GRADE 9-12 - 16 QUESTIONS

I. Number and Quantity

1. **Structure of Numerical Systems:**
   a. Place value
   b. Order relationships
   c. Relationships between operations
   d. Multiple forms of numbers
   e. Absolute value
   f. Signed numbers
   g. Integers and rational numbers
   h. Ratios and proportion

2. **Real and Complex Number Systems:**
   a. Rational and irrational numbers
   b. Multiple forms of complex numbers
   c. Properties of the real and complex number systems
   d. Operations with complex numbers
   e. Laws of exponents
   f. Roots and powers of real and complex numbers
   g. Scientific notation

3. **Elementary Number Theory:**
   a. Factors and divisibility
   b. Prime and composite
   c. Prime Factorization
   d. Euclid's Algorithm
   e. Congruence classes and modular arithmetic
   f. Mersenne primes and perfect numbers
   g. Fermat's Last Theorem
   h. Fundamental Theorem of Arithmetic

GRADE 3-8 – 22 QUESTIONS

I. Number and Quantity

1. **Structure of Numerical Systems:**
   a. Place value
   b. Order relationships
   c. Relationships between operations
   d. Multiple forms of numbers
   e. Factors and divisibility
   f. Prime and composite
   g. Prime factorization
   h. Properties of numerical systems

2. **Operations of integers, rational numbers, decimals, percentage, ratio and proportional relationships:**
   a. Order of operations
   b. Identity and inverse elements
   c. Associative, commutative, and distributive properties
   d. Absolute value
   e. Operations of signed numbers
   f. Multiple representations of numerical operations
   g. Analyzing algorithms for addition, subtraction, multiplication, and division of integers and rational numbers
   h. Number operations and their inverses

3. **Application of integers, rational numbers, decimals, percentage, ratio and proportional relationships:**
   a. Application problems using numerical systems
   b. Average rate of change
   c. Using estimation for verifying reasonableness of solutions

I. Number and Quantity cont.

4. **Structure of Real Number System:**
   a. Rational and irrational numbers and operations
   b. Properties of the real number system
   c. Operations and their inverses
   d. The real number line
   e. Roots and powers
   f. Laws of exponents
   g. Scientific notation
   h. Using number properties to prove theorems

Q.NO 1

If $i = \sqrt{-1}$ and $n \in N$, then

$i^n + i^{n+1} + i^{n+2} + i^{n+3}$ is equal to

(a) 1 (b) i (c) i^n (d) 0

QNO 2

Washington High School randomly selected freshman, sophomore, junior, and senior students for a survey about potential changes to next year's schedule. Of students selected for the survey, $\frac{1}{4}$ were freshmen and $\frac{1}{3}$ were sophomores. Half of the remaining selected students were juniors. If 336 students were selected for the survey, how many were seniors?

A) 240
B) 140
C) 120
D) 70

QNO 3

Plant A is currently 20 centimeters tall, and Plant B is currently 12 centimeters tall. The ratio of the heights of Plant A to Plant B is equal to the ratio of the heights of Plant C to Plant D. If Plant C is 54 centimeters tall, what is the height of Plant D, in centimeters?

A) 32.4

B) 44.0

C) 62.0

D) 90.0

QNO 4

Biologists found a new species of pale shrimp at the world's deepest undersea vent, the Beebe Vent Field. The vent is 3.1 miles below the sea's surface. Approximately how many kilometers below the sea's surface is the vent? (1 kilometer ≈ 0.6214 miles)

A) 2

B) 3

C) 4

D) 5

QNO 5

A cargo helicopter delivers only 100-pound packages and 120-pound packages. For each delivery trip, the helicopter must carry at least 10 packages, and the total weight of the packages can be at most 1,100 pounds. What is the maximum number of 120-pound packages that the helicopter can carry per trip?

A) 2

B) 4

C) 5

D) 6

QNO 6

A company purchased a machine valued at $120,000. The value of the machine depreciates by the same amount each year so that after 10 years the value will be $30,000. Which of the following equations gives the value, v, of the machine, in dollars, t years after it was purchased for $0 \leq t \leq 10$?

A) $v = 30{,}000 - 9{,}000t$

B) $v = 120,000 - 9,000t$

C) $v = 120{,}000 + 9{,}000t$

D) $v = 120{,}000 - 30{,}000t$

QNO 7

Jennifer bought a box of Crunchy Grain cereal. The nutrition facts on the box state that a serving size of the cereal is $\frac{3}{4}$ cup and provides 210 calories, 50 of which are calories from fat. In addition, each serving of the cereal provides 180 milligrams of potassium, which is 5% of the daily allowance for adults.

On Tuesday, Jennifer will mix Crunchy Grain cereal with Super Grain cereal for her breakfast. Super Grain cereal provides 240 calories per cup. If the total number of calories in one cup of Jennifer's mixture is 270, how much Super Grain cereal is in one cup of the mixture?

A) $\frac{1}{8}$ cup

B) $\frac{1}{4}$ cup

C) $\frac{1}{3}$ cup

D) $\frac{1}{2}$ cup

QNO 8

	Blood type			
Rhesus factor	A	B	AB	O
+	33	9	3	37
–	7	2	1	x

Human blood can be classified into four common blood types—A, B, AB, and O. It is also characterized by the presence (+) or absence (–) of the rhesus factor. The table above shows the distribution of blood type and rhesus factor for a group of people. If one of these people who is rhesus negative (–) is chosen at random, the probability that the person has blood type B is $\frac{1}{9}$. What is the value of x ?

QNO 9

Gisela would owe $15,500 in taxes each year if she were not eligible for any tax deductions. This year, Gisela is eligible for tax deductions that reduce the amount of taxes she owes by $2,325.00. If these tax deductions reduce the taxes Gisela owes this year by $d\%$, what is the value of d ?

QNO 10

International Tourist Arrivals, in millions

Country	2012	2013
France	83.0	84.7
United States	66.7	69.8
Spain	57.5	60.7
China	57.7	55.7
Italy	46.4	47.7
Turkey	35.7	37.8
Germany	30.4	31.5
United Kingdom	26.3	32.2
Russia	24.7	28.4

The table above shows the number of international tourist arrivals, rounded to the nearest tenth of a million, to the top nine tourist destinations in both 2012 and 2013.

The number of international tourist arrivals in Russia in 2012 was 13.5% greater than in 2011. The number of international tourist arrivals in Russia was k million more in 2012 than in 2011. What is the value of k to the nearest integer?

QNO 11

The combined volume of all the tanks at an aquarium is 1.25×10^6 gallons. The aquarium plans to install a new dolphin tank with a volume of 250,000 gallons. What will be the total volume of all of the tanks at the aquarium after the new dolphin tank is installed?

A 1.5×10^5

B 3.75×10^5

C 1.5×10^6

D 3.75×10^6

QNO 12

If the H.C.F. of 408 and 1032 is expressible in the form 1032m – 408 x 5, find m

QNO 13

105 goats, 140 donkeys and 175 cows have to be taken across a river. There is only one boat which will have to make many trips in order to do so. The lazy boatman has his own conditions for transporting them. He insists that he will take the same number of animals in every trip and they have to be of the same kind. He will naturally like to take the largest possible number each time. Can you tell how many animals went in each trip ?

QNO 14

Find the smallest number which when increased by 17 is exactly divisible by both 520 and 468

QNO 15

A circular field has a circumference of 360 km. Three cyclists start together and can cycle 48, 60 and 72 km a day, round the field. When will they meet again ?

QNO 16

Find the prime factorisation of the denominator of rational number expressed as $6.\overline{12}$ in simplest form.

QNO 17

The decimal expansion of the rational number $\frac{43}{2^4\ 5^3}$ will terminate after how many places of decimals?

QNO 18

Find the smallest x that satisfies:

$$x \equiv 3 \ (mod \ 5)$$

$$x \equiv 4 \ (mod \ 6)$$

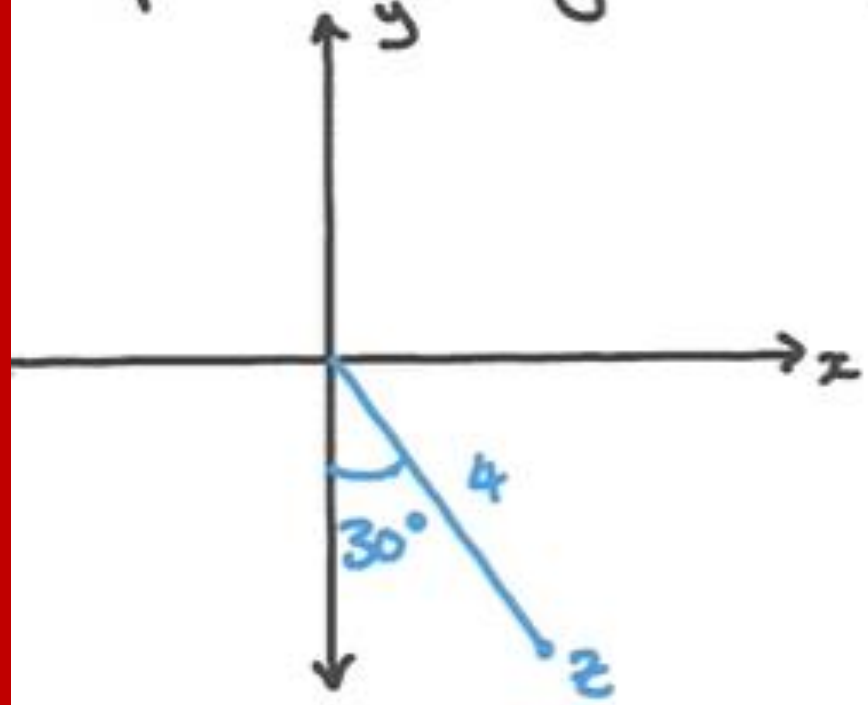
QNO 19

The solution for $x^8 \equiv 10 \pmod{11}$ is:

a) 5
b) 6
c) No solution
d) 4

QNO 20

Find the trigonometric form of the complex number z represented by the given Argand diagram.



QNO 21

Using the data in the table below, find the average rate of change of the price of gasoline between 2007 and 2009.

y	2005	2006	2007	2008	2009	2010	2011	2012
$C(y)$	2.31	2.62	2.84	3.30	2.41	2.84	3.58	3.68

QNO 22

Given the function $g\,(t)$ shown in Figure 1, find the average rate of change on the interval $[-1, 2]$.