29/10/2024 (1) Tuesday

Date: __/__/20__ Mock Exam-5 MON TUE WED THU FRI SAT

General Science and Ability

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Part - II

SECTION - I

Q.No2 (a) What is dengue? Give a brief account of its causative agents and its symptoms.

Definition of Dengue:

Dengue is a viral infection transmitted primarily by mosquitoes, particularly the Aedes aegypti species. It can cause severe flue-like symptoms and in some cases, develop into more severe forms such as dengue hemorrhagic fever or dengue shock syndrome.

"Prevention of dengue lies in reducing the mosquito population through community engagement."

(Dr. Neeraj Kumar)

I. Causative Agents of Dengue:

The causative agents of dengue are four closely related viruses known as dengue virus serotypes 1, 2, 3 and 4 (DENV-1, DENV-2, DENV-3, DENV-4). These viruses belongs to the Flavivirus genus. The infection typically occurs after a bite from an infected mosquito which transmits the virus into the human bloodstream.

II. Symptoms of Dengue:

Symptoms of dengue typically appear 4 to 10 days after being bitten by an infected mosquito. Common symptoms include:

1. High Fever:

Sudden onset of a high fever, often reaching upto 104°F (40°C)

2. Severe Headache:

Intense headaches, particularly behind the eyes.

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3. Joint and muscle Pain :

Severe muscle and joint pain often referred to as "breakbone fever"

4. Rash :

A rash that may appear a few days after the onset of fever.

5. Fatigue and Nausea :

General feelings of fatigue, along with nausea and vomiting.

In several cases, additional symptoms may include bleeding from the nose or gums, blood in urine or stool, and severe abdominal pain which can indicate the development of dengue fever.

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Q No 2 (b) Explain dark matter and dark energy.

1. Dark Matter:

i- Definition of Dark Matter:

Dark matter is a hypothetical form of matter that does not emit, absorb or reflect light, making it visible and detectable only through its gravitational effects on visible matter. It is believed to account for approximately 27% of the universe's total mass-energy content.

ii- Evidence for Existence:

The presence of dark matter is inferred from several astrophysical observations, including:

a. Galaxy Rotation Curves:

Observations of spiral galaxies show that their outer regions rotate at much higher speeds than would be expected based on visible mass alone. This discrepancy suggests the presence of additional, unseen mass.

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b. Gravitational Lensing:

Light from distant galaxies is bent by the gravitational influence of massive objects. The amount of bending often indicates more mass that what is visible, suggesting dark matter's presence.

c. Cosmic Microwave Background (CMB):

The CMB provides a snapshot of the early universe showing fluctuations that indicate the existence of dark matter.

"The CMB is a snapshot of the universe when it was just 380,000 years old, a time when the first atoms formed"

(Brane Greene)

iii. Composition of Dark Matter:

The exact nature of dark matter remains unknown, but it is hypothesized to consist of particles such as weakly interaction massive particles (WIMPs).

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2. Dark Energy:

i- Definition of Dark Energy:

Dark energy is a mysterious force that is driving the accelerated expansion of the universe. It is believed to constitute about 68% of the total universe mass-energy content.

ii- Evidence for Existence:

The evidence of the existence dark energy is supported by:

a. Supernova Observation:

Supernova in distant galaxies show that they are fainter than expected indicating that the universe's expansion is accelerating rather than decelerating.

b. Large Scale Structure:

The distribution of galaxies and cosmic structures also suggests an accelerating expansion influenced by dark energy.

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iii- Nature and Theories of Dark Energy:

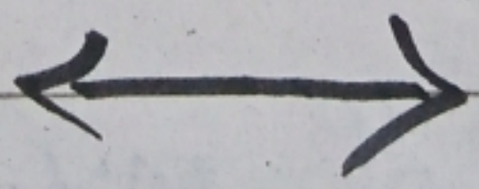
The exact nature of dark energy is still a topic of research, with several theories, and proposed, including:

1. Cosmological Constant:

Proposed by Albert Einstein, this constant represents a uniform energy density filling space by homogenously.

2. Quintessence:

A dynamic form of dark energy that changes with the passage of time and has different properties compared to a cosmological constant.



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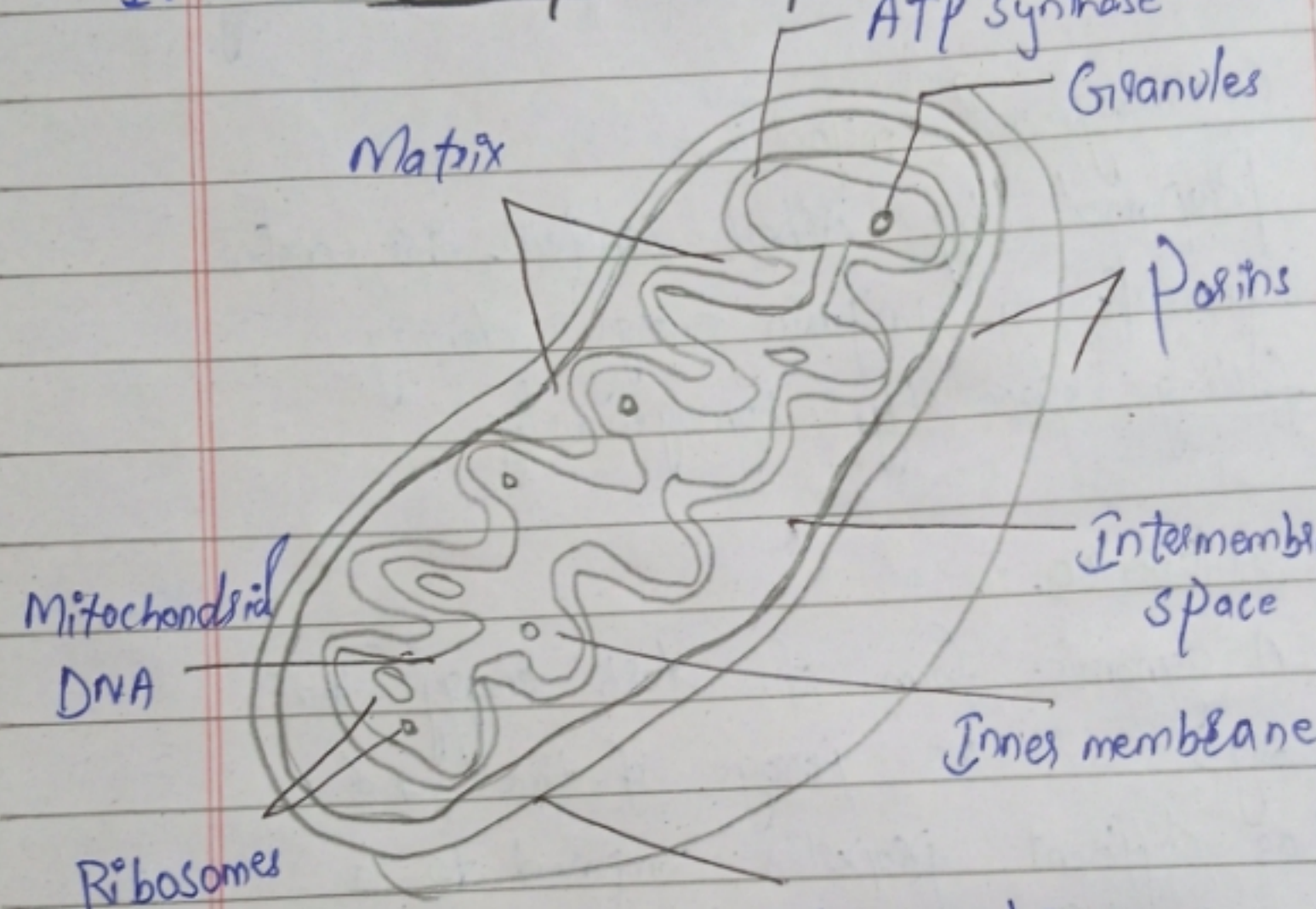
Q No 2: (c) Discuss structure and function of mitochondria. How is it the powerhouse?

I. Structure of Mitochondria



II. Functions of Mitochondria:

Mitochondria are often referred to as the "powerhouse of the cell" because they generate adenosine triphosphate (ATP). The primary energy currency of the cell. This process occurs through oxidation which involves two main stages.

1. Stages of ATP Production:

i- Citric Acid Cycle:

Citric Acid cycle takes place in the matrix where acetyl-CoA is oxidized producing NADH and $FADH_2$ which carry high energy electrons.

ii- Electron Transport Chain (ETC):

It is located in the inner membrane where electrons from NADH and $FADH_2$ are transferred through a series of protein complexes. This transfer pumps protons into the intermembrane space, creating a proton gradient.

2. Regulation of Metabolism:

Mitochondria play a key role in cellular metabolism by regulating the metabolic pathways of carbohydrates, fats and proteins:

3. **Apotosis:**
Mitochondria are involved in programmed cell death (apotosis) by releasing cytochrome c into the cytosol, triggered a cascade that leads to cell death.

4. **Calcium Storage of Mitochondria:**
Mitochondria helps to regulate intracellular calcium levels, playing a crucial role in cellular signalling.

III. Mitochondria as the Powerhouse:

Mitochondria are considered the powerhouse of the cell due to their ability to convert biochemical energy from nutrients into ATP through cellular respiration. This process is essential for providing energy for various cellular functions including muscle contraction, nerve impulse transmission, and biosynthesis of micromolecules.
The efficient energy production in mitochondria supports the metabolic needs of the cell, ensuring its survival and functionality.

Q No 2: (d) What are covalent bonds? Explain types along with elaborating structures.

Definition of Covalent Bond:

Covalent bonds are a type of chemical bond that involves the sharing of electron pairs between atoms. This bond formation typically occurs between nonmetals, allowing each atom to achieve a more stitable electron configuration, often resembling that of noble gases.

I. Types of Covalent Bonds:

1. Single Covalent Bond:

A single covalent bond is formed when two atoms share one pair of electrons.

Example: In hydrogen molecules H_2, two hydrogen atoms share one pair of electrons resulting in a single bond.

Structure of Single Covalent Bond:

The bond can be represented as.

H — H

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2. Double Covalent Bonds:

A double covalent bond is formed when two atoms share two pairs of electrons.

Example: In an oxygen molecule (O_2) two oxygen atoms share two pairs of electrons.

Structure of Double Covalent Bond:

The bond can be represented as

$$O = O$$

3. Triple Covalent Bonds:

A triple covalent bond is formed when two pairs of atoms share three (3) pairs of electrons

Example: In a nitrogen molecule (N_2) two nitrogen atoms share three pairs of electrons.

Structure of Triple Covalent Bond:

The bond can be represented as

$$N \equiv N$$

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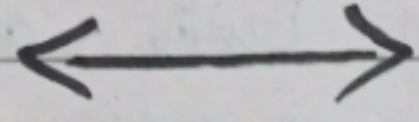
II. Elaborating on Covalent Bonding Structures:

H_2 : H — H

O_2 : O = O

N_2 : N ≡ N



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Q.No3:(a) What is lunar eclipse? Explain in detail with apt diagram.

Definition of Lunar Eclipse:

A lunar eclipse occurs when the Earth passes between the Sun and the moon; causing the Earth's shadow to fall on the moon. This phenomenon can only happen during a full moon when the Sun, Earth and Moon are aligned in a straight line.

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II. Types of Lunar Eclipse :

1. Total Lunar Eclipse :

In a total lunar eclipse, the entire Moon enters the Earth's umbra (the central darkest part of its shadow). During this eclipse, the moon can take on a reddish, often referred as "Blood moon".

2. Partial Lunar Eclipse :

In a partial lunar eclipse, only a portion of the Moon enters the Earth's umbra while the rest remains illuminated by direct sunlight. This result in part of the Moon appearing darkened.

3. Penumbral Lunar Eclipse :

A penumbral lunar eclipse occurs when the Moon passes through the Earth's penumbra (the outer part of its shadow). This type of eclipse is subtle and often difficult to observe since the Moon only slightly dims.

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III. How a Lunar Eclipse Occurs:

A. Alignment of the Sun, Earth, and Moon:

For a lunar eclipse to take place, the Sun, Earth and Moon must be aligned in a straight line which only happens during a full moon.

B. Shadow Formation:

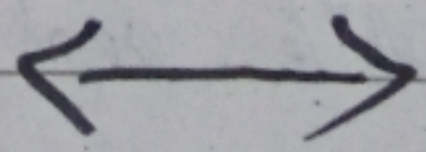
As the Earth blocks sunlight from reaching the Moon, two types of shadows are created:

1. Umbra:

The darkest part of the shadow where the sunlight is completely blocked.

2. Penumbra:

The lighter, outer part of the shadow where the sunlight is partially blocked.



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SECTION - II

Q.N 6: (a) Determine the "k" value if the arithmetic mean of 9, 8, 10, K, 12 is 15.

Solution:

By using formula of Arithmetic Mean

$$\text{Mean} = \frac{\text{Sum of values}}{\text{Number of values}}$$

Now, Putting the values in formula:

$$\bar{15} = \frac{9+8+\underline{10}+K+12}{\bar{5}}$$

$$\bar{5} \times \bar{15} = 39 + K$$

$$39 + K = 75$$

$$K = 75 - 39$$

$$\boxed{K = 36}$$

Q6: (c) What will be the volume of a football with a radius of 12 cm?

Solution:

Understand the formula for Volume of a sphere:

$$V = \frac{4}{3}\pi r^3$$

where:

V = is the volume

r is the radius of a sphere

π is constant approximately equal to 3.14

Given the radius = 12 cm

Now: Putting the values in the formula.

$$V = \frac{4}{3}\pi (12)^3$$

First Calculate:

$$12^3 = 12 \times 12 \times 12 = 1728.$$

Now,

$$V = \frac{4}{3}\pi (1728)$$

$$V = \frac{4 \times 1728}{3}\pi = \frac{6912}{3} = 2304$$

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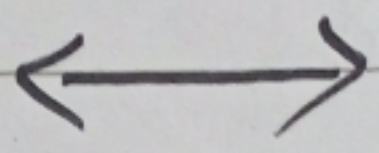
$$V = \frac{4 \times 1728\pi}{3}$$

$$V = \frac{6912\pi}{3}$$

$$V = 2304 \times 3.14159$$

$$\boxed{V = 7238.23\,cm^3}$$



Q[No6:(d)] Given a Series

$-10, -8, 6, 40, 102, ?$

Find what numbes would come in place of question mark (?)

Solution:

To find next numbes of the series $-10, -8, 6, 40, 102, ?$, let's analyze the differences between Consecutive terms to identify a pattern.

1. $-8 - (-10) = 2$
2. $6 - (-8) = 14$
3. $40 - 6 = 34$
4. $102 - 40 = 62$.

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The differences we have calculated are as:

2, 14, 34, 62

Now, lets calculate the difference of these numbers:

1. 14 - 2 = 12
2. 34 - 14 = 20
3. 62 - 34 = 28.

List the Second Differences are:

12, 20, 28.

The difference between these numbers are/is 8

28 + 8 = 36

62 + 36 = 98.

102 + 98 = 200.

Thus, the number that comes in place of the question mark (?) in the series is:

200 Ans

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Cl No 7 (a): If 20% of $x = y$, what is the value of $y\%$ of 20 in terms of x?

Solution:

To find the value of $y\%$ of 20 in terms of x.

From the given equation 20% of $x = y$, we can express y as

$$y = 0.20x$$

$$y\% \text{ of } 20 = \frac{y}{100} \times 20$$

$$= \frac{0.20x}{100} \times 20$$

$$= \frac{0.20x \times 20}{100}$$

$$= \frac{4x}{100}$$

$$= \boxed{0.04x}$$

Thus, the value of $y\%$ of 20 in terms of x is

$\boxed{0.04x}$ Ans.

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Q No 7:(5) Two coins are tossed 500 times, and we get:
Two heads = 105 times
one head = 275 times
No head = 120 times
Find the probability of each event to occur.

Solution:

Total outcomes = 500
From the given data:
Two heads occured = 105 times
one head occured = 275 times
No head occured = 120 times

The probability of an event is calculated by using formula.

$$P(\text{Event}) = \frac{\text{Number of favorable outcomes}}{\text{Total outcomes}}$$

a. Probability of Getting Two Heads

$$P(\text{Two Heads}) = \frac{105}{500}$$

$$= \boxed{0.21}$$

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b. Probability of Getting One Head:

$$P(\text{one Head}) = \frac{275}{500}$$

$$= \boxed{0.55}$$

c. Probability of Getting No Head:

$$P(\text{No Head}) = \frac{120}{500}$$

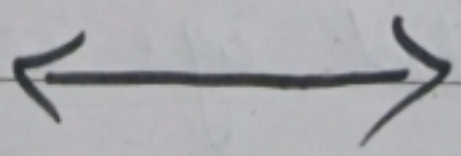
$$= \boxed{0.24}$$

Thus, the Probability of each events are:

Two Heads = 0.21

One Head = 0.55

No Head = 0.24.



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Cf7: (d) Jamie's dad is 4 times older than Jamie. In 14 years time Jamie's dad will be twice the age of Jamie. What is the sum of Jamie's age now and Jamie's dad age now?.

Solution:

Let j be Jamie's cussent age
Jamie's dad age d, is stated as being 4 time older than Jamie,

$$d = j + 4j = \boxed{5j} \longrightarrow (i)$$

Future Age Relationship

In 14 years:
Jamie's age will be $j + 14$
Jamie's dad age will be $d + 14$

According to the problem, in 14 years, Jamie's dad will twice Jamie's age

$$d + 14 = 2(j + 14)$$

Therefore $d = 5j$

$$5j + 14 = 2(j + 14)$$

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$$5j + 14 = 2(j + 14)$$

$$5j + 14 = 2j + 28$$

$$5j - 2j = 28 - 14$$

$$\boxed{3j = 14} \rightarrow (ii)$$

Solving for Jamie's Age:

$$j = \frac{14}{3}$$

Finding Jamie's Dad Age:

$$d = 5\left(\frac{14}{3}\right) = \frac{70}{3}$$

Sum of Their Ages:

$$j + d = \frac{14}{3} + \frac{70}{3}$$

$$= \frac{84}{3}$$

$$\boxed{= 28} \text{ Ans.}$$

THE END.