



CUET PG 2024 Atmospheric Science Shift 1

Time Allowed :1 Hours 45 minutes	Maximum Marks :300	Total Questions :75
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper comprises 75 questions. All questions are compulsory.
2. Each question carries 04 (four) marks.
3. For each correct response, the candidate will get 04 (four) marks.
4. For each incorrect response, 01 (one) mark will be deducted from the total score.
5. Un-answered/un-attempted response will be given no marks.
6. To answer a question, the candidate needs to choose one option as the correct option.
7. However, after the process of challenges of the Answer Key, in case there are multiple correct options or a change in the key, only those candidates who have attempted it correctly as per the revised Final Answer Key will be awarded marks.
8. In case a question is dropped due to some technical error, full marks shall be given to all the candidates irrespective of the fact who have attempted it or not.

Question 1: On a hot summer day while travelling in a bus, you notice a distant patch of road that appears wet. This phenomenon of mirage is due to:

- (A) Chromatic aberration
- (B) Rayleigh scattering
- (C) Total internal reflection
- (D) Mie scattering

Correct Answer: (C) Total internal reflection

Solution:

The phenomenon of a mirage occurs due to the total internal reflection of light. When light passes through layers of air with varying temperatures (and thus refractive indices), it bends. On hot surfaces, the air near the ground is less dense and warmer, while cooler air lies above it. This creates a gradient that causes the light to bend and reflect internally, giving the appearance of a wet surface.

Quick Tip

Tip: Remember that mirages are an optical phenomenon caused by the bending of light in temperature gradients, not scattering or aberrations.

Question 2: Arrange the principal gases of dry air in the decreasing order of their abundance in the atmosphere of the Earth.

- (A) Krypton
- (B) Argon
- (C) Methane
- (D) Carbon dioxide

Choose the correct answer from the options given below:



- (A) (A), (B), (C), (D)
- (B) (B), (D), (C), (A)
- (C) (A), (B), (D), (C)
- (D) (C), (B), (D), (A)

Correct Answer: (B) (B), (D), (C), (A)

Solution:

In dry air, the principal gases are arranged based on their abundance: - Argon (B) constitutes about 0.93% of dry air. - Carbon dioxide (D) is approximately 0.04%. - Methane (C) has a concentration of about 0.00018%. - Krypton (A) is around 0.0001%.

This order is based on their respective volumetric compositions in the Earth's atmosphere.

Quick Tip

Tip: Remember the mnemonic "ACMK" (Argon, Carbon dioxide, Methane, Krypton) to quickly recall the abundance of gases in dry air.

Question 3: Which of the following are most suitable conditions for photochemical smog formation in the ambient atmosphere?

- (A) SO₂, water vapours, sunlight ($T > 25^{\circ}\text{C}$)
- (B) NO₂, water vapours, sunlight ($T > 25^{\circ}\text{C}$)
- (C) NO₂, volatile hydrocarbons, sunlight ($T > 25^{\circ}\text{C}$)
- (D) SO₂, fog, volatile hydrocarbons, sunlight ($T < 25^{\circ}\text{C}$)

Correct Answer: (C) NO₂, volatile hydrocarbons, sunlight ($T > 25^{\circ}\text{C}$)

Solution:

Photochemical smog is primarily formed when nitrogen dioxide (NO₂) reacts with volatile organic compounds (VOCs) in the presence of sunlight and high temperatures ($T > 25^{\circ}\text{C}$).



This leads to the production of harmful secondary pollutants like ozone and peroxyacetyl nitrate.

Quick Tip

Tip: Photochemical smog forms in urban areas with high vehicle emissions, NO_2 , and VOCs under strong sunlight and warm temperatures.

Question 4: The potential energy of a system of four particles (mass 'm') placed at the vertices of a square of side 'l' would be:

- (A) $1.414 \text{ Gm}^2/\text{l}$
- (B) $5.41 \text{ Gm}^2/\text{l}$
- (C) $-1.414 \text{ Gm}^2/\text{l}$
- (D) $-5.41 \text{ Gm}^2/\text{l}$

Correct Answer: (D) $-5.41 \text{ Gm}^2/\text{l}$

Solution:

The potential energy of the system is calculated by summing the gravitational potential energies of all interacting particle pairs. For four masses at the corners of a square, the energy includes contributions from edge pairs and diagonal pairs. The negative sign indicates attraction.

Quick Tip

Tip: Use the formula $U = -\frac{Gm^2}{r}$ for gravitational potential energy, summing for all unique pairs.

Question 5: Which of the following is NOT a criteria pollutant under National Ambient



Air Quality Standards in India?

- (A) Carbon monoxide
- (B) Carbon dioxide
- (C) Ground-level ozone
- (D) PM₁₀

Correct Answer: (B) Carbon dioxide

Solution:

Carbon dioxide (CO₂) is not listed as a criteria pollutant under the National Ambient Air Quality Standards (NAAQS) in India. Criteria pollutants include carbon monoxide (CO), ground-level ozone (O₃), particulate matter (PM₁₀ and PM_{2.5}), nitrogen oxides (NO_x), sulfur dioxide (SO₂), lead, and ammonia.

Quick Tip

Tip: Remember that CO₂ is a greenhouse gas but not a criteria air pollutant under NAAQS.

Question 6: Average ocean salinity of 35 ppt can also be expressed as:

- (A) 35%
- (B) 3.5%
- (C) 35×10^{-12}
- (D) 0.35%

Correct Answer: (B) 3.5%

Solution:

The average ocean salinity of 35 parts per thousand (ppt) can be converted into a percentage by dividing it by 10. Thus, 35 ppt = $35 / 10 = 3.5\%$.



Quick Tip

Tip: To convert ppt to percentage, divide by 10. For example, 35 ppt becomes 3.5%.

Question 7: Consider the following list of processes, $L = \{P_1, P_2, P_3, P_4\}$ having CPU bursts, $T = \{6, 8, 7, 4\}$ in milliseconds. Applying shortest job first CPU scheduling, compute the average waiting time.

- (A) 6.75 milliseconds
- (B) 7.25 milliseconds
- (C) 7.75 milliseconds
- (D) 6.25 milliseconds

Correct Answer: (C) 7.75 milliseconds

Solution:

Shortest Job First (SJF) scheduling arranges processes by increasing order of CPU bursts: P_4 (4), P_1 (6), P_3 (7), P_2 (8).

Waiting times are:

- P_4 : 0 ms
- P_1 : 4 ms
- P_3 : 10 ms
- P_2 : 17 ms

Average waiting time = $(0 + 4 + 10 + 17) / 4 = 7.75$ ms.

Quick Tip

Tip: Arrange CPU bursts in ascending order for SJF and calculate waiting times incrementally.



Question 8: The hotter objects radiate more total energy per unit area than do colder objects. This concept is referred to as:

- (A) Wien's displacement law
- (B) Kirchhoff's law
- (C) Kepler's law
- (D) Stefan-Boltzmann law

Correct Answer: (D) Stefan-Boltzmann law

Solution:

The Stefan-Boltzmann law states that the total energy radiated per unit surface area of a blackbody is proportional to the fourth power of its absolute temperature ($E \propto T^4$). This explains why hotter objects radiate significantly more energy than colder ones.

Quick Tip

Tip: Remember Stefan-Boltzmann law as the $E \propto T^4$ relationship for radiative energy.

Question 9: Match List-I with List-II

List I	Electromagnetic Radiation	List II: Resulting Interaction
A	UV-Visible	I. Vibrational motion
B	Infrared	II. Ejection of internal electron
C	Microwave	III. Ejection of outer electron
D	X-rays	IV. Rotational motion

Options:

- (A) A-I, B-II, C-III, D-IV
- (B) A-III, B-I, C-IV, D-II
- (C) A-II, B-III, C-I, D-IV
- (D) A-IV, B-III, C-II, D-I



Correct Answer: (B) A-III, B-I, C-IV, D-II

Solution:

- **UV-Visible:** Causes the ejection of outer electrons, which is associated with the photoelectric effect.
- **Infrared:** Induces vibrational motion in molecules, forming the basis of infrared spectroscopy.
- **Microwave:** Causes rotational motion in molecules, used in microwave spectroscopy.
- **X-rays:** Eject internal electrons, leading to ionization and characteristic X-ray emission.

Quick Tip

UV-Visible: Ejection of outer electrons

Infrared: Vibrational motion

Microwave: Rotational motion

X-rays: Ejection of internal electrons

Mnemonic: *UV ejects, IR vibrates, MW rotates, X-rays ionize.*

Question 10: A cyclonic circulation denotes:

- (A) Counterclockwise circulation in the northern hemisphere
- (B) Clockwise circulation in the northern hemisphere
- (C) Clockwise circulation in the southern hemisphere
- (D) Counterclockwise circulation in the southern hemisphere

Choose the correct answer from the options given below:

- (A) (B) only
- (B) (B) and (D) only
- (C) (A) and (C) only
- (D) (D) only

Correct Answer: (C) (A) and (C) only



Solution:

In the northern hemisphere, cyclonic circulation is counterclockwise due to the Coriolis effect. In the southern hemisphere, cyclonic circulation is clockwise. This distinction is critical for understanding large-scale atmospheric movements.

Quick Tip

Tip: Cyclonic circulation direction reverses between hemispheres: counterclockwise in the north, clockwise in the south.

Question 11: Which of the following is not a consequence of increasing acidification of oceans?

- (A) Adverse effects on growth and survival of calcareous phytoplanktons
- (B) Adverse effects on growth and survival of coral reefs
- (C) Adverse effects on cloud seeding and formation
- (D) Adverse effects on survival of animals those have phytoplanktonic larvae

Correct Answer: (C) Adverse effects on cloud seeding and formation

Solution:

Ocean acidification impacts marine life significantly, especially calcareous organisms like phytoplanktons and coral reefs, as well as animals with phytoplanktonic larvae. However, cloud seeding and formation are atmospheric phenomena and are not affected by ocean acidification.

Quick Tip

Tip: Focus on biological impacts of acidification on marine organisms rather than atmospheric processes like cloud seeding.



Question 12: The average decrease of -6.5°C in temperature per kilometer in the troposphere is referred to as:

- (A) Temperature inversion
- (B) Environmental lapse rate
- (C) Adiabatic lapse rate
- (D) Geothermal gradient

Correct Answer: (B) Environmental lapse rate

Solution:

The environmental lapse rate refers to the average rate of temperature decrease with altitude in the troposphere, approximately -6.5°C per kilometer. It differs from the adiabatic lapse rate, which applies to dry or saturated air parcels.

Quick Tip

Tip: Remember the environmental lapse rate as the standard temperature drop of 6.5°C/km in the troposphere.

Question 13: In rate-monotonic scheduling, the worst-case CPU utilization achieved for execution of N processes can be expressed as:

- (A) 2^N
- (B) $(2^N - 1)$
- (C) $N(2^{1/N} - 1)$
- (D) $N(2^N - 1)$

Correct Answer: (D) $N(2^N - 1)$

Solution:

In rate-monotonic scheduling, the worst-case CPU utilization for N periodic tasks is given by



the formula: $U = N(2^N - 1)$. This ensures that tasks meet their deadlines under the most stringent conditions.

Quick Tip

Tip: Use the formula $U = N(2^N - 1)$ to calculate CPU utilization in rate-monotonic scheduling.

Question 14: The occurrence of aurora borealis and aurora australis takes place in the:

- (A) Troposphere
- (B) Stratosphere
- (C) Thermosphere
- (D) Tropopause

Correct Answer: (C) Thermosphere

Solution:

Auroras occur in the thermosphere, where charged particles from the solar wind interact with Earth's magnetic field, exciting atmospheric gases and creating light displays.

Quick Tip

Tip: Remember auroras occur in the thermosphere due to charged particles interacting with Earth's magnetic field.

Question 15: Arrange the following greenhouse gases in increasing order of their contribution to total global warming.

- (A) CH_4
- (B) N_2O



- (C) CO_2
(D) CFCs

Choose the correct answer from the options given below:

- (A) (C), (A), (B), (D)
(B) (B), (A), (C), (D)
(C) (D), (B), (A), (C)
(D) (C), (B), (D), (A)

Correct Answer: (B) (B), (A), (C), (D)

Solution:

The greenhouse gases can be arranged by their contribution to global warming as follows: 1. N_2O (highest Global Warming Potential (GWP))
2. CH_4 (higher GWP than CO_2)
3. CO_2 (contributes significantly due to its abundance)
4. CFCs (highest GWP but least contribution due to lower concentration).

Quick Tip

Tip: Arrange greenhouse gases by both their global warming potential and atmospheric concentration for accurate ranking.

Question 16: Absolute humidity in ambient air at a given temperature T is 3 g/m^3 .

Maximum absolute humidity at the same temperature T is 10 g/m^3 . What will the relative humidity at the same temperature T be?

- (A) 3%
(B) 0.3%
(C) 3.3%
(D) 30%



Correct Answer: (D) 30%

Solution:

Relative humidity is calculated using the formula:

$$\text{Relative Humidity} = \left(\frac{\text{Absolute Humidity}}{\text{Maximum Absolute Humidity}} \right) \times 100$$

Substituting the values:

$$\text{Relative Humidity} = \left(\frac{3}{10} \right) \times 100 = 30\%$$

Quick Tip

Tip: Remember the formula for relative humidity: $\text{RH} = \left(\frac{\text{Absolute Humidity}}{\text{Maximum Humidity}} \right) \times 100$.

Question 17: The zone of atmospheric window falls in the wavelength range of:

- (A) 0.4 to 0.7 μm
- (B) 8 to 12 mm
- (C) 8 to 12 μm
- (D) 1 to 3 μm

Correct Answer: (C) 8 to 12 μm

Solution:

The atmospheric window refers to a range of wavelengths in the infrared spectrum (8 to 12 μm) where the Earth's atmosphere allows thermal radiation to pass through with minimal absorption. This is crucial for heat radiation to escape into space.

Quick Tip

Tip: Atmospheric windows are in the infrared spectrum, primarily in the 8 to 12 μm range.



Question 18: Match List-I with List-II

List I	Type of Scattering	List II: Example
A	Rayleigh scattering	I. Haze
B	Mie scattering	II. Blue Sky
C	Non-selective scattering	III. Scattering of low intensity light by electron
D	Thomson scattering	IV. Cloud appears white

Options:

- (A) A-(II), B-(I), C-(IV), D-(III)
(B) A-(I), B-(III), C-(II), D-(IV)
(C) A-(II), B-(IV), C-(I), D-(III)
(D) A-(III), B-(IV), C-(I), D-(II)

Correct Answer: (A) A-(II), B-(I), C-(IV), D-(III)

Solution:

- **Rayleigh scattering:** Causes the blue color of the sky due to preferential scattering of shorter wavelengths.
- **Mie scattering:** Occurs with larger particles, causing phenomena like haze.
- **Non-selective scattering:** Scatters all wavelengths equally, making clouds appear white.
- **Thomson scattering:** Involves scattering of low-intensity light by electrons, explained in quantum physics.

Quick Tip

Rayleigh: Blue Sky (short wavelength)

Mie: Haze (large particles)

Non-selective: Clouds appear white

Thomson: Light scattered by electrons

Mnemonic: *Rayleigh-Blue, Mie-Haze, Non-selective-White, Thomson-Electron.*



Question 19: Match List-I with List-II

List I: Soil Types and Their Characteristics

List I	Soil Type	List II: Characteristics
A	Oxisol	I. Acid soil with leached upper horizon
B	Spodosol	II. Young soils with no horizon
C	Entisol	III. Clay-rich soils
D	Vertisol	IV. Highly weathered tropical and sub-tropical soils

Options:

- (A) A-(III), B-(II), C-(I), D-(IV)
- (B) A-(IV), B-(I), C-(II), D-(III)
- (C) A-(II), B-(IV), C-(III), D-(I)
- (D) A-(IV), B-(III), C-(I), D-(II)

Correct Answer: (D) A-(IV), B-(III), C-(I), D-(II)

Solution:

- **Oxisol:** Found in tropical and sub-tropical regions, these are highly weathered soils.
- **Spodosol:** Acidic soils with a leached upper horizon due to heavy rainfall and decomposition of organic matter.
- **Entisol:** Young soils with minimal profile development and no horizon formation.
- **Vertisol:** Rich in clay content, leading to expansion and contraction during wet and dry conditions.

Quick Tip

Oxisol: Highly weathered soils

Spodosol: Acidic soils with leached horizons

Entisol: Young soils with no horizons

Vertisol: Clay-rich soils

Mnemonic: *Oxisol-Tropic, Spodosol-Acid, Entisol-Young, Vertisol-Clay.*



Question 20: PM₁₀ stands for particulate matter having particles smaller than or equal to 10 μm . With respect to the particle characteristics, 10 μm represents:

- (A) Radius of the particle
- (B) Length of the particle
- (C) Aerodynamic diameter of the particle
- (D) Wavelength of the particle

Correct Answer: (C) Aerodynamic diameter of the particle

Solution:

The term PM₁₀ refers to particulate matter with an aerodynamic diameter of 10 μm or less. The aerodynamic diameter determines how particles behave in the atmosphere, including their potential to be inhaled into the respiratory tract.

Quick Tip

Tip: PM₁₀ indicates the aerodynamic diameter of particles, crucial for understanding their health impacts.

Question 21: Choose the incorrect statement:

- (A) Rising air expands and cools
- (B) Moist air rises to lower height compared to hot air under adiabatic conditions
- (C) Sinking air will compress
- (D) Moist air cools and expands slowly than warm air under adiabatic conditions

Correct Answer: (B) Moist air rises to lower height compared to hot air under adiabatic conditions

Solution:

Moist air rises higher than dry air due to its lower density, as water vapor is lighter than the



nitrogen and oxygen molecules it displaces. Thus, statement (B) is incorrect under adiabatic conditions.

Quick Tip

Tip: Moist air is less dense than dry air, so it rises higher under adiabatic conditions.

Question 22: Which of the following zones in a lake will have maximum nutrient and minimum dissolved oxygen?

- (A) Littoral zone
- (B) Profundal zone
- (C) Benthic zone
- (D) Epilimnion

Correct Answer: (C) Benthic zone

Solution:

The benthic zone is at the bottom of the lake, where organic matter accumulates. Decomposition by bacteria depletes oxygen levels while enriching nutrients, resulting in high nutrient content but low dissolved oxygen.

Quick Tip

Tip: The benthic zone is nutrient-rich but has low oxygen due to high decomposition activity.

Question 23: Mission LiFE was proposed by India in:

- (A) Paris convention held in the year 2015
- (B) Conference of Parties-26 held in Glasgow in the year 2021



- (C) G-20 presidency period in the year 2023
(D) Conference of Parties-27 held in Egypt in the year 2022

Correct Answer: (B) Conference of Parties-26 held in Glasgow in the year 2021

Solution:

Mission LiFE (Lifestyle for Environment) was proposed by India during COP-26 in Glasgow, 2021. It emphasizes sustainable living and climate-friendly behaviors to address global environmental challenges.

Quick Tip

Tip: Mission LiFE highlights sustainable lifestyle practices and was introduced at COP-26 in Glasgow.

Question 24: A narrow whitish ring with a large diameter centered on the sun is referred to as:

- (A) Corona
(B) Glory
(C) Halo
(D) Sun Pillar

Correct Answer: (C) Halo

Solution:

A halo is an optical phenomenon that forms as a ring around the sun (or moon) due to the refraction, reflection, and dispersion of light through ice crystals in the atmosphere.



Quick Tip

Tip: Halos are formed due to light interacting with ice crystals, creating circular rings around the sun or moon.

Question 25: Which of the following is an example of one of the most violent weather disturbances that occurs on the Earth?

- (A) Typhoons
- (B) Hurricane
- (C) Squall line
- (D) Tornadoes

Correct Answer: (D) Tornadoes

Solution:

Tornadoes are one of the most violent weather disturbances on Earth, characterized by strong rotating winds and extreme destruction. Their wind speeds can exceed 300 km/h, causing significant damage over a localized area.

Quick Tip

Tip: Tornadoes are highly localized but violent, with the highest wind speeds among weather phenomena.

Question 26: Match List-I with List-II

List I	Climate	List II: Characteristics
A	Tropical	I. Humid, Warm Summer
B	Drylands	II. Ice Caps
C	Sub-Tropical	III. Steppe
D	Polar	IV. Rainforest



Options:

- (A) A-(I), B-(II), C-(III), D-(IV)
- (B) A-(IV), B-(III), C-(I), D-(II)
- (C) A-(I), B-(III), C-(IV), D-(II)
- (D) A-(III), B-(IV), C-(I), D-(II)

Correct Answer: (B) A-(IV), B-(III), C-(I), D-(II)

Solution:

- **Tropical:** Associated with rainforests and humid conditions, supporting dense vegetation.
- **Drylands:** Characterized by steppe regions with limited rainfall and semi-arid conditions.
- **Sub-Tropical:** Experiences warm summers and moderate winters.
- **Polar:** Known for ice caps and extremely low temperatures.

Quick Tip

Tropical: Rainforest

Drylands: Steppe (semi-arid)

Sub-Tropical: Warm, humid summers

Polar: Ice Caps

Mnemonic: *Tropical-Rainforest, Drylands-Steppe, Sub-Tropical-Warm, Polar-Ice.*

Question 27: The process of aging of lakes/ponds (cultural eutrophication) is primarily caused by:

- (A) Reduction in precipitation
- (B) Excessive nutrient input to lake or ponds over short period
- (C) Input from acid rain
- (D) Deforestation along the lake and ponds

Correct Answer: (B) Excessive nutrient input to lake or ponds over short period

Solution:



Cultural eutrophication is caused by excessive nutrient input, such as nitrogen and phosphorus, from fertilizers, sewage, and industrial discharge. This leads to algal blooms and deoxygenation, accelerating the aging process of water bodies.

Quick Tip

Tip: Eutrophication is primarily linked to nutrient pollution from human activities.

Question 28: The Köppen classification is based on:

- (A) Monthly and average values of Temperature
- (B) Monthly and average values of Evaporation
- (C) Monthly and average values of Precipitation
- (D) Monthly and average values of Evapotranspiration

Choose the correct answer from the options given below:

- (A) (B) and (D) only
- (B) (A) and (C) only
- (C) (A), (B), (C) and (D)
- (D) (C) only

Correct Answer: (B) (A) and (C) only

Solution:

The Köppen climate classification is based on monthly and average values of temperature (A) and precipitation (C). These factors define the major climatic zones and vegetation types.

Quick Tip

Tip: Köppen classification focuses on temperature and precipitation to define climatic zones.



Question 29: Choose the correct statements:

- (A) Earth undergoes three basic motions: yearly revolution around Sun, daily rotation on its axis and a slow wobble of its axis
- (B) Precession is a slow wobbling of the axis as Earth spins
- (C) Apparent solar day is twenty four hours as determined from mean solar time
- (D) The event of time, noon, is the instant the Sun appears to move across the celestial meridian

Choose the correct answer from the options given below:

- (A) (A), (C) and (D) only
- (B) (A), (B) and (C) only
- (C) (B) and (C)
- (D) (A), (B) and (D) only

Correct Answer: (D) (A), (B) and (D) only

Solution:

Statements (A), (B), and (D) are correct. Earth has three motions: revolution, rotation, and axial wobble. Precession is the wobble of Earth's axis. Noon is defined as the Sun crossing the celestial meridian. Statement (C) is incorrect because the apparent solar day varies slightly.

Quick Tip

Tip: Precession is Earth's axial wobble, and noon marks the Sun's crossing of the celestial meridian.

Question 30: Choose the correct statements:

- (A) Transparent water can never be contaminated
- (B) River water will have high dissolved oxygen in winter compared to summer



- (C) Turbid water under sun light becomes warmer faster than clean water
(D) Pure water is a good conductor of electricity

Choose the correct answer from the options given below:

- (A) (A), (B) and (C) only
(B) (A), and (C) only
(C) (B) and (C)
(D) (A) and (D) only

Correct Answer: (C) (B) and (C)

Solution:

Statements (B) and (C) are correct. River water has higher dissolved oxygen in winter due to lower temperatures. Turbid water warms faster under sunlight due to greater absorption. Statement (A) is incorrect as transparent water can still be contaminated, and (D) is incorrect because pure water is a poor conductor of electricity.

Quick Tip

Tip: River water oxygen levels are higher in winter, and turbid water absorbs heat more efficiently.

Question 31: Choose the correct statements about earthquakes.

- (A) Seismograph measures P, S and surface waves
(B) S and P waves leave the focus of the earthquake essentially at the same time
(C) S waves move faster than P waves and get separated from each other
(D) Shallow earthquakes occur up to a depth of 70 km from Earth surface

Choose the correct answer from the options given below:

- (A) (A), (B) and (C) only
(B) (A), (B) and (D) only



(C) (A), (C) and (D) only

(D) (B), (C) and (D) only

Correct Answer: (B) (A), (B) and (D) only

Solution:

Statements (A), (B), and (D) are correct. A seismograph records P, S, and surface waves. P and S waves originate simultaneously at the earthquake focus, but P waves are faster.

Shallow earthquakes are defined as those occurring at depths less than 70 km.

Quick Tip

Tip: Remember that P waves are faster than S waves, and shallow earthquakes occur at depths less than 70 km.

Question 32: Choose the correct statements about El-Nino.

(A) El-Nino is warm current in the Pacific ocean near the coast of Peru

(B) El-Nino is cold current in the Pacific ocean near the coast of Peru

(C) El-Nino is an example of atmosphere-ocean interaction

(D) El-Nino is equatorial counter current

Choose the correct answer from the options given below:

(A) (B) and (D) only

(B) (A), (B), (C) and (D)

(C) (C) and (D) only

(D) (A), (C) and (D) only

Correct Answer: (D) (A), (C) and (D) only

Solution:

Statements (A), (C), and (D) are correct. El-Nino is a warm current near Peru and is an



example of atmosphere-ocean interaction. It also involves equatorial counter currents. Statement (B) is incorrect as El-Nino is not a cold current.

Quick Tip

Tip: El-Nino is a warm current associated with atmosphere-ocean interactions and equatorial counter currents.

Question 33: Reconstruction of past climates can be done using indirect evidence from:

- (A) Tree-growth rings
- (B) Cobalt isotope ratio in ice core
- (C) Oxygen isotope ratio in glacial ice
- (D) Sulphur isotope ratio in ice core

Choose the correct answer from the options given below:

- (A) (A), (B) (C) (D)
- (B) (A) and (C) only
- (C) (A), (C) and (D) only
- (D) (B), (C) and (D) only

Correct Answer: (B) (A) and (C) only

Solution:

Reconstruction of past climates relies on tree-growth rings (A) and oxygen isotope ratios in glacial ice (C). These indicators provide precise data about historical climate conditions. Sulphur and cobalt isotope ratios are not standard methods for paleoclimate reconstruction.

Quick Tip

Tip: Tree rings and oxygen isotopes are key tools for reconstructing past climate data.



Question 34: Match List-I with List-II**List I (Natural Causes of Climate Change) and List II (Associated Activity)**

List I	Natural Causes of Climate Change	List II: Associated Activity
A	Plate tectonics	I. Change in Earth's long-term climate
B	Solar variability	II. Change in reflectivity of the atmosphere
C	Variation in Earth's orbit	III. Rearrangement of the Continents
D	Volcanic activity	IV. Sunspots activity

Choose the correct answer from the options given below:

(A) A-(I), B-(II), C-(III), D-(IV)

(B) A-(I), B-(III), C-(II), D-(IV)

(C) A-(III), B-(II), C-(I), D-(IV)

(D) A-(III), B-(IV), C-(I), D-(II)

Correct Answer: (D) A-(III), B-(IV), C-(I), D-(II)

Solution:

- **Plate tectonics:** Responsible for the rearrangement of continents, impacting climate over geological timescales.
- **Solar variability:** Associated with sunspot activity, influencing Earth's climate by altering solar radiation.
- **Variation in Earth's orbit:** Causes changes in Earth's long-term climate patterns, such as Milankovitch cycles.
- **Volcanic activity:** Impacts atmospheric reflectivity through the release of aerosols, leading to temporary cooling effects.



Quick Tip

Plate Tectonics: Rearranges continents

Solar Variability: Sunspot activity

Earth's Orbit Variation: Long-term climate changes

Volcanic Activity: Reflectivity changes via aerosols

Mnemonic: *Plate-Rearrange, Solar-Sunspots, Orbit-Climate, Volcano-Aerosols.*

Question 35: Choose the correct statements:

- (A) Ozone depletion/ozone layer thinning in stratosphere occurs only over south pole
- (B) Ozone depletion/ozone layer thinning in stratosphere does not occur over north pole
- (C) Columnar ozone in atmosphere is measured in 1/100 unit of mm
- (D) Polar stratospheric clouds are largely responsible for ozone layer thinning over south pole

Choose the correct answer from the options given below:

- (A) (B) and (D) only
- (B) (B) and (C) only
- (C) (A) and (C) only
- (D) (C) and (D) only

Correct Answer: (D) (C) and (D) only

Solution:

Statements (C) and (D) are correct. Columnar ozone is measured in Dobson units (1/100 unit of mm), and polar stratospheric clouds contribute to ozone depletion over the south pole. Statements (A) and (B) are incorrect as ozone depletion also occurs over the north pole.

Quick Tip

Tip: Ozone depletion occurs at both poles, with Dobson units used to measure columnar ozone.



Question 36: Match List I with List II

List I	Radiation Law	List II (Equation)
A	Beer Lambert's Law	I. $\lambda_{\max} = bT$
B	Wien's displacement law	II. $\epsilon_1 = \epsilon_2$
C	Planck's formula of low frequencies	III. $I_\nu = \frac{2C\nu^3}{e^{\frac{h\nu}{kT}} - 1}$
D	Kirchoff's law	IV. $L_\nu = 2C\nu^{-4}KT$

Choose the correct answer from the options given below:

- (A) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (IV), (D) - (II)
(C) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
(D) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Correct Answer: (C) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Solution:

- (A) Beer Lambert's Law relates to $I_\nu = \frac{2C\nu^3}{e^{\frac{h\nu}{kT}} - 1}$, describing absorption of light proportional to the concentration of absorbing species.
- (B) Wien's displacement law corresponds to $L_\nu = 2C\nu^{-4}KT$, explaining temperature and blackbody radiation relationships.
- (C) Planck's formula of low frequencies is $\lambda_{\max} = bT$, describing the energy distribution of radiation.
- (D) Kirchoff's law links to $\epsilon_1 = \epsilon_2$, involving emissivity and absorptivity in thermal equilibrium.

Quick Tip

Quick Tip: Memorize the associations by understanding the physical context behind each law. For example, Wien's law ties temperature to wavelength, while Beer Lambert's law involves light absorption.



Question 37:

Given below is the concentration of CO₂ in the atmosphere in the last 11 years.

Calculate the mean and median concentration of CO₂.

Year	Concentration of CO ₂ (in ppm)
2013	330
2014	340
2015	350
2016	360
2017	370
2018	380
2019	390
2020	400
2021	410
2022	420
2023	425

Options:

- (A) 390 and 370
- (B) 379.54 and 370
- (C) 379.54 and 380
- (D) 370 and 380

Correct Answer: (C) 379.54 and 380

Solution:

To calculate the mean and median:

1. **Mean:** The mean is the average of the concentrations:

$$\text{Mean} = \frac{\text{Sum of all concentrations}}{\text{Total number of years}}$$

Sum of concentrations:

$$330 + 340 + 350 + 360 + 370 + 380 + 390 + 400 + 410 + 420 + 425 = 3,875$$



Total number of years = 11

$$\text{Mean} = \frac{3875}{11} = 379.54 \text{ ppm}$$

2. **Median:** The median is the middle value when data is arranged in ascending order. The sorted data is:

330, 340, 350, 360, 370, **380**, 390, 400, 410, 420, 425

The middle value (6th value) is 380 ppm.

Thus, the mean is 379.54 ppm, and the median is 380 ppm.

Quick Tip

Quick Tip: For odd-numbered datasets, the median is the middle value. For even-numbered datasets, take the average of the two middle values.

Question 38: Arrange the following periods of Paleozoic era in the correct order

starting from older to younger:

- (A) Cambrian
- (B) Devonian
- (C) Carboniferous
- (D) Permian
- (E) Silurian

Choose the correct answer from the options given below:

- (A) (A), (E), (B), (D), (C)
- (B) (A), (C), (B), (D), (E)
- (C) (C), (B), (E), (D), (A)
- (D) (D), (C), (B), (E), (A)

Correct Answer: (C) (C), (B), (E), (D), (A)



Solution:

The correct chronological order of the Paleozoic era periods is: 1. Carboniferous

2. Devonian

3. Silurian

4. Permian

5. Cambrian

This sequence represents the progression from older to younger periods.

Quick Tip

Tip: To recall Paleozoic periods, use mnemonics like "Cows Do See Pretty Colors."

Question 39: The two coherent sources of intensity ratio β interfere. The value of

$\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$ **is:**

(A) $\frac{2\beta}{1+\beta}$

(B) $\frac{2\sqrt{\beta}}{1+\beta}$

(C) $\frac{\beta}{1+\beta}$

(D) $\frac{\beta}{\sqrt{1+\beta}}$

Correct Answer: (C) $\frac{\beta}{1+\beta}$

Solution:

The formula for the ratio of intensity maxima and minima in terms of β (intensity ratio) is derived from the interference of coherent sources. Using the standard relation:

$$\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}} = \frac{\beta}{1 + \beta}$$

This matches the value provided in option (C).

Quick Tip

Tip: Use $\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}} = \frac{\beta}{1 + \beta}$ for intensity ratio interference problems.



Question 40: A radio station which can tune in to 7.5 MHz to 12 MHz corresponds to the wavelength band:

- (A) 4.0 m to 2.5 m
- (B) 40 m to 25 m
- (C) 1.0 m to 2.5 m
- (D) 1.0 m to 35 m

Correct Answer: (B) 40 m to 25 m

Solution:

The wavelength λ of a radio wave is related to its frequency f by:

$$\lambda = \frac{c}{f}$$

where $c = 3 \times 10^8$ m/s (speed of light). For 7.5 MHz (7.5×10^6 Hz):

$$\lambda = \frac{3 \times 10^8}{7.5 \times 10^6} = 40 \text{ m}$$

For 12 MHz (12×10^6 Hz):

$$\lambda = \frac{3 \times 10^8}{12 \times 10^6} = 25 \text{ m}$$

Thus, the wavelength band is 40 m to 25 m.

Quick Tip

Tip: Use $\lambda = \frac{c}{f}$ to calculate the wavelength range from a given frequency range.

Question 41: The magnetic field of the earth is thought to arise due to:

- (A) A bar magnet placed inside the earth
- (B) Iron in the crust
- (C) Convective motion of metallic fluids in the outer core
- (D) Electric currents running through the mantle of the Earth



Correct Answer: (C) Convective motion of metallic fluids in the outer core

Solution:

The Earth's magnetic field is generated by the dynamo effect, which is caused by the convective motion of electrically conductive fluids (molten iron and nickel) in the outer core. These motions generate electric currents, leading to the Earth's magnetic field.

Quick Tip

Tip: Remember the Earth's magnetic field is primarily due to the dynamo effect in the outer core.

Question 42: Standard deviation for first 10 even natural numbers is:

- (A) 11
- (B) 7.74
- (C) 5.74
- (D) 11.48

Correct Answer: (C) 5.74

Solution:

The first 10 even natural numbers are: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20. The mean is:

$$\mu = \frac{\text{Sum of numbers}}{\text{Count}} = \frac{2 + 4 + 6 + \dots + 20}{10} = 11$$

The standard deviation formula is:

$$\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{n}}$$

Calculating $\sum (x_i - \mu)^2$:

$$(x_i - \mu)^2 = (2 - 11)^2 + (4 - 11)^2 + \dots + (20 - 11)^2 = 81 + 49 + \dots + 81 = 330$$



Substituting:

$$\sigma = \sqrt{\frac{330}{10}} = 5.74$$

Quick Tip

Tip: Use $\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{n}}$ and verify by calculating each squared difference accurately.

Question 43: Mean square deviation of a distribution is least when deviations are taken about:

- (A) Mean
- (B) Median
- (C) Mode
- (D) Both mean and mode

Correct Answer: (A) Mean

Solution:

The mean minimizes the sum of squared deviations, making it the central measure where mean square deviation is least. Neither the median nor the mode achieves this property.

Quick Tip

Tip: Always remember that the mean minimizes squared deviations.

Question 44: 10 is the mean of a set of 7 observations and 5 is the mean of a set of 3 observations. The mean of the combined set is:

- (A) 15
- (B) 10



- (C) 8.5
(D) 7.2

Correct Answer: (C) 8.5

Solution:

The total sum of observations in the first set:

$$S_1 = 10 \times 7 = 70$$

The total sum of observations in the second set:

$$S_2 = 5 \times 3 = 15$$

The combined mean is:

$$\text{Mean} = \frac{S_1 + S_2}{7 + 3} = \frac{70 + 15}{10} = 8.5$$

Quick Tip

Tip: For combined mean, use $\text{Mean} = \frac{\text{Sum of both sets}}{\text{Total number of observations}}$.

Question 45: A statistical measure which cannot be determined graphically is:

- (A) Median
(B) Mode
(C) Harmonic mean
(D) Mean

Correct Answer: (C) Harmonic mean

Solution:

The harmonic mean cannot be represented graphically, as it is a calculated measure based on the reciprocals of the data values. Median and mode can be determined graphically from frequency distributions, while the mean can be inferred from histograms.



Quick Tip

Tip: Harmonic mean involves reciprocals and cannot be directly visualized in a graph.

Question 46: An ogive is used to determine:

- (A) Mean
- (B) Median
- (C) Mode
- (D) Harmonic Mean

Correct Answer: (B) Median

Solution:

An ogive is a cumulative frequency graph used to estimate the median of a data set. By plotting cumulative frequencies, the median is determined at the 50th percentile mark on the graph.

Quick Tip

Tip: To find the median from an ogive, locate the point corresponding to 50% of the cumulative frequency.

Question 47: If the coefficient of variance and the standard deviation of a distribution are 60 and 21 respectively, then their arithmetic mean is:

- (A) 35
- (B) $\frac{2000}{7}$
- (C) $2\sqrt{3}$
- (D) $\sqrt{35}$



Correct Answer: (A) 35

Solution:

The formula for the coefficient of variance (CV) is:

$$CV = \frac{\sigma}{\mu} \times 100$$

Given $CV = 60$ and $\sigma = 21$, solving for μ :

$$60 = \frac{21}{\mu} \times 100 \Rightarrow \mu = \frac{21 \times 100}{60} = 35$$

Quick Tip

Tip: Use $CV = \frac{\sigma}{\mu} \times 100$ to calculate the mean from the coefficient of variance and standard deviation.

Question 48: For dealing with qualitative data the best average is:

- (A) Arithmetic Mean
- (B) Geometric Mean
- (C) Mode
- (D) Median

Correct Answer: (D) Median

Solution:

For qualitative data, which involves non-numeric categories, the median is often the most appropriate measure. It represents the middle value in an ordered list, making it suitable for ordinal data.

Quick Tip

Tip: For ordinal or qualitative data, the median is often the best representation of central tendency.



Question 49: The coefficient of correlation between X and Y is 0.6. Their covariance is 4.8. The variance of X is 9. Then the standard deviation of Y is:

- (A) $\frac{4.8}{3 \times 0.6}$
- (B) $\frac{4.8}{0.6}$
- (C) $\frac{3 \times 4.8}{3}$
- (D) $\frac{4.8}{\sqrt{9 \times 0.6}}$

Correct Answer: (B) $\frac{4.8}{0.6}$

Solution:

The formula for the correlation coefficient is:

$$r = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y}$$

Substituting $r = 0.6$, $\text{Cov}(X, Y) = 4.8$, and $\sigma_X = \sqrt{\text{Var}(X)} = 3$:

$$0.6 = \frac{4.8}{3 \cdot \sigma_Y} \Rightarrow \sigma_Y = \frac{4.8}{3 \cdot 0.6} = 2.67$$

Quick Tip

Tip: Rearrange $r = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y}$ to find the missing standard deviation or covariance.

Question 50: The correlation coefficient between X and Y will have positive sign when:

- (A) X is increasing and Y is decreasing
- (B) Both X and Y are increasing
- (C) X is decreasing and Y is increasing
- (D) There is no change in X and Y

Correct Answer: (B) Both X and Y are increasing



Solution:

The correlation coefficient is positive when both variables increase together or decrease together. When X and Y move in the same direction, their covariance is positive, leading to a positive correlation coefficient.

Quick Tip

Tip: A positive correlation implies both variables increase or decrease together.

Question 51: The coefficient of correlation is independent of:

- (A) Change of scale only
- (B) Change of origin only
- (C) Both change of scale and origin
- (D) Neither change of scale nor change of origin

Correct Answer: (C) Both change of scale and origin

Solution:

The correlation coefficient is a pure number that remains unaffected by changes in scale (multiplication or division by a constant) or origin (addition or subtraction by a constant). It depends solely on the relative magnitudes of the variables.

Quick Tip

Tip: Remember that correlation is a measure of association, not the units or absolute values of the variables.

Question 52: Kepler's laws deal with:

- (A) Law of orbits
- (B) Law of periods
- (C) Law of gravitation
- (D) Law of areas

Choose the correct answer from the options given below:

- (A) (A), (B), and (D) only
- (B) (A), (B), and (C) only
- (C) (B) and (C) only
- (D) (C) and (D) only

Correct Answer: (A) (A), (B), and (D) only

Solution:

Kepler's laws describe the motion of planets: 1. **Law of Orbits:** Planets revolve around the Sun in elliptical orbits, with the Sun at one focus. 2. **Law of Areas:** A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time. 3. **Law of Periods:** The square of a planet's orbital period is proportional to the cube of the semi-major axis of its orbit. The law of gravitation (C) was formulated by Newton and is not part of Kepler's laws.

Quick Tip

Tip: Remember that Kepler's laws explain planetary motion, while Newton's law of gravitation provides the force behind the motion.

Question 53: In order to increase the resolving power of a telescope it is necessary to:

- (A) Increase the diameter of eyepiece
- (B) Decrease the diameter of eyepiece
- (C) Increase the diameter of the objective lens
- (D) Decrease the diameter of the objective lens



Correct Answer: (C) Increase the diameter of the objective lens

Solution:

The resolving power of a telescope is given by:

$$R = \frac{1.22\lambda}{D}$$

where D is the diameter of the objective lens. Increasing D reduces the angular resolution, improving the resolving power.

Quick Tip

Tip: A larger objective lens diameter collects more light and improves the resolving power.

Question 54: Match List I with List II

List I (Type of Processes)	List II (Feature)
A. Adiabatic	I. Temperature constant
B. Isochoric	II. Pressure constant
C. Isobaric	III. Volume constant
D. Isothermal	IV. No heat flow between the system and the surroundings

Choose the correct answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

(C) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)

(D) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Correct Answer: (D) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Solution:

- **Adiabatic:** In an adiabatic process, there is no heat flow between the system and the surroundings. Hence, it corresponds to IV.



- **Isochoric:** In an isochoric process, the volume remains constant while other parameters may vary. Hence, it corresponds to III.
- **Isobaric:** In an isobaric process, the pressure remains constant during the process. Hence, it corresponds to II.
- **Isothermal:** In an isothermal process, the temperature remains constant throughout. Hence, it corresponds to I.

Quick Tip

Quick Tip: For remembering these processes: - **Adiabatic** means "no heat flow." - **Isochoric** links to "constant volume." - **Isobaric** stands for "constant pressure." - **Isothermal** implies "constant temperature."

Question 55: Match List I with List II

List I (Discontinuity)	List II (Boundary location)
A. Moho	I. Crust and Upper mantle
B. Repetti	II. Upper mantle and Lower mantle
C. Gutenberg	III. Lower mantle and Outer core
D. Lehmann	IV. Outer and Inner core

Choose the correct answer from the options given below:

- (A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
- (B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
- (C) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)
- (D) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Correct Answer: (A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Solution:

- **Moho:** The Mohorovičić discontinuity (Moho) lies between the crust and the upper mantle. Hence, it corresponds to I.



- **Repetti:** The Repetti discontinuity separates the upper mantle from the lower mantle. Hence, it corresponds to II.
- **Lehmann:** The Lehmann discontinuity lies between the outer core and the inner core. Hence, it corresponds to III.
- **Gutenberg:** The Gutenberg discontinuity is located between the lower mantle and the outer core. Hence, it corresponds to IV.

Quick Tip

Quick Tip: Remember the sequence of Earth's layers and the discontinuities as: - Moho: Crust to Mantle, - Repetti: Upper to Lower Mantle, - Gutenberg: Mantle to Outer Core, - Lehmann: Outer to Inner Core.

Question 56: Arrange the following in order of their occurrence starting from land surface to deep ocean.

- (A) Abyssal Plains
- (B) Continental Rise
- (C) Continental Slope
- (D) Continental Shelf

Choose the correct answer from the options given below:

- (A) (A), (B), (C), (D)
- (B) (C), (B), (D), (A)
- (C) (C), (D), (B), (A)
- (D) (D), (C), (B), (A)

Correct Answer: (C) (C), (D), (B), (A)

Solution:

The correct sequence starts from the continental shelf, which is the shallowest part near the land surface, followed by the continental slope, the continental rise, and finally the abyssal



plains, which are the deep and flat regions of the ocean.

Quick Tip

Tip: Remember the sequence "Shelf-Slope-Rise-Plains" to recall the order of ocean features.

Question 57: In an ocean, Pycnocline refers to a layer representing:

- (A) Steep change in the density of the ocean
- (B) Steep change in the temperature of the ocean
- (C) Steep change in the salinity of the ocean
- (D) Steep change in the biomass of the ocean

Correct Answer: (A) Steep change in the density of the ocean

Solution:

Pycnocline is a layer in the ocean where there is a rapid change in water density with depth. This change is typically caused by variations in temperature and salinity. It acts as a barrier to vertical mixing of ocean water.

Quick Tip

Tip: Associate "Pycnocline" with "density" (from the Greek word "pyknos" meaning dense).

Question 58: The general solution of the differential equation $\frac{dy}{dx} = e^x + 2x^3e^x$ is (Where

C is an arbitrary constant):

- (A) $e^x + e^x x^4 + C$
- (B) $e^x + \frac{e^x x^4}{4} + C$



(C) $e^x + 4e^x x^3 + C$

(D) $e^x + 4e^x x^4 + C$

Correct Answer: (B) $e^x + \frac{e^x x^4}{4} + C$

Solution:

We separate the given equation into two parts:

$$\frac{dy}{dx} = e^x + 2x^3 e^x.$$

The integral of e^x is:

$$\int e^x dx = e^x.$$

For $2x^3 e^x$, we use integration by parts:

$$\int 2x^3 e^x dx = \frac{e^x x^4}{4}.$$

Thus, the general solution is:

$$y = e^x + \frac{e^x x^4}{4} + C.$$

Quick Tip

Tip: Always check for integration by parts when a product of exponential and polynomial terms appears.

Question 59: If the order of the differential equation $x^3 \frac{d^3 y}{dx^3} + 4 \frac{dy}{dx} + y = 0$ is α , then $2\alpha + 3$ is:

(A) 7

(B) 9

(C) 5

(D) 3

Correct Answer: (A) 7



Solution:

The order of a differential equation is the highest derivative present in the equation. In this case, the equation:

$$x^3 \frac{d^3 y}{dx^3} + 4 \frac{dy}{dx} + y = 0$$

has the highest derivative as $\frac{d^3 y}{dx^3}$, which means the order $\alpha = 3$.

Now, calculate $2\alpha + 3$:

$$2\alpha + 3 = 2(3) + 3 = 6 + 3 = 7.$$

Quick Tip

Tip: The order of a differential equation is determined solely by the highest derivative, irrespective of coefficients or variables.

Question 60: Solve the system of equations:

$$2x \begin{bmatrix} 4 \\ 7 \end{bmatrix} + 3y \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 3 \\ 12 \end{bmatrix}.$$

(A) $x = 9, y = -3$

(B) $x = 3, y = 2$

(C) $x = -3, y = 9$

(D) $x = 9, y = -2$

Correct Answer: (C) $x = -3, y = 9$

Solution:

Given the matrix equation:

$$2x \begin{bmatrix} 4 \\ 7 \end{bmatrix} + 3y \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 3 \\ 12 \end{bmatrix},$$

split it into two scalar equations:

$$8x + 3y = 3 \quad (\text{Equation 1}),$$



$$14x + 6y = 12 \quad (\text{Equation 2}).$$

From Equation 1:

$$8x + 3y = 3 \quad \implies \quad 3y = 3 - 8x \quad \implies \quad y = 1 - \frac{8x}{3}.$$

Substitute y into Equation 2:

$$14x + 6\left(1 - \frac{8x}{3}\right) = 12,$$

$$14x + 6 - 16x = 12,$$

$$-2x + 6 = 12,$$

$$-2x = 6 \quad \implies \quad x = -3.$$

Substitute $x = -3$ back into Equation 1:

$$8(-3) + 3y = 3,$$

$$-24 + 3y = 3,$$

$$3y = 27 \quad \implies \quad y = 9.$$

Thus, the solution is $x = -3, y = 9$.

Quick Tip

Tip: Always check your solution by substituting x and y back into both equations to verify correctness.

Question 61: The value of the determinant

$$\Delta = \begin{vmatrix} 0 & a & -b \\ -a & 0 & -c \\ b & c & 0 \end{vmatrix}$$

Options:

(A) $(a + b + c)^2$

(B) $a + b + c$

(C) $(a - b)(b - c)(c - a)$

(D) 0



Correct Answer: (D) 0

Solution:

For any skew-symmetric matrix of odd order, the determinant is always zero. Here, the matrix is 3×3 and skew-symmetric. Therefore:

$$\Delta = 0$$

Quick Tip

Tip: A skew-symmetric matrix has $\Delta = 0$ for odd dimensions.

Question 62: Let $g(x) = \begin{cases} -3\pi, & -\pi < x \leq 0 \\ 3\pi, & 0 < x \leq \pi \end{cases}$ be a periodic function of period 2π . The coefficient of $\sin(3x)$ in the Fourier series expansion of $g(x)$ on the interval $[-\pi, \pi]$ is:

Options:

- (A) 6
- (B) 4
- (C) 3π
- (D) 4π

Correct Answer: (B) 4

Solution:

Using the Fourier series formula for the sine coefficient:

$$b_n = \frac{2}{\pi} \int_{-\pi}^{\pi} g(x) \sin(nx) dx$$

Substituting $g(x)$ and solving for $n = 3$, we find:

$$b_3 = 4$$

Quick Tip

Tip: The sine coefficient b_n can be calculated using integration over the function's period.



Question 63: The inverse Laplace transform of:

$$\frac{1}{s(s^2 + \omega^2)}$$

Options:

- (A) $\frac{\sin(\omega t)}{\omega}$
- (B) $\frac{1}{\omega^2}(1 - \cos(\omega t))$
- (C) $\frac{1}{\omega^2}(1 - \cos(\omega t))$
- (D) $\frac{1}{\omega^2}(1 - \sin(\omega t))$

Correct Answer: (B) $\frac{1}{\omega^2}(1 - \cos(\omega t))$

Solution:

Using standard Laplace transform pairs and partial fraction decomposition:

$$\mathcal{L}^{-1} \left[\frac{1}{s(s^2 + \omega^2)} \right] = \frac{1}{\omega^2}(1 - \cos(\omega t))$$

Quick Tip

Tip: Memorize standard inverse Laplace transform results for quicker solving.

Question 64: If the centre of the circle

$$x^2 + y^2 - 4x - 8y - 45 = 0$$

is (a, b) , then the value of $3a + 2b$ is:

Options:

- (A) 1
- (B) 7
- (C) 26
- (D) 14

Correct Answer: (D) 14

Solution:



The general equation of a circle is:

$$(x - h)^2 + (y - k)^2 = r^2$$

Rewriting the given equation:

$$x^2 + y^2 - 4x - 8y - 45 = 0 \implies (x - 2)^2 + (y - 4)^2 = 65$$

So, the center is $(2, 4)$. Calculating $3a + 2b$:

$$3(2) + 2(4) = 6 + 8 = 14$$

Quick Tip

Tip: Always rewrite the circle equation in standard form to find its center and radius.

Question 65: The real numbers a and b if $(a - ib)(3 + 5i)$ is the conjugate of $-6 - 24i$ are

Options:

- (A) $a = 3, b = -3$
- (B) $a = -3, b = 3$
- (C) $a = 3, b = -2$
- (D) $a = -2, b = -3$

Correct Answer: (A) $a = 3, b = -3$

Solution:

Expanding $(a - ib)(3 + 5i)$ and equating it to the conjugate of $-6 - 24i$, we find:

$$a = 3, \quad b = -3$$

Quick Tip

Tip: Use complex number multiplication rules to simplify expressions.

Question 66: If A and B are two sets such that $A \cup B$ has 20 elements, A has 10 elements, and B has 17 elements. Then the number of elements in $A \cap B$ is:



Options:

- (A) 5
- (B) 7
- (C) 3
- (D) 2

Correct Answer: (B) 7**Solution:**

Using the formula for the union of two sets:

$$|A \cup B| = |A| + |B| - |A \cap B|$$

Substituting the given values:

$$20 = 10 + 17 - |A \cap B|$$

$$|A \cap B| = 27 - 20 = 7$$

Quick Tip

Tip: Remember the formula $|A \cup B| = |A| + |B| - |A \cap B|$ for set union and intersection calculations.

Question 67: If $y'' + y' + 5y = 6$, $y(0) = 0$, $y'(0) = 0$, then the Laplace Transformation $Y(s)$ of the solution $y(t)$ of the differential equation is equal to:

- (A) $\frac{6}{s^3+5}$
- (B) $\frac{6}{s \cdot (s^2+5)}$
- (C) $\frac{6}{s^3 \cdot (s^2+5)}$
- (D) $\frac{6}{s^2 \cdot (s^2+5)}$

Correct Answer: (C) $\frac{6}{s^3 \cdot (s^2+5)}$ **Solution:**

To solve this differential equation using the Laplace transform:

1. Take the Laplace transform on both sides:

$$\mathcal{L}[y''] + \mathcal{L}[y'] + 5\mathcal{L}[y] = \mathcal{L}[6]$$



Using $\mathcal{L}[y'] = sY(s) - y(0)$ and $\mathcal{L}[y''] = s^2Y(s) - sy(0) - y'(0)$, substitute $y(0) = 0$ and $y'(0) = 0$.

$$s^2Y(s) + sY(s) + 5Y(s) = \frac{6}{s^3}$$

2. Simplify:

$$Y(s)(s^2 + s + 5) = \frac{6}{s^3}$$
$$Y(s) = \frac{6}{s^3 \cdot (s^2 + 5)}$$

Thus, the Laplace transform of $y(t)$ is $\frac{6}{s^3 \cdot (s^2 + 5)}$.

Quick Tip

Tip: Apply the Laplace transform step-by-step, carefully substituting initial conditions and rearranging terms.

Question 68: Which of the following are statistical techniques for data pre-processing?

- (A) Measures of variability
- (B) Structured querying
- (C) Substring pattern matching
- (D) Central tendency

Options:

- (A) (A), (B), and (C) only
- (B) (B) and (C) only
- (C) (A), (B), and (D) only
- (D) (A) and (D) only

Correct Answer: (D) (A) and (D) only

Solution:

1. Measures of variability (A) are important in data pre-processing as they provide insights into the spread of data.
2. Structured querying (B) is not a statistical technique; it belongs to database operations.
3. Substring pattern matching (C) is a computational method, not statistical.



4. Central tendency (D) is a fundamental statistical method and directly aids in summarizing data during pre-processing.

Thus, the correct options are (A) and (D) only.

Quick Tip

Tip: Identify statistical techniques that focus on summarizing or analyzing data patterns during pre-processing.

Question 69: In the context of the traditional file system, which are considered to be the limitations that eventually motivated the emergence of a database management system?

- (A) Data redundancy
- (B) Data independence
- (C) Data inconsistency
- (D) Data isolation

Options: (A) (A), (B), and (D) only

- (B) (A), (B), and (C) only
- (C) (A), (C), and (D) only
- (D) (B), (C), and (D) only

Correct Answer: (C) (A), (C), and (D) only

Solution:

The traditional file system has the following limitations: 1. Data redundancy: Duplication of data across multiple files. 2. Data inconsistency: Due to redundancy, inconsistencies arise when data is updated in some files but not others. 3. Data isolation: Data is scattered across files, making it difficult to retrieve or access.

These limitations prompted the need for database management systems to provide efficient data storage, consistency, and retrieval mechanisms.

Quick Tip

Tip: Data redundancy and inconsistency are key factors leading to inefficiencies in traditional file systems, driving the adoption of DBMS.



Question 70: In the given uniform resource locator, correctly identify the domain name.

`https://www.cuet.gov.in/exam/paper.html`

Options:

- (A) paper.html
- (B) www.cuet.gov.in
- (C) https://www.cuet.gov.in
- (D) gov.in

Correct Answer: (B) www.cuet.gov.in

Solution:

In a URL: - Domain name refers to the main address where the site is hosted. - Here, 'www.cuet.gov.in' is the domain, while 'paper.html' is a resource within the site, and 'https' is the protocol.

Quick Tip

Tip: To identify the domain, exclude the protocol ('https://') and focus on the main address before the first '/'.

Question 71: Consider the following with respect to a network interface card used for communication:

- (A) It is also called an ethernet card.
- (B) It is an instance of a network router.
- (C) Data transfer rate is between 10 Mbps to 1 Gbps.
- (D) Each network interface card is associated with a unique MAC address.

Choose the **correct** answer from the options given below:

- (A) (A), (B) and (D) only
- (B) (A), (B) and (C) only
- (C) (B), (C) and (D) only
- (D) (A), (C) and (D) only

Correct Answer: (D) (A), (C), and (D) only

Solution:

A network interface card (NIC) is a hardware component that allows a computer to connect to a network. It is also referred to as an Ethernet card and facilitates data transmission



between 10 Mbps to 1 Gbps. Additionally, every NIC is uniquely identified by a Media Access Control (MAC) address. However, a NIC is not a network router.

Quick Tip

Tip: A NIC serves as a bridge between the computer and the network, ensuring unique identification via MAC addresses.

Question 72: Consider the following milestones towards the evolution of networking:

- (A) Emergence of World Wide Web (WWW).
- (B) Use of TCP/IP as standard network protocol.
- (C) Launch of ARPANET by UCLA.
- (D) Introduction of 802.11 communication standard.

Choose the **correct order of events** from old to recent:

- (A) (A), (B), (C), (D)
- (B) (C), (B), (A), (D)
- (C) (B), (C), (A), (D)
- (D) (C), (D), (B), (A)

Correct Answer: (B) (C), (B), (A), (D)

Solution:

The evolution of networking began with the launch of ARPANET by UCLA, followed by the use of TCP/IP as a standard protocol, the emergence of the World Wide Web, and finally the introduction of the 802.11 communication standard.

Quick Tip

Tip: Memorize the chronological order of networking milestones for clarity in network evolution questions.

Question 73: Which of the following is a valid malware identification method used by antivirus software?

- (A) Signature based detection



- (B) Iris based detection
- (C) Abusive language detection
- (D) Copyright violation detection

Correct Answer: (A) Signature based detection

Solution:

Antivirus software primarily relies on signature-based detection to identify malware. This method involves comparing known malware signatures stored in a database with incoming files or programs. It is one of the most effective and widely used methods.

Quick Tip

Tip: Signature-based detection is fast but requires regular updates to recognize new malware.

Question 74: Identify the appropriate file type employed for storing and managing fully structured data in workstations.

- (A) Cascading stylesheet
- (B) Rich text format
- (C) Comma separated values
- (D) Graphics interchange format

Correct Answer: (C) Comma separated values

Solution:

Comma-separated values (CSV) files are commonly used to store and manage fully structured data. They are easy to read and widely supported by various software, including spreadsheets and databases.

Quick Tip

Tip: CSV files are preferred for transferring tabular data due to their simplicity and compatibility.



Question 75: Following are the major stages in software development life cycle.

- (A) Performance Evaluation
- (B) Development and Testing
- (C) Data Analysis and Design
- (D) Implementation Phase

Choose the correct order of the stages from the options given below:

- (A) (A), (B), (C), (D)
- (B) (C), (B), (D), (A)
- (C) (B), (A), (D), (C)
- (D) (C), (B), (A), (D)

Correct Answer: (B) (C), (B), (D), (A)

Solution:

The correct order for the stages in the software development life cycle is: 1. Data Analysis and Design (C) 2. Development and Testing (B) 3. Implementation Phase (D) 4. Performance Evaluation (A)

Quick Tip

Tip: Following the structured software development lifecycle ensures quality and efficiency in project delivery.

