

**INDIA METEOROLOGICAL
DEPARTMENT
QUESTION BANK
OF
FORECASTERS TRAINING COURSE
(FTC)**

**FINAL EXAMINATION
BASED ON 176-191 BATCHES
(2013-2021)**

**PAPER-II: PHYSICAL
METEOROLOGY**

PART A

INDIA METEOROLOGICAL DEPARTMENT
METEOROLOGICAL TRAINING INSTITUTE
FORECASTER TRAINING COURSE FINAL EXAMINATION
PAPER II – PHYSICAL METEOROLOGY (PART- A)

Q.1 Fill up the blanks

1. _____ is the instrument used for measurement of ozone and the radiation between _____ and _____ are used for the measurement of ozone.
2. _____ is the source of particulate matter with size more than 1μ in the lower stratosphere and _____ is the type of clouds observed in the stratosphere.
3. _____ mainly responsible for destruction of ozone in the stratosphere.
4. _____ gives a measure of horizontal transport of pollution whereas _____ is a measure of vertical transport of pollution.
5. _____ is the coldest region in the atmosphere.
6. _____ substances have a pH value less than 7.0 and for rainwater the pH value is approximately _____ in general.
7. _____ and _____ are two examples in which artificial modification is carried out for suppression of natural disasters.
8. _____ and _____ are two examples of supply currents in the atmosphere.
9. _____ is the value of ionic conduction current and _____ is the value of resistance associated with fair weather electric field in general.
10. _____ scattering by aerosol particles comparable in size to visible wavelengths ($0.1-1\mu\text{m}$) is responsible for most visibility reduction, and dominates in urban areas.(Mie/Rutherford/Geometric)
11. _____ is the Mobile App launched by Ministry of Earth Sciences for giving lightning warning.
12. clouds in the upper stratosphere shows the evidence of condensation and the presence of water vapour.
13.and.....are the layers of atmosphere where temperature increases with height.
14.theory explains the precipitation mechanisms in warm clouds.
15.is the fundamental mechanism of homosphere and its height extend uptoKM.

16. 100 DU is approximately ----- thickness (1mm / 100 mm)
17. A corona is produced due to _____ of light.
18. A thunder cloud is characterized with _____ charge at the top and _____ charge at the base.
19. A typical CG discharge brings ----- charge to earth.
20. Aitken particles have a radius, r
21. Amount of ozone contained in a vertical column of unit base area at standard atmospheric temperature and pressure is called _____ and its global average amount is about _____.
22. An object can be visible only when there is _____ between it and its surrounding.
23. Any atmospheric condition which reduces the transparency of the atmosphere is termed as _____.
24. Any precipitation which has PH value less thanis consider as acid rain.
25. Artificial modification of the cloud is useful for both _____ and _____.
26. Atmospheric electric field value during fair weather is _____ than the that observed disturbed weather.
27. Bergeron process takes place in -----
28. Collision of ice crystals leading to their merging is known as _____ and formation of _____ is occurring due to that.
29. Condensation nuclei with affinity for water vapour is called _____ and _____ is an example for such nuclei.
30. Condensation nuclei with affinity for water vapour is termed as _____.
31. Condensation rate onto droplet is _____ than (to) condensation rate onto flat water surface .
(A)Less (B) Greater (C)equal (D) None
32. Corona is produced by _____ of visible radiation.
33. Depletion of ozone is found to be mainly due to its interaction with _____.
34. Distribution of water vapour in the atmosphere is distribution is in time and space and its concentration normally with altitude.
35. Dust particles are with diameter betweenand
36. Example for a natural condensation nuclei.
37. For an object to be visible, it should have _____ with its surroundings.

38. Global scale of air pollution involves the case of pollution associated with&.....
39. Ground level Ozone is _____ pollutant (Primary / Secondary)
40. Homogeneous nucleation takes place when RH is _____.
41. Ice Nuclei (IN) is required in ----- clouds
42. If the ratio $\frac{NO_2}{NO} > 3$ then formation of O₃ is _____
43. If the ratio of the radius of the scattering particle to the wavelength of incident radiation is small, the scattering involved is known as _____.
44. In a cloud, the droplets can grow by _____ and _____.
45. In a layer of the atmosphere _____ gives a measure of vertical mixing without layer whereas _____ gives a measure of horizontal mixing in that layer.
46. In chemical ozone sonde, interaction of ozone with _____ solution is utilized.
47. In cold clouds, ice particle grows at the expense of _____.
48. In order to prepare the wind roses for a station data of the wind speed and of that station are the basic information needed.
49. In the atmosphere, the specific conductivity _____ with height where as the current density _____ with height.
50. In unstable air, the chimney plume dispersion will be in the form of _____.
51. Incomplete combustion leads to the production of
52. Koschmieder equation relates visual range (visibility), and _____ coefficient. (Absorption/Extinction/Scattering)
53. Maximum mixing depth, (MMD) is a function of atmospheric
54. Mirages occur when there is a _____ at a height of few meters above ground.
55. Monochromatic brightness at a particular wavelength is the product of _____ and _____ at that wavelength.
56. Monochromatic brightness is the product of _____ and _____.
57. Name a gas that contribute for origin of internal particulate matter -----
58. Nighttime visual range is _____ than daytime range. (longer/smaller/zero)
59. Once the forces acting on a falling drop balance, the steady speed with which it falls is known as _____.
60. One lightning stroke consists of a _____ stroke and a _____ stroke.

61. Ozone absorbs almost all the incident solar radiation between the wavelengths _____ and _____.
62. Ozone acts as a _____ in the troposphere.
63. Ozone hole occurs in Antarctica in ----- season (Summer / Spring)
64. Ozone Layer thickness is maximum at an altitude of approximately -----
65. Ozone Layer thickness _____ with latitude. (Increases / decreases)
66. Periodicity of QBO is -----.
67. pH of normal rain water is -----.
68. Plume dispersion in the form of _____ produces lowest pollution concentration at the ground whereas plume dispersion in the form of _____ produces maximum pollution concentration at the ground.
69. Pollution from automobiles come under ----- scale pollution.
70. Process of ozone hole over Antarctica region is more prominent during southern hemispheric _____
71. QBO is the interaction of the stratospheric winds with thewaves.
72. QBO phenomena normally occurs in ----- layer of the atmosphere
73. Rainbows are produced due to _____ of sunlight through droplets of water suspended in the atmosphere.
74. Reciprocal of specific resistance is known as _____ and it _____ with height.
75. Role of VOC's in ground level ozone formation is conversion of NO to ----- In ECC ozone measurement method electrochemical reaction of ozone with _____ is used (Potassium iodide / Potassium nitrate)
76. Saturation vapor pressure over ice is -----than that over water
77. Saturation vapour pressure over ice is _____ than saturation vapour pressure over super cooled water.
78. Silver Iodide is used in _____ cloud seeding experiments.
79. Solar radiation in the region is strongly absorbed by in the stratosphere.
80. Specific conductivity is proportional to _____ and _____.
81. Stratonull region is characterized withand observed at a height of aboutKM.
82. Stratospheric Ozone Layer absorbs _____ part of sun's radiation. (Infrared/UV-B)

83. Sudden Stratospheric warming is observed in the month of for northern hemisphere.
84. Super cooled water droplets will freeze once they come into contact with _____ in the atmosphere.
85. Super cooled water freezes when they come into contact with _____ and _____ is an example of such particle.
86. superior mirage is observed when the temperature _____ with height in the atmosphere.
87. The amount of ozone contained in a vertical column of unit cross sectional area at standard temperature and pressure is called _____ and it is generally expressed in _____.
88. The amount of ozone contained in a vertical column of unit cross sectional area at standard atmospheric pressure and temperature is called _____.
89. The change of phase of water vapour is involved with the absorption or release of
90. The electrical generator in the global electric circuit is _____
91. The first leader stroke develops downward from the base of a cloud is termed as _____.
92. The first streamer stroke from the cloud base to the ground is called _____ whereas the streamers followed afterwards are called _____.
93. The glow discharge that takes place over the most of the ships exposed to intense thunderstorms are termed as _____.
94. The glow discharge which takes place on the mast of ships exposed to intense thunderstorm is called _____.
95. The growth of a drop by the collision-coalescence process is governed by _____ efficiency.
96. The layer of the atmosphere in which the neutral particles escape from the earth's gravitational field is called _____ and it is the region above _____ kilometers.
97. The layer of the atmosphere upto height of 80 km is known as -----.
98. The magnitude of the fair weather electric field is _____
99. The main source of ozone depletion is by its interaction with _____ and _____ is the international treaty for protection of ozone layer.
100. The material used for hygroscopic seeding is _____ .

101. The outermost region of the atmosphere where theof the molecules are so long that they are able to escape from the gravitational pull of the earth is termed as
102. The phase change from vapor to liquid is called _____ .
103. The radius of a corona varies _____ with the droplet size.
104. The stratosphere region with level of minimum horizontal temperature gradient is known as -----.
105. The total mass of droplets in unit volume of air is called _____.
106. The Transmissometer measures the _____.(meteorological optical range / cloud height)
107. The velocity with which an ion is moving in an electric field of 1 Volt/cm is called _____.
108. The westerly phase of the QBO is associated with temperature at thel region.
109. Threshold pH value of acid rain is -----
110. Threshold temperature for formation of polar stratospheric clouds (PSCs) is _____
(- 80 °C / -70 ° C)
111. Thunder is caused by the rapid expansion of _____
112. To prepare the wind rose diagram hourly data of wind ----- and ----- are used.
113. Tropopause is (colder/warmer) over tropics.
114. Tropopause is colder over _____ (Tropics/midlatitudes/polar region)
115. Weakening/ reversal of polar night jet and associated rapid warming of the stratosphere by about 50-70 °C is known as _____.
116. What are the units of ventilation coefficient -----
117. When combustion is complete _____ will be the product whereas incomplete combustion produces _____.
118. When the gravity and drag acting on a falling drop balance each other, the steady speed with which it falls is known as _____
119. When the temperature is decreasing with height, lapse rate is And when the temperature is increasing with height, lapse rate is
120. With reference to the fair weather electric field, the ionic conduction current is about-- _____for the entire earth and total resistance is about _____.
121. Electric field and conductivity are ----- related.
- a. *Inversely*(b) Directly (c). Not (d).Non linearly

122. Increase in aerosol concentration will ----- electric field.
 (a). *Increase* (b). Decrease (c). Not change
123. A fair weather air-earth current brings ----- charge to earth.
 (a). *Positive* (b). Negative (c) neutral
124. Homogeneous nucleation takes place at RH.
 (A) >100% (B) <100% (C) = 100% (D) None
125. If the water-vapor content of air remains constant, lowering air temperature causes.
 a) Decrease in relative humidity b) Increase in relative humidity
 c) Increase in evaporation d) temperature inversion.

Q.2 State whether the following are true or false with reason

1. Advection of polar air into tropical latitudes will give rise to a decrease in the amount of ozone in the tropics.
2. Advection of tropical air into polar latitudes will give rise to an increase in the amount of ozone.
3. Air must be super saturated for the cloud to form.
4. An inversion aloft with smokestack releasing pollutants within the inversion layer aloft can cause maximum concentration of pollution at the ground level.
5. At a location horizontal visibility increases after precipitation
6. Bergeron process takes place in warm clouds.
7. CCN tend to be more numerous in continental air than in marine air.
8. CO₂ in the atmosphere is responsible for slight acidity of rain
9. Collision and coalescence will be more effective when there is a spectrum of size distribution among the droplets.
10. Collision and coalescence will be more effective when there is small scale turbulence within the cloud.
11. Concentration of ozone goes on increasing with height in the atmosphere.
12. Coning of a pollution Plume is a due to high instability present in the atmosphere.
13. Current density associated with fair weather electrical field increases with height.
14. During summer daylight hours, mixing height can be a few thousand meters whereas in winter, it can be a few hundred meters only.

15. For Hygroscopic nuclei, condensation begins at $RH < 100\%$
16. For hygroscopic nuclei, condensation begins at $RH < 100\%$.
17. Greenhouse effect is good for earth's atmosphere.
18. Hailstones have a layered structure
19. Halons are harmful than Hydrochlorofluorocarbons (HCFC's) for ozone.
20. Halons contain Hydrogen atom.
21. High values of ventilation coefficient correspond to low dispersion of pollution.
22. High values of ventilation co-efficient corresponds to low pollution potential.
23. If the ELR is greater than the lapse rate of the parcel, the parcel will be stable.
24. If the ventilation coefficient is large, pollution potential is high.
25. In a Halo, red colour will be seen outside where as in a corona, it will be seen inside.
26. In a halo, the red colour ring appears outside.
27. In a halo, the red colour ring is inside with other colour rings outside.
28. In case of lofting of chimney plume dispersion, pollution concentration at the ground level, downstream will be maximum.
29. In case of lofting, the concentration of pollution at the ground level will be maximum.
30. In case of Rayleigh scattering, scattering coefficient is more for shorter wavelengths than for longer wavelengths.
31. In diurnal variation, concentration of ozone is maximum at midday
32. In presence of thunder cloud, the fair weather electric field gets reversed.
33. In winter hemisphere, the stratospheric temperature increases towards poles.
34. In winter hemisphere, the wind is westerly from troposphere to mesosphere.
35. Increased Greenhouse effect is good for earth's atmosphere.
36. Lapse rate is negative in the mesosphere.
37. Large depletion in the amount of ozone over Antarctica is more significant during spring season.
38. Meteorological optical Range (MOR) is obtained when contrast of threshold of visibility is increased to 5%.
39. Mixing height is lower during summer day light hours than winter
40. Multiple Tropopause events occur near the equator.
41. Normal rainwater is neutral in chemical nature.
42. Ozone depletion is more over Antarctic than Arctic
43. Ozone is responsible for thermal structure of Stratosphere

44. Ozone layer is present in troposphere.
45. Point discharge carries positive charges to the earth's surface.
46. Pollution potential is high if ventilation coefficient is high
47. Potential gradient associated with fair weather electric field decreases linearly with height.
48. Saturation vapour pressure on the surface of a small drop is less than saturation vapour pressure on the surface of a big drop.
49. Saturation vapour pressure over water is more than that over ice.
50. Silver iodide is used for seeding of warm clouds.
51. Slight turbulence within the cloud is effective for collision and Coalescence.
52. Stratosphere is a cloud free layer
53. Stratosphere meets the requirements for cloud formation.
54. Strong updrafts are required to produce large hailstones.
55. Sub-cloud layer influences the size of the precipitation elements.
56. Temperature increases with height in the thermosphere.
57. The atmospheric layer between cloud base and the ground influences the size of the precipitation element.
58. The current density increases with height, in fair weather electric field.
59. The fair weather electric field is not effected by the presence of a thunder cloud.
60. The fair-weather electric field is influenced by latitude, season and time of the day.
61. The lower layer of the atmosphere is characterized with decreasing molecular weight with height, as per composition.
62. The maximum ionization due to cosmic rays is occurring at about 12 Kms in the atmosphere.
63. The subcloud layer has no influence on the size of precipitation element.
64. There exists a balance between production as well as dissociation of ozone molecules in the atmosphere.
65. Time interval between the lightning seen and thunder heard can be used to determine the distance at which lightning has occurred.
66. Tropopause height is same at every point on earth.
67. Tropopause is a continuous layer from equator to poles.
68. Tropopause is a single continuous layer extending over the globe.
69. Troposphere and the mesosphere have negative lapse rates.
70. Turbulent mixing is the fundamental mechanism in heterosphere.

71. UVC & UVB radiation are responsible for ground level ozone formation.
72. Water spontaneously freezes once the temperature falls below 0°C.
73. Water vapour is a variable gas of the atmosphere.
74. Weather modification is useful in minimizing the impact of hazardous weather phenomena.
75. Weather pattern influences the ozone amount in the atmosphere.
76. Westerly phase of QBO will be there when the Kelvin waves are prominent and easterly phase of QBO will be there when Mixed Rossby Gravity waves are prominent.
77. When a solute is added to pure water, its saturation vapour pressure increases.
78. When the ventilation coefficient is less, pollution potential is less.
79. With the approach of a thundercloud, there occurs the reversal of fair weather electric field.

Q.3 Answer any one of the following :

1. Briefly describe the features of fair weather electric field? What are the mechanisms by which the fair weather electric field of the atmosphere is sustained?
2. Briefly explain the effect of curvature on saturation vapour pressure. Accordingly explain the amount of super saturation required for the growth of droplets.
3. Briefly explain the latitudinal, seasonal, diurnal variations and variation with height of fair weather electric field.
4. Briefly explain the main features of droplet growth by collision and coalescence.
5. Briefly explain the mechanism of precipitation from a cold cloud.
6. Briefly explain the mechanism of the generation and dissociation of ozone. Describe the latitudinal, seasonal as well as vertical distribution of ozone.
7. Briefly explain the mechanism of thunder and lightning.
8. Briefly explain the photochemical reaction leading to the generation as well as destruction of ozone in the atmosphere.
9. Briefly explain the process of initiation of precipitation from a warm cloud? What are the factors influencing the process? How the atmospheric layer between the cloud base and the ground influences the size of precipitation element?
10. Briefly explain Wilson's Theory of Charge Separation in a thunder cloud.
11. Define the meteorological visibility by day as per the WMO.

12. Define the meteorological visibility by night as per the WMO.
13. Derive the chemical formula for Halon 1211
14. Derive the chemical formula of CFC -011 and CFC-113
15. Derive the number for CFC-12
16. Derive the number for Halon C₂F₄Br₂.
17. Describe the different sources of ionization in the atmosphere and the contributions from each source with respect to land and oceanic area.
18. Describe the Umkehr method for the measurement of vertical distribution of ozone.
19. Discuss in brief the primary mechanisms of cloud electrification.
20. Electrical conductivity in the fair weather atmosphere increases with altitude. Discuss briefly whether it is true or false.
21. Explain Bergeron-Findeison Theory of precipitation. What are the different types of precipitation elements from a cold cloud? Describe the mechanism of their formation.
22. Explain charge distribution associated with thundercloud. Briefly explain the mechanism of lightning and thunder from a thundercloud.
23. Explain the concept of Meteorological Optical Range with respect to day and night time.
24. Explain the mechanism of precipitation from warm clouds.
25. Explain the precipitation mechanism associated with hail storms.
26. Explain the precipitation process in cold clouds.
27. Explain the procedure for observing night visibility.
28. Explain the process of thunder and lightning.
29. Explain the terminal velocity of a cloud drop? What are the factors affecting terminal velocity?
30. Explain the vertical structure of atmosphere based on temperature with a neat diagram.
31. Explain various mechanisms proposed for thunderstorm charging.
32. Explain Wilson's theory of charge separation in a thunder cloud.
33. Mention the main generator to the Global Electric Circuit.
34. Name and explain different ways by which victim gets struck by lightning.
35. Name any two charge generation theories proposed for thunderstorm electrification.
36. Name the atmospheric electric parameters measured commonly during fair weather. Explain in brief the techniques for measurements of each of these parameters.
37. Name the instruments used to measure air conductivity.

38. Name the instruments used to measure atmospheric electric field.
39. Name two main types of lightning discharges?
40. Short notes on effect of air pollution on visibility.
41. State WMO definition for Visibility.
42. The typical value of fair weather surface electric field is.
43. What are cloud condensation nuclei? What is their role in cloud physics? Classify them based on size and properties
44. What are condensation nuclei? What are the sources of condensation nuclei? Briefly describe the classification of condensation nuclei.
45. What are the different types of supply current available in the atmosphere? What is the function of a supply current?
46. What are the main source of ionization over sea surface and 1-2 km above land surface?
47. What are the precautionary measures to be observed during overhead lightning activity?
48. What is a supply current? What are the different forms of supply currents in the atmosphere and how they contribute towards maintaining the fair weather electric field?
49. What is a warm cloud? Briefly explain the process of precipitation from a warm cloud.
50. What is curvature effect?
51. What is extinction coefficient?
52. What is meteorological visual range.
53. What is ozone hole? Briefly explain the major causes of formation of ozone hole. What is that international treaty meant for protection of ozone layer.
54. What is ozone? Explain the importance of ozone with respect to its various aspects. Briefly explain the mechanism of formation and dissociation of ozone.
55. What is QBO? What are main features of QBO.
56. What is the purpose of using silver iodide for seeding of supercooled clouds?
57. What is visibility? How it can be defined? What are the factors which influence the transparency of the atmosphere?
58. What precautions should be taken to avoid damages to human lives?
59. What will be the effect of increase in aerosol concentration on air conductivity.
60. Which part of India gets more lightning?

61. Which part of world experiences more lightning activity?
62. With a neat diagram explain the different types of pollution plume dispersion.
63. Write a note on ozone hole.
64. Write a note on stratospheric and tropospheric Ozone.
65. Write a note on tropospheric and stratospheric ozone.
66. Write a short note on the global electric circuit.
67. Write in brief on tropospheric/ ground level ozone.
68. Write short notes on scattering of light.
69. Write the mathematical equation showing relationship between electric field and conductivity.

Q.4 Write short notes on any two of the following:-

1. Visibility is reduced due to dust storm because of the absorption and scattering of light.
2. Artificial modification of weather
3. Atmospheric visibility, and its measurement.
4. Collision and Coalescence
5. Curvature effect
6. Effect of curvature on saturation vapour pressure
7. Effects of air pollution on atmospheric visibility.
8. Explain the process of hail formation with a neat diagram.
9. Main sources of air pollution
10. Ozone hole
11. Ozone Sonde.
12. Precipitation making by artificial modification of cloud.
13. RVR is always equal to MOR.
14. Scattering of light in the atmosphere
15. Solution effect
16. Source of Ionization in the atmosphere
17. Sources of ionization and their features
18. Stratospheric warming.
19. The range of accurately measurable MOR values of a transmissometer is independent of its baseline length.
20. Three main sources of air pollution

21. Vertical division of the atmosphere based upon different features.
22. Weather modification
23. What are the lifting mechanisms responsible for cloud development?
24. What is cloud seeding? Explain different cloud seeding methods.
25. What is QBO and give at least three features of QBO