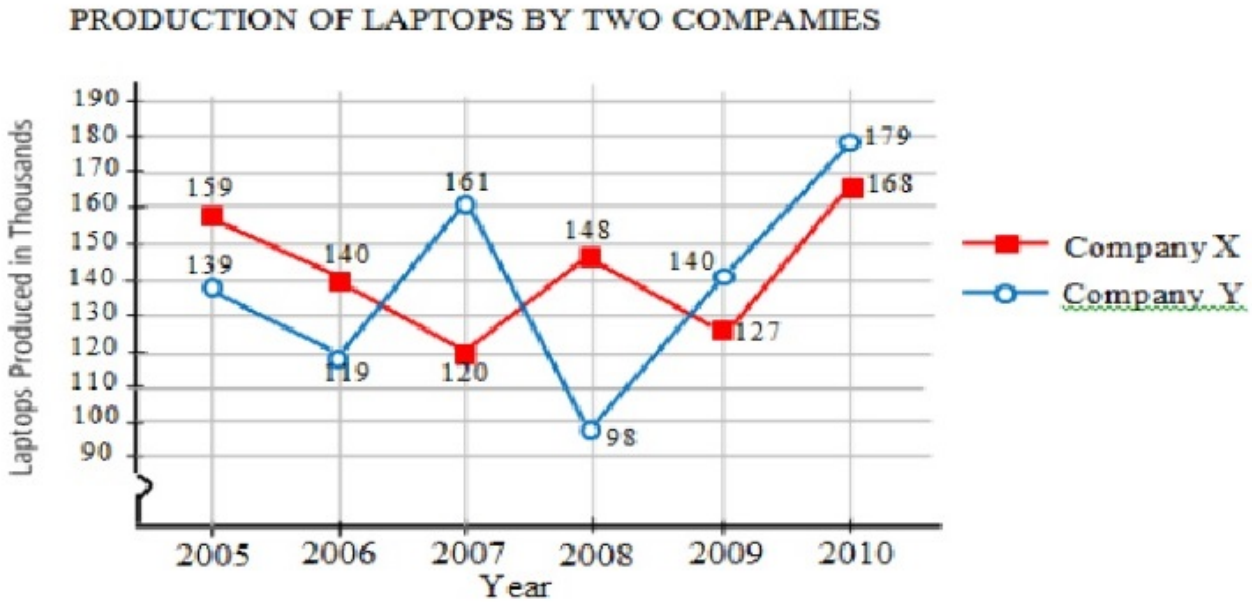
Qn 79. If R1 exports 42% of its Coffee at the rate of 6.50 dollar per kg and R4 exports 39% of its Coffee at the rate of 6 dollar per kg, what is the ratio of the income of R1 to that of R4 from the exports?

(A) 2 : 1 (B) 4 : 3 (C) 5 : 4 (D) 3 : 2

Qn 80. The percent increase in the price of a car was 4%. The new price is birr 15, 600. What was the price before increase?

(A) 15, 000 birr (B) 14, 600 birr (C) 14, 976 birr (D) 14, 000 birr

For questions 81 - 85 refer to the following graph



Qn 81. What was the maximum difference between the annual productions of the two companies?

(A) 50,000 (B) 41,000 (C) 50 (D) 41

Qn 82. What was the average annual production for Company X over the given period? (Rounded off to the nearest integer)

(A) 139, 333 (B) 172400 (C) 144 (D) 143667

Qn 83. The production of laptops by Company X was approximately what percentage of the production by Company Y in year 2008?

(A) 132% (B) 66% (C) 151% (D) 164%

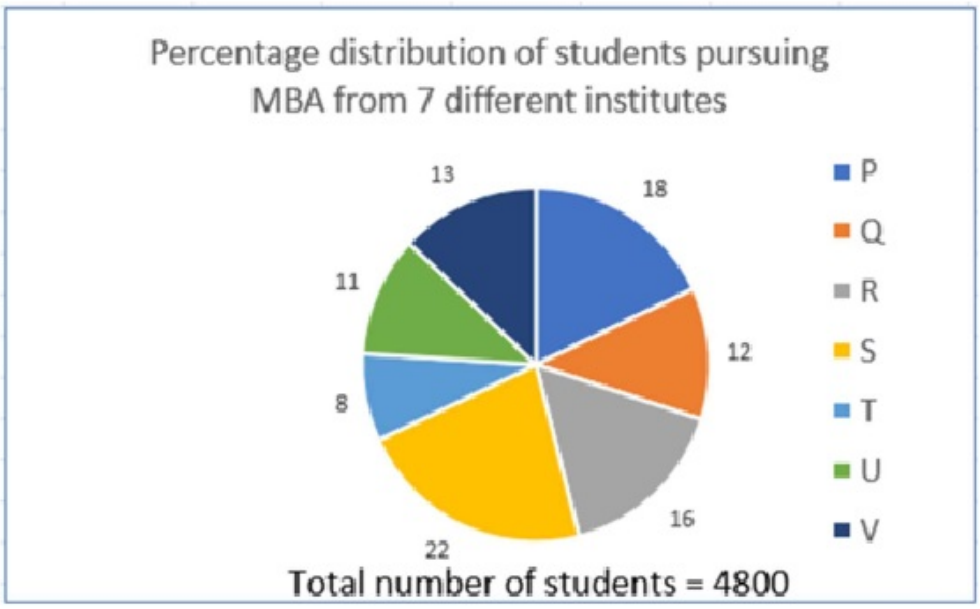
Qn 84. The total production by Company X was approximately what percentage of the total production by Company Y during the period?

(A) 132% (B) 66% (C) 151% (D) 95%

Qn 85. How many times larger was the decrease in production by Company Y in year 2008 than the decrease in year 2006?

(A) 3.85 (B) 3.15 (C) 3.45 (D) 3.54

Study the data given below and answer the questions that follow



The following table shows the ratio of male students to female students in the 7 institutes.

Institute	M : F
P	7 : 9
Q	5 : 4
R	5 : 7
S	6 : 5
T	3 : 5
U	7 : 4
V	7 : 5

Qn 86. Total number of students studying in institute Q is what percent of the total number of students studying in institute T?

(A) 150% (B) 115% (C) 125% (D) 100%

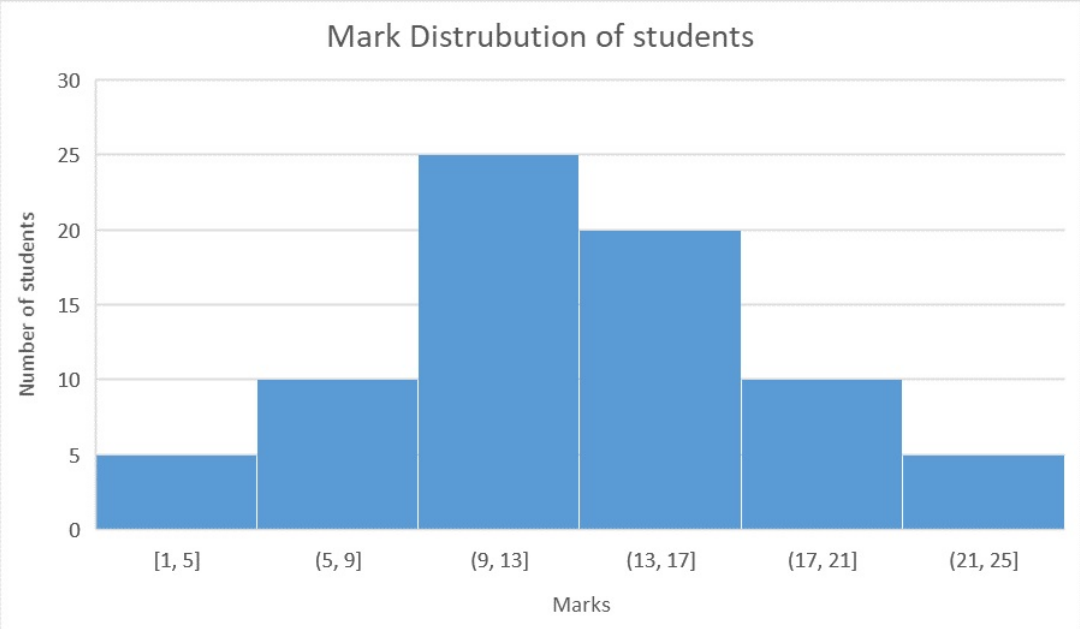
Qn 87. The total number of students in institutes Q and V together is what percentage of the total number of students in institutes S and T together?

(A) 66.66% (B) 73.33% (C) 83.33% (D) 78.33%

Qn 88. Total number students in institute R is approximately what percent more than the total students in institute U?

(A) 5% (B) 15% (C) 30% (D) 45%

The following histogram presents the marks of grade 12 students of a certain secondary school in mid-semester examination taken out of 26. Based on the given data in the histogram, answer questions 89 to 91



Qn 89. Which of the following is true about the data given in the histogram?

(A) The rage of the given data is 20.

(B) 10 students scored at least 9 marks.

(C) Most scored above 50%.

(D) 40 students scored at most 13 marks

Qn 90. Which one of the following is the total number of students considered in the given data?

(A) 60 (B) 45 (C) 55 (D) 75

Qn 91. What is the ratio of the number of students who scored below 13 marks to the number of students who scored at least 13 marks in the given data?

(A) 3 : 8 (B) 8 : 7 (C) 2 : 11 (D) 8 : 11

Probability

Qn 92. If two coins are tossed, what is the probability that at least one head turns up?

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

Qn 93. If a letter is selected from the word "Probability", what is the probability that the seiected letter is a vowel?

(A) $\frac{1}{11}$ (B) $\frac{3}{10}$ (C) $\frac{3}{11}$ (D) $\frac{4}{11}$

Qn 94. A class representative is to be selected from a classroom. 12 of the students in the classroom are boys. lf 48% of the students in the classroom are boys, what is the probability that the class representative that will be selected is a girl?

(A) $\frac{13}{25}$ (B) $\frac{12}{25}$ (C) $\frac{1}{25}$ (D) $\frac{7}{25}$

Qn 95. If a fair coin is tossed five times, how many possible different sequences of heads and tails are there?

(A) 10 (B) 32 (C) 64 (D) 16

Qn 96. Suppose that the Ethiopian premier league has 5 teams entered in the computation. In how many different orders can the teams finish?

(A) 120 (B) 840 (C) 720 (D) 125

Qn 97. How many different 7-digit numbers can be made using the digits 1, 1, 5, 5, 1, 8, 8 and 8?

(A) 120 (B) 140 (C) 210 (D) 240

Qn 98. A man walked diagonally across a rectangular plot of land from one of its corner to the opposite. If the plot is $30m$ by $40m$, what percentage of distance did he save by not walking along the edges?

(A) 45% (B) 71.4% (C) 65% (D) 54.5%

Qn 99. A committee of 3 people is to be chosen from among 8 members of a club. How many such committees are there?

(A) 6 (B) 12 (C) 56 (D) 42

Quantitative comparison

Directions: Each of the questions 6l-74 consists of two quantities, one in column A and one in column B. You are to compare the two quantities and choose:

A if the quantity in column A is greater;

B if the quantity in column B is greater;

C if the two quantities are equal;

D if the relationship cannot be determined from the information given.

Information: In a question, information concerning one or both of the quantities to be compared is centered above the two columns. A symbol that appears in both columns represents the same thing in column A as it does in column B.

Qn 100. m and n are negative integers.

Column A	**Column B**
$m+n$	$\frac{m}{n}$

Qn 101.

Column A	**Column B**
$\frac{2}{3}+\frac{4}{5}$	$\frac{3}{2}$

Qn 102. a, b, c and d are real numbers and $\frac{a}{b}=\frac{c}{d}$.

Column A	**Column B**
ad	bc

Qn 103. x is the perimeter of a rectangle with area $54cm^2$ and length 6cm.

Column A	**Column B**
x	15

Qn 104. The three sides of a triangle are 5, 1.5 and x .

Column A	**Column B**
x	3.5

Qn 105.

Column A	**Column B**
249^2-248^2	1

Qn 106.

Column A	**Column B**
$2^{17}-2^{16}$	2^{16}

Qn 107. $x < 0$ and x is less than its square by 30.

Column A	**Column B**
x	-6

Qn 108. Let x and y be real numbers such that $x < y$.

Column A	**Column B**
$x^2 + y^2$	$2xy$

Qn 109.

Column A	**Column B**
$12\frac{1}{2}\%$ of 40	$5\frac{1}{8}$

Qn 110. $\dfrac{x^2}{x+1} < 0$

Column A	**Column B**
x	-1

Qn 111. $\dfrac{x-6}{y-3} - 2 < 0$ and $y < 3$

Column A	**Column B**
$\frac{1}{2}x$	y

Qn 112. $y = 3^{-x} = (\frac{1}{3})^2 x - 1 < 0$ and x.

Column A	**Column B**
x	y

Qn 113. $a^k = 9$ and $3k = 2$.

Column A	**Column B**
a	27

Qn 114. $\sqrt{1-x^2} = \dfrac{\sqrt{3}}{2}$ and $x \geq 0$.

Column A	**Column B**
x	$\frac{2}{3}$

Qn 115. $x < 0$ and x is less than its square by 30.

Column A	**Column B**
x	-6

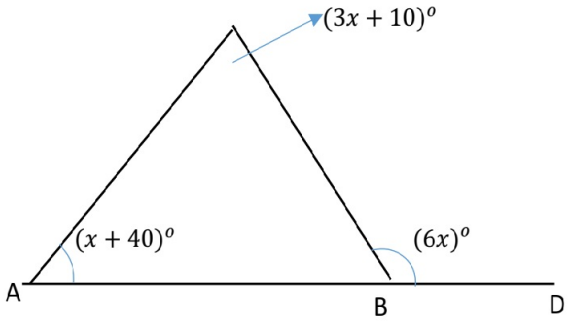
Qn 116.

Column A	**Column B**
$\frac{12!}{9!3!}$	220

Qn 117. Value of X: $13, 12.6, 15, 16.4, 12, 17$.

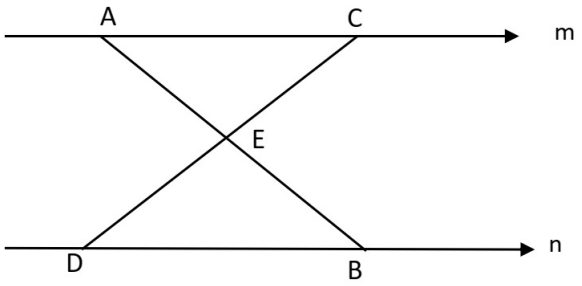
Column A	**Column B**
Average(Mean) of X	Median of X

Qn 118. In the diagram, AB is extended to point D,



Column A	**Column B**
6	65

Qn 119. m is parallel to n and E is the mid point of AB



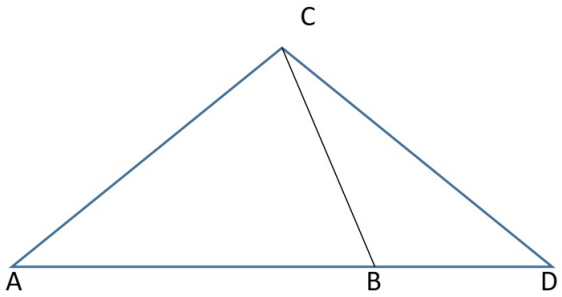
Column A	**Column B**
DE	EC

Qn 120. Parallelogram ABCD and rectangle ABEM are of equal area



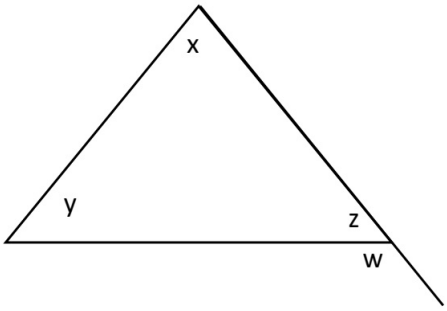
Column A	**Column B**
Perimeter of $ABCD$	Perimeter of $ABEM$

Qn 121. $\triangle$ABC is an equilateral triangle, B is midpoint of AD



Column A	**Column B**
$m(\angle ACD)$	100

Qn 122. Consider the figure given below



Column A	**Column B**
$x+y+z$	$z+w$

Qn 123. $2(a+1) = 3(b+1)$

Column A	**Column B**
$2a$	$3b$

Qn 124.

Column A	**Column B**
$14! + 15! + 16!$	$16!$

Qn 125.

Column A	**Column B**
$\frac{2}{x^2+6}$	$\frac{1}{3}$

Qn 126. $64^x = 16^y$

Column A	**Column B**
$\frac{y}{x}$	2

Qn 127. Let $0 < x < y < 5$ and x and y are integers.

Column A	**Column B**
$x - y$	-1

Qn 128.

Column A	**Column B**
$\frac{1}{3}+\frac{1}{5}+\frac{3}{2}$	$\frac{3}{5}+\frac{3}{8}$

Qn 129.

Column A	**Column B**
$4^{\frac{1}{4}}$	$3^{\frac{1}{3}}$

Qn 130. Let $(x+2y)(x-2y)=2$.

Column A	**Column B**
x^2-4y^2	2

Qn 131. Let $a+b=2$ and $a^2+b^2=2$

Column A	**Column B**
ab	2

Qn 132. Let $a_1=-1$ and $a_{n+1}=a_n+2n$

Column A	**Column B**
a_4-a_2	$2a_3$