3. Let $x$, $y$, $z$ be positive reals. Which of the following implies $x = y = z$?

A. $x^2 = y^2 = z^2$
B. $x+y+z = 3$  
C. $x^3 + y^3 + z^3 = 3xyz$


2. If $u$ is the smallest natural number such that $u!$ is a perfect square, then the number $998 + \cdots + \frac{u}{2} + \frac{u}{3} + \frac{u}{4} + \cdots + \frac{u}{1000}$ is divisible by

A. 2  
B. 3  
C. 5  
D. 7

1. Two distinct polynomials $(x)^8$ and $(x)^{10}$ are defined as

\[ f(x) = x^8 + 2x^7 + 3x^6 + \cdots + 8x + 9 \]
\[ g(x) = x^{10} + 3x^9 + 5x^8 + \cdots + 10x + 11 \]

If the equations $0 = (x)^8$ and $0 = (x)^{10}$ have a common root then the sum of the roots of the equation $0 = (x)^8 + 2x^7 + 3x^6 + x^5 + 2x^4 + x^3 + x^2 + x^1 + x$ is

A. 0  
B. 2  
C. 4  
D. 6

**MATHEMATICS**

One Mark Questions

**PART I**
5. \[ \frac{2}{1} + \frac{1}{2} + \frac{2}{3} = \frac{10}{6} \]

6. \[ \frac{4}{3} \]

7. \[ \text{If } \angle A = \angle C \text{ and } \angle B = \angle D, \text{ then } \angle A = \angle C. \]

8. \[ \text{Let } ABCD \text{ be a square of side length 1, and } \Phi \text{ a circle passing through } A, B, C, \text{ and } D. \]

9. \[ \text{Let } ABCD \text{ be a square of side length 1, and } \Phi \text{ a circle passing through } A, B, C, \text{ and } D. \]

10. \[ \text{The largest non-negative integer } k \text{ such that } 2^k \text{ divides } 19. \]

11. \[ D. \text{ } 19 \]

12. \[ C. \text{ } 28 \]

13. \[ B. \text{ } 32 \]

14. \[ A. \text{ } 38 \]

15. \[ B. \text{ } 60 \]

16. \[ A. \text{ } 30 \]

17. \[ C. \text{ } 90 \]

18. \[ D. \text{ } 120 \]

19. \[ \text{If } \angle A = \angle C \text{ and } \angle B = \angle D, \text{ then } \angle A = \angle C. \]

20. \[ \text{Let } p \text{ be an interior point of a triangle } ABC. \text{ Let } O \text{ and } \Phi \text{ be the reflections of } p \text{ in } AB \text{ and } AC, \text{ respectively.} \]

21. \[ \text{In the figure given below, a rectangle of perimeter 70 units is divided into 7 congruent rectangles.} \]
11. A man standing on a railway platform noticed that a train took 21 seconds to cross the platform. Assuming that the train was moving with uniform speed, what is the length of the train in metres?

A. $x = y$  
B. $x = 2y$  
C. $x = 3y$  
D. $x = 4y$

12. The least positive integer $n$ for which $\sqrt{n} - 1 < \frac{1}{12}$ is

A. 6  
B. 7  
C. 8  
D. 9

13. Let $n > 1$ be an integer. Which of the following sets of numbers necessarily contains a multiple of 3?

A. $n^{19}, n^{19} - 1$  
B. $n^{16}, n^{16} - 1$  
C. $n^{38}, n^{38} - 1$  
D. $n^{38}, n^{38} + 1$

14. The number of distinct primes dividing 121 + 131 + 141 is

A. 5  
B. 6  
C. 7  
D. 8

15. How many ways are there to arrange the letters of the word EDUCATION so that all the following three conditions hold:

- The vowels occur in the same order (EUAI).
- The consonants occur in the same order (DCNT).
- No two consonants are next to each other.

A. 15  
B. 24  
C. 72  
D. 120

10. In the figure given below, if the areas of the two regions are equal, then which of the following is true?

A. $\sqrt{x} = y$  
B. $\sqrt{x} = 2y$  
C. $\sqrt{x} = 3y$  
D. $\sqrt{x} = 4y$
15. If the axes of rotation of the earth were extended into space, then it would pass close to...

16. In an experiment, mass of an object is measured by applying a known force in the direction of the measured value of acceleration. If in the experiment, the measured value of acceleration is given by $a = \frac{F}{m}$, and $F = 1.00 \, \text{N}$ and $m = 1.00 \, \text{kg}$ respectively.

17. A hollow tilted cylindrical vessel of negligible mass rests on a horizontal plane. A cylinder of water is introduced into the cylinder. The diameter of the base is $\tan \theta = \frac{v}{g\sin \theta}$.

18. An object at rest at the origin begins to move in the $+x$ direction. The net force $F = \frac{m}{t}$ and the net force is applied to it. The graph for object's motion is $x = \frac{t}{2}$. The object moves with a uniform velocity of $4 \, \text{m/s}$.

19. The center of mass of all the planets in the solar system is

- A. the pole star
- B. the sun
- C. the moon
- D. the earth

PHYSICS
23. An optical device is constructed by fixing three identical concave lenses of focal length 10 cm each inside a hollow cone of equal spacing of 20 cm each. One end of the cone is placed 10 cm away from a point source. How much does the image shift when the device is moved away from the source by another 10 cm?

A. 0 cm
B. 5 cm
C. 15 cm
D. 45 cm

24. An isosceles glass prism with base angles 45° is clamped between two parallel plates of glass with refractive index 1.74. A ray of light incident normally on the glass is incident on the second plate at an angle of 70°. What is the distance between the plates if the angle of refraction for the second path is 70°? If the distance is less than the total internal reflection at the glass, calculate the angle of refraction for the first path.

A. 70°
B. 70° > 2.07
C. 70° > 1.74
D. 70° < 1.74

25. A point source of light is moving at a rate of 2 cm/s.

A. The image moves at a rate of 2 cm/s.
B. The image moves at a rate of 1 cm/s.
C. The image moves at a rate of 3 cm/s.
D. The image moves at a rate of 4 cm/s.
30. The international space station is maintained in a nearly circular orbit with a mean altitude of 300 km and a velocity of 7.6 km/s. The acceleration of the station's orbit is measured. The acceleration of an astronaut on the station is maximum of 410 m/s². An astronaut is thrown in the space station, and the astronaut moves a distance of 200 m in 5.0 s. The astronaut is in a nearly circular orbit. The astronaut is thrown in a nearly circular orbit from a space station.

\[ \frac{V}{A} \approx \frac{V}{A} \]

31. A 100 W incandescent light bulb has an operating temperature of approximately 2700 K. The temperature of the filament is 2600 K. The temperature of the bulb is 2700 K. The temperature of the filament is 2600 K.

27. A ball is launched from the top of Mt. Everest which is at an altitude of 9000 m. The ball moves in a circular orbit with a radius of 2500 m. The ball is launched from the top of Mt. Everest which is at an altitude of 9000 m.

\[ \frac{V}{A} \approx \frac{V}{A} \]

28. A planet is orbiting the sun in an elliptical orbit. Let N be the correct statement.

\[ \frac{V}{A} \approx \frac{V}{A} \]

29. One mole of ideal gas undergoes a linear process as shown below. The temperature expressed as a function of volume V is.

\[ \frac{V}{A} \approx \frac{V}{A} \]
38. The major product of the following reaction is

\[ \text{Zn(s)} + \text{O}_2(g) \rightarrow \] (a) ZnO and SO\(_2\)
(b) ZnO and SO\(_3\)
(c) ZnSO\(_4\) and SO\(_3\)
(d) ZnSO\(_4\) and SO\(_2\)

39. The correct order of acidity of the following compounds is

A. CH\(_3\)OH, CH\(_2\)CHOH
B. CH\(_3\)CH\(_2\)OH, CH\(_3\)CHOH
C. CH\(_3\)COOH, CH\(_3\)CHOH
D. CH\(_3\)COOH, CH\(_3\)CH\(_2\)OH

40. The element which readily forms an ionic bond has the electronic configuration

A. 1s\(^2\)2s\(^2\)2p\(^6\)3s\(^2\)3p\(^6\)3d\(^6\)4s\(^2\)
B. 1s\(^2\)2s\(^2\)2p\(^6\)3s\(^2\)3p\(^6\)4s\(^2\)4p\(^6\)
C. 1s\(^2\)2s\(^2\)2p\(^6\)3s\(^2\)3p\(^6\)4s\(^2\)3d\(^6\)
D. 1s\(^2\)2s\(^2\)2p\(^6\)3s\(^2\)3p\(^6\)4s\(^2\)3d\(^5\)4p\(^1\)

41. The gas released when baking soda is mixed with vinegar is

A. CH\(_3\)COOH, D. CH\(_3\)CHOH
B. CH\(_3\)CHOH, A. CH\(_3\)CH\(_2\)OH
C. CH\(_3\)CHO, B. HCOOH
D. HCOOH, C. CH\(_3\)COOH

42. Which of the following statements is true about elements in the periodic table?

A. Atomic mass
B. Atomic size
C. Reactivity of elements
D. Electronic configuration

43. Elements are a periodic function of their

A. Atomic mass
B. Atomic size
C. Reactivity of elements
D. Electronic configuration

44. The percentage of nitrogen by mass in ammonium nitrate (NH\(_4\)NO\(_3\)) is

A. 16 %
B. 24 %
C. 36 %
D. 30 %

45. The periodic law states that the properties of elements are classified by their

A. Electronic configuration
B. Atomic mass
C. Atomic size
D. Reactivity of elements
39. If the average number of sulfur atoms present in 200 ml of \( H_2SO_4 \) is \( \frac{a}{2} \), then the number of sulfur atoms is

40. The functional group present in a molecule having the

41. A sweet smelling compound formed by treating acetic

42. Among Mg, Cu, Fe, Zn, the metal that does not produce

43. The maximum number of isomeric ethers with the

44. The number of electrons required to reduce dichromium

45. At constant pressure, the volume of a fixed mass of a gas

46. \( C, 6 \)
   \( B, 3 \)
   \( A, 5 \)
   \( D, 2 \)

47. \( C, 4 \)
   \( B, 3 \)
   \( A, 5 \)
   \( D, 2 \)

48. \( C, HCHO \)
   \( B, CH_3CHO \)
   \( A, CH_3COOH \)
   \( D, C_2H_5COOH \)

49. \( C, 4/3 \)
   \( D, 4/2 \)
   \( A, 4/10 \)
   \( B, 4/3 \)

50. Complete: In \( C_2O^2- \) to \( C_2^+ \), in acidic medium, is

51. \( C \) is complectly in \( C_2O^2- \) to \( C_2^+ \), in acidic medium, is

52. The volume of the gas at 300 °C is larger than that at 0 °C.

53. By a factor of

54. The magnitude of the temperature at which a gas begins to react with hydronium acid is

55. The graph shows that the volume of a gas increases as a function of temperature as shown in the graph.
50. Glycolysis is the breakdown of glucose to pyruvate and water.

49. A person with blood group AB has neither anti-A nor anti-B antibodies in plasma. Therefore, a person with blood group AB is not antigen A on RBCs and anti-B antibodies in plasma.

48. Enzyme X is extracted from the digestive system of pigs. In the digestive system of pigs, it digests DNA from the 5' end. Therefore, it digests DNA from the 3' end.

47. Restriction endonucleases are enzymes that are used by prokaryotic cells to cut DNA at specific base sequences.

46. Excess salt inhibits bacterial growth in pickles by decreasing the osmotic pressure around the bacteria.

45. A. Exocytosis, B. Endocytosis, C. Oxidation, D. Denaturation

44. Enzyme X is extracted from the digestive system of pigs. In the digestive system of pigs, it digests DNA from the 5' end. Therefore, it digests DNA from the 3' end.

43. a. anti-B antibodies in plasma and b. no antigen on RBCs, but neither anti-A nor anti-B antibodies in plasma.

42. A. Skin epithelial cells, B. B cells, C. Lymphocytes, D. Liver cells

41. Which one of the following cell types is a part of innate immunity?

40. Which one of the following cell types is a part of immune response?


38. Oxygen is required for aerobic respiration. In electron transport, oxygen is known as molecular oxygen in bacteria and mitochondria is known as molecular oxygen in bacteria and mitochondria.

37. The process of transfer of electrons from glucose to oxygen is known as electron transport.

36. 4. D. Oxytocin, C. Leptin, B. Prolactin, A. Ghrelin

35. 52. Which one of the following cell types is a part of immune response?

34. 32. Which one of the following cell types is a part of immune system?

33. Deficiency of which one of the following vitamins can cause impaired blood clotting?

32. Which one of the following cell types is a part of immune response?

31. The process of transfer of electrons from glucose to oxygen is known as electron transport.
Which of the following is a modified leaf?
- A. Sweet potato
- B. Ginger
- C. Onion
- D. Carrot

Which one of the following are both polysaccharides?
- A. Cellulose and glycogen
- B. Starch and glucose
- C. Cellulose and fructose
- D. Ribose and sucrose

Which of the following pairs are both polyhydroxyaldehydes?
- A. DNA of 10 base pairs
- B. 3.5 KDa
- C. 10 KDa
- D. 500 Da

Which one of the following is detrimental to soil fertility?
- A. Grass since it is grass
- B. Grass since it eats the grass
- C. Tiger since it eats on the grass which feeds on the soil
- D. Grass since it grows in the contaminating soil

Which of the following is present in the diet of a food?
- A. Puchellar
- B. Pseudomonas
- C. Anaerobe
- D. Enterobacteriaceae

In which one of the following phyla is the body segmented?
- A. Porifera
- B. Platyhelminthes
- C. Nematoda
- D. Pseudomonas

What is the molecular mass of a double stranded 500 Da DNA of 10 base pairs?
- A. 3.5 KDa
- B. 500 Da
- C. 10 KDa
- D. 1 KDa

Considering the average molecular mass of a base to be 150 Da, which of the following could be the DNA of a single stranded molecule?
- A. 150 KDa
- B. 15 KDa
- C. 15 KDa
- D. 1500 Da
69. For a real number $x$, let $[x]$ denote the largest integer less than or equal to $x$. The number of solutions $x$ to the equation $[x] = x$ is 8. 9. \[ \frac{18}{17} \]

61. A trapezoidal corner is cut from a rectangular piece of paper. \textbf{MATHEMATICS}

\textbf{Part II}

Two-Part Questions

\[ 23. \begin{align*} 0 > 0 & \quad \text{D.}\ 0 = 0 & \quad \text{C.}\ 0 > 0 \quad \text{B.}\ 0 < 0 \quad \text{A.}\ 0 < 0. \end{align*} \]

63. \[ \text{Let } ABCD \text{ be a trapezium with } AD \parallel BC. \]

\[ \text{BC} \parallel AD \text{ such that } AB = AM \text{ and } DC = DM. \]

\[ \text{Then, the ratio of the area of the trapezium to the area of triangle } \text{is } \frac{1}{3}. \]

65. The average incomes of the people in two villages are $\frac{40}{9}$ and $\frac{4}{3}$, respectively. Assume that $\frac{4}{3} > \frac{40}{9}$, respectively. Then the ratio of the heights of water in these two villages is $\frac{4}{3} : \frac{40}{9}$, respectively. The ratio of the volumes of water in these two villages is $\frac{4}{3} \cdot \frac{40}{9}$, respectively. If $x$ units are transplanted between these two villages, the number of units of water in these two villages is $\frac{4}{3} \cdot \frac{40}{9}$, respectively. Initially, the volumes of water in these two villages are $\frac{4}{3} \cdot \frac{40}{9}$, respectively. Initially, the volumes of water in these two villages are $\frac{4}{3} \cdot \frac{40}{9}$, respectively. Initially, the volumes of water in these two villages are $\frac{4}{3} \cdot \frac{40}{9}$, respectively. Initially, the volumes of water in these two villages are $\frac{4}{3} \cdot \frac{40}{9}$, respectively. Initially, the volumes of water in these two villages are $\frac{4}{3} \cdot \frac{40}{9}$, respectively.
A rigid body in the shape of a cylinder has two equal arms of radius R. The center of mass of the body is at a distance l from the axis of rotation.

\[ \frac{1}{2} \frac{l}{R} \cos \beta \]

\[ \cos \frac{\beta}{2} \]

A point object is placed 20 cm left of a convex lens of focal length f = 5 cm (see the figure). The lens is made of glass with refractive index \( n = 1.5 \).

\[ \frac{1}{f} = \frac{1}{D} + \frac{1}{d} \]

A point object is placed 80 cm from a concave lens of focal length f = 10 cm (see the figure). The lens is made of glass with refractive index \( n = 1.5 \).

\[ \frac{1}{f} = \frac{1}{D} + \frac{1}{d} \]

A point object is placed 60 cm from a converging lens of focal length f = 15 cm (see the figure). The lens is made of glass with refractive index \( n = 1.5 \).

\[ \frac{1}{f} = \frac{1}{D} + \frac{1}{d} \]

A point object is placed 100 cm from a diverging lens of focal length f = -10 cm (see the figure). The lens is made of glass with refractive index \( n = 1.5 \).

\[ \frac{1}{f} = \frac{1}{D} + \frac{1}{d} \]

The depth of a swimming pool is 6 m. The area of bottom of the pool is 20 m². The depth of a swimming pool can be seen through the glass is approximately 100 m².

A penny is dropped into a circular glass slab (refractive index \( n = 1.5 \)).
of CO₂ gas at STP and 7.2 g of water are produced. The volume of the oxygen gas at STP consumed in the reaction is closest to

When 22.4 L of CO₂ at STP is burnt completely, 89.6 L of

73. Reaction is:

D. Ethyl sulfate
C. Bromoethane
B. Ethylene glycol
A. 1,2-Dibromoethane

The major product obtained in this reaction is ethyl bromide. The minor product formed is ethylene bromide. In this experiment, 10% of the product was 1-octene.

72.

C. 1:1
D. 1:2
B. 1:4
A. 1:3

The reaction is balanced as follows:

1. 1.5XeF₂ + 1.5XeF₆ → 2XeF₅

When 22.6 g of xenon (atomic mass = 131) reached

**CHEMISTRY**

Pipe in time t can be written as:

\[ \Delta t = \frac{l}{v} \]

70. Stoke's law states that the viscous drag force D is given by:

\[ D = 6\pi \eta r v \]
The major product of the reaction is

The amount of Ag (atomic mass = 108) deposited at the

cathode when a current of 0.5 Amp is passed through a

solution of AgNO₃ for 1 hour is closest to

Distribution of bases in the genome

with which it will cut the DNA assuming a random

which is a four-base-pair cutter. What is the frequency

C. 1/256

D. 1/24

B. 1/4

A. 1/1296

If rice is cooked in a pressure cooker on the Stokken

A. Glen cooked faster on the Decuman plain.

B. Glen cooked faster at sea beach.

C. Glen cooked faster on the Stokken Glacier.

D. Glen cooked at the same time at all three places.

BIOLOGY
A. A line is drawn from the exterior of an animal cell to the center of the nucleus, crossing through one mitochondrion.

B. A line is drawn from the exterior of an animal cell to the center of the nucleus, crossing through one mitochondrion.

C. Glycogen gives more rigidity to the cells.

D. Molecules, resulting in excess water within the cell, more osmotic pressure than a single glycogen molecule, resulting in loss of water from the cell.

Glucose present as monomers within the cell exerts from the corresponding glucose monomers.

Glucose present as monomers within the cell exerts energy obtained from glycogen is more than that animals instead of storing glucose as glycogen in

When is the advantage of storing glucose as glycogen not