

Q7(a)

let the tens digit = t

units digit = $t + 2$

The number = $11t + 2$

Sum of digits = $2t + 2$

expand solve:

$$(11t + 2)(2t + 2) = 144$$

$$22t^2 + 26t + 4 = 144$$

$$= 22t^2 + 26t - 140 = 0$$

$$\text{Discriminant } 13^2 + 4 \cdot 11 \cdot 70 = 3249$$

$$= (57)^2$$

$$t = \frac{-13 + 57}{22} = \frac{44}{22} = 2 \text{ (digit)}$$

$$\text{unit digit} = 2 + 2 = 4$$

$$\text{number} = 24.$$

Q 7(c)

Interpretation if 20% of a is b (ie $0.2a = b$) then $b\%$ of 20 equals what?

$$b\% \text{ of } 20 = \frac{b}{100} \times 20 \\ = 0.2b$$

$$b = 0.2a$$

$$\text{this is } = 0.2 \times 0.2a \\ = 0.04a$$

$$b\% \text{ of } 20 = 4\% \text{ of } a$$

Q 7(d)

- (i) 14, 14
- (ii) 56
- (iii) 429
- (iv) B
- (v) Y

$$\text{Profit} = 7920 - 7500 = 420 \text{ Rs}$$

$$\% \text{ age profit} = 420 / 7500 \times 100$$

$$= 0.056 \times 100$$

$$= 5.6\% \text{ profit}$$

Q#7 d)

let present age of father = F

and son = S

$$\text{Ten years ago} = F - 10 = 3(S - 10)$$

$$\Rightarrow F = 3S - 20$$

$$\text{Ten years hence } F + 10 = 2(S + 10)$$

$$F = 2S + 10$$

Equate:-

$$3S - 20 = 2S + 10 \Rightarrow S = 30$$

$$\text{Then } F = 2S + 10 = 70$$

$$F : S = 70 : 30 = 7 : 3$$

$$\text{Discriminant } D = 17^2 + 4 \cdot 60 = 289 + 240 \\ = 529 = \sqrt{D} = 23$$

$$\text{Roots } x = \frac{-17 \pm 23}{2}$$

$$= \frac{-17 + 23}{2} = \frac{6}{2} = 3$$

Q5(c)

Initial population = 175,000

Final = 262,500

$$\text{Increase over 10 years} = 262,500 - 175,000 \\ = 87,500$$

$$\text{Average increase per year} = 87,500 \div 10 \\ = 8,750 \text{ / year}$$

Q5(d)

Purchased 20 dozens = $20 \times 12 = 240$ eggs

$$\text{cost per dozen} = \text{Rs } 37.50 \text{ so total cost} \\ = 20 \times 37.5 \\ = \text{Rs } 7500$$

sold each egg at = Rs 33 .

$$\text{Total revenue} = 33 \times 240 = \text{Rs } 7920$$

• Stress: chronic stress impairs memory and risk of mental disorders increase

Section II

Q #5(a)

Let the three consecutive primes be $p_1 + p_2 + p_3$

$$p_1 + p_2 + p_3 = 187$$

Try primes around $187/3 = 62.33$

Primes 59, 61, and 67

$$59 + 61 + 67 = 120 + 67 = 187$$

$$\text{so } p_1 = 59 \quad p_2 = 61 \quad p_3 = 67.$$

Q 5#(b)

Let the positive number = x

$$\text{Given } x + 17 = 60 \times \frac{1}{x}$$

Multiply by x

$$x^2 + 17x = 60 \times \frac{1}{x}$$

$$x^2 + 17x - 60 = 0$$

Major Brain Regions:-

- Cerebrum - Its function is reasoning, memory and voluntary actions
- Cerebellum It is responsible for balance and coordination.
- Brainstem It controls breathing, heartbeat, reflexes
- Limbic System is for emotions and motivation.

Interconnectedness:

Neurons and synapses allow communication between regions, ensuring coordination of functions like speech, learning and movements.

Factors affecting Brain Function:-

- Sleep restores memory and concentration.
- Nutrition - deficiency of omega 3s - vitamins, and glucose which fuel brain activity.

- 2 Aerial photography for detailed local surveys and mapping.
- 3 Radar and LiDAR - provide elevation models, topography and forest cover analysis.

Use in environmental monitoring:-

- Climate Change Tracking ice-melt, deforestation and desertification.
- Agriculture - crop health and irrigation planning.
- Natural Disasters - monitoring floods, hurricanes, earthquakes and wildfires.

Q3d

Human Brain and its functions:

The brain controls:-

cognition, memory, emotions, movement, sensory processing and homeostasis.

star clusters. Over time, galaxies evolved through:

- Star formation: converting gas into stars.
- Mergers and Collisions: galaxies combine forming larger structures.
- Feedback from supernovae and Black holes: regulating star formation.
- Cosmic Expansion: influencing galaxy distribution and growth.

Q 3(c) Remote Sensing:

Remote sensing is the process of collecting information about the earth's surface without direct contact, using sensors on satellites, aircraft or drones.

Types of Remote Sensing.

1. Satellite Imaging: do continuous monitoring of land use, vegetation and oceans.

Structure and Composition of the Milky Way:

The Milky Way is a barred spiral galaxy with four main parts

- Galactic Bulge - dense star cluster at the centre, containing a supermassive black hole (Sagittarius A)
- Disk - spiral arms rich in gas, dust and young stars
- Halo globular clusters, dark matter, and old stars.
- Dark matter Halo:- invisible component providing gravitational stability.

Formation and evolution of galaxies:

Galaxies formed after the Big Bang when matter clumped under gravity. Protogalactic clouds of gas collapsed to form stars and

Q#3(b)

Galaxies and the Milkyway.

Q What is a Galaxy?

A galaxy is a vast system of stars, gas, dust and dark matter bound by gravity. Galaxies are basic building blocks of the universe.

Classification of Galaxies (Hubble's Tuning Fork)

1 **Elliptical** - These are smooth, featureless, old stars e.g (E0 - E7)

2 **Spiral** - These spiral shaped arms and have a central bulge e.g (Sa, Sb, Sc)

3 **Barred Spiral**: These have bar shaped core e.g (SBa, SBb, SBc)

4 **Irregular**: These have no definite shape, often due to collisions.

mysterious force driving the accelerated expansion of the universe, discovered through observations of distant supernova. Together, they shape the universe's structure and future.

Key evidence supporting Big Bang:-

- 1 Cosmic Microwave Background Radiation (CMB) - It is a faint radiation remnant of the early universe.
- 2 Redshift of Galaxies (Hubble's law) Galaxies moving away indicate the expansion.
- 3 Abundance of Light elements: predicted ratios of hydrogen, helium, and lithium match astronomical observations.

Q#3(a)

Big Bang Theory:

The big bang theory explains that the universe originated about 13.8 billion years ago from an extremely dense and hot singularity. A massive explosion initiated rapid expansion, during which energy transformed into matter. Over time, atoms formed, followed by stars, galaxies, and planetary systems. This model explains not only the origin but also the continuous evolution of the universe.

Role of Dark Matter and Dark Energy:

Dark matter: makes up most of the universe's mass. Though invisible, it provides gravitational binding, keeping galaxies and clusters stable.

Dark Energy by contrast, is a

Primary vs. Secondary Pollutants:-

Primary pollutants are directly emitted into the atmosphere such as carbon monoxide, sulfur dioxide, nitrogen oxides, and particulate matter.

Secondary pollutants form when primary pollutants undergo chemical reactions in the atmosphere, like ozone, and peroxyacetyl nitrates (PANs). Secondary pollutants often cause smog and long-term atmospheric damage.

Reducing Air Pollution:-

Pollution can be reduced through individual actions such as using public transport, adopting clean energy, planting trees and reducing waste burning. At the collective level stricter environmental laws, promotion of renewable energy, industrial regulation, and global cooperation are crucial to combat air pollution sustainably.

resources. These actions lead to biodiversity loss, climate change and soil and water degradation. Unsustainable practices threaten ecological balance and the capacity of Earth to support life in the long run.

Q2(d)

Sources and Effects of Air Pollution

Air pollution arises mainly from industrial emissions, vehicle exhaust, burning of fossil fuels, deforestation, and agricultural practices. Its effects include smog, acid rain, and global warming. For humans, polluted air causes respiratory diseases, cardiovascular diseases and weakened immunity, while the environment suffers from reduced biodiversity, soil degradation and damaged ecosystems.

interact through heat transfer and tectonic activity, shaping earthquakes, volcanoes and mountain formation.

The water cycle and its role in life:

The water cycle involves continuous movement of water through evaporation, condensation, precipitation, infiltration and runoff. This cycle regulates climate, replenishes freshwater sources, and distributes nutrients. It is vital for agriculture, ecosystems and all living organisms, ensuring the availability of water necessary for survival.

Human Impacts on

Ecosystems and Resources:

Human activities such as deforestation, industrial pollution, overfishing and excessive fossil fuel consumption disrupt natural cycles and deplete

Mobile phones have transformed communication by making it global, instantaneous and multimedia based. Access to knowledge has become democratized, as smartphones connect users to vast information through the internet within seconds. However, this rapid access has also raised concerns about misinformation, privacy breaches and reduced attention spans.

Q2(c)

Layers of Earth

The Earth is composed of distinct layers. The **crust** is the thin, solid outermost layer where we live. Beneath it lies the **mantle**, made of semi-solid rock that circulates through convection currents, driving plate tectonics.

The **outer core**, composed of liquid iron and nickel, generates Earth's magnetic field, while the **inner core** is solid due to immense pressure. These layers

financial inclusion. They also improve personal security by allowing users to contact help in emergencies. Moreover, social networking apps and messaging platforms have made interaction faster and more convenient.

Disadvantages of Mobile Phone:

Excessive reliance on mobile phones can lead to negative outcomes.

Continuous notifications and social media use often cause distractions, stress, and reduced productivity. Over-exposure to screens has been linked to sleep disorders, digital addiction, and eye strain. Research also shows associations between heavy mobile use and rising levels of anxiety, depression, and loneliness, particularly among youth.

Impact on Communication and Access to Information:

Mobile communication is powered by multiple technologies. Cellular networks (2G to 5G) enable fast and reliable voice and data transmission. SIM cards authenticate users and secure connection. Smartphone Operating System (like Android and iOS) allow applications to run smoothly. Wifi and bluetooth complement mobile networks by enabling short-range connectivity. Advanced features such as satellite communication, GPS and cloud storage further expand the scope of mobile usage.

Advantages of Mobile Phone Use:

Mobile phones provide instant connectivity, bridging geographical distances. They enhance access to information, education and health services through the internet. Mobile banking and e-commerce empower economies by enabling

-dants. Homeostatic safeguards internal stability despite external fluctuations

Q.2(b)

How Mobile Phones Work:

Mobile phones work by transmitting and receiving radio signals through nearby cell towers. Each tower covers a 'cell' region, and as a user moves, the call or data session is handed over from one tower to another seamlessly. Voice signals are converted into digital data, transmitted via radio waves and then routed through networks to reach the recipient. Data services, including internet access, rely on packet switching technology, where information is broken into small packets and reassembled at the destination.

Key technologies Enabling Mobile Communication

Response to External Stimuli:

Cells detect and process external signals through specialized receptors on their membrane. In eukaryotes, G-protein coupled receptors, receptor tyrosine kinases, and ion channels trigger intracellular cascades involving second messengers like Ca^{2+} and cAMP. In prokaryotes, two-component systems and chemotaxis machinery allow movement toward nutrients or away from harmful conditions. These mechanisms ensure cells adapt quickly to environmental changes.

Maintenance of Homeostasis

Homeostasis is preserved through negative feedback loops. Cells regulate ion balance with pumps (e.g. Na^+/K^+) maintain osmotic stability via aquaporins and vacuoles, control temperature and protein folding through heat shock proteins, and detoxify harmful molecules with antioxidants.

Feature	Prokaryotic Cells	Eukaryotic Cells
• Nucleus	Absent (DNA in Nucleoid)	Present (DNA enclosed in nuclear envelope)
• DNA structure	Single circular chromosome plasmids	Multiple linear chromosomes with histones
• Organelles	No membrane bound organelles	Membrane bound organelles (Mitochondria, ER, Golgi etc)
• Ribosomes	70S ribosomes	80S ribosomes (cytoplasm)
• Size	Small ($0.1 - 5 \mu\text{m}$)	Larger ($10 - 100 \mu\text{m}$)
• Cell Division	Binary Fission	Mitosis and Meiosis
• Cell Wall	Peptidoglycan (bacteria) or other polymers (archaea)	Cell wall in plants (cellulose), absent in animals.
• Motility	Flagella (simple rotary)	Flagella/cilia (complex, microtubule-based)

and peroxisomes degrade waste. In plants, chloroplasts capture solar energy for photosynthesis and vacuoles maintain turgor pressure. These components function as an integrated system to maintain life processes.

Coordination of Cellular Functions

Cellular structures are independent. DNA in the nucleus encodes proteins, ribosomes synthesize them, ER and Golgi modify and transport them, mitochondria supply ATP to power reactions, and the cytoskeleton organizes traffic and division. This coordination ensures survival, reproduction, and adaptability.

Difference between Prokaryotic and Eukaryotic Cells

General Science and Ability

PART - II

SECTION - I

Q#2:

(a) Main Components of a Cell:

The cell being the basic unit of life, is made up of several essential structures that work together to sustain life. The plasma membrane controls exchange between the cell and its environment.

The cytoplasm contains enzymes, metabolites, and ribosomes for metabolic activities, while the cytoskeleton maintains shape and organizes transport. In eukaryotic cells, membrane bound organelles perform specialized functions: the nucleus regulates genetic material, mitochondria generate ATP, the endoplasmic reticulum and Golgi apparatus process and transport proteins and lipids, and Lysosomes