NIOS — Class 12th

Tutor Marked Assignment (TMA)

Mathematics (211)

Session: 2025-2026 | Maximum Marks: 20

Gyantech Guru ji | 9518616764 | youtube.com/@GyanTechGuruJi

Question 1 (Any One) — 2 Marks

Q.1(A): Write all Palindrome numbers less than 100. Is there a number which is a factor of all such numbers? Will they be Rational or Irrational? (Lesson-1)

Answer:

Palindrome numbers less than 100:

Single-digit numbers (0–9) are all palindromes since they read the same forwards and backwards: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

Two-digit palindrome numbers (where both digits are same): 11, 22, 33, 44, 55, 66, 77, 88, 99.

Common Factor:

Yes — the number 11 is a common factor of all two-digit palindrome numbers, since every two-digit palindrome can be written as 11 × (the repeated digit). For example: $22 = 11 \times 2$, $33 = 11 \times 3$, $44 = 11 \times 4$, and so on.

Rational or Irrational:

All these palindrome numbers (0, 1, 2, ..., 99) are Rational Numbers, because every such number can be expressed in the form p/q (where $q \neq 0$), and they are whole numbers / integers, which are a subset of rational numbers.

Q.1(B): Anil was learning Laws of Exponents. (i) Find x if $5^x \times 3^{(2x-8)} = 28{,}125$. (ii) Simplify $(2^0 + 7^0)/5^0$. (Lesson-2)

Answer:

(i) Finding the value of x:

We are given: $5^x \times 3^{(2x-8)} = 28{,}125$

Let us factorize 28,125:

$28{,}125 = 5^5 \times 3^2$ (since $5^5 = 3{,}125$ and $3{,}125 \times 9 = 28{,}125$)

So: $5^x \times 3^{(2x-8)} = 5^5 \times 3^2$

Comparing powers of 5: $x = 5$

Comparing powers of 3: $2x - 8 = 2$

Substituting $x = 5$: $2(5) - 8 = 10 - 8 = 2$ ✓ (verified)

Therefore, $x = 5$

(ii) Simplifying (2^0 + 7^0)/5^0:

By the Law of Exponents, any non-zero number raised to power 0 equals 1.

So: $2^0 = 1$, $7^0 = 1$, $5^0 = 1$

$(2^0 + 7^0)/5^0 = (1 + 1)/1 = 2/1 = 2$

Therefore, the simplified value = 2

Question 2 (Any One) — 2 Marks

Q.2(A): Two ropes AB and CD intersect at O, with rope OP tied at the intersection. Given $\angle COP = 3x+7$, $\angle POB = x+5$, $\angle BOD = 40°$. Find (i) value of x (ii) measure of $\angle BOP$. (Lesson-10)

Answer:

Working:

Since AB and CD are straight lines intersecting at O, and ray OP lies between OC and OB:

$\angle AOC$ and $\angle BOD$ are vertically opposite angles, so $\angle AOC = \angle BOD = 40°$.

Since AOB is a straight line, angles on one side ($\angle COP + \angle POB$) and $\angle BOD$ together... Let us use the linear pair concept: $\angle AOC + \angle COP + \angle POB = 180°$ (angles on straight line AB along one side through C...)

Using the straight line CD: $\angle COA + \angle AOD = 180°$, and using straight line AB with rays OC, OP and OD on one side:

Since AB is a straight line: $\angle AOC + \angle COP + \angle POB + \angle BOD$ form angles, but more directly, $\angle COB = \angle COP + \angle POB$ (P lies between rays OC and OB).

Since AB is a straight line, $\angle AOC + \angle COB = 180°$. Also $\angle COB$ and $\angle AOD$ are vertically opposite, and $\angle AOC = \angle BOD = 40°$ (vertically opposite angles).

So, $\angle COB = 180° - \angle AOC = 180° - 40° = 140°$

Since OP lies between OC and OB: $\angle COP + \angle POB = \angle COB$

$(3x + 7) + (x + 5) = 140°$

$4x + 12 = 140°$

$4x = 128°$

$x = 32°$

Answers:

(i) Value of $x = 32°$

(ii) $\angle BOP = x + 5 = 32° + 5° = 37°$

Q.2(B): Three friends walk from a fixed point in three directions, each path equally inclined to the other two. (i) Find the angles between paths. (ii) Name the type of lines formed. (Lesson-12)

Answer:

Since the three paths are equally inclined to each other and they emerge from a single fixed point, the three paths divide the complete angle around that point (360°) into three equal parts.

(i) Angle between the paths:

Angle between each pair of paths = 360° ÷ 3 = 120°

Therefore, each path makes an angle of 120° with the other two paths.

(ii) Type of lines formed:

Since the three paths originate from the same fixed point and extend outward in different directions, they form Concurrent Lines (lines that pass through or meet at a common point). They are not parallel, intersecting in pairs, or perpendicular — they are simply three concurrent rays/lines meeting at one common point, each equally inclined to the others at 120°.

Question 3 (Any One) — 2 Marks

Q.3(A): Table shows number of books read by students. (i) Find class mark of 15-20. (ii) Convert to cumulative frequency table. (Lesson-24)

Answer:

(i) Class Mark of 15-20:

Class Mark = (Upper Limit + Lower Limit)/2 = (15 + 20)/2 = 35/2 = 17.5

(ii) Cumulative Frequency Table:

Class Interval	Frequency	Cumulative Frequency	Class Mark
0-5	7	7	2.5
5-10	12	19	7.5
10-15	15	34	12.5
15-20	10	44	17.5
20-25	6	50	22.5

Cumulative Frequency is calculated by adding each frequency to the sum of all previous frequencies (less than upper class boundary). Total students = 50.

Q.3(B): Company records monthly salaries (₹1000s). (i) Calculate class width. (ii) Explain if data is discrete or continuous. (Lesson-24)

Answer:

(i) Class Width:

Class Width = Upper Limit − Lower Limit

For 10-20: Class Width = 20 − 10 = 10

Similarly, for all other classes (20-30, 30-40, 40-50, 50-60), the class width is also 10, since all classes have equal width.

(ii) Discrete or Continuous:

The given data is Continuous Data.

Justification:

- Continuous data can take any value within a given range (including decimals/fractions), unlike discrete data which can only take fixed, separate values (usually whole numbers).
- Salary, when expressed in a range like ₹10,000-₹20,000, can take any value within that interval (e.g., ₹15,750.50), making it continuous in nature.
- Since the class intervals here are continuous ranges (10-20, 20-30, etc.) rather than fixed discrete values, this confirms the data is continuous.

Question 4 (Any One) — 4 Marks

Q.4(A): Door's upper half has length:breadth ratio 5:3. Glass portion = breadth−0.5ft, length−1ft. (i) Express glass dimensions in terms of x. (ii) Find polynomial for glass area and its zeros. (Lesson-2,3)

Answer:

(i) Glass Dimensions in terms of x:

Given: Length of upper part = $5x$, Breadth of upper part = $3x$

Glass portion length = $5x - 1$

Glass portion breadth = $3x - 0.5$

(ii) Polynomial for Glass Area:

Area = Length × Breadth

Area = $(5x - 1)(3x - 0.5)$

Area = $5x(3x) + 5x(-0.5) + (-1)(3x) + (-1)(-0.5)$

Area = $15x^2 - 2.5x - 3x + 0.5$

Area = $15x^2 - 5.5x + 0.5$

So, the polynomial representing the area is: $p(x) = 15x^2 - 5.5x + 0.5$

Finding Zeros of the Polynomial:

To find zeros, set $p(x) = 0$:

$15x^2 - 5.5x + 0.5 = 0$

Multiplying throughout by 2 to remove decimals: $30x^2 - 11x + 1 = 0$

Using the quadratic formula: $x = [-b \pm \sqrt{(b^2-4ac)}] / 2a$, where $a=30$, $b=-11$, $c=1$

Discriminant $= b^2 - 4ac = (-11)^2 - 4(30)(1) = 121 - 120 = 1$

$x = [11 \pm \sqrt{1}] / 60 = [11 \pm 1] / 60$

$x = 12/60 = 1/5 = 0.2$ OR $x = 10/60 = 1/6 = 0.167$ (approx)

Therefore, the zeros of the polynomial are $x = 1/5$ and $x = 1/6$

(Note: Since x represents a physical dimension, the value must be checked for practical feasibility — i.e., glass dimensions $5x-1$ and $3x-0.5$ must remain positive.)

Q.4(B): A curious student observed prime trio 7, 11, 13. (i) Sum of these — what type of number? Does this hold for all prime trios? (ii) 157157 ÷ 7, 11, 13 — what happens? (Lesson-1)

Answer:

(i) Sum of 7, 11, 13:

$7 + 11 + 13 = 31$

31 is a Prime Number (since it has only two factors: 1 and 31).

Does this hold for all sets of three consecutive prime numbers?

No, this property does NOT hold for all sets of three consecutive primes.

Counter-example:

Consider the consecutive primes 2, 3, 5:

Sum = $2 + 3 + 5 = 10$, which is NOT a prime number ($10 = 2 \times 5$).

Another example: 3, 5, 7 → Sum = $3 + 5 + 7 = 15$, which is also NOT prime ($15 = 3 \times 5$).

Therefore, while $7+11+13=31$ happens to be prime, this is not a general property of all consecutive prime trios.

(ii) Dividing 157157 by 7, 11, and 13:

$157157 \div 7 = 22{,}451$

$157157 \div 11 = 14{,}287$

$157157 \div 13 = 12{,}089$

Interestingly, 157157 is exactly divisible by all of 7, 11, and 13, with no remainder.

Why this happens:

When a 3-digit number 'abc' is repeated to form a 6-digit number 'abcabc', it is mathematically equal to abc × 1001 (since abcabc = abc × 1000 + abc = abc × 1001).

Since $1001 = 7 \times 11 \times 13$, the 6-digit number formed this way is ALWAYS divisible by 7, 11, and 13.

Two more examples:

Example 1: Take 234, form 234234. Then $234234 = 234 \times 1001 = 234 \times 7 \times 11 \times 13$. So 234234 is divisible by 7, 11, and 13.

Example 2: Take 589, form 589589. Then 589589 = 589 × 1001 = 589 × 7 × 11 × 13. So 589589 is also divisible by 7, 11, and 13.

Observation:

Any 6-digit number formed by repeating a 3-digit number is always divisible by 7, 11, and 13 because of the special property that 1001 = 7 × 11 × 13.

Question 5 (Any One) — 4 Marks

Q.5(A): Table shows production (million tonnes) of sugar substitutes by 6 units over 5 months. Answer (i)-(iv). (Lesson-24)

Answer:

Month	A	B	C	D	E	F
April	310	180	169	137	140	120
May	318	179	177	162	140	122
June	320	160	188	173	135	130
July	326	167	187	180	146	130
August	327	150	185	178	145	128

(i) In which month does unit B contribute approximately 15% of total production?

Total production for each month:

April: 310+180+169+137+140+120 = 1056; B's share = 180/1056 = 17.0%

May: 318+179+177+162+140+122 = 1098; B's share = 179/1098 = 16.3%

June: 320+160+188+173+135+130 = 1106; B's share = 160/1106 = 14.5%

July: 326+167+187+180+146+130 = 1136; B's share = 167/1136 = 14.7%

August: 327+150+185+178+145+128 = 1113; B's share = 150/1113 = 13.5%

The closest to 15% is June (14.5%) and July (14.7%). June's value (14.5%) is closest to 15%.

Answer: June is the month where unit B's contribution is approximately 15% of the total production.

(ii) Which unit shows continuous increase in production?

Checking each unit month-on-month:

Unit A: 310 → 318 → 320 → 326 → 327 (continuously increasing every month)

Answer: Unit A shows a continuous increase in production across all five months.

(iii) In Unit F, which pair of months had equal production?

Unit F values: April=120, May=122, June=130, July=130, August=128

June and July both show production = 130 million tonnes.

Answer: June and July had equal production in Unit F.

(iv) In July, how many units contributed more than 25% of total production?

Total production in July = 1136

25% of 1136 = 284

Checking each unit's July production: A=326 (>284 ✓), B=167, C=187, D=180, E=146, F=130

Only Unit A (326) exceeds 284 (25% threshold).

Answer: Only 1 unit (Unit A) contributed more than 25% of total production in July.

Q.5(B): (i) Two key differences between Bar Graph and Histogram. (ii) Draw histogram for given data. (Lesson-24)

Answer:

(i) Two Key Differences between Bar Graph and Histogram:

1. Gap between bars: In a Bar Graph, there is a uniform gap/space between bars since it represents discrete categories. In a Histogram, there is no gap between bars since it represents continuous class intervals.
2. Type of Data Represented: A Bar Graph is used to represent discrete/categorical data (like sales of different products), while a Histogram is used to represent continuous/grouped data (like age distribution in class intervals).

(ii) Histogram Data:

Class Interval	Frequency
1-10	15
11-20	10
21-30	5
31-40	8

To draw the histogram: Plot Class Intervals (1-10, 11-20, 21-30, 31-40) on the X-axis and Frequency on the Y-axis. Draw adjacent rectangular bars (with no gaps between them) with heights equal to 15, 10, 5, and 8 respectively for each class interval. Since all class widths are equal (width = 10 each: 1-10, 11-20, 21-30, 31-40 i.e. 9-10 unit width), the height of each bar directly represents the frequency.

(Draw this histogram with bars of height 15, 10, 5, 8 touching each other, on your answer sheet using a ruler and pencil.)

Question 6 (Any One) — 6 Marks [Project]

Q.6(A): Rectangular village ABCD. Triangle APD with ∠APD=60°, ∠PDA=30°. BC=10km, DC extended to E such that CE=BC. (i) Draw figure. (ii) ∠PAD? (iii) ∠BCE? (iv) Length BE? (v) Check congruency if APD is equilateral. (Lesson-11,13)

Answer:

(i) Figure Description:

Draw rectangle ABCD with AB parallel to DC, and AD parallel to BC. Inside the rectangle, mark triangle APD with vertex P such that $\angle APD = 60^\circ$ and $\angle PDA = 30^\circ$. Extend side DC beyond C to a point E such that CE = BC = 10 km.

(Draw this figure neatly with a ruler on your answer sheet, labeling all points A, B, C, D, P, E clearly with given angles and measurements.)

(ii) Finding ∠PAD:

In triangle APD, the sum of all interior angles = 180°

$\angle APD + \angle PDA + \angle PAD = 180^\circ$

$60^\circ + 30^\circ + \angle PAD = 180^\circ$

$\angle PAD = 180^\circ - 90^\circ = 90^\circ$

Therefore, $\angle PAD = 90^\circ$

(iii) Finding ∠BCE:

Since ABCD is a rectangle, $\angle BCD = 90^\circ$ (angle of rectangle).

Since DC is extended to E, points D, C, E are collinear, so $\angle BCD$ and $\angle BCE$ are supplementary (linear pair) — they lie on a straight line DE.

$\angle BCD + \angle BCE = 180^\circ$

$90^\circ + \angle BCE = 180^\circ$

$\angle BCE = 90^\circ$

(iv) Finding length BE:

In triangle BCE: BC = CE = 10 km (given), and $\angle BCE = 90^\circ$ (found above).

By Pythagoras Theorem in right triangle BCE:

$BE^2 = BC^2 + CE^2$

$BE^2 = 10^2 + 10^2 = 100 + 100 = 200$

$BE = \sqrt{200} = 10\sqrt{2}$ km ≈ 14.14 km

(v) If △APD is Equilateral — Check Congruency with △BCE:

If △APD were equilateral, all its angles would be 60° (not 90°, 60°, 30° as originally given) and all sides would be equal.

For $\triangle APD \cong \triangle BCE$ by SAS (Side-Angle-Side) congruency rule, we would need: two sides and the included angle of one triangle equal to two sides and the included angle of the other.

However, △BCE has $\angle BCE = 90^\circ$ and BC = CE = 10 km (an isosceles right triangle), while an equilateral △APD would have all angles = 60° and all sides equal.

Since the angles (90° vs 60°) and the nature of the triangles are different (right isosceles vs equilateral), △APD and △BCE would NOT be congruent even if △APD were equilateral, because their corresponding angles and side relationships do not match — congruency requires exact matching of all corresponding sides and angles (SSS, SAS, ASA, or RHS rules), which is not satisfied here.

Therefore, $\triangle APD \ncong \triangle BCE$ (not congruent) under this condition.

— End of TMA Solution (Mathematics 211) —

Gyantech Guru ji | 9518616764 | https://www.youtube.com/@GyanTechGuruJi